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Fortsættes ...

WO-A1-2011/073180

WO-A1-2013/008171

WO-A2-2006/029879

WO-A2-2007/133290

US-A1- 2004 110 226

US-B1- 7 291 331

MICHAEL CROFT: "Control of Immunity by the TNFR-Related Molecule OX40 (CD134)", ANNUAL REVIEW OF IMMUNOLOGY, vol. 28, no. 1, 1 March 2010 (2010-03-01), pages 57-78, XP055039398, ISSN: 0732-0582, DOI: 10.1146/annurev-immunol-030409-101243

RUDIKOFF S ET AL: "Single amino acid substitution altering antigen-binding specificity", PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES (PNAS), US, vol. 79, 1 March 1982 (1982-03-01), pages 1979-1983, XP007901436, ISSN: 0027-8424, DOI: 10.1073/PNAS.79.6.1979

COLMAN ET AL: "Effects of amino acid sequence changes on antibody-antigen interactions", RESEARCH IN IMMUNOLOGY, EDITIONS SCIENTIFIQUES ET MEDICALES ELSEVIER, FR, vol. 145, no. 1, 1 January 1994 (1994-01-01), pages 33-36, XP023944838, ISSN: 0923-2494, DOI: 10.1016/S0923-2494(94)80039-1 [retrieved on 1994-01-01]

Ph Kussie ET AL: "A single engineered amino acid substitution changes antibody fine specificity", The Journal of Immunology, 1 January 1994 (1994-01-01), page 146, XP055530279, United States Retrieved from the Internet: URL:<http://www.jimmunol.org/content/jimmunol/152/1/146.full.pdf> [retrieved on 2018-12-05]

C. Chen ET AL: "Enhancement and destruction of antibody function by somatic mutation: unequal occurrence is controlled by V gene combinatorial associations.", The EMBO Journal, vol. 14, no. 12, 1 June 1995 (1995-06-01), pages 2784-2794, XP055530299, ISSN: 0261-4189, DOI: 10.1002/j.1460-2075.1995.tb07278.x

DESCRIPTION

[0001] The present invention is as defined by the claims and relates to anti-human OX40L antibodies, new medical uses and methods. The invention is defined by the claims and any other aspects, configurations or embodiments set forth herein not falling within the scope of the claims are for information.

[0002] Any references in the description to methods of treatment refer to the compounds, pharmaceutical compositions and medicaments of the present invention for use in a method for treatment of the human (or animal) body by therapy (or for diagnosis).

BACKGROUND

[0003] OX40 ligand (OX40L) is a TNF family member; a 34 kDa type II transmembrane protein. The crystalized complex of human OX40 and OX40L is a trimeric configuration of one OX40L (trimer) and three OX40 monomers. The human extracellular domain is 42% homologous to mouse OX40L.

[0004] OX40L is not constitutively expressed but can be induced on professional APCs such as B-cells, dendritic cells (DCs) and macrophages. Other cell types such as Langerhans cells, endothelial cells, smooth muscle cells, mast cells and natural killer (NK) cells can be induced to express OX40L. T-cells can also express OX40L. The OX40L receptor, OX40, is expressed on activated T-cells (CD4 and CD8 T-cells, Th2, Th1 and Th17 cells) and CD4⁺Foxp3⁺ cells, even in the absence of activation.

[0005] The interaction between OX40 and OX40L occurs during the T-cell-DC interaction 2 or 3 days after antigen recognition. After leaving DCs, the OX40-expressing T-cell may interact with an OX40L-expressing cell other than a DC and receive an OX40 signal from this cell, which may provide essential signals for the generation of memory T-cells, the enhancement of Th2 response and the prolongation of the inflammatory responses. OX40 signals into responder T-cells render them resistant to Treg mediated suppression.

[0006] Graft versus host disease is a major cause of mortality following allogeneic bone marrow treatment. In the acute version of the disease, mature T-cells present in the bone marrow graft recognise the donor tissue as foreign in an environment of damaged tissue, which, via host APCs cause the activation and proliferation of the donor T-cells, with subsequent T-cell migration into the liver, spleen, gut, skin and lungs, causing tissue damage by the CTL effector response and inflammatory cytokine/chemokine release. Onset for acute disease is usually within the first 100 days post transplantation (Hsi-Ferrari, Blood May 1, 2000 vol. 95 no. 9 2754-275, Reddy-Ferrari Blood, Volume 17, Issue 4, December 2003).

[0007] Chronic GVHD usually appears 100 days post transplantation and several factors are thought to be involved, including thymic damage caused by prior acute GVHD which results in a reduced clearance of pathogenic T-cells (Zhang et al. September 1, 2007 vol. 179 no. 5 3395-3314), up-regulation of TGF- β , which causes fibrosis (McComick et al J Immunol, November 15, 1999 vol. 163 no. 10 5695-5699), and a B-cell component driven by elevated B-Cell activating factor (BAFF) (Sarantisopoulos et al. Clin Cancer Res October 15, 2007 13: 6107) as well as auto-antibodies against platelet derived growth factor receptor (Swagill et al., Blood July 1, 2007 vol. 110 no. 1 237-241).

[0008] Clinical studies have shown that OX40 is up-regulated in both acute (Morante et al, Clinical and Experimental Immunology, 145:36-43) and chronic (Kotani et al, Blood November 15, 2001 vol. 96 no. 10 3162-3164) GVHD. Administration of an antagonistic anti-OX40L enhanced survival in a lethal acute mouse model of GVHD, with a 70% survival in the treated group compared to the untreated who all died by day 43 (Totsuka et al. Blood, 1 April 2000, Volume 95, Number 7) whereas treatment with an agonistic anti-OX40 Ab accelerated the disease and mortality (Blazar et al Blood May 1, 2003 vol. 101 no. 9 3741-3748). Blockade of the OX40-OX40L interaction has been shown to be efficacious in several other inflammatory disease, with anti-OX40L Ab being used to treat a mouse model of colitis (Totsuka et al., AJP - GI April 1, 2003 vol. 284 no. 4 G695-G693), and that an anti-OX40L Ab could block the development of diabetes in NOD mice (Pakala et al European Journal of Immunology Volume 34, Issue 11, pages 3039-3046, November 2004).

References

[0009]

Lamb, L.S., Athyankar, S.A., Hazlett, L., O'Neal, W., Folk, R.S., Vogt, S., Parrish, R.S., Bridges, K., Henslee-Downey, P.J. and Gee, A. P. (1999), Expression of CD134 (OX40) on T-cells during the first 100 days following allogeneic bone marrow transplantation as a marker for lymphocyte activation and therapy-resistant graft-versus-host disease. Cytometry, 38: 235-243.

Xupeng Ge, Julia Brown, Megan Sykes, Vassiliki Bousaotis, CD134-Alloplection Allows Selective Elimination of Alloreactive Human T-cells without Loss of Virus-Specific and Leukemia-Specific Effectors, Biology of Blood and Marrow Transplantation, Volume 14, Issue 5, May 2008, Pages 518-530.

Naoto Kishi, Takeshi Takahashi, Pejman Soroosh, Kazuo Sugamura, Chapter 3 - OX40-OX40 Ligand Interaction in T-Cell-Mediated Immunity and Immunopathology, In: Frederick W. Alt, Editor(s), Advances in Immunology, Academic Press, 2010, Volume 105, Pages 63-98.

Croft, M., So, T., Duan, W and Soroosh, P. (2009). The significance of OX40 and OX40L to T-cell biology and immune disease. Immunological Reviews, 229: 173-191.

WO 2006/029979 (F. Hofman-La Roche) describes anti-OX40L antibodies and, in particular, to anti-OX40L antibodies and variants thereof that contain a Fc part derived from human origin and do not bind complement factor C1q.

SUMMARY OF THE INVENTION

[0010] The invention is defined by the claims and any other aspects, configurations or embodiments set forth herein not falling within the scope of the claims are for information. The invention provides anti-human OX40L (hOX40L) antibodies and fragments and novel medical applications for treating or preventing hOX40L-mediated diseases or conditions in humans. To this end, the invention provides:-

In a first configuration

[0011] An antibody or a fragment thereof that specifically binds to hOX40L for treating or preventing a hOX40L-mediated disease or condition in a human in a method wherein the antibody or fragment is administered to said human, wherein the antibody or fragment is for treating or preventing said hOX40L-mediated disease or condition by decreasing one, more or all of

1. a secretion of a cytokine selected from TNF alpha, IL-2, IL-3, IL-4, IL-5, IL-6, IL-8, IL-9, IL-10, IL-13, IL-17, RANTES and interferon gamma in the human;
2. b. the proliferation of leukocytes of the human; and
3. c. binding of hOX40 receptor expressed by human T-cells with endothelial cell expressed hOX40L..

In a second configuration

[0012] An antibody or a fragment thereof, that specifically binds to hOX40L and competes for binding to said hOX40L with an antibody selected from the group consisting of 02D10, 10A07, 09H4 and 19H01.

In a third configuration

[0013] Use of an antibody or a fragment thereof, that specifically binds to hOX40L in the manufacture of a medicament for administration to a human, for treating or preventing a hOX40L-mediated disease or condition in the human by decreasing one, more or all of

1. a secretion of a cytokine selected from TNF alpha, IL-2, IL-3, IL-4, IL-5, IL-6, IL-8, IL-9, IL-10, IL-13, IL-17, RANTES and interferon gamma in the human;
2. b. the proliferation of leukocytes of the human; and
3. c. binding of hOX40 receptor expressed by human T-cells with endothelial cell expressed hOX40L..

In a fourth configuration

[0014] A method of treating or preventing a hOX40L-mediated disease or condition in a human by decreasing one, more or all of

1. a secretion of a cytokine selected from TNF alpha, IL-2, IL-3, IL-4, IL-5, IL-6, IL-8, IL-9, IL-10, IL-13, IL-17, RANTES and interferon gamma in the human;
2. b. the proliferation of leukocytes of the human; and
3. c. binding of hOX40 receptor expressed by human T-cells with endothelial cell expressed hOX40L..

wherein the method comprises administering to said human a therapeutically effective amount of an antibody or fragment that specifically binds to hOX40L.

In a fifth configuration

[0015] An antibody or a fragment thereof, that specifically binds to hOX40L and competes for binding to said hOX40L with the antibody 02D10, wherein the antibody or fragment comprises a VH domain which comprises a HCDR3 comprising the motif VRGXYYY, wherein X is any amino acid.

In a sixth configuration

[0016] An antibody or a fragment thereof, that specifically binds to hOX40L and competes for binding to said hOX40L with the antibody 02D10, wherein the antibody or fragment comprises a VH domain which comprises the HCDR3 sequence of SEQ ID NO:40 or 46 or the HCDR3 sequence of SEQ ID NO:40 or 46 comprising less than 5 amino acid substitutions.

In a seventh configuration

[0017] A human antibody or fragment thereof comprising a HCDR3 of from 16 to 27 amino acids and derived from the recombination of a human VH gene segment, a human D gene segment and a human JH gene segment, wherein the human JH gene segment is IGJH6, which specifically binds to hOX40L for treating or preventing an autoimmune disease selected from an autoimmune disease or condition, a systemic inflammatory disease or condition, or transplant rejection.

In an eighth configuration

[0018] Use of a human antibody or fragment thereof comprising a HCDR3 of from 16 to 27 amino acids and derived from the recombination of a human VH gene segment, a human D gene segment and a human JH gene segment, wherein the human JH gene segment is IGJH6, which specifically binds to hOX40L in the manufacture of a medicament for administration to a human for treating or preventing a hOX40L mediated disease or condition in the human selected from an autoimmune disease or condition, a systemic inflammatory disease or condition, or transplant rejection.

In a ninth configuration

[0019] A method of treating or preventing a hOX40L mediated disease or condition selected from an autoimmune disease or condition, a systemic inflammatory disease or condition, or transplant rejection, comprising administering to said human a therapeutically effective amount of a human antibody or fragment thereof comprising a HCDR3 of from 16 to 27 amino acids and derived from the recombination of a human VH gene segment, a human D gene segment and a human JH gene segment, wherein the human JH gene segment is IGJH6, which specifically binds to hOX40L, wherein the hOX40L mediated disease or condition is thereby treated or prevented.

[0020] The invention also provides pharmaceutical compositions, kits, nucleic acids, vectors and hosts.

BRIEF DESCRIPTION OF THE FIGURES

[0021]

Figure 1: Profiling of fully human recombinant anti-OX40L antibodies in HTRF Ligand/Receptor Neutralisation assay. Data shown is representative of three repeat experiments.

Figure 2: Determining effect of anti-OX40L antibodies in allogeneic PBMC/T Mixed Lymphocyte Reaction. Data shown is from three independent donor pairings where it is assumed each donor is a different individual.

Figure 3: Expansion of Tscm cells following allogeneic HCT. Plots are gated on CD4⁺ CD45RA⁺CCR7⁺ T-cells.

Figure 4: OX40L blockade controls expansion of CD4⁺ Tscm cells while preserving CD4⁺ T naive cells following allogeneic HCT. Absolute numbers of peripheral blood CD4⁺ Tscm (left) and Tnaive (right) following allogeneic HCT in control animal and 2D10 IgG4PE treated animals.

Figure 5: OX40 expression on naive CD4⁺ T and memory stem T-cells in a representative animal following allogeneic HCT. Left and middle FACS plots were gated on CD3⁺CD4⁺CD45RA⁺CCR7⁺. The histogram on the right shows OX40 expression in different T-cell subsets of CD4⁺ T-cells: Naive (CD45RA⁺CCR7⁺CD45⁺), memory stem (SCM: CD45RA⁺CCR7⁺CD45⁺), central memory (CM: CD45RA⁺CCR7⁺), effector memory (EM: CD45RA⁺CCR7⁺) and terminally differentiated effector-memory cells re-expressing CD45RA (TEMRA: CD45RA⁺CCR7⁺).

Figure 6: Effects of OX40L blockade on SCM CD4⁺ T-cells. Datapoints for 02D10 IgG4PE are shown by circles, rapamycin by filled squares and tacrolimus plus methotrexate (Tac/MTX) by open squares.

Figure 6: Effects of OX40L blockade on SCM CD4⁺ T-cells. Datapoints for 02D10 IgG4PE are shown by circles, rapamycin by filled squares and Tac/MTX by unfilled squares.

Figure 7: Kaplan-Meier survival curve for rhesus monkey recipients of hematopoietic stem cell transplants derived from the peripheral blood of haploidentical sibling donors. Results are shown for animals that did not receive post-transplant prophylactic therapy (No-treatment control; median survival time, MST= 8 days; n=4), and those receiving rapamycin monotherapy (MST= 17 days; n=4), 2D10 monotherapy (MST= 19 days; n=4), or rapamycin plus 2D10 (MST > 82 days; n=3). Note that animals 2 and 3 indicated on the figure were on-study at the time of drafting, neither showed signs of GVHD at Day 82 or Day

41 post-transplant, respectively. Asterisk * for the no treatment control and rapamycin monotherapy groups is data taken from Furlan et al., 2015, Science Translational Medicine, vol 7 (315), 315ra191.

DETAILED DESCRIPTION OF THE INVENTION

[0022] The description provides the following aspects 1 to 113.

[0023] The invention is useful, for example, for treating or preventing transplant rejection, e.g., graft versus host disease (GvHD) or allogeneic transplant rejection. The invention is also useful, for example, for treating or preventing an inflammatory bowel disease, e.g., UC or CD, or for treating or preventing an airway inflammatory disease or condition. In an example this aspect is useful for treating or preventing asthma. The invention is also useful, for example, for treating or preventing fibrosis. The invention is also useful, for example, for treating or preventing diabetes. The invention is also useful, for example, for treating or preventing osteitis. The invention is also useful, for example, for treating or preventing pyoderma gangrenosum. The invention is also useful, for example, for treating or preventing giant cell arteritis. The invention is also useful, for example, for treating or preventing Schitzler syndrome. The invention is also useful, for example, for treating or preventing non-infectious scleritis.

1. An antibody or a fragment thereof that specifically binds to hOX40L for treating or preventing a hOX40L-mediated disease or condition in a human in a method wherein the antibody or fragment is administered to said human, wherein the antibody or fragment is for treating or preventing said hOX40L-mediated disease or condition by decreasing one, more or all of:
 1. a secretion of a cytokine selected from **TNF** alpha, IL-2, IL-3, IL-4, IL-5, IL-6, IL-8, IL-9, IL-10, IL-13, IL-17, **RANTES** and interferon gamma in the human; and
 2. b. the proliferation of leukocytes of the human; and
 3. c. binding of hOX40 receptor expressed by human T-cells with endothelial cell expressed hOX40L.

[0024] The inventors, thus identified for the first time decreases of (a), (b) and (c) as ways of treating and/or preventing OX40L-mediated disease and conditions in humans and they provide antibodies and antibody fragments for this purpose.

[0025] In an example, the secretion is leukocyte secretion. In an example, (a) is indicated by a significantly elevated level of the cytokine(s) in human blood, plasma or serum.

[0026] In an example, the cytokine is selected from (i) **TNF** alpha, (ii) IL-2 and (iii) interferon gamma. In example, the cytokine **TNF** alpha. In example, the cytokine is IL-2. In an example, the cytokine is interferon gamma. In an example, the cytokines are (i) and (ii); or (i) and (iii); or (ii) and (iii); or (i)-(iii).

[0027] In an example, the decrease of (a), (b) or (c) or any other decrease disclosed herein is a decrease of at least 10 or 20% compared to the level in a human at risk of or suffering from the hOX40L-mediated disease or condition. In an example, the latter is the human recited in aspect 1 prior to administration of the antibody or fragment; in another example the latter human is a different human. In an example, said decrease is at least 10, 20, 30, 40, 50 or 60%.

1. (i) In an example, the antibody or fragment is capable of effecting a decrease of secretion of the relevant cytokine from leukocytes (eg, human T-cells) in an *in vitro* assay (as explained further below), and thus administration of such antibody or fragment to the human leads to decrease of (a).
2. (ii) In an example, the antibody or fragment is capable of effecting a decrease of the proliferation of leukocytes (eg, human PBMCs and/or human T-cells) in an *in vitro* assay (as explained further below), and thus administration of such antibody or fragment to the human leads to decrease of (b).
3. (iii) In an example, the antibody or fragment is capable of effecting a decrease of the binding of hOX40 receptor expressed by human T-cells with endothelial cell expressed hOX40L, in an *in vitro* assay (as explained further below), and thus administration of such antibody or fragment to the human leads to decrease of (c).

[0028] In an example, (i) and (ii); or (i) and (iii); or (ii) and (iii); or (i)-(iii) apply.

[0029] Additionally or alternatively, assessment of said decreases can be performed using samples from the treated human. For example, reference is made to J. Clin. Immunol., 2004 Jan, 24(1):74-85; "Increased expression of CCL20 in human inflammatory bowel disease", Kaser A et al. This publication provides an example of a generally-applicable technique of using tissue biopsies and reading out decreased cytokine levels indicative of decreased cytokine secretion after treatment with an antibody *in vivo*. Similar methods can be used to determine decrease of the secretion of one or more cytokines in a human having received an antibody of the invention. The skilled person will be familiar with techniques for assessing cytokine levels in patients and patient samples, for example, by use of one or more of tissue biopsy, immunohistochemistry, immunofluorescence, tissue staining, cytokine mRNA quantification (e.g., using PCR, such as Taqman™ PCR), cytokine protein detection and quantification (e.g., using cytokine-specific tool antibody and quantification, such as by ELISA or another standard protein quantification technique). For example, where the disease or condition is one of the GI tract (e.g., IBD), one can perform biopsy of relevant gut tissue from a patient that has received an antibody of the invention, followed by quantification of cytokine mRNA and/or cytokine protein (e.g., using quantitative PCR). The result can be compared with a cytokine quantification in biopsied relevant tissue from the same patient prior to antibody administration or compared to another human patient suffering from the same disease or condition but receiving no anti-OX40L treatment or no treatment for the disease or condition. In this way, the skilled person can determine that the antibody of the invention decreases secretion of the cytokine in the human recipient. Instead of assessing gut tissue levels, one can instead use a different tissue or sample from the human patient dependent upon the nature and location of the disease or condition. For example, where the disease or condition is one of the airways (e.g., lung), it is possible to take a lung or other airway tissue sample for cytokine assessment. Alternatively, one can use a bronchoalveolar lavage (BAL) sample, as will be apparent to the skilled person. In another example, for some disease or conditions one can assess the decrease in cytokine in a blood, serum or plasma sample taken from a human that has received an antibody of the invention, and then comparing to the level before receiving the antibody or comparing to the level in an untreated human, as discussed above.

[0030] As is known in the art, the term "leukocytes" includes, for example, one or more of lymphocytes, polymorphonuclear leukocytes and monocytes. As is also readily apparent to the skilled person the term "monocytes" includes, for example, peripheral blood mononuclear cells (PBMCs) or monocyte-derived cells, e.g., dendritic cells (DCs). See, for example, Immunobiology, 2013 Nov, 218(11):1382-401, doi: 10.1016/j.imbio.2013.07.005, Epub 2013 Jul 25; "Leukoreduction system chambers are an efficient, valid, and economic source of functional monocyte-derived dendritic cells and lymphocytes", Pfeiffer IA et al.

[0031] The proliferation of leukocytes, for example, *in lamina propria lymphocytes (LPLs)*, can be assessed using tissue biopsy, staining and histology, as will be apparent to the skilled person. Hematoxylin and eosin stain (H&E stain or **HE** stain) is, for example, commonly used in histology to look for infiltrating lymphocytes a whole range of human tissue and is one of the principal stains in histology. It is the most widely used stain in medical diagnosis and is often the gold standard, and as such can be used to assess proliferation of leukocytes as per the invention. For example, GI tract tissue (e.g., gut tissue) from a human that is suffering from or at risk of a hOX40L-mediated disease or condition can be obtained, stained and assessed for the extent of infiltration of LPLs. Comparison can be made between such tissue from a human that has received an antibody of the invention compared to the extent of infiltration in tissue obtained from the same human prior to administration of antibody or from another human that has not received treatment and is at risk of or suffering from the disease or condition. For example, the comparison is between human gut tissues taken from the same (or different) humans suffering from IBD.

[0032] One can, for example, determine if the antibody or fragment is capable of decreasing binding of hOX40 receptor expressed by human T-cells with endothelial cell expressed hOX40L using standard binding assays are familiar to the skilled person, e.g., using ELISA or SPR.

[0033] Inflammatory bowel disease (IBD) is a chronic inflammatory disorder affecting the gastrointestinal tract with an apparently ever-increasing incidence and tendency to more severe clinical phenotypes. The disease is characterised by an exaggerated immune response to the luminal flora, suggesting that deficiencies in barrier function of intestinal flora may be involved, and studies support this notion (Cucchiara et al., 2012; Joedits et al., 2012; Manichanh et al., 2012; Salzman et al., 2007, all cited in Deuring et al., "The cell biology of the intestinal epithelium and its relation to inflammatory bowel disease", The International Journal of Biochemistry & Cell Biology 45 (2013) 799-806). IBD includes two main groups: Crohn's disease (CD) and ulcerative colitis (UC). CD patients can have inflammatory lesions in their entire gastrointestinal tract, whereas the inflammation in UC patients is restricted to the colon. Reference is also made to Hsiamatsu et al., "Immune aspects of the pathogenesis of inflammatory bowel disease", Pharmacology & Therapeutics 137 (2013) 283-297 and the documents cited therein.

[0034] Granuloma formation is one of the most important pathological characteristics of human Crohn's disease. Mizoguchi et al demonstrated that F4/80-positive immature CD11c⁺ dendritic cells (DCs) produce IL-23 and contribute to granuloma formation in a murine colitis model (Mizoguchi et al., 2007). A Th1 immune response is predominant in Crohn's disease. Indeed, CD4⁺ T-cells in the LP of Crohn's disease expressed Th1 and produced large amounts of interferon (IFN- γ) (Matsuoka et al., 2004). Sakuraba et al demonstrated that DCs in the mesenteric lymph nodes of patients with Crohn's disease strongly promoted a Th1 and Th17 immune response (Sakuraba et al., 2009). Mesenteric lymph node DCs contribute to IBD pathogenesis, particularly that of Crohn's disease.

Role of Cytokines in Disease and Conditions

[0035] Reference is made to Muzes et al, World J Gastroenterol 2012 November 7; 18(41): 5848-5861 ISSN 1007-9327 (print) ISSN 2219-2840 (online), "Changes of the cytokine profile in inflammatory bowel Diseases".

[0036] Cytokines are indispensable signals of the mucosa-associated immune system for maintaining normal gut homeostasis. An imbalance of their profile in favour of inflammation initiation may lead to disease states, such as that is observed in inflammatory bowel diseases (IBD), e.g., Crohn's disease (CD) and ulcerative colitis (UC). The role of pro-inflammatory cytokines such as IL-1 α , IL-1 β , IL-2, -6, -8, -12, -17, -23, IFN-gamma, or **TNF** alpha in IBD is associated with the initiation and progression of UC and CD. CD is often described as a prototype of T-helper (Th) 1-mediated diseases because the primary inflammatory mediators are the Th1 cytokines such as Interleukin (IL)-12, interferon (IFN)- γ , and tumour necrosis factor (TNF)- α .

[0037] Binding of **TNF**-like ligands to their receptors triggers intracellular pathways that are directly involved in cell proliferation, differentiation, and survival. Most members of the **TNF/TNF**-receptor protein superfamilies are expressed on immune cells and play a critical role in multiple components of the immune response. **TNF**- α is a master cytokine in the pathogenesis of IBD. It exerts its pleiotropic effects through the expression of adhesion molecules, fibroblast proliferation, procoagulant factors, as well as the initiation of cytotoxic, apoptotic and acute-phase responses. The source of **TNF**- α in IBD is partly the innate immune cells such as macrophages or monocytes, and also differentiated Th1 cells. The serum levels of **TNF**- α correlate with the clinical activity of UC and CD[31]. It plays an orchestrating role in colonic inflammation in IBD. The role of **TNF**- α in CD has been widely investigated. Binding **TNF**- α to serum soluble **TNF** receptor 1 and 2 (sTNFR1 and 2) initiates pro-inflammatory signaling. The levels of sTNFR1 and 2 are elevated in CD.

[0038] Tumour necrosis factor-like factor (TL1A), another member of the **TNF** family, stimulates IFN- γ secretion by binding to death receptor 3 (DR3). DR3 is expressed by a high percentage of cells from mucosal biopsies of UC and CD, and an increase of IFN- γ level has been observed with disease activity in IBD patients. The **TL1A**DR3 system is involved in the pathogenesis of CD. The macrophages of the lamina propria are a major producer of TL1A, which expression is markedly enhanced in CD. It has been found that TL1A and IL-23 synergistically promotes the production of IFN- γ by mucosal T-cells. IFN- γ is produced by Th1 T-cells. Once inflammation is initiated, IFN- γ is produced and subsequently acts through various molecules and pathways of the immune system to intensify the inflammatory process. There is an overwhelming body of literature extensively documenting the proinflammatory nature of IFN- γ which has led to the mainstream opinion that IFN- γ is a prime proinflammatory cytokine in inflammation and autoimmune disease. Interferon-gamma is causatively involved in experimental inflammatory bowel disease in mice (Bo et al, Clinical and Experimental Immunology (2006), 146:330-338). The study clearly demonstrated that IFN- γ mice manifested attenuated colitis after stimulation with DSS, in terms of the degree of body weight loss, DAI, histological score and MPO activity. IFN- γ was increasingly produced in the colon of DSS-treated WT mice that showed severe IBD-like symptoms.

[0039] Interleukin-2 (IL-2) is produced by T-cells and is mostly important for T-cells to differentiate into effector T-cells. IL-2 is also important for T-cell proliferation. This is important for IBD because effector T-cells are thought to be a major cell type to cause damage in IBD.

[0040] IL-8 (interleukin-8; aka CXCL8) primarily mediates the activation and migration of neutrophils into tissue from peripheral blood and to sites of inflammation. The tissue level of IL-8 has been found to be higher in active UC compared to normal colonic tissue, and its serum concentration has been related to endoscopic and histological severity of all important inflammatory settings and cancer (see, e.g., "The Chemokine CXCL8 in Cancer: Proinflammation and Drug Response", ISRN Oncol. 2013 Oct 9;2013:359154; Gales D et al., Future Oncol., 2010 Jan5(1):111-6, doi: 10.2217/109.128; "CXCL8 and its cognate receptors in melanoma progression and metastasis", Singh S et al.). In cancer particularly, IL-8 is thought to contribute also by supporting angiogenesis.

[0041] In any configuration, aspect, concept or example herein the antibody or fragment antagonises the binding of hOX40L to an OX40 receptor.

[0042] In any configuration, aspect, concept or example herein, the antibody or fragment antagonises the binding of hOX40L to OX40.

[0043] In any configuration, aspect, concept or example herein, the OX40L receptor can be human OX40.

[0044] In any configuration, aspect, concept or example herein the human is suffering from or at risk of asthma and the antibody or fragment decreases IgE in a human.

[0045] In any configuration, aspect, concept or example herein the human is suffering from or at risk of asthma and the antibody or fragment is for decreasing IgE in a human.

[0046] 2. The antibody or fragment of aspect 1, wherein the antibody or fragment decreases the binding of hOX40 receptor expressed by human T-cells with endothelial cell expressed hOX40L and decreases the proliferation of human T-cells; wherein the antibody or fragment is for treating or preventing said hOX40L-mediated disease or condition by decreasing the secretion of a cytokine selected from **TNF** alpha, IL-2, IL-3, IL-4, IL-5, IL-6, IL-8, IL-9, IL-10, IL-13, IL-17, **RANTES** and interferon gamma.

[0047] In an example, the cytokine is selected from (i) **TNF** alpha, (ii) IL-2 and (iii) interferon gamma. In an example, the cytokine is IL-2. In an example, the cytokine is interferon gamma. In an example, the cytokines are (i) and (ii); or (i) and (iii); or (ii) and (iii); or (i)-(iii).

[0048] 3. The antibody or fragment of aspect 1, wherein the leukocytes are selected from the group consisting of polymorphonuclear leukocytes, monocytes, peripheral blood mononuclear cells (PBMCs), lymphocytes, T-cells, antigen presenting cells (APCs), dendritic cells (DC cells) and natural killer cells (NK cells).

[0049] In one embodiment, the leukocytes are peripheral blood mononuclear cells (PBMCs) and T-cells (e.g. PBMCs).

[0050] 4. The antibody or fragment of aspect 3, wherein the leukocytes comprise lamina propria lymphocytes (LPLs) and the disease or condition is a disease or condition of the gastrointestinal tract (GI tract).

[0051] 5. The antibody or fragment of any preceding aspect, wherein the epithelial cells comprise cells selected from the group consisting of gastrointestinal cells, colon cells, intestinal cells and airway (e.g., lung) epithelial cells.

[0052] In another embodiment, the epithelial cells comprise cells selected from the group consisting of gastrointestinal cells, colon cells, intestinal cells, ocular cells and airway (e.g., lung) epithelial cells. In another embodiment, the epithelial cells comprise cells selected from the group consisting of gastrointestinal cells, colon cells, intestinal cells and ocular cells. In a further embodiment, the epithelial cells comprise ocular cells.

[0053] 6. The antibody or fragment of any preceding aspect, for treating or preventing said hOX40L-mediated disease or condition in said human by decreasing the proliferation of T-cells in said human.

[0054] In an example, the antibody or fragment is capable of effecting a decrease of the proliferation of T-cells in an *in vitro* assay (e.g., in a human DC cell/T-cell *in vitro* assay, for example as explained further below), and thus administration of such antibody or fragment to the human leads to decrease of the proliferation of T-cells in said human.

[0055] 7. The antibody or fragment of any preceding aspect, for treating or preventing said hOX40L-mediated disease or condition in said human by antagonising the interaction between hOX40L and leukocytes of the human, wherein the proliferation of leukocytes is decreased.

[0056] In an example, the antibody or fragment is capable of effecting a decrease of the proliferation of leukocytes (e.g., mononuclear cells) in an *in vitro* assay (e.g., in a MLR *in vitro* assay, for example as explained further below), and thus administration of such antibody or fragment to the human leads to decrease of the proliferation of leukocytes in said human.

[0057] 8. The antibody or fragment of any preceding aspect, for treating or preventing said hOX40L-mediated disease or condition in said human by decreasing the proliferation of leukocytes of the human by antagonising the OX40L/OX40L receptor interaction mediated by T-cells in said human.

[0058] In an example, the antibody or fragment is capable of effecting a decrease of the proliferation of leukocytes (e.g., mononuclear cells) in an *in vitro* assay wherein the antibody or fragment antagonises OX40L/OX40L receptor interaction mediated by T-cells in said assay, and thus administration of such antibody or fragment to the human leads to decrease of the proliferation of leukocytes in said human.

[0059] 9. The antibody or fragment of any preceding aspect, for treating or preventing said hOX40L-mediated disease or condition in said human by decreasing the secretion of a cytokine selected from **TNF** alpha, IL-2 and interferon gamma in the human.

[0060] In an example, the antibody or fragment is for treating or preventing said hOX40L-mediated disease, condition or epithelial cell damage in said human by decreasing the secretion of (i) IL-2 and interferon gamma, (ii) IL-2 and **TNF** alpha or (iii) interferon gamma and **TNF** alpha in the human.

[0061] In an example, the antibody or fragment is capable of effecting a decrease of the secretion of a cytokine selected from IL-2, **TNF** alpha and interferon gamma in an *in vitro* assay (e.g., in a MLR *in vitro* assay, for example as explained further below), and thus administration of such antibody or fragment to the human leads to decrease of the secretion of said selected cytokine(s) in said human.

[0062] In an example, the antibody or fragment is capable of effecting a decrease of the secretion of IL-8 in an *in vitro* assay (e.g., in a MLR *in vitro* assay, for example as explained further below), and thus administration of such antibody or fragment to the human leads to decrease of the secretion of IL-8 in said human.

[0063] 10. The antibody or fragment of aspect 9, for treating or preventing said disease or condition by decreasing the secretion of said cytokine mediated by the interaction of dendritic cells (DC cells) with T-cells in the human.

[0064] In an example, the antibody or fragment is capable of effecting a decrease of said cytokine(s) secretion in a DC cell/T-cell *in vitro* assay (for example as explained further below), and thus administration of such antibody or fragment to the human leads to decrease of the secretion of said cytokine(s) in said human.

[0065] 11. The antibody or fragment of any preceding aspect, wherein gastrointestinal cell, colon cell, intestinal cell or airway (e.g., lung) cell damage is a symptom or cause of said disease or condition in humans.

[0066] In another embodiment, the epithelial cells comprise cells selected from the group consisting of gastrointestinal cells, colon cells, intestinal cells, ocular cells and airway (e.g., lung) epithelial cells. In another embodiment, the epithelial cells comprise cells selected from the group consisting of gastrointestinal cells, colon cells, intestinal cells and ocular cells. In a further embodiment, the epithelial cells comprise ocular cells.

[0067] 12. The antibody or fragment of any preceding aspect, wherein the human is suffering from or at risk of an inflammatory bowel disease (IBD), allogeneic transplant rejection, graft-versus-host disease (GVHD), diabetes or airway inflammation and said method treats or prevents IBD, allogeneic transplant rejection, GVHD, diabetes or airway inflammation in the human.

[0068] 12a. The antibody or fragment of any preceding aspect, wherein the human is suffering from or at risk of an inflammatory bowel disease (IBD), allogeneic transplant rejection, graft-versus-host disease (GVHD), uveitis, pyoderma gangrenosum, giant cell arteritis, Schnitzler syndrome, non-infectious scleritis, diabetes or airway inflammation and said method treats or prevents IBD, allogeneic transplant rejection, GVHD, uveitis, pyoderma gangrenosum, giant cell arteritis, Schnitzler syndrome, non-infectious scleritis, diabetes or airway inflammation in the human.

[0069] In an example of any preceding aspect the human is suffering from or at risk of an inflammatory or autoimmune disease or condition or has been diagnosed as such.

[0070] In an example, the autoimmune disease or condition is selected from the following:-

Acute disseminated encephalomyelitis (ADEM)

Addison's disease

Allergic granulomatosis and angitis or Churg-Strauss syndrome (CSS)

Alopecia or Alopecia Areata (AA)

Ankylosing spondylitis

Autoimmune chronic active hepatitis (CAH)

Autoimmune hemolytic anemia

Autoimmune pancreatitis (AP)

Autoimmune retinopathy (AR) see Retinopathy

Autoimmune thrombocytopenic purpura

Autoimmune neutropenia

Autoimmune Inner Ear Disease (AIED)

Antiphospholipid Syndrome (APS)

Autoimmune Lymphoproliferative Syndrome (ALPS)

Behcet's syndrome

Bullous pemphigoid

Celiac disease

Churg-Strauss Syndrome (CSS) or Allergic Granulomatosis Angitis

Chronic bullous disease of childhood

Chronic inflammatory demyelinating Polyradiculoneuropathy (CIDP)

Cicatricial pemphigoid (CP)

Central Nervous System Vasculitis

Crohn's Disease

Cryoglobulinemia

Dermatitis herpetiformis (DH)

Discoid lupus erythematosus (DLE)

Encephalomyelitis

Epi-dermolysis bullosa acquisita (EBA)

Giant Cell Arteritis see Temporal arteritis

Graft-versus-host disease

Graves' Disease

Gullain-Barre syndrome

Haiot Syndrome see Primary biliary Cirrhosis

Hashimoto's thyroiditis also called autoimmune thyroiditis and chronic lymphocytic thyroiditis Hypersensitivity Vasculitis (HV) or small vessel vasculitis

Immune-mediated infertility

Inflammatory bowel disease

Insulin-dependent diabetes mellitus

Isolated vasculitis of the Central nervous system or CNS Vasculitis

Isaacs' Syndrome: Neuromyotonia

Kawasaki disease (KD)

Lambert-Eaton myasthenic syndrome (LEMS)

Linear IgA disease

Lupus - see Systemic lupus erythematosus

Meulien's Disease

Microscopic Polyangiitis (MPA)

Mixed connective tissue disease or MCTD

Monoclonal Gammopathy

Myasthenia Gravis

Multiple Sclerosis

Multifocal motor neuropathy

Neuromyotonia or Isaacs's syndrome

Neutropenia see Autoimmune Neutropenia

Ophoritis

Opaedonus-myoedonus syndrome

orchitis

Paraneoplastic neurologic disorders

Pemphigus vulgaris

Pemphigus foliaceus (PF)

Pemphigoid gestationis (PG)

Perniciou anemia

Paraneoplastic pemphigus (PNP)

Polyangiitis - see Microscopic polyangiitis

Polyarteritis nodosa (PAN)

Polymyositis/Dermatomyositis

Polymyalgia Rheumatica

Primary biliary Cirrhosis (PBC) also called Haiot Syndrome

Primary sclerosing cholangitis (PSC)

Raynaud's phenomenon

Recoverin-associated retinopathy(RAR) see Retinopathy

Reactive Arthritis formerly known as Reiter's syndrome,

Retinopathy

Rheumatoid arthritis (RA)

Sarcoidosis

Sclerosing cholangitis see Primary Sclerosing Cholangitis

Sjogren's syndrome

Systemic necrotizing vasculitides

Sjögren syndrome or Mørsch-Wolmann syndrome

Systemic lupus erythematosus

Systemic sclerosis (scleroderma)

Temporal arteritis or giant cell arteritis (GCA)

Takayasu's arteritis

Thromboangitis obliterans or Buerger's disease

Thyroiditis with hypothyroidism

Thyroiditis with hyperthyroidism

Type I autoimmune polyglandular syndrome (APS)

Type II autoimmune polyglandular syndrome

Vasculitis

Wegener's granulomatosis

[0071] In an example of any aspect, configuration, concept or embodiment, the human is suffering from uveitis. For example, the uveitis is non-infectious and/or autoimmune in nature, i.e. is non-infectious uveitis or is autoimmune uveitis. For example, the non-infectious/autoimmune uveitis is caused by and/or is associated with Behçet disease, Fuchs heterochromic iridocyclitis, granulomatosis with polyangiitis, HLA-B27 related uveitis, juvenile idiopathic arthritis, sarcoidosis, spondylarthritis, sympathetic ophthalmia, tubulointerstitial nephritis or uveitis syndrome. In an example, the uveitis is systemic in nature, i.e. is systemic uveitis. For example, the systemic uveitis is caused by and/or is associated with ankylosing spondylitis, Behçet's disease, chronic granulomatous disease, entheitis, inflammatory bowel disease, juvenile rheumatoid arthritis, Kawasaki's disease, multiple sclerosis, polyarteritis nodosa, psoriatic arthritis, reactive arthritis, sarcoidosis, systemic lupus erythematosus, Vogt-Koyanagi-Harada syndrome or Whipple's disease.

[0072] In an example of any aspect, configuration, concept or embodiment, the human is suffering from pyoderma gangrenosum, giant cell arteritis, Schitzler syndrome or non-infectious scleritis. In an example, the human is suffering from pyoderma gangrenosum. In an example, the human is suffering from giant cell arteritis. In an example, the human is suffering from Schitzler syndrome. In an example, the human is suffering from non-infectious scleritis.

[0073] In an example of any aspect, configuration, concept or embodiment, the human is suffering from a HOK40L mediated disease or condition selected from an autoimmune disease or condition, a systemic inflammatory disease or condition, or transplant rejection; for example inflammatory bowel disease (IBD), Crohn's disease, rheumatoid arthritis, transplant rejection, allogeneic transplant rejection, graft-versus-host disease (GVHD), ulcerative colitis, systemic lupus erythematosus (SLE), diabetes, uveitis, ankylosing spondylitis, contact hypersensitivity, multiple sclerosis and atherosclerosis, in particular GVHD. In another embodiment, the human is suffering from or is at risk from multibursal organ transplant rejection.

13. An antibody or a fragment thereof, that specifically binds to HOK40L and competes for binding to said HOK40L, with an antibody selected from the group consisting of 02D10, 10A07, 09H04 and 19H01.

[0074] In an example of any aspect, configuration, concept or embodiment, competition is determined by surface plasmon resonance (SPR), such techniques being readily apparent to the skilled person. SPR can be carried out using Biacore™, Protein™ or another standard SPR technique. Such competition may be due, for example, to the antibodies/fragments binding to identical or overlapping epitopes of HOK40L. In an example of any aspect, configuration, concept or embodiment, competition is determined by ELISA, such techniques being readily apparent to the skilled person. In an example of any aspect, configuration, concept or embodiment, competition is determined by fluorescence activated cell sorting (FACS), such techniques being readily apparent to the skilled person. In one aspect, the HTFR, ELISA and/or FACS methods are carried out as described in the Examples hereinbelow.

[0075] 14. The antibody or fragment of aspect 13, wherein the antibody or fragment is according to any one of aspects 1 to 12.

[0076] 15. The antibody or fragment of any preceding aspect, comprising lambda light chain variable domains (optionally which are human).

[0077] In an example of any aspect, configuration, concept or embodiment of the present invention, the variable domains of the antibody or fragment are human or humanised. Additionally, optionally the antibody or fragment further comprises human or humanised constant regions (e.g., human Fc and/or human CL). In an example of any aspect of the present invention, the variable domains of the antibody or fragment are produced by a transgenic animal (e.g., a rodent, mouse, rat, rabbit, chicken, sheep, Camelid or shark). In an example of any aspect of the present invention, the variable domains of the antibody or fragment are produced or identified by phage display, ribosome display or yeast display.

[0078] In an example of any aspect, configuration, concept or embodiment of the present invention, the antibody or fragment is recombinant.

[0079] In an example of any aspect, configuration, concept or embodiment of the present invention, the antibody or fragment is produced by a recombinant mammalian, bacterial, insect, plant or yeast cell. In an example, the mammalian cell is a CHO or HEK293 cell and the antibody or fragment comprises CHO or HEK293 cell glycosylation.

[0080] In an example of any aspect, configuration, concept or embodiment of the present invention, the antibody or fragment is isolated.

[0081] 16. The antibody or fragment of any preceding aspect, comprising a VH domain which comprises a HCDR1 sequence selected from the group consisting of the HCDR1 of

1. a. 02D10, and wherein the antibody or fragment competes with 02D10 for binding to said HOK40L;
2. b. 10A07, and wherein the antibody or fragment competes with 10A07for binding to said HOK40L;
3. c. 09H04, and wherein the antibody or fragment competes with 09H04 for binding to said HOK40L; and
4. d. 19H01, and wherein the antibody or fragment competes with 19H01for binding to said HOK40L.

[0082] 17. The antibody or fragment of any preceding aspect, comprising a VH domain which comprises a HCDR2 sequence selected from the group consisting of the HCDR2 of

1. a. 02D10, and wherein the antibody or fragment competes with 02D10 for binding to said HOK40L;
2. b. 10A07, and wherein the antibody or fragment competes with 10A07for binding to said HOK40L;
3. c. 09H04, and wherein the antibody or fragment competes with 09H04 for binding to said HOK40L; and
4. d. 19H01, and wherein the antibody or fragment competes with 19H01for binding to said HOK40L.

[0083] 18. The antibody or fragment of any preceding aspect, comprising a VH domain which comprises a HCDR3 sequence selected from the group consisting of the HCDR3 of

1. a. 02D10, and wherein the antibody or fragment competes with 02D10 for binding to said HOK40L;
2. b. 10A07, and wherein the antibody or fragment competes with 10A07for binding to said HOK40L;
3. c. 09H04, and wherein the antibody or fragment competes with 09H04 for binding to said HOK40L; and
4. d. 19H01, and wherein the antibody or fragment competes with 19H01for binding to said HOK40L.

[0084] 19. The antibody or fragment of any preceding aspect, comprising a VH domain which comprises (i) the CDR1 and 2, (ii) CDR1 and 3, (iii) CDR2 and 3 or (iv) CDR1, 2 and 3 sequences:

1. a. recited in (a) of aspects 16-18, and wherein the antibody or fragment competes with 02D10 for binding to said HOK40L;
2. b. recited in (b) of aspects 16-18, and wherein the antibody or fragment competes with 10A07 for binding to said HOK40L;
3. c. recited in (c) of aspects 16-18, and wherein the antibody or fragment competes with 09H04 for binding to said HOK40L; or
4. d. recited in (d) of aspects 16-18, and wherein the antibody or fragment competes with 19H01 for binding to said HOK40L.

[0085] 20. The antibody or fragment of any preceding aspect, comprising a VH domain which comprises an amino acid sequence selected from the group consisting of the VH amino acid sequences in the sequence listing.

[0086] In an aspect, the invention provides an anti-HOK40L antibody or fragment (optionally according to any other aspect recited herein) comprising a VH domain which comprises an amino acid sequence selected from the group consisting of the VH amino acid sequences in the sequence listing. In an aspect, the VH domain comprises an amino acid sequence selected from Seq ID No:2, Seq ID No:34, Seq ID No:66, Seq ID No:94, Seq ID No:122, Seq ID No:134, Seq ID No:126, Seq ID No:128, Seq ID No:132 or Seq ID No:134.

[0087] In another example of the invention, the antibody or fragment comprises a VH domain amino acid sequence set out in the sequence listing below. Additionally or alternatively, the antibody or fragment comprises a HCDR1 domain amino acid sequence set out in the sequence listing below (i.e. Seq ID No:4, Seq ID No:10, Seq ID No:36, Seq ID No:42, Seq ID No:68, Seq ID No:74, Seq ID No:96 or Seq ID No:102, in particular, Seq ID No:36 or Seq ID No:42). Additionally or alternatively, the antibody or fragment comprises a HCDR2 domain amino acid sequence set out in the sequence listing below (i.e. Seq ID No:6, Seq ID No:12, Seq ID No:38, Seq ID No:44, Seq ID No:70, Seq ID No:76, Seq ID No:98 or Seq ID No:104, in particular Seq ID No:38 or Seq ID No:44). Additionally or alternatively, the antibody or fragment comprises a HCDR3 domain amino acid sequence set out in the sequence listing below (i.e. Seq ID No:8, Seq ID No:14, Seq ID No:40, Seq ID No:46, Seq ID No:72, Seq ID No:78, Seq ID No:100 or Seq ID No:106, in particular Seq ID No:40 or Seq ID No:46).

[0088] In an example of the invention, the antibody or fragment comprises a VL domain amino acid sequence set out in the sequence listing below. Additionally or alternatively, the antibody or fragment comprises a LCDR1 domain amino acid sequence set out in the sequence listing below (i.e. Seq ID No:18, Seq ID No:24, Seq ID No:50, Seq ID No:56, Seq ID No:82, Seq ID No:88, Seq ID No:110 or Seq ID No:116, in particular Seq ID No:50 or Seq ID No:56). Additionally or alternatively, the antibody or fragment comprises a LCDR2 domain amino acid sequence set out in the sequence listing below (i.e. Seq ID No:20, Seq ID No:26, Seq ID No:52, Seq ID No:58, Seq ID No:80, Seq ID No:86, Seq ID No:112 or Seq ID No:118, in particular Seq ID No:52 or Seq ID No:58). Additionally or alternatively, the antibody or fragment comprises a LCDR3 domain amino acid sequence set out in the sequence listing below (i.e. Seq ID No:22, Seq ID No:28, Seq ID No:54, Seq ID No:60, Seq ID No:86, Seq ID No:92, Seq ID No:114 or Seq ID No:120, in particular Seq ID No:54 or Seq ID No:60).

[0089] In an example of any aspect herein, the antibody or fragment comprises a heavy chain comprising a constant region selected from the group consisting of the heavy chain constant region SEQ ID NOs in the sequence listing (i.e. any of Seq ID Nos: 126, 128, 132, or 134, in particular the constant region of Seq ID No: 128); and optionally a VH domain as recited in aspect 19 or 20. In an example, the antibody or fragment comprises two copies of such a heavy chain. In another example, the heavy chain comprise a rodent, rat, mouse, human, rabbit, chicken, Camelid, sheep, bovine, non-human primate or shark constant region (e.g., Fc), in particular a mouse constant region.

[0090] In an example of any aspect herein, the antibody or fragment comprises a heavy chain comprising a gamma (e.g., human gamma) constant region, e.g., a human gamma1 constant region. In another example of any aspect herein, the antibody or fragment comprises a human gamma4 constant region. In another embodiment, the heavy chain constant region does not bind Fcγ receptors, and e.g. comprises a Leu235Glu mutation (i.e. where the wild type leucine residue is mutated to a glutamic acid residue). In another embodiment, the heavy chain constant region comprises a Ser228Pro mutation to increase stability. In another embodiment, the heavy chain constant region is IgG4 comprising both the Leu235Glu mutation and the Ser228Pro mutation. This heavy chain constant region is referred to as "IgG4-PE" herein.

[0091] In an example of any aspect herein, the antibody or fragment is chimeric, e.g., it comprises human variable domains and non-human (e.g., rodent, mouse or rat, such as mouse) constant regions.

[0092] 21. The antibody or fragment of any one of aspects 16 to 20, comprising first and second copies of said VH domain.

[0093] 22. The antibody or fragment of any preceding aspect, comprising a VL domain which comprises a LCDR1 sequence selected from the group consisting of the LCDR1 of:

1. a. 02D10, and wherein the antibody or fragment competes with 02D10 for binding to said HOK40L;
2. b. 10A07, and wherein the antibody or fragment competes with 10A07for binding to said HOK40L;
3. c. 09H04, and wherein the antibody or fragment competes with 09H04 for binding to said HOK40L; and
4. d. 19H01, and wherein the antibody or fragment competes with 19H01for binding to said HOK40L.

[0094] 23. The antibody or fragment of any preceding aspect, comprising a VL domain which comprises a LCDR2 sequence selected from the group consisting of the LCDR2 of:

1. a. 02D10, and wherein the antibody or fragment competes with 02D10 for binding to said HOK40L;
2. b. 10A07, and wherein the antibody or fragment competes with 10A07 for binding to said HOK40L;
3. c. 09H04, and wherein the antibody or fragment competes with 09H04 for binding to said HOK40L; and
4. d. 19H01, and wherein the antibody or fragment competes with 19H01for binding to said HOK40L.

[0095] 24. The antibody or fragment of any preceding aspect, comprising a VL domain which comprises a LCDR3 sequence selected from the group consisting of the LCDR3 of:

1. a. 02D10, and wherein the antibody or fragment competes with 02D10 for binding to said HOK40L;
2. b. 10A07, and wherein the antibody or fragment competes with 10A07 for binding to said HOK40L;
3. c. 09H04, and wherein the antibody or fragment competes with 09H04 for binding to said HOK40L; and
4. d. 19H01, and wherein the antibody or fragment competes with 19H01for binding to said HOK40L.

[0096] 25. The antibody or fragment of any preceding aspect, comprising a VL domain which comprises (i) the CDR1 and 2, (ii) CDR1 and 3, (iii) CDR2 and 3 or (iv) CDR1, 2 and 3 sequences:

1. a. recited in (a) of aspects 22-24, and wherein the antibody or fragment competes with 02D10 for binding to said HOK40L;
2. b. recited in (b) of aspects 22-24, and wherein the antibody or fragment competes with 10A07 for binding to said HOK40L;
3. c. recited in (c) of aspects 22-24, and wherein the antibody or fragment competes with 09H04 for binding to said HOK40L; or

4. d. recited in (d) of aspects 22-24, and wherein the antibody or fragment competes with **10H01** for binding to said hOX40L.

[0097] 26. The antibody or fragment of any preceding aspect, comprising a VL domain which comprises an amino acid sequence selected from the group consisting of the VL amino acid sequences in the sequence listing.

[0098] In an aspect of the invention, there is provided an anti-hOX40L antibody or fragment (optionally according to any other aspect herein), comprising a VL domain which comprises an amino acid sequence selected from the group consisting of the VL amino acid sequences in the sequence listing (i.e. Seq ID No:16, Seq ID No:48, Seq ID No:89 or Seq ID No: 106, in particular Seq ID No:48).

[0099] In an example of any aspect herein, the antibody or fragment comprises a light chain (e.g., lambda light chain) comprising a constant region selected from the group consisting of the light chain constant region sequences in the sequence listing (i.e. Seq ID No:136, Seq ID No:138, Seq ID No:140, Seq ID No:142, Seq ID No:144, Seq ID No:146, Seq ID No:148, Seq ID No:152, Seq ID No:154, Seq ID No:156, Seq ID No:158, Seq ID No:160, Seq ID No:162, Seq ID No:164 or Seq ID No:166); and optionally a VL domain (e.g., lambda VL) as recited in aspect 25 or 26. In an example, the antibody or fragment comprises two copies of such a light chain (optionally also two copies of the heavy chain described above). In another example, the light chain comprise a rodent, rat, mouse, human, rabbit, chicken, Camelid, sheep, bovine, non-human primate or shark constant region.

[0100] In an example of any aspect herein, the antibody or fragment comprises a light chain (e.g., kappa light chain) comprising a constant region selected from the group consisting of the light chain constant region sequences in the sequence listing (i.e. Seq ID No:136, Seq ID No:138, Seq ID No:140, Seq ID No:142, Seq ID No:144, Seq ID No:146, Seq ID No:148, Seq ID No:152, Seq ID No:154, Seq ID No:156, Seq ID No:158, Seq ID No:160, Seq ID No:162, Seq ID No:164 or Seq ID No:166); and optionally a VL domain (e.g., kappa VL) as recited in aspect 25 or 26. In an example, the antibody or fragment comprises two copies of such a light chain (optionally also two copies of the heavy chain described above). In another example, the light chain comprise a rodent, rat, mouse, human, rabbit, chicken, Camelid, sheep, bovine, non-human primate or shark constant region.

[0101] In an example, the antibody or fragment comprises a lambda light chain comprising a constant region selected from the group consisting of the light chain constant region sequences in the sequence listing (i.e. Seq ID No:146, Seq ID No:148, Seq ID No:152, Seq ID No:154, Seq ID No:156, Seq ID No:158, Seq ID No:160, Seq ID No:162, Seq ID No:164 or Seq ID No:166); and optionally a lambda VL domain.

[0102] In an example, the antibody or fragment comprises a kappa light chain comprising a constant region selected from the group consisting of the light chain constant region sequences in the sequence listing (i.e. i.e. Seq ID No:136, Seq ID No:138, Seq ID No:140, Seq ID No:142 or Seq ID No:144); and optionally a kappa VL domain.

[0103] In an example, the VL domains of the antibody or fragment are lambda Light chain variable domains. In an example, the VL domains of the antibody or fragment are kappa Light chain variable domains.

[0104] 27. The antibody or fragment of any one of aspects 22 to 26, comprising first and second copies of said VL domain.

[0105] 28. The antibody or fragment of any preceding aspect, wherein the hOX40L is human cell surface-expressed hOX40L, e.g., on endothelial cells (e.g., an airway or GI tract endothelial cell).

[0106] In another embodiment, the epithelial cells comprise cells selected from the group consisting of gastrointestinal cells, colon cells, intestinal cells, ocular cells and airway (e.g., lung) epithelial cells. In another embodiment, the epithelial cells comprise cells selected from the group consisting of gastrointestinal cells, colon cells, intestinal cells and ocular cells. In a further embodiment, the epithelial cells comprise ocular cells.

[0107] 29. The antibody or fragment of any preceding aspect, wherein the antibody or fragment decreases the proliferation of human PBMCs or T-cells in the presence of hOX40L in an *in vitro* mixed lymphocyte reaction (MLR) assay by at least 20, 30, 40, 50 or 60% compared to the proliferation of human PBMCs or T-cells in the presence of hOX40L in an *in vitro* control MLR assay in the absence of an antibody that is specific for hOX40L. An illustration of a suitable assay is provided in the examples below.

[0108] 30. The antibody or fragment of aspect 28, wherein the hOX40L in the assay is surface-expressed on human dendritic cells (DC cells).

[0109] An illustration of a suitable assay is provided in the examples below.

[0110] 31. The antibody or fragment of any preceding aspect, wherein the antibody or fragment decreases NF- κ B activity in human HT-1080 cells expressing hOX40 receptor *in vitro* in the presence of hOX40L.

[0111] In an example, the antibody or fragment the decrease in NF- κ B activity is determined by detecting a decrease in IL-8 secretion by HT-1089 cells (ATCC® CCL-121) (optionally transfected with hOX40 Receptor, in the presence of hOX40) *in vitro*.

[0112] 32. The antibody or fragment of any preceding aspect, wherein the antibody or fragment decreases IL-8 secretion from human HT-1080 cells expressing hOX40 receptor *in vitro* in the presence of hOX40L.

[0113] 33. The antibody or fragment of aspect 32, wherein the antibody or fragment decreases IL-8 secretion by at least 20, 30, 40, 50 or 60% compared to the IL-8 production by HT-1089 cells expressing hOX40 receptor *in vitro* in the presence of hOX40L in the absence of an antibody that is specific for hOX40L.

[0114] 34. The antibody or fragment of any preceding aspect, wherein the antibody or fragment decreases hOX40L-stimulated human T-cell proliferation *in vitro*.

[0115] 35. The antibody or fragment of any preceding aspect, wherein the antibody or fragment decreases hOX40L-stimulated IL-2 secretion from human T-cells *in vitro*.

[0116] 36. The antibody or fragment of any preceding aspect, wherein the antibody or fragment decreases cytokine secretion mediated by the interaction of human dendritic cells (DC cells) with human T-cells, wherein the cytokine is selected from one, two, more or all of TNF alpha, IL-2, IL-3, IL-4, IL-5, IL-6, IL-8, IL-9, IL-10, IL-13, IL-17, RANTES and interferon gamma.

[0117] This can be assessed, for example, using a MLR *in vitro* assay (e.g., a DC/T-cell MLR *in vitro* assay). An illustration of a suitable assay is provided in the examples below.

[0118] In an example, the DC cells are mismatched to the T-cells, e.g., MHC mis-matched, as is possible for example when the DC cells are from a human that is different from the T-cell human source. In an example, the DC cells are produced by *in vitro* induction of human monocytes with GM-CSF and IL-4.

[0119] 37. The antibody or fragment of any preceding aspect, wherein the antibody or fragment decreases interferon gamma secretion by at least 20, 30, 40, 50 or 60% compared to the production of interferon gamma mediated by the interaction of human dendritic cells (DC cells) with human T-cells in the absence of an antibody that is specific for hOX40L.

[0120] 38. The antibody or fragment of any preceding aspect, wherein the antibody or fragment decreases TNF alpha secretion by at least 20, 30, 40, 50 or 60% compared to the production of TNF alpha mediated by the interaction of human dendritic cells (DC cells) with human T-cells in the absence of an antibody that is specific for hOX40L.

[0121] 39. The antibody or fragment of any preceding aspect, wherein the antibody or fragment decreases IL-2 secretion by at least 10, 20, 30, 40, 50 or 60% compared to the production of IL-2 mediated by the interaction of human dendritic cells (DC cells) with human T-cells in the absence of an antibody that is specific for hOX40L.

[0122] 40. The antibody or fragment of any preceding aspect, wherein the antibody or fragment decreases cytokine secretion (e.g., leukocyte cytokine secretion) in a human peripheral blood mononuclear cell (PBMC) mixed lymphocyte (MLR) assay, wherein the cytokine is selected from one, two, more or all of TNF alpha, IL-2, IL-4, IL-6, IL-8, IL-10, IL-17, RANTES and interferon gamma.

[0123] 41. The antibody or fragment of any preceding aspect, wherein the antibody or fragment decreases interferon gamma secretion by at least 20, 30, 40, 50 or 60% compared to the production of interferon gamma in a human PBMC MLR assay in the absence of an antibody that is specific for hOX40L.

[0124] In one embodiment, the comparison is to the production of interferon gamma in a human PBMC MLR assay in the absence of antibody.

[0125] 42. The antibody or fragment of any preceding aspect, wherein the antibody or fragment decreases TNF alpha secretion by at least 20, 30, 40, 50 or 60% compared to the production of TNF alpha in a human PBMC MLR assay in the absence of an antibody that is specific for hOX40L.

[0126] 43. The antibody or fragment of any preceding aspect, wherein the antibody or fragment decreases IL-2 secretion by at least 10, 20, 30, 40, 50 or 60% compared to the production of IL-2 in a human PBMC MLR assay in the absence of an antibody that is specific for hOX40L.

[0127] 44. The antibody or fragment of any one of aspects 36 to 43, wherein the cells are primary cells.

[0128] A 'primary cell' refers to a cell in a human or such a cell that has been taken from the patient for binding to the antibody or fragment of the invention *in vitro* (as may be useful, for example, in a method of diagnosis of OX40L status or disease/condition status in the human). Primary cells as used herein are not cells of human cell lines, which typically have undergone many cultures *in vitro*. The ability of the antibody or fragment of the invention to specifically inhibit hOX40L binding to receptor in this embodiment is advantageous since it provides a direct indication of the utility for addressing cells in human patients suffering or at risk of a hOX40L-mediated disease or condition.

[0129] 45. The antibody or fragment of any preceding aspect, wherein the antibody or fragment inhibits binding of hOX40L to a hOX40L receptor (e.g., hOX40) with an IC₅₀ of 1×10^{-8} or less in a HTRF (homogenous time resolved fluorescence) assay.

[0130] In an example, the IC₅₀ is in the range from 1×10^{-9} to 1×10^{-11} or in the range from 1×10^{-9} to 1×10^{-10} .

[0131] 46. A pharmaceutical composition for treating and/or preventing a OX40L-mediated condition or disease, the composition comprising an antibody or fragment of any preceding aspect and a diluent, excipient or carrier; and optionally further comprising an anti-inflammatory drug.

[0132] In an example, the anti-inflammatory drug is independently selected from the group consisting of corticosteroids (e.g. methylprednisolone), anti-IL12/IL-23 antibodies (e.g. ustekinumab), anti-VLA4 antibodies (e.g. natalizumab), anti-LFA1 antibodies, anti-complement C5 antibodies (e.g. eculizumab), anti-s4b7 integrin antibodies (e.g. vedolizumab), anti-IL6 antibodies (e.g. tocilizumab), anti-IL2R antibodies (e.g. basilixumab) or anti-TNFR antibodies TNFR-Fc molecules (e.g. etanercept, adalimumab, infliximab, golimumab, certolizumab pegol). In an example, the anti-inflammatory drug is independently selected from the group consisting of corticosteroids (e.g. methylprednisolone) and anti-LFA1 antibodies.

[0133] 47. A pharmaceutical composition or kit for treating and/or preventing a OX40L-mediated condition or disease, the composition or kit comprising an antibody or fragment of the invention (and optionally an anti-inflammatory drug) optionally in combination with a label or instructions for use to treat and/or prevent said disease or condition in a human; optionally wherein the label or instructions comprise a marketing authorisation number (e.g., an FDA or EMA authorisation number); optionally wherein the kit comprises an IV or injection device that comprises the antibody or fragment.

[0134] 48. A nucleic acid that encodes the HCDR3 of an antibody recited in any one of aspects 1 to 45.

[0135] In one embodiment, the HCDRs herein are according to Kabat nomenclature. In another embodiment, the HCDRs herein are according to the IMGT nomenclature.

[0136] 49. The nucleic acid of aspect 48 comprising a nucleotide sequence that is at least 80, 85, 90, 95, 96, 97, 98 or 99% identical or is 100% identical to a HCDR3 sequence in the sequence listing.

[0137] In an aspect, the invention provides a nucleic acid comprising a nucleotide sequence that encodes a VH domain of an anti-hOX40L antibody, wherein the nucleotide sequence comprises a HCDR3 sequence that is at least 80, 85, 90, 95, 96, 97, 98 or 99% identical or is 100% identical to a HCDR3 sequence in the sequence listing. Optionally, the antibody is according to any other aspect herein.

[0138] In another embodiment, there is provided the nucleic acid of aspect 48 comprising a nucleotide sequence that is 100% identical to a HCDR3 sequence in the sequence listing, except for 1, 2 or 3 nucleotide substitutions, wherein each substitution produces no amino acid change or produces a conservative amino acid change (i.e., the nucleotide substitution is a synonymous substitution) in the corresponding protein sequence. The skilled person will be familiar with conservative amino acid changes.

[0139] Amino acid substitutions include alterations in which an amino acid is replaced with a different naturally-occurring amino acid residue. Such substitutions may be classified as "conservative", in which case an amino acid residue contained in a polypeptide is replaced with another naturally occurring amino acid of similar character either in relation to polarity, side chain functionality or size. Such conservative substitutions are well known in the art. Substitutions encompassed by the present invention may also be "non-conservative", in which an amino acid residue which is present in a peptide is substituted with an amino acid having different properties, such as naturally-occurring amino acid from a different group (e.g., substituting a charged or hydrophobic amino; add with alanine), or alternatively, in which a naturally-occurring amino acid is substituted with a non- conventional amino acid.

[0140] Additionally or alternatively, there is provided the nucleic acid of aspect 49 comprising a nucleotide sequence that is 100% identical to a HCDR3 sequence in the sequence listing, except for 1, 2, 3, 4, 5, 6 or 7 synonymous nucleotide substitutions and no, 1, 2 or 3 nucleotide substitutions that produce conservative amino acid changes in the corresponding protein sequence.

[0141] 50. A nucleic acid that encodes the HCDR2 of an antibody recited in any one of aspects 1 to 45; optionally wherein the nucleic acid is according to aspect 48 or 49.

[0142] 51. The nucleic acid of aspect 50 comprising a nucleotide sequence that is at least 80, 85, 90, 95, 96, 97, 98 or 99% identical or is 100% identical to a HCDR2 sequence in the sequence listing.

[0143] In an aspect, the invention provides a nucleic acid comprising a nucleotide sequence that encodes a VH domain of an anti-hOX40L antibody, wherein the nucleotide sequence comprises a HCDR2 sequence that is at least 80, 85, 90, 95, 96, 97, 98 or 99% identical or is 100% identical to a HCDR2 sequence in the sequence listing. Optionally, the antibody is according to any other aspect herein.

[0144] In another embodiment, there is provided the nucleic acid of aspect 51 comprising a nucleotide sequence that is 100% identical to a HCDR2 sequence in the sequence listing, except for 1, 2 or 3 nucleotide substitutions, wherein each substitution produces no amino acid change or produces a conservative amino acid change (i.e., the nucleotide substitution is a synonymous substitution) in the corresponding protein sequence. The skilled person will be familiar with conservative amino acid changes.

[0145] Additionally or alternatively, there is provided the nucleic acid of aspect 50 comprising a nucleotide sequence that is 100% identical to a HCDR2 sequence in the sequence listing, except for 1, 2, 3, 4, 5, 6 or 7 synonymous nucleotide substitutions and no, 1, 2 or 3 nucleotide substitutions that produce conservative amino acid changes in the corresponding protein sequence.

[0146] 52. A nucleic acid that encodes the HCDR1 of an antibody recited in any one of aspects 1 to 45; optionally wherein the nucleic acid is according to any one of aspects 48 to 51.

[0147] 53. The nucleic acid of aspect 52 comprising a nucleotide sequence that is at least 80, 85, 90, 95, 96, 97, 98 or 99% identical to or is 100% identical to a HCDR1 sequence in the sequence listing.

[0148] In an aspect, the invention provides a nucleic acid comprising a nucleotide sequence that encodes a VH domain of an anti-hOX40L antibody, wherein the nucleotide sequence comprises a HCDR1 sequence that is at least 80, 85, 90, 95, 96, 97, 98 or 99% identical or is 100% identical to a HCDR1 sequence in the sequence listing. Optionally, the antibody is according to any other aspect herein.

[0149] In another embodiment, there is provided the nucleic acid of aspect 52 comprising a nucleotide sequence that is 100% identical to a HCDR1 sequence in the sequence listing, except for 1, 2 or 3 nucleotide substitutions, wherein each substitution produces no amino acid change or produces a conservative amino acid change (i.e., the nucleotide substitution is a synonymous substitution) in the corresponding protein sequence. The skilled person will be familiar with conservative amino acid changes.

[0150] Additionally or alternatively, there is provided the nucleic acid of aspect 52 comprising a nucleotide sequence that is 100% identical to a HCDR1 sequence in the sequence listing, except for 1, 2, 3, 4, 5, 6 or 7 synonymous nucleotide substitutions and no, 1, 2 or 3 nucleotide substitutions that produce conservative amino acid changes in the corresponding protein sequence.

[0151] 54. A nucleic acid that encodes a VH domain and/or a VL domain of an antibody recited in any one of aspects 1 to 45.

[0152] 55. The nucleic acid of aspect 54 comprising a nucleotide sequence that is at least 80, 85, 90, 95, 96, 97, 98 or 99% identical to or is 100% identical to a VH domain nucleotide sequence in the sequence listing.

[0153] In another embodiment, there is provided the nucleic acid of aspect 54 comprising a nucleotide sequence that is 100% identical to a VH domain nucleotide sequence in the sequence listing, except for 1, 2 or 3 nucleotide substitutions, wherein each substitution produces no amino acid change or produces a conservative amino acid change (i.e., the nucleotide substitution is a synonymous substitution) in the corresponding protein sequence. The skilled person will be familiar with conservative amino acid changes.

[0154] Additionally or alternatively, there is provided the nucleic acid of aspect 54 comprising a nucleotide sequence that is 100% identical to a VH domain nucleotide sequence in the sequence listing, except for 1, 2, 3, 4, 5, 6 or 7 synonymous nucleotide substitutions and no, 1, 2 or 3 nucleotide substitutions that produce conservative amino acid changes in the corresponding protein sequence.

[0155] 56. The nucleic acid of aspect 54 or 55 comprising a nucleotide sequence that is at least 80, 85, 90, 95, 96, 97, 98 or 99% identical to or is 100% identical to a VL domain nucleotide sequence in the sequence listing.

[0156] In another embodiment, there is provided the nucleic acid of aspect 54 or 55 comprising a nucleotide sequence that is 100% identical to a VL domain nucleotide sequence in the sequence listing, except for 1, 2 or 3 nucleotide substitutions, wherein each substitution produces no amino acid change or produces a conservative amino acid change (i.e., the nucleotide substitution is a synonymous substitution) in the corresponding protein sequence. The skilled person will be familiar with conservative amino acid changes.

[0157] Additionally or alternatively, there is provided the nucleic acid of aspect 54 or 55 comprising a nucleotide sequence that is 100% identical to a VL domain nucleotide sequence in the sequence listing, except for 1, 2, 3, 4, 5, 6 or 7 synonymous nucleotide substitutions and no, 1, 2 or 3 nucleotide substitutions that produce conservative amino acid changes in the corresponding protein sequence.

[0158] 57. A nucleic acid that encodes a heavy chain or a light chain of an antibody recited in any one of aspects 1 to 45.

[0159] 58. The nucleic acid of aspect 57, comprising a nucleotide sequence as recited in any one of aspects 48 to 56.

[0160] 59. A vector (e.g., a mammalian expression vector) comprising the nucleic acid of any one of aspects 48 to 58; optionally wherein the vector is a CHO or HEK293 vector. In an example, the vector is a yeast vector, e.g., a *Saccharomyces* or *Pichia* vector.

[0161] 60. A host comprising the nucleic acid of any one of aspects 48 to 58 or the vector of aspect 59. In an example, the host is a mammalian (e.g., human, e.g., CHO or HEK293) cell line or a yeast or bacterial cell line.

[0162] 61. Use of an antibody or a fragment thereof, that specifically binds to hOX40L in the manufacture of a medicament for administration to a human, for treating or preventing a hOX40L-mediated disease or condition in the human by decreasing one, more or all of

1. a secretion of a cytokine selected from TNF α , IL-2, IL-3, IL-4, IL-5, IL-6, IL-8, IL-9, IL-10, IL-13, IL-17, RANTES and interferon gamma in the human;
2. b. the proliferation of leukocytes of the human; and
3. c. binding of hOX40 receptor expressed by human T-cells with endothelial cell expressed hOX40L.

[0163] The features of any of the previous aspects, configurations, concepts, examples or embodiments optionally apply *mutatis mutandis* to this use.

[0164] In an example, the human is suffering from or at risk of asthma and the antibody or fragment is for decreasing IgE in the human, thereby treating, preventing or reducing asthma in the human.

[0165] 62. A method of treating or preventing a hOX40L-mediated disease or condition in a human by decreasing one, more or all of

1. a secretion of a cytokine selected from TNF α , IL-2, IL-3, IL-4, IL-5, IL-6, IL-8, IL-9, IL-10, IL-13, IL-17, RANTES and interferon gamma in the human;
2. b. the proliferation of leukocytes of the human; and
3. c. binding of hOX40 receptor expressed by human T-cells with endothelial cell expressed hOX40L;

wherein the method comprises administering to said human a therapeutically effective amount of an antibody or fragment that specifically binds to hOX40L.

[0166] The features of any of the previous aspects, examples or embodiments optionally apply *mutatis mutandis* to this method.

[0167] The method of the invention treats or prevents said disease or condition in the human. A "therapeutically effective amount" of the antibody or fragment is that amount (administered in one or several doses, which may be spaced in time, e.g., substantially monthly administration) that is effective to bring about said treatment or prevention. This will be readily apparent to the skilled person and may vary according to the particular human patient and disease or condition being addressed.

[0168] In an example, the human is suffering from or at risk of asthma and the antibody or fragment decreases IgE in the human, thereby treating, preventing or reducing asthma in the human.

[0169] 63. The method or use of aspect 61 or 62, for treating or preventing said hOX40L-mediated disease, condition or epithelial cell damage in said human by decreasing the proliferation of T-cells in said human.

[0170] 64. The method or use of any one of aspects 61 to 63, for treating or preventing said hOX40L-mediated disease, condition or epithelial cell damage in said human by antagonising the interaction between hOX40L and leukocytes of the human, wherein the proliferation of leukocytes is decreased.

[0171] 65. The method or use of any one of aspects 61 to 64, for treating or preventing said hOX40L-mediated disease, condition or epithelial cell damage in said human by decreasing the proliferation of leukocytes of the human by antagonising the OX40L/OX40L receptor interaction mediated by T-cells in said human.

[0172] 66. The method or use of any one of aspects 61 to 65, for treating or preventing said hOX40L-mediated disease, condition or epithelial cell damage in said human by decreasing the secretion of IL-6 cytokine in the human.

[0173] 67. The method of aspect 66, for treating or preventing said disease, condition or epithelial cell damage by decreasing the secretion of said IL-6 mediated by the interaction of dendritic cells (DC cells) with T-cells in the human.

[0174] 68. The method or use of any one of aspects 61 to 67, wherein gastrointestinal cell, colon cell, intestinal cell or airway (e.g., lung) cell damage is a symptom or cause of said disease or condition in humans.

[0175] In another embodiment, the epithelial cells comprise cells selected from the group consisting of gastrointestinal cells, colon cells, intestinal cells, ocular cells and airway (e.g., lung) epithelial cells. In another embodiment, the epithelial cells comprise cells selected from the group consisting of gastrointestinal cells, colon cells, intestinal cells and ocular cells. In a further embodiment, the epithelial cells comprise ocular cells.

[0176] 69. The method or use of any one of aspects 61 to 68, wherein the human is suffering from or at risk of an inflammatory bowel disease (IBD), allogeneic transplant rejection, graft-versus-host disease (GvHD), diabetes or airway inflammation and said method treats or prevents IBD, allogeneic transplant rejection, GvHD, diabetes or airway inflammation in the human.

[0177] 69a. The method or use of any one of aspects 61 to 68, wherein the human is suffering from or at risk of an inflammatory bowel disease (IBD), allogeneic transplant rejection, graft-versus-host disease (GvHD), uveitis, pyoderma gangrenosum, giant cell arteritis, Schnitzler syndrome, non-infectious scleritis, diabetes or airway inflammation and said method treats or prevents IBD, allogeneic transplant rejection, GvHD, uveitis, pyoderma gangrenosum, giant cell arteritis, Schnitzler syndrome, non-infectious scleritis, diabetes or airway inflammation in the human.

[0178] In any aspect, configuration, concept or embodiment, the human is suffering from or at risk of a hOX40L-mediated disease or condition selected from an autoimmune disease or condition, a systemic inflammatory disease or condition, or transplant rejection; for example inflammatory bowel disease (IBD), Crohn's disease, rheumatoid arthritis, transplant rejection, allogeneic transplant rejection, graft-versus-host disease (GvHD), ulcerative colitis, systemic lupus erythematosus (SLE), diabetes, uveitis, ankylosing spondylitis, contact hypersensitivity, multiple sclerosis and atherosclerosis, in particular GvHD.

[0179] 70. The method or use of any one of aspects 61 to 69a, wherein the antibody or fragment is according to any one of aspects 1 to 45 or any example, configuration, concept, aspect or embodiment described herein.

[0180] 71. The antibody, fragment, composition, kit, method or use of any preceding aspect, for treating or preventing an inflammatory or autoimmune disease or condition in a human or for reducing or preventing angiogenesis in a human.

[0181] 72. The antibody, fragment, composition, kit, method or use of any preceding aspect, wherein the disease or condition is selected from the group consisting of an inflammatory bowel disease (IBD), Crohn's disease, rheumatoid arthritis, psoriasis, bronchiolitis, gingivitis, transplant rejection, allogeneic transplant rejection, graft-versus-host disease (GvHD), asthma, adult respiratory distress syndrome (ARDS), septic shock, ulcerative colitis, Sjogren's syndrome, airway inflammation, systemic lupus erythematosus (SLE), diabetes, contact hypersensitivity, multiple sclerosis and atherosclerosis.

[0182] 72a. The antibody, fragment, composition, kit, method or use of any preceding aspect, wherein the disease or condition is selected from the group consisting of an inflammatory bowel disease (IBD), Crohn's disease, rheumatoid arthritis, psoriasis, bronchiolitis, gingivitis, transplant rejection, allogeneic transplant rejection, graft-versus-host disease (GvHD), asthma, adult respiratory distress syndrome (ARDS), septic shock, ulcerative colitis, Sjogren's syndrome, airway inflammation, systemic lupus erythematosus (SLE), uveitis, pyoderma gangrenosum, giant cell arteritis, Schnitzler syndrome, non-infectious scleritis, diabetes, contact hypersensitivity, multiple sclerosis and atherosclerosis.

[0183] In any aspect, configuration, concept or embodiment, the human is suffering from or at risk of a hOX40L-mediated disease or condition selected from an autoimmune disease or condition, a systemic inflammatory disease or condition, or transplant rejection; for example inflammatory bowel disease (IBD), Crohn's disease, rheumatoid arthritis, transplant rejection, allogeneic transplant rejection, graft-versus-host disease (GvHD), ulcerative colitis, systemic lupus erythematosus (SLE), diabetes, uveitis, ankylosing spondylitis, contact hypersensitivity, multiple sclerosis and atherosclerosis, in particular GvHD.

[0184] In an example, the disease or condition is an OX40L-mediated disease or condition disclosed in US7512133 or EP1791869.

[0185] In an example, the disease or condition is an inflammatory or autoimmune disease or condition. In an example, the disease or condition is transplant rejection.

[0186] As used herein, inflammatory disease or condition refers to pathological states resulting in inflammation, for example caused by neutrophil chemotaxis. Examples of such disorders include inflammatory skin diseases including psoriasis; responses associated with inflammatory bowel disease (such as Crohn's disease and ulcerative colitis); ischemic reperfusion; adult respiratory distress syndrome; dermatitis; meningitis; encephalitis; uveitis; autoimmune diseases such as rheumatoid arthritis, Sjogren's syndrome, vasculitis; diseases involving leukocyte diapedesis; central nervous system (CNS) inflammatory disorder; multiple organ injury syndrome secondary to septicemia or trauma; alcoholic hepatitis, bacterial pneumonia, antigen-antibody complex mediated diseases; inflammations of the lung, including pleurisy, alveolitis, vasculitis, pneumonia, chronic bronchitis, bronchiectasis, and cystic fibrosis; etc. The preferred indications are bacterial pneumonia and inflammatory bowel disease such as ulcerative colitis. The invention is thus in an example provided for treating or preventing any one or more of such conditions.

[0187] In an example, the disease or condition is cancer.

[0188] In an example, the disease is uveitis, such as systemic uveitis or autoimmune/non-infectious uveitis.

[0189] 73. An antibody or a fragment thereof, that specifically binds to hOX40L and competes for binding to said hOX40L with the antibody 02D10, wherein the antibody or fragment comprises a VH domain which comprises a HCDR3 comprising the motif V_HGKYYY, wherein X is any amino acid.

[0190] The features of the antibodies of any of the aspects, configurations, concepts, examples or embodiments described herein optionally apply *mutatis mutandis* to these antibodies, e.g. the antibody may be a human antibody or chimeric antibody having functional features as described herein. Competition may be determined as described in any aspect, embodiment, example, concept or configuration described herein, e.g. as determined by SPR, ELISA, HTRF or FACS.

[0191] In one embodiment, the antibody or fragment competes with the variable regions of 02D10 (e.g. competes with an antibody comprising the heavy chain variable region of SEQ ID No: 34 and the light chain variable region of SEQ ID No:48). In another embodiment, the antibody or fragment competes with 02D10 IgG4-PE having a heavy chain amino acid sequence of SEQ ID No:62 and a light chain amino acid sequence of SEQ ID No:64.

[0192] In another embodiment, the antibody or fragment additionally or alternatively competes with 10A7. In one embodiment, the antibody or fragment competes with the variable regions of 10A7 (e.g. competes with an antibody comprising the heavy chain variable region of SEQ ID No: 2 and the light chain variable region of SEQ ID No:16). In another embodiment, the antibody or fragment competes with 02D10 IgG4-PE having a heavy chain amino acid sequence of SEQ ID No:30 and a light chain amino acid sequence of SEQ ID No:32.

[0193] In one embodiment, the amino acid is any naturally-occurring amino acid.

[0194] 74. The antibody or fragment according to aspect 73, where X is a neutral amino acid, optionally P or G.

[0195] In an embodiment, X is P or G. In an embodiment, X is selected from P, N, A or G. In another embodiment, X is selected from P, G or N. In another embodiment, X is selected from P, G or A.

[0196] 75. An antibody or a fragment thereof, optionally according to aspect 73 or 74, that specifically binds to hOX40L and competes for binding to said hOX40L with the antibody 02D10, wherein the antibody or fragment comprises a VH domain which comprises the HCDR3 sequence of SEQ ID NO:49 or 46 or the HCDR3 sequence of SEQ ID NO:49 or 46 comprising less than 5 amino acid substitutions.

[0197] The features of the antibodies of any of the aspects, configurations, concepts, examples or embodiments described herein optionally apply *mutatis mutandis* to these antibodies, e.g. the antibody may be a human antibody or chimeric antibody having functional features as described herein. Competition may be determined as described in any aspect, embodiment, concept, example or configuration described herein, e.g. as determined by SPR, ELISA, HTRF or FACS.

[0198] In an embodiment, the HCDR3 sequence of SEQ ID NO:49 or 46 comprises less than 4 amino acid substitutions (i.e. 3 or fewer). In an embodiment, the HCDR3 sequence of SEQ ID NO:49 or 46 comprises less than 3 amino acid substitutions (i.e. 2 or 1 substitutions). In an embodiment, the HCDR3 sequence of SEQ ID NO:49 or 46 comprises less than 2 amino acid substitutions (i.e. one substitution).

[0199] In one embodiment, the antibody or fragment competes with the variable regions of 02D10 (e.g. competes with an antibody comprising the heavy chain variable region of SEQ ID No: 34 and the light chain variable region of SEQ ID No:48). In another embodiment, the antibody or fragment competes with 02D10 IgG4-PE having a heavy chain amino acid sequence of SEQ ID No:62 and a light chain amino acid sequence of SEQ ID No:64.

[0200] In another embodiment, the antibody or fragment additionally or alternatively competes with 10A7. In one embodiment, the antibody or fragment competes with the variable regions of 10A7 (e.g. competes with an antibody comprising the heavy chain variable region of SEQ ID No: 2 and the light chain variable region of SEQ ID No:16). In another embodiment, the antibody or fragment competes with 02D10 IgG4-PE having a heavy chain amino acid sequence of SEQ ID No:30 and a light chain amino acid sequence of SEQ ID No:32.

[0201] 76. An antibody or fragment according to any one of aspects 73 to 75, the VH domain comprising a HCDR3 of from 16 to 27 amino acids and which is derived from the recombination of a human VH gene segment, a human D gene segment and a human JH gene segment, wherein the human JH gene segment is IGJH6 (e.g. IGJH6'02).

[0202] In an embodiment, the human JH gene segment is selected from IGJH6'01, IGJH6'02, IGJH6'03 and IGJH6'04. In another embodiment, the human JH gene segment is selected from IGJH6'02 and IGJH6'04. In another embodiment, the JH gene segment is IGJH6'02.

[0203] In a further embodiment, the human VH gene segment is IGHV3-23, for example selected from IGHV3-23'01, IGHV3-23'02, IGHV3-23'03, IGHV3-23'04 or IGHV3-23'05. In another embodiment, the human VH gene segment is IGHV3-23'01 or IGHV3-23'04, in particular IGHV3-23'04.

[0204] In a further embodiment, the human DH gene segment is IGHD3-19, for example selected from IGHD3-19'01 or IGHD3-19'02. In one embodiment, the human DH gene segment is IGHD3-19'01. In one embodiment, the human DH gene segment is IGHD3-19'02.

[0205] 77. The antibody or fragment according to any one of aspects 73 to 76, the VH domain comprising the HCDR1 sequence of SEQ ID NO:36 or 42 or the HCDR1 sequence of SEQ ID NO:36 or 42 comprising less than 4 amino acid substitutions.

[0206] In an embodiment, the HCDR1 sequence of SEQ ID NO:36 or 42 comprises less than 3 amino acid substitutions (i.e. 2 or 1 substitutions). In an embodiment, the HCDR1 sequence of SEQ ID NO:36 or 42 comprises less than 2 amino acid substitutions (i.e. one substitution).

[0207] 78. The antibody or fragment according to any one of aspects 73 to 77, the VH domain comprising the HCDR2 sequence of SEQ ID NO:38 or 44, or the HCDR2 sequence of SEQ ID NO:38 or 44 comprising less than 5 amino acid substitutions.

[0208] In an embodiment, the HCDR2 sequence of SEQ ID NO:38 or 44 comprises less than 4 amino acid substitutions (i.e. 3 or fewer). In an embodiment, the HCDR2 sequence of SEQ ID NO:38 or 44 comprises less than 3 amino acid substitutions (i.e. 2 or 1 substitutions). In an embodiment, the HCDR2 sequence of SEQ ID NO:38 or 44 comprises less than 2 amino acid substitutions (i.e. one substitution).

[0209] 79. The antibody or fragment according to any one of aspects 73 to 76, the VH domain comprising an amino acid sequence of SEQ ID NO:34, or a heavy chain variable domain amino acid sequence that is at least 80% (e.g. at least 85%) identical to SEQ ID NO:34.

[0210] In an embodiment, the heavy chain variable domain amino acid sequence is at least 85%, at least 90%, at least 95%, least 96% at least 97% at least 98% or at least 99% identical to SEQ ID NO:34.

[0211] 80. The antibody or fragment according to any one of aspects 73 to 79 comprising first and second copies of said VH domain.

[0212] 81. The antibody or fragment according to any one of aspects 73 to 80, comprising a VL domain which comprises the LCDR1 sequence of SEQ ID NO:54 or 60, or the LCDR2 sequence of SEQ ID NO:54 or 60 comprising less than 5 amino acid substitutions.

[0213] In an embodiment, the LCDR3 sequence of SEQ ID NO:54 or 60 comprises less than 4 amino acid substitutions (i.e. 3 or fewer). In an embodiment, the LCDR3 sequence of SEQ ID NO:54 or 60 comprises less than 3 amino acid substitutions (i.e. 2 or 1 substitutions). In an embodiment, the LCDR3 sequence of SEQ ID NO:54 or 60 comprises less than 2 amino acid substitutions (i.e. one substitution).

[0214] 82. The antibody or fragment according to any one of aspects 73 to 81, comprising a or said VL domain, which VL domain comprises the LCDR2 sequence of SEQ ID NO:52 or 58, or the LCDR2 sequence of SEQ ID NO:52 or 58 comprising less than 2 amino acid substitutions.

[0215] 83. The antibody or fragment according to any one of aspects 73 to 82, comprising a or said VL domain, which VL domain comprises the LCDR1 sequence of SEQ ID NO:54 or 60, or the LCDR1 sequence of SEQ ID NO:54 or 60 comprising less than 4 amino acid substitutions.

[0216] In an embodiment, the LCDR1 sequence of SEQ ID NO:54 or 60 comprises less than 3 amino acid substitutions (i.e. 2 or 1 substitutions). In an embodiment, the LCDR1 sequence of SEQ ID NO:54 or 60 comprises less than 2 amino acid substitutions (i.e. one substitution).

[0217] 84. The antibody or fragment according to any one of aspects 73 to 83, comprising a or said VL domain, which VL domain comprises an amino acid sequence of SEQ ID NO:48, or a light chain variable domain amino acid sequence that is at least 80% (e.g. at least 85%) identical to SEQ ID NO:48.

[0218] In an embodiment, the light chain variable domain amino acid sequence is at least 85%, at least 90%, at least 95%, least 96% at least 97% at least 98% or at least 99% identical to SEQ ID NO:48.

[0219] 85. The antibody or fragment according to any one of aspects 81 to 84, comprising first and second copies of said VL domain.

[0220] 86. The antibody or fragment according to any one of aspects 81 to 85, wherein the antibody or fragment comprises a kappa light chain.

[0221] In another embodiment, the VL domain is a kappa VL domain. In an embodiment, the kappa VL domain is derived from the recombination of a human VL gene segment, and a human JL gene segment, wherein the human VL gene segment is IGKV1D-39. In another embodiment, the VL gene segment is IGKV1D-39*01.

[0222] In a further embodiment, the human JL gene segment is IGKJ1 or IGKJ3. In another embodiment, the JL gene segment is IGKJ1*01. In another embodiment, the JL gene segment is IGKJ3*01.

[0223] 87. The antibody or fragment according to any one of aspects 75 to 86 wherein the amino acid substitutions are conservative amino acid substitutions, optionally wherein the conservative substitutions are from one of six groups (each group containing amino acids that are conservative substitutions for one another) selected from:

1. f) Alanine (A), Serine (S), Threonine (T);
2. Z) Aspartic acid (D), Glutamic acid (E);
3. J) Asparagine (N), Glutamine (Q);
4. d) Arginine (R), Lysine (K);
5. J) Isoleucine (I), Leucine (L), Methionine (M), Valine (V); and
6. f) Phenylalanine (F), Tyrosine (Y), Tryptophan (W)

[0224] In an embodiment, the conservative amino acid substitutions are as described herein. For example, the substitution may be of Y with F, T with S or K, P with A, E with D or Q, N with D or G, R with K, G with N or A, T with S or K, D with N or E, I with L or V, F with Y, S with T or A, R with K, G with N or A, K with R, A with S, K or P. In another embodiment, the conservative amino acid substitutions may be wherein Y is substituted with F, T with A or S, I with L or V, W with Y, M with L, N with D, G with A, T with A or S, D with N, I with L or V, F with Y or L, S with A or T and A with S, G, T or V.

[0225] 88. The antibody or fragment according to any one of aspects 73 to 87, wherein the antibody or fragment comprises a constant region, e.g. an IgG4 constant region, optionally wherein the constant region is IgG4-PE (Seq ID No. 128).

[0226] In another example of any aspect herein, the antibody or fragment comprises a human gamma 4 constant region. In another embodiment, the heavy chain constant region does not bind Fcγ receptors, and e.g. comprises a Leu235Glu mutation (i.e. where the wild type leucine residue is mutated to a glutamic acid residue). In another embodiment, the heavy chain constant region comprises a Ser228Pro mutation to increase stability.

[0227] 89. The antibody according to any one of aspects 73 to 88, wherein the antibody comprises a heavy chain and a light chain, the heavy chain amino acid sequence consisting of the sequence of SEQ ID No:62 and the light chain amino acid sequence consisting of the sequence of SEQ ID No:64.

[0228] 90. An antibody or fragment as defined in any one of aspects 73 to 89, 99, 101 or 102 for use in treating or preventing a hOX40L-mediated disease or condition selected from an autoimmune disease or condition, a systemic inflammatory disease or condition, or transplant rejection; for example inflammatory bowel disease (IBD), Crohn's disease, rheumatoid arthritis, transplant rejection, allogeneic transplant rejection, graft-versus-host disease (GvHD), ulcerative colitis, systemic lupus erythematosus (SLE), diabetes, uveitis, ankylosing spondylitis, contact hypersensitivity, multiple sclerosis or atherosclerosis, in particular GvHD.

[0229] The features of the antibodies, and the hOX40L-mediated disease of any of the aspects, configurations, concepts, examples or embodiments as described herein optionally apply *mutatis mutandis* to this use. Any of the compositions, dosing schedules or modes of administration as described in any aspect, configuration, concept, example or embodiment herein optionally apply *mutatis mutandis* to this use.

[0230] 91. Use of an antibody or fragment as defined in any one of aspects 73 to 89, 99, 101 or 102 in the manufacture of a medicament for administration to a human for treating or preventing a hOX40L mediated disease or condition in the human selected from an autoimmune disease or condition, a systemic inflammatory disease or condition, or transplant rejection; for example inflammatory bowel disease (IBD), Crohn's disease, rheumatoid arthritis, transplant rejection, allogeneic transplant rejection, graft-versus-host disease (GvHD), ulcerative colitis, systemic lupus erythematosus (SLE), diabetes, uveitis, ankylosing spondylitis, contact hypersensitivity, multiple sclerosis or atherosclerosis, in particular GvHD.

[0231] The features of the antibodies, and the hOX40L-mediated disease of any of the aspects, configurations, concepts, examples or embodiments as described herein optionally apply *mutatis mutandis* to this use. Any of the compositions, dosing schedules or modes of administration as described in any aspect, configuration, concept, example or embodiment herein optionally apply *mutatis mutandis* to this use.

[0232] 92. A method of treating or preventing a hOX40L mediated disease or condition selected from an autoimmune disease or condition, a systemic inflammatory disease or condition, or transplant rejection; for example inflammatory bowel disease (IBD), Crohn's disease, rheumatoid arthritis, transplant rejection, allogeneic transplant rejection, graft-versus-host disease (GvHD), ulcerative colitis, systemic lupus erythematosus (SLE), diabetes, uveitis, ankylosing spondylitis, contact hypersensitivity, multiple sclerosis or atherosclerosis, in particular GvHD in a human, comprising administering to said human a therapeutically effective amount of an antibody or fragment as defined in any one of aspects 73 to 89, 99, 101 or 102, wherein the hOX40L mediated disease or condition is thereby treated or prevented.

[0233] The features of the antibodies, and the hOX40L-mediated disease of any of the aspects, configurations, concepts, examples or embodiments as described herein optionally apply *mutatis mutandis* to this method. Any of the compositions, dosing schedules or modes of administration as described in any aspect, configuration, concept, example or embodiment herein optionally apply *mutatis mutandis* to this method.

[0234] 93. The antibody or fragment according to aspect 90, the use according to aspect 91, or the method according to aspect 92, wherein the hOX40L-mediated disease or condition is GvHD.

[0235] In another embodiment, the antibody or fragment is capable of treating or preventing GvHD.

[0236] 94. The antibody or fragment, the use or the method according to any one of aspects 90 to 93, wherein the antibody is administered prophylactically.

[0237] In an embodiment, the prophylaxis prevents the onset of the disease or condition or of the symptoms of the disease or condition. In one embodiment, the prophylactic treatment prevents the worsening, or onset, of the disease or condition. In one embodiment, the prophylactic treatment prevents the worsening of the disease or condition.

[0238] In another embodiment, said antibody is administered intravenously. In another embodiment, said antibody is administered at a dose of about 5-10 mg/kg (e.g. at about 8 mg/kg). In another embodiment, said antibody is administered at a dose selected from about 0.1 mg/kg, about 0.5 mg/kg, about 1 mg/kg, 3 mg/kg, 5 mg/kg, about 10 mg/kg, about 15 mg/kg, about 20 mg/kg, about 25 mg/kg, about 30 mg/kg, about 40 mg/kg, about 50 mg/kg, about 60 mg/kg, about 70 mg/kg, about 80 mg/kg, about 90 mg/kg or about 100 mg/kg, in particular about 1 mg/kg, or about 3 mg/kg.

[0239] In another embodiment, said antibody is administered 1-4 days before transplant, e.g. 1-3 days before transplant or 1-2 days before transplant. In another embodiment, said antibody is administered weekly, bi-weekly or monthly following transplant, e.g. bi-weekly. In a further embodiment, said antibody is administered intravenously prophylactically 1-3 days before transplant at a dose of about 5-10 mg/kg (e.g. about 8 mg/kg) and then intravenously, bi-weekly at a dose of about 5-10 mg/kg (e.g. about 8 mg/kg).

[0240] In another embodiment, the patient is monitored periodically post-transplant, for the presence of a biomarker predictive for the development of GvHD (e.g. acute GvHD), and the anti-OX40L antibody of the invention is administered once the biomarker levels are such that the patient is determined to be at risk of developing GvHD (e.g. acute GvHD). This strategy would avoid unnecessary dosing of drug and unnecessary suppression of the immune system. Examples of biomarkers which may be useful as predictive biomarkers of acute GvHD may be those identified in Levine *et al.*, "A prognostic score for acute graft-versus-host disease based on biomarkers: a multicentre study", *Lancet Haematol* 2015; 2:e21-29. These biomarkers include, but are not limited to TNFR1, ST-2, eNf and IL2ra and Reg3α.

[0241] 95. A human antibody or fragment thereof comprising a HCDR3 of from 16 to 27 amino acids and derived from the recombination of a human VH gene segment, a human D gene segment and a human JH gene segment, wherein the human JH gene segment is IGHB6 (e.g. IGHB6*02), which specifically binds to hOX40L, for treating or preventing a hOX40L-mediated disease or condition selected from an autoimmune disease or condition, a systemic inflammatory disease or condition, or transplant rejection; for example inflammatory bowel disease (IBD), Crohn's disease, rheumatoid arthritis, transplant rejection, allogeneic transplant rejection, graft-versus-host disease (GvHD), ulcerative colitis, systemic lupus erythematosus (SLE), diabetes, uveitis, ankylosing spondylitis, contact hypersensitivity, multiple sclerosis or atherosclerosis, in particular GvHD (e.g. wherein the antibody is for the prevention of GvHD).

[0242] The features of the antibodies, and the hOX40L-mediated disease of any of the aspects, configurations, concepts, examples or embodiments optionally apply *mutatis mutandis* to this use. Any of the compositions, dosing schedules or modes of administration as described in any aspect, configuration, concept, example or embodiment herein optionally apply *mutatis mutandis* to this use.

[0243] 96. Use of a human antibody or fragment thereof comprising a HCDR3 of from 16 to 27 amino acids and derived from the recombination of a human VH gene segment, a human D gene segment and a human JH gene segment, wherein the human JH gene segment is IGHB6 (e.g. IGHB6*02), which specifically binds to hOX40L, in the manufacture of a medicament for administration to a human for treating or preventing a hOX40L mediated disease or condition in the human selected from an autoimmune disease or condition, a systemic inflammatory disease or condition, or transplant rejection; for example inflammatory bowel disease (IBD), Crohn's disease, rheumatoid arthritis, transplant rejection, allogeneic transplant rejection, graft-versus-host disease (GvHD), ulcerative colitis, systemic lupus erythematosus (SLE), diabetes, uveitis, ankylosing spondylitis, contact hypersensitivity, multiple sclerosis or atherosclerosis, in particular GvHD.

[0244] The features of the antibodies, and the hOX40L-mediated disease of any of the aspects, configurations, concepts, examples or embodiments optionally apply *mutatis mutandis* to this use. Any of the compositions, dosing schedules or modes of administration as described in any aspect, configuration, concept, example or embodiment herein optionally apply *mutatis mutandis* to this use.

[0245] 97. A method of treating or preventing a hOX40L mediated disease or condition selected from an autoimmune disease or condition, a systemic inflammatory disease or condition, or transplant rejection; for example inflammatory bowel disease (IBD), Crohn's disease, rheumatoid arthritis, transplant rejection, allogeneic transplant rejection, graft-versus-host disease (GvHD), ulcerative colitis, systemic lupus erythematosus (SLE), diabetes, uveitis, ankylosing spondylitis, contact hypersensitivity, multiple sclerosis or atherosclerosis, in particular GvHD in a human, comprising administering to said human a therapeutically effective amount of a human antibody or fragment thereof comprising a HCDR3 of from 16 to 27 amino acids and derived from the recombination of a human VH gene segment, a human D gene segment and a human JH gene segment, wherein the human JH gene segment is IGHB6 (e.g. IGHB6*02), which specifically binds to hOX40L, wherein the hOX40L mediated disease or condition is thereby treated or prevented.

[0246] The features of the antibodies, and the hOX40L-mediated disease of any of the aspects, configurations, concepts, examples or embodiments optionally apply *mutatis mutandis* to this method. Any of the compositions, dosing schedules or modes of administration as described in any aspect, configuration, concept, example or embodiment herein optionally apply *mutatis mutandis* to this method.

[0247] In an embodiment of any one of aspects 95 to 97, the human JH gene segment is selected from IGHB6*01, IGHB6*02, IGHB6*03 and IGHB6*04. In another embodiment of any one of aspects 95 to 97, the human JH gene segment is selected from IGHB6*01, IGHB6*02 and IGHB6*04. In another embodiment of any one of aspects 95 to 97, the JH gene segment is IGHB6*02.

[0248] In a further embodiment of any one of aspects 95 to 97, the human VH gene segment is IGHV3-23, for example selected from IGHV3-23*01, IGHV3-23*02, IGHV3-23*03, IGHV3-23*04 or IGHV3-23*05. In another embodiment of any one of aspects 95 to 97 the human VH gene segment is IGHV3-23*01 or IGHV3-23*04, in particular IGHV3-23*04.

[0249] In a further embodiment of any one of aspects 95 to 97, the human DH gene segment is IGHD3-19, for example selected from IGHD3-19*01 or IGHD3-19*02. In one embodiment of any one of aspects 95 to 97, the human DH gene segment is IGHD3-19*01. In one embodiment of any one of aspects 95 to 97, the human DH gene segment is IGHD3-19*02.

[0250] In an embodiment of any one of aspects 90 to 97, the antibody is capable of treating or preventing GvHD. In another embodiment of any one of aspects 90 to 97, the antibody or fragment is used for the treatment or prevention of a disease other than GvHD, but the antibody or fragment is capable of treating or preventing GvHD.

[0251] 98. The antibody or fragment according to aspect 96, or the antibody or fragment according to aspect 95, the use according to aspect 96, or the method according to aspect 97, wherein the antibody or fragment comprises a kappa light chain, e.g. wherein the VL domain of the light chain is derived from the recombination of a human VL gene segment, and a human JL gene segment, wherein the human VL gene segment is IGKV1D-39 (e.g. IGKV1D-39*01), and optionally the human JL gene segment is IGKJ1 (e.g. IGKJ1*01) or IGKJ3 (e.g. IGKJ3*01).

[0252] In another embodiment, the VL domain is a kappa VL domain. In an embodiment, the kappa VL domain is derived from the recombination of a human VL gene segment, and a human JL gene segment, wherein the human VL gene segment is IGKV1D-39. In another embodiment, the VL gene segment is IGKV1D-39*01.

[0253] In a further embodiment, the human JL gene segment is IGKJ1. In another embodiment, the JL gene segment is IGKJ1*01. In a further embodiment, the human JL gene segment is IGKJ3. In another embodiment, the JL gene segment is IGKJ3*01.

[0254] 99. The antibody or fragment according to any one of aspects 73 to 89, 99, 101 or 102, or the antibody or fragment use or method according to any one of aspects 90 to 98, wherein the antibody or fragment enables greater than 80% stem cell donor chimerism by day 12 in a Rhesus macaque model of haploidentical hematopoietic stem cell transplantation, optionally wherein the antibody is for the prevention of GvHD.

[0255] In another aspect, there is provided an antibody or fragment, use or method according to any one of aspects 95 to 98, wherein the antibody or fragment is for treating or preventing transplant rejection (e.g. GvHD) in a human by enabling greater than 80% stem cell donor chimerism by day 12 in said human following donor human hematopoietic stem cell transplantation.

[0256] In another embodiment, there is provided an antibody or fragment according to any one of aspects 73 to 89, 96, 101 or 102, wherein the antibody or fragment enables greater than 80% stem cell donor chimerism by day 12 in a *Rhesus macaque* model of haploidentical hematopoietic stem cell transplantation.

[0257] In one embodiment, the chimerism is T cell (CD3⁺/CD29⁺) chimerism. In another embodiment, the chimerism is peripheral blood chimerism. In another embodiment, the chimerism is peripheral blood or T cell (CD3⁺/CD29⁺) chimerism.

[0258] In one embodiment, the stem cell donor chimerism (e.g. the peripheral blood or T cell (CD3⁺/CD29⁺) chimerism) is determined using divergent donor- and recipient-specific MHC-linked microsatellite markers, by comparing peak heights of the donor- and recipient-specific amplicons. In another embodiment, stem cell donor chimerism is determined as described in Khan, L.S. et al., "Induction of chimerism in rhesus macaques through stem cell transplant and costimulation blockade-based immunosuppression", *Am J Transplant*. 2007 Feb;7(2):320-35. In another embodiment, stem cell donor chimerism is determined as described in Example 7.

[0259] In one embodiment, the *Rhesus macaque* model of haploidentical haematopoietic stem cell is performed by the transplant (HSCT) recipient animals undergoing a conditioning procedure together with anti-CD40L antibody administration, followed by infusion of a peripheral blood product isolated from a half-sibling donor animal, following which animals continue to receive weekly doses of the anti-CD40L antibody of the invention, and blood samples are taken and analysed.

[0260] In another embodiment, in the HSCT model, recipient animals receive a conditioning radiation dose of 1020 cGy in 4 dose fractions over 2 days (experimental Day -2 and Day -1) to ablate the host haematopoietic system before intravenous administration of an anti-CD40L antibody of the invention (Day -2 with subsequent intravenous doses on Days 5, 12, 19, 26, 33, 40, 47) and transplant of white blood cell- and stem cell-enriched peripheral blood from an MHC half-matched (half-sibling) donor animal to reconstitute the recipient's immune system, together with provision of continuous supportive care, blood sampling and monitoring for signs of GVHD.

[0261] In one embodiment, the antibody or fragment, use or method is for the prevention of GVHD.

[0262] In an embodiment, the anti-CD40L antibody of the invention is administered prophylactically. In one embodiment, the prophylactic treatment prevents the worsening or onset of the disease or condition.

[0263] In another embodiment, said antibody is administered intravenously. In another embodiment, said antibody is administered at a dose of about 5-10 mg/kg (e.g. at about 8 mg/kg). In another embodiment, said antibody is administered at a dose selected from about 0.1 mg/kg, about 0.5 mg/kg, about 1 mg/kg, 3 mg/kg, 5 mg/kg, about 10 mg/kg, about 15 mg/kg, about 20 mg/kg, about 25 mg/kg, about 30 mg/kg, about 40 mg/kg, about 50 mg/kg, about 60 mg/kg, about 70 mg/kg, about 80 mg/kg about 90 mg/kg or about 100 mg/kg, in particular about 1 mg/kg, or about 5 mg/kg.

[0264] In another embodiment, said antibody is administered 1-4 days before transplant, e.g. 1-3 days before transplant or 1-2 days before transplant. In another embodiment, said antibody is administered weekly, bi-weekly or monthly following transplant, e.g. bi-weekly. In a further embodiment, said antibody is administered intravenously prophylactically 1-3 days before transplant at a dose of about 5-10 mg/kg (e.g. about 8 mg/kg) and then intravenously, bi-weekly at a dose of about 5-10 mg/kg (e.g. about 5 mg/kg).

[0265] In another embodiment, the patient is monitored periodically post-transplant, for the presence of a biomarker predictive for the development of GVHD (e.g. acute GVHD), and the anti-CD40L antibody of the invention is administered once the biomarker levels are such that the patient is determined to be at risk of developing GVHD (e.g. acute GVHD). This strategy would avoid unnecessary dosing of drug and unnecessary suppression of the immune system. Examples of biomarkers which may be useful as predictive biomarkers of acute GVHD may be those identified in Levine et al., "A prognostic score for acute graft-versus-host disease based on biomarkers: a multicentre study", *Lancet Haematol* 2015; 2:e21-29. These biomarkers include, but are not limited to TNFR1, ST-2, eLain and IL2Ro and Reg3a.

[0266] In a further embodiment, the HSCT model is conducted as described in Miller, Weston P., et al. "GVHD after haploidentical transplant: a novel, MHC-defined rhesus macaque model identifies CD28⁺-CD8⁺-T cells as a reservoir of breakthrough T-cell proliferation during costimulation blockade and sirolimus-based immunosuppression", *Blood*, 116, 24(2010):5493-5418. In a further embodiment, the HSCT model is carried out as described in Example 7.

[0267] 100. The antibody or fragment, use or method according to any one of aspects 95 to 99, wherein the antibody is as defined in any one of aspects 73 to 89, 96, 99, 101 or 102.

[0268] 101. The antibody or fragment according to any one of aspects 73 to 89, 96, 99 or 102, or the antibody or fragment, use or method according to any one of aspects 90 to 100, wherein the antibody or fragment expresses as a stably transfected pool in Lonza GS-XceedTM at level greater than 1.5g/L in a fed batch overgrowth culture using Lonza version 8 feed system with an overgrowth period of 14 days.

[0269] In one embodiment, the expression level is greater than 1.0g/L, greater than 1.1g/L, greater than 1.2g/L, greater than 1.3g/L, or greater than 1.4g/L.

[0270] 102. The antibody or fragment according to any one of aspects 73 to 89, 96, 99 or 101, or the antibody or fragment, use or method according to any one of aspects 90 to 101, wherein the antibody or fragment maintains a naive population of CD4⁺ T-cells of >20% of total CD4⁺ T cell population at day 12 in a *Rhesus macaque* model of haploidentical hematopoietic stem cell transplantation.

[0271] In another aspect, there is provided an antibody or fragment according to any one of aspects 73 to 89, 96, 99 or 101, or an antibody or fragment, use or method according to any one of aspects 90 to 101, wherein the antibody or fragment is for treating or preventing transplant rejection in a human by maintaining a naive population of donor CD4⁺ T-cells of >20% of total CD4⁺ T cell population at day 12 in said human following donor human hematopoietic stem cell transplantation

[0272] In one embodiment, the HSCT model is as described in any embodiment contemplated hereinabove, e.g. as described in connection with aspect 99.

[0273] In another embodiment, the naive population is measured by evaluating the relative proportion of specific T cell phenotypes using flow cytometry where cell subsets are identified by labelling with fluorescent antibody probes and whereby naive CD4⁺ or CD8⁺-T-cells are labelled CD4⁺/CD28⁺/CD95⁺ or CD8⁺/CD28⁺/CD95⁺, respectively, central memory CD4⁺ or CD8⁺-T-cells are labelled CD4⁺/CD28⁺/CD95⁺ or CD8⁺/CD28⁺/CD95⁺, respectively, and effector memory CD4⁺ or CD8⁺-T-cells are labelled CD4⁺/CD28⁺/CD95⁺ or CD8⁺/CD28⁺/CD95⁺, respectively.

[0274] 103. The antibody or fragment, use or the method according to any one of aspects 90 to 102, further comprising administering to the human a further therapeutic agent, optionally wherein the further therapeutic agent is independently selected from the group consisting of rapamycin (sirolimus), tacrolimus, ciclosporin, corticosteroids (e.g. methylprednisolone), methotrexate, mycophenolate mofetil, anti-CD28 antibodies, anti-IL12/IL-23 antibodies (e.g. ustekinumab), anti-CD29 antibodies (e.g. rituximab), anti-CD39 antibodies (e.g. brentuximab), CTLA4-Fc molecules (e.g. abatacept), CCR5 receptor antagonists (e.g. maraviroc), anti-CD4L antibodies, anti-VLA4 antibodies (e.g. natalizumab), anti-LFA1 antibodies, fludarabine, anti-CD52 antibodies (e.g. alemtuzumab), anti-CD45 antibodies, cyclophosphamide, anti-thymocyte globulins, anti-complement C5 antibodies (e.g. eculizumab), anti-a4b7 integrin antibodies (e.g. vedolizumab), anti-IL6 antibodies (e.g. tocilizumab), anti-IL2R antibodies (e.g. basilixumab), anti-CD25 antibodies (e.g. daclizumab), anti-TNF α /TNF α -Fc molecules (e.g. etanercept, adalimumab, infliximab, golimumab or certolizumab pegol) and Vorinostat, in particular rapamycin (sirolimus), tacrolimus, ciclosporin, corticosteroids (e.g. methylprednisolone), methotrexate, mycophenolate mofetil, anti-CD28 antibodies, CTLA4-Fc molecules (e.g. abatacept), anti-CD4L antibodies, anti-LFA1 antibodies, anti-CD52 antibodies (e.g. alemtuzumab), cyclophosphamide and anti-thymocyte globulins.

[0275] In one embodiment, the further therapeutic agent is an anti-inflammatory drug. In another embodiment, the anti-inflammatory drug is independently selected from the group consisting of corticosteroids (e.g. methylprednisolone), anti-IL12/IL-23 antibodies (e.g. ustekinumab), anti-VLA4 antibodies (e.g. natalizumab), anti-LFA1 antibodies, anti-complement C5 antibodies (e.g. eculizumab), anti-a4b7 integrin antibodies (e.g. vedolizumab), anti-IL6 antibodies (e.g. tocilizumab), anti-IL2R antibodies (e.g. basilixumab) or anti-TNF α antibodies/TNF α -Fc molecules (e.g. etanercept, adalimumab, infliximab, golimumab or certolizumab pegol). In an example, the anti-inflammatory drug is independently selected from the group consisting of corticosteroids (e.g. methylprednisolone) and anti-LFA1 antibodies.

[0276] In one embodiment, the combination comprises an anti-CD40L antibody of the invention and further therapeutic agents independently selected from the group consisting of calcineurin inhibitors (e.g. tacrolimus, ciclosporin), mTOR inhibitors (e.g. rapamycin (sirolimus)), and antiproliferative agents (e.g. mycophenolate mofetil, cyclophosphamide).

[0277] In one embodiment, the combination comprises an anti-CD40L antibody of the invention and further therapeutic agents independently selected from the group consisting of immunosuppressants that modulate IL-2 signalling (e.g. tacrolimus, ciclosporin, rapamycin (sirolimus)), and anti-CD25 antibodies (e.g. basilixumab, daclizumab).

[0278] In one embodiment, the combination comprises an anti-CD40L antibody of the invention and rapamycin (sirolimus). In another embodiment, the combination comprises an anti-CD40L antibody of the invention and tacrolimus. In another embodiment, the combination comprises an anti-CD40L antibody of the invention and tacrolimus and methotrexate. In another embodiment, the combination comprises an anti-CD40L antibody of the invention and ciclosporin. In another embodiment, the combination comprises an anti-CD40L antibody of the invention and ciclosporin and methotrexate. In another embodiment, the combination comprises an anti-CD40L antibody of the invention and cyclophosphamide. In another embodiment, the combination comprises an anti-CD40L antibody of the invention and mycophenolate mofetil.

[0279] 104. The antibody or fragment, use or the method according to aspect 103, wherein the further therapeutic agent is administered sequentially or simultaneously with the anti-CD40L antibody or fragment.

[0280] 105. A pharmaceutical composition comprising an antibody or fragment as defined in any one of aspects 73 to 89, 96, 99, 101 or 102 and a pharmaceutically acceptable excipient, diluent or carrier and optionally further comprising a further therapeutic agent independently selected from the group consisting of rapamycin (sirolimus), tacrolimus, ciclosporin, corticosteroids (e.g. methylprednisolone), methotrexate, mycophenolate mofetil, anti-CD28 antibodies, anti-IL12/IL-23 antibodies (e.g. ustekinumab), anti-CD29 antibodies (e.g. rituximab), anti-CD39 antibodies (e.g. brentuximab), CTLA4-Fc molecules (e.g. abatacept), CCR5 receptor antagonists (e.g. maraviroc), anti-CD4L antibodies, anti-VLA4 antibodies (e.g. natalizumab), anti-LFA1 antibodies, fludarabine, anti-CD52 antibodies (e.g. alemtuzumab), anti-CD45 antibodies, cyclophosphamide, anti-thymocyte globulins, anti-complement C5 antibodies (e.g. eculizumab), anti-a4b7 integrin antibodies (e.g. vedolizumab), anti-IL6 antibodies (e.g. tocilizumab), anti-IL2R antibodies (e.g. basilixumab), anti-CD25 antibodies (e.g. daclizumab), anti-TNF α / TNF α -Fc molecules (e.g. etanercept, adalimumab, infliximab, golimumab or certolizumab pegol) and Vorinostat, in particular rapamycin (sirolimus), tacrolimus, ciclosporin, corticosteroids (e.g. methylprednisolone), methotrexate, mycophenolate mofetil, anti-CD28 antibodies, CTLA4-Fc molecules (e.g. abatacept), anti-CD4L antibodies, anti-LFA1 antibodies, anti-CD52 antibodies (e.g. alemtuzumab), cyclophosphamide and anti-thymocyte globulins.

[0281] The pharmaceutically acceptable excipients, diluents or carriers as described herein apply *mutatis mutandis* to these compositions.

[0282] In one embodiment, the further therapeutic agent is an anti-inflammatory drug. In another embodiment, the anti-inflammatory drug is independently selected from the group consisting of corticosteroids (e.g. methylprednisolone), anti-IL12/IL-23 antibodies (e.g. ustekinumab), anti-VLA4 antibodies (e.g. natalizumab), anti-LFA1 antibodies, anti-complement C5 antibodies (e.g. eculizumab), anti-a4b7 integrin antibodies (e.g. vedolizumab), anti-IL6 antibodies (e.g. tocilizumab), anti-IL2R antibodies (e.g. basilixumab) or anti-TNF α antibodies/TNF α -Fc molecules (e.g. etanercept, adalimumab, infliximab, golimumab or certolizumab pegol). In an example, the anti-inflammatory drug is independently selected from the group consisting of corticosteroids (e.g. methylprednisolone) and anti-LFA1 antibodies.

[0283] In one embodiment, the further therapeutic agent is independently selected from the group consisting of calcineurin inhibitors (e.g. tacrolimus, ciclosporin), mTOR inhibitors (e.g. rapamycin (sirolimus)), and antiproliferative agents (e.g. mycophenolate mofetil, cyclophosphamide).

[0284] In one embodiment, the further therapeutic agent is independently selected from the group consisting of immunosuppressants that modulate IL-2 signalling (e.g. tacrolimus, ciclosporin, rapamycin (sirolimus)), and anti-CD25 antibodies (e.g. basilixumab, daclizumab).

[0285] In one embodiment, the further therapeutic agent is rapamycin (sirolimus). In another embodiment, the further therapeutic agent is tacrolimus. In another embodiment, the further therapeutic agent is a combination of tacrolimus and methotrexate. In another embodiment, the further therapeutic agent is ciclosporin. In another embodiment, the further therapeutic agent is a combination of ciclosporin and methotrexate. In another embodiment, the further therapeutic agent is cyclophosphamide. In another embodiment, the further therapeutic agent is mycophenolate mofetil.

[0286] 106. A pharmaceutical composition according to aspect 105, or a kit comprising a pharmaceutical composition as defined in aspect 105, wherein the composition is for treating and/or preventing a CD40L-mediated condition or disease selected from an autoimmune disease or condition, a systemic inflammatory disease or condition, or transplant rejection; for example inflammatory bowel disease (IBD), Crohn's disease, rheumatoid arthritis, transplant rejection, allogeneic transplant rejection, graft-versus-host disease (GVHD), ulcerative colitis, systemic lupus erythematosus (SLE), diabetes, uveitis, ankylosing spondylitis, contact hypersensitivity, multiple sclerosis and atherosclerosis, in particular GVHD.

[0287] The CD40L-mediated diseases of any of the aspects, configurations, concepts, examples or embodiments described herein optionally apply *mutatis mutandis* to this combination.

[0288] 107. A pharmaceutical composition according to aspect 105 or aspect 106 in combination with, or kit according to aspect 106 comprising a label or instructions for use to treat and/or prevent said disease or condition in a human; optionally wherein the label or instructions comprise a marketing authorisation number (e.g., an FDA or EMA authorisation number); optionally wherein the kit comprises an IV or injection device that comprises the antibody or fragment.

[0289] The labels, instructions, CD40L-mediated diseases and conditions of any of the aspects, configurations, concepts, examples or embodiments described herein optionally apply *mutatis mutandis* to this combination.

[0290] 108. A nucleic acid that encodes the HCDR3 of an antibody or fragment as defined in any one of aspects 73 to 89, 96, 99, 101 or 102.

[0291] 109. A nucleic acid that encodes a VH domain and/or a VL domain of an antibody or fragment as defined in any one of aspects 73 to 89, 96, 99, 101 or 102.

[0292] 110. A nucleic acid according to aspect 109 comprising a nucleotide sequence that is at least 80% identical to the sequence of SEQ ID NO: 33 and/or SEQ ID NO: 47.

[0293] In an example, the nucleotide sequence is at least 85% identical, at least 90% identical, at least 95% identical, at least 97% identical, at least 99% identical or at least 99% identical to the sequence of SEQ ID NO: 33 and/or SEQ ID NO: 47.

[0294] 111. A nucleic acid that encodes a heavy chain or a light chain of an antibody recited in any one of aspects 73 to 89, 96, 99, 101 or 102.

[0295] 112. A vector comprising the nucleic acid of any one of aspects 106 to 111; optionally wherein the vector is a CHO or HEK293 vector.

[0296] 113. A host comprising the nucleic acid of any one of aspects 106 to 111 or the vector of aspect 112.

[0297] The present invention furthermore relates to the following concepts.
Concept 1. A method of reducing the proportion of (e.g. of depleting or decreasing the level of) CD45RA⁺CCR7⁺CD95⁺OX40⁺ memory stem T-cells (T_{scm}) comprising combining said cells with an agent (such as an anti-CD40 or an anti-CD40L antibody or fragment thereof) which reduces the proportion of T_{scm} cells (e.g. which depletes or decreases the level of said T_{scm} cells), and whereby the proportion of said T_{scm} cells is reduced (e.g. whereby the level of said T_{scm} cells is decreased or depleted).

[0298] CD45RA⁺CCR7⁺CD95⁺OX40⁺ memory stem T-cells (T_{scm}) are thought to be a newly-defined subset of stem cell memory T-cells which are long-lived and have the capacity for self-renewal. Therefore, these cells may be detrimental in various diseases, such as GVHD and autoimmune disorders, because they are the source of a persistent and multipotent population of potentially self-reactive effector T-cells. It is known that T-cells develop through a pathway beginning with naive T-cells (T_n), through stem cell memory T-cells (T_{scm}), through central memory T-cells (T_{cm}) and effector memory T-cells (T_{em}), before developing into short-lived effector T-cells (T_{eff}), as described in Gattinoni and Restifo (2013), *Inside Blood*, 121(4), 567-568. At these various stages, different markers are expressed on the surface of the T-cells, their tissue localisation and their responsiveness to various stimuli such as inflammatory cytokines.

[0299] T_{scm} cells as defined herein are characterised as CD45RA⁺CCR7⁺CD95⁺OX40⁺. For alternative prior art classifications of different T-cell types, see the figure in Gattinoni and Restifo (2013). Further markers may be present or absent, but T_{scm} cells must at a minimum be CD45RA⁺CCR7⁺CD95⁺OX40⁺. The various cell-surface markers are, in one embodiment, identified using flow cytometry using methods which are well-known to those of skill in the art. In one embodiment, the T_{scm} cells may additionally be CD62L⁺. Flow cytometry techniques are well-known to those skilled in the art. Agents which may be used in flow cytometry techniques are defined in Example 7 below. In one embodiment, the flow cytometry is carried out as described in Example 7 below. In another embodiment, the flow cytometry is carried out as described in Baumgarth & Roederer (2009), *Journal of Immunological Methods*, 243, 77-97. (see concept 25 hereinbelow).

[0300] In a particular embodiment, the T_{scm} cells are characterised as being CD4⁺CD45RA⁺CCR7⁺CD95⁺OX40⁺.

[0301] Without being bound by theory, it is thought that reducing this T_{scm} population will have a number of benefits in various diseases, as set out herein. In one embodiment, the T_{scm} cells are active T_{scm} cells.

[0302] Throughout concepts 1 to 63 herein, the proportion or levels of T_{scm} cells may be reduced in a sample, or indeed in (a sample of) the blood of a subject. The proportion or levels of T_{scm} cells may be determined relative to the entire T-cell population in the sample. In one embodiment, the proportion or level of T_{scm} cells is determined relative to other T-cells in the sample. T-cells generally may be identified as being CD3⁺, and include T_n cells, T_{scm} cells, T_{cm} cells and T_{eff} cells. In a particular embodiment, the proportion or level of T_{scm} cells is determined relative to T_n cells (as defined hereinbelow) in the sample. The proportion or level of T_{scm} cells may be altered by depletion or by a decrease. In one embodiment, a ratio of T-cell types may be the same as a proportion of T_{scm} cells (e.g. as for concept 2 hereinbelow). In another embodiment, a level of T-cell types may be the same as a proportion of T_{scm} cells. In one embodiment, the ratio or proportion of T_{scm} T_n is greater than 50:50. Particular ratios and proportions are as described in concepts 23 and 24.

[0303] As used in concepts 1 to 63 herein "depleting" and "depletes" describes an active effect following combination with an agent (such as an antibody) on the desired target to kill or remove the target cells (e.g. T_{scm} cells). When the agent is an antibody, this is usually achieved through effector functions, such as ADCC, ADCG or CDC. Alternatively, the target may be killed or removed by a toxin, which may be conjugated to a drug or targeting moiety (such as an anti-CD40 or an anti-CD40L antibody). Such toxins will selectively kill or remove the cell to which they are targeted. Suitable immunconjugates are described on

page 90, and on pages 114 to 116, and 134 (in particular pages 114 to 116) herein.

[0304] "Decreasing" or "decreasing" as used in concepts 1 to 83 herein refers to a mechanism other than depletion, which reduces the absolute number of cells in a given population. This may be achieved indirectly, for example through a blocking or neutralising agent (such as an antibody) against a target which indirectly results in the killing of a target cell (such as a Tscm), or prevents the expansion or growth of the target cells, resulting in an apparent decrease in proportions relative to another type of cell (such as Tn cells).

[0305] As used in concepts 1 to 83 herein, a "level" of a T-cell population may refer to the absolute number, or to the relative proportion of a type of T-cell.

[0306] Throughout the various concepts 1 to 83 described herein, an agent which reduces the proportion of Tscm cells may be, for example, an antibody or fragment thereof, a short interfering RNA (siRNA), a zinc finger, a DAPPin, an aptamer, a Spiegelmer, an anti-cd11a, a receptor-Fc fusion, a ligand-Fc fusion or a small molecule. In one embodiment, the agent targets OX40 (e.g. human OX40), or ligands of OX40. In another embodiment, the agent targets OX40L (e.g. human OX40L), or receptors of OX40L. In one example, the agent may be an OX40-Fc fusion protein (e.g. hOX40-Fc fusion), or may be an OX40L-Fc fusion protein (e.g. hOX40L-Fc fusion), both including functional fragments of OX40 and OX40L. These types of constructs are known to those skilled in the art. In another embodiment, the agent targets OX40 (e.g. human OX40). In another embodiment, the agent targets OX40L (e.g. human OX40L).

[0307] In a particular embodiment, the agent is an antibody or fragment thereof. Formats and structures of antibodies and fragments are described elsewhere herein and may be applied to any of the concepts disclosed herein. The antibody or fragment may be any of the constructs as described herein (for example, as in any one of concepts 52 to 64 herein). In a particular embodiment, the agent is an anti-human OX40 antibody or fragment thereof. In another particular embodiment, the agent is an anti-human OX40L antibody, such as an antibody comprising the amino acid sequence of 02D10 described herein or an antibody comprising the amino acid sequence of aezulmab.

[0308] Concept 2. A method of altering the ratio of cell types in a T-cell population in a sample, the method comprising:

1. a. providing said population, wherein the population comprises a mixture of different T-cell types, wherein the population comprises CD45RA+CCR7+CD95+OX40+ Tscm cells,
2. b. providing an agent which reduces the proportion of Tscm cells (or providing an anti-OX40 or an anti-OX40L antibody or fragment thereof); and
3. c. combining said cell population with an amount of said agent (e.g. antibody or fragment thereof) effective to alter the ratio (e.g. to reduce the proportion) of Tscm cells in said population.

[0309] Throughout concepts 1 to 83 herein, the ratio of T-cell types may be altered in a sample, for example by increasing the proportion of naive T-cells (Tn, as defined hereinbelow). In another embodiment, the ratio of T-cell types may be altered by decreasing the proportion of Tscm cells. The ratio of Tscm cells may be determined relative to the entire sample. In one embodiment, the ratio of T-cells is determined by comparing the proportion of naive T-cells or Tscm cells relative to other T-cells in the sample. T-cells generally may be identified as being CD3+, and include Tn cells, Tscm cells, Tem cells and Treg cells. In a particular embodiment, the ratio of T-cells is determined as the ratio of Tscm cells relative to naive T-cells in the sample. The ratio of T-cells may be altered by depletion or by a decrease of Tscm cells. The ratio of T-cells may be altered by an increase or expansion of naive T-cells.

[0310] Concept 3. A method according to concept 2, wherein in step a), the population further comprises CD45RA+CCR7+CD95- naive T-cells (Tn).

[0311] Naive T-cells (Tn) as defined in concepts 1 to 83 herein are characterised as CD45RA+CCR7+CD95-. Further markers may be present or absent, but Tn cells must at a minimum be CD45RA+CCR7+CD95-. In one embodiment, Tn cells may additionally be CD8+ or CD4+. It is thought that Tn are beneficial because these represent the entire pool of T-cells from which adaptive T-cell immune responses can develop to protect an individual when exposed to potentially harmful pathogens and malignant cells.

[0312] Concept 4. A method according to concept 3 wherein the ratio of Tscm:Tn in the population of step a) is greater than 50:50.

[0313] Concept 5. A method according to any one of concepts 1 to 4, wherein the method is carried out ex vivo in a sample of blood extracted from a human donor subject.

[0314] Concept 6. A method according to concept 5, wherein blood produced by said method is reintroduced to a recipient human subject.

[0315] In one embodiment, the recipient human subject is the same donor human subject from whom the sample was removed. In another embodiment, the recipient human subject is different to the donor human subject. When the recipient is different to the donor, it is preferable that the donor is of the same gender as the recipient subject. In another embodiment, the donor may be of a similar age and ethnicity as the recipient subject. In another embodiment, the donor may have the same or similar allele markers as the recipient subject.

[0316] In another embodiment, the recipient human donor may receive more than one transfusion of donor blood, according to the severity of the disease to be treated.

[0317] Concept 7. A method according to any one of concepts 1 to 4, wherein the method is carried out in vivo in a human subject.

[0318] Concept 8. A method according to concept 7, wherein the subject has or is at risk of a Tscm-mediated disease or condition.

[0319] As used herein, a subject may be identified as being "at risk of a Tscm-mediated disease or condition" when the cellular changes in their T-cell population have begun to take place, but the subject has not yet presented symptoms or would not be diagnosed as having such a disease by any conventional method. Thus, the methods and uses disclosed herein may aid in the early identification of patients who will develop such diseases. In one embodiment, the disease is prevented (e.g. the treatment is prophylactic).

[0320] In a particular embodiment, the subject is at risk of GvHD or transplant rejection when they are pre-operative for a transplant. Potential transplant therapies are envisaged in concept 78 hereinbelow.

[0321] In any of concepts 1 to 83 described herein, a Tscm-mediated disease may be as defined in any of concepts 71 to 80 hereinbelow.

[0322] Concept 9. A method of treating or reducing the risk of a Tscm-mediated disease or condition in a subject, the method comprising combining a population of T-cells with an agent (e.g. an anti-OX40 or an anti-OX40L antibody or fragment thereof) which reduces the proportion of Tscm cells (e.g. which depletes or decreases the level of said Tscm cells), and whereby the proportion of CD45RA+CCR7+CD95+OX40+ Tscm cells is reduced in the population (e.g. whereby the level of said Tscm cells is decreased or depleted in said population).

[0323] As used in concepts 1 to 83 herein, the "treatment" of a Tscm-mediated disease includes the reduction of one or more symptom(s) of said Tscm-mediated disease. The "prevention" of a Tscm-mediated disease includes the prevention of one or more symptom(s) of said Tscm-mediated disease.

[0324] Concept 10. A method according to any one of concepts 7 to 9, wherein the agent (e.g. antibody or fragment thereof) is combined by administering said agent (e.g. antibody or fragment) in a therapeutically effective amount to said subject, whereby said Tscm-mediated disease or condition is treated or the risk of said Tscm-mediated disease or condition is reduced in said subject.

[0325] In one embodiment, the administration is prophylactic to reduce the risk of a Tscm-mediated disease.

[0326] In any of the concepts described herein, a therapeutically effective or prophylactically effective amount of the antibody or fragment is as described elsewhere (see page 29, 73, 105 to 107 for therapy, and pages 72, and 102 to 103 for prophylaxis). In any of the concepts described herein, modes and compositions for administration may be as described elsewhere (see pages 116 to 142 herein). In one embodiment, the antibody or fragment is administered by bolus injection (e.g. intravenously).

[0327] Concept 11. A method of treating or reducing the risk of a Tscm-mediated disease or condition in a subject comprising administering to said subject a therapeutically effective amount of an agent (e.g. an anti-OX40 or an anti-OX40L antibody or fragment thereof) which reduces the proportion of Tscm cells (e.g. which depletes or decreases the level of said Tscm cells), and whereby the proportion of CD45RA+CCR7+CD95+OX40+ Tscm cells is reduced (e.g. whereby the level of said Tscm cells is decreased or depleted), wherein the Tscm-mediated disease or condition is thereby treated or the risk of said Tscm-mediated disease or condition is reduced.

[0328] Concept 12a. An agent (e.g. an anti-OX40 or an anti-OX40L antibody or fragment thereof) which reduces the proportion of Tscm cells (e.g. which depletes or decreases the level of said Tscm cells) for use in treating or reducing the risk of a Tscm-mediated disease or condition in a subject; or concept 12b. An anti-OX40 or an anti-OX40L antibody or fragment thereof for use in treating or reducing the risk of a Tscm-mediated disease or condition in a subject.

[0329] Concept 13a. Use of an agent (e.g. an anti-OX40 or an anti-OX40L antibody or fragment thereof) which reduces the proportion of Tscm cells (e.g. which depletes or decreases the level of said Tscm cells) for the treatment or prevention of a Tscm-mediated disease or condition in a subject; or concept 13b. Use of an anti-OX40 or an anti-OX40L antibody or fragment thereof for the treatment or prevention of a Tscm-mediated disease or condition in a subject.

[0330] Concept 14a. Use of an agent (e.g. an anti-OX40 or an anti-OX40L antibody or fragment thereof) which reduces the proportion of Tscm cells (e.g. which depletes or decreases the level of said Tscm cells) in the manufacture of a medicament for the treatment or prevention of a Tscm-mediated disease or condition in a subject; or concept 14b. The use of an anti-OX40 or an anti-OX40L antibody or fragment thereof in the manufacture of a medicament for the treatment or prevention of a Tscm-mediated disease or condition in a subject.

[0331] Concept 15a. A composition comprising an agent (e.g. an anti-OX40 or an anti-OX40L antibody or fragment thereof) which reduces the proportion of Tscm cells (e.g. which depletes or decreases the level of said Tscm cells) for the treatment or prevention of a Tscm-mediated disease or condition in a subject; or concept 15b. A composition comprising an anti-OX40 or an anti-OX40L antibody or fragment thereof for the treatment or prevention of a Tscm-mediated disease or condition in a subject.

[0332] Concept 16. A method of treating a disease or condition in a subject in need thereof, comprising:

1. a. Performing an assay to measure the level of CD45RA+CCR7+CD95- Tn cells and the level of CD45RA+CCR7+CD95+OX40+ Tscm cells in a sample obtained from the subject; and
2. b. Administering an agent (e.g. an anti-OX40 or an anti-OX40L antibody or fragment thereof) which reduces the proportion of Tscm cells (e.g. which depletes or decreases the level of said Tscm cells), such as an anti-OX40 or an anti-OX40L antibody or fragment thereof, to the subject when the ratio of Tscm:Tn cells in the sample is determined in the assay to be greater than 50:50.

[0333] Concept 17a. An agent (e.g. an anti-OX40 or an anti-OX40L antibody or fragment thereof) which reduces the proportion of Tscm cells (e.g. which depletes or decreases the level of said Tscm cells) for use in therapy of a subject, wherein the agent is to be administered to a subject who has, or has been determined to have, a ratio of CD45RA+CCR7+CD95+OX40+ Tscm cells:CD45RA+CCR7+CD95- Tn cells of greater than 50:50; or concept 17b. An anti-OX40 or an anti-OX40L antibody or fragment thereof for use in therapy of a subject, wherein the antibody or fragment thereof is to be administered to a subject who has, or has been determined to have, a ratio of CD45RA+CCR7+CD95+OX40+ Tscm cells:CD45RA+CCR7+CD95- Tn cells of greater than 50:50.

[0334] Concept 18a. Use of an agent (e.g. an anti-OX40 or an anti-OX40L antibody or fragment thereof) which reduces the proportion of Tscm cells (e.g. which depletes or decreases the level of said Tscm cells) for therapy of a subject who has, or has been determined to have, a ratio of CD45RA+CCR7+CD95+OX40+ Tscm cells:CD45RA+CCR7+CD95- Tn cells of greater than 50:50; or concept 18b. Use of an anti-OX40 or an anti-OX40L antibody or fragment thereof for therapy of a subject who has, or has been determined to have, a ratio of CD45RA+CCR7+CD95+OX40+ Tscm cells:CD45RA+CCR7+CD95- Tn cells of greater than 50:50.

[0335] Concept 19a. Use of an agent (e.g. an anti-OX40 or an anti-OX40L antibody or fragment thereof) which reduces the proportion of Tscm cells (e.g. which depletes or decreases the level of said Tscm cells) in the manufacture of a medicament for use in therapy of a subject, wherein the agent is to be administered to a subject who has, or has been determined to have, a ratio of CD45RA+CCR7+CD95+OX40+ Tscm cells:CD45RA+CCR7+CD95- Tn cells of greater than 50:50; or concept 19b. Use of an anti-OX40 or an anti-OX40L antibody or fragment thereof in the manufacture of a medicament for use in therapy of a subject, wherein the antibody or fragment thereof is to be administered to a subject who has, or has been determined to have, a ratio of CD45RA+CCR7+CD95+OX40+ Tscm cells:CD45RA+CCR7+CD95- Tn cells of greater than 50:50.

[0336] In any of concepts 17 to 19, the ratio is determined in a sample, for example, in a sample of blood obtained from said subject.

[0337] Concept 20. A method according to concept 16a or b, an agent or an antibody or fragment for the use according to concept 17a or b, or the use according to concept 18a or b or concept 19 a or b, wherein the therapy is the treatment or prevention of a Tscm-mediated disease or condition, preferably wherein the therapy is the treatment of a Tscm-mediated disease or condition.

[0338] In another embodiment, the subject has or is at risk of a Tscm-mediated disease or condition. The Tscm-mediated disease or condition may be as defined in any one of concepts 71 to 80 hereinbelow.

[0339] Concept 21. A method of classifying a subject as having or as being at risk of a Tscm-mediated disease or condition (e.g. which disease or condition is suitable for treatment with an anti-OX40 or an anti-OX40L antibody or fragment thereof), comprising:

1. a. performing an assay that detects (i) CD45RA+CCR7+CD95+OX40+ Tscm cells, and (ii) CD45RA+CCR7+CD95- Tn cells in a sample obtained from said subject; and
2. b. classifying the subject as having, or as being at risk of a Tscm-mediated disease or condition if the ratio of Tscm:Tn cells in the sample is greater than 50:50.

[0340] Concept 22. A method according to concept 21 further comprising the step of:

c. administering to said subject an anti-OX40 or an anti-OX40L antibody or fragment thereof which reduces the proportion of said Tscm cells in the blood of said subject, (e.g. which depletes or decreases the level of said Tscm cells) if said subject has been classified as having or as being at risk of a Tscm-mediated disease or condition in step b).

[0341] Tscm-mediated diseases or conditions which may be suitable for treatment with an anti-OX40 or an anti-OX40L antibody or fragment thereof are as described in any one of concepts 71 to 80 herein below.

[0342] Concept 23. A method according to any one of concepts 4, 16, or 20 to 22, an agent or an antibody or fragment for the use according to concept 17 or 20, or the use according to any one of concepts 18 to 20, wherein the ratio of Tscm:Tn cells is (or is determined or classified to be) greater than 60:40, or is greater than 70:30, or is greater than 75:25, such as greater than 70:30.

[0343] In another embodiment, the ratio is (or is determined or classified to be) greater than 55:45. In another embodiment, the ratio is (or is determined or classified to be) greater than 65:35.

[0344] Concept 24. A method, agent or an antibody or fragment for the use, or the use according to concept 23, wherein the ratio of Tscm:Tn cells is (or is determined or classified to be) greater than 80:20, or is greater than 85:15, for example greater than 90:10, e.g. greater than 95:5.

[0345] Concept 25. A method according to any one of concepts 4, 16, or 20 to 24, an agent or an antibody or fragment for the use according to any one of concepts 17, 20, 23 or 24, or the use according to any one of concepts 18 to 20, 23 or 24, wherein the ratio of Tscm:Tn cells is determined (or is determinable) by flow cytometry.

[0346] Flow cytometry techniques are well-known to those skilled in the art, as discussed above. Agents which may be used in flow cytometry techniques are defined in Example 7 below. In one embodiment, the flow cytometry is carried out as described in Example 7 below. In another embodiment, the flow cytometry is carried out as described in Baumgart & Roederer (2000).

[0347] Concept 26. A method for treating or reducing the risk of a Tscm-mediated disease or condition with an agent (e.g. an anti-OX40 or an anti-OX40L antibody or fragment thereof) which reduces the proportion of Tscm cells (e.g. which depletes or decreases the level of said Tscm cells), or with an anti-OX40 or an anti-OX40L antibody or fragment thereof, comprising the steps of:

1. a. determining whether the subject is a candidate for treatment by detecting the presence of OX40 on the surface of CD45RA+CCR7+CD95+ Tscm cells obtained from a sample from the subject; and
2. b. administering said agent, such as said antibody or fragment, to the subject if the subject is identified as a candidate for treatment.

[0348] Concept 27. A method according to concept 26, wherein the presence of OX40 on the surface of the Tscm cells is determined using flow cytometry.

[0349] In one embodiment, the subject is a human and the OX40 is human OX40.

[0350] Concept 28. A method, comprising:

1. a. obtaining at least two T-cell samples derived from a subject who has or is at risk of a Tscm-mediated disease or condition, wherein said at least two samples comprise a first sample and a second sample;
2. b. determining levels of CD45RA+CCR7+CD95+OX40+ Tscm cells in said first and second samples;
3. c. treating said subject to reduce the proportion of CD45RA+CCR7+CD95+OX40+ Tscm cells (e.g. to deplete or decrease the level of Tscm cells) by administering an agent which reduces the proportion of Tscm cells (e.g. which depletes or decreases the level of said Tscm cells), or by administering an anti-OX40 or an anti-OX40L antibody or fragment thereof, if the levels of Tscm cells in said second sample are elevated as compared to said first sample, in order to treat or reduce the risk of said Tscm-mediated disease or condition.

[0051] The levels of Tscm in said first and second samples in step b. may be either the absolute number of Tscm cells, or may be the relative proportions of Tscm (e.g. the ratio of Tscm:Tn, or Tscm:total T-cell count). The levels of Tscm cells may be elevated in the second sample if they are statistically significantly higher than the levels in the first sample.

[0052] Concept 29. A method according to concept 28, wherein said first sample is collected:

1. i. before the onset of said disease or condition; or
2. ii. after the onset of said disease or condition; and

optionally wherein said second sample is collected no longer than one month, e.g. no longer than one week after the first sample.

[0053] As used in the concepts herein, a subject may be determined to be "before the onset of a Tscm-mediated disease or condition" if the subject is presenting no symptoms which would conventionally be associated with said disease or condition or if the subject would not be diagnosed as having such a disease or condition by any conventional method. For example, the presence of signs and symptoms of acute GVHD may be staged and graded according to a standardised scale such as described in Przepiorka et al. (1995), 1994 Consensus Conference on Acute GVHD Grading Bone Marrow Transplant 1995; 15, 825-826. Similar disease grading scales are also in routine clinical use for other relevant diseases, such as rheumatoid arthritis and inflammatory bowel diseases.

[0054] Concept 30. A method according to concept 28 or concept 29, wherein the Tscm-mediated disease or condition is a transplant, and wherein in step c) the treatment is in order to reduce the risk of transplant rejection, optionally wherein the first sample is taken before the transplant, and the second sample is taken after the transplant.

[0055] The first sample may be taken pre-operatively, e.g. after the subject has been identified as a candidate for treatment. The second sample is taken after the transplant and may be used by physicians as a method of monitoring the acceptance of the transplant. Thus, it may be that the physician may take more than one sample after the transplant, e.g. a daily blood sample to monitor the subject for changes in the proportion of Tscm:Tn or the levels of Tscm in the sample. The samples may be taken every other day, weekly, monthly or longer (including yearly) according to the likelihood of transplant rejection. For example, if the transplant is autologous, then the likelihood of transplant rejection may be reduced as compared to an allogeneic transplant, and therefore the time period between sample collections post-transplant may be longer than with an allogeneic transplant, where the risk of rejection is higher.

[0056] Concept 31. A method according to concept 30, wherein in step a), the first sample is collected no longer than a week, e.g. no longer than 6 days, no longer than 5 days, no longer than 4 days, or no longer than 3 days, such as no longer than 2 days before said transplant.

[0057] Concept 32. A method according to any one of concepts 28 to 31, wherein the second sample is collected no longer than 6 days, no longer than 5 days, no longer than 4 days, or no longer than 3 days, such as no longer than 2 days after the first sample or after said transplant.

[0058] Concept 33. A method according to any one of concepts 28 to 32, wherein in step c), the levels of Tscm cells in said second sample are greater than double the levels as compared to said first sample, for example are greater than three times the level, or preferably are greater than 4 times the levels as compared to said first sample.

[0059] In one embodiment, in step c), the levels of Tscm cells in said second sample are greater than 4 times (e.g. greater than 4.5 times) the levels as compared to said first sample. In another embodiment, in step c), the levels of Tscm cells in said second sample are greater than 5 times the levels as compared to said first sample.

[0060] Concept 34. A method according to any one of concepts 30 to 33, wherein the subject is given a prophylactic dose of an agent which reduces the proportion of Tscm cells (e.g. which depletes or decreases the level of said Tscm cells), or is given a prophylactic dose of an anti-OX40 or an anti-OX40L antibody or fragment thereof, before said transplant, and the first sample is taken before administration of said agent, or antibody or fragment thereof, and wherein the second sample is taken after the transplant or after administration of the agent, or the antibody or fragment thereof (preferably, where in the second sample is taken after the transplant).

[0061] In one embodiment, the prophylactic dose is an effective prophylactic dose. By "effective", it is meant that the dose is effective to reduce the proportion or level of Tscm as described herein, or effective to prevent or reduce the risk of a Tscm-mediated disease or condition.

[0062] The methods as described herein may be used to correct an already-aberrant level of Tscm cells, by administration of an agent which reduces the proportion of Tscm cells (e.g. which depletes or decreases the level of said Tscm cells), or by administration of an anti-OX40 or an anti-OX40L antibody or fragment thereof, before a transplant, in order to reduce the risk of transplant rejection after the transplant. Therefore, multiple samples may be taken after administration of the agent (or of the anti-OX40 or an anti-OX40L antibody or fragment thereof), but before the transplant. Comparison may be made between the collected samples and a sample obtained from a healthy donor.

[0063] Concept 35. A method according to any one of concepts 30 to 33, wherein the subject is given a therapeutic dose of an agent which reduces the proportion of Tscm cells (e.g. which depletes or decreases the level of said Tscm cells), or is given a therapeutic dose of an anti-OX40 or an anti-OX40L antibody or fragment thereof, after the transplant, and wherein the first sample is taken before said transplant, and the second sample is taken after the transplant.

[0064] In one embodiment, the therapeutic dose is an effective therapeutic dose. By "effective", it is meant that the dose is effective to reduce the proportion or level of Tscm as described herein, or effective to treat a Tscm-mediated disease or condition.

[0065] In one embodiment, the second sample is taken after the administration of the agent, or antibody or fragment thereof. This would enable a physician to check that the levels or proportion of Tscm cells remain "normal", i.e. as compared to the first sample, or to a sample obtained from a healthy donor.

[0066] Concept 36. A method according to any one of concepts 30 to 33, wherein the subject is given a therapeutic dose of an agent which reduces the proportion of Tscm cells (e.g. which depletes or decreases the level of said Tscm cells), or is given a therapeutic dose of an anti-OX40 or an anti-OX40L antibody or fragment thereof, after the transplant, and wherein the first sample is taken before said transplant, and the second sample is taken after the administration of said agent, or of said antibody or fragment thereof.

[0067] Concept 37. A method according to any one of concepts 34 to 36, further comprising the steps of:

d. obtaining a third sample derived from said subject;

e. determining the levels of CD45RA+CCR7+CD95+OX40+ Tscm cells in said third sample;

f. treating said subject to reduce the proportion of CD45RA+CCR7+CD95+OX40+ Tscm cells (e.g. to deplete or decrease the level) of Tscm cells by administering an agent which reduces the proportion of Tscm cells (e.g. which depletes or decreases the level of said Tscm cells), or by administering an anti-OX40 or an anti-OX40L antibody or fragment thereof, if the levels of Tscm cells in said third sample are elevated as compared to said second or said first sample.

[0068] The levels are considered to be "elevated" as described hereinabove (e.g. as for concept 28 or 33).

[0069] Concept 38. A method according to concept 37, wherein steps d) to f) are repeated as necessary until the levels of Tscm cells remain at a therapeutically-effective, or at a prophylactically-effective levels, e.g. at a substantially constant level in said subject.

[0070] As used in the concepts herein, a "substantially constant level" may be described as within 30% variance between samples. In one embodiment, a substantially constant level is within 20% variance between samples. In another embodiment, a substantially constant level is within 15% variance between samples, such as within 10% variance between samples, e.g. within 5% variance between samples.

[0071] Concept 39. A method according to any one of concepts 28 to 38, wherein the second sample is taken no longer than one month after the first sample, such as no longer than one week, no longer than 6 days, no longer than 5 days, no longer than 4 days, or no longer than 3 days, e.g. no longer than 2 days after the first sample, and optionally wherein the third sample is taken no longer than one month after the second sample, such as no longer than one week, no longer than 6 days, no longer than 5 days, no longer than 4 days, or no longer than 3 days, e.g. no longer than 2 days after the second sample.

[0072] Timepoints for taking any of the samples described in these concepts will depend on a number of factors, such as the likelihood of the subject having or being at risk of a Tscm-mediated disease (e.g. GVHD or transplant rejection), the level determined in the previous sample, the type of transplant, etc. A person skilled in the art will be able to determine appropriate time points as necessary or desired. The timepoints may be monthly, every other month, quarterly, half-yearly or yearly, if desired.

[0073] Concept 40. *In vitro* use of CD45RA+CCR7+CD95+OX40+ Tscm cells, as a diagnostic for a Tscm-mediated disease or condition in a subject (for example, which disease or condition can be treated or prevented with an agent which reduces the proportion of Tscm cells (e.g. which depletes or decreases the level of said Tscm cells), or with an anti-OX40 or an anti-OX40L antibody or fragment thereof in the subject).

[0074] In one embodiment, there is provided biomarker of an autoimmune disease, HIV-1, and a T-cell malignancy, wherein the biomarker is a CD45RA+CCR7+CD95+OX40+ Tscm cell. In another embodiment, the biomarker is of any of the diseases described in concepts 71 to 80 hereinbelow. In another embodiment, the Tscm cell is a CD4+CD45RA+CCR7+CD95+OX40+ Tscm cell.

[0075] Concept 41. Use of a biomarker of a Tscm-mediated disease or condition, wherein the biomarker is CD45RA+CCR7+CD95+OX40+ Tscm cells, *in vitro* as a diagnostic for a Tscm-mediated disease or condition (e.g. which disease or condition can be treated or prevented with an agent which reduces the proportion of Tscm cells (e.g. which depletes or decreases the level of said Tscm cells), or with an anti-OX40 or an anti-OX40L antibody or fragment thereof in the subject).

[0076] In one embodiment, the Tscm-mediated diseases are any of those described in concepts 71 to 80 hereinbelow.

[0077] Concept 42. A method of maintaining CD45RA+CCR7+CD95+ Tn cells, whilst decreasing CD45RA+CCR7+CD95+OX40+ Tscm cells in a population of T-cells in a sample, said method comprising contacting said sample with an effective amount of an agent which reduces the proportion of Tscm cells (e.g. which depletes or decreases the level of said Tscm cells), or with an anti-OX40 or an anti-OX40L antibody or fragment thereof.

[0078] As used in concepts 1 to 83 herein, "maintains" or "maintaining" with respect to a level or a proportion may be described as substantially constant. A substantially constant level may be within 30% variance between samples. In one embodiment, a substantially constant level is within 20% variance between samples. In one embodiment, a substantially constant level is within 15% variance between samples, e.g. with 10% variance between samples, e.g. with 5% variance between samples. In another embodiment, a substantially constant level is one which does not show a statistically significant change in level. In one embodiment, a substantially constant level is one which reaches the 95% confidence level (e.g. greater than 97% or greater than 99%). "Statistically significant" may be as defined above in concept 28 herein.

[0079] Concept 43. A method according to concept 42, wherein the level of said Tn cells are at least maintained, whilst the levels of said Tscm cells are decreased in said sample, optionally wherein the sample is from a subject.

[0080] Concept 44. A method according to any one of concepts 2 to 8, 10, 16, 20, 21, 23 to 39, 42 or 43, an agent or an antibody or fragment thereof for the use according to any one of concepts 12, 17, 20, 21 or 23 to 25, the use according to any one of concepts 13, 14, 18 to 20 or 23 to 25, or the composition according to concept 15, wherein agent (e.g. the antibody or fragment thereof) reduces the proportion of CD45RA+CCR7+CD95+OX40+ Tscm cells (e.g. depletes or decreases the level of Tscm cells).

[0081] Concept 45. A method or fragment thereof according to any one of concepts 1 to 8, 10, 16, 20, 21, 23 to 39 or 42 to 44, an agent or an antibody or fragment thereof for the use according to any one of concepts 12, 17, 20, 21, 23 to 25, or 44, the use according to any one of concepts 13, 14, 18 to 20 or 23 to 25 or 44, or the composition according to concept 15 or concept 44, wherein the agent (e.g. the antibody or fragment thereof) maintains CD45RA+CCR7+CD95+ Tn cells.

[0082] Concept 46. A method according to concept 42 or 45, an agent or an antibody or fragment thereof for the use according to concept 45, the use according to concept 45, or the composition according to concept 45, wherein the Tn cells are maintained at a level of not below 50% of the level of said Tn cells in a sample from a healthy donor or from said subject before the onset of disease.

[0083] The healthy donor is preferably of the same species as the subject, for example, wherein the subject is a human, the donor is most preferably also a human. The donor is also preferably of the same gender as the subject. The donor is preferably of a similar age and ethnicity as the subject.

[0084] Concept 47. A method, an agent or an antibody or fragment for the use, a use or a composition according to concept 46, wherein the Tn cells are maintained at a level of not below 55% (such as not below 60%, for example not below 65%, e.g. not below 70%).

[0085] Concept 48. A method, an agent or an antibody or fragment for the use, a use or a composition according to concept 47, wherein the Tn cells are maintained at a level of not below 75% (such as not below 80%, for example not below 85%, e.g. not below 90%).

[0086] Concept 49. A method according to any one of concepts 1 to 8, or 42 to 48, an agent or an antibody or fragment thereof for the use according to any one of concepts 44 to 48, the use according to any one of concepts 38 to 41, or the composition according to any one of concepts 44 to 48, wherein the Tscm cells are depleted or decreased to a level of less than 50% of the level of said Tscm cells in a sample from a healthy donor or from said subject before the onset of disease.

[0087] Concept 50. A method, an antibody or fragment for the use, a use or a composition according to concept 49, wherein the Tscm cells are depleted or decreased to a level of less than 45% (such as less than 40%, for example less than 35%, e.g. less than 30 % or less than 25%).

[0088] Concept 51. A method, an antibody or fragment for the use, a use or a composition according to concept 50, wherein the Tscm cells are depleted or decreased to a level of less than 20% (such as less than 15%, for example less than 10%).

[0089] Concept 52. A method, an antibody or fragment for the use, a use or a composition according to any preceding concept, wherein the antibody or fragment is a depleting antibody or fragment that specifically binds OX40 (in particular human OX40), optionally wherein the antibody is engineered for enhanced ADCC and/or CDC.

[0090] The potency of Fc-mediated effects may be enhanced by engineering the Fc domain by various established techniques. Such methods increase the affinity for certain Fc-receptors, thus creating potential diverse profiles of activation enhancement. This can be achieved by modification of one or several amino acid residues (e.g. as described in Lazar et al., 2006, Proc. Natl. Acad. Sci. U.S.A., Mar 14; 103(11):4005-10) or by altering the natural glycosylation profile of the Fc domain by, for example, generating under N-glycosylated or de-N-glycosylated variants (as described in Natsume et al., 2009, Drug Des. Devel. Ther., 3:7-16). For example, to increase ADCC, residues in the hinge region can be altered to increase binding to Fc-gammaRIII (see, for example, Shlekis et al., 2001, J Biol Chem., Mar 2; 276(9):6591-6594).

[0091] Equally, the enhancement of CDC may be achieved by amino acid changes that increase affinity for C1q, the first component of the classic complement activation cascade (see Kuslogue et al., J. Immunol., 2001; 166:2571-2575). Another approach is to create a chimeric Fc domain created from human IgG4 and human IgG3 segments that exploit the higher affinity of IgG3 for C1q (Natsume et al., 2006, Cancer Res., 66: 3963-3672).

[0092] The antibody may be a targeting antibody (such as an anti-OX40 or an anti-OX40L antibody) which exhibits its effects through a toxin, to which the antibody may be conjugated. Such toxins will selectively kill or remove the cell to which they are targeted. Suitable immunoconjugates are described on page 90, and on pages 114 to 116, and 134 (in particular pages 114 to 116) herein.

[0093] Thus, in one embodiment, the antibody or fragment thereof is de-N-glycosylated. In another embodiment, the antibody or fragment thereof contains one or more mutations in the hinge or Fc region which enhances the ADCC and/or the CDC functionality.

[0094] Methods for determining depletion and/or ADCC and/or CDC functionality may be as described herein, or as well-known by those skilled in the art.

[0095] The OX40 antibodies may be as described in WO2014/146865 (Biocorex Products & Janssen Pharmaceuticals; see claims on pages 136 to 139 for specific sequences), WO2015/139102 and WO2015/118202 (Providence Health & Services - Oregon; see mAb 2812 as described in Weinberg, A.D., et al., J. Immunother., 29: 575-585 (2006), and fusions with IL-2), WO2013/035191 (Biocorex B.V.; see claims 4 to 11 for specific antibody sequences), WO2013/025201 (Board of Regents, the University of Texas System; see claims 1 to 12 for specific antibody sequences), WO2012/027326 (Board of Regents, the University of Texas System; see claims 1 to 11 for specific antibody sequences), WO2010/096416 (UCB Pharma S.A.; see claims 1 to 9 and 11 to 14 for specific antibody sequences), WO2009/079335 (Madalex, Inc & Pfizer, Inc; see claims 1 to 9 and 14 to 17 for specific antibody sequences), WO2009/106116 (Genentech, Inc; see claims 1 to 12 for specific antibody sequences), WO2007/062245 (Xin Biotech Kabushiki Kaisha & La Jolla Institute for Allergy and Immunology; see claim 12 for specific antibody deposit numbers, and claim 16 for specific antibody sequences) WO03/106486 (Cruell Holland B.V.; see claims 3 and 4 for specific antibody sequences).

[0096] More generally anti-OX40 antibodies are described in WO89/42565, WO95/21251, WO95/21915 and WO95/42673.

[0397] Concept 53. A method, an antibody or fragment for the use, a use or a composition according to any preceding concept, wherein the antibody is an antagonistic or blocking antibody.

[0398] Methods for determining antagonism or blocking functionality may be as described herein, or as well-known by those skilled in the art. For example, *in vitro* techniques include SPR and/or ELISA, which are described elsewhere herein.

[0399] Concept 54. A method, an antibody or fragment for the use, a use or a composition according to concept 53, wherein the antibody specifically binds to OX40L (in particular human OX40L).

[0400] The OX40L antibodies may be any antibody or fragment as described herein. In one embodiment, the OX40L antibody is the antagonist anti-human OX40L (gp34) antibody ik-1 described by Matsumura et al., J Immunol. (1999), 163-2007.

[0401] Concept 55. A method, an antibody or fragment for the use, a use or a composition according to concept 56, wherein the antibody antagonises specific binding of OX40 to OX40L, e.g. as determined using SPR or ELISA.

[0402] SPR and ELISA methods may be as described elsewhere herein.

[0403] Concept 56. A method, an antibody or fragment for the use, a use or a composition according to any preceding concept, wherein the antibody is a humanized, human or fully human antibody.

[0404] Other antibody constructs may be as described herein.

[0405] Concept 57. A method, an antibody or fragment for the use, a use or a composition according to any preceding concept, wherein the antibody is a fragment of an antibody selected from the list of multispecific antibodies (e.g. bi-specific antibodies), intrabodies, single-chain Fv antibodies (scFv), camelized antibodies, Fab fragments, F(ab') fragments, disulide-linked Fc (scFv), anti-idiotypic (anti-Id) antibodies, and epitope-binding fragments thereof.

[0406] Concept 58. A method, an antibody or fragment for the use, a use or a composition according to any preceding concept, wherein the antibody or fragment enables greater than 80% stem cell donor chimerism by day 12 in a Rhesus macaque model of haploidentical hematopoietic stem cell transplantation.

[0407] Concept 59. A method, an antibody or fragment for the use, a use or a composition according to any preceding concept, wherein the antibody or fragment expresses as a stably transfected pool in Lonza GS-Xceed™ at level greater than 1.5g/L in a fed batch overgrowth culture using Lonza version 8 fed system with an overgrowth period of 14 days.

[0408] Concept 60. A method, an antibody or fragment for the use, a use or a composition according to any preceding concept, wherein the antibody or fragment thereof comprises a HCDR3 of from 16 to 27 amino acids and derived from the recombination of a human VH gene segment, a human D gene segment and a human JH gene segment, wherein the human JH gene segment is IGJH6 (e.g. IGJH6*02).

[0409] Concept 61. A method, an antibody or fragment for the use, a use or a composition according to any preceding concept, wherein the antibody or fragment thereof comprises a HCDR3 selected from:

1. a. the HCDR3 of antibody 2D10 (Seq ID No:40 or Seq ID No:46);
2. b. the HCDR3 of antibody 10A7 (Seq ID No:5 or Seq ID No:14);
3. c. the HCDR3 of antibody 99H4 (Seq ID No:72 or Seq ID No:76);
4. d. the HCDR3 of antibody 10H01 (Seq ID No:100 or Seq ID No:106);
5. e. a CDR3 of any of the nanobodies disclosed in WO2011/073180 (Abyx, Seq ID Nos: 161 to 167 therein);
6. f. a HCDR3 of any of the antibodies disclosed in WO2006/029679 (Roche/Genentech, Seq ID Nos: 33 to 38 therein); or
7. g. a HCDR3 of any of the antibodies disclosed in US7,812,133 (Genentech, Seq ID Nos: 11 or 12 therein).

[0410] Concept 62. A method, an antibody or fragment for the use, a use or a composition according to any preceding concept, wherein the antibody or fragment thereof comprises:

1. a. the CDRs of antibody 2D10 (Seq ID No:40 or Seq ID No:46 for CDRH3, SEQ ID No:38 or SEQ ID No:44 for CDRH2, SEQ ID No:36 or SEQ ID No:42 for CDRH1, SEQ ID No:50 or SEQ ID No:56 for CDR1, SEQ ID No:52 or SEQ ID No:58 for CDR2 and SEQ ID No:54 or SEQ ID No:60 for CDR3);
2. b. the CDRs of antibody 10A7 (Seq ID No:4 or SEQ ID No:14 for CDRH3, SEQ ID No:6 or SEQ ID No:10 for CDRH2, SEQ ID No:8 or SEQ ID No:14 for CDRH1, SEQ ID No:20 or SEQ ID No:26 for CDR2 and SEQ ID No:28 for CDR3);
3. c. the CDRs of antibody 99H4 (Seq ID No:72 or Seq ID No:76 for CDRH3, SEQ ID No:70 or SEQ ID No:76 for CDRH2, SEQ ID No:68 or SEQ ID No:74 for CDRH1, SEQ ID No:82 or SEQ ID No:88 for CDR1, SEQ ID No:84 or SEQ ID No:90 for CDR2 and SEQ ID No:86 or SEQ ID No:92 for CDR3);
4. d. the CDRs of antibody 10H01 (Seq ID No:100 or Seq ID No:106 for CDRH3, SEQ ID No:98 or SEQ ID No:104 for CDRH2, SEQ ID No:96 or SEQ ID No:102 for CDRH1, SEQ ID No:110 or SEQ ID No:116 for CDR1, SEQ ID No:112 or SEQ ID No:118 for CDR2 and SEQ ID No:114 or SEQ ID No:120 for CDR3);
5. e. the CDRs of any of the nanobodies disclosed in WO2011/073180 (Abyx, Seq ID Nos: 161 to 167 therein for CDR3; Seq ID Nos: 147 to 153 therein for CDR2; and Seq ID Nos: 133 to 139 therein for CDR1);
6. f. the CDRs of any of the antibodies disclosed in WO2006/029679 (Roche/Genentech, Seq ID Nos: 33 to 38 therein for CDRH3; Seq ID Nos: 24 to 25 therein for CDRH1 and Seq ID Nos: 26 to 32 therein for CDRH2; SEQ ID Nos: 39 to 44 therein for CDR1; SEQ ID Nos: 45 to 50 therein for CDR2; and SEQ ID Nos: 51 to 57 therein for CDR3); or
7. g. the CDRs of any of the antibodies disclosed in US7,812,133 (Genentech, Seq ID Nos: 11 or 12 therein for CDRH3; Seq ID Nos: 7 or 8 therein for CDRH1 and Seq ID Nos: 9 or 10 therein for CDRH2; SEQ ID Nos: 1 or 2 therein for CDR1; SEQ ID Nos: 3 or 4 therein for CDR2; and SEQ ID Nos: 5 or 6 therein for CDR3).

[0411] Concept 63. A method, an antibody or fragment for the use, a use or a composition according to any preceding concept, wherein the antibody or fragment thereof comprises the VH and/or VL domains selected from the following:

1. a. the VH and/or VL domains of antibody 2D10 (Seq ID No:34 for VH and/or Seq ID No:48 for VL);
2. b. the VH and/or VL domains of antibody 10A7 (Seq ID No:2 for VH and/or Seq ID No:16 for VL);
3. c. the VH and/or VL domains of antibody 99H4 (Seq ID No:66 for VH and/or Seq ID No:80 for VL);
4. d. the VH and/or VL domains of antibody 10H01 (Seq ID No:84 for VH and/or Seq ID No: 108 for VL);
5. e. a VH domain of any of the nanobodies disclosed in WO2011/073180 (Abyx, Seq ID Nos: 177 to 185, 199 to 226 therein [reproduced herein as Seq ID Nos: 177 to 213]);
6. f. the VH and/or VL domains of any of the antibodies disclosed in WO2006/029679 (Roche/Genentech, Seq ID Nos: 2, 4, 6, 8, 10, 12, 17, 19 and 20 therein for VH domains; and Seq ID Nos: 1, 3, 5, 7, 9, 11, 16 and 18 therein for VL domains [reproduced herein as Seq ID Nos: 214 to 230]); or
7. g. the VH and/or VL domains of any of the antibodies disclosed in US7,812,133 (Genentech, Seq ID Nos: 15 and 16 therein for VH domains; and Seq ID Nos: 13 and 14 therein for VL domains [reproduced herein as Seq ID Nos: 231 to 234]).

[0412] Concept 64. A method, an antibody or fragment for the use, a use or a composition according to any preceding concept, wherein the antibody is oexulmab.

[0413] Concept 65. A method, an agent or an antibody or fragment for the use, a use or a composition according to any preceding concept, where in the Tscm cells and/or the Tn cells are CD4+.

[0414] In another embodiment, the Tscm cells and/or the Tn cells are CD8+.

[0415] Concept 66. A method, an agent or an antibody or fragment for the use, a use or a composition according to concept 64, wherein the Tscm cells and/or the Tn cells are circulating T-cells.

[0416] Concept 67. A method, an agent or an antibody or fragment for the use, a use or a composition according to concept 65, wherein the Tscm cells and/or the Tn cells are in a sample of blood, e.g. peripheral blood.

[0417] Whereas T-cells present in blood are relatively straightforward to isolate and characterise, T-cells which are present in the tissues of a subject are generally more difficult to isolate. That said, it may be possible to isolate T-cells from various tissues (such as skin, tissues of the GI tract, e.g. bowel, and from inflamed joints, e.g. synovium)

[0418] Concept 68. A method according to any one of concepts 9 to 11, 16, 20 to 39 or 43 to 67, an agent or an antibody or fragment for the use according to any one of concepts 12, 17, 20, 21, 23 to 25 or 44 to 67, a use according to any one of concepts 13, 14, 18 to 20 or 23 to 25 or 44 to 67, or a composition according to any one of concepts 15 or 44 to 67, wherein the subject is a human patient.

[0419] Concept 69. A method, an agent or an antibody or fragment for the use, a use or a composition according to concept 68, wherein the subject is at risk of a Tscm-mediated disease or condition.

[0420] Concept 70. A method, an agent or an antibody or fragment for the use, a use or a composition according to concept 68, wherein the subject has a Tscm-mediated disease or condition.

[0421] Concept 71. A method, an agent or an antibody or fragment for the use, a use or a composition according to any preceding concept, wherein the Tscm-mediated disease or condition is mediated by CD45RA+CCR7+CD95+OX40+ Tscm cells.

[0422] Concept 72. A method, an agent or an antibody or fragment for the use, a use or a composition according to any one of concept 68 to 70, wherein the Tscm-mediated disease or condition is characterised by having a ratio of CD45RA+CCR7+CD95+OX40+ Tscm cells:CD45RA+CCR7+CD95- Tn cells of greater than 50:50.

[0423] In another embodiment, the disease or condition is characterised by having a ratio of Tscm cells:Tn cells as set out in any of concepts 23 to 25.

[0424] Concept 73. A method, an agent or an antibody or fragment for the use, a use or a composition according to concept 72, wherein the Tscm-mediated disease or condition is characterised by having a ratio of Tscm:Tn of greater than 60:40, or greater than 70:30, or greater than 75:25, such as greater than 70:30.

[0425] Concept 74. A method, an agent or an antibody or fragment for the use, a use or a composition according to concept 73, wherein the Tscm-mediated disease or condition is characterised by having a ratio of Tscm:Tn of greater than 80:20, or greater than 85:15, for example greater than 80:10, e.g. greater than 95:5.

[0426] Concept 75. A method, an agent or an antibody or fragment for the use, a use or a composition according to any preceding concept, wherein the Tscm-mediated disease or condition is selected from an autoimmune disease, HIV-1, and a T-cell malignancy.

[0427] Concept 76. A method, an agent or an antibody or fragment for the use, a use or a composition according to concept 75, wherein the Tscm-mediated disease or condition is selected from GVHD, transplant rejection, psoriasis, rheumatoid arthritis, systemic lupus erythematosus, multiple sclerosis, juvenile dermatomyositis, T-cell lymphoma and T-cell leukaemia.

[0428] Concept 77. A method, an agent or an antibody or fragment for the use, a use or a composition according to concept 76, wherein the Tscm-mediated disease or condition is GVHD or transplant rejection.

[0429] Concept 78. A method, an agent or an antibody or fragment for the use, a use or a composition according to concept 76, wherein the transplant is a cell, tissue or organ transplant (e.g. liver, lung, heart, kidney or bowel), or a blood transplant (e.g. autologous or allogeneic), for example where the blood is bone marrow-derived, is cord-blood derived (umbilical), or is peripheral-blood derived.

[0430] In one embodiment, the transplant is a CAR T-cell transplant (chimeric antigen receptor).

[0431] Concept 79. A method, an agent or an antibody or fragment for the use, a use or a composition according to concept 76, wherein the Tscm-mediated disease or condition is a T-cell lymphoma selected from T-cell non-Hodgkin's lymphoma, peripheral T-cell lymphoma (PTCL), anaplastic large cell lymphoma (ALCL), angioimmunoblastic lymphoma, cutaneous T-cell lymphoma, adult T-cell leukemia/lymphoma, blastic NK-cell lymphoma, enteropathy-type T-cell lymphoma, hematogenous gamma-delta T-cell lymphoma, lymphoblastic lymphoma (T-LBL) and nasal NK-T-cell lymphoma.

[0432] Concept 80. A method, an agent or an antibody or fragment for the use, a use or a composition according to concept 76, wherein the Tscm-mediated disease or condition is a T-cell leukemia selected from large granular lymphocytic leukemia (LGLL), T-cell prolymphocytic leukemia (T-PLL), T-cell acute lymphoblastic leukemia (T-ALL) and Sezary syndrome.

[0433] Concept 81. A method, an agent or an antibody or fragment for the use, a use or a composition according to any preceding concept, further comprising administering to the human a further therapeutic agent, optionally wherein the further therapeutic agent is independently selected from the group consisting of rapamycin (sirolimus), tacrolimus, ciclosporin, corticosteroids (e.g. methylprednisolone), methotrexate, mycophenolate mofetil, anti-CD28 antibodies, anti-IL12/IL-23 antibodies (e.g. ustekinumab), anti-CD20 antibodies (e.g. rituximab), anti-CD29 antibodies (e.g. brentuximab), CTLA4-Fc molecules (e.g. abatacept), CCR5 receptor antagonists (e.g. maraviroc), anti-CD4L antibodies (e.g. natalizumab), anti-LFA1 antibodies, fludarabine, anti-CD52 antibodies (e.g. alemtuzumab), anti-CD45 antibodies, cyclophosphamide, anti-thymocyte globulins, anti-complement C5 antibodies (e.g. eculizumab), anti-a4b7 integrin antibodies (e.g. vedolizumab), anti-IL6 antibodies (e.g. basilixumab), anti-IL2R antibodies (e.g. basilixumab), anti-CD25 antibodies (e.g. daclizumab), anti-TNF α / TNF β -Fc molecules (e.g. etanercept, adalimumab, infliximab, golimumab or certolizumab pegol) and Vorinostat. In particular rapamycin (sirolimus), tacrolimus, ciclosporin, corticosteroids (e.g. methylprednisolone), methotrexate, mycophenolate mofetil, anti-CD28 antibodies, CTLA4-Fc molecules (e.g. abatacept), anti-CD4L antibodies, anti-LFA1 antibodies, anti-CD52 antibodies (e.g. alemtuzumab), cyclophosphamide and anti-thymocyte globulins.

[0434] In one embodiment, the further therapeutic agent is independently selected from the group consisting of calcineurin inhibitors (e.g. tacrolimus, ciclosporin), mTOR inhibitors (e.g. rapamycin (sirolimus)), and antiproliferative agents (e.g. mycophenolate mofetil, cyclophosphamide).

[0435] In one embodiment, the further therapeutic agent is independently selected from the group consisting of immunosuppressants that modulate IL-2 signalling (e.g. tacrolimus, ciclosporin, rapamycin (sirolimus), and anti-CD25 antibodies (e.g. basilixumab, daclizumab).

[0436] In one embodiment, the further therapeutic agent is rapamycin (sirolimus). In another embodiment, the further therapeutic agent is tacrolimus. In another embodiment, the further therapeutic agent is a combination of tacrolimus and methotrexate. In another embodiment, the further therapeutic agent is cyclophosphamide. In another embodiment, the further therapeutic agent is mycophenolate mofetil.

[0437] Concept 82. A method, an agent or an antibody or fragment for the use, a use or a composition according to any preceding concept, further comprising administering to the human a therapeutically effective amount of rapamycin.

[0438] Concept 83. A method, an agent or an antibody or fragment for the use, a use or a composition according to any preceding concept, further comprising administering to the human a therapeutically effective amount of tacrolimus.

[0439] The inventors have surprisingly found that an anti-OX40L antibody may provide synergistic effects when administered as part of a combination therapy with a further therapeutic agent. To that end, further concepts are provided below:

Concept 101. An anti-OX40L antibody or fragment thereof for use in treating or reducing the risk of an OX40L-mediated disease or condition in a subject in combination with a further therapeutic agent independently selected from the group consisting of rapamycin (sirolimus), tacrolimus, ciclosporin, corticosteroids (e.g. methylprednisolone), methotrexate, mycophenolate mofetil, anti-CD28 antibodies, anti-IL12/IL-23 antibodies (e.g. ustekinumab), anti-CD20 antibodies (e.g. rituximab), anti-CD29 antibodies (e.g. brentuximab), CTLA4-Fc molecules (e.g. abatacept), CCR5 receptor antagonists (e.g. maraviroc), anti-CD4L antibodies (e.g. natalizumab), anti-LFA1 antibodies, fludarabine, anti-CD52 antibodies (e.g. alemtuzumab), anti-CD45 antibodies, cyclophosphamide, anti-thymocyte globulins, anti-complement C5 antibodies (e.g. eculizumab), anti-a4b7 integrin antibodies (e.g. vedolizumab), anti-IL6 antibodies (e.g. basilixumab), anti-IL2R antibodies (e.g. basilixumab), anti-CD25 antibodies (e.g. daclizumab), anti-TNF α / TNF β -Fc molecules (e.g. etanercept, adalimumab, infliximab, golimumab or certolizumab pegol) and Vorinostat.

Concept 102. Use of an anti-OX40L antibody or fragment thereof for the treatment or prevention of an OX40L-mediated disease or condition in a subject in combination with a further therapeutic agent independently selected from the group consisting of rapamycin (sirolimus), tacrolimus, ciclosporin, corticosteroids (e.g. methylprednisolone), methotrexate, mycophenolate mofetil, anti-CD28 antibodies, anti-IL12/IL-23 antibodies (e.g. ustekinumab), anti-CD20 antibodies (e.g. rituximab), anti-CD29 antibodies (e.g. brentuximab), CTLA4-Fc molecules (e.g. abatacept), CCR5 receptor antagonists (e.g. maraviroc), anti-CD4L antibodies (e.g. natalizumab), anti-LFA1 antibodies, fludarabine, anti-CD52 antibodies (e.g. alemtuzumab), anti-CD45 antibodies, cyclophosphamide, anti-thymocyte globulins, anti-complement C5 antibodies (e.g. eculizumab), anti-a4b7 integrin antibodies (e.g. vedolizumab), anti-IL6 antibodies (e.g. basilixumab), anti-IL2R antibodies (e.g. basilixumab), anti-CD25 antibodies (e.g. daclizumab), anti-TNF α / TNF β -Fc molecules (e.g. etanercept, adalimumab, infliximab, golimumab or certolizumab pegol) and Vorinostat.

Concept 103. Use of an anti-OX40L antibody or fragment thereof for the manufacture of a medicament for the treatment or prevention of an OX40L-mediated disease or condition in a subject in combination with a further therapeutic agent independently selected from the group consisting of rapamycin (sirolimus), tacrolimus, ciclosporin, corticosteroids (e.g. methylprednisolone), methotrexate, mycophenolate mofetil, anti-CD28 antibodies, anti-IL12/IL-23 antibodies (e.g. ustekinumab), anti-CD20 antibodies (e.g. rituximab), anti-CD29 antibodies (e.g. brentuximab), CTLA4-Fc molecules (e.g. abatacept), CCR5 receptor

antagonists (e.g. maraviroc), anti-CD40L antibodies, anti-VLA4 antibodies (e.g. natalizumab), anti-LFA1 antibodies, fludarabine, anti-CD52 antibodies (e.g. alemtuzumab), anti-CD45 antibodies, cyclophosphamide, anti-thymocyte globulins, anti-complement C5 antibodies (e.g. eculizumab), anti-a4b7 integrin antibodies (e.g. vedolizumab), anti-IL6 antibodies (e.g. tocilizumab), anti-IL2R antibodies (e.g. basilixumab), anti-CD25 antibodies (e.g. daclizumab), anti-TNFr / TNFr-Fc molecules (e.g. etanercept, adalimumab, infliximab, golimumab or certolizumab pegol) and Vedolizet.

Concept 104. A composition comprising an anti-**OX40L** antibody or fragment thereof for the treatment or prevention of an **OX40L**-mediated disease or condition in a subject in combination with a further therapeutic agent independently selected from the group consisting of rapamycin (sirolimus), tacrolimus, ciclosporin, corticosteroids (e.g. methylprednisolone), methotrexate, mycophenolate mofetil, anti-CD28 antibodies, anti-IL12/IL-23 antibodies (e.g. ustekinumab), anti-CD29 antibodies (e.g. rituximab), anti-CD30 antibodies (e.g. brentuximab), CTLA4-Fc molecules (e.g. abatacept), CCR5 receptor antagonists (e.g. maraviroc), anti-CD40L antibodies, anti-VLA4 antibodies (e.g. natalizumab), anti-LFA1 antibodies, fludarabine, anti-CD52 antibodies (e.g. alemtuzumab), anti-CD45 antibodies, cyclophosphamide, anti-thymocyte globulins, anti-complement C5 antibodies (e.g. eculizumab), anti-a4b7 integrin antibodies (e.g. vedolizumab), anti-IL6 antibodies (e.g. tocilizumab), anti-IL2R antibodies (e.g. basilixumab), anti-CD25 antibodies (e.g. daclizumab), anti-TNFr / TNFr-Fc molecules (e.g. etanercept, adalimumab, infliximab, golimumab or certolizumab pegol) and Vedolizet.

Concept 105. A method of treating or preventing an **OX40L**-mediated disease or condition in a subject comprising administering to said human a therapeutically effective amount of an anti-**OX40L** antibody or fragment thereof in combination with a further therapeutic agent independently selected from the group consisting of rapamycin (sirolimus), tacrolimus, ciclosporin, corticosteroids (e.g. methylprednisolone), methotrexate, mycophenolate mofetil, anti-CD28 antibodies, anti-IL12/IL-23 antibodies (e.g. ustekinumab), anti-CD29 antibodies (e.g. rituximab), anti-CD30 antibodies (e.g. brentuximab), CTLA4-Fc molecules (e.g. abatacept), CCR5 receptor antagonists (e.g. maraviroc), anti-CD40L antibodies, anti-VLA4 antibodies (e.g. natalizumab), anti-LFA1 antibodies, fludarabine, anti-CD52 antibodies (e.g. alemtuzumab), anti-CD45 antibodies, cyclophosphamide, anti-thymocyte globulins, anti-complement C5 antibodies (e.g. eculizumab), anti-a4b7 integrin antibodies (e.g. vedolizumab), anti-IL6 antibodies (e.g. tocilizumab), anti-IL2R antibodies (e.g. basilixumab), anti-CD25 antibodies (e.g. daclizumab), anti-TNFr / TNFr-Fc molecules (e.g. etanercept, adalimumab, infliximab, golimumab or certolizumab pegol) and Vedolizet, wherein the **OX40L**-mediated disease or condition is thereby treated or prevented.

[0440] In any of the concepts herein, the combination may be used in the prevention of an **OX40L**-mediated disease. In any of the concepts, the combination may be used to reduce the risk of an **OX40L**-mediated disease. In any of the concepts, the combination may be used in the treatment of an **OX40L**-mediated disease.

[0441] A "combination" as described here may be as defined elsewhere herein, for example on page 100, on pages 105 to 107, and on pages 119 to 120. In one embodiment, the disease is rheumatoid arthritis or psoriasis, and the further therapeutic agent is an anti-IL-17 antibody (such as brodalumab, secukinumab and ixekizumab). Combinations may be administered concomitantly or sequentially. Administration may be via any of the methods disclosed herein, for example, as discussed in the section entitled "Methods of Administration and Dosing" beginning on page 130 herein.

[0442] As used in any of the concepts herein, the "treatment" of an **OX40L**-mediated disease includes the reduction of one or more symptom(s) of said **OX40L**-mediated disease. Treatment may be interpreted as described elsewhere herein, for example on page 107, and in the section entitled "9ds" (beginning on page 149, in particular page 152)

[0443] Immunosuppressive drug intervention in the management of **GvHD** associated with hematopoietic stem cell transplant (HSCT) may be administered to treat patients with confirmed disease. **GvHD** grading may be determined as described below.

[0444] In one embodiment, the administration is prophylactic to reduce the risk of an **OX40L**-mediated disease. As used in the concepts herein, "prevent(n)" (or "prevent" or "preventing" and the like) of an **OX40L**-mediated disease includes the prevention of one or more symptom(s) of said **OX40L**-mediated disease. Preventing may refer to the total or partial inhibition of the development, recurrence, onset or spread of an **OX40L**-mediated disease and/or symptom related thereto, resulting from the administration combination of therapies provided herein (e.g., a combination of prophylactic and/or therapeutic agents). Preventing may be interpreted as disclosed elsewhere herein.

[0445] Immunosuppressive drug intervention in the management of **GvHD** associated with hematopoietic stem cell transplant (HSCT) may be administered to prevent disease in patients known to be at risk.

[0446] Thus, in one embodiment, a prophylactically-effective dose is administered before the onset of an **OX40L**-mediated disease or condition. As used in the concepts herein, a subject may be determined to be "before the onset of an **OX40L**-mediated disease or condition" if the subject is presenting no symptoms which would conventionally be associated with said disease or condition or if the subject would not be diagnosed as having such a disease or condition by any conventional method. In another embodiment, administration which is before the onset of disease may be termed "pre-emptive treatment", which refers to the use of further therapeutic agents (such as immunosuppressant agent) and/or an anti-**OX40L** antibody of the invention in individuals at risk of developing disease and where there may be early signs that emergence of clinically-relevant **GvHD** is imminent. For example, an experimental or predictive serum or cellular biomarker may indicate the optimal time for initiation of pre-emptive **GvHD** treatment.

[0447] For example, the presence of signs and symptoms of acute **GvHD** in a human may be staged and graded according to a standardised scale such as described in Przyeplora et al. In a primate, such as a rhesus macaque monkey, the presence of signs and symptoms of acute **GvHD** may be staged and graded according to a standardised scale such as described herein in Example 7. Similar disease grading scales are also in routine clinical use for other relevant diseases, such as rheumatoid arthritis and inflammatory bowel diseases.

[0448] "Prevention" or "prophylaxis" may be as described in aspect 94 herein, with diseases and timings of administration of the anti-**OX40L** antibody as described. A prophylactic agent may be used in any of the methods described on page 102 to 103.

[0449] The **OX40L**-mediated diseases or conditions may be any of the diseases or conditions mentioned herein, including those which are defined elsewhere herein as Tcm-mediated diseases or conditions (see concepts 75 to 80 hereinabove). In one embodiment, the **OX40L**-mediated diseases or conditions are as described in any of aspects 12, 12a, 6b, 6Ba, 71, 72, 72a, 90 to 93 as described herein. In one embodiment, the **OX40L**-mediated diseases or conditions are as described in any of aspects 12, 12a, 6b, 6Ba, 71, 72, 72a, 90 to 93 as described herein. In one embodiment, the **OX40L**-mediated disease or condition is a **HOV40L**-mediated disease or condition as described herein, for example on pages 103 to 104, or on page 131. In another embodiment, the **OX40L**-mediated diseases or conditions are as described in the section entitled "Methods of Administration and Dosing" beginning on page 130 herein. In a preferred embodiment, the disease or condition is **GvHD** or transplant rejection, in particular **GvHD**. In another embodiment, the **OX40L**-mediated disease or condition is Crohn's disease. In another embodiment, the **OX40L**-mediated disease of condition is inflammatory bowel disease (IBD). In another embodiment, the **OX40L**-mediated disease of condition is ulcerative colitis. In another embodiment, the **OX40L**-mediated disease of condition is psoriasis.

[0450] In any of concepts described herein, the anti-**OX40L** antibody and/or the further therapeutic agent are administered to the subject. Administration may be by any method described herein, for example as described on page 93, or in the sections entitled "Pharmaceutical compositions" and "Methods of Administration" beginning on pages 118 and 130 respectively. In one embodiment, the anti-**OX40L** antibody of the invention is administered intravenously. In one embodiment, the anti-**OX40L** antibody of the invention is administered subcutaneously.

[0451] In one embodiment, the further therapeutic agent is rapamycin (sirolimus) and is administered orally. In one embodiment, the further therapeutic agent is tacrolimus and is administered orally. In one embodiment, the further therapeutic agent is methotrexate and is administered orally and/or intravenously. In one embodiment, the further therapeutic agent is ciclosporin and is administered intravenously and/or orally. In one embodiment, the further therapeutic agent is cyclophosphamide and is administered intravenously and/or orally. In one embodiment, the further therapeutic agent is methyl prednisolone and is administered orally and/or intravenously.

[0452] Concept 106. A method, an antibody or fragment for the use, a composition for the use, or the use according to any one of concepts 101 to 105, wherein the subject has a post-treatment or post-prophylaxis survival time of at least 14 days, or at least 21 days, or at least 28 days, or at least 40 days, or at least 50 days, or at least 60 days.

[0453] Concept 107. A method, an antibody or fragment for the use, a composition for the use, or the use according to any one of concepts 101 to 105, wherein post-prophylaxis, the subject has at least 7 days, or at least 14 days, or at least 21 days, or at least 28 days, or at least 40 days, or at least 50 days, or at least 60 days disease-free.

[0454] Concept 108. A method, an antibody or fragment for the use, a composition for the use, or the use according to any one of concepts 101 to 105, wherein post-treatment, the subject has at least 7 days, or at least 14 days, or at least 21 days, or at least 28 days, or at least 40 days, or at least 50 days, or at least 60 days disease progression-free.

[0455] Concept 109. A method, an antibody or fragment for the use, a composition for the use, or the use according to any one of concepts 106 to 108, wherein the number of days of survival, the number of disease-free days, or the number of disease-progression free days is at least 2 months, or at least 3 months, or at least 4 months, e.g. at least 5 months, such as at least 6 months.

[0456] Concept 110. A method, an antibody or fragment for the use, a composition for the use, or the use according to concept 109, wherein the number of days of survival, the number of disease-free days, or the number of disease-progression free days is at least 9 months, or at least one year.

[0457] Concept 111. A method of preventing the onset of an **OX40L**-mediated disease or condition in a subject by administering a prophylactically-effective amount of an anti-**OX40L** antibody and administering a prophylactically-effective amount of a further therapeutic agent independently selected from the group consisting of rapamycin (sirolimus), tacrolimus, ciclosporin, corticosteroids (e.g. methylprednisolone), methotrexate, mycophenolate mofetil, anti-CD28 antibodies, anti-IL12/IL-23 antibodies (e.g. ustekinumab), anti-CD29 antibodies (e.g. rituximab), anti-CD30 antibodies (e.g. brentuximab), CTLA4-Fc molecules (e.g. abatacept), CCR5 receptor antagonists (e.g. maraviroc), anti-CD40L antibodies, anti-VLA4 antibodies (e.g. natalizumab), anti-LFA1 antibodies, fludarabine, anti-CD52 antibodies (e.g. alemtuzumab), anti-CD45 antibodies, cyclophosphamide, anti-thymocyte globulins, anti-complement C5 antibodies (e.g. eculizumab), anti-a4b7 integrin antibodies (e.g. vedolizumab), anti-IL6 antibodies (e.g. tocilizumab), anti-IL2R antibodies (e.g. basilixumab), anti-CD25 antibodies (e.g. daclizumab), anti-TNFr / TNFr-Fc molecules (e.g. etanercept, adalimumab, infliximab, golimumab or certolizumab pegol) and Vedolizet, wherein the onset of the **OX40L**-mediated disease or condition is prevented.

[0458] By "prophylactically-effective", it is meant that the dose is effective to prevent or reduce the risk of an **OX40L**-mediated disease or condition.

[0459] In one embodiment, the combination may be used to reduce the risk of an **OX40L**-mediated disease or condition. In concept 111, the anti-**OX40L** antibody of the invention and the further therapeutic agent may be administered to the patient prophylactically, which administration may be sequential or simultaneous. The dosing regimens and modes of administration may be those which are normal or traditionally administered by physicians for the further therapeutic agent. The dosing regimens and modes of administration may be those which are normal or traditionally administered by physicians for the anti-**OX40L** antibody of the invention. However, the concurrent use of both agents is expected to result in an improved prophylaxis as compared to either agent alone.

[0460] Concept 112. A method of treating an **OX40L**-mediated disease or condition in a subject by administering a prophylactically-effective amount of an anti-**OX40L** antibody and administering a therapeutically-effective amount of a further therapeutic agent independently selected from the group consisting of rapamycin (sirolimus), tacrolimus, ciclosporin, corticosteroids (e.g. methylprednisolone), methotrexate, mycophenolate mofetil, anti-CD28 antibodies, anti-IL12/IL-23 antibodies (e.g. ustekinumab), anti-CD29 antibodies (e.g. rituximab), anti-CD30 antibodies (e.g. brentuximab), CTLA4-Fc molecules (e.g. abatacept), CCR5 receptor antagonists (e.g. maraviroc), anti-CD40L antibodies, anti-VLA4 antibodies (e.g. natalizumab), anti-LFA1 antibodies, fludarabine, anti-CD52 antibodies (e.g. alemtuzumab), anti-CD45 antibodies, cyclophosphamide, anti-thymocyte globulins, anti-complement C5 antibodies (e.g. eculizumab), anti-a4b7 integrin antibodies (e.g. vedolizumab), anti-IL6 antibodies (e.g. tocilizumab), anti-IL2R antibodies (e.g. basilixumab), anti-CD25 antibodies (e.g. daclizumab), anti-TNFr / TNFr-Fc molecules (e.g. etanercept, adalimumab, infliximab, golimumab or certolizumab pegol) and Vedolizet, wherein the onset of the **OX40L**-mediated disease or condition is treated.

[0461] By "therapeutically effective", it is meant that the dose is effective to treat an **OX40L**-mediated disease or condition. Effective may be as defined on pages 96 to 97, or on page 152 herein, and may provide serum concentrations as described in the section entitled "Pharmaceutical Compositions" starting on page 118 herein.

[0462] In concept 112, the anti-**OX40L** antibody of the invention may be administered to the patient, but despite prophylaxis, the onset of the **OX40L**-mediated disease or condition occurs (the onset may be delayed by a number of days or weeks, as compared with a patient who had not been receiving the antibody of the invention). In this case, a therapeutically-effective amount of a further therapeutic agent may be administered to treat the disease or condition.

[0463] Concept 113. A method of treating an **OX40L**-mediated disease or condition in a subject by administering a therapeutically-effective amount of an anti-**OX40L** antibody and administering a prophylactically-effective amount of a further therapeutic agent independently selected from the group consisting of rapamycin (sirolimus), tacrolimus, ciclosporin, corticosteroids (e.g. methylprednisolone), methotrexate, mycophenolate mofetil, anti-CD28 antibodies, anti-IL12/IL-23 antibodies (e.g. ustekinumab), anti-CD29 antibodies (e.g. rituximab), anti-CD30 antibodies (e.g. brentuximab), CTLA4-Fc molecules (e.g. abatacept), CCR5 receptor antagonists (e.g. maraviroc), anti-CD40L antibodies, anti-VLA4 antibodies (e.g. natalizumab), anti-LFA1 antibodies, fludarabine, anti-CD52 antibodies (e.g. alemtuzumab), anti-CD45 antibodies, cyclophosphamide, anti-thymocyte globulins, anti-complement C5 antibodies (e.g. eculizumab), anti-a4b7 integrin antibodies (e.g. vedolizumab), anti-IL6 antibodies (e.g. tocilizumab), anti-IL2R antibodies (e.g. basilixumab), anti-CD25 antibodies (e.g. daclizumab), anti-TNFr / TNFr-Fc molecules (e.g. etanercept, adalimumab, infliximab, golimumab or certolizumab pegol) and Vedolizet, wherein the onset of the **OX40L**-mediated disease or condition is treated.

[0464] In concept 113, the further therapeutic agent may be administered to the patient, but despite prophylaxis, the onset of the **OX40L**-mediated disease or condition occurs (the onset may be delayed by a number of days or weeks, as compared with a patient who had not been receiving the further therapeutic agent). In this case, a therapeutically-effective amount of an anti-**OX40L** antibody of the invention may be administered to treat the disease or condition.

[0465] Concept 114. A method of treating an **OX40L**-mediated disease or condition in a subject by administering a therapeutically-effective amount of an anti-**OX40L** antibody and administering a therapeutically-effective amount of a further therapeutic agent independently selected from the group consisting of rapamycin (sirolimus), tacrolimus, ciclosporin, corticosteroids (e.g. methylprednisolone), methotrexate, mycophenolate mofetil, anti-CD28 antibodies, anti-IL12/IL-23 antibodies (e.g. ustekinumab), anti-CD29 antibodies (e.g. rituximab), anti-CD30 antibodies (e.g. brentuximab), CTLA4-Fc molecules (e.g. abatacept), CCR5 receptor antagonists (e.g. maraviroc), anti-CD40L antibodies, anti-VLA4 antibodies (e.g. natalizumab), anti-LFA1 antibodies, fludarabine, anti-CD52 antibodies (e.g. alemtuzumab), anti-CD45 antibodies, cyclophosphamide, anti-thymocyte globulins, anti-complement C5 antibodies (e.g. eculizumab), anti-a4b7 integrin antibodies (e.g. vedolizumab), anti-IL6 antibodies (e.g. tocilizumab), anti-IL2R antibodies (e.g. basilixumab), anti-CD25 antibodies (e.g. daclizumab), anti-TNFr / TNFr-Fc molecules (e.g. etanercept, adalimumab, infliximab, golimumab or certolizumab pegol) and Vedolizet, wherein the onset of the **OX40L**-mediated disease or condition is treated.

[0466] In concept 114, both the anti-**OX40L** antibody of the invention and the further therapeutic agent are not administered until there are clinical signs of the **OX40L**-mediated disease or condition. The combination treatment of both agents may provide further benefits as compared to either agent alone.

[0467] Concept 115. A method according to concept 111 or concept 113, wherein the further therapeutic agent is independently selected from rapamycin (sirolimus), tacrolimus, a combination of tacrolimus and methotrexate, cyclophosphamide, ciclosporin, and a combination of ciclosporin and methotrexate.

[0468] In one embodiment, the **OX40L**-mediated disease or condition is **GvHD** or transplant rejection, particularly **GvHD**. In one embodiment, the **OX40L**-mediated disease or condition is **GvHD** or transplant rejection, particularly **GvHD**, and the further therapeutic agent is rapamycin (sirolimus). In one embodiment, the **OX40L**-mediated disease or condition is **GvHD** or transplant rejection, particularly **GvHD**, and the further therapeutic agent is tacrolimus. In one embodiment, the **OX40L**-mediated disease or condition is **GvHD** or transplant rejection, particularly **GvHD**, and the further therapeutic agent is a combination of tacrolimus and methotrexate. In one embodiment, the **OX40L**-mediated disease or condition is **GvHD** or transplant rejection, particularly **GvHD**, and the further therapeutic agent is cyclophosphamide. In one embodiment, the **OX40L**-mediated disease or condition is **GvHD** or transplant rejection, particularly **GvHD**, and the further therapeutic agent is ciclosporin. In one embodiment, the **OX40L**-mediated disease or condition is **GvHD** or transplant rejection, particularly **GvHD**, and the further therapeutic agent is a combination of ciclosporin and methotrexate. In one embodiment, the **OX40L**-mediated disease or condition is **GvHD** or transplant rejection, particularly **GvHD**, and the further therapeutic agent is mycophenolate mofetil.

[0469] In one embodiment, the anti-**OX40L** antibody is administered to a patient who is already receiving rapamycin (sirolimus). In another embodiment, the anti-**OX40L** antibody is administered to a patient who is already receiving tacrolimus. In another embodiment, the anti-**OX40L** antibody is administered to a patient who is already receiving a combination of tacrolimus and methotrexate. In another embodiment, the anti-**OX40L** antibody is administered to a patient who is already receiving a combination of ciclosporin and methotrexate. In another embodiment, the anti-**OX40L** antibody is administered to a patient who is already receiving cyclophosphamide. In another embodiment, the anti-**OX40L** antibody is administered to a patient who is already receiving ciclosporin. In another embodiment, the anti-**OX40L** antibody is administered to a patient who is already receiving mycophenolate mofetil.

[0470] These further therapeutic agents may be used prophylactically in the treatment of **OX40L**-mediated diseases or conditions. For example, In **GvHD**, preventive therapy (prophylaxis) is typically administered around the time of HSCT and is continued for a period of time following transplant to maintain immunosuppression during the period of greatest risk of developing acute **GvHD**. Specific drug regimens differ between transplant centres, but as an example prophylaxis with calcineurin inhibitors such as ciclosporin or tacrolimus, or with rapamycin (sirolimus) may be initiated within the 7 day period preceding transplant (such as Day -3, or Day -1 pre-HSCT), or immediately following the HSCT procedure (e.g. on Day 0, or Day +1 after transplant). Prophylaxis with mycophenolate mofetil is typically dosed following HSCT, for example starting between Day +1 to Day +5 post-transplant. Prophylaxis with these agents may be continued, for example between 2 to 160 days or longer following transplant, with daily dosages calculated to maintain serum levels in the range to achieve effective immunosuppression without limiting side effects. In addition to calcineurin inhibitors, methotrexate is often used as an adjunct to prophylaxis, typically being administered on Days+1, +3, +6, and +11 post-transplant.

[0471] An anti-**OX40L** antibody of the invention may be used as prophylaxis in combination with tacrolimus, ciclosporin, a combination of tacrolimus and methotrexate, a combination of ciclosporin and methotrexate, cyclophosphamide, mycophenolate mofetil or rapamycin, where prophylaxis with any of these agents is started before or around the time of HSCT, or immediately following the transplant procedure, for example within the period 7 days before, to 7 days after transplant. Tacrolimus, or ciclosporin, or rapamycin may then be administered at therapeutically effective dose and frequency, for example daily, for up to 180 days following the transplant. An anti-**OX40L** antibody of the invention may be administered concurrently, starting before or around the time of HSCT, or immediately following the transplant procedure, for example within the period 7 days before, to 7 days after transplant. The anti-**OX40L** antibody may then be dosed at a therapeutically effective dose and frequency, for example biweekly or monthly, for up to 180 days following the transplant. Under these circumstances the combined activity of the anti-**OX40L** antibody and the additional prophylactic agent would be expected to display a synergistic effect in preventing the onset and / or severity of **GvHD**.

[0472] Concept 116. A method according to concept 112 or concept 114, wherein the further therapeutic agent is a corticosteroid (e.g. methylprednisolone).

[0473] In one embodiment, the **OX40L**-mediated disease or condition is **GvHD** or transplant rejection, in particular **GvHD**. In one embodiment, the **OX40L**-mediated disease or condition is **GvHD** or transplant rejection, in particular **GvHD**, and the further therapeutic agent is methylprednisolone.

[0474] In cases where breakthrough **GvHD** occurs (for example, even despite prophylaxis), treatment may be initiated immediately upon confirmation of Grade II or higher **GvHD** disease. Systemic corticosteroids such as methylprednisolone are the first-line treatment of choice, administered concurrently with ongoing prophylaxis with, for example, a calcineurin inhibitor such as ciclosporin or tacrolimus.

[0475] Where first-line treatment or prophylaxis fails to control **GvHD**, "salvage therapy" may be attempted in which case additional previously unused immunosuppressants such as rapamycin or mycophenolate mofetil may be administered. Thus, in one embodiment, a therapeutically effective amount of an anti-**OX40L** antibody of the invention is administered to a patient who is refractory to prophylaxis or treatment with any of rapamycin, tacrolimus, tacrolimus in combination with methotrexate, cyclophosphamide, ciclosporin, ciclosporin in combination with methotrexate, or corticosteroids (e.g. methylprednisolone). In another embodiment, a therapeutically effective amount of an anti-**OX40L** antibody of the invention is administered to a patient who is refractory to prophylaxis or treatment with any of the further therapeutic agents mentioned herein. In another embodiment, an anti-**OX40L** antibody of the invention is administered as a salvage therapy.

[0476] Concept 117. A method of prolonging survival in a subject having or at risk of an OX40L-mediated disease or condition by administering a therapeutic or prophylactic combination of an anti-OX40L antibody and a further therapeutic agent independently selected from the group consisting of rapamycin (sirolimus), tacrolimus, ciclosporin, corticosteroids (e.g. methylprednisolone), methotrexate, mycophenolate mofetil, anti-CD28 antibodies, anti-IL12/IL-23 antibodies (e.g. ustekinumab), anti-CD29 antibodies (e.g. rituximab), anti-CD39 antibodies (e.g. brentuximab), CTLA4-Fc molecules (e.g. abatacept), CCR5 receptor antagonists (e.g. maraviroc), anti-CD40L antibodies, anti-VLA4 antibodies (e.g. natalizumab), anti-LFA1 antibodies, fludarabine, anti-CD52 antibodies (e.g. alemtuzumab), anti-CD45 antibodies, cyclophosphamide, anti-thymocyte globulins, anti-complement C5 antibodies (e.g. eculizumab), anti-a4b7 integrin antibodies (e.g. vedolizumab), anti-IL6 antibodies (e.g. tocilizumab), anti-IL2R antibodies (e.g. basilixumab), anti-CD25 antibodies (e.g. daclizumab), anti-TNF α / TNF α -Fc molecules (e.g. etanercept, adalimumab, infliximab, golimumab or certolizumab pegol) and Virostatat.

[0477] In one embodiment, then OX40L-mediated disease or condition is GvHD or transplant rejection, in particular GvHD. A number of factors affect the severity and disease progression in GvHD, such as the pre-transplant conditioning regimen (e.g. myeloablation by irradiation, preparative chemotherapy), degree of donor-recipient tissue matching (HLA matching, and/or relationship of donor-recipient), and therapeutic or prophylactic treatment regimens.

[0478] In general, however, in primates, such as rhesus macaque that have received haploidentical stem cell transplants, the mean survival time (MST) post-transplant and in the absence of therapy is 8 days.

[0479] Concept 118. A method according to concept 117, wherein survival is increased by at least 7 days, or by at least 14 days, or by at least 20 days, or by at least 30 days or by at least 40 days, or by at least 50 days, or by at least 60 days, or by at least 70 days.

[0480] Concept 119. A method of increasing the number of disease-free, or disease-progression free, days in a subject having or at risk of an OX40L-mediated disease or condition by administering a therapeutic or prophylactic combination of an anti-OX40L antibody and a further therapeutic agent independently selected from the group consisting of rapamycin (sirolimus), tacrolimus, ciclosporin, corticosteroids (e.g. methylprednisolone), methotrexate, mycophenolate mofetil, anti-CD28 antibodies, anti-IL12/IL-23 antibodies (e.g. ustekinumab), anti-CD29 antibodies (e.g. rituximab), anti-CD39 antibodies (e.g. brentuximab), CTLA4-Fc molecules (e.g. abatacept), CCR5 receptor antagonists (e.g. maraviroc), anti-CD40L antibodies, anti-VLA4 antibodies (e.g. natalizumab), anti-LFA1 antibodies, fludarabine, anti-CD52 antibodies (e.g. alemtuzumab), anti-CD45 antibodies, cyclophosphamide, anti-thymocyte globulins, anti-complement C5 antibodies (e.g. eculizumab), anti-a4b7 integrin antibodies (e.g. vedolizumab), anti-IL6 antibodies (e.g. tocilizumab), anti-IL2R antibodies (e.g. basilixumab), anti-CD25 antibodies (e.g. daclizumab), anti-TNF α / TNF α -Fc molecules (e.g. etanercept, adalimumab, infliximab, golimumab or certolizumab pegol) and Virostatat.

[0481] In one embodiment, then OX40L-mediated disease or condition is GvHD or transplant rejection, in particular GvHD. In humans, the presence of signs and symptoms of acute GvHD may be staged and graded according to a standardised scale such as described in Przepiorka et al. In primates, such as rhesus macaques, the presence of signs and symptoms of acute GvHD may be staged and graded according to a standardised scale such as described herein. Example 7.

[0482] Thus, the number of disease free days may be measured by absence of clinical grading symptoms. The number of disease-progression free days may be measures as the number of days where the clinical grading score does not change.

[0483] Concept 120. A method according to concept 119, wherein the number of disease-free, or disease-progression free, days is at least 7 days, or at least 14 days, or at least 21 days, or at least 28 or at least 40 days, or at least 50 days, or by at least 60 days, or at least 70 days.

[0484] Concept 121. A method according to concept 120, wherein the number of disease free, or disease-progression free, days is at least 90 days, at least 150 days or at least 365 days.

[0485] Concept 122. A method of treating or reducing the risk of transplant rejection or GvHD in a subject by administering a therapeutic or prophylactic combination of an anti-OX40L antibody and a further therapeutic agent independently selected from the group consisting of rapamycin (sirolimus), tacrolimus, ciclosporin, corticosteroids (e.g. methylprednisolone), methotrexate, mycophenolate mofetil, anti-CD28 antibodies, anti-IL12/IL-23 antibodies (e.g. ustekinumab), anti-CD29 antibodies (e.g. rituximab), anti-CD39 antibodies (e.g. brentuximab), CTLA4-Fc molecules (e.g. abatacept), CCR5 receptor antagonists (e.g. maraviroc), anti-CD40L antibodies, anti-VLA4 antibodies (e.g. natalizumab), anti-LFA1 antibodies, fludarabine, anti-CD52 antibodies (e.g. alemtuzumab), anti-CD45 antibodies, cyclophosphamide, anti-thymocyte globulins, anti-complement C5 antibodies (e.g. eculizumab), anti-a4b7 integrin antibodies (e.g. vedolizumab), anti-IL6 antibodies (e.g. tocilizumab), anti-IL2R antibodies (e.g. basilixumab), anti-CD25 antibodies (e.g. daclizumab), anti-TNF α / TNF α -Fc molecules (e.g. etanercept, adalimumab, infliximab, golimumab or certolizumab pegol) and Virostatat, wherein the combination results in an increased survival in a Rhesus macaque model of haploidentical hematopoietic stem cell transplantation as compared to either the antibody or the further therapeutic agent as a monotherapy.

[0486] In one embodiment, the method is a method of preventing an OX40L-mediated disease or condition.

[0487] In one embodiment, the OX40L-mediated disease or condition is GvHD or transplant rejection, in particular GvHD. In one embodiment, the OX40L-mediated disease or condition is GvHD or transplant rejection, in particular GvHD, and the further therapeutic agent is a rapamycin (sirolimus). In one embodiment, the OX40L-mediated disease or condition is GvHD or transplant rejection, in particular GvHD, and the further therapeutic agent is tacrolimus. In one embodiment, the OX40L-mediated disease or condition is GvHD or transplant rejection, in particular GvHD, and the further therapeutic agent is a combination of tacrolimus and methotrexate. In one embodiment, the OX40L-mediated disease or condition is GvHD or transplant rejection, in particular GvHD, and the further therapeutic agent is cyclophosphamide. In one embodiment, the OX40L-mediated disease or condition is GvHD or transplant rejection, in particular GvHD, and the further therapeutic agent is ciclosporin. In one embodiment, the OX40L-mediated disease or condition is GvHD or transplant rejection, in particular GvHD, and the further therapeutic agent is a combination of ciclosporin and methotrexate. In one embodiment, the OX40L-mediated disease or condition is GvHD or transplant rejection, in particular GvHD, and the further therapeutic agent is mycophenolate mofetil.

[0488] The Rhesus macaque model of haploidentical hematopoietic stem cell transplantation may be as described in aspect 99 herein.

[0489] Concept 123. A method according to any one of concepts 106, 109, 110, 111, 119, or 122, wherein the survival is increased by at least 7 days, or by at least 14 days, or by at least 21 days, or by at least 28 days, or by at least 40 days, or by at least 50 days, or by at least 60 days, or by at least 70 days as compared to either the antibody or the further therapeutic agent as a monotherapy.

[0490] Concept 124. A method according to any one of concepts 106, 109, 110, 111, 119, or 122, wherein survival is at least doubled, e.g. tripled, as compared to either the antibody or the further therapeutic agent as a monotherapy.

[0491] Concept 125. A method, an antibody or fragment for the use, a composition for the use, or the use according to any preceding concept, wherein the antibody specifically binds to human OX40L (hOX40L).

[0492] The hOX40L may be as described in aspect 28 or aspect 39 described herein.

[0493] In any of the concepts provided herein, the anti-OX40L antibody may be as described elsewhere herein. In one embodiment, the anti-OX40L antibody is as described in any of aspects 1 to 11, 13 to 27, 29, 31 to 43 or 45 described herein. In another embodiment, the anti-OX40L antibody is as described in aspects 73 to 88, or as in any of aspects 95 to 102 described herein. In another embodiment, the anti-OX40L antibody is as described in any of concepts 53 to 64 hereinabove. Other properties of anti-OX40L antibodies are described on pages 86 to 89, in the section entitled "Isotypes" beginning on page 130 herein and in the section entitled "Methods of Administration and Dosing" beginning on page 130 herein.

[0494] Concept 126. A method, an antibody or fragment for the use, a composition for the use, or the use according to concept 125, which competes for binding to said hOX40L with an antibody selected from the group consisting of 92D10, 10A07, 99H04 and 19H01.

[0495] Competition between antibodies may be determined as described in aspect 13 or aspect 73, for example as determined by SPR, ELISA, HTRF or FACS. Methods related to the measurement methods are disclosed herein, including in the Examples.

[0496] Concept 127. A method, an antibody or fragment for the use, a composition for the use, or the use according to concept 126, which competes for binding to said hOX40L with the antibody 92D10, wherein the antibody or fragment comprises a VH domain which comprises a HCDR3 comprising the motif VRGQYYVY, wherein X is any amino acid.

[0497] Concept 128. A method, an antibody or fragment for the use, a composition for the use, or the use according to any preceding concept, wherein the antibody antagonises specific binding of OX40 to OX40L, e.g. as determined using SPR or ELISA.

[0498] Antagonism and inhibition may be carried out as defined on page 94 to 95.

[0499] Concept 129. A method, an antibody or fragment for the use, a composition for the use, or the use according to any preceding concept, wherein the antibody is a humanized, human or fully human antibody.

[0500] Concept 130. A method, an antibody or fragment for the use, a composition for the use, or the use according to any preceding concept, wherein the antibody is a fragment of an antibody selected from the list of multispecific antibodies (e.g. bi-specific antibodies), intrabodies, single-chain Fv antibodies (scFv), camelized antibodies, Fab fragments, F(ab')₂ fragments, disulfide-linked Fw (scFv), anti-idiotypic Fv (scFv), and epitope-binding fragments thereof.

[0501] Concept 131. A method, an antibody or fragment for the use, a composition for the use, or the use according to any preceding concept, wherein the antibody or fragment enables greater than 80% stem cell donor chimerism by day 12 in a Rhesus macaque model of haploidentical hematopoietic stem cell transplantation.

[0502] Concept 132. A method, an antibody or fragment for the use, a composition for the use, or the use according to any preceding concept, wherein the antibody or fragment expresses as a stably transfected pool in Lonza GS-XceedTM at level greater than 1.5 μ g/L in a fed batch overgrowth culture using Lonza version 8 feed system with an overgrowth period of 14 days.

[0503] Concept 133. A method, an antibody or fragment for the use, a composition for the use, or the use according to any preceding concept, wherein the antibody or fragment thereof comprises a HCDR3 of from 16 to 27 amino acids and derived from the recombination of a human VH gene segment, a human D gene segment and a human JH gene segment, wherein the human JH gene segment is IGJHJ6 (e.g. IGJHJ6)32.

[0504] Concept 134. A method, an antibody or fragment for the use, a composition for the use, or the use according to any preceding concept, wherein the antibody or fragment thereof comprises a CDR selected from:

1. a. the HCDR3 of antibody 2D10 (Seq ID No:40 or Seq ID No:46);
2. b. the HCDR3 of antibody 10A7 (Seq ID No:8 or Seq ID No:14);
3. c. the HCDR3 of antibody 99H04 (Seq ID No:72 or Seq ID No:76);
4. d. the HCDR3 of antibody 19H01 (Seq ID No:100 or Seq ID No:106);
5. e. a CDR3 of any of the nanobodies having the variable region amino acid sequence of Seq ID Nos: 177 to 213;
6. f. an HCDR3 of any of the antibodies having the variable region amino acid sequence of Seq ID Nos: 215, 217, 219, 221, 223, 225, 227, 229 or 230; or
7. g. an HCDR3 of any of the antibodies having the variable region amino acid sequence of Seq ID Nos: 232 or 234.

[0505] Concept 135. A method, an antibody or fragment for the use, a composition for the use, or the use according to any preceding concept, wherein the antibody or fragment thereof comprises:

1. a. the CDRs of antibody 2D10 (Seq ID No:40 or Seq ID No:46 for CDRL4, SEQ ID No:38 or SEQ ID No:44 for CDRL2, SEQ ID No:36 or SEQ ID No:42 for CDRL1, SEQ ID No:50 or SEQ ID No:56 for CDRL2 and SEQ ID No:54 or SEQ ID No:60 for CDRL3);
2. b. the CDRs of antibody 10A7 (Seq ID No:8 or SEQ ID No:14 for CDRL4, SEQ ID No:6 or SEQ ID No:12 for CDRL2, SEQ ID No:4 or SEQ ID No:10 for CDRL1, SEQ ID No:16 or SEQ ID No:24 for CDRL1, SEQ ID No:20 or SEQ ID No:26 for CDRL2 and SEQ ID No:22 or SEQ ID No:28 for CDRL3);
3. c. the CDRs of antibody 99H04 (Seq ID No:72 or Seq ID No:76 for CDRL4, SEQ ID No:70 or SEQ ID No:76 for CDRL2, SEQ ID No:68 or SEQ ID No:74 for CDRL1, SEQ ID No:82 or SEQ ID No:88 for CDRL1, SEQ ID No:84 or SEQ ID No:90 for CDRL2 and SEQ ID No:86 or SEQ ID No:92 for CDRL3);
4. d. the CDRs of antibody 19H01 (Seq ID No:100 or Seq ID No:106 for CDRL4, SEQ ID No:98 or SEQ ID No:104 for CDRL2, SEQ ID No:96 or SEQ ID No:102 for CDRL1, SEQ ID No:110 or SEQ ID No:116 for CDRL1, SEQ ID No:112 or SEQ ID No:118 for CDRL2 and SEQ ID No:114 or SEQ ID No:120 for CDRL3);
5. e. the CDRs of any of the nanobodies having the variable region amino acid sequence of Seq ID Nos: 177 to 213;
6. f. the heavy chain CDRs of any of the antibodies having the heavy chain variable region amino acid sequence of Seq ID Nos: 215, 217, 219, 221, 223, 225, 227, 229 or 230, and the light chain CDRs of any of the antibodies having the light chain variable region amino acid sequence of Seq ID Nos: 214, 216, 218, 220, 222, 224, 226 or 228; or
7. g. the heavy chain CDRs of any of the antibodies having the heavy chain variable region amino acid sequence of Seq ID Nos: 232 or 234, and the light chain CDRs of any of the antibodies having the light chain variable region amino acid sequence of Seq ID Nos:231 or 233.

[0506] Concept 136. A method, an antibody or fragment for the use, a composition for the use, or the use according to any preceding concept, wherein the antibody or fragment thereof comprises the VH and/or VL domains selected from the following:

1. a. the VH and/or VL domains of antibody 2D10 (Seq ID No:34 for VH and/or Seq ID No:48 for VL);
2. b. the VH and/or VL domains of antibody 10A7 (Seq ID No:2 for VH and/or Seq ID No:16 for VL);
3. c. the VH and/or VL domains of antibody 99H04 (Seq ID No:66 for VH and/or Seq ID No:80 for VL);
4. d. the VH and/or VL domains of antibody 19H01 (Seq ID No:84 for VH and/or Seq ID No:108 for VL);
5. e. a VH domain of any of the nanobodies having the variable region amino acid sequence of Seq ID Nos: 177 to 213;
6. f. a VH domain of any of the antibodies having the heavy chain variable region amino acid sequence of Seq ID Nos: 215, 217, 219, 221, 223, 225, 227, 229 or 230, and a VL domain of any of the antibodies having the light chain variable region amino acid sequence of Seq ID Nos: 214, 216, 218, 220, 222, 224, 226 or 228; or
7. g. a VH domain of any of the antibodies having the heavy chain variable region amino acid sequence of Seq ID Nos: 232 or 234, and a VL domain of any of the antibodies having the light chain variable region amino acid sequence of Seq ID Nos:231 or 233.

[0507] Concept 137. A method, an antibody or fragment for the use, a composition for the use, or the use according to any preceding concept, wherein the antibody is oxelumab.

[0508] Concept 138. A method, an antibody or fragment for the use, a composition for the use, or the use according to any preceding concept, wherein the subject is a primate.

[0509] The term "subject" may be other subjects as described herein, for example as described on page 104. In one embodiment, the primate is a rhesus macaque monkey.

[0510] Concept 139. A method, an antibody or fragment for the use, a composition for the use, or the use according to any preceding concept, wherein the subject is a human.

[0511] In one embodiment, the subject is a human patient.

[0512] Concept 140. A method, an antibody or fragment for the use, a composition for the use, or the use according to any preceding concept, wherein the subject is at risk of an OX40L-mediated disease or condition.

[0513] In one embodiment, a subject may be identified as being "at risk of an OX40L-mediated disease or condition" if the subject has been previously identified as having an increased risk, e.g. by genotyping and/or phenotyping, but the subject has not yet presented symptoms or would not be diagnosed as having such a disease or condition by any conventional method. Thus, the methods and uses disclosed herein may aid in the early identification of patients who will develop such diseases or conditions. In one embodiment, the disease or condition is prevented (i.e. the treatment is prophylactic).

[0514] In one embodiment, the OX40L-mediated disease or condition is GvHD or transplant rejection, in particular GvHD. In a particular embodiment, the subject is at risk of GvHD or transplant rejection when they are pre-operative for a transplant. In particular, a subject is at risk of GvHD or transplant rejection when they have commenced a pre-transplant conditioning regimen (e.g. myeloablation by irradiation, preparative chemotherapy), and when degree of donor-recipient tissue matching (HLA matching, and/or relationship of donor-recipient) is not 100%. Potential transplant therapies are envisaged in concept 78 hereinabove.

[0515] Concept 141. A method, an antibody or fragment for the use, a composition for the use, or the use according to concept 40, wherein the method, antibody or fragment for the use, the use or the composition is for the prevention of the OX40L-mediated disease or condition.

[0516] Concept 142. A method, an antibody or fragment for the use, a composition for the use, or the use according to any one of concepts 101 to 139, wherein the subject has an OX40L-mediated disease or condition.

[0517] A subject has an OX40L-mediated disease or condition if the subject is presenting symptoms which would conventionally be associated with said disease or condition or if the subject would be diagnosed as having such a disease or condition by any conventional method. In one embodiment, the OX40L-mediated disease or condition is GvHD or transplant rejection, particularly GvHD, and a subject may be determined to have the disease by any of the methods mentioned in concepts 101 to 105 and 119 hereinabove.

[0518] Concept 143. A method, an antibody or fragment for the use, a composition for the use, or the use according to concept 142, wherein the method, antibody or fragment for the use, the composition for the use, or the use is for the treatment of the OX40L-mediated disease or condition.

[0619] In one embodiment, treatment is commenced when the OX40L-mediated disease or condition has been diagnosed as a confirmed disease or condition.

[0620] In one embodiment, the OX40L-mediated disease or condition is **GvHD** or transplant rejection, in particular **GvHD**. **GvHD** grading may be determined as described herein (see concepts 101 to 105 and 119 hereinabove). In one embodiment, the subject is a human having Grade II clinical symptoms of **GvHD**.

[0621] Concept 144. A method, an antibody or fragment for the use, a composition for the use, or the use according to any preceding concept, wherein the OX40L-mediated disease or condition is selected from an autoimmune disease or condition, a systemic inflammatory disease or condition, or transplant rejection.

[0622] Concept 145. A method, an antibody or fragment for the use, a composition for the use, or the use according to concept 144, wherein the OX40L-mediated disease or condition is selected from inflammatory bowel disease (**IBD**), Crohn's disease, rheumatoid arthritis, transplant rejection, allogeneic transplant rejection, graft-versus-host disease (**GvHD**), ulcerative colitis, systemic lupus erythematosus (**SLE**), diabetes, uveitis, ankylosing spondylitis, contact hypersensitivity, multiple sclerosis and atherosclerosis.

[0623] Concept 146. A method, an antibody or fragment for the use, a composition for the use, or the use according to concept 145, wherein the OX40L-mediated disease or condition is **GvHD** or transplant rejection.

[0624] Concept 147. A method, an antibody or fragment for the use, a composition for the use, or the use according to concept 146, wherein the OX40L-mediated disease or condition is **GvHD**.

[0625] Concept 148. A method, an antibody or fragment for the use, a composition for the use, or the use according to concept 146, wherein the transplant is a cell, tissue or organ transplant (e.g. liver, lung, heart, kidney or bowel), or a blood transplant (e.g. autologous or allogeneic), for example where the blood is bone marrow-derived, is cord-blood derived (umbilical), or is peripheral-blood derived.

[0626] Concept 149. A method, an antibody or fragment for the use, a composition for the use, or the use according to any one of concepts 146 to 148, wherein the anti-OX40L antibody or fragment thereof is administered before transplant.

[0627] Concept 150. A method, an antibody or fragment for the use, a composition for the use, or the use according to any one of concepts 146 to 148, wherein the anti-OX40L antibody or fragment thereof is administered after transplant.

[0628] Concept 151. A method, an antibody or fragment for the use, a composition for the use, or the use according to concept 149 or concept 150, wherein the further therapeutic agent is administered after transplant.

[0629] In one embodiment, the further therapeutic agent is rapamycin (sirolimus). In one embodiment, the further therapeutic agent is tacrolimus. In one embodiment, the further therapeutic agent is a combination of tacrolimus and methotrexate. In one embodiment, the further therapeutic agent is cyclophosphamide. In one embodiment, the further therapeutic agent is ciclosporin. In one embodiment, the further therapeutic agent is a combination of ciclosporin and methotrexate. In one embodiment, the further therapeutic agent is mycophenolate mofetil. In one embodiment, the further therapeutic agent is methylprednisolone.

[0630] Concept 152. A method, an antibody or fragment for the use, a composition for the use, or the use according to concept 149 or concept 150, wherein the further therapeutic agent is administered before transplant.

[0631] In one embodiment, the further therapeutic agent is rapamycin (sirolimus). In one embodiment, the further therapeutic agent is tacrolimus. In one embodiment, the further therapeutic agent is a combination of tacrolimus and methotrexate. In one embodiment, the further therapeutic agent is cyclophosphamide. In one embodiment, the further therapeutic agent is ciclosporin. In one embodiment, the further therapeutic agent is a combination of ciclosporin and methotrexate. In one embodiment, the further therapeutic agent is mycophenolate mofetil.

[0632] Concept 153. A pharmaceutical composition comprising an anti-OX40L antibody or fragment thereof and a pharmaceutically acceptable excipient, diluent or carrier and further comprising a further therapeutic agent independently selected from the group consisting of rapamycin (sirolimus), tacrolimus, ciclosporin, corticosteroids (e.g. methylprednisolone), methotrexate, mycophenolate mofetil, anti-CD28 antibodies, anti-IL12/IL-23 antibodies (e.g. ustekinumab), anti-CD20 antibodies (e.g. rituximab), anti-CD30 antibodies (e.g. brentuximab), CTLA4-Fc molecules (e.g. abatacept), CCR5 receptor antagonists (e.g. maraviroc), anti-CD40L antibodies, anti-VLA4 antibodies (e.g. natalizumab), anti-LFA1 antibodies, fludarabine, anti-CD52 antibodies (e.g. alemtuzumab), anti-CD45 antibodies, cyclophosphamide, anti-thymocyte globulins, anti-complement C5 antibodies (e.g. eculizumab), anti- α 6 β 7 integrin antibodies (e.g. vedolizumab), anti-IL6 antibodies (e.g. tocilizumab), anti-IL2R antibodies (e.g. basilixumab), anti-CD25 antibodies (e.g. daclizumab), anti-TNFRs / TNFR-Fc molecules (e.g. etanercept, adalimumab, infliximab, golimumab or certolizumab pegol) and Vedrostat.

[0633] In one embodiment, there is provided a composition or kit for treating and/or preventing a OX40L-mediated condition or disease, the composition or kit comprising an antibody or fragment of the invention in combination with a further therapeutic agent optionally in combination with a label or instructions for use to treat and/or prevent said disease or condition in a human; optionally wherein the label or instructions comprise a marketing authorisation number (e.g., an FDA or EMA authorisation number); optionally wherein the kit comprises an IV or injection device that comprises the antibody or fragment.

[0634] The composition may be as described in aspect 105, 106 or 107 herein. Exemplars for use in pharmaceutical formulations are well-known to the skilled person and may be as defined on page 97 herein, or in the section entitled "Pharmaceutical Compositions" beginning on page 118 herein, or in the section entitled "Methods of Administration and Dosing" beginning on page 130 herein.

[0635] Concept 154. A method, an antibody or fragment for the use, a composition for the use, the use or the composition according to any preceding concept, wherein the further therapeutic agent is independently selected from the group consisting of rapamycin (sirolimus), tacrolimus, ciclosporin, corticosteroids (e.g. methylprednisolone), methotrexate, mycophenolate mofetil, anti-CD28 antibodies, CTLA4-Fc molecules (e.g. abatacept), anti-CD40L antibodies, anti-LFA1 antibodies, anti-CD52 antibodies (e.g. alemtuzumab), cyclophosphamide and anti-thymocyte globulins.

[0636] Other combinations may be with the anti-inflammatory drugs described in aspect 46 herein, or as described in aspect 100. Other combinations are as described in concepts 81 to 83 hereinabove, or in any of concepts 101 to 153 hereinabove.

[0637] Concept 155. A method, an antibody or fragment for the use, a composition for the use, the use or the composition according to any preceding concept, further comprising administering to the human a therapeutically effective amount, or a prophylactically effective amount, of a further therapeutic agent independently selected from the group consisting of rapamycin, tacrolimus, ciclosporin, cyclophosphamide, corticosteroids (e.g. methylprednisolone), methotrexate or mycophenolate mofetil, anti-CD28 antibodies, CTLA4-Fc molecules (e.g. abatacept) and anti-thymocyte globulins.

[0638] Concept 156. A method, an antibody or fragment for the use, a composition for the use, the use or the composition according to any preceding concept, further comprising administering to the human a therapeutically effective amount, or a prophylactically effective amount of a further therapeutic agent independently selected from the group consisting of rapamycin, tacrolimus, ciclosporin, cyclophosphamide, corticosteroids (e.g. methylprednisolone), methotrexate and mycophenolate mofetil.

[0639] Concept 157. A method, an antibody or fragment for the use, a composition for the use, the use or the composition according to any preceding concept, further comprising administering to the human a therapeutically effective amount, or a prophylactically effective amount of a further therapeutic agent independently selected from the group consisting of an immunosuppressant that modulate IL-2 signalling (e.g. tacrolimus, ciclosporin, rapamycin (sirolimus), and anti-CD25 antibodies (e.g. basilixumab, daclizumab).

[0640] Concept 158. A method, an antibody or fragment for the use, a composition for the use, the use or the composition according according to any preceding concept, further comprising administering to the human a therapeutically effective amount, or a prophylactically effective amount of a further therapeutic agent independently selected from the group consisting of calcineurin inhibitors (e.g. tacrolimus, ciclosporin), mTOR inhibitors (e.g. rapamycin (sirolimus), and antiproliferative agents (e.g. mycophenolate mofetil, cyclophosphamide).

[0641] Concept 159. A method, an antibody or fragment for the use, a composition for the use, the use or the composition according to any preceding concept, further comprising administering to the human a therapeutically effective amount, or a prophylactically effective amount of rapamycin.

[0642] Concept 160. A method, an antibody or fragment for the use, a composition for the use, the use or the composition according to any preceding concept, further comprising administering to the human a therapeutically effective amount, or a prophylactically effective amount of tacrolimus.

[0643] Concept 161. A method, an antibody or fragment for the use, a composition for the use, the use or the composition according to any preceding concept, further comprising administering to the human a therapeutically effective amount, or a prophylactically effective amount of ciclosporin and methotrexate.

[0644] Concept 162. A method, an antibody or fragment for the use, a composition for the use, the use or the composition according to any preceding concept, further comprising administering to the human a therapeutically effective amount, or a prophylactically effective amount of ciclosporin.

[0645] Concept 163. A method, an antibody or fragment for the use, a composition for the use, the use or the composition according to any preceding concept, further comprising administering to the human a therapeutically effective amount, or a prophylactically effective amount of ciclosporin and methotrexate.

[0646] Concept 164. A method, an antibody or fragment for the use, a composition for the use, the use or the composition according to any preceding concept, further comprising administering to the human a therapeutically effective amount, or a prophylactically effective amount of cyclophosphamide.

[0647] Concept 165. A method, an antibody or fragment for the use, a composition for the use, the use or the composition according to any preceding concept, further comprising administering to the human a therapeutically effective amount, or a prophylactically effective amount of mycophenolate mofetil.

[0648] Concept 166. A method, an antibody or fragment for the use, a composition for the use, the use or the composition according to any preceding concept, further comprising administering to the human a therapeutically effective amount, or a prophylactically effective amount of a corticosteroid (e.g. methyl prednisolone).

[0649] Concept 167. A method, an antibody or fragment for the use, a composition for the use, the use or the composition according to any preceding concept, wherein the further therapeutic agent is administered sequentially or simultaneously with the anti-OX40L antibody or fragment.

[0650] As explained in the examples, the inventors devised a set of criteria that is particularly useful for identifying antibodies and fragments of the invention, these criteria being:-

1. (a) The ability of the antibody or fragment to bind cell-surface hOX40L on CHO-3 cells (optionally transfected with full length human OX40L) and/or bind recombinant hOX40L in a **HTFRF** assay;
2. (b) The ability of the antibody or fragment to neutralise human OX40L (e.g. neutralise human OX40L binding to human OX40 receptor) in a receptor neutralisation **HTFRF** assay and/or a flow cytometry receptor neutralisation assay; and
3. (c) The ability of the antibody or fragment to specifically bind both human and rhesus monkey OX40L (useful so that the PK, PD, efficacy and other parameters of the antibody or fragment can be assessed in the rhesus model as a surrogate for humans).

[0651] Thus, in an example of the invention the antibody or fragment meets criteria (a), (b) and (c).

[0652] In an example, criterion (a) is set so that the antibody or fragment shows <70% receptor binding by **FAICS** to hOX40L expressed by CHO-3 cells.

[0653] In an example, criterion (a) is set so that the antibody or fragment shows <90% of receptor binding to OX40L in the **HTFRF** assay.

[0654] In an example, criterion (a) is set so that the antibody or fragment shows at least a 20% effect in the **HTFRF** assay.

[0655] In an example, OX40 is used in criterion (b).

[0656] In an embodiment, assaying or testing of an antibody or fragment of the invention is carried out at or substantially at pH7 (e.g., for *in vitro* tests and assays) and at or substantially at rtp.

[0657] Optionally, the antibody or fragment specifically binds hOX40L with an affinity (apparent affinity, K_D) of less than 1 microm, 1000 nM to 100 nM, 100 nM to 10 nM, 10 nM to 1 nM, 1000 pM to 500 pM, 500 pM to 200 pM, less than 200 pM, 200 pM to 150 pM, 200 pM to 100 pM, 100 pM to 10 pM, 10 pM to 1 pM, e.g., in the range of 1nM to 1pM (e.g., 1nM to 100pM, 10nM to 100pM, 1nM to 10pM, or 100pM to 1pM) as determined by SPR, e.g., under SPR conditions disclosed herein). Additionally or alternatively, the antibody or fragment specifically binds rhesus monkey OX40L with an affinity (apparent affinity, K_D) of less than 1 microm, 1000 nM to 100 nM, 10 nM to 10 nM, 1000 pM to 500 pM, 500 pM to 200 pM, less than 200 pM, 200 pM to 150 pM, 200 pM to 100 pM, 100 pM to 10 pM, 10 pM to 1 pM, e.g., in the range of 1nM to 1pM (e.g., 1nM to 100pM, 10nM to 100pM, 1nM to 10pM, or 100pM to 1pM) as determined by SPR, e.g., under SPR conditions disclosed herein). Such binding measurements can be made using a variety of binding assays known in the art, e.g., using surface plasmon resonance (SPR), such as by Biacore™ or using the ProteOn XPR36™ (Bio-Rad®), using KinExa® (Sepidyne Instruments, Inc), or using ForteBio Octet (Pall ForteBio Corp.).

[0658] OX40L binding ability, specificity and affinity (K_D , $K_{1/2}$ and/or $K_{0.5}$) can be determined by any routine method in the art, e.g., by surface plasman resonance (SPR). The term " K_D ", as used herein, is intended to refer to the equilibrium dissociation constant of a particular antibody-antigen interaction.

[0659] In one embodiment, the surface plasmon resonance (SPR) is carried out at 25°C. In another embodiment, the SPR is carried out at 37°C.

[0660] In one embodiment, the SPR is carried out at physiological pH, such as about pH7 or at pH7.6 (e.g., using HEPES buffered saline at pH7.6 (also referred to as HBS-EP)).

[0661] In one embodiment, the SPR is carried out at a physiological salt level, e.g., 150mM NaCl.

[0662] In one embodiment, the SPR is carried out at a detergent level of no greater than 0.05% by volume, e.g., in the presence of P20 (polyoxybate 20; e.g., Tween-20™) at 0.05% and EDTA at 3mM.

[0663] In one example, the SPR is carried out at 25°C or 37°C in a buffer at pH7.6, 150mM NaCl, 0.05% detergent (e.g., P20) and 3mM EDTA. The buffer can contain 10mM HEPES. In one example, the SPR is carried out at 25°C or 37°C in HBS-EP. HBS-EP is available from Teknova Inc (California; catalogue number H0022).

[0664] In an example, the affinity of the antibody or fragment is determined using SPR by

1. Coupling anti-mouse (or other relevant human, rat or non-human vertebrate antibody constant region species-matched) IgG (e.g., Biacore™ BR-1009-36) to a biosensor chip (e.g., GLM chip) such as by primary amine coupling;
2. Exposing the anti-mouse IgG (or other matched species antibody) to a test IgG antibody to capture test antibody on the chip;
3. Passing the test antigen over the chip's capture surface at 1024nM, 256nM, 64nM, 16nM, 4nM with a 0nM (i.e. buffer alone); and
4. And determining the affinity of binding of test antibody to test antigen using surface plasmon resonance, e.g., under an SPR condition discussed above (e.g., at 25°C in physiological buffer). SPR can be carried out using any standard SPR apparatus, such as by Biacore™ or using the ProteOn XPR36™ (Bio-Rad®).

[0665] Regeneration of the capture surface can be carried out with 10mM glycine at pH1.7. This removes the captured antibody and allows the surface to be used for another interaction. The binding data can be fitted to 1:1 model inherent using standard techniques, e.g., using a model inherent to the ProteOn XPR36™ analysis software.

[0666] In an example, the antibody or fragment of the invention is contained in a medical container, e.g., a viral, syringe, IV container or an injection device (e.g., an intracocular or intravitreal injection device). In an example, the antibody or fragment is *in vitro*, e.g., in a sterile container. In an example, the invention provides a kit comprising the antibody or fragment of the invention, packaging and instructions for use in treating or preventing or diagnosing in a human a disease or condition mediated by the OX40L. In an example, the instructions indicate that the human should be genotyped for an OX40L variant sequence of the invention before administering the antibody or fragment to the human. In an example, the instructions indicate that the human should be phenotyped for an OX40L variant of the invention before administering the antibody or fragment to the human. In an example, the human is of Chinese (e.g., Han or CHS) ethnicity and the instructions are in Chinese (e.g., Mandarin).

[0667] In an example the binding site(s) of the antibody or fragment are selected from a plurality (e.g., library) of binding sites. For example, the plurality of binding sites comprises or consists of a plurality of 4-chain antibodies or fragments thereof, e.g., dAbs, Fab's or scFvs. Suitable methods for producing pluralities of binding sites for screening include phage display (producing a phage display library of antibody binding sites), ribosome display (producing a ribosome display library of antibody binding sites), yeast display (producing a yeast display library of antibody binding sites), or immunisation of a non-human vertebrate (e.g., a rodent, e.g., a mouse or rat, e.g., a Velocmouse™, Xymouse™, Alva Mouse™, HuMab Mouse™, Omnimouse™, Omnitrac™ or MeMo Mouse™) with hOX40L or a hOX40L epitope and isolation of a repertoire of antibody-producing cells (e.g., a B-cell, plasma cell or plasmablast repertoire) and/or a repertoire of isolated antibodies, fragments or binding sites.

[0668] The term "epitope" is a region of an antigen that is bound by an antibody or fragment. Epitopes may be defined as structural or functional. Functional epitopes are generally a subset of the structural epitopes and have those residues that directly contribute to the affinity of the interaction. Epitopes may also be conformational, that is, composed of non-linear amino acids. In certain embodiments, epitopes may include determinants that are chemically active surface groupings of molecules such as amino acids, sugar side chains, phosphoryl groups, or sulfanyl groups, and, in certain embodiments, may have specific three-dimensional structural characteristics, and/or specific charge characteristics.

[0669] The term "isolated" with reference to any aspect of the invention, e.g., an antibody or fragment, means that a subject antibody or fragment etc. (1) is free of at least some other proteins with which it would normally be found, (2) is essentially free of other proteins from the same source, e.g., from the same

species, (3) is expressed by a cell from a different species, (4) has been separated from at least about 50 percent of polynucleotides, lipids, carbohydrates, or other materials with which it is associated in nature, (5) is operably associated (by covalent or noncovalent interaction) with a polypeptide with which it is not associated in nature, or (6) does not occur in nature. Typically, an "isolated" antibody, fragment, etc. consists of at least about 5%, at least about 10%, at least about 25%, or at least about 50%, 60%, 70%, 80%, 85%, 90%, 92%, 95%, 97%, 98%, 99% or 99.9% of a given sample. Genomic DNA, cDNA, mRNA or other RNA, of synthetic origin, or any combination thereof can encode such an isolated antibody, fragment, etc. Preferably, the isolated antibody, fragment, etc. is substantially free from proteins or polypeptides or other contaminants that are found in its natural environment that would interfere with its therapeutic, diagnostic, prophylactic, research or other use.

[0670] For example, an "isolated" antibody is one that has been identified, separated and/or recovered from a component of its production environment (e.g., naturally or recombinantly). Preferably, the isolated polypeptide is free of association with all other components from its production environment, e.g., so that the antibody has been isolated to an FDA-approvable or approved standard. Contaminant components of its production environment, such as that resulting from recombinant transfected cells, are materials that would typically interfere with research, diagnostic or therapeutic uses for the antibody, and may include enzymes, hormones, and other proteinaceous or non-proteinaceous solutes. In preferred embodiments, the polypeptide will be purified: (1) to greater than 95% by weight of antibody as determined by, for example, the Lowry method, and in some embodiments, to greater than 99% by weight; (2) to a degree sufficient to obtain at least 15 residues of N-terminal or internal amino acid sequence by use of a spinning cup sequenator, or (3) to homogeneity by SDS-PAGE under non-reducing or reducing conditions using Coomassie blue or, preferably, silver stain. Isolated antibody includes the antibody *in situ* within recombinant cells since at least one component of the antibody's natural environment will not be present. Ordinarily, however, an isolated polypeptide or antibody will be prepared by at least one purification step.

Immunocongulates

[0671] The invention encompasses the antibody or fragment conjugated to a therapeutic moiety ("immunoconguate"), such as a cytotoxin, a chemotherapeutic drug, an immunosuppressant or a radioisotope. Cytotoxin agents include any agent that is detrimental to cells. Examples of suitable cytotoxin agents and chemotherapeutic agents for forming immunoconguates are known in the art, see for example, WO 95/030361.

Bispecifics

[0672] The antibodies and fragments of the present invention may be monospecific, bispecific, or multispecific. Multispecific mAbs may be specific for different epitopes of one target polypeptide or may contain antigen-binding domains specific for more than one target polypeptide. See, e.g., Tutt *et al.*, (1991) *J. Immunol.* 147:60-69. The human anti-hOX40L antibodies or fragments can be linked to or co-expressed with another functional molecule, e.g., anther peptide or protein. For example, an antibody or fragment thereof can be functionally linked (e.g., by chemical coupling, genetic fusion, noncovalent association or otherwise) to one or more other molecular entities, such as another antibody or antibody fragment, to produce a bispecific or a multispecific antibody with a second binding specificity.

[0673] An exemplary bispecific antibody format that can be used in the context of the present invention involves the use of a first immunoglobulin (Ig) CH3 domain and a second Ig CH3 domain, wherein the first and second Ig CH3 domains differ from one another by at least one amino acid, and wherein at least one amino acid difference reduces binding of the bispecific antibody to Protein A as compared to a bispecific antibody lacking the amino acid difference. In one embodiment, the first Ig CH3 domain binds Protein A and the second Ig CH3 domain contains a mutation that reduces or abolishes Protein A binding such as an H95R modification (by IMGT exon numbering; H35R by EU numbering). The second CH3 may further comprise a Y429F modification (by IMGT; Y436F by EU). Further modifications that may be found within the second CH3 domain are described by, for example, the Lowy method, and in some embodiments, to greater than 95% by weight; (2) to a degree sufficient to obtain at least 15 residues of N-terminal or internal amino acid sequence by use of a spinning cup sequenator, or (3) to homogeneity by SDS-PAGE under non-reducing or reducing conditions using Coomassie blue or, preferably, silver stain. Isolated antibody includes the antibody *in situ* within recombinant cells since at least one component of the antibody's natural environment will not be present. Ordinarily, however, an isolated polypeptide or antibody will be prepared by at least one purification step.

[0674] In certain embodiments, the antibody or OX40L binding fragment thereof comprises less than six CDRs. In some embodiments, the antibody or antigen binding fragment thereof comprises or consists of one, two, three, four, or five CDRs selected from the group consisting of HCDR1, HCDR2, HCDR3, LCDR1, LCDR2, and LCDR3. In specific embodiments, the antibody or antigen binding fragment thereof comprises or consists of one, two, three, four, or five CDRs selected from the group consisting of the HCDR1, HCDR2, HCDR3, LCDR1, LCDR2, and LCDR3 sequences in the sequence listing (i.e., Seq ID No.4, Seq ID No.6, Seq ID No.8, Seq ID No.10, Seq ID No.12, Seq ID No.14, Seq ID No.16, Seq ID No.18, Seq ID No.20, Seq ID No.22, Seq ID No.24, Seq ID No.26, Seq ID No.28, Seq ID No.30, Seq ID No.32, Seq ID No.34, Seq ID No.36, Seq ID No.38, Seq ID No.40, Seq ID No.42, Seq ID No.44, Seq ID No.46, Seq ID No.48, Seq ID No.50, Seq ID No.52, Seq ID No.54, Seq ID No.56, Seq ID No.58, Seq ID No.60, Seq ID No.62, Seq ID No.64, Seq ID No.66, Seq ID No.68, Seq ID No.70, Seq ID No.72, Seq ID No.74, Seq ID No.76, Seq ID No.78, Seq ID No.80, Seq ID No.82, Seq ID No.84, Seq ID No.86, Seq ID No.88, Seq ID No.90, Seq ID No.92, Seq ID No.94, Seq ID No.96, Seq ID No.98, Seq ID No.100, Seq ID No.102, Seq ID No.104, Seq ID No.106, Seq ID No.108, Seq ID No.110, Seq ID No.112, Seq ID No.114, Seq ID No.116, Seq ID No.118, Seq ID No.120, Seq ID No.122, Seq ID No.124, Seq ID No.126, Seq ID No.128, Seq ID No.130, Seq ID No.132, Seq ID No.134, Seq ID No.136, Seq ID No.138, Seq ID No.140, Seq ID No.142, Seq ID No.144, Seq ID No.146, Seq ID No.148, Seq ID No.150, Seq ID No.152, Seq ID No.154, Seq ID No.156, Seq ID No.158, Seq ID No.160, Seq ID No.162, Seq ID No.164, Seq ID No.166, Seq ID No.168, Seq ID No.170, Seq ID No.172, Seq ID No.174, Seq ID No.176, Seq ID No.178, Seq ID No.180, Seq ID No.182, Seq ID No.184, Seq ID No.186, Seq ID No.188, Seq ID No.190, Seq ID No.192, Seq ID No.194, Seq ID No.196, Seq ID No.198, Seq ID No.200, Seq ID No.202, Seq ID No.204, Seq ID No.206, Seq ID No.208, Seq ID No.210, Seq ID No.212, Seq ID No.214, Seq ID No.216, Seq ID No.218, Seq ID No.220, Seq ID No.222, Seq ID No.224, Seq ID No.226, Seq ID No.228, Seq ID No.230, Seq ID No.232, Seq ID No.234, Seq ID No.236, Seq ID No.238, Seq ID No.240, 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Proteins of Immunological Interest, Fifth Edition, U.S. Department of Health and Human Services, **NH** Publication No. 91-3242). Exemplary methods of producing fully human antibodies are provided, e.g., in the Examples herein, but any method known in the art may be used.

[0600] The phrase "recombinant human antibody" includes human antibodies that are prepared, expressed, created or isolated by recombinant means, such as antibodies expressed using a recombinant expression vector transfected into a host cell, antibodies isolated from a recombinant, combinatorial human antibody library, antibodies prepared from an animal (e.g., a mouse or cow) that is transgenic and/or transdomesomal for human immunoglobulin genes (see e.g., Taylor, L. D. et al., (1992) *Nucl. Acids Res.* 20:6287-6295) or antibodies prepared, expressed, created or isolated by any other means that involves splicing of human immunoglobulin gene sequences to other DNA sequences. Such recombinant human antibodies can have variable and constant regions derived from human germline immunoglobulin sequences (See Kabat, E.A. et al. (1991) *Sequences of Proteins of Immunological Interest*, Fifth Edition, U.S. Department of Health and Human Services, **NH** Publication No. 91-3242). In certain embodiments, however, such recombinant human antibodies are subjected to *in vitro* mutagenesis (or, when an animal transgenic for human Ig sequences is used, *in vivo* somatic mutagenesis) and thus the amino acid sequences of the VH and VL regions of the recombinant antibodies are sequences that, while derived from and related to human germline VH and VL sequences, may not naturally exist within the human antibody germline repertoire *in vivo*.

[0601] The term "fusion protein" as used herein refers to a polypeptide that comprises an amino acid sequence of an antibody and an amino acid sequence of a heterologous polypeptide or protein (i.e., a polypeptide or protein not normally a part of the antibody (e.g., a non-anti-hOX40L antigen antibody)). The term "fusion" when used in relation to hOX40L, or to an anti-hOX40L antibody, or fragment, variant and/or derivative thereof, is used in the context of a heterologous peptide or polypeptide. Preferably, the fusion protein retains the biological activity of the hOX40L, or anti-hOX40L, antibody. In certain embodiments, the fusion protein comprises a hOX40L antibody VH domain, VL domain, VH CDR (one, two or three VH CDRs), and/or VL CDR (one, two or three VL CDRs), wherein the fusion protein specifically binds to a hOX40L epitope.

[0602] The term "heavy chain" when used in reference to an antibody refers to five distinct types, called alpha (α), delta (δ), epsilon (ϵ), gamma (γ) and mu (μ). These distinct types of heavy chains are well known and give rise to five classes of antibodies, IgA, IgD, IgE, IgG and IgM, respectively, including four subclasses of IgG, namely IgG1, IgG1, IgG3 and IgG4. Preferably the heavy chain is a human heavy chain. In one example, the heavy chain is a disabled IgG isotype, e.g. a disabled IgG4. In certain embodiments, the antibodies of the invention comprise a human gamma constant region. In another embodiment, the heavy chain constant region does not bind Fc γ receptors, and e.g. comprises a Leu253Glu mutation. In another embodiment, the heavy chain constant region comprises a Ser228Pro mutation to increase stability. In another embodiment, the heavy chain constant region is IgG4-FE.

[0603] The term "host" as used herein refers to an animal, preferably a mammal, and most preferably a human.

[0604] The term "host cell" as used herein refers to the particular subject cell transfected with a nucleic acid molecule and the progeny or potential progeny of such a cell. Progeny of such a cell may not be identical to the parent cell transfected with the nucleic acid molecule due to mutations or environmental influences that may occur in succeeding generations or integration of the nucleic acid molecule into the host cell genome.

[0605] The term "immunomodulatory agent" and variations thereof including, but not limited to, immunomodulatory agents, as used herein refer to an agent that modulates a host's immune system. In certain embodiments, an immunomodulatory agent is an immunosuppressant agent. In certain other embodiments, an immunomodulatory agent is an immunostimulatory agent. In accordance with the invention, an immunomodulatory agent used in the combination therapies of the invention does not include an anti-hOX40L antibody or antigen-binding fragment. Immunomodulatory agents include, but are not limited to, small molecules, peptides, polypeptides, proteins, fusion proteins, antibodies, inorganic molecules, mimetic agents, and organic molecules.

[0606] As used herein, the term "in combination" in the context of the administration of other therapies refers to the use of more than one therapy. The use of the term "in combination" does not restrict the order in which therapies are administered to a subject with a disease. A first therapy can be administered before (e.g., 1 minute, 45 minutes, 30 minutes, 45 minutes, 1 hour, 2 hours, 4 hours, 6 hours, 12 hours, 24 hours, 48 hours, 72 hours, 96 hours, 1 week, 2 weeks, 3 weeks, 4 weeks, 5 weeks, 6 weeks, 8 weeks, or 12 weeks), concurrently, or after (e.g., 1 minute, 45 minutes, 30 minutes, 45 minutes, 1 hour, 2 hours, 4 hours, 6 hours, 12 hours, 24 hours, 48 hours, 72 hours, 96 hours, 1 week, 2 weeks, 3 weeks, 4 weeks, 5 weeks, 6 weeks, 8 weeks, or 12 weeks) the administration of a second therapy to a subject which had, has, or is susceptible to a hOX40L-mediated disease. Any additional therapy can be administered in any order with the other additional therapies. In certain embodiments, the antibodies of the invention can be administered in combination with one or more therapies (e.g., therapies that are not the antibodies of the invention that are currently administered to prevent, treat, manage, and/or ameliorate a hOX40L-mediated disease. Non-limiting examples of therapies that can be administered in combination with an antibody of the invention include anesthetic agents, anesthetic agents, antibiotics, or immunomodulatory agents or any other agent listed in the U.S. Pharmacopeia and/or Physician's Desk Reference.

[0607] An "isolated" or "purified" antibody is for example substantially free of cellular material or other contaminating proteins from the cell or tissue source from which the antibody is derived, or substantially free of chemical precursors or other chemicals when chemically synthesized. The language "substantially free of cellular material" includes preparations of an antibody in which the antibody is separated from cellular components of the cells from which it is isolated or recombinantly produced. Thus, an antibody that is substantially free of cellular material includes preparations of antibody having less than about 30%, 20%, 10%, or 5% (by dry weight) of heterologous protein (also referred to herein as a "contaminating protein"). When the antibody is recombinantly produced, it is also preferably substantially free of culture medium, i.e., culture medium represents less than about 20%, 10%, or 5% of the volume of the protein preparation. When the antibody is produced by chemical synthesis, it is preferably substantially free of chemical precursors or other chemicals, i.e., it is separated from chemical precursors or other chemicals which are involved in the synthesis of the protein. Accordingly such preparations of the antibody have less than about 30%, 20%, 10%, 5% (by dry weight) of chemical precursors or compounds other than the antibody of interest. In a preferred embodiment, antibodies of the invention are isolated or purified.

[0608] An "isolated" nucleic acid molecule is one which is separated from other nucleic acid molecules which are present in the natural source of the nucleic acid molecule. Moreover, an "isolated" nucleic acid molecule, such as a cDNA molecule, can be substantially free of other cellular material, or culture medium when produced by recombinant techniques, or substantially free of chemical precursors or other chemicals when chemically synthesized. In a specific embodiment, a nucleic acid molecule(s) encoding an antibody of the invention is isolated or purified.

[0609] The term "human OX40L," "hOX40L," or "hOX40L polypeptide" and similar terms refers to the polypeptides ("polypeptides," "peptides" and "proteins" are used interchangeably herein) comprising the amino acid sequence in the sequence listing and related polypeptides, including SNP variants thereof. Related polypeptides include allelic variants (e.g., SNP variants); splice variants; fragments; derivatives; substitution, deletion, and insertion variants; fusion polypeptides; and interspecies homologs, preferably, which retain hOX40L activity and/or are sufficient to generate an anti-hOX40L immune response. Also encompassed are soluble forms of hOX40L which are sufficient to generate an anti-hOX40L immunological response. As those skilled in the art will appreciate, an anti-hOX40L antibody of the invention can bind to a hOX40L polypeptide, polypeptide fragment, antigen, and/or epitope, as an epitope is part of the larger antigen, which is part of the larger polypeptide fragment, which, in turn, is part of the larger polypeptide hOX40L, can exist in a trimeric (native) or monomeric (denatured) form.

[0610] The terms "Kabat numbering," and like terms are recognized in the art and refer to a system of numbering amino acid residues which are more variable (i.e., hypervariable) than other amino acid residues in the heavy chain variable regions of an antibody, or an antigen binding portion thereof (Kabat et al. (1971) *Ann. NY Acad. Sci.* 190:382-391 and Kabat et al. (1991) *Sequences of Proteins of Immunological Interest*, Fifth Edition, U.S. Department of Health and Human Services, **NH** Publication No. 91-3242). For the heavy chain variable region, the hypervariable region typically ranges from amino acid positions 31 to 35 for CDR1, amino acid positions 50 to 65 for CDR2, and amino acid positions 95 to 102 for CDR3.

[0611] The term "monoclonal antibody" refers to an antibody obtained from a population of homogeneous or substantially homogeneous antibodies, and each monoclonal antibody will typically recognize a single epitope on the antigen. In preferred embodiments, a "monoclonal antibody," as used herein, is an antibody produced by a single hybridoma or other cell, wherein the antibody specifically binds to only a hOX40L epitope as determined, e.g., by ELISA or other antigen-binding or competitive binding assay known in the art or in the Examples provided herein. The term "monoclonal" is not limited to any particular method for making the antibody. For example, monoclonal antibodies of the invention may be made by the hybridoma method as described in Kohler et al.; *Nature*, 256:495 (1975) or may be isolated from phage libraries using the techniques as described herein, for example. Other methods for the preparation of clonal cell lines and of monoclonal antibodies expressed thereby are well known in the art (see, for example, Chapter 11 in: *Short Protocols in Molecular Biology*, (2002) 5th Ed., Ausubel et al., eds., John Wiley and Sons, New York). Other exemplary methods of producing other monoclonal antibodies are provided in the Examples herein.

[0612] The term "naturally occurring" or "native" when used in connection with biological materials such as nucleic acid molecules, polypeptides, host cells, and the like, refers to those which are found in nature and not manipulated by a human being.

[0613] The term "pharmaceutically acceptable" as used herein means being approved by a regulatory agency of the Federal or a state government, or listed in the U.S. Pharmacopeia, European Pharmacopeia or other generally recognized Pharmacopeia for use in animals, and more particularly in humans.

[0614] "Polyclonal antibodies" as used herein refers to an antibody population generated in an immunogenic response to a protein having many epitopes and thus includes a variety of different antibodies directed to the same and to different epitopes within the protein. Methods for producing polyclonal antibodies are known in the art (See, e.g., see, for example, Chapter 11 in: *Short Protocols in Molecular Biology*, (2002) 5th Ed., Ausubel et al., eds., John Wiley and Sons, New York).

[0615] As used herein, the term "polynucleotide," "nucleotide," nucleic acid "nucleic acid molecule" and other similar terms are used interchangeably and include DNA, RNA, mRNA and the like.

[0616] As used herein, the terms "prevent," "preventing," and "prevention" refer to the total or partial inhibition of the development, recurrence, onset or spread of a hOX40L-mediated disease and/or symptom related thereto, resulting from the administration of a therapy or combination of therapies provided herein (e.g., a combination of prophylactic or therapeutic agents, such as an antibody of the invention).

[0617] As used herein, the term "prophylactic agent" refers to any agent that can totally or partially inhibit the development, recurrence, onset or spread of a hOX40L-mediated disease and/or symptom related thereto in a subject. In certain embodiments, the term "prophylactic agent" refers to an antibody of the invention. In certain other embodiments, the term "prophylactic agent" refers to an agent other than an antibody of the invention. Preferably, a prophylactic agent is an agent which is known to be useful for, or has been or is currently being used to prevent a hOX40L-mediated disease and/or symptom related thereto or impede the onset, development, progression and/or severity of a hOX40L-mediated disease and/or a symptom related thereto. In specific embodiments, the prophylactic agent is a fully human anti-hOX40L antibody, such as a fully human anti-hOX40L monoclonal antibody.

[0618] In an embodiment, the prophylaxis prevents the onset of the disease or condition or of the symptoms of the disease or condition. In one embodiment, the prophylactic treatment prevents the worsening, or onset, of the disease or condition. In one embodiment, the prophylactic treatment prevents the worsening of the disease or condition.

[0619] In another embodiment, an anti-hOX40L antibody of the invention is administered intravenously (e.g. before or concomitantly with a transplant, e.g. blood or organ transplant). In another embodiment, said antibody is administered at a dose of about 5-10 mg/kg (e.g. at about 8 mg/kg). In another embodiment, said antibody is administered at a dose selected from about 0.1 mg/kg, about 0.5 mg/kg, about 1 mg/kg, 3 mg/kg, 5 mg/kg, about 10 mg/kg, about 15 mg/kg, about 20 mg/kg, about 25 mg/kg, about 30 mg/kg, about 40 mg/kg, about 50 mg/kg, about 60 mg/kg, about 70 mg/kg, about 80 mg/kg about 90 mg/kg or about 100 mg/kg, in particular about 1 mg/kg, or about 3 mg/kg.

[0620] In another embodiment, said antibody is administered 1-4 days before transplant (e.g. of blood or organs), e.g. 1-3 days before transplant or 1-2 days before transplant. In another embodiment, said antibody is administered weekly, bi-weekly or monthly following transplant, e.g. bi-weekly. In a further embodiment, said antibody is administered intravenously prophylactically 1-3 days before transplant at a dose of about 5-10 mg/kg (e.g. about 8 mg/kg) and then intravenously, bi-weekly at a dose of about 5-10 mg/kg (e.g. about 8 mg/kg).

[0621] In another embodiment, the patient is monitored periodically post-transplant, for the presence of a biomarker predictive for the development of transplant rejection or of GvHD (e.g. acute GvHD), and the anti-hOX40L antibody of the invention is administered once the biomarker levels are such that the patient is determined to be at risk of developing transplant rejection or of GvHD (e.g. acute GvHD). This strategy would avoid unnecessary dosing of drug and unnecessary suppression of the immune system. Examples of biomarkers which may be useful as predictive biomarkers of acute GvHD may be those identified in Levine et al., "A prognostic score for acute graft-versus-host disease based on biomarkers: a multicenter study", *Lancet Haematol* 2015; 2:e21-29. These biomarkers include, but are not limited to TNFR1, ST-2, elafin and IL2Ra and Reg3a.

[0622] A region of a hOX40L contributing to an epitope may be contiguous amino acids of the polypeptide or the epitope may come together from two or more non-contiguous regions of the polypeptide. The epitope may or may not be a three-dimensional surface feature of the antigen. A localized region on the surface of a hOX40L antigen that is capable of eliciting an immune response is a hOX40L epitope. The epitope may or may not be a three-dimensional surface feature of the antigen.

[0623] A "hOX40L-mediated disease" and "hOX40L-mediated condition" are used interchangeably and refer to any disease or condition that is completely or partially caused by or is the result of hOX40L. In certain embodiments, hOX40L is aberrantly (e.g., highly) expressed on the surface of a cell. In some embodiments, hOX40L may be aberrantly upregulated on a particular cell type. In other embodiments, normal, aberrant or excessive cell signaling is caused by binding of hOX40L to a hOX40L ligand. In certain embodiments, the hOX40L ligand is OX40, for example, that is expressed on the surface of a cell, such as a colonic epithelial cell. In certain embodiments, the hOX40L-mediated disease is an inflammatory bowel disease (IBD), such as Crohn's disease (CD) or ulcerative colitis (UC). In other embodiments, the hOX40L-mediated disease or condition selected from a hOX40L-mediated disease or condition selected from Crohn's disease or ulcerative colitis (UC). In other embodiments, a hOX40L mediated disease or condition selected from an autoimmune disease or condition, a systemic inflammatory disease or condition, or transplant rejection, for example inflammatory bowel disease (IBD), Crohn's disease, rheumatoid arthritis, transplant rejection, allogeneic transplant rejection, graft-versus-host disease (GvHD), ulcerative colitis, systemic lupus erythematosus (SLE), diabetes, uveitis, ankylosing spondylitis, contact hypersensitivity, multiple sclerosis and atherosclerosis, in particular GvHD.

[0624] The terms "hOX40L receptor" or "hOX40L binding receptor" are used interchangeably herein and refer to a receptor polypeptide that binds to hOX40L. In specific embodiments, the hOX40L receptor is Hsx40. In some embodiments, the hOX40L receptor is expressed on the surface of a cell, such as a colonic epithelial cell, or on graft or transplant tissue or on host tissue.

[0625] As used herein, the terms "subject" and "patient" are used interchangeably. As used herein, a subject is preferably a mammal such as a non-primate (e.g., cows, pigs, horses, cats, dogs, rats, etc.) or a primate (e.g., monkey and human), most preferably a human. In one embodiment, the subject is a mammal, preferably a human, having a hOX40L-mediated disease. In another embodiment, the subject is a mammal, preferably a human, at risk of developing a hOX40L-mediated disease.

[0626] As used herein "substantially all" refers to refers to at least about 60%, at least about 70%, at least about 75%, at least about 80%, at least about 85%, at least about 90%, at least about 95%, at least about 96%, at least about 98%, or about 100%.

[0627] The term "substantially free of surfactant" as used herein refers to a formulation of an antibody that specifically binds to a hOX40L antigen, said formulation containing less than 0.0005%, less than 0.0003%, or less than 0.0001% of surfactants and/or less than 0.0005%, less than 0.0003%, or less than 0.0001% of surfactants.

[0628] The term "substantially free of salt" as used herein refers to a formulation of an antibody that specifically binds to a hOX40L antigen, said formulation containing less than 0.0005%, less than 0.0003%, or less than 0.0001% of inorganic salts.

[0629] The term "surfactant" as used herein refers to organic substances having amphiphilic structures; namely, they are composed of groups of opposing solubility tendencies, typically an oil-soluble hydrocarbon chain and a water-soluble ionic group. Surfactants can be classified, depending on the charge of the surface-active moiety, into anionic, cationic, and nonionic surfactants. Surfactants are often used as wetting, emulsifying, solubilizing, and dispersing agents for various pharmaceutical compositions and preparations of biological materials.

[0630] As used herein, the term "tag" refers to any type of moiety that is attached to, e.g., a polypeptide and/or a polynucleotide that encodes a hOX40L or hOX40L antibody or antigen binding fragment thereof. For example, a polynucleotide that encodes a hOX40L, hOX40L antibody or antigen binding fragment thereof can contain one or more additional tag-encoding nucleotide sequences that encode a, e.g., a detectable moiety or a moiety that aids in affinity purification. When translated, the tag and the antibody can be in the form of a fusion protein. The term "detectable" or "detectable" with reference to a tag refers to any tag that is capable of being visualized or wherein the presence of the tag is otherwise able to be determined and/or measured (e.g., by quantitation). A non-limiting example of a detectable tag is a fluorescent tag.

[0631] As used herein, the term "therapeutic agent" refers to any agent that can be used in the treatment, management or amelioration of a hOX40L-mediated disease and/or a symptom related thereto. In certain embodiments, the term "therapeutic agent" refers to an antibody of the invention. In certain other embodiments, the term "therapeutic agent" refers to an agent other than an antibody of the invention. Preferably, a therapeutic agent is an agent which is known to be useful for, or has been or is currently being used for the treatment, management or amelioration of a hOX40L-mediated disease or one or more symptoms related thereto. In specific embodiments, the therapeutic agent is a fully human anti-hOX40L antibody, such as a fully human anti-hOX40L monoclonal antibody.

[0632] The combination of therapies (e.g., use of prophylactic or therapeutic agents) which is more effective than the additive effects of any two or more single therapy. For example, a synergistic effect of a combination of prophylactic and/or therapeutic agents permits the use of lower dosages of one or more of the agents and/or less frequent administration of said agents to a subject with a hOX40L-mediated disease. The ability to utilize lower dosages of prophylactic or therapeutic therapies and/or to administer said therapies less frequently reduces the toxicity associated with the administration of said therapies to a subject without reducing the efficacy of said therapies in the prevention, management, treatment or amelioration of a hOX40L-mediated disease. In addition, a synergistic effect can result in improved efficacy of therapies in the prevention, or in the management, treatment or amelioration of a hOX40L-mediated disease. Finally, synergistic effect of a combination of therapies (e.g., prophylactic or therapeutic agents) may avoid or reduce adverse or unwanted side effects associated with the use of any single therapy.

[0633] In one embodiment, the combination comprises an anti-hOX40L antibody of the invention and a further therapeutic agents independently selected from the group consisting of rapamycin (sirolimus), tacrolimus, ciclosporin, corticosteroids (e.g., methylprednisolone), methotrexate, mycophenolate mofetil, anti-CD28 antibodies, anti-IL12 α -23 antibodies (e.g. ustekinumab), anti-CD28 antibodies (e.g. rhutumab), anti-CD28 antibodies (e.g. brentisumab), CTLA-4-Fc molecules (e.g. abatacept), CD28 receptor antagonists (e.g. marverox), anti-CD40L antibodies, anti-LFA1 antibodies, anti-LFA1 antibodies, anti-CD28 antibodies (e.g. adalimumab), anti-TNF α TNF α -Fc molecules (e.g. etanercept, adalimumab, golimumab or certolizumab pegol) and Virostatin. In another embodiment the combination comprises an anti-hOX40L antibody of the invention and a further therapeutic agents independently selected from the group consisting of rapamycin (sirolimus), tacrolimus, ciclosporin, corticosteroids (e.g., methylprednisolone), methotrexate, mycophenolate mofetil, anti-CD28 antibodies, CTLA-4-Fc molecules (e.g. abatacept), anti-CD40L antibodies, anti-LFA1 antibodies, anti-CD28 antibodies (e.g. adalimumab), cyclophosphamide and anti-thymocyte globulins.

[0634] In some embodiments the combination comprises an anti-hOX40L antibody of the invention and further therapeutic agents independently selected from the group consisting of calcineurin inhibitors (e.g. tacrolimus, ciclosporin), mTOR inhibitors (e.g. rapamycin (sirolimus)), and antiproliferative agents (e.g. mycophenolate mofetil, cyclophosphamide).

[0635] In further embodiments the combination comprises an anti-hOX40L antibody of the invention and further therapeutic agents independently selected from the group consisting of immunosuppressants that modulate IL-2 signalling (e.g. tacrolimus, ciclosporin, rapamycin (sirolimus), and anti-CD28 antibodies (e.g. basilixumab, daclizumab).

[0636] Without being bound by theory, it is thought that the mechanism of action of an anti-hOX40L antibody of the invention is complementary to further therapeutic agents which modulate immune function. In particular, agents that modulate IL-2 signalling or that inhibit IL-2/IL-2R-mediated T cell proliferation may synergistically combine with an anti-hOX40L antibody resulting in greater immune modulation than would be observed with either agent alone. As shown in Examples 7 and 9 herebelow, both tacrolimus and rapamycin display immune modulating activity. Tacrolimus and rapamycin are both agents which are known to modulate IL-2 signalling. In particular, rapamycin is known to act as an mTOR inhibitor, which reduces IL-2 and IL2R transcription, and inhibits cell cycle progression evoked by IL2 activation, but there may be other mechanisms on proliferation of T cells by which mTOR inhibitors may function (Thomson et al., *Nat. Rev. Immunol.*, 2005, 5(5), 324-337; Schöffel & Raza, *J. Thorac. Dis.*, 2014, 6(9), 1034-1055). Figure 6 herein shows that the mechanism of an anti-hOX40L antibody is different with regards to T cell population to both these agents, and Figure 7 shows a synergistic effect on survival of an anti-hOX40L antibody of the invention in combination with rapamycin. It is therefore thought that other agents having a similar mechanism of action to rapamycin and/or tacrolimus will also result in a synergistic effect when used in combination with the anti-hOX40L antibodies of the invention.

[0637] In one embodiment, the combination comprises an anti-hOX40L antibody of the invention and rapamycin (sirolimus).

[0646] Further, an antibody of the invention may be conjugated or recombinantly fused to a therapeutic moiety or drug moiety that modifies a given biological response. Therapeutic moieties or drug moieties are not to be construed as limited to classical chemical therapeutic agents. For example, the drug moiety may be a protein, peptide, or polypeptide possessing a desired biological activity. Such proteins may include, for example, a toxin such as abrin, ricin, A, pseudomonas exotoxin, cholera toxin, or diphtheria toxin; a protein such as tumor necrosis factor, interferon, α -interferon, nerve growth factor, platelet derived growth factor, tissue plasminogen activator, an apoptotic agent, e.g., TNF- α , AIM I (see, International Publication No. WO 97/03899), AIM II (see, International Publication No. WO 97/04911), Fas Ligand (Takahashi et al., 1994, J. Immunol., 6:1567-1574), and VEGF (see, International Publication No. WO 99/23105), an anti-angiogenic agent, e.g., angiostatin, endostatin or a component of the coagulation pathway (e.g., tissue factor); or, a biological response modifier such as, for example, a lymphokine (e.g., interferon gamma, interleukin-1 ("IL-1"), interleukin-2 ("IL-2"), interleukin-5 ("IL-5"), interleukin-6 ("IL-6"), interleukin-7 ("IL-7"), interleukin ("IL-8"), interleukin-10 ("IL-10"), interleukin-12 ("IL-12"), interleukin-15 ("IL-15"), interleukin-23 ("IL-23"), granulocyte macrophage colony stimulating factor ("GM-CSF"), and granulocyte colony stimulating factor ("G-CSF")), or a growth factor (e.g., growth hormone ("GH")), or a coagulation agent (e.g., calcium, vitamin K, tissue factors, such as but not limited to, Hageman factor (factor XII), high-molecular-weight kininogen ("HMWK"), prekallikrein (PK), coagulation protein-factors II (prothrombin), factor V, Xa, VII, XIIIa, XI, Xa, IX, Xa, IX, Xa, X, phospholipid, and fibrin monomer).

[0649] The present invention encompasses antibodies of the invention recombinantly fused or chemically conjugated (covalent or non-covalent conjugations) to a heterologous protein or polypeptide (or fragment thereof, preferably to a Fab fragment, or about 10, about 20, about 30, about 40, about 50, about 60, about 70, about 80, about 90 or about 100 amino acids) to generate fusion proteins. In particular, the invention provides fusion proteins comprising an antigen-binding fragment of an antibody of the invention (e.g., a Fab fragment, Fd fragment, Fv fragment, F(ab)2 fragment, a VH domain, a VL domain or a VL CDR) and a heterologous protein, polypeptide, or peptide. In one embodiment, the heterologous protein, polypeptide, or peptide that the antibody is fused to is useful for targeting the antibody to a particular cell type, such as a cell that expresses hOXA4L, or an hOXA4L receptor. For example, an antibody that specifically binds to a cell surface receptor expressed by a particular cell type (e.g., an immune cell) may be fused or conjugated to a modified antibody of the invention.

[0670] A conjugated or fusion protein of the invention comprises any antibody of the invention described herein and a heterologous polypeptide. In one embodiment, a conjugated or fusion protein of the invention comprises the variable domains of an antibody disclosed in the Examples and a heterologous polypeptide.

[0671] In addition, an antibody of the invention can be conjugated to therapeutic moieties such as a radioactive metal ion, such as alpha-emitters such as ^{213}Bi or macrocyclic chelators useful for conjugating radiometal ions, including but not limited to, ^{125}I , ^{131}I , ^{125}I , ^{125}I , ^{125}I , to polypeptides. In certain embodiments, the macrocyclic chelator is 1,4,7,10-tetraazacyclododecane-NN',N''N'''-tetraacetic acid (DOTA) which can be attached to the antibody via a linker molecule. Such linker molecules are commonly known in the art and described in Denardo et al., 1998, Clin Cancer Res. 4(10):2463-90; Peterson et al., 1999, Bioconj. Chem. 10(4):553-7; and Zimmerman et al., 1999, Nud. Med. Biol., 26(8):943-50.

[0672] Moreover, antibodies of the invention can be fused to marker sequences, such as a peptide to facilitate purification. In preferred embodiments, the marker amino acid sequence is a heaa-histidine peptide, such as the tag provided in a pQE vector (CAGEN, Inc.), among others, many of which are commercially available. As described in Geitz et al., 1989, Proc. Nat. Acad. Sci. USA 86:321-324, for instance, heaa-histidine provides for convenient purification of the fusion protein. Other peptide tags useful for purification include, but are not limited to, the hemagglutinin ("HA") tag, which corresponds to an epitope derived from the influenza hemagglutinin protein (Mason et al., 1984, Cell 37:767), and the "FLAG" tag.

[0673] Methods for fusing or conjugating therapeutic moieties (including polypeptides) to antibodies are well known, see, e.g., Aron et al., "Monoclonal Antibodies For Immunotargeting Of Drugs In Cancer Therapy", In Monoclonal Antibodies And Cancer Therapy, Reisfeld et al. (eds.), pp. 243-56 (Alan R. Liss, Inc. 1985); Hershman et al., "Antibody Drug Delivery", In Controlled Drug Delivery (2nd Ed.), Robinson et al. (eds.), pp. 69-83 (Marcel Dekker, Inc. 1987); Thorpe, "Antibody Carriers In Cancer Therapy: A Review", In Monoclonal Antibodies In Cancer Therapy, Baskin et al. (eds.), pp. 393-46 (Academic Press 1985); Thorpe et al., 1992, Immunol. Rev. 62:119-56; U.S. Pat. Nos. 5,336,603, 5,622,829, 5,359,045, 5,447,551, 5,723,125, 5,763,181, 5,906,626, 5,844,095, and 5,112,946; EP 384,327; PCT publications WO 91/06570, WO 96/04388, WO 96/22024, WO 97/34681, and WO 99/04513; Ashkenazi et al., Proc. Natl. Acad. Sci. USA, 88:10535-10539, 1991; Trautner et al., Nature, 331:34-36, 1988; Zheng et al., J. Immunol., 154:559-5630, 1995; Vil et al., Proc. Natl. Acad. Sci. USA, 89:1327-1334, 1992.

[0674] Fusion proteins may be generated, for example, through the techniques of gene-shuffling, motif-shuffling, exon-shuffling, and/or codon-shuffling (collectively referred to as "DNA shuffling"). DNA shuffling may be employed to alter the activities of antibodies of the invention (e.g., antibodies with higher affinities and lower dissociation rates). See, generally, U.S. Pat. Nos. 5,695,790, 5,811,236, 5,830,721, 5,834,252, and 5,837,456; Patten et al., 1997, Cur. Opin. Biotechnol., 8:224-33; Harayama, 1996, Trends Biotechnol., 16(2):76-82; Hanson et al., 1999, J. Mol. Biol. 287:265-76; and Lorenzen and Blasco, 1996, Biotechniques 24(2):306-313. Antibodies, or the encoded antibodies, may be altered by being subjected to random mutagenesis by error-prone PCR, random nucleic acid insertion or other methods prior to recombination. A polynucleotide encoding an antibody of the invention may be recombined with one or more components, motifs, scaffolds, parts, domains, fragments, etc. of one or more heterologous molecules.

[0675] An antibody of the invention can also be conjugated to a second antibody to form an antibody heteroconjugate as described in U.S. Pat. No. 4,676,980.

[0676] The therapeutic moiety or drug conjugated or recombinantly fused to an antibody of the invention that specifically binds to a hOXA4L antigen should be chosen to achieve the desired prophylactic or therapeutic effect(s). In certain embodiments, the antibody is a modified antibody. A clinician or other medical personnel should consider the following when deciding on which therapeutic moiety or drug to conjugate or recombinantly fuse to an antibody of the invention: the nature of the disease, the severity of the disease, and the condition of the subject.

[0677] Antibodies of the invention may also be attached to solid supports, which are particularly useful for immunoassays or purification of the target antigen. Such solid supports include, but are not limited to, glass, cellulose, polycrylamide, nylon, polystyrene, polyvinyl chloride or polypropylene.

Pharmaceutical Compositions

[0678] The following discussion on compositions also applies to fragments so that disclosure mentioning antibodies can also apply to *mutatis mutandis* fragments of the invention.

[0679] Therapeutic formulations containing one or more antibodies of the invention provided herein can be prepared for storage by mixing the antibody having the desired degree of purity with optional physiologically acceptable carriers, excipients or stabilizers (Remington's Pharmaceutical Sciences (1990) Mack Publishing Co., Easton, Pa.), in the form of lyophilized formulations or aqueous solutions. Acceptable carriers, excipients, or stabilizers are known to redipients at the dosages and concentrations employed, and include buffers such as phosphate, citrate, and other organic acids; antioxidants including ascorbic acid and methionine; preservatives (such as octadecylmethylmyl ammonium chloride; hexamethonium chloride; benzalkonium chloride, benzethonium chloride; phenol, butyl or benzyl alcohol; alkyl parabens such as methyl or propyl parabens; catechol; resorcinol; cyclohexanol; 3-pentanol; and m-cresol); low molecular weight (less than about 10 residues) polypeptides; proteins, such as serum albumin, gelatin, or immunoglobulins; hydrophilic polymers such as polyvinylpyrrolidone; amino acids such as glycine, glutamine, asparagine, histidine, arginine, or tyrosine; monoaccharides, disaccharides, and other carbohydrate; including glucose, mannose or dextrose; chelating agents such as EDTA; sugars such as sucrose, mannitol, trehalose or sorbitol; salt-forming counter-ions such as sodium; metal complex (e.g., Zn-protein complexes); and/or non-ionic surfactants such as Tween®TM, PLURONIC®TM or polyethylene glycol (PEG).

[0680] The antibodies of the invention provided herein can also, for example, be formulated in liposomes. Liposomes containing the molecule of interest are prepared by methods known in the art, such as described in Epstein et al. (1985) Proc. Natl. Acad. Sci. USA 82:3688; Hwang et al. (1980) Proc. Natl. Acad. Sci. USA 77:4930; and U.S. Pat. Nos. 4,485,045 and 4,544,545. Liposomes with enhanced circulation time are disclosed in U.S. Pat. No. 5,013,556.

[0681] Particularly useful immunoliposomes can be generated by the reverse phase evaporation method with a lipid composition containing phosphatidylcholine, cholesterol and PEG-derivatized phosphatidylethanolamine (PEG-PE). Liposomes are extruded through filters of defined pore size to yield liposomes with the desired diameter. Fab' fragments of an antibody provided herein can be conjugated to the liposomes as described in Martin et al. (1982) J. Biol. Chem. 257:296-298 via a disulfide interchange reaction. A chemotherapeutic agent (such as Doxorubicin) is optionally contained within the liposome; See Galbizon et al., (1989) J. National Cancer Inst. 81(19): 1484.

[0682] Formulations, such as those described herein, can also contain more than one active compound as necessary for the particular indication being treated. In certain embodiments, formulations comprise an antibody of the invention and one or more active compounds with complementary activities that do not adversely affect each other. Such molecules are suitably present in combination in amounts that are effective for the purpose intended. For example, an antibody of the invention can be combined with one or more other therapeutic agents. Such combined therapy can be administered to the patient orally or simultaneously or in sequence.

[0683] In one embodiment, the combination comprises an anti-OXA4L antibody of the invention and a further therapeutic agents independently selected from the group consisting of rapamycin (sirolimus), tacrolimus, ciclosporin, corticosteroids (e.g., methylprednisolone), methotrexate, mycophenolate mofetil, anti-CD25 antibodies, anti-IL12 α -23 antibodies (e.g., ustekinumab), anti-CD28 antibodies (e.g., brentuximab), anti-CD29 antibodies (e.g., brentuximab), CTLA-4-Fc molecules (e.g., abatacept), CD28 receptor antagonists (e.g., maraviroc), anti-CD4L antibodies, anti-VLA4 antibodies, anti-LFA1 antibodies, Kudarabine, anti-CD25 antibodies (e.g., alemtuzumab), anti-CD45 antibodies, cyclophosphamide, anti-thymocyte globulin, anti-complement C5 antibodies (e.g., eculizumab), anti- α IIb/IIIa integrin antibodies (e.g., vedolizumab), anti-IL6 antibodies (e.g., tocilizumab), anti-IL2 α antibodies (e.g., basiliximab), anti-CD25 antibodies (e.g., daclizumab), anti-TNF α TNF α -Fc molecules (e.g., etanercept, adalimumab, infliximab, golimumab or certolizumab pegol) and Vorinostat. In another embodiment the combination comprises an anti-OXA4L antibody of the invention and a further therapeutic agents independently selected from the group consisting of rapamycin (sirolimus), tacrolimus, ciclosporin, corticosteroids (e.g., methylprednisolone), methotrexate, mycophenolate mofetil, anti-CD28 antibodies, CTLA-4-Fc molecules (e.g., abatacept), anti-CD4L antibodies, anti-LFA1 antibodies, anti-CD52 antibodies (e.g., alemtuzumab), cyclophosphamide and anti-thymocyte globulin.

[0684] In some embodiments the combination comprises an anti-OXA4L antibody of the invention and further therapeutic agents independently selected from the group consisting of calcineurin inhibitors (e.g., tacrolimus, ciclosporin), mTOR inhibitors (e.g., rapamycin (sirolimus)), and antiproliferative agents (e.g., mycophenolate mofetil, cyclophosphamide).

[0685] In further embodiments the combination comprises an anti-OXA4L antibody of the invention and further therapeutic agents independently selected from the group consisting of immunosuppressants that modulate L-2 signalling (e.g., tacrolimus, ciclosporin, rapamycin (sirolimus), and anti-CD25 antibodies (e.g., basiliximab, daclizumab).

[0686] In one embodiment, the combination comprises an anti-OXA4L antibody of the invention and rapamycin (sirolimus). In one embodiment, the combination comprises an anti-OXA4L antibody of the invention and tacrolimus. In one embodiment, the combination comprises an anti-OXA4L antibody of the invention and a combination of tacrolimus and methotrexate. In another embodiment, the combination comprises an anti-OXA4L antibody of the invention and ciclosporin. In another embodiment, the combination comprises an anti-OXA4L antibody of the invention and cyclophosphamide. In another embodiment, the combination comprises an anti-OXA4L antibody of the invention and mycophenolate mofetil.

[0687] An antibody of the invention can also be entrapped in microcapsule prepared, for example, by coacervation techniques or by interfacial polymerization, for example, hydroxyethylcellulose or gelatin-microcapsule and poly(methylmethacrylate) microcapsule, respectively, in colloidal drug delivery systems (for example, liposomes, albumin microspheres, microemulsions, nano-particles and nanoemulsions. Such techniques are disclosed in Remington's Pharmaceutical Sciences (1990) Mack Publishing Co., Easton, Pa.

[0688] The formulations to be used for in vivo administration can be sterile. This is readily accomplished by filtration through, e.g., sterile filtration membranes.

[0689] Sustained-release preparations can also be prepared. Suitable examples of sustained-release preparations include semipermeable matrices of solid hydrophobic polymers containing the antigen, such matrices are in the form of shaped articles, e.g., films, or microcapsule. Examples of sustained-release matrices include polyesters, hydrogels (for example, poly(2-hydroxyethyl-methacrylate), or poly(vinylalcohol)), polylactides (U.S. Pat. No. 3,773,919), copolymers of L-glutamic acid and ethyl-L-glutamate, non-degradable ethylene-vinyl acetate, degradable lactic acid-glycolic acid copolymers such as the LUPRON DEPOTTM (injectable microspheres composed of lactic acid-glycolic acid copolymer and leuprolide acetate), and poly-D-(+)-3-hydroxybutyric acid. While polymers such as ethylene-vinyl acetate and lactic acid-glycolic acid enable release of molecules for over 100 days, certain hydrophobic release proteins for shorter time periods. When encapsulated antibodies remain in the body for a long time, they may denature or aggregate as a result of exposure to moisture at 37 °C, resulting in a loss of biological activity and possible changes in immunogenicity. Rational strategies can be devised for stabilization depending on the mechanism involved. For example, if the aggregation mechanism is discovered to be intermolecular S-S bond formation through this disulfide interchange, stabilization may be achieved by modifying sulfhydryl residues, lyophilizing from acidic solutions, controlling moisture content, using appropriate additives, and developing specific polymer matrix compositions.

[0690] The pharmaceutical compositions provided herein contain therapeutically effective amounts of one or more of the antibodies of the invention, provided herein, and optionally one or more additional prophylactic or therapeutic agents, in a pharmaceutically acceptable carrier. Such pharmaceutical compositions are useful in the prevention, treatment, management or amelioration of a hOXA4L-mediated disease, such as an inflammatory bowel disease, transplant rejection, GVHD or one or more of the symptoms thereof.

[0691] Pharmaceutical carriers suitable for administration of the compounds provided herein include any such carriers known to those skilled in the art to be suitable for the particular mode of administration.

[0692] In addition, the antibodies of the invention may be formulated as the sole pharmaceutically active ingredient in the composition or may be combined with other active ingredients (such as one or more other prophylactic or therapeutic agents).

[0693] The compositions can contain one or more antibodies of the invention. In one embodiment, the antibodies are formulated into suitable pharmaceutical preparations, such as solutions, suspensions, tablets, dispersible tablets, pills, capsules, powders, sustained release formulations or elixirs, for oral administration or in sterile solutions or suspensions for parenteral administration, as well as transdermal patch preparation and dry powder inhalers. In one embodiment, the antibodies described above are formulated into pharmaceutical compositions using techniques and procedures well known in the art (see, e.g., Ansel (1985) Introduction to Pharmaceutical Dosage Forms, 4th Ed., p. 126).

[0694] In the compositions, effective concentrations of one or more antibodies or derivatives thereof is (are) mixed with a suitable pharmaceutical carrier. The concentrations of the compounds in the compositions are effective for delivery of an amount, upon administration, that treats, prevents, or ameliorates a hOXA4L-mediated disease or symptom thereof.

[0695] In one embodiment, the compositions are formulated for single dosage administration. To formulate a composition, the weight fraction of compound is dissolved, suspended, dispersed or otherwise mixed in a selected carrier at an effective concentration such that the treated condition is relieved, prevented, or one or more symptoms are ameliorated.

[0696] An antibody of the invention is included in the pharmaceutically acceptable carrier in an effective amount sufficient to exert a therapeutically useful effect in the absence of undesirable side effects on the patient treated. The therapeutically effective concentration can be determined empirically by testing the compounds in *in vitro* and *in vivo* systems using routine methods and then extrapolated therefrom for dosages for humans.

[0697] The concentration of antibody in the pharmaceutical composition will depend on, e.g., the physicochemical characteristics of the antibody, the dosage schedule, and amount administered as well as other factors known to those of skill in the art.

[0698] In one embodiment, a therapeutically effective dosage produces a serum concentration of antibody of from about 0.1 ng/ml to about 50-100 $\mu\text{g/ml}$. The pharmaceutical compositions, in another embodiment, provide a dosage of from about 0.001 mg to about 2000 mg of antibody per kilogram of body weight per day. Pharmaceutical dosage unit forms can be prepared to provide from about 0.01 mg, 0.1 mg or 1 mg to about 500 mg, 1000 mg or 2000 mg, and in one embodiment from about 10 mg to about 500 mg of the antibody and/or a combination of other optional essential ingredients per dosage unit form.

[0699] The antibody can be administered at once, or may be divided into a number of smaller doses to be administered at intervals of time. It is understood that the precise dosage and duration of treatment is a function of the disease being treated and can be determined empirically using known testing protocols or by extrapolation from *in vivo* or *in vitro* test data. It is to be noted that concentrations and dosage values can also vary with the severity of the condition to be alleviated. It is to be further understood that for any particular subject, specific dosage regimens can be adjusted over time according to the individual need and the professional judgment of the person administering or supervising the administration of the compositions, and that the concentration ranges set forth herein are exemplary only and are not intended to limit the scope or practice of the claimed compositions.

[0700] Upon mixing or addition of the antibody, the resulting mixture can be a solution, suspension, emulsion or the like. The form of the resulting mixture depends upon a number of factors, including the intended mode of administration and the solubility of the compound in the selected carrier or vehicle. The effective concentration is sufficient for ameliorating the symptoms of the disease, disorder or condition treated and may be empirically determined.

[0701] The pharmaceutical compositions are provided for administration to humans and animals in unit dosage forms, such as tablets, capsules, pills, powders, granules, sterile parenteral solutions or suspensions, and oral solutions or suspensions, and oil-water emulsions containing suitable quantities of the compounds or pharmaceutically acceptable derivatives thereof. The antibody is, in one embodiment, formulated and administered in unit-dosage forms or multiple-dosage forms. Unit-dose forms as used herein refers to physically discrete units suitable for human and animal subjects and packaged individually as is known in the art. Each unit-dose contains a predetermined quantity of the antibody sufficient to provide the desired therapeutic effect, in association with the required pharmaceutical carrier, vehicle or diluent. Examples of unit-dose forms include ampoules and syringes and individually packaged tablets or capsules. Unit-dose forms can be administered in fractions or multiples thereof. A multiple-dose form is a plurality of identical unit-dosage forms packaged in a single container to be administered in segregated unit-dose form. Examples of multiple-dose forms include vials, bottles of tablets or capsules or bottles of pills or gallsins. Hence, multiple dose form is a multiple of units which are not segregated in packaging.

[0702] In preferred embodiments, one or more anti-hOXA4L antibodies of the invention are in a liquid pharmaceutical formulation. Liquid pharmaceutically administrable compositions can, for example, be prepared by dissolving, dispersing, or otherwise mixing an active compound as defined above and optional pharmaceutical adjuvants in a carrier, such as, for example, water, saline, aqueous dextrose, glycerol, glycols, ethanol, and the like, to thereby form a solution or suspension. If desired, the pharmaceutical composition to be administered can also contain minor amounts of nontoxic auxiliary substances such as wetting agents, emulsifying agents, solubilizing agents, pH buffering agents and the like, for example, acetate, sodium citrate, cyclooctedrine derivative, sorbitan monoacetate, triethanolamine sodium acetate, triethanolamine oleate, and other such agents.

[0703] Actual methods of preparing such dosage forms are known, or will be apparent, to those skilled in this art; for example, see Remington's Pharmaceutical Sciences (1990) Mack Publishing Co., Easton, Pa.

[0704] Dosage forms or compositions containing antibody in the range of 0.005% to 100% with the balance made up from non-toxic carrier can be prepared. Methods for preparation of these compositions are known to those skilled in the art.

[0705] Oral pharmaceutical dosage forms are either solid, gel or liquid. The solid dosage forms are tablets, capsules, granules, and pill powders. Types of oral tablets include compressed, chewable lozenges and tablets which may be enteric-coated, sugar-coated or film-coated. Capsules can be hard or soft gelatin capsules, while granules and powders can be provided in non-effervescent or effervescent form with the combination of other ingredients known to those skilled in the art.

[0706] In certain embodiments, the formulations are solid dosage forms. In certain embodiments, the formulations are capsules or tablets. The tablets, pills, capsules, troches and the like can contain one or more of the following ingredients, or compounds of a similar nature: a binder; a lubricant; a diluent; a glidant; a disintegrating agent; a coloring agent; a sweetening agent; a flavoring agent; an emulsifying agent; and a film coating. Examples of binders include microcrystalline cellulose, gum tragacanth, glucose, sorbitol, acids, mallic acid, polyvinylpyrrolidone, povidone, croscarmellose, sucrose and starch paste. Lubricants include talc, stearic, magnesium or calcium stearate, hypodermic and stearic acid. Diluents include, for example, lactose, sucrose, starch, kaolin, salt, mannitol and disodium phosphate. Diluents include, but are not limited to, colloidal silicon dioxide. Disintegrating agents include croscarmellose, sodium starch glycolate, alginic acid, corn starch, potato starch, bentonite, methylcellulose, agar and carboxymethylcellulose. Coloring agents include, for example, any of the approved certified water soluble FD and C dyes, mixtures thereof; and water insoluble FD and C dyes suspended

on alumina hydrate. Sweetening agents include sucrose, lactose, mannitol and artificial sweetening agents such as saccharin, and any number of spray dried flavours. Flavouring agents include natural flavours extracted from plants such as fruits and synthetic blends of compounds which produce a pleasant sensation, such as, but not limited to peppermint and methyl salicylate. Wetting agents include propylene glycol monolaurate, sorbitan monolaurate, diethylene glycol monolaurate and polyoxyethylene lauryl ether. Emelio-coatings include fatty acids, fats, waxes, shella, ammoniated stearic and cellulose acetate phthalates. Film coatings include hydroxyethylcellulose, sodium carboxymethylcellulose, polyethylene glycol 4000 and cellulose acetate phthalate.

[0707] The antibodies of the invention can be provided in a composition that protects them from the acidic environment of the stomach. For example, the composition can be formulated in an enteric coating that maintains its integrity in the stomach and releases the active compound in the intestine. The composition can also be formulated in combination with an antacid or other such ingredient.

[0708] When the dosage unit form is a capsule, it can contain, in addition to material of the above type, a liquid carrier such as a fatty oil. In addition, dosage unit forms can contain various other materials which modify the physical form of the dosage unit, for example, coatings of sugar and other enteric agents. The compounds can also be administered as a component of an elixir, suspension, syrup, wafer, sprinkle, chewing gum or the like. A syrup may contain, in addition to the active compounds, sucrose as a sweetening agent and certain preservatives, dyes and colourings and flavours.

[0709] The antibody can also be mixed with other active materials which do not impair the desired action, or with materials that supplement the desired action, such as antacids, H₂ blockers, and diuretics. The active ingredient is an antibody or pharmaceutically acceptable derivative thereof as described herein. Higher concentrations, up to about 95% by weight of the active ingredient may be included.

[0710] In all embodiments, tablets and capsules formulations can be coated as known by those of skill in the art in order to modify or sustain dissolution of the active ingredient. Thus, for example, they may be coated with a conventional enterically digestible coating, such as phenylsalicylate, waxes and cellulose acetate phthalate.

[0711] In preferred embodiments, the formulations are liquid dosage forms. Liquid oral dosage forms include aqueous solutions, emulsions, suspensions, solutions and/or suspensions reconstituted from non-effervescent granules and effervescent preparations reconstituted from effervescent granules. Aqueous solutions include, for example, elixirs and syrups. Emulsions are ether oil-in-water or water-in-oil.

[0712] Elixirs are clear, sweetened, hydroalcoholic preparations. Pharmaceutically acceptable carriers used in elixirs include solvents. Syrups are concentrated aqueous solutions of a sugar, for example, sucrose, and may contain a preservative. An emulsion is a two-phase system in which one liquid is dispersed in the form of small globules throughout another liquid. Pharmaceutically acceptable carriers used in emulsions are non-aqueous liquids, emulsifying agents and preservatives. Suspensions use pharmaceutically acceptable suspending agents and preservatives.

[0713] Pharmaceutically acceptable substances used in non-effervescent granules, to be reconstituted into a liquid oral dosage form, include diluents, sweeteners and wetting agents. Pharmaceutically acceptable substances used in effervescent granules, to be reconstituted into a liquid oral dosage form, include organic acids and a source of carbon dioxide. Colouring and flavoring agents are used in all of the above dosage forms.

[0714] Solvents include glycerin, sorbitol, ethyl alcohol and syrup. Examples of preservatives include glycerin, methyl and propylparaben, benzoic acid, sodium benzoate and alcohol. Examples of non-aqueous liquids utilized in emulsions include mineral oil and cottonseed oil. Examples of emulsifying agents include gelatin, acacia, tragacanth, bentonite, and surfactants such as polyoxyethylene sorbitan monooleate. Suspending agents include sodium carboxymethylcellulose, pectin, tragacanth, Veegum and acacia. Sweetening agents include sucrose, syrups, glycerol and artificial sweetening agents such as saccharin. Wetting agents include propylene glycol monolaurate, sorbitan monolaurate and polyoxyethylene lauryl ether. Organic acids include citric and tartaric acid. Sources of carbon dioxide include sodium bicarbonate and sodium carbonate. Colouring agents include any of the approved certified water soluble FD and C dyes, and mixtures thereof. Flavouring agents include natural flavours extracted from plants such fruits, and synthetic blends of compounds which produce a pleasant taste sensation.

[0715] For a solid dosage form, the solution or suspension, for example propylene carbonate, vegetable oils or triglycerides, is, in one embodiment, encapsulated in a gelatin capsule. Such solutions, and the preparation and encapsulation thereof, are disclosed in U.S. Pat. Nos. 4,328,245; 4,409,239; and 4,410,545. For a liquid dosage form, the solution, e.g., for example, in a polyethylene glycol, can be diluted with a sufficient quantity of a pharmaceutically acceptable liquid carrier, e.g., water, to be easily measured for administration.

[0716] Alternatively, liquid or semi-solid oral formulations can be prepared by dissolving or dispersing the active compound or salt in vegetable oils, glycols, triglycerides, propylene glycol esters (e.g., propylene carbonate) and other such carriers, and encapsulating these solutions or suspensions in hard or soft gelatin capsule shells. Other useful formulations include those set forth in U.S. Patent Nos. R28,819 and 4,356,603. Briefly, such formulations include, but are not limited to, those containing a compound provided herein, a dialkylated mono- or poly-alkylene glycol, including, but not limited to, 1,2-dimethoxyethane, diglyme, triglyme, tetraglyme, polyethylene glycol-350-dimethyl ether, polyethylene glycol-550-dimethyl ether, polyethylene glycol-750-dimethyl ether wherein 350, 550 and 750 refer to the approximate average molecular weight of the polyethylene glycol, and one or more antacid salts, such as butylated hydroxytoluene (BHT), butylated hydroxyanisole (BHA), propyl gallate, vitamin E, hydroquinone, hydroxyacetamin, ethanamine, lecithin, cephalin, ascorbic acid, malic acid, sorbitol, phosphoric acid, nicotinicpropionic acid and its esters, and diethoxyacetamides.

[0717] Other formulations include, but are not limited to, aqueous alcoholic solutions including a pharmaceutically acceptable alcohol. Alcohols used in these formulations are any pharmaceutically acceptable water-miscible solvents having one or more hydroxyl groups, including, but not limited to, propylene glycol and ethanol. Alcohols include, but are not limited to, di(lower alkyl) acetals of lower alkyl aldehydes such as acetaldehyde diethyl acetal.

[0718] Parenteral administration, in one embodiment, is characterized by injection, either subcutaneously, intramuscularly or intravenously & also contemplated herein. Injectable can be prepared in conventional forms, either as liquid solutions or suspensions, solid forms suitable for solution or suspension in liquid prior to injection, or as emulsions. The injectables, solutions and emulsions also contain one or more excipients. Suitable excipients are, for example, water, saline, dextrose, glycerol or ethanol. In addition, if desired, the pharmaceutical compositions to be administered can also contain minor amounts of non-toxic auxiliary substances such as wetting or emulsifying agents, pH buffering agents, stabilizers, solubility enhancers, and other such agents, such as for example, sodium acetate, sorbitan monolaurate, triethanolamine oleate and cyclooctadecins.

[0719] Implantation of a slow-release or sustained-release system, such that a constant level of dosage is maintained (see, e.g., U.S. Pat. No. 3,710,795) is also contemplated herein. Briefly, a compound provided herein is dispersed in a solid inert matrix, e.g., polymethylmethacrylate, polybutylmethacrylate, plasticized or unplasticized polyvinylchloride, plasticized nylon, plasticized polyethyleneterephthalate, natural rubber, polysoprene, polyisobutylene, polybutadiene, polyethylene, ethylene-vinylacetate copolymers, silicone rubbers, polydimethylsiloxanes, silicone carbonate copolymers, hydrophilic polymers such as hydrogels of esters of acrylic and methacrylic acid, collagen, cross-linked polyvinylalcohol and cross-linked partially hydrolyzed polyvinyl acetate, that is surrounded by an outer polymeric membrane, e.g., polyethylene, polypropylene, ethylene/propylene copolymers, ethylene/ethyl acrylate copolymers, ethylene/vinylacetate copolymers, silicone rubbers, polydimethyl siloxanes, neoprene rubber, chlorinated polyethylene, polyvinylchloride, vinylchloride copolymers with vinyl acetate, vinylidene chloride, ethylene and propylene, ionomer polyethylene terephthalate, butyl rubber epichlorohydrin rubbers, ethylene/vinyl alcohol copolymer, ethylene/vinyl acetate/vinyl alcohol terpolymer, and ethylene/vinylalcohol terpolymer, that is insoluble in body fluids. The antibody diffuses through the outer polymeric membrane in a release rate controlling step. The amount of antibody contained in such parenteral compositions is highly dependent on the specific nature thereof, as well as the activity of the compound and the needs of the subject.

[0720] Preparations for parenteral administration include sterile solutions ready for injection, sterile dry soluble products, such as lyophilized powders, ready to be combined with a solvent just prior to use, including hypodermic tablets, sterile suspensions ready for injection, sterile dry insoluble products ready to be combined with a vehicle just prior to use and sterile emulsions. The solutions may be either aqueous or nonaqueous.

[0721] If administered intravenously, suitable carriers include physiological saline or phosphate buffered saline (PBS), and solutions containing thickening and solubilizing agents, such as glucose, polyethylene glycol, and polypropylene glycol and mixtures thereof.

[0722] Pharmaceutically acceptable carriers used in parenteral preparations include aqueous vehicles, nonaqueous vehicles, antimicrobial agents, isotonic agents, buffers, antioxidants, local anaesthetics, suspending and dispersing agents, emulsifying agents, sequestering or chelating agents and other pharmaceutically acceptable substances.

[0723] Examples of aqueous vehicles include Sodium Chloride Injection, Ringers Injection, Isotonic Dextrose Injection, Sterile Water Injection, Dextrose and Lactated Ringers Injection. Nonaqueous parenteral vehicles include fixed oils of vegetable origin, cottonseed oil, corn oil, sesame oil and peanut oil. Antimicrobial agents in bacteriostatic or fungistatic concentrations can be added to parenteral preparations packaged in multiple-dose containers which include phenols or cresols, mercurials, benzyl alcohol, chlorobutanol, methyl and propyl p-hydroxybenzoic acid esters, thimerosal, benzalkonium chloride and benzethonium chloride. Isotonic agents include sodium chloride and dextrose. Buffers include phosphate and citrate. Antioxidants include sodium bisulfate. Local anesthetics include procaine hydrochloride. Suspending and dispersing agents include sodium carboxymethylcellulose, hydroxypropyl methylcellulose and polyvinylpyrrolidone. Emulsifying agents include Polysorbate 80 (Tween® 80). A sequestering or chelating agent of metal ions includes EDTA. Pharmaceutical carriers also include ethyl alcohol, polyethylene glycol and propylene glycol for water miscible vehicles; and sodium hydroxide, hydrochloric acid, citric acid or lactic acid for pH adjustment.

[0724] The concentration of the pharmaceutically active compound is adjusted so that an injection provides an effective amount to produce the desired pharmacological effect. The exact dose depends on the age, weight and condition of the patient or animal as is known in the art.

[0725] The unit-dose parenteral preparations can be packaged in an ampoule, a vial or a syringe with a needle. All preparations for parenteral administration can be sterile, as is known and practiced in the art.

[0726] Illustratively, intravenous or intraarterial infusion of a sterile aqueous solution containing an active compound is an effective mode of administration. Another embodiment is a sterile aqueous or oily solution or suspension containing an active material injected as necessary to produce the desired pharmacological effect.

[0727] Injectables are designed for local and systemic administration. In one embodiment, a therapeutically effective dosage is formulated to contain a concentration of at least about 0.1% w/w up to about 90% w/w or more, in certain embodiments more than 1% w/w of the active compound to the treated tissue(s).

[0728] The antibody can be suspended in microlized or other suitable form. The form of the resulting mixture depends upon a number of factors, including the intended mode of administration and the solubility of the compound in the selected carrier or vehicle. The effective concentration is sufficient for ameliorating the symptoms of the condition and may be empirically determined.

[0729] In other embodiments, the pharmaceutical formulations are lyophilized powders, which can be reconstituted for administration as solutions, emulsions and other mixtures. They may also be reconstituted and formulated as solids or gels.

[0730] The lyophilized powder is prepared by dissolving an antibody provided herein, or a pharmaceutically acceptable derivative thereof, in a suitable solvent. In some embodiments, the lyophilized powder is sterile. The solvent may contain an excipient which improves the stability or other pharmacological component of the powder or reconstituted solution, prepared from the powder. Excipients that may be used include, but are not limited to, dextrose, sorbitol, fructose, corn syrup, glytol, glycerin, glucose, sucrose or other suitable agent. The solvent may also contain a buffer, such as citrate, sodium or potassium phosphate or other such buffer known to those of skill in the art at, in one embodiment, about neutral pH. Subsequent sterile filtration of the solution followed by lyophilization under standard conditions known to those of skill in the art provides the desired formulation. In one embodiment, the resulting solution will be apportioned into vials for lyophilization. Each vial will contain a single dose or multiple dosages of the compound. The lyophilized powder can be stored under appropriate conditions, such as at about 4° C. to room temperature.

[0731] Reconstitution of this lyophilized powder with water for injection provides a formulation for use in parenteral administration. For reconstitution, the lyophilized powder is added to sterile water or other suitable carrier. The precise amount depends upon the selected compound. Such amount can be empirically determined.

[0732] Topical mixtures are prepared as described for the local and systemic administration. The resulting mixture can be a solution, suspension, emulsions or the like and can be formulated as creams, gels, ointments, emulsions, solutions, elixirs, lotions, suspensions, tinctures, pastes, foams, aerosols, irrigations, sprays, suppositories, bandages, dermal patches or any other formulations suitable for topical administration.

[0733] The antibodies of the invention can be formulated as aerosols for topical application, such as by inhalation (see, e.g., U.S. Pat. Nos. 4,044,126, 4,414,209, and 4,364,923, which describe aerosols for delivery of a steroid useful for treatment of inflammatory diseases, particularly asthma). These formulations for administration to the respiratory tract can be in the form of an aerosol or solution for a nebulizer, or as a micronize powder for insufflations, alone or in combination with an inert carrier such as lactose. In such a case, the particles of the formulation will, in one embodiment, have diameters of less than 50 microns, in one embodiment less than 10 microns.

[0734] The compounds can be formulated for local or topical application, such as for topical application to the skin and mucous membranes, such as in the eye, in the form of gels, creams, and lotions and for application to the eye or for intracutaneous or intrascleral application. Topical administration is contemplated for transdermal delivery and also for administration to the eyes or mucosa, or for inhalation therapies. Nasal solutions of the active compound alone or in combination with other pharmaceutically acceptable excipients can also be administered.

[0735] These solutions, particularly those intended for ophthalmic use, may be formulated as 0.91%-10% isotonic solutions, pH about 5-7, with appropriate salts.

[0736] Other routes of administration, such as transdermal patches, including iontophoretic and electrophoretic devices, and rectal administration, are also contemplated herein.

[0737] Transdermal patches, including iontophoretic and electrophoretic devices, are well known to those of skill in the art. For example, such patches are disclosed in U.S. Pat. Nos. 6,267,993, 6,261,595, 6,256,533, 6,167,301, 6,004,075, 6,010,715, 5,955,317, 5,963,134, 5,948,433, and 5,960,957.

[0738] For example, pharmaceutical dosage forms for rectal administration are rectal suppositories, capsules and tablets for systemic effect. Rectal suppositories are used herein mean solid bodies for insertion into the rectum which melt or soften at body temperature releasing one or more pharmacologically or therapeutically active ingredients. Pharmaceutically acceptable substances utilized in rectal suppositories are bases or vehicles and agents to raise the melting point. Examples of bases include cocoa butter (theobroma oil), glycerin-gelatin, carbowax (polyoxyethylene glycol) and appropriate mixtures of mono-, di- and triglycerides of fatty acids. Combinations of the various bases may be used. Agents to raise the melting point of suppositories include spermaceti and wax. Rectal suppositories may be prepared either by the compressed method or by moulding. The weight of a rectal suppository, in one embodiment, is about 2 to 3 gm.

[0739] Tablets and capsules for rectal administration can be manufactured using the same pharmaceutically acceptable substance and by the same methods as for formulations for oral administration.

[0740] The antibodies and other compositions provided herein may also be formulated to be targeted to a particular tissue, receptor, or other area of the body of the subject to be treated. Many such targeting methods are well known to those of skill in the art. All such targeting methods are contemplated herein for use in the instant compositions. For non-limiting examples of targeting methods, see, e.g., U.S. Pat. Nos. 6,316,652, 6,274,352, 6,271,359, 6,253,072, 6,139,965, 6,131,570, 6,120,751, 6,071,495, 6,060,062, 6,048,736, 6,039,975, 6,034,534, 5,985,307, 5,972,366, 5,950,252, 5,840,674, 5,759,542 and 5,709,874. In some embodiments, the anti-HOX40L antibodies of the invention are targeted (or otherwise administered) to the colon, such as in a patient having or at risk of having an IBD. In some embodiments, the anti-HOX40L antibodies of the invention are targeted (or otherwise administered) to the eye, such as in a patient having or at risk of having uveitis.

[0741] In one embodiment, liposomal suspensions, including tissue-targeted liposomes, may also be suitable as pharmaceutically acceptable carriers. These can be prepared according to methods known to those skilled in the art. For example, liposome formulations can be prepared as described in U.S. Pat. No. 4,522,811. Briefly, liposomes such as multilamellar vesicles (MLVs) may be formed by drying down egg phosphatidyl choline and brain phosphatidyl serine (7:3 molar ratio) on the inside of a flask. A solution of a compound provided herein in phosphate buffered saline lacking divalent cations (PBS) is added and the flask shaken until the lipid film is dispersed. The resulting vesicles are washed to remove unencapsulated compound, pelleted by centrifugation, and then resuspended in PBS.

Methods of Administration and Dosage

[0742] The present invention further provides for compositions comprising one or more antibodies or fragments of the invention for use in the prevention, management, treatment and/or amelioration of a HOX40L-mediated disease (or symptom thereof). Discussion in respect of antibodies also applies *mutatis mutandis* to fragments of the invention. In an alternative, the present invention further provides for compositions comprising one or more antibodies or fragments of the invention for use in the prevention, management, treatment and/or amelioration of an OX40L-mediated disease (or symptom thereof) in a subject, wherein the OX40L is non-human (e.g., canine, feline, equine, bovine, ovine or porcine) and the subject is respectively a dog, cat, horse, cow, sheep or pig.

[0743] In certain embodiments, provided herein are compositions comprising one or more antibodies of the invention for use in the prevention, management, treatment and/or amelioration of a HOX40L-mediated disease, such as IBD (e.g., ulcerative colitis or Crohn's disease), or a symptom thereof. IBD symptoms may range from mild to severe and generally depend upon the part of the intestinal tract involved. Exemplary symptoms of IBD include abdominal cramps and pain, bloody diarrhoea, severe urgency to have a bowel movement, fever, loss of appetite, weight loss, anorexia, fatigue, and/or sores on lower legs, ankles, calves, thighs, and arms. Exemplary intestinal complications of IBD include proctitis, bleeding from the ulcers, perforation or rupture of the bowel, strictures and obstruction, fistulas (abnormal passages) and perianal disease, toxic megacolon (e.g., acute nonobstructive dilation of the colon), and/or malignancy (e.g., cancer of the colon or small intestine). Exemplary extraintestinal complications of IBD include arthritis, skin conditions, inflammation of the eye, liver and kidney disorders, and bone loss. Any combination of these symptoms may be prevented, managed, treated, and/or ameliorated using the compositions and methods provided herein.

[0744] In certain embodiments, provided herein are compositions comprising one or more antibodies of the invention for use in the prevention, management, treatment and/or amelioration of an HOX40L-mediated disease, such as GVHD, or a symptom thereof. GVHD generally occurs following allogeneic or matched unrelated bone marrow transplants (BMT).

[0745] In some embodiments, the GVHD is acute GVHD. The symptoms of acute GVHD can happen quickly and can be mild or severe. In certain instances, acute GVHD develops within about three months after transplant, such as when blood counts recover after transplant. It certain instances, the acute GVHD affects the skin, gastrointestinal (GI) tract and/or liver. For example, in some patients, acute skin GVHD begins with a rash, for example, on the palms of the patient's hands, soles of the feet, or shoulders. However, the rash can become widespread, may be itchy and painful and/or might blister and peel. Acute liver GVHD may affect normal functions of the liver, such as liver enzymes, and may in turn, cause jaundice. Acute liver GVHD may also cause the patient's abdomen to become swollen and painful if the liver becomes enlarged. Finally, symptoms of acute gut GVHD (or GIHD of the digestive system) can include diarrhoea, mucus or blood in the stool, cramping or abdominal pain, indigestion, nausea and/or loss of appetite. Other general symptoms of acute GVHD can include anaemia, low grade fever, and/or being more prone to infections. Any combination of these symptoms of acute GVHD may be prevented, managed, treated, and/or ameliorated using the compositions and methods provided herein.

[0746] In other embodiments, the GVHD is chronic GVHD. Chronic GVHD can occur from about three months to about a year or longer after transplant. Chronic GVHD can be mild or severe, and generally includes symptoms similar to those of acute GVHD. Chronic GVHD can affect the skin and digestive system, including the liver but can also involve other organs and the immune system (e.g., making the patient more prone to infections) and/or connective tissues. Symptoms of chronic skin GVHD include a rash, dry skin, tight skin, itchy skin, darkening of the colour of the skin, thickening of the skin, and/or may affect hair (e.g., hair loss, turning grey) or nails (e.g., hard or brittle nails). Chronic gut GVHD can affect the digestive system, mouth, oesophagus, lining of the stomach, and/or the lining of the bowel, and symptoms can include diarrhoea, dry or sore mouth, painful swallowing, low nutrient absorption by the stomach, bloating, stomach cramps. Chronic liver GVHD can cause damage and scarring of the liver (cirrhosis). Chronic GVHD of the eyes can affect the glands that make tears, causing eyes to become dry, burning and painful or difficult to tolerate bright light. Chronic lung GVHD can cause shortness of breath, wheezing, persistent

cough, and/or being more prone to chest infections. Chronic GVHD affects tendons (e.g., inflammation) that connect muscle to bone causing difficulty straightening or bending your arms and legs. Any combination of these symptoms of chronic GVHD may be prevented, managed, treated, and/or ameliorated using the compositions and methods provided herein.

[0747] In certain embodiments provided herein are compositions comprising one or more antibodies of the invention for use in the prevention, management, treatment and/or amelioration of a hCX49L-mediated disease, such as uveitis, or a symptom thereof.

[0748] In certain embodiments provided herein are compositions comprising one or more antibodies of the invention for use in the prevention, management, treatment and/or amelioration of a hCX49L-mediated disease, such as pyoderma gangrenosum, giant cell arteritis, Schirmer syndrome or non-infectious scleritis.

[0749] In certain embodiments provided herein are compositions comprising one or more antibodies of the invention for use in the prevention, management, treatment and/or amelioration of a hCX49L-mediated disease or condition selected from an autoimmune disease or condition, a systemic inflammatory disease or condition, or transplant rejection; for example inflammatory bowel disease (IBD), Crohn's disease, rheumatoid arthritis, transplant rejection, allogeneic transplant rejection, graft-versus-host disease (GVHD), ulcerative colitis, systemic lupus erythematosus (SLE), diabetes, uveitis, ankylosing spondylitis, contact hypersensitivity, multiple sclerosis and atherosclerosis, in particular GVHD.

[0750] In a specific embodiment, a composition for use in the prevention, management, treatment and/or amelioration of a hCX49L-mediated disease comprises the CX49L binding sites of an antibody of the invention, e.g., an antibody disclosed in the Examples.

[0751] In another embodiment, a composition for use in the prevention, management, treatment and/or amelioration of a hCX49L-mediated disease comprises one or more antibodies comprising one or more VH domains having an amino acid sequence of any one of the VH domains in the sequence listing (i.e. Seq ID No.2, Seq ID No.34, Seq ID No.66 or Seq ID No.94), in particular Seq ID No.34). In another embodiment, a composition for use in the prevention, management, treatment and/or amelioration of a hCX49L-mediated disease comprises one or more antibodies comprising one or more VH CDR1s having an amino acid sequence of any one of the VH CDR1s in the sequence listing (i.e. Seq ID No.4, Seq ID No.10, Seq ID No.36, Seq ID No.68, Seq ID No.74, Seq ID No.96 or Seq ID No.102). In particular, Seq ID No.36 or Seq ID No.42). In another embodiment, a composition for use in the prevention, management, treatment and/or amelioration of a hCX49L-mediated disease comprises one or more antibodies comprising one or more VH CDR2s having an amino acid sequence of any one of the VH CDR2s in the sequence listing (i.e. Seq ID No.6, Seq ID No.12, Seq ID No.38, Seq ID No.70, Seq ID No.76, Seq ID No.98 or Seq ID No.104), in particular Seq ID No.38 or Seq ID No.44). In a preferred embodiment, a composition for use in the prevention, management, treatment and/or amelioration of a hCX49L-mediated disease comprises one or more antibodies comprising one or more VH CDR3s having an amino acid sequence of any one of the VH CDR3s in the sequence listing (i.e. Seq ID No.8, Seq ID No.14, Seq ID No.46, Seq ID No.72, Seq ID No.78, Seq ID No.100 or Seq ID No.106, in particular Seq ID No.40 or Seq ID No.46).

[0752] In another embodiment, a composition for use in the prevention, management, treatment and/or amelioration of a hCX49L-mediated disease comprises one or more antibodies comprising one or more V_L domains having an amino acid sequence of any one of the V_L domains in the sequence listing (i.e. Seq ID No.16, Seq ID No.48, Seq ID No.80, or Seq ID No.108, in particular Seq ID No.48) (optionally comprising also the cognate VH domain as set out in the sequence listing (i.e. Seq ID No.216, Seq ID No.344/8, Seq ID No.66/60 or Seq ID No.94/108, in particular Seq ID No.344/8). In another embodiment, a composition for use in the prevention, management, treatment and/or amelioration of a hCX49L-mediated disease comprises one or more antibodies comprising one or more V_L CDR1s having an amino acid sequence of any one of the V_L CDR1s in the sequence listing (i.e. Seq ID No.16, Seq ID No.48, Seq ID No.80, Seq ID No.82, Seq ID No.88, Seq ID No.110 or Seq ID No.116, in particular Seq ID No.50 or Seq ID No.56). In another embodiment, a composition for use in the prevention, management, treatment and/or amelioration of a hCX49L-mediated disease comprises one or more antibodies comprising one or more V_L CDR2s having an amino acid sequence of any one of the V_L CDR2s in the sequence listing (i.e. Seq ID No.20, Seq ID No.52, Seq ID No.84, Seq ID No.90, Seq ID No.96 or Seq ID No.102), in particular Seq ID No.38 or Seq ID No.42), and one or more V_L CDR3s having an amino acid sequence of any one of the V_L CDR3s in the sequence listing (i.e. Seq ID No.22, Seq ID No.28, Seq ID No.54, Seq ID No.60, Seq ID No.86, Seq ID No.92, Seq ID No.114 or Seq ID No.120, in particular Seq ID No.54 or Seq ID No.60).

[0753] In another embodiment, a composition for use in the prevention, management, treatment and/or amelioration of a hCX49L-mediated disease comprises one or more antibodies comprising one or more VH domains having an amino acid sequence of any one of the VH domains in the sequence listing (i.e. Seq ID No.2, Seq ID No.34, Seq ID No.66 or Seq ID No.94), in particular Seq ID No.34), and one or more V_L domains having an amino acid sequence of any one of the V_L domains in the sequence listing (i.e. Seq ID No.16, Seq ID No.48, Seq ID No.80, or Seq ID No.108, in particular Seq ID No.48).

[0754] In another embodiment, a composition for use in the prevention, management, treatment and/or amelioration of a hCX49L-mediated disease comprises one or more antibodies comprising one or more VH CDR1s having an amino acid sequence of any one of the VH CDR1s in the sequence listing (i.e. Seq ID No.4, Seq ID No.10, Seq ID No.36, Seq ID No.42, Seq ID No.68, Seq ID No.74, Seq ID No.96 or Seq ID No.102), in particular, Seq ID No.36 or Seq ID No.42), and one or more V_L CDR1s having an amino acid sequence of any one of the V_L CDR1s in the sequence listing (i.e. Seq ID No.16, Seq ID No.24, Seq ID No.50, Seq ID No.56, Seq ID No.82, Seq ID No.88, Seq ID No.110 or Seq ID No.116, in particular Seq ID No.50 or Seq ID No.56). In another embodiment, a composition for use in the prevention, management, treatment and/or amelioration of a hCX49L-mediated disease comprises one or more antibodies comprising one or more VH CDR2s having an amino acid sequence of any one of the VH CDR2s in the sequence listing (i.e. Seq ID No.6, Seq ID No.10, Seq ID No.36, Seq ID No.42, Seq ID No.68, Seq ID No.74, Seq ID No.96 or Seq ID No.102), in particular, Seq ID No.36 or Seq ID No.42), and one or more V_L CDR2s having an amino acid sequence of any one of the V_L CDR2s in the sequence listing (i.e. Seq ID No.20, Seq ID No.26, Seq ID No.52, Seq ID No.58, Seq ID No.84, Seq ID No.90, Seq ID No.96 or Seq ID No.112 or Seq ID No.118, in particular Seq ID No.52 or Seq ID No.58). In another embodiment, a composition for use in the prevention, management, treatment and/or amelioration of a hCX49L-mediated disease comprises one or more antibodies comprising one or more VH CDR3s having an amino acid sequence of any one of the VH CDR3s in the sequence listing (i.e. Seq ID No.8, Seq ID No.10, Seq ID No.36, Seq ID No.42, Seq ID No.48, Seq ID No.74, Seq ID No.86, Seq ID No.92, Seq ID No.114 or Seq ID No.120, in particular Seq ID No.54 or Seq ID No.60).

[0755] As discussed in more detail elsewhere herein, a composition of the invention may be used either alone or in combination with other compounds or compositions. Moreover, the antibodies may further be recombinantly fused to a heterologous polypeptide at the N- or C-terminus or chemically conjugated (including covalently and non-covalently conjugations) to polypeptides or other compositions. For example, antibodies of the present invention may be recombinantly fused or conjugated to molecules useful as labels in detection assays and effector molecules such as cytotoxic polypeptides, drugs, radionuclides, or toxins. See, e.g., PCT publications WO 92/04945, WO 91/14438; WO 99/12624; U.S. Pat. No. 5,314,995; and EP 396,387.

[0756] In certain embodiments, provided herein are methods for decreasing or inhibiting binding of hCX49L to an CX49L receptor or cognate ligand (e.g., CX49L in a subject (e.g., a human subject), comprising administering to the subject an effective amount of an antibody that specifically binds to a hCX49L polypeptide (e.g., a cell surface-expressed or soluble hCX49L). In some embodiments, a hCX49L biological activity, such as secretion of CCL20, IL8 and/or RANTES, or INF- γ , TNF- α or IL-2, in particular INF- γ or another cytokine disclosed herein, is also decreased in the subject, for example decreased by at least 10, 20, 30, 40, 50 or 60%, or 70%, or 80%, or 90% or 95% or >95%.

[0757] In certain embodiments, provided herein are methods for decreasing or inhibiting a hCX49L biological activity, such as secretion of interferon gamma, IL-2, CCL20, IL8 and/or RANTES or other cytokine, or INF- γ , TNF- α or IL-2, in particular INF- γ in a subject (e.g., a human subject), comprising administering to the subject an effective amount of an antibody that specifically binds to a hCX49L polypeptide (e.g., a cell surface-expressed hCX49L), wherein hCX49L biological activity is decreased by the antibody.

[0758] In other embodiments, provided herein are methods for decreasing or inhibiting binding of hCX49L to an CX49L receptor or cognate ligand (e.g., CX49L in a cell having cell surface-expressed hCX49L), contacting the cell with an effective amount of an antibody that specifically binds to a hCX49L polypeptide (e.g., a cell surface-expressed or soluble hCX49L), such as a hCX49L polypeptide, a hCX49L polypeptide fragment, or a hCX49L epitope. In some embodiments, a hCX49L biological activity, such as secretion of interferon gamma, IL-2, CCL20, IL8 and/or RANTES, or INF- γ , TNF- α or IL-2, in particular INF- γ or other cytokine disclosed herein, is also decreased in the cell.

[0759] In certain embodiments, provided herein are methods for decreasing or inhibiting a hCX49L biological activity, such as secretion of interferon gamma, IL-2, CCL20, IL8 and/or RANTES or other cytokine disclosed herein, in a cell having a cell surface-expressed hCX49L receptor (such as CX49L), contacting the cell with an effective amount of an antibody that specifically binds to a hCX49L polypeptide (e.g., a cell surface-expressed or soluble hCX49L), wherein hCX49L biological activity is decreased by the antibody.

[0760] Antibodies of the present invention may be used, for example, to purify, detect, and target hCX49L antigens, in both *in vitro* and *in vivo* diagnostic and therapeutic methods. For example, the modified antibodies have use in immunoassays for qualitatively and quantitatively measuring levels of hCX49L in biological samples. See, e.g., Harlow et al., *Antibodies: A Laboratory Manual*, Cold Spring Harbor Laboratory Press, 2nd ed. 1998).

[0761] The invention also provides methods of preventing, managing, treating and/or ameliorating a hCX49L-mediated disease by administering to a subject of an effective amount of an antibody, or pharmaceutical composition comprising an antibody of the invention. In one aspect, an antibody is substantially purified (i.e., substantially free from substances that limit its effect or produce undesired side-effects). As preferred embodiments, the antibody is a fully human monoclonal antibody, such as a fully human monoclonal antagonist antibody. The subject administered a therapy is preferably a mammal such as non-primate (e.g., cows, pigs, horses, cats, dogs, rodents, mice or rats) or a primate (e.g., a monkey, such as a rhesus or cynomolgus monkey, or a human). In a preferred embodiment, the subject is a human infant or a human infant born prematurely. In another embodiment, the subject is a human with a hCX49L-mediated disease.

[0762] Various delivery systems are known and can be used to administer a prophylactic or therapeutic agent (e.g., an antibody of the invention), including, but not limited to, encapsulation in liposomes, microparticles, microcapsules, recombinant cells capable of expressing the antibody, receptor-mediated endocytosis (see, e.g., Wu and Ma, *J. Biol. Chem.* 262:4429-4432 (1987)), construction of a nucleic acid as part of a retroviral or other vector, etc. Methods of administering a prophylactic or therapeutic agent (e.g., an antibody of the invention), or pharmaceutical composition include, but are not limited to, parenteral administration (e.g., intradermal, intramuscular, intraperitoneal, intravenous and subcutaneous), epidural and mucosal (e.g., intranasal and oral routes). In a specific embodiment, a prophylactic or therapeutic agent (e.g., an antibody of the present invention), or a pharmaceutical composition is administered intranasally, intramuscularly, intravenously, or subcutaneously. The prophylactic or therapeutic agents or compositions may be administered by any convenient route, for example by infusion or bolus injection, by absorption through epithelial or mucocutaneous linings (e.g., oral mucosa, intranasal mucosa, rectal and intestinal mucosa, etc.) and may be administered together with other biologically active agents. Administration can be systemic or local. In addition, pulmonary administration can also be employed, e.g., by use of an inhaler or nebulizer, and formulation with an aerosolizing agent. See, e.g., U.S. Pat. Nos. 6,019,666, 5,965,320, 5,965,309, 5,934,272, 5,874,064, 5,858,913, 5,290,540, and 4,880,076; and PCT publications WO 92/02444, WO 91/073572, WO 91/04103, WO 90/31346, and WO 90/66680.

[0763] In a specific embodiment, it may be desirable to administer a prophylactic or therapeutic agent, or a pharmaceutical composition of the invention locally to the area in need of treatment. This may be achieved by, for example, and not by way of limitation, local infusion, topical administration (e.g., by intranasal spray), by injection, or by means of an implant, said implant being of a porous, non-porous, or gelatinous material, including membranes, such as silastic membranes, or fibers. Preferably, when administering an antibody of the invention, care must be taken to use materials to which the antibody does not absorb.

[0764] In another embodiment, a prophylactic or therapeutic agent, or a composition of the invention can be delivered in a vesicle, in particular a liposome (see Langer, 1990, *Science* 249:1527-1533; Treast et al., in *Liposomes in the Therapy of Infectious Disease and Cancer*, Lopez-Berestein and Faller (eds.), Liss, New York, pp. 353-365 (1989); Lopez-Berestein, *ibid.*, pp. 317-327; see generally *ibid.*).

[0765] In another embodiment, a prophylactic or therapeutic agent, or a composition of the invention can be delivered in a controlled release or sustained release system. In one embodiment, a pump may be used to achieve controlled or sustained release (see Langer, supra; Sefton, 1987, *CRC Crit. Rev. Biomed. Eng.* 14:229; Buchwald et al., 1980, *Surgery* 89:574; Spector, *ibid.* 81:241). In another embodiment, polymeric materials can be used to achieve controlled or sustained release of a prophylactic or therapeutic agent (e.g., an antibodies of the invention) or a composition of the invention (see, e.g., Medical Applications of Controlled Release, Langer and Wess (eds.), CRC Press, Boca Raton, Fla. (1974); Controlled Drug Bioavailability Drug Product Design and Performance, Smolen and Ball (eds.), Wiley, New York (1984); Ranger and Peppas, 1983, *J. Macromol. Sci. Rev. Macromol. Chem.* 23(61); see also Levy et al., 1985, *Science* 228:190; Durfin et al., 1989, *Ann. Neurol.* 25:351; Howard et al., 1989, *J. Neurosurg.* 71:105). U.S. Pat. Nos. 5,678,377, U.S. Pat. No. 5,916,507, U.S. Pat. No. 5,912,015, U.S. Pat. No. 5,909,463, U.S. Pat. No. 5,128,326; PCT publications WO 90/15154; and PCT publication No. WO 92/02553. Examples of polymers used in sustained release formulations include, but are not limited to, poly(2-hydroxy ethyl methacrylate), poly(methyl methacrylate), poly(methyl methacrylate), poly(acrylic acid), poly(ethylene-co-vinyl acetate), poly(ethylene-co-vinyl pyrrolidone), poly(vinyl alcohol), polyacrylamide, poly(ethylene glycol), poly(lactide-co-glycolide) (PLGA), and polyorthoesters. In a preferred embodiment, the polymer used in a sustained release formulation is inert, free of leachable impurities, stable on storage, sterile, and biodegradable. In yet another embodiment, a controlled or sustained release system can be placed in proximity of the therapeutic target, i.e., the nasal passages or lungs, thus requiring only a fraction of the systemic dose (see, e.g., Goodwin, in Medical Applications of Controlled Release, supra, vol. 2, pp. 115-138 (1984)). Controlled release systems are discussed in the review by Langer (1990, *Science* 249:1527-1533). Any technique known to one of skill in the art can be used to produce sustained release formulations comprising one or more antibodies of the invention. See, e.g., U.S. Pat. No. 4,526,308; PCT publication WO 91/05548; PCT publication WO 92/06098; Ning et al., 1990, "Intratumoral Radioimmunotherapy of a Human Colon Cancer Xenograft Using a Sustained-Release Gel", *Radiotherapy & Oncology* 39:179-189; Song et al., 1995, "Antibody Mediated Long Targeting of Lung Circulating Emboli", *PDA Journal of Pharmaceutical Science & Technology* 50:372-387; Cleek et al., 1997, "Biodegradable Polymeric Carriers for a bFGF Antibody for Cardiovascular Application", *Proc. Int'l. Symp. Control Rel. Biomat. Mater.* 24:759-760.

[0766] In a specific embodiment, the composition is formulated in accordance with routine procedures as a pharmaceutical composition adapted for intravenous administration to human beings. Typically, compositions for intravenous administration are solutions in sterile isotonic aqueous buffer. Where necessary, the composition may also include a solubilizing agent and a local anesthetic to ease pain at the site of the injection. Such compositions, however, may be administered by a route other than intravenous.

[0767] In a specific embodiment, a composition of the invention comprises one, two or more antibodies or fragments of the invention. In another embodiment, a composition of the invention comprises one, two or more antibodies or fragments of the invention and a prophylactic or therapeutic agent other than an antibody of the invention. Preferably, the agents are known to be useful for or have been or are currently used for the prevention, management, treatment and/or amelioration of a hCX49L-mediated disease. In addition to prophylactic or therapeutic agents, the compositions of the invention may also comprise a carrier.

[0768] The compositions of the invention include bulk drug compositions useful in the manufacture of pharmaceutical compositions (e.g., compositions that are suitable for administration to a subject or patient) that can be used in the preparation of unit dosage forms. In a preferred embodiment, a composition of the invention is a pharmaceutical composition. Such compositions comprise a prophylactically or therapeutically effective amount of one or more prophylactic or therapeutic agents (e.g., an antibody of the invention or other prophylactic or therapeutic agent), and a pharmaceutically acceptable carrier. Preferably, the pharmaceutical compositions are formulated to be suitable for the route of administration to a subject.

[0769] In a specific embodiment, the term "carrier" refers to a diluent, adjuvant (e.g., Freud's adjuvant (complete and incomplete), oil-in-water emulsion, or vehicle with which the therapeutic is administered. Such pharmaceutical carriers can be sterile liquids, such as water and oils, including those of petroleum, animal, vegetable or synthetic origin, such as peanut oil, soybean oil, mineral oil, sesame oil and the like. Water is a preferred carrier when the pharmaceutical composition is administered intravenously. Saline solutions and aqueous dextrose and glycerol solutions can also be employed as liquid carriers, particularly for injectable solutions. Suitable pharmaceutical excipients include starch, glucose, lactose, sucrose, gelatin, malt, rice, flour, chalk, silica gel, sodium stearate, glycerol monostearate, latex, sodium chloride, dried skim milk, glycerol, propylene, glycol, water, ethanol and the like. The composition, if desired, can also contain minor amounts of wetting or emulsifying agents, or pH buffering agents. These compositions can take the form of solutions, suspensions, emulsion, tablets, pills, capsules, powders, sustained-release formulations and the like. Oral formulation can include standard carriers such as pharmaceutical grades of mannitol, lactose, starch, magnesium stearate, sodium saccharine, cellulose, magnesium carbonate, etc. Examples of suitable pharmaceutical carriers are described in Remington's Pharmaceutical Sciences (1990) Mack Publishing Co., Easton, Pa. Such compositions will contain a prophylactically or therapeutically effective amount of the antibody, preferably in purified form, together with a suitable amount of carrier so as to provide the form for proper administration to the patient. The formulation should suit the mode of administration.

[0770] In a preferred embodiment, the composition is formulated in accordance with routine procedures as a pharmaceutical composition adapted for intravenous administration to human beings. Typically, compositions for intravenous administration are solutions in sterile isotonic aqueous buffer. Where necessary, the composition may also include a solubilizing agent and a local anesthetic to ease pain at the site of the injection. Such compositions, however, may be administered by a route other than intravenous.

[0771] Generally, the ingredients of compositions of the invention are supplied either separately or mixed together in unit dosage form, for example, as a dry lyophilized powder or water free concentrate in a hermetically sealed container such as an ampoule or sachette indicating the quantity of active agent. Where the composition is to be administered by infusion, it can be dispersed with an infusion bottle containing sterile pharmaceutical grade water or saline. Where the composition is administered by injection, an ampoule of sterile water for injection or saline can be provided so that the ingredients may be mixed prior to administration.

[0772] The invention also provides that an antibody of the invention is packaged in a hermetically sealed container such as an ampoule or sachette indicating the quantity of antibody. In one embodiment, the antibody is supplied as a dry sterilized lyophilized powder or water free concentrate in a hermetically sealed container and can be reconstituted, e.g., with water or saline to the appropriate concentration for administration to a subject. Preferably, the antibody is supplied as a dry sterile lyophilized powder in a hermetically sealed container at a unit dosage of at least 0.1 mg/ml, at least 0.5 mg/ml, at least 2 mg/ml, at least 3 mg/ml, and more preferably at least 5 mg/ml, at least 10 mg/ml, at least 15 mg/ml, at least 25 mg/ml, at least 30 mg/ml, at least 45 mg/ml, at least 50 mg/ml, at least 60 mg/ml, at least 75 mg/ml, at least 90 mg/ml, at least 95 mg/ml, at least 100 mg/ml, at least 125 mg/ml, at least 150 mg/ml, at least 160 mg/ml, at least 175 mg/ml, at least 190 mg/ml, at least 200 mg/ml, at least 210 mg/ml, at least 225 mg/ml, at least 240 mg/ml, at least 250 mg/ml, at least 260 mg/ml, at least 270 mg/ml, at least 280 mg/ml, at least 290 mg/ml, at least 300 mg/ml, at least 310 mg/ml, at least 320 mg/ml, at least 330 mg/ml, at least 340 mg/ml, at least 350 mg/ml, at least 360 mg/ml, at least 370 mg/ml, at least 380 mg/ml, at least 390 mg/ml, at least 400 mg/ml, at least 410 mg/ml, at least 420 mg/ml, at least 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However, as will be apparent to those in the art, other dosing amounts and schedules are easily determinable and within the scope of the invention.

[0770] In a specific embodiment, approximately 100 mg/kg, approximately 75 mg/kg or less, approximately 50 mg/kg or less, approximately 25 mg/kg or less, approximately 10 mg/kg or less, approximately 5 mg/kg or less, approximately 1 mg/kg or less, approximately 0.5 mg/kg or less, approximately 0.1 mg/kg or less of an antibody or fragment of the invention in a sustained release formulation is administered to a subject, preferably a human, to prevent, manage, treat and/or ameliorate a hCX40L-mediated disease. In another specific embodiment, an approximately 100 mg/kg, approximately 75 mg/kg or less, approximately 50 mg/kg or less, approximately 25 mg/kg or less, approximately 10 mg/kg or less, approximately 5 mg/kg or less, approximately 1 mg/kg or less, approximately 0.5 mg/kg or less, approximately 0.1 mg/kg or less bolus of an antibody the invention not in a sustained release formulation is administered to a subject, preferably a human, to prevent, manage, treat and/or ameliorate a hCX40L-mediated disease, and after a certain period of time, approximately 100 mg/kg, approximately 75 mg/kg or less, approximately 50 mg/kg or less, approximately 25 mg/kg or less, approximately 10 mg/kg or less, approximately 5 mg/kg or less, approximately 1 mg/kg or less, approximately 0.5 mg/kg or less, approximately 0.1 mg/kg or less of an antibody of the invention in a sustained release is administered to said subject (e.g., intranasally or intramuscularly) two, three or four times (preferably are time). In accordance with this embodiment, a certain period of time can be 1 to 5 days, a week, two weeks, or a month.

[0781] In some embodiments, a single dose of an antibody or fragment of the invention is administered to a patient to prevent, manage, treat and/or ameliorate a hCX40L-mediated disease two, three, four, five, six, seven, eight, nine, ten, eleven, twelve times, thirteen, fourteen, fifteen, sixteen, seventeen, eighteen, nineteen, twenty, twenty-one, twenty-two, twenty-three, twenty-four, twenty five, or twenty six at bi-weekly (e.g., about 14 day) intervals over the course of a year, wherein the dose is selected from the group consisting of about 0.1 mg/kg, about 0.5 mg/kg, about 1 mg/kg, about 5 mg/kg, about 10 mg/kg, about 15 mg/kg, about 20 mg/kg, about 25 mg/kg, about 30 mg/kg, about 35 mg/kg, about 40 mg/kg, about 45 mg/kg, about 50 mg/kg, about 55 mg/kg, about 60 mg/kg, about 65 mg/kg, about 70 mg/kg, about 75 mg/kg, about 80 mg/kg, about 85 mg/kg, about 90 mg/kg, about 95 mg/kg, about 100 mg/kg, or a combination thereof (i.e., each dose monthly dose may or may not be identical).

[0781] In another embodiment, a single dose of an antibody of the invention is administered to patient to prevent, manage, treat and/or ameliorate a hCX40L-mediated disease two, three, four, five, six, seven, eight, nine, ten, eleven, or twelve times at about monthly (e.g., about 30 day) intervals over the course of a year, wherein the dose is selected from the group consisting of about 0.1 mg/kg, about 0.5 mg/kg, about 1 mg/kg, about 5 mg/kg, about 10 mg/kg, about 15 mg/kg, about 20 mg/kg, about 25 mg/kg, about 30 mg/kg, about 35 mg/kg, about 40 mg/kg, about 45 mg/kg, about 50 mg/kg, about 55 mg/kg, about 60 mg/kg, about 65 mg/kg, about 70 mg/kg, about 75 mg/kg, about 80 mg/kg, about 85 mg/kg, about 90 mg/kg, about 95 mg/kg, about 100 mg/kg, or a combination thereof (i.e., each dose monthly dose may or may not be identical).

[0782] In one embodiment, a single dose of an antibody or fragment of the invention is administered to a patient to prevent, manage, treat and/or ameliorate a hCX40L-mediated disease two, three, four, five, or six times at about bi-monthly (e.g., about 60 day) intervals over the course of a year, wherein the dose is selected from the group consisting of about 0.1 mg/kg, about 0.5 mg/kg, about 1 mg/kg, about 5 mg/kg, about 10 mg/kg, about 15 mg/kg, about 20 mg/kg, about 25 mg/kg, about 30 mg/kg, about 35 mg/kg, about 40 mg/kg, about 45 mg/kg, about 50 mg/kg, about 55 mg/kg, about 60 mg/kg, about 65 mg/kg, about 70 mg/kg, about 75 mg/kg, about 80 mg/kg, about 85 mg/kg, about 90 mg/kg, about 95 mg/kg, about 100 mg/kg, or a combination thereof (i.e., each bi-monthly dose may or may not be identical).

[0783] In some embodiments, a single dose of an antibody or fragment of the invention is administered to a patient to prevent, manage, treat and/or ameliorate a hCX40L-mediated disease two, three, or four times at about tri-monthly (e.g., about 120 day) intervals over the course of a year, wherein the dose is selected from the group consisting of about 0.1 mg/kg, about 0.5 mg/kg, about 1 mg/kg, about 5 mg/kg, about 10 mg/kg, about 15 mg/kg, about 20 mg/kg, about 25 mg/kg, about 30 mg/kg, about 35 mg/kg, about 40 mg/kg, about 45 mg/kg, about 50 mg/kg, about 55 mg/kg, about 60 mg/kg, about 65 mg/kg, about 70 mg/kg, about 75 mg/kg, about 80 mg/kg, about 85 mg/kg, about 90 mg/kg, about 95 mg/kg, about 100 mg/kg, or a combination thereof (i.e., each tri-monthly dose may or may not be identical).

[0784] In certain embodiments, the route of administration for a dose of an antibody or fragment of the invention to a patient is intranasal, intramuscular, intravenous, or a combination thereof, but other routes described herein are also acceptable. In certain embodiments, the route of administration is intranasal. Each dose may or may not be administered by an identical route of administration. In some embodiments, an antibody or fragment of the invention may be administered via multiple routes of administration simultaneously or subsequently to other doses of the same or a different antibody or fragment of the invention.

[0785] In certain embodiments, antibodies or fragments of the invention are administered prophylactically or therapeutically to a subject. Antibodies or fragments of the invention can be prophylactically or therapeutically administered to a subject so as to prevent, lessen or ameliorate a hCX40L-mediated disease or symptom thereof.

Gene Therapy

[0786] In a specific embodiment, nucleic acids or nucleotide sequences of the invention are administered to prevent, manage, treat and/or ameliorate a hCX40L-mediated disease by way of gene therapy. Gene therapy refers to therapy performed by the administration to a subject of an expressed or expressible nucleic acid. In an embodiment of the invention, the nucleic acids produce their encoded antibody, and the antibody mediates a prophylactic or therapeutic effect.

[0787] Any of the methods for gene therapy available in the art can be used according to the present invention.

Diagnostic Use of Antibodies

[0788] Although antibodies are mentioned in respect of diagnostic uses, this disclosure is to be read as also applying *mutatis mutandis* to the fragments of the invention.

[0789] Labelled antibodies or of the invention and derivatives and analogues thereof, which specifically bind to a hCX40L antigen can be used for diagnostic purposes to detect, diagnose, or monitor a hCX40L-mediated disease. The invention provides methods for the detection of a hCX40L-mediated disease comprising: (a) assaying the expression of a hCX40L antigen in cells or a tissue sample of a subject using one or more antibodies of the invention that specifically bind to the hCX40L antigen; and (b) comparing the level of the hCX40L antigen with a control level, e.g., levels in normal tissue samples (e.g., from a patient not having a hCX40L-mediated disease, or from the same patient before disease onset), whereby an increase in the assayed level of hCX40L antigen compared to the control level of the hCX40L antigen is indicative of a hCX40L-mediated disease.

[0790] The invention provides a diagnostic assay for diagnosing a hCX40L-mediated disease comprising: (a) assaying for the level of a hCX40L antigen in cells or a tissue sample of an individual using one or more antibodies of the invention that specifically bind to a hCX40L antigen; and (b) comparing the level of the hCX40L antigen with a control level, e.g., levels in normal tissue samples, whereby an increase in the assayed hCX40L antigen level compared to the control level of the hCX40L antigen is indicative of a hCX40L-mediated disease. A more definitive diagnosis of a hCX40L-mediated disease may allow health professionals to employ preventive measures or aggressive treatment earlier thereby preventing the development or further progression of the hCX40L-mediated disease.

[0791] Antibodies of the invention can be used to assay hCX40L antigen levels in a biological sample using classical immunohistochemical methods as described herein or as known to those of skill in the art (e.g., see Jalkanen et al., 1985, J. Cell. Biol. 101:976-985; and Jalkanen et al., 1987, J. Cell. Biol. 105:3087-3096). Other antibody-based methods useful for detecting protein gene expression include immunoassays, such as the enzyme linked immunosorbent assay (ELISA) and the radioimmunoassay (RIA). Suitable antibody assay labels are known in the art and include enzyme labels, such as, glucose oxidase; radiolabels, such as iodine (¹²⁵I), carbon (¹⁴C), sulfur (³⁵S), tritium (³H), indium (¹¹¹In), and technetium (^{99m}Tc); luminescent labels, such as lumino; and fluorescent labels, such as fluorescein and rhodamine, and biotin.

[0792] One aspect of the invention is the detection and diagnosis of a hCX40L-mediated disease in a human. In one embodiment, diagnosis comprises: a) administering (for example, parenterally, subcutaneously, or intraperitoneally) to a subject an effective amount of a labelled antibody that specifically binds to a hCX40L antigen; b) waiting for a time interval following the administration for permitting the labelled antibody to preferentially concentrate at sites in the subject where the hCX40L antigen is expressed (and for unbound labelled molecule to be cleared to background level); c) determining background level; and d) detecting the labelled antibody in the subject, such that detection of labelled antibody above the background level indicates that the subject has a hCX40L-mediated disease. Background level can be determined by various methods including, comparing the amount of labelled molecule detected to a standard value previously determined for a particular system.

[0793] It will be understood in the art that the size of the subject and the imaging system used will determine the quantity of imaging moiety needed to produce diagnostic images. In the case of a radiolabelled moiety, for a human subject, the quantity of radioactivity injected will normally range from about 5 to 20 millicuries of ^{99m}Tc. The labelled antibody will then preferentially accumulate at the location of cells which contain the specific protein. *In vivo* tumour imaging is described in S. W. Burchiel et al., "Immunopharmacokinetics of Radiolabeled Antibodies and Their Fragments," (Chapter 13 in Tumor Imaging: The Radiochemical Detection of Cancer, S. W. Burchiel and B. A. Rhodes, eds., Masson Publishing Inc. (1982).

[0794] Depending on several variables, including the type of label used and the mode of administration, the time interval following the administration for permitting the labelled antibody to preferentially concentrate at sites in the subject and for unbound labelled antibody to be cleared to background level is 6 to 48 hours or 6 to 24 hours or 6 to 12 hours. In another embodiment the time interval following administration is 5 to 20 days or 5 to 10 days.

[0795] In one embodiment, monitoring of a hCX40L-mediated disease is carried out by repeating the method for diagnosing the a hCX40L-mediated disease, for example, one month after initial diagnosis, six months after initial diagnosis, one year after initial diagnosis, etc.

[0796] Presence of the labelled molecule can be detected in the subject using methods known in the art for *in vivo* scanning. These methods depend upon the type of label used. Skilled artisans will be able to determine the appropriate method for detecting a particular label. Methods and devices that may be used in the diagnostic methods of the invention include, but are not limited to, computed tomography (CT), whole body scan such as positron emission tomography (PET), magnetic resonance imaging (MRI), and sonography.

[0797] In a specific embodiment, the molecule is labelled with a radiolabel and is detected in the patient using a radiation responsive surgical instrument (Thurston et al., U.S. Pat. No. 5,441,050). In another embodiment, the molecule is labelled with a fluorescent compound and is detected in the patient using a fluorescence responsive scanning instrument. In another embodiment, the molecule is labelled with a positron emitting label and is detected in the patient using positron emission-tomography. In yet another embodiment, the molecule is labelled with a paramagnetic label and is detected in a patient using magnetic resonance imaging (MRI).

Methods of Producing Antibodies

[0798] Antibodies and fragments of the invention that specifically bind to an antigen (CX40L) can be produced by any method known in the art for the synthesis of antibodies, in particular, by chemical synthesis or preferably, by recombinant expression techniques. The practice of the invention employs, unless otherwise indicated, conventional techniques in molecular biology, microbiology, genetic analysis, recombinant DNA, organic chemistry, biochemistry, PCR, oligonucleotide synthesis and modification, nucleic acid hybridization, and related fields within the skill of the art. These techniques are described in the references cited herein and are fully explained in the literature. See, e.g., Maniatis et al. (1982) Molecular Cloning: A Laboratory Manual, Cold Spring Harbor Laboratory Press; Sambrook et al. (1989), Molecular Cloning: A Laboratory Manual, Second Edition, Cold Spring Harbor Laboratory Press; Sambrook et al. (1990) Molecular Cloning: A Laboratory Manual, Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY; Ausubel et al., Current Protocols in Immunology, John Wiley & Sons (1987 and annual updates); Current Protocols in Immunology, John Wiley & Sons (1987 and annual updates) Gail (ed.) (1984) Oligonucleotide Synthesis: A Practical Approach, IRL Press, Oxford (ed.) (1991) Oligonucleotides and Analogs: A Practical Approach, IRL Press; Brenn et al. (eds.) (1999) Genome Analysis: A Laboratory Manual, Cold Spring Harbor Laboratory Press.

[0799] Polyclonal antibodies that specifically bind to an antigen can be produced by various procedures well-known in the art. For example, a human antigen can be administered to various host animals including, but not limited to, rabbits, mice, rats, etc. to induce the production of sera containing polyclonal antibodies specific for the human antigen. Various adjuvants may be used to increase the immunological response, depending on the host species, and include but are not limited to, Freund's (complete and incomplete), mineral gels such as aluminum hydroxide, surface active substances such as lysolecithin, pluronic polyols, polyalanins, peptides, oil emulsions, keyhole limpet hemocyanins, dinitrophenol, and potentially useful human adjuvants such as BCG (bacille Calmette-Guerin) and Corynebacterium parvum. Such adjuvants are also well known in the art.

[0800] Monoclonal antibodies can be prepared using a wide variety of techniques known in the art including the use of hybridoma, recombinant, and phage display technologies, or a combination thereof. For example, monoclonal antibodies can be produced using hybridoma techniques including those known in the art and taught, for example, in Harlow et al., Antibodies: A Laboratory Manual, (Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY, 2nd ed., 1988); Hermeling et al., in: Monoclonal Antibodies and T-cell Hybridomas, 963-981 (Elsevier, N.Y., 1981). The term "monoclonal antibody" as used herein is not limited to antibodies produced through hybridoma technology. Other exemplary methods of producing monoclonal antibodies are discussed elsewhere herein, such as e.g., use of the XM Mouse™. Additional exemplary methods of producing monoclonal antibodies are provided in the Examples herein.

[0801] Methods for producing and screening for specific antibodies using hybridoma technology are routine and well known in the art. Briefly, mice can be immunized with a hCX40L antigen and once an immune response is detected, e.g., antibodies specific for hCX40L antigen are detected in the mouse serum, the mouse spleen is harvested and splenocytes isolated. The splenocytes are then fused by well known techniques to any suitable myeloma cells, for example cells from cell line SP20 available from the ATCC. Hybridomas are selected and cloned by limited dilution.

[0802] Additionally, a RMMS (replicative immunomultiple site) technique can be used to immunize an animal (Diptrak et al., 1997 Hybridoma 16:331-9). The hybridoma clones are then assayed by methods known in the art for cells that secrete antibodies capable of binding a polypeptide of the invention. Ascites fluid, which generally contains high levels of antibodies, can be generated by immunizing mice with positive hybridoma clones.

[0803] Accordingly, the present invention provides methods of generating antibodies by culturing a hybridoma cell secreting a modified antibody of the invention wherein, preferably, the hybridoma is generated by fusing splenocytes isolated from a mouse immunized with a hCX40L antigen with myeloma cells and then screening the hybridomas resulting from the fusion for hybridoma clones that secrete an antibody able to bind to a hCX40L antigen.

[0804] Antibody fragments which recognize specific hCX40L antigens may be generated by any technique known to those of skill in the art. For example, Fab and F(ab)₂ fragments of the invention may be produced by proteolytic cleavage of immunoglobulin molecules, using enzymes such as pepsin (to produce Fab fragments) or papain (to produce F(ab)₂ fragments). F(ab)₂ fragments contain the variable region, the light chain constant region and the CH1 domain of the heavy chain. Further, the antibodies of the present invention can also be generated using various phage display methods known in the art.

[0805] For example, antibodies can also be generated using various phage display methods. In phage display methods, functional antibody domains are displayed on the surface of phage particles which carry the polynucleotide sequences encoding them. In particular, DNA sequences encoding VH and VL domains are amplified from animal cDNA libraries (e.g., human or murine cDNA libraries of selected tissues). The DNA encoding the VH and VL domains are recombined together with an scFv linker by PCR and cloned into a phagemid vector. The vector is electroporated in E. coli and the E. coli is infected with helper phage. Phage used in these methods are typically filamentous phage including M13 and the VH and VL domains are usually recombinantly fused to either the phage gene III or gene VIII. Phage expressing an antigen binding domain that binds to a particular antigen can be selected or identified with antigen, e.g., using labelled antigen or antigen bound or captured to a solid surface or bead. Examples of phage display methods that can be used to make the antibodies of the present invention include those disclosed in Brinkman et al., 1995, J. Immunol. Methods 182:241-50; Ames et al., 1995, J. Immunol. Methods 184:177-186; Kettleborough et al., 1994, Eur. J. Immunol. 24:952-959; Persio et al., 1997, Gene 187:9-18; Burton et al., 1994, Advances in Immunology 57:191-280; PCT Application No. PCT/G89/101134 (published as WO 199202809, WO 90/02809, WO 91/01737, WO 92/01947, WO 92/01619, WO 93/11236, WO 95/5902, WO 95/24041, and WO/9713844; and U.S. Pat. Nos. 5,695,426, 5,223,406, 5,403,434, 5,560,711, 5,427,805, 5,750,753, 5,821,047, 5,571,696, 5,427,805, 5,516,637, 5,780,225, 5,655,727, 5,733,743 and 5,969,108.

[0806] As described in the above references, after phage selection, the antibody coding regions from the phage can be isolated and used to generate whole antibodies, including human antibodies, or any other desired antigen binding fragment, and expressed in any desired host, including mammalian cells, insect cells, plant cells, yeast, and bacteria, e.g., as described below. Techniques to recombinantly produce Fab, Fab' and F(ab)₂ fragments can also be employed using methods known in the art such as those disclosed in PCT publication No. WO 92/22324; Mullnax et al., 1992, BioTechniques 12(6):964-969; Savat et al., 1995, A/R 34:26-34; and Better et al., 1998, Science 240: 1041-1043.

[0807] To generate whole antibodies, PCR primers including VH or VL nucleotide sequences, a restriction site, and a flanking sequence to protect the restriction site can be used to amplify the VH or VL sequences in scFv clones. Utilizing cloning techniques known to those of skill in the art, the PCR amplified VH domains can be cloned into vectors expressing a VH constant region, e.g., the human gamma 4 constant region, and the PCR amplified VL domains can be cloned into vectors expressing a VL constant region, e.g., human kappa or lambda constant regions. The VH and VL domains may also be cloned into one vector expressing the necessary constant regions. The heavy chain conversion vectors and light chain conversion vectors are then co-transfected into cell lines to generate stable or transient cell lines that express full-length antibodies, e.g., IgG, using techniques known to those of skill in the art.

[0808] For some uses, including *in vivo* use of antibodies in humans and *in vitro* detection assays, it may be preferable to use human or chimeric antibodies. Completely human antibodies are particularly desirable for therapeutic treatment of human subjects. Human antibodies can be made by a variety of methods known in the art including phage display methods described above using antibody libraries derived from human immunoglobulin sequences. See also U.S. Pat. Nos. 4,444,887 and 4,716,111; and International Publication Nos. WO 90/66645, WO 90/59433, WO 90/24593, WO 90/66651, WO 90/34096, WO 90/37335, and WO 91/07474.

[0809] In preferred embodiments, human antibodies are produced. Human antibodies and/or fully human antibodies can be produced using any method known in the art, including the Examples provided herein. For example, transgenic mice which are incapable of expressing functional endogenous immunoglobulins, but which can express human immunoglobulin genes. For example, the human heavy and light chain immunoglobulin gene complexes may be introduced randomly or by homologous recombination into mouse embryonic stem cells. Alternatively, the human variable region, constant region, and diversity region may be introduced into mouse embryonic stem cells in addition to the human heavy and light chain genes. The mouse heavy and light chain immunoglobulin genes may be rendered non-functional separately or simultaneously with the introduction of human immunoglobulin loci by homologous recombination. In particular, homologous deletion of the JH region prevents endogenous antibody production. The modified embryonic stem cells are expanded and microinjected into blastocysts to produce chimeric mice. The chimeric mice are then bred to produce homozygous offspring which express human antibodies. The transgenic mice are immunized in the normal fashion with a selected antigen, e.g., all or a portion of a polypeptide of the invention. Monoclonal antibodies directed against the antigen can be obtained from the immunized, transgenic mice using conventional hybridoma technology. The human immunoglobulin transgenes harbored by the transgenic mice rearrange during B-cell differentiation, and subsequently undergo class switching and somatic mutation. Thus, using such a technique, it is possible to produce therapeutically useful IgG, IgA, IgM and IgE antibodies. For an overview of this technology for producing human antibodies, see Loring and Hasker (1995, Int. Rev. Neurobiol. 19:65-99). For a detailed discussion of this technology for producing human antibodies and human monoclonal antibodies and protocols for producing such antibodies, see, e.g., PCT publication Nos. WO 96/24993, WO 96/34096, and WO 96/37335; and U.S. Pat. Nos. 5,413,323, 5,685,138, 5,633,425, 5,569,825, 5,461,016, 5,545,906, 5,914,315, and 5,938,596. Other methods are detailed in the Examples herein. In addition, companies such as Abgenex, Inc/Amgen, (Thousand Oaks, Calif.) OMT (Palo Alto, Calif.), Argene-x (Breda, Netherlands), Abiles (San Francisco, Calif.) or Harbour Antibodies (Cambridge, Mass.) can be engaged to provide human antibodies directed against a selected antigen using technology similar to that described above.

[0810] A chimeric antibody is a molecule in which different portions of the antibody are derived from different immunoglobulin molecules. Methods for producing chimeric antibodies are known in the art. See, e.g., Morrison, 1985, Science 229:1202; Ot et al., 1986, BioTechniques 4:214; Gilles et al., 1989, J. Immunol. Methods 125:191-202; and U.S. Pat. Nos. 5,037,715, 4,916,567, 4,816,397, and 6,331,415.

[0811] A humanized antibody is an antibody or its variant or fragment thereof which is capable of binding to a predetermined antigen and which comprises a framework region having substantially the amino acid sequence of a human immunoglobulin and a CDR having substantially the amino acid sequence of a non-human immunoglobulin. A humanized antibody comprises substantially all of at least one, and typically two, variable domains (Fab, Fab', F(ab)₂, Fab, Fv) in which all or substantially all of the CDR regions correspond to those of a non-human immunoglobulin (i.e., donor antibody) and all or substantially all of the framework regions are those of a human immunoglobulin consensus sequence. Preferably, a humanized antibody also comprises at least a portion of an immunoglobulin constant region (Fc), typically that of a human immunoglobulin. Ordinarily, the antibody will contain both the light chain as well as at least the variable domain of a heavy chain. The antibody also may include the CH1, hinge, CH2, CH3, and CH4 regions of the heavy chain. The humanized antibody can be selected from any class of immunoglobulins, including IgM, IgG, IgD, IgA and IgE, and any isotype, including IgG1, IgG2, IgG3 and IgG4. Usually the

constant domain is a complement fixing constant domain where it is desired that the humanized antibody exhibit cytotoxic activity, and the class is typically IgG1. Where such cytotoxic activity is not desirable, the constant domain may be of the IgG2 class. In certain embodiments, the antibodies of the invention comprise a human gamma-4 constant region. In another embodiment, the heavy chain constant region does not bind Fc receptors, and e.g. comprises a Leu235del mutation. In another embodiment, the heavy chain constant region comprises a Ser229Pro mutation to increase stability. In another embodiment, the heavy chain constant region is IgG4-1F8. Examples of VL and VH constant domains that can be used in certain embodiments of the invention include, but are not limited to, C-kappa and C-gamma-1 (cG1m) described in Johnson et al. (1997) *J. Infect. Dis.* 176, 1215-1224 and those described in U.S. Pat. No. 5,824,307. The humanized antibody may comprise sequences from more than one class or isotype, and selecting particular constant domains to optimize desired effector functions is within the ordinary skill in the art. The framework and CDR regions of a humanized antibody need not correspond precisely to the parental sequences, e.g., the donor CDR or the consensus framework may be mutagenized by substitution, insertion or deletion at at least one residue so that the CDR or framework residue at that site does not correspond to either the consensus or the import antibody. Such mutations, however, will not be extensive. Usually, at least 75% of the humanized antibody residues will correspond to those of the parental FR and CDR sequences, more often 90%, and most preferably greater than 95%. Humanized antibodies can be produced using variety of techniques known in the art, including but not limited to, CDR-grafting (European Patent No. EP 239,400; International publication No. WO 94/09967; and U.S. Pat. Nos. 5,225,529, 5,530,101, and 5,565,089), veneering or resurfacing (European Patent Nos. EP 592,106 and EP 519,596; Paskin, 1991; Molecular Immunology 26(4):549-499; Studitski et al., 1994; Protein Engineering 7(6):805-814; and Roguska et al., 1994, PNAS 91:969-973), chain shuffling (U.S. Pat. No. 5,565,332), and techniques disclosed in, e.g., U.S. Pat. No. 6,467,213, U.S. Pat. No. 5,766,886, WO 80/1105, Tan et al., *J. Immunol.* 169:1119-25 (2002), Caldas et al., *Protein Eng.* 13(5):553-60 (2000), Morea et al., *Methods* 20(3):267-79 (2000), Baca et al., *J. Biol. Chem.* 272(16):10679-84 (1997), Roguska et al., *Protein Eng.* 9(10):985-904 (1996), Couto et al., *Cancer Res.* 55 (23 Supp) 5973s-5977s (1995), Couto et al., *Cancer Res.* 55(8): 1717-22 (1995), Sandhu et al., *Gene* 150(2):409-10 (1994), and Pedersen et al., *J. Mol. Biol.* 235(3):954-73 (1994). See also U.S. Patent Pub. No. US 2005/0042664 A1 (Feb. 24, 2005). Often, framework residues in the framework residues will be substituted with the corresponding residue from the CDR donor antibody to alter, preferably improve, antigen binding. These framework substitutions are identified by methods well known in the art, e.g., by modelling of the interactions of the CDR and framework residues to identify framework residues important for antigen binding and sequence comparison to identify unusual framework residues at particular positions. (See, e.g., Queen et al., U.S. Pat. No. 5,555,089; and Riechmann et al., 1989, *Nature* 332:323-325).

[0012] Single domain antibodies, for example, antibodies lacking the light chains, can be produced by methods well-known in the art. See Riechmann et al., 1999, *J. Immunol.* 231:25-38; Nutall et al., 2000, *Curr. Pharm. Biotechnol.* 1(3):253-263; Muykenman, 2001, *J. Biotechnol.* 74(4):277302; U.S. Pat. No. 6,005,079; and International Publication Nos. WO 94/04678, WO 92/5591, and WO 01/44301.

[0013] Further, the antibodies that specifically bind to a HOK40L antigen can, in turn, be utilized to generate anti-idiotype antibodies that "mimic" an antigen using techniques well known to those skilled in the art. (See, e.g., Greenspan & Bona, 1989, *FASEB J.* 7(5):437-444; and Messinoff, 1991, *J. Immunol.*, 147(8):2429-2438).

Kits

[0014] The invention also provides a pharmaceutical or diagnostic pack or kit comprising one or more containers filled with one or more of the ingredients of the pharmaceutical compositions of the invention, such as one or more antibodies or fragments provided herein. Optionally associated with such container(s) can be a notice in the form prescribed by a governmental agency regulating the manufacture, use or sale of pharmaceuticals or biological products, which notice reflects approval by the agency of manufacture, use or sale for human administration, e.g., an authorization number.

[0015] The present invention provides kits that can be used in the above methods. In one embodiment, a kit comprises an antibody of the invention, preferably a purified antibody, in one or more containers. In a specific embodiment, the kits of the present invention contain a substantially isolated HOK40L antigen as a control. Preferably, the kits of the present invention further comprise a control antibody which does not react with the HOK40L antigen. In another specific embodiment, the kits of the present invention contain a means for detecting the binding of a modified antibody to a HOK40L antigen (e.g., the antibody may be conjugated to a detectable substrate such as a fluorescent compound, an enzymatic substrate, a radioactive compound or a luminescent compound, or a second antibody which recognizes the first antibody may be conjugated to a detectable substrate). In specific embodiments, the kit may include a recombinantly produced or chemically synthesized HOK40L antigen. The HOK40L antigen provided in the kit may also be attached to a solid support. In a more specific embodiment the detecting means of the above described kit includes a solid support to which HOK40L antigen is attached. Such a kit may also include a non-attached reporter-labelled anti-human antibody. In this embodiment, binding of the antibody to the HOK40L antigen can be detected by binding of the said reporter-labelled antibody.

[0016] "Conservative amino acid substitutions" result from replacing one amino acid with another having similar structural and/or chemical properties, such as the replacement of a leucine with an isoleucine or valine, an aspartate with a glutamate, or a threonine with a serine. Thus, a "conservative substitution" of a particular amino acid sequence refers to substitution of those amino acids that are not critical for polypeptide activity or substitution of amino acids with other amino acids having similar properties (e.g., acidic, basic, positively or negatively charged, polar or non-polar, etc.) such that the substitution of even critical amino acids does not reduce the activity of the peptide. (i.e. the ability of the peptide to penetrate the blood brain barrier (BBB)). Conservative substitution tables providing functionally similar amino acids are well known in the art. For example, the following six groups each contain amino acids that are conservative substitutions for one another: 1) Alanine (A), Serine (S), Threonine (T); 2) Aspartic acid (D), Glutamic acid (E); 3) Asparagine (N), Glutamine (Q); 4) Arginine (R), Lysine (K); 5) Isoleucine (I), Leucine (L), Methionine (M), Valine (V); and 6) Phenylalanine (F), Tyrosine (Y), Tryptophan (W). (See also Creighton, Proteins, W. H. Freeman and Company (1984)). In some embodiments, individual substitutions, deletions or additions that alter, add or delete a single amino acid or a small percentage of amino acids can also be considered "conservative substitutions" if the change does not reduce the activity of the peptide. Insertions or deletions are typically in the range of about 1 to 5 amino acids. The choice of conservative amino acids may be selected based on the location of the amino acid to be substituted in the peptide, for example if the amino acid is on the exterior of the peptide and exposed to solvents, or on the interior and not exposed to solvents.

[0017] In alternative embodiments, one can select the amino acid which will substitute an existing amino acid based on the location of the existing amino acid, i.e. its exposure to solvents (i.e. if the amino acid is exposed to solvents or is present on the outer surface of the peptide or polypeptide as compared to internally localized amino acids or residues). Selection of such conservative amino acid substitutions are well known in the art, for example as disclosed in Dordo et al. *J. Mol. Biol.* 1999, 217, 721-739 and Taylor et al., *J. Theor. Biol.* 199(196):205-216 and S. French and B. Robson, *J. Mol. Evol.*, 13(1993):171. Accordingly, one can select conservative amino acid substitutions suitable for amino acids on the exterior of a protein or peptide (i.e. amino acids exposed to a solvent), for example, but not limited to, the following substitutions can be used: substitution of Y with F, T with S or K, P with A, E with D or Q, N with D or G, R with K, with N or A, T with S or K, D with N or E, I with L or V, F with Y, S with T or A, R with K, G with N or A, K with R, A with S, K or P.

[0018] In alternative embodiments, one can also select conservative amino acid substitutions encompassed suitable for amino acids on the interior of a protein or peptide, for example one can use suitable conservative substitutions for amino acids is on the interior of a protein or peptide (i.e. the amino acids are not exposed to a solvent), for example but not limited to, one can use the following conservative substitutions: where Y is substituted with F, T with A or S, I with L, or V with W, Y with L, N with D, G with A, T with A or S, D with N, I with L or V, F with Y or L, S with A or T, and A with S, G, T or V. In some embodiments, non-conservative amino acid substitutions are also encompassed within the term of variants.

[0019] As used herein an "antibody" refers to IgG, IgM, IgA, IgD or IgE molecules or antigen-specific antibody fragments thereof (including, but not limited to, a Fab, Fab2), Fv, disulphide linked Fc scFv, single domain antibody, closed conformation multispecific antibody, disulphide-linked scd, diabody), whether derived from any species that naturally produces an antibody, or created by recombinant DNA technology, whether isolated from serum, B cells, hybridomas, transduced cells, or yeast or bacteria. Antibodies can be humanized using routine technology.

[0020] As described herein, an "antigen" is a molecule that is bound by a binding site on an antibody agent. Typically, antigens are bound by antibody ligands and are capable of raising an antibody response *in vivo*. An antigen can be a polypeptide, protein, nucleic acid or other molecule or portion thereof. The term "antigenic determinant" refers to an epitope on the antigen recognized by an antigen-binding molecule, and more particularly, by the antigen-binding site of said molecule.

[0021] As used herein, the term "antibody fragment" refers to a polypeptide that includes at least one immunoglobulin variable domain or immunoglobulin variable domain sequence and which specifically binds a given antigen. An antibody fragment can comprise an antibody or a polypeptide comprising an antigen-binding domain of an antibody. In some embodiments, an antibody fragment can comprise a monoclonal antibody or a polypeptide comprising an antigen-binding domain of a monoclonal antibody. For example, an antibody can include a heavy (H) chain variable region (abbreviated herein as VH), and an OX40L (L) chain variable region (abbreviated herein as VL). In another example, an antibody includes two heavy (H) chain variable regions and two OX40L (L) chain variable regions. The term "antibody fragment" encompasses antigen-binding fragments of antibodies (e.g., single chain antibodies, Fab and F(ab) fragments, F(ab)2, Fd fragments, Fv fragments, scFv, and domain antibodies (dAb) fragments (see, e.g. de Wit et al., *Eur. J. Immunol.*, 1996, 26(3):629-39)) as well as complete antibodies. An antibody can have the structural features of IgA, IgG, IgE, IgD, IgM (which are all subtypes and combinations thereof). Antibodies can be from any source, including mouse, rabbit, pig, rat, and primate (human and non-human primate) and primate antibodies. Antibodies also include antibodies, humanized antibodies, chimeric antibodies, and the like.

[0022] As used herein, "antibody variable domain" refers to the portions of the OX40L and heavy chains of antibody molecules that include amino acid sequences of Complementarity Determining Regions (CDRs), i.e., CDR1, CDR2, and CDR3, and Framework Regions (FRs). VH refers to the variable domain of the heavy chain. VL refers to the variable domain of the light chain. According to the methods used in this invention, the amino acid positions assigned to CDRs and FRs may be defined according to Kabat (Sequences of Proteins of Immunological Interest (National Institutes of Health, Bethesda, MD., 1987 and 1991)) or according to IMGT nomenclature.

[0023] As used herein, the term "antibody binding site" refers to a polypeptide or domain that comprises one or more CDRs of an antibody and is capable of binding an antigen. For example, the polypeptide comprises a CDR3 (e.g., HCDR3). For example the polypeptide comprises CDRs 1 and 2 (e.g., HCDR1 and 2) or CDRs 1-3 of a variable domain of an antibody (e.g., HCDR1-3). In an example, the antibody binding site is provided by a single variable domain (e.g., a VH or VL domain). In another example, the binding site comprises a WHV, pair or two or more of such pairs.

[0024] As used herein, "genotyping" refers to a process of determining the specific allelic composition of a cell and/or subject at one or more position within the genome, e.g. by determining the nucleic acid sequence at that position. Genotyping refers to a nucleic acid analysis and/or analysis at the nucleic acid level. As used herein, "phenotyping" refers to a process of determining the identity and/or composition of an expression product of a cell and/or subject, e.g. by determining the polypeptide sequence of an expression product. Phenotyping refers to a protein analysis and/or analysis at the protein level.

[0025] As used herein, the terms "treat", "treatment", "treating", or "amelioration" refer to therapeutic treatments, wherein the object is to reverse, alleviate, ameliorate, inhibit, slow down or stop the progression or severity of a condition associated with a disease or disorder. The term "treating" includes, reducing or alleviating at least one adverse effect or symptom of a condition, disease or disorder. Treatment is generally "effective" if one or more symptoms or clinical markers are reduced. Alternatively, treatment is "effective" if the progression of a disease is reduced or halted. That is, "treatment" includes not just the improvement of symptoms or markers, but also a cessation of, or at least slowing of, progress or worsening of symptoms compared to what would be expected in the absence of treatment. Beneficial or desired clinical results include, but are not limited to, alleviation of one or more symptom(s), diminishment of extent of disease, stabilized (i.e., not worsening) state of disease, delay or slowing of disease progression, amelioration or palliation of the disease state, remission (whether partial or total), and/or decreased mortality, whether detectable or undetectable. The term "treatment" of a disease also includes providing relief from the symptoms or side-effects of the disease (including palliative treatment). For treatment to be effective a complete cure is not contemplated. The method can in certain aspects include cure as well.

[0026] As used herein, the term "pharmaceutical composition" refers to the active agent in combination with a pharmaceutically acceptable carrier e.g. a carrier commonly used in the pharmaceutical industry. The phrase "pharmaceutically acceptable" is employed herein to refer to those compounds, materials, compositions, and/or device forms which are, within the scope of sound medical judgment, suitable for use in contact with the tissues of human beings and animals without excessive toxicity, irritation, allergic response, or other problem or complication, commensurate with a reasonable benefit/risk ratio.

[0027] As used herein, the term "administering" refers to the placement of a compound as disclosed herein into a subject by a method or route which results in at least partial delivery of the agent at a desired site. Pharmaceutical compositions comprising the compounds disclosed herein can be administered by any appropriate route which results in an effective treatment in the subject.

[0028] Multiple compositions can be administered separately or simultaneously. Separate administration refers to the two compositions being administered at different times, e.g. at least 10, 20, 30, or 10-60 minutes apart, or 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12 hours apart. One can also administer compositions at 24 hours apart, or even longer apart. Alternatively, two or more compositions can be administered simultaneously, e.g. less than 10 or less than 5 minutes apart. Compositions administered simultaneously can, in some aspects, be administered as a mixture, with or without similar or different time release mechanism for each of the components.

[0029] As used herein, "authorization number" or "marketing authorization number" refers to a number issued by a regulatory agency upon that agency determining that a particular medical product and/or composition may be marketed and/or offered for sale in the area under the agency's jurisdiction. As used herein "regulatory agency" refers to one of the agencies responsible for evaluating, e.g., the safety and efficacy of a medical product and/or composition and controlling the sales/marketing of such products and/or compositions in a given area. The Food and Drug Administration (FDA) in the US and the European Medicines Agency (EMA) in Europe are but two examples of such regulatory agencies. Other non-limiting examples can include SDA, MPA, MHRA, ANMAT, HONG KONG Department of Health-Drug Office, CDSCO, Medsafe, and KFDA.

[0030] As used herein, "injection device" refers to a device that is designed for carrying out injections, an injection including the steps of temporarily fluidically coupling the injection device to a person's tissue, typically the subcutaneous tissue. An injection further includes administering an amount of liquid drug into the tissue and decoupling or removing the injection device from the tissue. In some embodiments, an injection device can be an intravenous device or IV device, which is a type of injection device used when the target tissue is the blood within the circulatory system, e.g., the blood in a vein. A common, but non-limiting example of an injection device is a needle and syringe.

[0031] As used herein, a "buffer" refers to a chemical agent that is able to absorb a certain quantity of acid or base without undergoing a strong variation in pH.

[0032] As used herein, "packaging" refers to how the components are organized and/or restrained into a unit fit for distribution and/or use. Packaging can include, e.g., boxes, bags, syringes, ampoules, vials, tubes, clamshell packaging, barriers and/or containers to maintain sterility, labeling, etc.

[0033] As used herein, "instructions" refers to a display of written, printed or graphic matter on the immediate container of an article, for example the written material displayed on a vial containing a pharmaceutically active agent, or details on the composition and use of a product of interest included in a kit containing a composition of interest. Instructions set forth the method of treatment as contemplated to be administered or performed.

[0034] As used herein the term "comprising" or "comprises" is used in reference to antibodies, fragments, uses, compositions, methods, and respective component(s) thereof, that are essential to the method or composition, yet open to the inclusion of unspecified elements, whether essential or not.

[0035] The term "consisting of" refers to antibodies, fragments, uses, compositions, methods, and respective components thereof as described herein, which are exclusive of any element not recited in that description of the embodiment.

[0036] As used herein the term "consisting essentially of" refers to those elements required for a given embodiment. The term permits the presence of elements that do not materially affect the basic and novel or functional characteristic(s) of that embodiment.

[0037] The singular terms "a," "an," and "the" include plural referents unless context clearly indicates otherwise. Similarly, the word "or" is intended to include "and" unless the context clearly indicates otherwise. Although methods and materials similar or equivalent to those described herein can be used in the practice or testing of this disclosure, suitable methods and materials are described below. The abbreviation, "e.g." is derived from the Latin exempli gratia, and is used herein to indicate a non-limiting example. Thus, the abbreviation "e.g." is synonymous with the term "for example."

[0038] Definitions of common terms in cell biology and molecular biology can be found in "The Merck Manual of Diagnosis and Therapy", 19th Edition, published by Merck Research Laboratories, 2006 (ISBN 0-911910-10-0); Robert S. Porter et al. (eds.), The Encyclopedia of Molecular Biology, published by Blackwell Science Ltd., 1994 (ISBN 0-632-02182-9); Benjamin Lewin, Genes, published by Jones & Bartlett Publishing, 2009 (ISBN-10: 0763766321); Kendrew et al. (eds.), Molecular Biology and Biotechnology: A Comprehensive Desk Reference, published by VCH Publishers, Inc., 1995 (ISBN 1-56091-569-8) and Current Protocols in Protein Sciences 2009, Wiley Intersciences, Coligan et al., eds.

[0039] Unless otherwise stated, the present invention was performed using standard procedures, as described, for example in Sambrook et al., Molecular Cloning: A Laboratory Manual (4 ed.), Cold Spring Harbor Laboratory Press, Cold Spring Harbor, N.Y., USA (2012); Davis et al., Basic Methods in Molecular Biology, Elsevier Science Publishing, Inc., New York, USA (1995); or Methods in Enzymology: Guide to Molecular Cloning Techniques Vol.152, S. L. Berger and A. R. Kimmel Eds., Academic Press Inc., San Diego, USA (1987); Current Protocols in Protein Science (CPS) (John E. Coligan, et al., ed., John Wiley and Sons, Inc.), Current Protocols in Cell Biology (CPCB) (Juan S. Bonifantio et al., ed., John Wiley and Sons, Inc.), and Culture of Animal Cells: A Manual of Basic Technique by R. Ian Freshney, Publisher: Wiley-Liss; 5th edition (2005), Animal Cell Culture Methods (Methods in Cell Biology, Vol. 57, Jennie P. Mather and David Barnes editors, Academic Press, 1st edition, 1996).

[0040] The use of the word "a" or "an" when used in conjunction with the term "comprising" in the claims and/or the specification may mean "one," but it is also consistent with the meaning of "one or more," "at least one," and "one or more than one." The use of the term "in" in the claims is used to mean "in" or "into" unless explicitly indicated to refer to alternatives only or the alternatives are mutually exclusive, although the disclosure supports a definition that refers to only alternatives and "and/or." Throughout this application, the term "about" is used to indicate that a value includes the inherent variation of error for the device, the method being employed to determine the value, or the variation that exists among the study subjects.

[0041] As used in this specification and claim(s), the words "comprising" (and any form of comprising, such as "comprises" and "comprising"), "having" (and any form of having, such as "have" and "has"), "including" (and any form of including, such as "includes" and "include") or "containing" (and any form of containing, such as "contains" and "contain") are inclusive or open-ended and do not exclude additional, unrecited elements or method steps.

[0042] Any part of this disclosure may be read in combination with any other part of the disclosure, unless otherwise apparent from the context.

EXAMPLES

Example 1

Antigen Preparation, Immunization Procedures, and Hybridoma Generation

[0043] The following example provides a detailed description of the generation and identification of a panel of anti-human OX40L monoclonal antibodies using the *KyMac*™ system (see, e.g., WO2911/004192). To this end, genetically engineered mice containing a large number of human immunoglobulin genes were immunized with soluble recombinant human OX40L (commercial or in-house produced) or surface expressed human OX40L displayed on mouse embryonic fibroblast (MEF) cells. Various immunization regimes, including conventional intraperitoneal injections as well as a rapid immunisation at multiple sites regime were set up, boosting animals over several weeks. At the end of each regime, secondary lymphoid tissue such as the spleen, and in some cases, the lymph nodes were removed. Tissues were prepared into a single cell suspension and fused with SP2/0 cells to generate a stable hybridoma cell line.

Materials and Methods

Cloning, expression and purification of recombinant Rheus and human OX40L

[0644] cDNA encoding the extracellular domain of human OX40L was cloned into a pREP4 expression plasmid (Invitrogen) using standard molecular biology techniques. The constructs also contained a FLAG peptide motif to aid purification and an isoleucine zipper motif to aid trimerisation. Constructs were sequenced to ensure their correct sequence composition.

[0645] Rhesus (*Macaca mulatta*) OX40L was created using the human OX40L plasmid created above as a template and using site directed mutagenesis to introduce the amino acid changes.

[0646] Human OX40L, well as Rhesus monkey OX40L were expressed transiently to produce recombinant protein using Invitrogen's Freestyle™ CHO-S suspension adapted cell line. Plasmids were transfected into the cells using PEI (polyethylenimine MW4000) and left to overgrow for a period of 13 days before harvesting the supernatant for purification. Cells were fed during the overgrow process with AdiCHO™ Feeds A and B from GE Healthcare to help boost productivity and promote longevity of the cells. During the overgrow process samples were taken regularly to monitor cell growth and viability.

[0647] FLAG-tagged OX40L proteins were purified in a two-step process, firstly the clarified tissue culture supernatants from the CHO-S expression were purified using M2 anti-FLAG affinity chromatography. The eluted fractions containing the OX40L protein were then subjected to size exclusion chromatography and assessed for purity by SDS-PAGE analysis and quantified by spectrophotometer reading at OD280nm.

Cloning, expression and purification of recombinant human OX40 receptor

[0648] cDNA encoding the extracellular domain of human OX40 Receptor was cloned into a pREP4 expression plasmid (Invitrogen) using standard restriction enzyme digestion and ligation. The construct contained a human Fc portion to aid purification. Constructs were sequenced to ensure their correct sequence composition.

[0649] Human OX40 Receptor was expressed transiently to produce recombinant protein using Invitrogen's Freestyle™ CHO-S suspension adapted cell line. Plasmids were transfected into the cells using PEI (polyethylenimine MW 4000) and left to overgrow for a period of 13 days before harvesting the supernatant for purification. Cells were fed during the overgrow process with AdiCHO™ Feeds A and B from GE Healthcare to help boost productivity and promote longevity of the cells. During the overgrow process, samples were taken regularly to monitor cell growth and viability.

[0650] The Fc tagged OX40 Receptor protein was purified in a two-step process, firstly the clarified tissue culture supernatants from the CHO-S expression were purified using Protein G affinity chromatography. The eluted fractions containing the OX40 Receptor protein were then subjected to size exclusion chromatography and assessed for purity by SDS-PAGE analysis and quantified by spectrophotometer reading at OD280nm.

Generation of stably transfected MEF and CHO-S cells expressing human OX40L

[0651] The full human OX40L sequences were codon optimized (Seq ID No:173) for mammalian expression and cloned into an expression vector under the CMV promoter flanked by 3' and 5' piggyBac specific terminal repeat sequences facilitating stable integration into the cell genome (see: "A hyperactive piggyBac transposase for mammalian applications", Yusa K, Zhou L, Li MA, Bradley A, Craig NL. Proc Natl Acad Sci USA. 2011 Jan 25). Furthermore, the expression vector contained either a puromycin or neomycin selection cassette to facilitate stable cell line generation. The hOX40L expression plasmid was co-transfected with a plasmid encoding piggyBac transposase into an in-house derived mouse embryonic fibroblast (MEF) cell line (embryos used to generate this line were obtained from a 129S5 crossed to C57BL6 female mouse) and CHO-S cells using the FreeStyle Maxtransfection reagent (Invitrogen) according to manufacturer instructions. 24 hours after transfection, the media was supplemented with G418 or neomycin and grown for at least 2 weeks to select a stable cell line, with media being exchanged every 3-4 days. The expression of hOX40L was assessed by flow cytometry using an anti-human OX40L-PE conjugated antibody (eBioscience). Complete MEF media was made up of Dubecco's Modified Eagle's Medium (Gibco) supplemented with 10% v/v fetal bovine serum (Gibco). Complete CHO-S media was made up of CD-CHO media supplemented with 8mM glutamax (Gibco).

Generation of HT1080 expressing OX40R and NF-Kappa reporter Gene

[0652] The full human OX40 receptor sequence was codon optimized (Seq ID No:175) for mammalian expression and cloned into an expression vector under the CMV promoter flanked by 3' and 5' piggyBac specific terminal repeat sequences facilitating stable integration into the cell genome (see: "A hyperactive piggyBac transposase for mammalian applications", Yusa K, Zhou L, Li MA, Bradley A, Craig NL. Proc Natl Acad Sci USA. 2011 Jan 25). Furthermore, the expression vector contained either a puromycin selection cassette to facilitate stable cell line generation. The hOX40L receptor expression plasmid was co-transfected with a plasmid encoding piggyBac transposase into HT1080 cells (ATCC® CCL-121) using the FreeStyle Maxtransfection reagent (Invitrogen) according to manufacturer instructions. 24 hours after transfection, the media was supplemented with puromycin and grown for at least 2 weeks to select a stable cell line with media being exchanged every 3-4 days. The expression of OX40 receptor was assessed by flow cytometry using an anti-human OX40 receptor-PE conjugated antibody (R&D, clone 443316). Following the generation of a stable cell line expressing the OX40 receptor, cells were transfected with the pHTF-2-SEAP plasmid (Invitrogen) containing 5 repeated NFkB transcription factor binding sites followed by secreted alkaline phosphatase. Stable cells were selected with the addition to azido to the media with fresh media being added every 3-4 days. Complete HT1080 media was made up of MEM supplemented with 10% fetal calf serum.

Preparation of MEF cells for mouse immunizations:

[0653] Cell culture medium was removed and cells washed once with 1xPBS. Cells were treated for 5 minutes with trypsin to loosen cells from tissue culture surface. Cells were collected and trypsin neutralized by the addition of complete media containing 10% v/v fetal bovine serum (FCS). Cells were then centrifuged at 300 xg for 10 minutes and washed with 25 mL of 1xPBS. Cells were counted and resuspended at the appropriate concentration in 1xPBS.

Immunization Procedures:

[0654] Transgenic Kymize were immunized with hOX40L. In either soluble recombinant form, expressed by CHO-S cells, or membrane bound form, expressed by stably transfected MEF cells.

[0655] When immunizing with cells, the adjuvant was mixed with cells at a 1:1 v/v ratio and gently mixed by pipetting before injecting intraperitoneally. When immunizing with protein, the adjuvant was mixed with protein at a 1:1 v/v ratio and vortexed repeatedly. All mice were bled before being primed and then boosted every three weeks. At least 3 serial bleeds spaced apart at least 2 weeks were collected and analysed for hOX40L specific IgG titre using an ELISA or flow cytometry based assay

Determination of serum titers by FACS using CHO-S expressing hOX40L

[0656] CHO-S cells expressing hOX40L or untransfected CHO-S cells, diluted in FACS buffer (PBS + 1% w/v BSA + 0.1% w/v NaN₃) were distributed to a 96 well V-bottom plate (Greiner) at a density of 1x10⁵ cells per well. Cells were washed with 150 µL of PBS and centrifuged at 300 xg for 3 min. Supernatant was aspirated and 150 µL of PBS added. This wash step was repeated. A titration of mouse serum was prepared, diluting samples in FACS buffer. 50 µL/well of this titration was then added to the cell plate. To determine the change in activity level due to immunization, serum from each animal prior to immunization was diluted to 1 in 100 in FACS buffer and 50 µL/well added to the cells. A suitable reference antibody (anti-OX40L antibody MAB10541, R&D systems) or mouse IgG1 control antibody (Sigma) were diluted in FACS buffer (between 1-9 µg/mL) and 50 µL added to cells. Cells were incubated at 4 °C for 30 minutes. Cells were washed twice with 150 µL of PBS, centrifuging after each wash step and aspirating supernatant (centrifuged at 300 xg for 3 minutes). To detect antibody binding, APC goat-anti-mouse IgG (Jackson ImmunoResearch) was diluted 1 in 500 in FACS buffer and 50 µL was added to the cells. Cells were incubated 30 minutes at 4 °C in dark. Cells were washed twice with 150 µL of PBS centrifuging after each wash step and aspirating supernatant (centrifuged at 300 xg for 3 minutes). To fix cells 100 µL 2% v/v paraformaldehyde was added and cells incubated for 30 minutes at 4°C, cells were pelleted by centrifugation at 300 xg and the plates resuspended in 50 µL of FACS buffer. APC signal intensity (geomean) was measured by flow cytometry using a BD FACS Array instrument.

Determination of serum titers by DELFIA immunoassay using recombinant hOX40L

[0657] Titres in mouse serum samples were determined using a reverse OX40L ELISA protocol. Anti-mouse IgG capture antibody (Southern Biotech) (4 µg/mL, diluted in PBS, 50 µL/well) was adsorbed to 96 well low auto-fluorescent, high protein binding plates (Costar) overnight at 4 °C. Excess IgG was removed by washing with PBS-Tween (0.1% v/v) and the wells were blocked with 1% v/v bovine serum albumin (BSA, Sigma) in PBS for 1 hr at RT, after which plates were washed as described previously. A titration of mouse serum was prepared, diluting samples in reagent diluent (0.1% w/v BSA/PBS). 50 µL/well of this titration was then added to ELISA plates. To determine the change in activity level due to immunization, serum from each animal prior to immunization was diluted to 1 in 100 in reagent diluent and 50 µL/well added to the ELISA plate. As a positive control for biotinylated OX40L binding an anti-OX40L antibody (MAB10541, R&D systems) diluted to 1 µg/mL was added to plates at 50 µL. Mouse IgG1 isotype control (Sigma) was included as a negative control and was diluted to 1 µg/mL in reagent diluent and 50 µL/well added to ELISA plate. In some instances serum sample from a mouse immunized with a non-relevant antigen was diluted 1 in 1000 and 50 µL/well was added to the ELISA plate. The plates were incubated at room temperature for at least 1 hour. Following incubation, plates were washed as before to remove unbound proteins. Biotinylated OX40L (100 ng/mL in reagent diluent; 50 µL/well) was then added to the plate and incubated at RT for 1 hour. Unbound biotinylated OX40L was removed by washing with PBS-Tween (0.1% v/v), while the remaining biotinylated OX40L was detected by streptavidin-Europium3+ conjugate (DELFLA® detection, PerkinElmer) diluted in DELFLA® assay buffer (Perkin Elmer) or streptavidin-HRP diluted in reagent diluent.

[0658] In the case of streptavidin-HRP, the plates were washed as described before and 50 µL of TMB (Sigma) was added to the plate. Then the reaction was stopped by adding 50 µL of 1M sulfuric acid (Fluka analytical). The OD at 450 nm was measured on an Envision plate reader (PerkinElmer).

[0659] In case of streptavidin-Europium3+, the plates were washed with TBS (Tris buffered saline)-Tween (0.1% v/v) and 200µL/well of DELFLA Enhancement solution (Perkin Elmer) was added to the plate. The time-resolved fluorescence was measured at 615 nm on an Envision plate reader (PerkinElmer). Fluorescence data was plotted as Europium counts.

Murine tissue isolation and preparation:

[0660] Spleens were excised from immunised mice and washed in 1xPBS and kept on ice until further processing. Tissues were prepared in buffer containing 1xPBS (Invitrogen) and 3% heat-inactivated FBS (Invitrogen). Spleenocytes were dispersed by mashing the tissue through a 45 µm strainer (BD Falcon) and rinsing with 30 mL 3xPBS/PBS buffer before centrifugation at 700 xg for 10 minutes at 4 °C. To remove red blood cells, the pelleted spleenocytes were resuspended in 4 mL of Red Blood Cell Lysis Buffer (Sigma). After 4 minutes of incubation, the lysis reaction was stopped by addition of 3% PBS/1xPBS buffer. Cell clumps were filtered out with a 45 µm strainer. The remaining spleenocytes were pelleted for further procedures.

Hybridoma Fusion

[0661] For the KM055 experiment, pelleted spleenocytes were progressed directly to fusion without any selection or overnight CpG stimulation. For the KM040 experiment, B-cells were subjected to a positive selection method using the MACS® Separation system. Cells were resuspended in 50 µL 3% PBS/PBS buffer per 1x10⁷ cells, before adding anti-mouse IgG1 plus anti-mouse IgG2a+b MicroBeads (Miltenyi Biotec) and incubated for 15 minutes at 4 °C. The cells/microBeads mixture was then applied to a pre-wetted LS column placed in a magnetic MACS Separator and washed with 3% PBS/PBS buffer. IgG1 positive cells were collected in the labelled, column-bound fraction in 3% PBS/PBS buffer.

[0662] For the KM040 experiment, enriched B-cells were treated with CpG overnight (final concentration 25 µM) and the following day washed once in BSA fusion buffer (0.3M D-Sorbitol, 0.11 mM calcium acetate hydrate, 0.5 mM magnesium acetate tetrahydrate and 0.1% BSA (v/v), adjusted to pH7.2). For the KM055 experiment, pelleted spleenocytes from red blood cell lysis were washed once in BSA fusion buffer on the same day as tissue preparation. Fusion occurred in the same way for both experiments after this point. Washed cells were resuspended in 200 µL of BSA fusion buffer and cell count determined. SP20 cells were treated in the same way, but washed twice with BSA fusion buffer. B-cells were fused at a ratio of 3:1 with SP20 myeloma cells by electrosolusing using a BTX ECM 2001 Electro Cell Manipulator (Harvard Apparatus). Each fusion was left overnight in recovery medium (Dubecco's Modified Eagle's Medium - high glucose (no phenol red, no L-G) containing OPI (Sigma), L-Glutamax (Gibco), 20% FBS (Gibco, batch-tested for hybridoma) and 2-mercaptoethanol). On the final day, cells were pelleted and resuspended in 1 part recovery medium to 9 parts semi-solid media (Clonacell-HF Hybridoma Selection Medium D, Stemcell Technologies) and then seeded onto 10 cm petri dishes. Colonies were picked 12 days later into 96-well plates and cultured for another 2-3 days prior to screening.

Example 2

Hybridoma Supernatant Screening

[0663] After generation of hybridoma clones, the hybridoma supernatant was assessed in a sequential primary and secondary screen and appropriate hybridoma clones selected based on criteria of antibody binding to CHO expressed hOX40L and receptor neutralization activity (see details in materials and methods) (Table 1).

[0664] For the primary screen, the inventors devised the following selection criteria: wells containing hybridoma clones were selected if antibodies present in the supernatant could bind to natively displayed hOX40L expressed on the cell surface. This assay was set up by plating CHO-S cells expressing hOX40L on the cell surface, followed by incubation with hybridoma supernatant, followed by a fluorescent detection antibody. The presence of an anti-OX40L antibody in the supernatant was read-out using a plate reader capable of reading the appropriate fluorescence. Furthermore, the inventors assessed hybridoma supernatant for binding to recombinantly expressed human OX40, using a HTRF (Homogeneous Time Resolved Fluorescence) assay. The inventors also determined whether the hybridoma supernatant had the ability to reduce the binding of human recombinant OX40L to human OX40R Fc. Clones meeting certain selection criteria (see further detailed description below), using data from the above mentioned three primary screen assays, were then cherry-picked and moved on to a secondary screen where the ability of each antibody to neutralize hOX40L binding to its receptors, OX40 Receptor (aka CD134), was determined. The inventors decided to assess this using a receptor neutralization HTRF assay and a flow cytometry-based receptor neutralization assay. Lastly, the inventors decided to analyse hybridoma supernatant by SPR to evaluate apparent affinity of the antibodies to recombinant trimeric human OX40L, as well as cross-reactivity to Rhesus monkey OX40L.

[0665] Antibodies were defined as a secondary hit when antibodies in hybridoma supernatant bound to hOX40L, with high apparent affinity as well as cross-reacted with recombinant Rhesus monkey OX40L. Additionally, antibodies in the supernatant had to show the ability to neutralize hOX40L binding to its receptor, i.e. OX40 Receptor (aka CD134) in either HTRF or flow cytometry based assay.

Materials and Methods

Primary screen - Binding to cell expressed human OX40L

[0666] Supernatants collected from hybridoma cells were tested to assess the ability of secreted antibodies to bind to hOX40L expressed on the surface of CHO-S cells. To determine CHO-S hOX40L binding, cells were plated in clear bottom tissue culture treated 384-well plates (Costar or BRAND) at 2x10⁴ cells/well in F12 media (GIBCO) supplemented with 10% v/v FBS (GIBCO) and cultured overnight. Culture media was removed from 384-well assay plates. At least 40 µL of hybridoma supernatant or positive control anti-human OX40L reference antibody (at a final concentration of 1 µg/mL) or isotype IgG1 control antibody (relevant to in some instances as Ctrl; Sigma M8260) at a final concentration of 1 µg/mL diluted in hybridoma maintaining media (HMM) were added to each well. Hybridoma maintaining media was made up of: Adenod DMEM (Gibco) supplemented with 1x Glutamax (Gibco), 20% v/v FBS (Gibco), 0.05 mM p-Mercaptoethanol, 1xHT supplement (Gibco), and 1xpenicillin/streptomycin (Gibco). Plates were incubated for 1 hour at 4 °C. Culture media was aspirated and 50 µL of goat anti-mouse Alexa Fluor 700 (Jackson ImmunoResearch, H15-655-071) at 1000 ng/mL, supplemented with 0.2 µM DRAQOS (Bioassays) diluted in FACS Buffer (PBS+1% w/v BSA+0.1% v/v NaN₃) were added. Plates were again incubated for 1 hour at 4 °C. Supernatant was aspirated and 25 µL of 4% v/v paraformaldehyde added and plates were incubated 15 minutes at room temperature. Plates were washed twice with 100 µL PBS and then the wash buffer was completely removed. Fluorescence intensity was read by scanning plates using an Odyssey Infrared Imaging System (LI-COR®). Anti-mouse binding (600 nm channel) was normalised to cell number (700 nm channel) according to LI-COR® recommended algorithm. Percent effect was calculated as detailed below (Equation 1). Total binding was defined using reference antibody at a final assay concentration of 1 µg/mL. Non specific binding was defined using mouse IgG1 isotype control (Sigma) at a final assay concentration of 1 µg/mL. Wells were defined as hits where percent effect was greater than or equal to 5%.

Equation 1: Calculation of Percentages Effect from Primary Screen (LI-COR® and HTRF) (Using 800% Resp values (LI-COR®) or 66.6620nm ratio (see Equation 2) (HTRF))

sample well - non specific binding

Percent effect = $\frac{\text{total binding} - \text{non specific binding}}{\text{total binding} - \text{non specific binding}}$

[0647] Non-specific binding = values from wells containing isotype control mouse IgG1 or HMM or buffer

[0648] Total Binding (Binding HTRF and ICORF) = values from wells containing reference antibody Total binding (OX40L/OX40RFc assay) = OX40L and OX40RFc

Primary screen: Binding to recombinant human OX40L:

[0649] In parallel to screening for binding to CHO-S expressed OX40L, supernatants collected from hybridoma wells were also tested to assess the ability of secreted antibodies to bind to hOX40L expressed as a recombinant protein (produced in-house, see details in Example 1). Binding of secreted antibodies to recombinant hOX40L were identified by HTRF® (Homogeneous Time-Resolved Fluorescence, Cytobio) assay format using biotinylated hOX40L. 5 µL of hybridoma supernatant was transferred to a white 384 well low volume non binding surface polystyrene plate (Greiner). Then 5µL of biotinylated hOX40L (working concentration 20 nM) diluted in HTRF buffer (PBS (Sigma) + 0.5 M KF (Sigma) + 0.1% w/v BSA (Sigma) was added. 5 µL of combined detection reagents Streptavidin D2 (Cytobio) diluted 1:100 in HTRF assay buffer for final dilution 1:400 and goat anti-mouse IgG (Southern Biotech) labelled with europium cryptate (Cytobio) diluted 1:100 in HTRF assay buffer for final dilution 1:400 were added. The concentration of goat anti-mouse IgG (Southern Biotech) labelled with europium cryptate was batch dependent and in some cases a dilution of 1:1000 was performed to achieve a final assay concentration of 1:4000. To adjust the total assay volume to 20 µL, 5 µL of HTRF assay buffer was added to all wells. To define non-specific binding, addition of positive control antibody or hybridoma media was replaced with HTRF assay buffer or HMM. The plate was left to incubate in dark for 3 hours prior to reading time resolved fluorescence at 620 nm and 665 nm emission wavelengths using an EnVision plate reader (Perkin Elmer). More details of the HTRF® assay technology can be found in Mathis (1995) Clinical Chemistry 41(9), 1391-1397. Data were analysed by calculating 665/620 ratio and percent effect for each sample according to Equation 2 and Equation 1 respectively.

Equation 2: Calculation of 665/620 ratio

665/620 ratio = $\frac{\text{sample 665/620 nm value}}{\text{sample 665/620 nm value}} \times 10000$

[0670] For clones derived from KM049-1 and KM055-1 a selection criteria of greater than or equal to 20 percent effect was applied by the inventors to define a well as a hit from recombinant hOX40L binding as described in Table 1.

Primary screen: human OX40L/human OX40R Fc binding assay:

[0671] In order to determine whether supernatants collected from hybridoma wells inhibited the binding of OX40L to OX40RFc, secreted antibodies were tested in an OX40L/OX40RFc binding HTRF® assay. 5 µL of hybridoma supernatant was transferred to a white 384 well low volume non-binding surface polystyrene plate (Greiner). Biotinylated OX40L was diluted in HTRF assay buffer to a working concentration of 2.4 nM and 5 µL added. OX40RFc was then diluted to working concentration of 4.8 nM and 5 µL added. Non-specific binding was defined by replacing OX40RFc with assay buffer or HMM. Streptavidin cryptate (Cytobio) and anti-human Fc D2 (Cytobio) were diluted in HTRF assay buffer to working concentration of 1:100 and 5 nM respectively. Plates were covered, protected from light and incubated at room temperature for 3 hrs prior to reading time resolved fluorescence at 620 nm and 665 nm emission wavelengths using an EnVision plate reader (Perkin Elmer). Data were analysed by calculating 665/620 ratio and percent effect for each sample according to Equation 2 and Equation 5 respectively.

[0672] For clones derived from KM049-1 and KM055-1, a selection criteria of less than or equal to 90 percent of the assay signal of OX40 receptor Fc binding to OX40L was applied by the inventors to define a well as a hit as described in Table 1.

Secondary screen: Binding to cell expressed and recombinant human OX40L

[0673] To determine whether wells selected using the primary screen selection criteria had the required characteristics set by the inventors, a number of assays were performed. Hybridoma clones selected as hits from primary screening were cultured for 3 days and the supernatants collected from hybridoma clones were tested to assess whether the secreted antibodies that bind to CHO-S expressed hOX40L, in some case bind to untransfected CHO-S cells and whether they neutralise recombinant OX40R Fc binding to CHO-S hOX40L and ability to neutralise OX40R binding to recombinant biotinylated hOX40L.

Binding to CHO-S expressed hOX40L and receptor neutralisation:

[0674] CHO-S cells expressing hOX40L or untransfected CHO-S cells, diluted in FACS buffer (PBS + 1% w/v BSA + 0.1% w/v NaN₃) were distributed to a 96 well V-bottom plate (Greiner) at a density of 1×10⁵ cells per well. Cells were washed with 150 µL of PBS and centrifuged at 300 xg for 3 min. Supernatant was aspirated and 150 µL of PBS added. This wash step was repeated.

[0675] 25 µL of hybridoma supernatant or purified antibody from hybridoma supernatant diluted in FACS buffer was added to the washed cells and incubated for 10-15 minutes. Reference Antibody or mouse IgG1 control antibody (Sigma) were diluted in FACS buffer to 20 µg/mL and 25 µL added to cells. 25 µL of human OX40R Fc (in-house) diluted to 1000 ng/mL in FACS buffer were then added to wells. Cells were incubated at 4 °C for 30 minutes.

[0676] Cells were washed twice with 150 µL of PBS centrifuging after each wash step and aspirating supernatant (centrifuged at 300 xg for 3 minutes).

[0677] To detect antibody and receptor binding, 50 µL of goat anti-human IgG-PE (Jackson ImmunoResearch) and APC anti-mouse IgG (Jackson ImmunoResearch) diluted 1 in 500 in FACS buffer was added to the cells. Cells were incubated 30 minutes at 4 °C in the dark.

[0678] Cells were washed twice with 150 µL of PBS centrifuging after each wash step and aspirating supernatant (centrifuged at 300 xg for 3 minutes).

[0679] To fix cells 100 µL 2% v/v paraformaldehyde was added and cells incubated for 30 minutes at 4 °C, cells were pelleted by centrifugation 300 xg and the plates and resuspended in 50 µL of FACS buffer. PE and APC signal intensity (geomean) was measured by flow cytometry using a BD FACS Array instrument.

[0680] % of control binding was calculated using geomean fluorescence as described in equation 1 where total binding was defined as reference antibody at 10 µg/mL and non-specific binding as mouse IgG1 antibody at 10 µg/mL. % receptor binding was calculated using Equation 3.

Equation 3: Percentage of receptor binding (FACS)

[0681] Based on geomean fluorescence
% of Receptor binding = $\frac{\text{sample value} - \text{non specific binding}}{\text{total binding} - \text{non specific binding}} \times 100$

[0682] Non-specific binding = No antibody, no receptor
Total binding = receptor (OX40R) only binding (no inhibitor) + isotype control at 10 µg/mL

Secondary Screen – HTRF Ligand/Receptor Neutralisation

[0683] To determine whether antibodies identified from primary screen neutralise OX40L binding to OX40RFc an human OX40L/human OX40R Fc binding assay was performed as described for primary screen.

[0684] Plates were left to incubate in dark for 3 hours prior to reading time resolved fluorescence at 620 nm and 665 nm emission wavelengths using an EnVision plate reader (Perkin Elmer). More details of the HTRF® assay technology can be found in Mathis (1995) Clinical Chemistry 41(9), 1391-1397. Data were analysed by calculating delta F as described in Equation 4 and percentage of receptor for each sample according to Equation 5.

Equation 4: Calculation of % delta F

% delta F = $\frac{\text{sample 665/620 nm ratio value} - (\text{non-specific control 665/620 nm ratio value})}{(\text{non-specific control 665/620 nm ratio value})} \times 100$

Equation 5: Percentage of receptor binding (HTRF)

[0685] Based on calculation of % delta F (Equation 4) or 665/620 ratio (Equation 2)
% of Receptor binding = $\frac{\text{sample value} - \text{non specific binding}}{\text{total binding} - \text{non specific binding}} \times 100$

Non specific binding = HMM or buffer + OX40L (no receptor)

Total binding = receptor (OX40R) and OX40L (no inhibitor)

Hit criteria selection from secondary screening:

[0686] A panel of hits were selected based on binding and neutralisation assays. Hits in CHO-S OX40L binding assay were defined by the inventors as significant binding to CHO-S OX40L cells and no binding to CHO-S cells by FACS. Hits were further defined as having the ability to significantly reduce OX40RFc binding to recombinant OX40L (HTRF) and significantly reduce OX40RFc binding to hOX40L expressed on CHO cells. Data is summarised in Table 1. Apparent affinity measurements by SPR were also considered.

Example 3

Antibody Lead Characterisation

[0687] Based on the screening selected wells were expanded and murine/human chimeric antibodies purified using a standard Protein G based affinity chromatography purification (see method below). The antibodies were subjected to various assays to assess their ability to block hOX40L binding to it receptor OX40R, as well as the ability of each antibody to bind to human as well as Rhesus monkey OX40L with high apparent affinity. To decipher which antibodies were the best, selected clones were tested using OX40L/OX40RFc-HTRF assay and OX40L induced IL2 release from primary human T-cells.

Table 1: Antibody Lead Characterisation

Antibody	FACS Binding	HTRF Receptor Neutralisation IC50 nM (+/- SEM)	Primary T-cell Assay IC50 nM (+/- SEM)	Apparent Affinity hOX40L (nM)	Apparent Affinity RhuOX40L (nM)
10A07 (hybridoma)	YES	+++	+++	CNROR	CNROR
10A07 (human)	YES	+++ 1.2nM (+/-0.17)	+++ 0.83nM (+/- 1.2)	CNROR	CNROR
2D10 (hybridoma)	YES	+++	ND	CNROR	CNROR
2D10 (human)	ND	+++ 0.75nM (+/-0.04)	+++ 0.81nM (+/- 0.06)	CNROR	CNROR
9H04 (hybridoma)	YES	++	ND	S 3	ND
19H01 (hybridoma)	YES	+	ND	2.2	ND
CHORFc= Control resolve offsite					
IC50 data represents arithmetic mean +/- standard error of mean (SEM) for three independent experiments or donors.					

Materials and Methods:

Purification of antibodies from hybridoma supernatant:

[0688] Antibodies were purified using Protein G affinity chromatography. Antibodies were eluted from the Protein G media using IgG Elute reagent (Pierce) and the eluted antibodies were buffer swapped into PBS prior to use. Antibody purity was assessed by SDS-PAGE analysis and quantified by spectrophotometer reading at OD280 nm.

[0689] Binding of antibodies purified from hybridoma supernatant was carried out as described herein.

HTRF Ligand/Receptor Neutralisation.

[0690] The following methods were carried out with a titration of inhibitor in order to establish the clone potency as measured by IC50 values in the assay. Antibody binding from hybridoma was titrated by diluting in HTRF assay buffer and 5 µL of this titration transferred to a white 384 well low volume non-binding surface polystyrene plate (Greiner). Biotinylated OX40L was diluted in HTRF assay buffer to a working concentration of 2.4 nM and 5 µL added. OX40RFc was then diluted to working concentration of 4.8 nM and 5 µL added. Non-specific binding was defined by replacing OX40RFc with assay buffer or HMM. Streptavidin cryptate (Cytobio) and anti-human Fc D2 (Cytobio) were diluted in HTRF assay buffer to working concentration of 1:100 and 5 nM respectively. Plates were covered, protected from light and incubated at room temperature for 3 hrs prior to reading time resolved fluorescence at 620 nm and 665 nm emission wavelengths using an EnVision plate reader (Perkin Elmer). Data were analysed by calculating delta F as described in Equation 4 and percentage of receptor for each sample according to Equation 5 or in some cases Equation 6. IC50 values were determined using GraphPad Prism software by curve fitting

using a four-parameter logistic equation (Equation 7).

Equation 6: Per cent of receptor binding (HTRF)

Based on calculation of % DeltaF (Equation 8)

% of Receptor binding sample value x100
 total binding

[0091] Total binding = receptor (OX40R) and OX40L (no inhibitor)

Equation 7: Four Parameter logistic calculation

$$Y = Bottom + (Top - Bottom) / (1 + 10^{-(\log(C50 - X) * HillSlope)})$$

X = logarithm of concentration.

Y = specific binding (equation 6)

Top and Bottom = Plateaus in same units as Y (specific binding)

Log IC50 in same units as X. Y starts at Bottom and goes to Top with a sigmoid shape. Specific binding decreases as X increases.

Profiling of fully human recombinant anti-OX40L antibodies in HTRF Ligand/Receptor Neutralisation assay

[0092] In order to determine whether recombinantly expressed fully human purified IgG inhibit human OX40L binding to OX40R the following method was carried out. Fully human purified IgG or other inhibitor were tested in order to establish the clone potency as measured by IC50 values in the assay. Antibodies recombinantly expressed and purified were titrated by diluting in HTRF assay buffer and 5 µL of this titration transferred to a white 384 well low volume non-binding surface polystyrene plate (Greiner). Biotinylated OX40L was diluted in HTRF assay buffer to a working concentration of 2.4 nM and 5 µL added. OX40R-Fc directly labelled with AP647 was then diluted to working concentration of 10 nM and 5 µL added. Non-specific binding was defined by replacing OX40R-Fc-AP647 with assay buffer or HMM. Streptavidin cryptate (CisBio) was diluted in HTRF assay buffer to working concentration of 1:100 and 5 µL added to all wells of the plate. Plates were covered, protected from light and incubated at room temperature for 3 hrs prior to reading time resolved fluorescence at 620 nm and 665 nm emission wavelengths using an EnVision plate reader (Perkin Elmer). Data were analysed by calculating delta F as described in Equation 4 and percentage of receptor for each sample according to Equation 5 or in some cases Equation 6. IC50 values were determined using GraphPad Prism software by curve fitting using a four-parameter logistic equation (Equation 7) (Figure 1).

Determining effect of anti-OX40L antibodies on recombinant OX40L induced IL-2 release from primary isolated T-cells

[0093] Recombinant human OX40L (in house) was diluted in culture media to a concentration of 400 ng/mL and 50 µL added to a tissue culture treated 96 well plate (Costar). Anti-OX40L antibodies or appropriate species isotype control (Sigma or in house) were titrated in culture media in a 96 well plate (greiner) and then 50 µL of titration transferred to the 96 well plate containing 50 µL OX40L. The antibody titration was incubated for 30 minutes at room temperature with the recombinant OX40L before CD3 positive T-cells were added.

[0094] PBMCs were isolated from leukoreduction system chambers (NHIST) using Ficol-Paque plus (GE Healthcare) by density gradient centrifugation. CD3 positive cells (T-cells) were isolated from human PBMC by negative selection using magnetic microbeads (Miltenyi Biotec) according to manufacturer's recommendations. The isolated cells were centrifuged at 300 xg/5 min, resuspended in culture media (culture media was defined as either RPMI (Gibco) + 10% v/v FBS or RPMI + 5% v/v human AB serum) and 50 µL of the cell suspension added to the 96 well plate containing the recombinant OX40L and antibody titration to achieve final concentration of 2x10⁵ cells/well.

[0095] Then 50 µL of PHA at 8 µg/mL was added to all wells to achieve a final assay concentration of 2 µg/mL. The cells were incubated at 37 °C for 3 days before supernatant were harvested and analysed for IL-2 concentration. Maximal IL-2 release was defined by OX40L stimulation in the absence of inhibitor. Minimal IL-2 release was defined by culture media only (no OX40L).

[0096] IL-2 levels in supernatants were determined using human IL-2 Duoset ELISA kit (R & D Systems) according to manufacturer's recommendations. IL-2 capture antibody (4 µg/mL diluted in PBS, 50 µL/well) was adsorbed to 96 well low auto-fluorescent, high protein binding plates (Costar) overnight at 4 °C. Excess IgG was removed by washing with PBS-Tween and the wells were blocked with 1% bovine serum albumin (BSA) in PBS for 1 hour at room temperature, after which plates were washed as described previously. 50 µL/well of conditioned culture media was then added IL-2 standards (from 2000 pg/mL, 1:2 dilution) were also added to ELISA plates as an ELISA control and the plates were incubated at room temperature for at least 1 hour.

[0097] Following incubation, plates were washed as before to remove unbound proteins. Biotinylated IL-2 detection Ab (200 ng/mL in reagent diluent (0.1% BSA/PBS); 50 µL/well) was then added to the plates and incubated at RT for 1 h. Unbound detection antibody was removed by washing with PBS-Tween (0.1% v/v), while the remaining biotinylated antibody was detected by streptavidin-Europium-3-conjugate (DELTA[®] detection, PerkinElmer). Time-resolved fluorescence was measured at 615 nm on an Envision plate reader (PerkinElmer). Fluorescence data was plotted as Europium counts or concentration of IL-2 release calculated from standard curve by linear regression according to manufacturer's recommendations. IC50 values were determined using GraphPad Prism software by curve fitting using a four-parameter logistic equation (Equation 7).

Surface Plasmon Resonance Analysis

[0098] SPR analysis was carried out using the ProteOn[™] XPR36 Array System (BioRad). Anti-mouse IgG (GE Healthcare BR-1038-38) was immobilised on a GLM biosensor surface using amine coupling, the surface was then blocked using 1 M ethanolamine. Test antibodies were captured on this surface and recombinant hOX40L (human and rhesus) were used at a single concentration of 256 nM, binding sensograms were double referenced using a buffer injection (i.e. 0 nM) to remove baseline drift and injection artefacts. Apparent affinities for the OX40L-antibody interaction were determined using the 1:1 model inherent to the ProteOn XPR36 analysis software. The assay was run using HBS-EP (Ternova) as running buffer and carried out at 25 °C.

Example 4

Sequence Recovery of Lead Antibody Candidates

[0099] After the selection and characterization of lead candidates, their fully human variable domains were recovered using RT-PCR using a mixture of forward and reverse primers. Antibodies were reformat into a human IgG4 backbone (IgG4-FE) and expressed using a transient expression system in CHO-S cells. A summary of all sequences is displayed in the Sequence Listing.

RNA isolation from hybridoma cells

[0100] Total RNA was extracted from hybridoma cells using TRIzol[™] Reagent (Invitrogen). The quantity and quality of the isolated RNA was analysed spectrophotometrically.

Antibody variable domain recovery by RT-PCR

[0101] Selected clones were used for preparing total RNA, which was used in an RT-PCR reaction to recover the heavy chain V-regions. IgG specific reverse primers and Ig leader sequence specific forward primer sets or alternatively IgG specific reverse primers and Ig 5' untranslated region (UTR) sequence specific forward primer sets were used for the heavy chains. Kappa constant region specific reverse primers and kappa leader sequence specific forward primer sets or alternatively Kappa constant region specific reverse primers and kappa 5'UTR sequence specific forward primer sets were used for the kappa OX40L chains. The RT-PCR products were separated by agarose gel electrophoresis with the DNA of the predicted size being sequenced in the forward and reverse directions. Alternatively, the RT-PCR products were subcloned into a cloning vector and DNA of individual colonies submitted for sequencing.

Cloning of recombinant antibodies

[0102] DNA encoding the heavy chain variable region of mAb 10A7 was cloned into a pREP4 expression plasmid (Invitrogen) in frame with the Human IgG1 constant region and DNA encoding the light chain variable region of mAb 10A7 was cloned into a pREP4 expression plasmid in frame with the Human Kappa constant region using standard restriction enzyme digestion and ligation.

[0103] The heavy chain variable region coding sequences of mAbs 10A7 and 2D10 in frame with the Human IgG4-FE constant region were codon optimized for mammalian expression and cloned into a pXC-10.4 expression plasmid (Lonza) and the light chain coding sequences of mAbs 10A7 and 2D10 in frame with the Human Kappa constant region were codon optimized for mammalian expression and cloned into a pXC-17.4 expression plasmid (Lonza) using standard restriction enzyme digestion and ligation. For the simultaneous expression of the heavy and light chains the vectors a pXC-17.4 and a pXC-10.4 were fused into one single vector using standard restriction enzyme digestion and ligation.

[0104] All constructs were sequenced to ensure their correct sequence composition.

Transient Expression of OX40L Antibodies

[0105] Antibodies were expressed transiently to produce recombinant protein using Invitrogen's Freestyle[™] CHO-S suspension adapted cell line. Plasmids were transfected into the cells using PEI (polyethylenimine MW 40000) and left to overgrow for a period of 13 days before harvesting the supernatant for purification. Cells were fed during the overgrowth process with AxiCHO[™] Feeds A and B from GE Healthcare to help boost productivity and promote longevity of the cells. During the overgrowth process samples were taken regularly to monitor cell growth and viability.

Generation of Stable Lonza Pools

[0106] In order to produce the gram amounts required for toxicology studies, 10A7 and 2D10 OX40L antibodies were transferred to the Lonza GS Xceed system for stable expression. The HC and LC for each antibody was first codon optimised for expression in CHO cells by Geneviz. The HC cassette (containing the optimised IgG4FE constant region) was then cloned into Lonza's pXC16.4 vector and LC cassette (containing the optimised kappa constant region) cloned into Lonza's pXC17.4 vector using standard restriction enzyme digestion and ligation. A double gene vector (DGV) encoding both the HC and LC sequences was then created by restriction enzyme digestion and ligation and sequence confirmed before expression.

[0107] Prior to stable pool creation, the single gene vectors encoding the HC and LC's separately as well as the DGV containing both, were expressed in the Lonza CHO-K1/SVO cell line transiently using PEI (polyethylenimine MW 40000). Cells were left to overgrow for a period of 13 days before harvesting the supernatant for purification. During this period cells were fed with AxiCHO[™] Feeds A and B from GE Healthcare to help boost productivity and promote longevity of the cells. During the overgrowth process samples were taken regularly to monitor cell growth and viability. Once transient expression was confirmed and purified material analysed the antibodies were expressed as stable pools.

[0108] Stable pools were generated using Lonza's proprietary methods and media. 4 pools were created per antibody and left to recover over a period of 10-15 days. After the cells had recovered, pre-seed stocks (PSS) of cells were frozen down for later recovery and creation of MCB. Small scale (50 mL) shake flask fed batch overgrows were then set up using Lonza's proprietary media. Cells were left to overgrow for a period of 14 days. During this period cells were monitored for growth, viability and glucose levels. Cells were supplemented accordingly with Lonza's proprietary feed and 400g/L glucose. Samples were also taken throughout the process for crude sample quantification. At the end of the overgrowth process the supernatant was harvested for purification.

[0109] Stable pools were generated using Lonza's proprietary methods and media. 4 pools were created per antibody and left to recover over a period of 10-15 days. After the cells had recovered, pre-seed stocks (PSS) of cells were frozen down for later recovery and creation of MCB. Small scale (50 mL) shake flask fed batch overgrows were then set up using Lonza's proprietary media. Cells were left to overgrow for a period of 14 days. During this period cells were monitored for growth, viability and glucose levels. Cells were supplemented accordingly with Lonza's proprietary feed and 400 g/L glucose. Samples were also taken throughout the process for crude sample quantification. At the end of the overgrowth process the supernatant was harvested for purification.

[0110] Whilst the 2D10 and 10A7 were similar in sequence, there expression profiles in the stable Lonza pools were different, 10A07 expressed to very low titres, whereas 2D10 expressed at much greater titres (see Table 2) under optimal conditions when using shake flasks in 4 separate generated stable pools.

Table 2 (Concentration in mg/L)

Stable pool	Day 7	Day 8	Day 9	Day 10	Day 11	Day 12	Day 13	Day 14
2D10-1	261	492	681	993	1157	1590	1630	1575
2D10-2	245	461	665	983	1127	1485	2025	1995
2D10-3	317	528	731	1163	1367	1785	1905	1860
2D10-4	372	677	785	1286	1350	1935	1965	1800
Control Antibody 1	92	129	167	229	297	357	416	N/A
Control Antibody 1	66	95	127	161	208	238	268	N/A
Control Antibody 1	68	102	132	182	266	324	314	N/A
Control Antibody 1	55	129	165	245	328	410	385	N/A

[0111] After expression, the antibody to be used in the Rhesus Macaque GvHD model was purified using a two-step purification process. The antibodies were first purified using MabSelect SuRe (GE Healthcare) affinity chromatography. Antibodies were eluted from the MabSelect SuRe media using IgG Blue reagent (Pierce) and the eluted antibodies were dialysed in sodium acetate (pH 5.5) buffer prior to the second purification step. Antibodies were then purified by cation exchange and eluted with sodium chloride in sodium acetate buffer. Eluted antibodies were dialysed in PBS. Antibodies were quantified by spectrophotometer reading at OD280nm and adjusted to the desired concentration (10mg/mL). Antibody purity was assessed by SDS-PAGE analysis and size exclusion chromatography. Endotoxin concentration was measured with Endosafe PTS and LAL Test Cartridges (Charles River Laboratories).

Example 5

Determining effect of anti-OX40L antibodies in allogeneic PBMC Mixed Lymphocyte Reaction

[0912] PBMCs are isolated from leukoreduction system chambers (NHBT) using Ficoll-Paque plus (GE Healthcare) density gradient centrifugation. PBMC were pre-incubated with mitomycin C (Sigma) at 10 µg/ml in PBS for one hour at 37 °C. Cells are then washed 3 times in PBS centrifuging at 300 xg for 3 minutes, aspirating the supernatant after each wash. Allogeneic PBMC (not treated with mitomycin C) are added to a 96-well plate in RPMI supplemented with 10% v/v FBS at a concentration of 2x10⁶/ml, 50 µL/well. Anti-CD40L antibodies are diluted in culture media and added to 96 well plate containing PBMC (not mitomycin C treated) at 50 µL/well. Mitomycin C treated PBMC are then added to allogeneic PBMC (not treated with mitomycin C) in 96-well plate at a final cell ratio in range of 1:1 to 4:1 mitomycin C treated to non mitomycin C based on number of cells/well. The cells are incubated for five days at 37 °C/5% CO₂. After five days TNF-α, IFN-γ, and IL-2 are measured by duoset ELISA (R&D Systems) according to manufacturer's recommendations. Proliferation is measured by CFSE dilution according to manufacturer's recommendations.

[0913] PBMCs were isolated from leukoreduction system chambers (NHBT) using Ficoll-Paque plus (GE Healthcare) density gradient centrifugation. PBMC were pre-incubated with mitomycin C (Sigma) at 10 µg/ml in PBS for one hour at 37 °C. Cells were then washed 3 times in PBS centrifuging at 300 xg for 3 minutes, aspirating the supernatant after each wash. T-lymphocytes (T-cells) in some cases CD4 and CD8 positive were isolated from allogeneic PBMC by negative selection using magnetic microbeads (Miltenyi Biotec) according to manufacturer's recommendations. In some cases, non-mitomycin C treated PBMC were used instead of T-cells. The isolated cells were centrifuged at 300 xg/5 min, resuspended in culture media (culture media was defined as either RPMI + 10% v/v FBS or RPMI + 5% v/v human AB serum) and 50 µL of the cell suspension added to the 96 well plate containing the recombinant CD40L and antibody titration to achieve final concentration of 2x10⁵ cells/well. Anti-CD40L antibodies were diluted in culture media to a final assay concentration 100nM or in some cases a titration of antibody was used. The antibodies were added to 96 well plate containing T-cells or non-mitomycin C treated PBMC at 50 µL/well. Mitomycin C treated PBMC were then added to T-cells or non mitomycin C treated PBMC in 96-well plate at a final cell ratio in range of 1:1 to 4:1 mitomycin C treated PBMC to T-cells (or PBMC) based on number of cells/well. The cells were incubated for five days at 37 °C/5% CO₂. After five days, IFN-γ was measured by duoset ELISA (R&D Systems) according to manufacturer's recommendations.

[0914] Anti-CD40L antibodies were defined as inhibitors in allogeneic PBMC/T cell MLR or PBMC/PBMC MLR when >20% inhibition (see Equation 8) of factor release (IFN-γ) or were observed relative to control wells in the absence of antibody. From four experiments performed, one experiment was a technical failure, defined as no MLR response (IFN-γ release) detected between allogeneic donors. Of the three remaining experiments, all three showed inhibition (>20% inhibition of factor release (IFN-γ) observed relative to control wells in the absence of antibody) with 2D10, 10A07 and positive control 1, however in one of three experiments, significant inhibition was also observed with the isotype control antibody (Figure 2). For PBMC-PBMC MLR, three experiments were performed. Of three experiments, two were regarded as technical failure as there was no or low IFN-γ release. However, in another experiment 10A07 inhibited IFN-γ release when compared to the isotype control.

Equation 8: Percentage inhibition (MLR)

[0915] Based on values from IFN-γ or IL-2 release (pg/ml) determined as described

$$\% \text{ inhibition} = 100 - \frac{\text{sample value} - \text{no stimulus}}{\text{no IgG} - \text{no stimulus}} \times 100$$

No Stimulus = wells where only T-cells or non-mitomycin C treated PBMC are added (no mitomycin C treated PBMC)

No IgG = wells where T-cells or in some cases non-mitomycin C treated PBMC along with mitomycin C treated PBMC are added but no IgG

Example 8

Determine effect of anti-CD40L antibodies on CD3 primed primary human T lymphocytes

[0916] In order to determine whether anti-CD40L had the ability to induce T-cell responses in the absence of CD40L, the assay below was performed using method adapted from Wang et al., Hybridoma (Larchmt), 2009 Aug; 28(4):269-76, in which an agonist anti-CD40L antibody was described.

[0917] A mouse anti-human CD3 antibody (Becton Dickinson) was diluted to 0.5 µg/ml in sterile PBS and 50 µL/well added to a 96 well high binding sterile plate and incubated overnight at 4 °C.

[0918] Following overnight incubation, the plate was washed three times with 100 µL of sterile PBS.

[0919] T-cells (CD3 positive) were isolated from PBMC derived from leukoreduction system chambers (NHBT) as described in Example 3. Following isolation, the cells were added to wells in 100 µL to achieve a final concentration of 1x10⁵ cells/well.

[0920] Test antibodies were diluted in RPMI+ 10% FBS and 50 µL or 100 µL/well added to cell plate to achieve a final assay concentration of 10 µg/mL. In some cases, a mouse anti-human CD28 antibody (Becton Dickinson) was also added to wells at a final concentration of 1 µg/ml

[0921] The assay was incubated for 5 days. After 5 days, harvest supernatants and IFN-γ levels in supernatant were determined as described in Example 5.

[0922] The assay was performed in four independent donors and no effect of adding 10A07 or 2D10 in IgG4PE format was observed (IFN-γ release) over that observed with human IgG4PE isotype control.

Example 7

Rhesus Macaque Graft versus Host Disease (GVHD) Model

[0923] The effectiveness of antibody 2D10 IgG4PE as a mono therapy prophylactic for the prevention of GVHD was examined in a Rhesus Macaque model of haploidentical hematopoietic stem cell transplantation (HSCT). It had been previously described that monkeys undergoing HSCT in this model had a survival time of 6-8 days (Miller, Weston P, et al. "GVHD after haploidentical transplantation: a novel, MHC-defined rhesus macaque model identifies CD28⁺ CD8⁺ T-cells as a reservoir of breakthrough T cell proliferation during costimulation blockade and stromal-based immunosuppression." Blood, 116, 24(2019):5403-5418).

[0924] All transplants were between half-sibling pairs that are mismatched at one MHC haplotype ("haploidentical-HCT"). Recipient animals had irradiation based pre-myeleoblastic pre-transplant conditioning using a linear accelerator. Dose rate: 7.5Gy/min. Dose 1920 cGy given in 4 fractions. The leukapheresis donor animal underwent G-CSF mobilisation and underwent leukapheresis using a Spectra Optia apheresis machine. The table below gives the dose per kg of total nucleated cells (TNC) dose of CD3⁺ cells, and CD34⁺ cells for the four successful experiments.

Table 3				
Recipient ID#	Animal No.	Recipient Bodyweight (kg)	TNC (10 ⁶ /kg)	CD3 ⁺ T-cells 10 ⁶ /kg
A14079	#2	9.75	1.13	148.76
A14081	#4	7.02	2.69	389.08
A14082	#5	7.6	2.24	312.95
A14087	#6	6.75	3.44	385.66

[0925] 2D10 IgG4PE was dosed at 10 mg/kg i.v. according to a planned dosing schedule to take place on Day -2, Day +5, Day +12, Day +19, Day +26, Day +33, Day +40, Day +47 post-transplant. No serious adverse dosing side effects were seen with any of the animals as a result of administering 2D10 IgG4PE.

[0926] Samples were taken during the course of the study to monitor donor chimerism (Table 4) and white blood cell counts. The primary end point was based on survival, with a survival to 15 days deemed to be a sign of successful prophylactic therapy (and compared to the documented survival of 6-8 days with no prophylaxis; Miller et al 2010, *supra*). Though full pathology and histology with GVHD grading scores, markers of T-cell proliferation and activation (such as Ki-67 and granzyme B) and gene array analysis are planned, they were not available for inclusion at the time of drafting.

[0927] Methods for these studies are essentially as described in Miller WP et al., (2010) "GVHD after haploidentical transplantation: a novel, MHC-defined rhesus macaque model identifies CD28⁺ CD8⁺ T cells as a reservoir of breakthrough T-cell proliferation during costimulation blockade and stromal-based immunosuppression", Blood 116:5403-5418.

Clinical staging of GVHD

[0928] Scoring of clinical symptoms was based on observational assessments and clinical chemistry, classified according to the criteria set out in Table 5.

Histopathology

[0929] Tissues, including lung, liver, skin and gastrointestinal tract were collected at necropsy and fixed in formalin and paraffin-embedded. Sections were cut, slide-mounted and stained with haematoxylin/eosin or with T cell markers for visualisation of tissue infiltration by lymphocytes. Prepared slides are read by a histopathologist with specific expertise in GVHD using a semiquantitative scoring system.

Flow cytometry

[0930] Longitudinal peripheral blood samples were collected before and after haematopoietic stem cell transplant and at necropsy for flow cytometric analysis of lymphocyte subsets. Lung, liver, colon spleen and lymph node (axillary and inguinal) tissues were collected at necropsy and dissociated or enzymatically digested as appropriate for subsequent analysis of lymphocyte infiltrates by flow cytometry. Samples were analysed by multicolour flow cytometry using a LSRIFortessa cell analyser (BD Biosciences) using the following T lymphocyte marker probes: CD3 (APC-Cy7 label; clone SP34-2, BD Biosciences), CD4 (BV786 label; clone L200, BD Biosciences), CD8 (BV605 label; clone RPA-T6, BD Biosciences), CD28 (PE-Cy7 label; clone CD28.2, eBioscience), CD45 (BV605 label; clone DX2, Biolegend). Proliferating cell populations were identified using Ki-67 (FITC label; Dako). CD4⁺ or CD8⁺ T cell subcompartments were labelled as follows: naive T-cells (CD28⁺CD45⁺), central memory T-cells (CD28⁺CD45⁺), effector memory T-cells (CD28⁺CD45⁺).

[0931] Blood was collected into tubes with Sodium EDTA, and then red blood cells were lysed with lysis buffer containing ammonium chloride. Remaining leukocytes were washed with FACS buffer (PBS with 2% FBS) and stained with antibody cocktail (Table 7) for 30 minutes at 4 °C. After staining, cells were washed and fixed in 1x BD Stabilizing Fixative. Acquisition of flow data was performed on BD LSR Fortessa cytometer. Data were analyzed using FlowJo. T-cells were defined as CD3⁺ CD4/CD20- lymphocytes.

Table 7. List of used antibodies for T cell immunophenotyping by flow cytometry			
Antibody	Fluorochrome	Clone	Company
CD3	APC-Cy7	SP34-2	BD Biosciences
CD4	BV786	L200	BD Biosciences
CD8	BV605	RPA-T6	BD Biosciences
CD14	PerCP-Cy5.5	M5E2	BD Biosciences
CD20	PerCP-Cy5.5	2H7	eBioscience
CD28	PE-Cy7	CD28.2	eBioscience
CD45RA	APC	2H4LDH11LD89	Beckman Coulter
CD45	BV605	DX2	Biolegend
CCR7 (CD197)	BV421	G043H7	Biolegend
OX40 (CD134)	PE	L106	BD Biosciences

Results:

1: Expansion of memory stem T-cells after transplantation

[0932] In a non-human primate model of acute Graft-versus-Host disease (GVHD), allogeneic hematopoietic cell transplantation (HCT) results in early expansion of both CD4 and CD8 memory stem T-cells (Tscm: CD45RA⁺CCR7⁺CD45⁺) at the expense of reconstitution of bona fide naive T-cells (Tn: CD45RA⁺CCR7⁺CD45⁺) (Fig. 3). These Tscm cells circulate in the blood, and also reside in both lymphoid (lymph nodes, spleen) and non-lymphoid organs (lung, liver and colon).

2: 2D10 IgG4PE limits expansion of Tscm

[0933] Treatment with the blocking anti-CD40L antibody, 2D10 IgG4PE, results in prolonged survival of animals after allogeneic HCT and reduces clinical symptoms of acute GVHD. This delay in GVHD progression was associated with limited CD4⁺ Tscm expansion and preservation of CD4⁺ Tn cells (Fig. 4).

3: CD4 Tscm cells express OX40 on their surface

[0934] As shown in Figure 5, CD4⁺ Tscm express OX40 on their surface, but naive T-cells do not. Moreover, the level of OX40 expression was comparable between CD4⁺ Tscm and central memory cells (Tcm). Importantly, OX40 expression was detected on CD4⁺ Tscm cells broadly. They are detected in naive monkeys before transplantation (both in the blood and lymphoid organs), as well as in leukapheresis products. This expression is also seen in allogeneic HCT recipients longitudinally after transplantation.

4: Comparative Analysis of Tscm in 2D10 IgG4PE treated animals compared to standard GVHD therapies

[0935] The proportion of post-HCT Tscm cells evident in the peripheral blood of rhesus monkeys that received 2D10 IgG4PE were compared with Tscm from separate groups of animals administered either sirolimus (rapamycin) or a combination of tacrolimus plus methotrexate (Tac/MTX). The results for CD4⁺ Tscm cells are shown in Figure 6a, and the results for CD8⁺ Tscm cells are shown in Figure 6b. Data indicate that treatment with anti-CD40L antibody 2D10 IgG4PE results in a sustained inhibition of the proportion of Tscm cells compared with the sirolimus and Tac/MTX treatment.

Conclusions:

[0936] An OX40-expressing subset of Tscm might be sensitive to 2D10 IgG4PE-mediated OX40L-blockade. This blockade may control Tscm expansion and therefore limit the progression of acute GVHD. The OX40 pathway is a potentially novel mechanism of Tscm regulation, which can be used in clinical practice to treat immune-mediated diseases or improve the outcome of adoptive immunotherapy.

Chimerism

[0937] Peripheral blood or T cell (CD3+CD20-) chimerism was determined using divergent donor- and recipient-specific MHC-linked microsatellite markers, by comparing peak heights of the donor- and recipient-specific amplicons (Penedo MC et al., (2005) "Microsatellite typing of the rhesus macaque MHC region", *Immunogenetics* 57:198-209).

Table 5

Stage	Skin	Liver (Bilirubin)	GI
0	No GVHD rash	< 4-fold increase over baseline	No diarrhea
1	Rash <25% of surface area	4- to 5-fold increase	"Mild" diarrhea
2	Rash 25-50% of surface area	6- to 20-fold increase	"Moderate" diarrhea
3	Rash >50% of surface area	20- to 50-fold increase	"Severe" diarrhea
4	Generalized erythroderma with bullous formation	> 50-fold increase	"Very severe" diarrhea

[0292] A total of six animals were selected to receive HCT. Of these six animals, two of the experiments were deemed a technical failure, one animal experienced viral reactivation which may have hampered engraftment and it was seen that donor chimerism initially declined but then dropped, indicating that second retransfusion was autologous repopulation. A single high cytomegalovirus (CMV) and *Rheme macaque* lymphoproliferative (rhLV) reading was seen at the same time as the drop in chimerism and autologous repopulation. The second technical failure resulted of the failure of the apheresis machine to produce a suitable product for transplantation. Since the recipient animal had already been irradiated, it had to be sacrificed. The four other animals all survived to the primary endpoint of 15 days, exhibiting extended survival compared to both historical and contemporaneous non-prophylaxis controls. Table 6 below outlines the summary of each animal in this study.

Example 8

Pharmacokinetics

[9330] Rhesus macaques were dosed with 10 mg/kg of ZD10 or appropriate non-functional isotype control antibody on Day 0. Samples were taken, after +15 minutes, +1 hour, +6 hours, +24-36 hours, +72 hours, +96 hours, +Day 8, +Day 11, +Day 15, +Day 16, +Day 22, +Day 25. On Day 29, animals were dosed with 3 mg/kg of ZD10 or appropriate non-functional isotype control antibody. Samples were taken on Day 29 after +15 minutes, +1 hour, +6 hours and then 24-36 hours after Day 29. Samples continued to be taken on +Day 32, +Day 33, +Day 36, +Day 39, +Day 43, +Day 46, +Day 50, +Day 53, +Day 57, +Day 60, +Day 64, +Day 67 and +Day 71.

194940 To determine the PK, anti-human IgG is diluted to 0.5 µg/ml in PBS and adsorbed to 96 well low auto-fluorescent, high protein binding plates (Costar) overnight at 4 °C. Excess IgG is removed by washing with PBS-Tween and wells are blocked with 5% w/v non-fat dried milk (blocking buffer) for 1 hour at room temperature. Following incubation period, plates are washed. Plasma samples are diluted in blocking buffer (multiple dilutions). A standard curve is also generated using a titration of polyclonal control anti-Ox4L antibody diluted in blocking buffer from 10 µg/ml (1 in 3 dilution). Either titration or diluted plasma sample are added to plate and incubated for 1 hr at room temperature. Plates are then washed and biotinylated human Ox4L is diluted to 500 ng/ml in blocking buffer added for 1 hour at room temperature. Plates are then washed and streptavidin-Europium³⁺-conjugate (DELIA[®] detection, PerkinElmer) diluted in DELIA[®] assay buffer (Perkin Elmer) is added. Plates are then washed 3 times in Tris Buffered Saline +0.1% tween. Then, DELIA Enhancement solution (Perkin Elmer) is added to the plate and time-resolved fluorescence is measured at 615 nm on an Envision plate reader (PerkinElmer). The concentration of anti-Ox4L antibody in the plasma is calculated by extrapolating fluorescence values from samples wells to those obtained from the standard curve generated from the titration of the positive control anti-Ox4L antibody using a four parameter logistic curve fitting algorithm.

Example 9

Rhesus Macaque (GrHD) Model: effect of combined prophylaxis with 2D10 IgG4PE plus rapamycin

[B041] A further rhesus macaque GvHD study was conducted to determine the effect of combined post-HSCT prophylaxis with 2D10 IgG4PE and rapamycin. The study was performed as described in Example 7, with dosing as follows: 2D10 IgG4PE was administered i.v. at 10mg/kg on Day -2, Day -5, Day +12, Day +19, Day +26, Day +33, Day +40, Day +47 and Day +56 post-transplant. Rapamycin was administered at a loading dose of 0.1 mg/kg i.m. on Day -14, followed by daily i.m. maintenance doses of 0.025 mg/kg until the scheduled termination of the study at Day +100. Rapamycin dosing was adjusted to maintain serum trough levels within the range 5-15ng/ml.

Results:

[0492] Post-HSCT administration of ZD10 to G4PE together with rapamycin resulted in extended G4PE-free and absolute survival (median survival time, MST: 82 days; n=3) compared to historical control animals that did not receive post-HSCT experimental treatment (MST: 6 days; n=4, Furlan et al, Science Translational Medicine, 7(315): 315ra110). The effect of combined ZD10 G4PE plus rapamycin displayed above survival also to be greater than the additive effect of each molecule when administered alone (Figure 7, MST for post-HSCT ZD10 G4PE and rapamycin were 19 and 17 days, respectively; both n=4). It is also noted that Furlan et al discloses a MST for combined prophylaxis with tacrolimus plus methotrexate of 49 days. It is expected that a combination of tacrolimus plus methotrexate and an anti-CD40L antibody (such as ZD10), or indeed a combination of tacrolimus and an anti-CD40L antibody (such as ZD10), would also provide the synergistic results as seen in this Example.

Table 4

Animal No.	Animal ID	Survival Duration (days)	Whole Blood Chimerism (%)																	
			Day 0	Day 1	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 11	Day 12	Day 14	Day 15	Day 16	Day 18	Day 20	Day 21	Day 23	Day 26
#(1)	(13159)	(24)	0		6.6				27.5		90.4				16.7		0			
#2	14076	16	0	5.7			31.7			66.3		92.3		88.2	78.8					
#(3)	(14075)	(0)																		
#4	14081	26		22.0			68.2		82.9		92.1		97.5			98.4		95.5	95.7	
#5	14082	22					91.4		96.4		98.6		99.1			99.2		95.6		
#6	14087	16		16.6			66.3		97.4		99.5		99.4							

[0543] Data in brackets indicates experimental failure due to infection (animal 1) or technical failure (animal 3).

Table 6

		2D10 IgG4Pc Rheumatoid GvHD Study	
Animal			Details
#1	Survived to Day 14. Received 4 doses of 2D10 IgG4Pc. Erythroid hematopoietic reconstitution; peripheral blood chimerism data indicated initial donor engraftment followed by autologous repopulation concurrent with evidence of CMV and rHLCV infection. Viral infection considered possible cause of graft failure. Received no Technical Failure.		
#2	Survived to Day 16. Received 3 doses of 2D10 IgG4Pc. Peak peripheral blood donor chimerism of 85% at Day 15. No evidence of CMV or rHLCV infection. Study terminated on veterinary advice due to wound at catheter site (not deemed to be treatment or GvHD related). GvHD staging at necropsy: skin 1 (rash < 25%); liver 0 (no bilirubin elevation); GI 0 (no diarrhea).		
#3	Received no Technical Failure. Apheresis equipment failure resulted in drastically suboptimal donor blood product.		
#4	Survived to Day 26. Received 4 doses of 2D10 IgG4Pc. Clear hematopoietic reconstitution with peak peripheral blood donor chimerism of 99% by Day 23. No evidence of CMV or rHLCV infection. Study terminated on veterinary advice due to ascites.		
#5	Received no Technical Failure. GvHD staging at necropsy: skin 2 (rash 25-50%); liver 2 (no bilirubin elevation); GI 2 (no diarrhea).		
#6	Survived to Day 22. Received 4 doses of 2D10 IgG4Pc. Clear hematopoietic reconstitution with peak peripheral blood donor chimerism of 99% by Day 12. No evidence of CMV or rHLCV infection. Study terminated due to persistent low platelet count with high bleeding risk and developing signs of acute systemic GvHD. GvHD staging at necropsy: skin 3 (rash > 50%); liver 1 (+4-8 x bilirubin elevation); GI 3 (severe diarrhea).		
#7	Received no Technical Failure. GvHD staging at necropsy: skin 2 (rash 25-50%); liver 1 (+4-8 x bilirubin elevation); GI 2 (no diarrhea).		
#8	Survived to Day 16. Received 3 doses of 2D10 IgG4Pc. Clear hematopoietic reconstitution with peak peripheral blood donor chimerism of 100% on Day 12. No evidence of CMV or rHLCV infection. GvHD staging at necropsy: skin 2 (rash 25-50%); liver 1 (+4-8 x bilirubin elevation); GI 2 (no diarrhea).		

SEQUENCE LISTING

SEQ ID NO:		Accession	Gene
1	10A07		VH Nucleotide Sequence
2			VH Amino Acid Sequence
3			HCDR1 Nucleotide Sequence (IMGT)
4			HCDR1 Amino Acid Sequence (IMGT)
5			HCDR2 Nucleotide Sequence (IMGT)
6			HCDR2 Amino Acid Sequence (IMGT)
7			HCDR3 Nucleotide Sequence (IMGT)
8			HCDR3 Amino Acid Sequence (IMGT)
9			HCDR1 Nucleotide Sequence (KABAT)
10			HCDR1 Amino Acid Sequence (KABAT)
11			HCDR2 Nucleotide Sequence (KABAT)
12			HCDR2 Amino Acid Sequence (KABAT)
13			HCDR3 Nucleotide Sequence (KABAT)
14			HCDR3 Amino Acid Sequence (KABAT)
15			VL Nucleotide Sequence
16			VL Amino Acid Sequence
17			LCDR1 Nucleotide Sequence (IMGT)
18			LCDR1 Amino Acid Sequence (IMGT)
19			LCDR2 Nucleotide Sequence (IMGT)
20			LCDR2 Amino Acid Sequence (IMGT)
21			LCDR3 Nucleotide Sequence (IMGT)
22			LCDR3 Amino Acid Sequence (IMGT)

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

SEQ ID NO.			
192	OX40L040	Amino Acid Sequence of OX40L040 (Seq ID No 207 in WO2011/073180, Table A-2)	DVQLVESGGGLVQPGGSLRLCAASGSGRLDRMWYHRHRTGPARELV ATTIGSSNNG D FNGS FRTSRDNGNTVYLQM NSLRPEDTAVYCN FN KYVTSRTWAGQGLTVTVSS
193	OX40L041	Amino Acid Sequence of OX40L041 (Seq ID No 208 in WO2011/073180, Table A-2)	DVQLVESGGGLVQPGGSLRLCAASGSGRLDRMWYHRHRTGPARELV ATTIGSSNNG D FNGS FRTSRDNGNTVYLQM NSLRPEDTAVYCN FN KYVTSRTWAGQGLTVTVSS
194	OX40L042	Amino Acid Sequence of OX40L042 (Seq ID No 209 in WO2011/073180, Table A-2)	DVQLVESGGGLVQPGGSLRLCAASGSGRLDRMWYHRHRTGPARELV ATTIGSSNNG D FNGS FRTSRDNGNTVYLQM NSLRPEDTAVYCN FN KYVTSRTWAGQGLTVTVSS
195	OX40L043	Amino Acid Sequence of OX40L043 (Seq ID No 210 in WO2011/073180, Table A-2)	DVQLVESGGGLVQPGGSLRLCAASGSGRLDRMWYHRHRTGPARELV ATTIGSSNNG D FNGS FRTSRDNGNTVYLQM NSLRPEDTAVYCN FN KYVTSRTWAGQGLTVTVSS
196	OX40L044	Amino Acid Sequence of OX40L044 (Seq ID No 211 in WO2011/073180, Table A-2)	DVQLVESGGGLVQPGGSLRLCAASGSGRLDRMWYHRHRTGPARELV ATTIGSSNNG D FNGS FRTSRDNGNTVYLQM NSLRPEDTAVYCN FN KYVTSRTWAGQGLTVTVSS
197	OX40L045	Amino Acid Sequence of OX40L045 (Seq ID No 212 in WO2011/073180, Table A-2)	DVQLVESGGGLVQPGGSLRLCAASGSGRLDRMWYHRHRTGPARELV ATTIGSSNNG D FNGS FRTSRDNGNTVYLQM NSLRPEDTAVYCN FN KYVTSRTWAGQGLTVTVSS
198	OX40L046	Amino Acid Sequence of OX40L046 (Seq ID No 213 in WO2011/073180, Table A-2)	DVQLVESGGGLVQPGGSLRLCAASGSGRLDRMWYHRHRTGPARELV ATTIGSSNNG D FNGS FRTSRDNGNTVYLQM NSLRPEDTAVYCN FN KYVTSRTWAGQGLTVTVSS
199	OX40L047	Amino Acid Sequence of OX40L047 (Seq ID No 214 in WO2011/073180, Table A-2)	DVQLVESGGGLVQPGGSLRLCAASGSGRLDRMWYHRHRTGPARELV ATTIGSSNNG D FNGS FRTSRDNGNTVYLQM NSLRPEDTAVYCN FN KYVTSRTWAGQGLTVTVSS
200	OX40L048	Amino Acid Sequence of OX40L048 (Seq ID No 215 in WO2011/073180, Table A-2)	DVQLVESGGGLVQPGGSLRLCAASGSGRLDRMWYHRHRTGPARELV ATTIGSSNNG D FNGS FRTSRDNGNTVYLQM NSLRPEDTAVYCN FN KYVTSRTWAGQGLTVTVSS
201	OX40L049	Amino Acid Sequence of OX40L049 (Seq ID No 216 in WO2011/073180, Table A-2)	DVQLVESGGGLVQPGGSLRLCAASGSGRLDRMWYHRHRTGPARELV ATTIGSSNNG D FNGS FRTSRDNGNTVYLQM NSLRPEDTAVYCN FN KYVTSRTWAGQGLTVTVSS
202	OX40L050	Amino Acid Sequence of OX40L050 (Seq ID No 217 in WO2011/073180, Table A-2)	DVQLVESGGGLVQPGGSLRLCAASGSGRLDRMWYHRHRTGPARELV ATTIGSSNNG D FNGS FRTSRDNGNTVYLQM NSLRPEDTAVYCN FN KYVTSRTWAGQGLTVTVSS
203	OX40L053	Amino Acid Sequence of OX40L053 (Seq ID No 218 in WO2011/073180, Table A-2)	DVQLVESGGGLVQPGGSLRLCAASGSGRLDRMWYHRHRTGPARELV ATTIGSSNNG D FNGS FRTSRDNGNTVYLQM NSLRPEDTAVYCN FN KYVTSRTWAGQGLTVTVSS
204	OX40L054	Amino Acid Sequence of OX40L054 (Seq ID No 219 in WO2011/073180, Table A-2)	DVQLVESGGGLVQPGGSLRLCAASGSGRLDRMWYHRHRTGPARELV ATTIGSSNNG D FNGS FRTSRDNGNTVYLQM NSLRPEDTAVYCN FN KYVTSRTWAGQGLTVTVSS
205	OX40L055	Amino Acid Sequence of OX40L055 (Seq ID No 220 in WO2011/073180, Table A-2)	DVQLVESGGGLVQPGGSLRLCAASGSGRLDRMWYHRHRTGPARELV ATTIGSSNNG D FNGS FRTSRDNGNTVYLQM NSLRPEDTAVYCN FN KYVTSRTWAGQGLTVTVSS
206	OX40L056	Amino Acid Sequence of OX40L056 (Seq ID No 221 in WO2011/073180, Table A-2)	DVQLVESGGGLVQPGGSLRLCAASGSGRLDRMWYHRHRTGPARELV ATTIGSSNNG D FNGS FRTSRDNGNTVYLQM NSLRPEDTAVYCN FN KYVTSRTWAGQGLTVTVSS
207	OX40L069	Amino Acid Sequence of OX40L069 (Seq ID No 222 in WO2011/073180, Table A-2)	DVQLVESGGGLVQPGGSLRLCAASGSGRLDRMWYHRHRTGPARELV ATTIGSSNNG D FNGS FRTSRDNGNTVYLQM NSLRPEDTAVYCN FN KYVTSRTWAGQGLTVTVSS
208	OX40L070	Amino Acid Sequence of OX40L070 (Seq ID No 223 in WO2011/073180, Table A-2)	DVQLVESGGGLVQPGGSLRLCAASGSGRLDRMWYHRHRTGPARELV ATTIGSSNNG D FNGS FRTSRDNGNTVYLQM NSLRPEDTAVYCN FN KYVTSRTWAGQGLTVTVSS
209	OX40L071	Amino Acid Sequence of OX40L071 (Seq ID No 224 in WO2011/073180, Table A-2)	DVQLVESGGGLVQPGGSLRLCAASGSGRLDRMWYHRHRTGPARELV ATTIGSSNNG D FNGS FRTSRDNGNTVYLQM NSLRPEDTAVYCN FN KYVTSRTWAGQGLTVTVSS
210	OX40L082	Amino Acid Sequence of OX40L082 (Seq ID No 225 in WO2011/073180, Table A-2)	DVQLVESGGGLVQPGGSLRLCAASGSGRLDRMWYHRHRTGPARELV ATTIGSSNNG D FNGS FRTSRDNGNTVYLQM NSLRPEDTAVYCN FN KYVTSRTWAGQGLTVTVSS
211	OX40L083	Amino Acid Sequence of OX40L083 (Seq ID No 226 in WO2011/073180, Table A-2)	DVQLVESGGGLVQPGGSLRLCAASGSGRLDRMWYHRHRTGPARELV ATTIGSSNNG D FNGS FRTSRDNGNTVYLQM NSLRPEDTAVYCN FN KYVTSRTWAGQGLTVTVSS
OX40L benchmark antibody heavy chain		Amino acid sequence of OX40L benchmark antibody heavy chain (Seq ID No: 177 in WO2011/073180, Table A-5)	EVQLVESGGGLVQPGGSLRLCAASGSGRLDRMWYHRHRTGPARELV ATTIGSSNNG D FNGS FRTSRDNGNTVYLQM NSLRPEDTAVYCN FN KYVTSRTWAGQGLTVTVSS
OX40L benchmark antibody light chain		Amino acid sequence of OX40L benchmark antibody light chain (Seq ID No: 178 in WO2011/073180, Table A-5)	DIQMTQSPSSLSASVGDRVTITKASGSGSLAWYQQKQPKPKATLS ASLQSGDSGVPRFSGSGSTFTLTSLQSGEDFATYYCQQSNFYPTTIG QTLKSLKLTAAADYVPRFSGSLKSCSGSGSLAWYQQKQPKPKATLS YQALWLGSGSGSTFTLTSLQSGEDFATYYCQQSNFYPTTIGQTLKSLK LTAAADYVPRFSGSLKSCSGSGSLAWYQQKQPKPKATLS
heavy chain variable region of LC 001		Amino acid sequence of heavy chain variable region of LC 001 (Seq ID No: 1 in WO2006/029879)	DIQMTQSPSSLSASVGDRVTITKASGSGSLAWYQQKQPKPKATLS ASLQSGDSGVPRFSGSGSTFTLTSLQSGEDFATYYCQQSNFYPTTIG QTLKSLKLTAAADYVPRFSGSLKSCSGSGSLAWYQQKQPKPKATLS YQALWLGSGSGSTFTLTSLQSGEDFATYYCQQSNFYPTTIGQTLKSLK LTAAADYVPRFSGSLKSCSGSGSLAWYQQKQPKPKATLS
heavy chain variable region of LC 001		Amino acid sequence of heavy chain variable region of LC 001 (Seq ID No: 2 in WO2006/029879)	DVQLVESGGGLVQPGGSLRLCAASGSGRLDRMWYHRHRTGPARELV ATTIGSSNNG D FNGS FRTSRDNGNTVYLQM NSLRPEDTAVYCN FN KYVTSRTWAGQGLTVTVSS
light chain variable region of LC 005		Amino acid sequence of light chain variable region of LC 005 (Seq ID No: 3 in WO2006/029879)	EVLTQSPATLSLSPGERATLSCAASGSGSLAWYQQKQPKPKATLS ASLQSGDSGVPRFSGSGSTFTLTSLQSGEDFATYYCQQSNFYPTTIG QTLKSLKLTAAADYVPRFSGSLKSCSGSGSLAWYQQKQPKPKATLS YQALWLGSGSGSTFTLTSLQSGEDFATYYCQQSNFYPTTIGQTLKSLK LTAAADYVPRFSGSLKSCSGSGSLAWYQQKQPKPKATLS
heavy chain variable region of LC 005		Amino acid sequence of heavy chain variable region of LC 005 (Seq ID No: 4 in WO2006/029879)	DVQLVESGGGLVQPGGSLRLCAASGSGRLDRMWYHRHRTGPARELV ATTIGSSNNG D FNGS FRTSRDNGNTVYLQM NSLRPEDTAVYCN FN KYVTSRTWAGQGLTVTVSS
light chain variable region of LC 010		Amino acid sequence of light chain variable region of LC 010 (Seq ID No: 5 in WO2006/029879)	EVLTQSPATLSLSPGERATLSCAASGSGSLAWYQQKQPKPKATLS ASLQSGDSGVPRFSGSGSTFTLTSLQSGEDFATYYCQQSNFYPTTIG QTLKSLKLTAAADYVPRFSGSLKSCSGSGSLAWYQQKQPKPKATLS YQALWLGSGSGSTFTLTSLQSGEDFATYYCQQSNFYPTTIGQTLKSLK LTAAADYVPRFSGSLKSCSGSGSLAWYQQKQPKPKATLS

SEQ ID NO:			
225	y heavy chain variable region of LC.033	Amino acid sequence of y heavy chain variable region of LC.033 (Seq ID No: 12 in WO/2006/029679)	EVLLEGGGLVQGGSLALSCASGFTTSYAWHWVRQPKGLEWISLSSGG GFTTYSASVGRFTTSFGDKRTLLYLQNLRAEDATYTCWGLYVIGTALYV WGQGLVTVSS
226	mutant kappa light chain variable region of LC.033	Amino acid sequence of mutant kappa light chain variable region of LC.033 (Seq ID No: 16 in WO/2006/029679)	EVALTQPTLSLSPGERATLCPASQSSVSNLYAWYQCKRQKAPLLTGASSRA TGPDPFSSGGGDTPTLTLSLSPEDAWYVYQDQSSFTTGFQNTVQK
227	y heavy chain variable region of LC.059	Amino acid sequence of y heavy chain variable region of LC.059 (Seq ID No: 17 in WO/2006/029679)	EVLLEGGGLVQGGSLALSCASGFTTSYAWHWVRQPKGLEWISLSSGG GFTTYSASVGRFTTSFGDKRTLLYLQNLRAEDATYTCWGLYVIGTALYV WGQGLVTVSS
228	kappa light chain variable region of LC.060	Amino acid sequence of kappa light chain variable region of LC.060 (Seq ID No: 18 in WO/2006/029679)	AQLTQPSPLSASVGRQVTTTPASQSSQALAWYQCKRQKAPLLTVDSLES GVPRFSSGGGDTPTLTLSLSPERATYVYQDQSSFTTGFQNTVQK
229	y heavy chain variable region of LC.060	Amino acid sequence of y heavy chain variable region of LC.060 (Seq ID No: 19 in WO/2006/029679)	EVLLEGGGLVQGGSLALSCASGFTTSYAWHWVRQPKGLEWISLSSGG GFTTYSASVGRFTTSFGDKRTLLYLQNLRAEDATYTCWGLYVIGTALYV WGQGLVTVSS
230	y heavy chain variable region of LC.063	Amino acid sequence of y heavy chain variable region of LC.063 (Seq ID No: 20 in WO/2006/029679)	EVLLEGGGLVQGGSLALSCASGFTTSYAWHWVRQPKGLEWISLSSGG GFTTYSASVGRFTTSFGDKRTLLYLQNLRAEDATYTCWGLYVIGTALYV WGQGLVTVSS
231	SE12 light chain variable region	Amino acid sequence of SE12 light chain variable region (Seq ID No: 13 in US7,812,133)	DILMTDTPLSLVSLDQASISQSSQSVHNGHTLYLWLPQGGZPLLYLW LVNPRSGVPRFSSGGGDTPTLTLSLSPEDAWYVYQDQSSFTTGFQNTVQK
232	SE12 heavy chain variable region	Amino acid sequence of SE12 heavy chain variable region (Seq ID No: 14 in US7,812,133)	DILMTDTPLSLVSLDQASISQSSQSVHNGHTLYLWLPQGGZPLLYLW LVNPRSGVPRFSSGGGDTPTLTLSLSPEDAWYVYQDQSSFTTGFQNTVQK
233	13G5 light chain variable region	Amino acid sequence of 13G5 light chain variable region (Seq ID No: 15 in US7,812,133)	QVLQDQKQELVPGFTSYLSCASGFTTSYAWHWVRQPKGLEWISLSSGG GFTTYSASVGRFTTSFGDKRTLLYLQNLRAEDATYTCWGLYVIGTALYV WGQGLVTVSS
234	13G5 heavy chain variable region	Amino acid sequence of 13G5 heavy chain variable region (Seq ID No: 16 in US7,812,133)	QVLQDQKQELVPGFTSYLSCASGFTTSYAWHWVRQPKGLEWISLSSGG GFTTYSASVGRFTTSFGDKRTLLYLQNLRAEDATYTCWGLYVIGTALYV WGQGLVTVSS

IMGT indicates that CDR is determined using IMGT nomenclature.
Kabat indicates that CDR is determined using Kabat nomenclature.
The numbering in the sequence correlation table takes precedence over any inconsistent numbering elsewhere in this text.

REFERENCES CITED IN THE DESCRIPTION

Cited references

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Patent documents cited in the description

- [illegible]

[illegible]

- JALKANEN et al. *J. Cell. Biol.*, 1985, vol. 101, 976-985 [\[0241\]](#)
- JALKANEN et al. *J. Cell. Biol.*, 1987, vol. 105, 3087-3096 [\[0242\]](#)
- Immunopharmacokinetics of Radiolabeled Antibodies and Their Fragments, S. W. BURCHIEL et al. *Tumor Imaging: The Radiochemical Detection of Cancer* Massan Publishing Inc. 19820000 [\[0243\]](#)
- MANIATIS et al. *Molecular Cloning: A Laboratory Manual* Cold Spring Harbor Laboratory Press 19820000 [\[0244\]](#)
- SAMBROOK et al. *Molecular Cloning: A Laboratory Manual* Cold Spring Harbor Laboratory Press 19890000 [\[0245\]](#)
- SAMBROOK et al. *Molecular Cloning: A Laboratory Manual* Cold Spring Harbor Laboratory Press 20010000 [\[0246\]](#)
- AUSUBEL et al. *Current Protocols in Molecular Biology* John Wiley & Sons 19870000 [\[0247\]](#)
- Current Protocols in Immunology, John Wiley & Sons 19870000 [\[0248\]](#)
- Oligonucleotide Synthesis: A Practical Approach IRL Press 19840000 [\[0249\]](#)
- Oligonucleotides and Analogues: A Practical Approach IRL Press 19910000 [\[0250\]](#)
- Genome Analysis: A Laboratory Manual Cold Spring Harbor Laboratory Press 19890000 [\[0251\]](#)
- HAMMERLING et al. *Monoclonal Antibodies and T-Cell Hybridomas* Elsevier 19810000 [\[0252\]](#)
- KILPATRICK et al. *Hybridoma*, 1997, vol. 16, 381-9 [\[0253\]](#)
- BRINKMAN et al. *J. Immunol. Methods*, 1995, vol. 182, 41-50 [\[0254\]](#)
- AMESJ. *Immunol. Methods*, 1995, vol. 184, 177-186 [\[0255\]](#)
- KETTLERBOUGH et al. *Eur. J. Immunol.*, 1994, vol. 24, 952-956 [\[0256\]](#)
- PERICH et al. *Gene*, 1997, vol. 187, 9-18 [\[0257\]](#)
- BURTON et al. *Advances in Immunology*, 1994, vol. 57, 191-209 [\[0258\]](#)
- MULLINAX et al. *BioTechniques*, 1992, vol. 12, 686-689 [\[0259\]](#)
- SAWAI et al. *FASEB*, 1995, vol. 9, 26-34 [\[0260\]](#)
- BETTER et al. *Science*, 1989, vol. 249, 1041-1043 [\[0261\]](#)
- LONBERGHUSZARH. *Rev. Immunol.*, 1995, vol. 13, 65-93 [\[0262\]](#)
- MORRISON *Science*, 1985, vol. 229, 1202-1203 [\[0263\]](#)
- Ol et al. *BioTechniques*, 1986, vol. 4, 214-10 [\[0264\]](#)
- GALLIES et al. *J. Immunol. Methods*, 1989, vol. 125, 191-202 [\[0265\]](#)
- JOHNSON et al. *J. Infect. Dis.*, 1997, vol. 176, 1215-1224 [\[0266\]](#)
- PADLAN *Molecular Immunology*, 1991, vol. 28, 4-549-499 [\[0267\]](#)
- STUENKKA et al. *Protein Engineering*, 1994, vol. 7, 605-614 [\[0268\]](#)
- ROGUSKA et al. *PNAS*, 1994, vol. 91, 969-973 [\[0269\]](#)
- TAN et al. *J. Immunol.*, 2002, vol. 169, 1119-25 [\[0270\]](#)
- CALDAS et al. *Protein Eng.*, 2000, vol. 13, 5353-60 [\[0271\]](#)
- MOREA et al. *Methods*, 2000, vol. 20, 3267-79 [\[0272\]](#)
- BACA et al. *J. Biol. Chem.*, 1997, vol. 272, 1619678-84 [\[0273\]](#)
- ROGUSKA et al. *Protein Eng.*, 1996, vol. 9, 13095-904 [\[0274\]](#)
- COUTO et al. *Cancer Res.*, 1995, vol. 55, 2359736-5975 [\[0275\]](#)
- COUTO et al. *Cancer Res.*, 1995, vol. 55, 91717-22 [\[0276\]](#)
- SANDHU J *Science*, 1994, vol. 150, 2409-10 [\[0277\]](#)
- PEDERSEN et al. *J. Mol. Biol.*, 1994, vol. 235, 3959-73 [\[0278\]](#)
- REICHMANN et al. *Nature*, 1988, vol. 332, 323-323 [\[0279\]](#)
- REICHMANN et al. *J. Immunol.*, 1989, vol. 231, 25-36 [\[0280\]](#)
- NUTTALL et al. *Curr. Pharm. Biotechnol.*, 2000, vol. 1, 263-263 [\[0281\]](#)
- MUYLDERMANJ. *Biotechnol.*, 2001, vol. 74, 4277302-3012 [\[0282\]](#)
- GREENSPANBONAFASEB J., 1989, vol. 7, 5437-444 [\[0283\]](#)
- NISSINOFFJ. *Immunol.*, 1991, vol. 147, 82429-2439 [\[0284\]](#)
- CREIGHTONProteinW. H. Freeman and Company 19890000 [\[0285\]](#)
- DORDO et al. *J. Mol. Biol.*, 1999, vol. 217, 721-739 [\[0286\]](#)
- TAYLOR et al. *J. Theor. Biol.*, 1986, vol. 119, 205-219 [\[0287\]](#)
- S. FRENCHB. *ROBSONJ. Mol. Evol.*, 1983, vol. 19, 171-171 [\[0288\]](#)
- DEWILDT et al. *Eur. J. Immunol.*, 1996, vol. 26, 3629-39 [\[0289\]](#)
- KABATSequences of Proteins of Immunological InterestNational Institutes of Health 19870000 [\[0290\]](#)
- The Merck Manual of Diagnosis and TherapyMerck Research Laboratories 20060000 [\[0291\]](#)
- The Encyclopedia of Molecular BiologyBlackwell Science Ltd 19940000 [\[0292\]](#)
- BENJAMIN LEWINGenesJones & Bartlett Publishing 20000000vol. X. [\[0293\]](#)
- Molecular Biology and Biotechnology: a Comprehensive Desk ReferenceVCH Publishers, Inc. 19950000 [\[0294\]](#)
- Current Protocols in Protein ScienceWiley Interscience 20000000 [\[0295\]](#)
- SAMBROOK et al. *Molecular Cloning: A Laboratory Manual* Cold Spring Harbor Laboratory Press 20120000 [\[0296\]](#)
- DAVIS et al. *Basic Methods in Molecular Biology* Elsevier Science Publishing, Inc. 19950000 [\[0297\]](#)
- Methods in Enzymology: Guide to Molecular Cloning TechniquesAcademic Press Inc. 19870000vol. 152. [\[0298\]](#)
- Current Protocols in Protein Science (CPRS)John Wiley and Sons, Inc. [\[0299\]](#)
- Current Protocols in Cell Biology (CPCB)John Wiley and Sons, Inc. [\[0300\]](#)
- R. IAN FRESHNEYCulture of Animal Cells: A Manual of Basic TechniquesWiley-Liss 20050000 [\[0301\]](#)
- 1998Animal Cell Culture Methods (Methods in Cell BiologyAcademic Pressvol. 57. [\[0302\]](#)
- YUSA KZHOU LLI MABRADLEY ACRAIG NLA hyperactive piggyBac transposase for mammalian applicationsProc Natl Acad Sci USA., 2011, [\[0303\]](#) [\[0304\]](#)
- MATYSClinical Chemistry, 1995, vol. 41, 91391-1397 [\[0305\]](#) [\[0306\]](#)
- WANG et al. *Hybridoma (Larchmt)*, 2000, vol. 29, 4269-76 [\[0307\]](#)
- MILLER, WESTON P. et al. *GVHD after haploidentical transplantation: a novel, MHC-defined rhesus macaque model identifies CD28- CD8+ T cells as a reservoir of breakthrough T cell proliferation during costimulation blockade and sirolimus-based immunosuppression* *Blood*, 2010, vol. 116, 245403-5416 [\[0308\]](#)
- MILLER WP et al. *GVHD after haploidentical transplantation: a novel, MHC-defined rhesus macaque model identifies CD28- CD8+ T cells as a reservoir of breakthrough T-cell proliferation during costimulation blockade and sirolimus-based immunosuppression* *Blood*, 2010, vol. 116, 5403-5416 [\[0309\]](#)
- FEMEDO MC et al. *Microsatellite typing of the rhesus macaque MHC regionImmunogenetics*, 2005, vol. 57, 189-209 [\[0310\]](#)
- FURLAN et al. *Science Translational Medicine*, vol. 7, 315315-1910 [\[0311\]](#)

Patentkrav

1. Kombination, som omfatter et antistof eller et fragment deraf, der binder specifikt til hOX40L, hvor antistoffet eller
5 fragmentet omfatter et V_H-domæne, der omfatter en aminosyresekvens ifølge SEQ ID NO: 34; og et V_L-domæne, der omfatter en aminosyresekvens ifølge SEQ ID NO:48, hvor antistoffet er et IgG4-antistof, og et yderligere terapeutisk middel, der er valgt uafhængigt fra
10 gruppen, der består af rapamycin (sirolimus), tacrolimus, ciclosporin, kortikosteroider (f.eks. methylprednisolon), basilixumab og daclizumab.
2. Kombination ifølge krav 1, hvor antistoffet eller
15 fragmentet omfatter første og anden kopier af V_H-domænet, og/eller hvor antistoffet eller fragmentet omfatter første og anden kopier af V_L-domænet.
3. Kombination ifølge krav 1 eller 2, hvor
20 (a) antistoffet eller fragmentet omfatter en kappa-let kæde; og/eller
(b) den lette kæde omfatter en konstant region fra gnaver, rotte, mus, menneske, kanin, kylling, kamel, får, okse, ikke-human primat eller haj; og/eller
25 (c) antistoffet eller fragmentet yderligere omfatter humane eller humaniserede konstante regioner af let kæde, f.eks. human CL; og/eller
(d) antistoffet eller fragmentet omfatter en kappa-let kæde, der omfatter en konstant region valgt fra gruppen, der består af
30 aminosyresekvenserne for konstant region af kappa-let kæde ifølge SEQ ID NO: 136, 138, 140, 142 og 144; og/eller
(e) antistoffet er et fuldstændigt humant antistof; og/eller
(f) antistoffet omfatter en human gamma 4-konstant region, eventuelt en konstant region af tung kæde ifølge SEQ ID NO: 128.
35
4. Kombination ifølge et hvilket som helst af ovennævnte krav, hvor antistoffet eller fragmentet omfatter en tung kæde, der omfatter en aminosyresekvens, der består af sekvensen ifølge SEQ

ID No: 62, og en let kæde, der omfatter en aminosyresekvens, der består af sekvensen ifølge SEQ ID NO: 64.

5. Kombination ifølge et hvilket som helst af ovennævnte krav, der er formuleret til parenteral administration valgt blandt intravenøs eller subkutan administration.

6. Kit, som omfatter:

(i) et antistof eller et fragment deraf ifølge et hvilket som helst af ovennævnte krav; og
(ii) et yderligere terapeutisk middel, der er valgt uafhængigt fra gruppen, der består af rapamycin (sirolimus), tacrolimus, ciclosporin, kortikosteroider (f.eks. methylprednisolon), basilixumab og daclizumab.

7. Kit ifølge krav 6, hvor kittet omfatter en etiket eller en vejledning, hvor etiketten eller vejledningen er til anvendelse til behandling og/eller forbyggelse af en hOX40L-medieret tilstand eller sygdom valgt blandt en autoimmunsygdom eller -tilstand, en systemisk inflammatorionssygdom eller -tilstand eller transplantatafstødning; for eksempel inflammatorisk tarmsygdom (IBD), Crohns sygdom, rheumatoid arthritis, allogen transplantatafstødning, *graft-versus-host-sygdom* (GvHD), ulcerativ colitis, systemisk lupus erythematosus (SLE), diabetes, uveitis, ankyloserende spondylitis, kontaktoverfølsomhed, multipel sklerose og aterosklerose, især GvHD, eventuelt hvor etiketten eller vejledningen omfatter et markedsføringstilladelsesnummer (f.eks. et FDA- eller EMA-tilladelsesnummer).

8. Kit ifølge et hvilket som helst af kravene 6 eller 7, som omfatter en i.v.- eller injektionsanordning, der omfatter antistoffet eller fragmentet deraf.

9. Kombination ifølge et hvilket som helst af kravene 1 til 5 til anvendelse til behandling og/eller forebyggelse af en hOX40L-medieret sygdom valgt blandt en autoimmunsygdom, en

systemisk inflammationssygdom eller transplantatafstødning.

10. Antistof eller fragment deraf ifølge et hvilket som helst af kravene 1 til 5 til anvendelse til behandling eller forebyggelse af en hOX40L-medieret sygdom valgt blandt en autoimmunsygdom, en systemisk inflammationssygdom eller transplantatafstødning hos et individ, hvor individet også får administreret et yderligere terapeutisk middel, der er valgt uafhængigt fra gruppen, der består af rapamycin (sirolimus), tacrolimus, ciclosporin, kortikosteroider (f.eks. methylprednisolon), basilixumab og daclizumab.

11. Kombination til anvendelse ifølge krav 9 eller antistof eller fragment til anvendelse ifølge krav 10, hvor den hOX40L-medierede sygdom er valgt blandt inflammatorisk tarmsygdom (IBD), Crohns sygdom, rheumatoid arthritis, allogen transplantatafstødning, *graft-versus-host-sygdom* (GvHD), ulcerativ colitis, systemisk lupus erythematosus (SLE), diabetes, uveitis, ankyloserende spondylitis, kontaktoverfølsomhed, multipel sklerose og aterosklerose.

12. Kombination til anvendelse ifølge krav 9 eller antistof eller fragment til anvendelse ifølge krav 10, hvor den hOX40L-medierede sygdom er dermatitis.

13. Kombination til anvendelse ifølge et hvilket som helst af kravene 9, 11 og 12 eller antistof eller fragment til anvendelse ifølge et hvilket som helst af kravene 10 til 12, hvor antistoffet eller fragmentet administreres parenteralt, for eksempel ved intravenøs eller subkutan administration.

14. Kombination ifølge et hvilket som helst af kravene 1 til 5 til anvendelse til terapi.

DRAWINGS

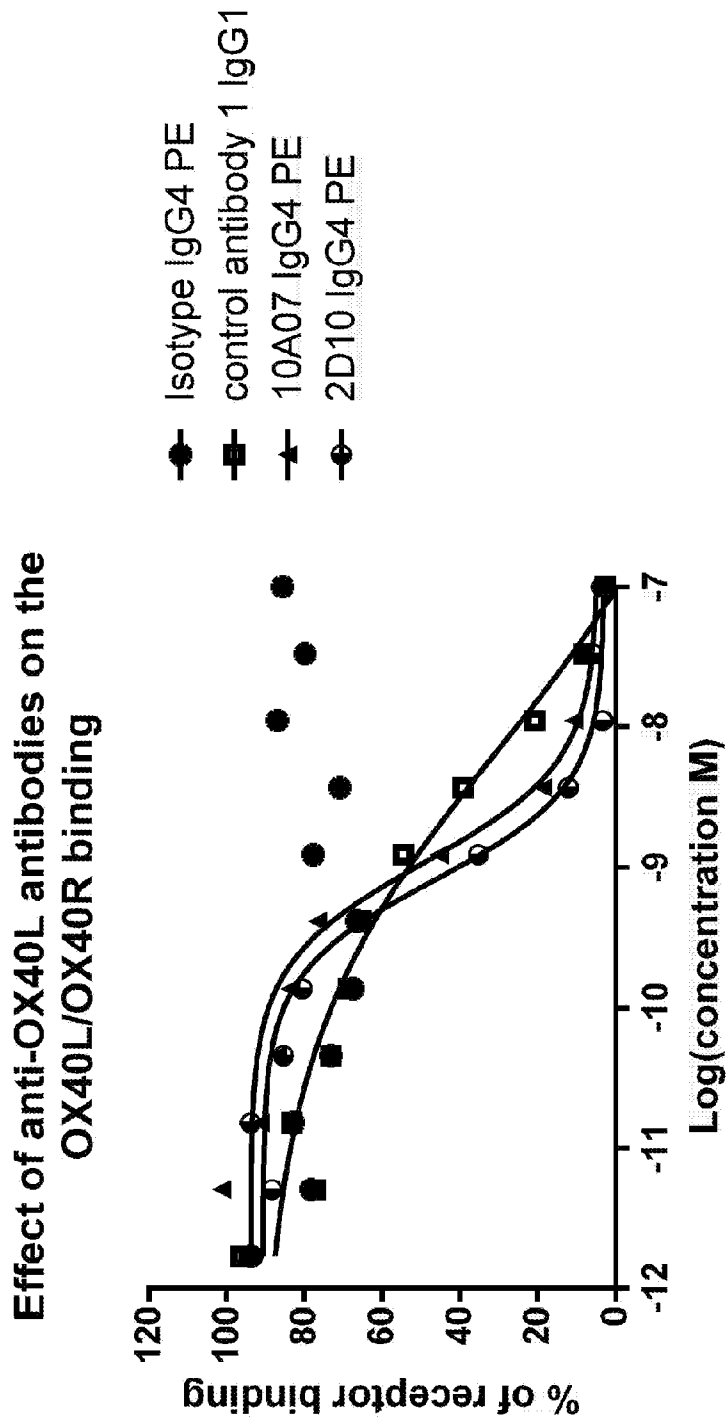
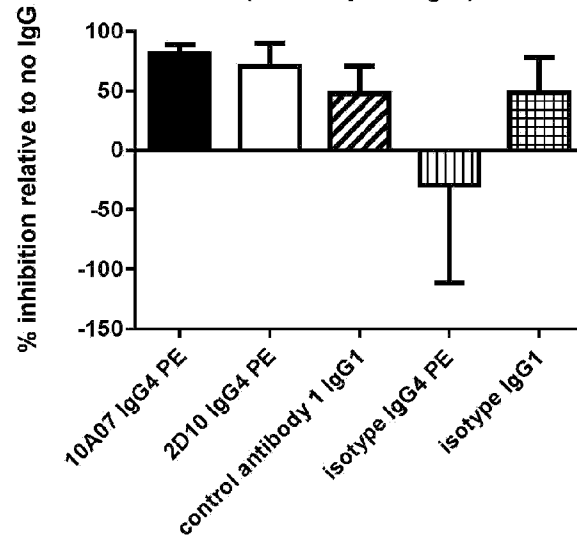


Figure 1

Figure 2

**Effect of anti-OX40L Antibodies in PBMC/T MLR
Percentage Inhibition Relative to no IgG wells
(Donor pairing 1)**



**Effect of anti-OX40L Antibodies in PBMC/T MLR
Percentage Inhibition Relative to no IgG wells
(Donor pairing 2)**

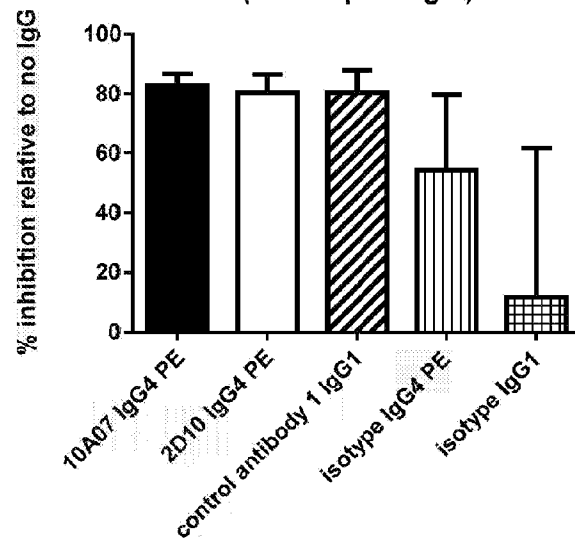
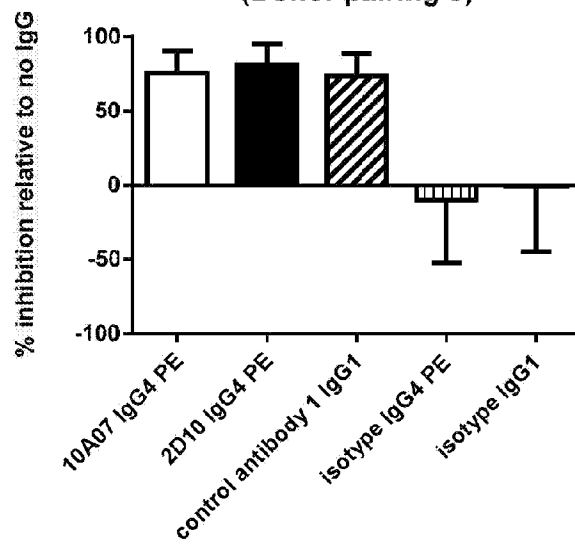


Figure 2 continued

**Effect of anti-OX40L Antibodies in PBMC/T MLR
Percentage Inhibition Relative to no IgG wells
(Donor pairing 3)**



**Effect of anti-OX40L Antibodies in PBMC/T MLR
IFN gamma Relative to no IgG wells
(Donor pairing 1)**

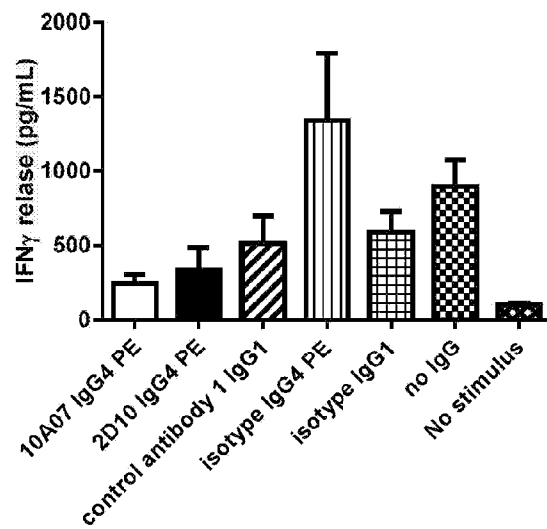
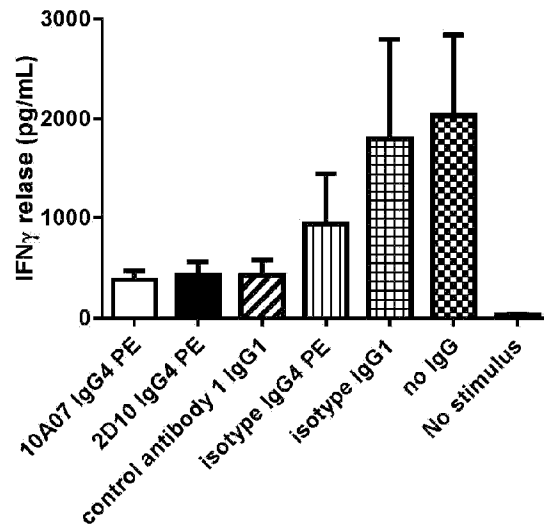


Figure 2 continued

**Effect of anti-OX40L Antibodies in PBMC/T MLR
IFN gamma Relative to no IgG wells
(Donor pairing 2)**



**Effect of anti-OX40L Antibodies in PBMC/T MLR
IFN gamma Relative to no IgG wells
(Donor pairing 3)**

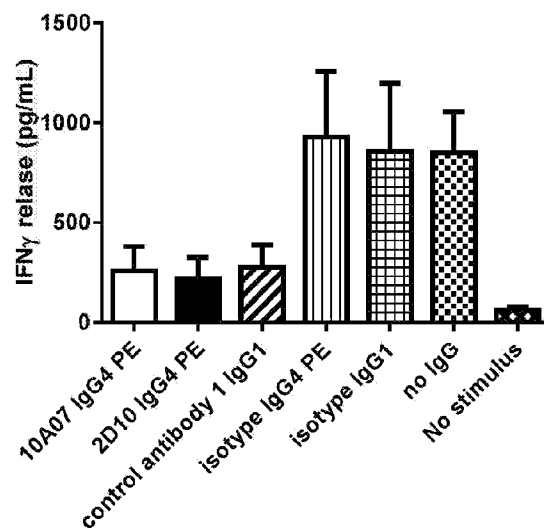


Figure 3

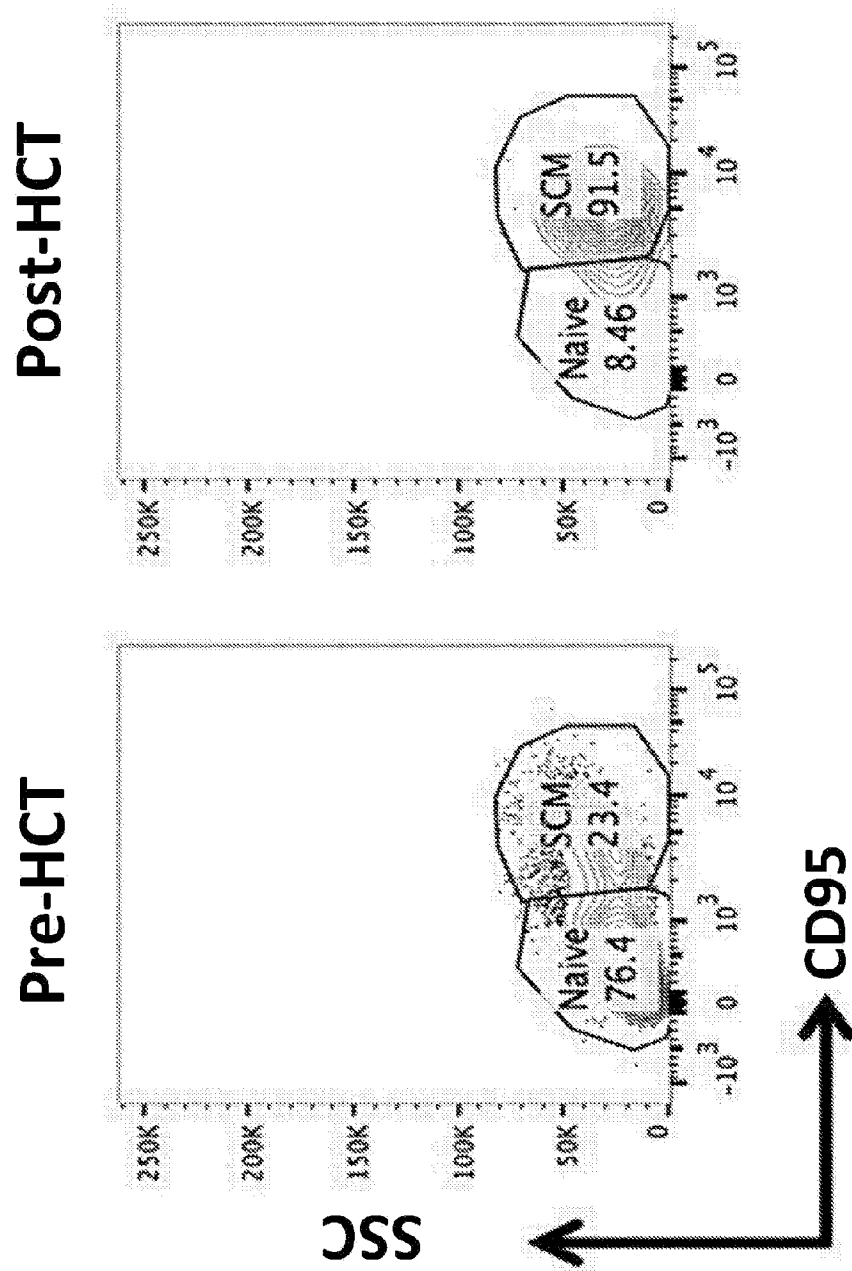


Figure 4

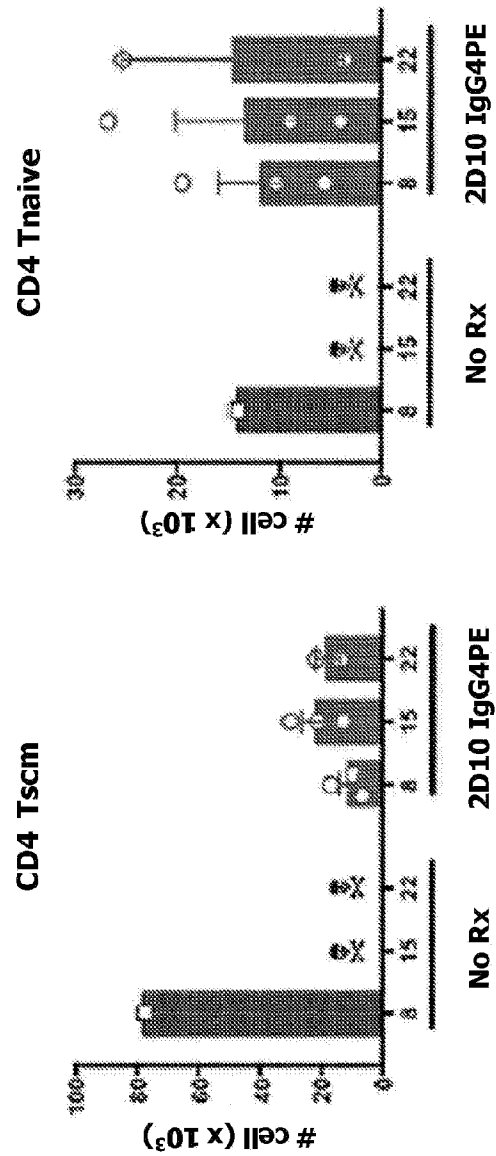


Figure 5

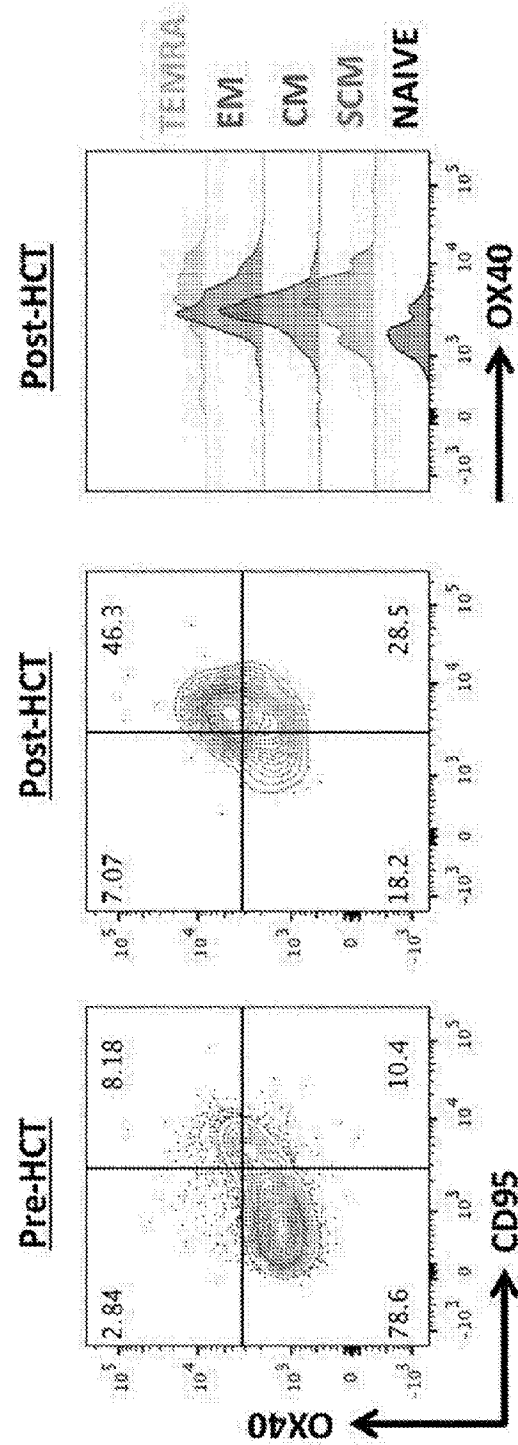


Figure 6a

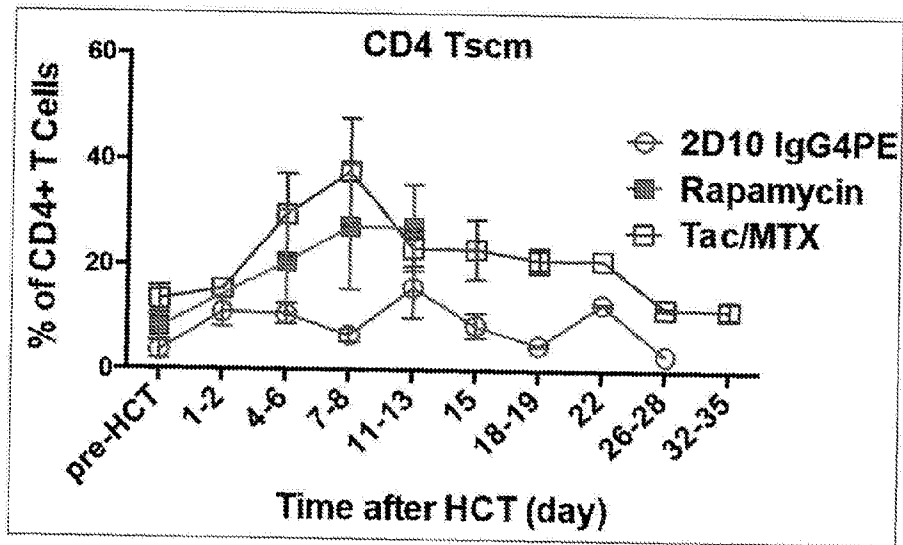


Figure 6b

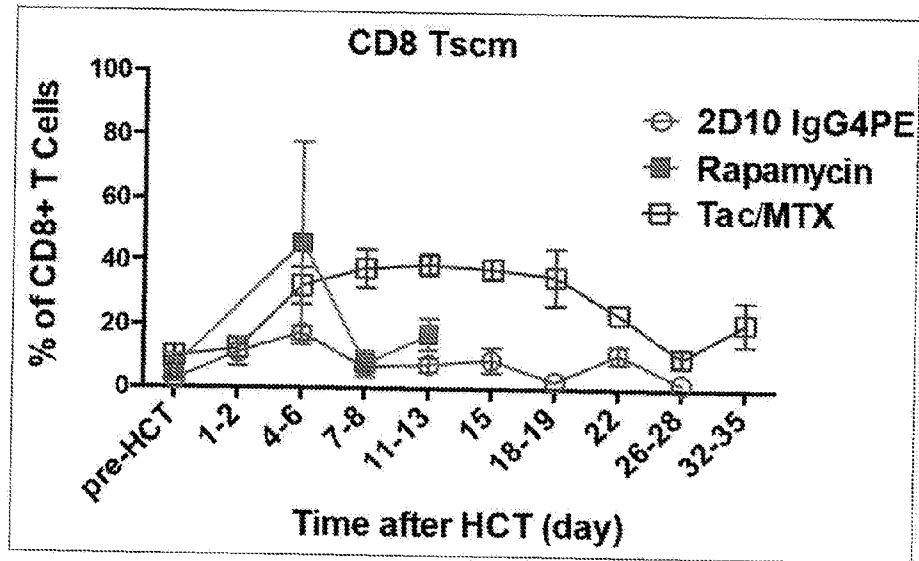


Figure 7

