(19) DANMARK

(10) **DK/EP 3411400 T3**

Patent- og Varemærkestyrelsen

(12) # Oversættelse af europæisk patentskrift

(51) Int.Cl.: ***C 07 K 16/18 (2006.01)*** ***A 61 P 17/00 (2006.01)*** ***A 61 P 17/10 (2006.01)*** ***A 61 P 29/00 (2006.01)*** ***A 61 P 37/02 (2006.01)***

(45) Oversættelsen bekendtgjort den: **2021-10-11**

(80) Dato for Den Europæiske Patentmyndigheds bekendtgørelse om meddelelse af patentet: **2021-09-22**

(86) Europæisk ansøgning nr.: **18701250.5**

(86) Europæisk indleveringsdag: **2018-01-03**

(87) Den europæiske ansøgnings publiceringsdag: **2018-12-12**

(86) International ansøgning nr.: **EP2018050146**

(87) Internationalt publikationsnr.: **WO2018184739**

(30) Prioritet: **2017-04-03 EP 17164573** **2017-06-23 EP 17177657** **2017-09-07 EP 17189938**

(84) Designerede stater: **AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**

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(54) Benævnelse: **BEHANDLING AF INFLAMMATORISKE SYGDOMME MED HÆMMERE AF C5A-AKTIVITET**

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DESCRIPTION

FIELD OF THE INVENTION

[0001] The present invention relates to the inhibitor of C5a activity, IFX-1 and its use in the treatment of cutaneous, neutrophilic, inflammatory diseases in a subject.

BACKGROUND OF THE INVENTION

Target C5a in Inflammation

[0002] C5a is a 74 amino acid spanning split product of its "mother molecule" C5 and represents one endpoint of the complement activation cascade. It can be generated through activation of at least three well-described pathways (the alternative, the classical and the MBL pathway). All pathways merge at the level of C3, forming the C5- or alternative C5 convertase leading to cleavage of C5 into C5a and C5b. The latter binds with C6, C7, C8 and multiple C9 molecules ultimately leading to formation of pores in e.g. bacterial membranes (terminal Membrane Attack Complex = MAC). C5a is generated when the complement system is activated in settings of inflammation and other immunological and inflammatory disorders / diseases.

[0003] Among the complement activation products, C5a is one of the most potent inflammatory peptides, with a broad spectrum of functions (Guo and Ward, 2005). C5a exerts its effects through the high-affinity C5a receptors (C5aR and C5L2) (Ward, 2009). C5aR belongs to the rhodopsin family of G-protein-coupled receptors with seven transmembrane segments; C5L2 has a similar structure but appears not to be G-protein-coupled. It is currently believed that C5a exerts its biological functions primarily through C5a-C5aR interaction, as few biological responses have been found for C5a-C5L2 interaction. However, latest reports demonstrate signaling also through C5L2 activation (Rittirsch and others, 2008).

[0004] C5aR is widely expressed on myeloid cells including neutrophils, eosinophils, basophils, and monocytes, and non-myeloid cells in many organs, especially in the lung and liver, indicative of the importance of C5a/C5aR signaling. Widespread up-regulation of C5aR expression occurs during the onset of sepsis, and blockade of C5a/C5aR interaction by antiC5a, or anti-C5aR antibodies, or C5aR antagonists renders highly protective effects in rodent models of sepsis (Czermak and others, 1999; Huber-Lang and others, 2001; Riedemann and others, 2002).

[0005] C5a has a variety of biological functions (Guo and Ward, 2005). C5a is a strong chemoattractant for neutrophils and also has chemotactic activity for monocytes and macrophages. C5a causes an oxidative burst (O_2 consumption) in neutrophils and enhances phagocytosis and release of granular enzymes. C5a has also been found to be a vasodilator. C5a has been shown to be involved in modulation of cytokine expression from various cell types and to enhance expression of adhesion molecule expression on neutrophils. High doses of C5a can lead to nonspecific chemotactic "desensitization" of neutrophils, thereby causing broad dysfunction. Many inflammatory diseases are attributable to the effects of C5a, including sepsis, acute lung injury, inflammatory bowel disease, rheumatoid arthritis and others. In the experimental setting of sepsis, exposure of neutrophils to C5a can lead to neutrophil dysfunction and paralysis of signaling pathways, leading to defective assembly of NADPH oxidase, paralysis of MAPK signaling cascades, a great depression of oxidative burst, phagocytosis and chemotaxis (Guo and others, 2006; Huber-Lang and others, 2002). Thymocytes apoptosis and delayed neutrophil apoptosis are two important pathogenic events for sepsis development, which are dependent on the presence of C5a. During experimental sepsis, C5a up-regulates β2-integrin expression on neutrophils to promote cell migration into organs, one of the major causes for multi-organ failure (MOF). It is also found that C5a is attributable to the activation of the coagulation pathway that occurs in experimental sepsis. C5a stimulates the synthesis and release from human leukocytes of pro-inflammatory cytokines such as TNF-α, IL-1β, IL-6, IL-8, and macrophage migration inhibitory factor (MIF). Given that complement activation is an event occurring during the onset of acute inflammation, C5a may come into play before emergence of most of the inflammatory "cytokine storm". It appears that C5a plays a key role in orchestrating and amplifying the performance of the cytokine network and the formation of systemic inflammatory response syndrome (SIRS).

[0006] In the immunological regulatory network tailing to the adaptive immunity, C5a affects the crosstalk between dendritic cells (DC) and δεT cells, and this may result in a large production of inflammatory mediators such as IL-17 (Xu and others, 2010). An essential role for C5a has been established and defined in the generation of pathogenic Th17 responses in systemic lupus erythematosus (SLE) (Pawaria and others, 2014). In addition, it has been reported that C5a is a key regulator for Treg cells offering a powerful suppressive effect for Treg propagation and induction (Strainic and others, 2013). Given the fact that Treg and TH17 are the essential players in the autoimmune disease setting, inhibition of C5a signaling would be expected to significantly reduce overactive immune status in the autoimmune diseases.

IFX-1

[0007] IFX-1 is a chimaeric monoclonal IgG4 antibody which specifically binds to the soluble human complement split product C5a. IFX-1 is composed of 1328 amino acids and has an approximate molecular weight of 148,472 Daltons. The CDR and FR sequences of IFX-1 are disclosed in in Table 1 below.

[0008] IFX-1 is expressed in a mammalian CHO cell line as recombinant protein and finally formulated in a phosphate buffered saline solution for intravenous administration. The binding of this antibody to human C5a facilitates a highly effective blockade of C5a-induced biological effects by disabling C5a binding to and reacting with its corresponding cell-bound receptors.

[0009] Various nonclinical studies were conducted to assess pharmacological and toxicological aspects of IFX-1, which can be divided into *in vitro* / *ex vivo* tests and *in vivo* studies including GLP toxicology studies in cynomolgus monkey (using IFX-1). None of the conducted nonclinical tests and studies revealed any toxicological or safety concerns for IFX-1. Human Phase I trial indicated that safety laboratory parameters, vital signs and ECG parameters showed no clinically relevant time or dose-related changes.

[0010] *In vitro* analysis of IFX-1 demonstrates a strong binding capacity to soluble human C5a as well as a high blocking activity of C5a-induced biological effects such as lysozyme release from human neutrophils or CD11b up-regulation in neutrophils in human whole blood. One IFX-1 antibody reaches the capability of neutralizing the effects of 2 molecules C5a with close to 100% efficiency in experimental *in vitro* settings. Clinical trials with IFX-1 have been ongoing to test its clinical efficacy in several inflammatory diseases including septic organ dysfunction and complex cardiac surgery.

Neutrophils

[0011] Neutrophils, terminally differentiated cells with a short lifespan in circulation, are the most abundant leukocytes in the human body. As a first line of defense against invading microorganisms, neutrophils are characterized by their ability to act as phagocytic cells, release lytic enzymes from their granules and produce reactive oxygen species upon stimulation. In addition to microbial products, other stimuli such as immune complex can also induce the respiratory burst in neutrophils, leading to enhanced inflammation and the recruitment of inflammatory cells (Kaplan, 2013).

[0012] After infiltrating into inflamed tissues, neutrophils engage in many other cell types, such as macrophages, dendritic cells (DCs), natural killer cells, lymphocytes and mesenchymal stem cells, regulate innate and adaptive immune responses. For instance, neutrophils can modulate DC maturation and the proliferation and polarization of T cells, and they can also directly prime antigen-specific T-helper type 1 and T-helper type 17 cells (Abi Abdallah and others, 2011). A variety of stimuli induce neutrophil degranulation, including C5a, formyl-methionyl-leucyl-phenylalanine (FMLP), lipopolysaccharide, platelet activating factor, and Tumor necrosis factor (TNF) (Kaplan, 2013). The contents released from degranulation and oxidative species together with cytokines and chemokines resulted from neutrophil activation are the primary inflammatory mediators that cause tissue damage, and this mechanism is believed to be attributable to many types of inflammatory tissue injury.

Hidradenitis Suppurativa (HS)

[0013] HS is a chronic devastating skin disorder affecting areas rich in apocrine glands, and it is considered as one of neutrophil-associated cutaneous inflammatory diseases. Nodules appear in the affected areas, and they progressively become swollen and rupture with the release of pus. This process occurs repeatedly leading to sinus tract formation and scars (Jemec, 2004). This disease course creates a frustrating situation for the patients but also for physicians. The point prevalence is reported to range between 1% and 4% (Jemec and others, 1996).

[0014] The exact pathophysiology of HS is not well defined. Smoking, dietary habits and genetic predisposition have all been linked with HS (Kurzen and others, 2008; Slade and others, 2003). The percentage of NK cells was increased and that of CD4-lymphocytes decreased compared to healthy controls probably implying the existence of an autoimmune predilection for the disorder. IL-1β and IL-17 have been found to be upregulated in the lesion of HS, being associated with the activation of inflammasome (Lima and others, 2016). Hidradenitis suppurativa (HS) is presented with the high number of neutrophil infiltrates in the inflamed skin, especially in the late stage of disease (Lima and others, 2016; Marzano, 2016). Activated neutrophils could be an important effector cell type causing tissue damage through direct harmful effect or indirect regulatory effect toward other effect cells such as active T cells and TH17 in this disease setting.

[0015] A hypothesis for the implication of some autoimmune or autoinflammatory mechanism in the pathogenesis of HS has been created over the last years. The hypothesis is further reinforced by positive results from the administration of TNF antagonists in prospective, placebo-controlled studies, which result in the approval of Adalimumab (an antibody directed against tumor necrosis factor α) in patients with moderate to severe HS. One major, yet unanswered question is how neutrophils are recruited to the affected skin lesion and to what extent activated neutrophils would contribute to the disease development.

[0016] The wide range of possible pathogenic mechanisms suggested by different studies may imply that HS is associated with host mechanisms rather than exogenous factors. Taking into account of the paradox that both anti-infectious (antibiotics) and pro-infectious (anti-TNF, corticosteroids, immunosuppressive drugs) therapies may be helpful, HS may appear as an auto-inflammatory disease based on a defect in the hair follicle innate immunity (Revuz, 2009), which is supported by the fact that pro-inflammatory cytokines such as interleukin (IL)-1β, and tumor necrosis factor-α (TNF-α) are markedly increased in lesional and perilesional skin (Wollina and others, 2013).

[0017] A clinical phase II trial investigating the use of complement inhibition by IFX-1 in HS patients was announced in 2017, without disclosing any outcome of the trial. The primary goal was to evaluate safety and tolerability of IFX-1. In addition the trial aims to characterize the pharmacokinetics and pharmacodynamics of IFX-1 as well as to generate preliminary data on the efficacy of IFX-1.

Neutrophilic Dermatoses

[0018] The neutrophilic dermatoses (ND) are a group of disorders characterized by skin lesions for which histologic examination reveals intense inflammatory infiltrates composed primarily of neutrophils with no evidence of infection. ND mainly include Sweet syndrome (SS), pyoderma gangrenosum (PG), subcorneal pustular dermatosis (SPD), other well-defined entities, and their atypical or transitional forms (Prat and others, 2014). Hidradenitis suppurativa (HS) has recently been assigned to the family of ND based on the high number of neutrophil infiltrates observed in the inflamed skin (Lima and others, 2016; Marzano, 2016).

[0019] Pyoderma gangrenosum (PG) and hidradenitis suppurativa (HS) are prototypic neutrophilic dermatoses that are regarded as autoinflammatory disease in origin with the hallmark of the accumulation of neutrophils in the skin (Braun-Falco and others, 2012; Marzano and others, 2014). Autoinflammatory Syndrome represents an emerging group of inflammatory conditions that are distinct from autoimmune, allergic, and infectious disorders. From a pathophysiological perspective, all the autoinflammatory syndromes such as PAPA (pyogenic arthritis, PG and acne), PASH (PG, acne and hidradenitis suppurativa) or PAPASH (pyogenic arthritis, acne, PG and hidradenitis suppurativa) share common mechanisms consisting of over-activation of the innate immune system and 'sterile' neutrophil-rich cutaneous inflammation (Cugno and others, 2017).

Neutrophils and Autoimmune Diseases

[0020] Autoimmune diseases are defined by defective differentiation of self and non-self molecules, leading to inappropriate recognition of self molecules and tissues as foreign structures, and concomitant immune attack against host organs. The pathogenesis of autoimmune diseases can generally be divided into two phases, immunization phase and effector phase. Immunization phase is characterized by the emergence of autoreactive T-lymphocytes. Those T-cells then trigger a secondary response leading to tissue damaging phase by activating various other cell types (B-cells, cytotoxic T-cells, NK-cells, neutrophils, macrophages, osteoclasts, fibroblasts, etc.). The activation of those effector cells by the autoreactive T cells can be considered as the effector phase which can be mediated by multiple levels including autoantibody production, cytokine networks or direct cell-cell contacts (Nemeth and Mocsai, 2012).

[0021] The role of neutrophils in the pathophysiological development of autoimmune diseases has been limitedly defined, but increasingly appreciated. Neutrophils could participate in the multiple steps of the autoimmune disease process, including antigen presentation, regulation of the activity of other immune cell types, and direct tissue damage. Neutrophils can expose/release autoantigens when activated, or when dying by apoptosis, or during formation of neutrophil extracellular traps (NETs). They can also contribute to tissue deposition of autoantibodies or, as an effector cell type, they can induce tissue damage themselves. Accumulative studies have demonstrated that neutrophils play an active role in the development of autoimmune diseases, such as, rheumatoid arthritis (RA), systemic lupus erythematosus (SLE), bullous pemphigoid, epidermolysis bullosa acquisita, ANCA-associated vasculitis, familial Mediterranean fever, cryopyrin-associated periodic disorders (CAPS) and gout, etc. (Nemeth and Mocsai, 2012; Nemeth and others, 2016). As the skin being an easy target for immune responses, cutaneous inflammation is one of most frequent syndromes presented by these autoimmune diseases.

TECHNICAL PROBLEMS UNDERLYING THE PRESENT INVENTION

[0022] As explained above, there existed a need in the prior art for effective therapies for the treatment of neutrophilic dermatoses, such as Hidradenitis suppurativa (HS).

[0023] The present inventors have now surprisingly found that molecules inhibiting C5a signaling, i.e. the anti-C5a antibody IFX-1, are exceptionally well-suited for the treatment of Hidradenitis suppurativa. The present inventors have additionally studied the physiological mechanism leading to neutrophil activation and found out that C5a is the key driver of neutrophil activation.

SUMMARY OF THE INVENTION

[0024] In a first aspect the present invention relates to a compound for use in the treatment of a cutaneous, neutrophilic, inflammatory disease in a subject, wherein the compound is an inhibitor of C5a activity, and wherein the cutaneous, neutrophilic, inflammatory disease is selected from the group consisting of hidradenitis suppurativa (HS); PASH (PG, acne and hidradenitis suppurativa); PAPASH (pyogenic arthritis, acne, PG and hidradenitis suppurativa), wherein the inhibitor of C5a activity is the IFX-1 antibody or antigen binding fragment thereof comprising a variable heavy chain consisting in the following order of the amino acid sequences of FR1 of SEQ ID NO: 18, CDR1 of SEQ ID NO: 14, FR2 of SEQ ID NO: 19, CDR2 of SEQ ID NO: 10, FR3 of SEQ ID NO: 20, CDR3 of SEQ ID NO: 6 and FR4 of SEQ ID NO: 21 and a variable light chain consisting in the following order of the amino acid sequences of FR1 of SEQ ID NO: 22, CDR1 of SEQ ID NO: 16, FR2 of SEQ ID NO: 23, CDR2 of SEQ ID NO: 12, FR3 of SEQ ID NO: 24, CDR3 of SEQ ID NO: 8 and FR4 of SEQ ID NO: 25.

[0025] This summary of the invention does not necessarily describe all features of the present invention. Other embodiments will become apparent from a review of the ensuing detailed description.

BRIEF DESCRIPTION OF THE FIGURES

[0026]

Figure 1. Blocking activity of IFX-1 to recombinant human C5a (rhC5a)-induced CD11b upregulation on blood neutrophils. IFX-1-004 and IFX-1-012 represent two different production batches. Human whole blood was incubated with buffer, antibody alone, rhC5a alone, or combinations of different antibody concentration and rhC5a. After incubation, cells were stained with anti- mouse CD11b:FITC and CD11b MFI was analysed by flow cytometry. Results are presented as mean ± SD. The percentage of IFX-1 blocking activity of C5a-induced CD11b expression is marked (arrow). Statistical differences were calculated by One-Way-ANOVA, p values of $p<0.05$ were statistically significant.

Figure 2. Blocking activity of IFX-1 on endogenous C5a (eC5a)-driven CD11b upregulation on neutrophils. Zymosan-activated human plasma (ZAP) was used as the source of eC5a. Whole blood was incubated with buffer, IFX-1 alone, ZAP alone, or combinations of IFX-1 and ZAP. After incubation, cells were stained with anti-mouse CD11b:FITC and analysed by flow cytometry. Results are presented as mean ± SEM. The percentage of IFX-1 blocking activity of C5a-induced CD11b expression is marked (arrow). Statistical differences were calculated by One-Way-ANOVA, p values of $p<0.05$ were statistically significant.

Figure 3. Activation of blood neutrophils by zymosan and IFX-1 blocking activity. Whole blood was incubated with HBSS, rhC5a and zymosan A alone, or combinations of different IFX-1 concentrations and rhC5a or zymosan A. After incubation, cells were stained with anti-mouse CD11b:FITC, and CD11b MFI was analysed by flow cytometry. Results are presented as mean ± SD. The percentage of IFX-1 blocking activity of C5a-induced CD11b expression is marked (arrow). Statistical differences were calculated by One-Way-ANOVA, p values of $p<0.05$ were statistically significant.

Figure 4. IFX-1 inhibits zymosan-induced generation of IL-8 in human whole blood. IL-8 concentrations were obtained by ELISA after incubation of human whole blood with different zymosan A concentrations as indicated on the x-axis in the presence (empty circles) or absence (filled circles) of IFX-1. Results were presented as mean ± SD.

Figure 5. Concentrations of C3a (Fig. 5A), C5a (Fig. 5B) and C5b-9 (Fig. 5C) in the plasma of 14 healthy controls and of 54 patients with hidradenitis suppurativa (HS). Circles denote outliers and asterisks denote extremes. P values symbolize significant differences between patients and controls.

Figure 6. Effect of HS plasma on blood neutrophil activation and the potential role of C5a. HS plasma samples were incubated with human plasma in the presence and absence of IFX-1, and CD11b expression on blood neutrophils was determined by flow cytometric analysis. C5a levels in the control and HS samples were labeled in the embedded table.

Figure 7. HiSCR reponse post IFX-1 treatment in HS patients. HiSCR responder is defined as a ≥ 50% reduction in inflammatory lesion count (abscesses + inflammatory nodules), and no increase in abscesses or draining fistulas when compared with baseline.

DETAILED DESCRIPTION OF THE INVENTION

Definitions

[0027] Before the present invention is described in detail below, it is to be understood that this invention is not limited to the particular methodology, protocols and reagents described herein as these may vary. It is also to be understood that the terminology used herein is for the purpose of describing particular embodiments only, and is not intended to limit the scope of the present invention which will be limited only by the appended claims. Unless defined otherwise, all technical and scientific terms used herein have the same meanings as commonly understood by one of ordinary skill in the art to which this invention belongs.

[0028] Preferably, the terms used herein are defined as described in "A multilingual glossary of biotechnological terms: (IUPAC Recommendations)", Leuenberger, H.G.W, Nagel, B. and Kölbl, H. eds. (1995), Helvetica Chimica Acta, CH-4010 Basel, Switzerland).
Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" and "comprising", will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

[0029] Several documents (for example: patents, patent applications, scientific publications, manufacturer's specifications, instructions, GenBank Accession Number sequence submissions etc.) are cited throughout the text of this specification. Nothing herein is to be construed as an admission that the invention is not entitled to antedate such disclosure by virtue of prior invention.

[0030] Sequences: All sequences referred to herein are disclosed in the attached sequence listing that, with its whole content and disclosure, is a part of this specification.

[0031] In the context of the present invention, C5a particularly refers to human C5a. Human C5a is a 74 amino acid peptide with the following amino acid sequence:
TLQKKIEEIA AKYKHSVVKK CCYDGACVNN DETCEQRAAR ISLGPRCIKA
FTECCVVASQ LRANISHKDM QLGR (SEQ ID NO: 1).

[0032] The amino acid sequence of human C5 can be found under the accession number UniProtKB P01031 (CO5_HUMAN).

[0033] As used herein, the term "inhibitor of C5a activity" refers to any compound that in any way reduces the activity of C5a. This activity reduction can be achieved by directly or indirectly lowering the concentration of C5a, or by reducing the activity of C5a, or by preventing that C5a exerts its effects on one or more of its receptors (e.g. on C5aR or C5L2), or by reducing the concentration or activity of one or more receptors of C5a.

[0034] In the context of the present invention, the expression "C5a receptor" refers to any potential C5a binding ligand on the cell surface, especially to any receptor protein to which C5a may bind and elicit a reaction on said receptor (e.g. activation or inhibition of the receptor). The term "C5a receptor" particularly encompasses the two receptors C5aR and C5L2. Alternative names for C5aR are C5aR1 and CD88. An alternative name for C5L2 is C5aR2.

[0035] In the context of the present invention, the expression "protein ligand" refers to any molecule composed of amino acids linked by peptide bonds, irrespective of the total size of the molecule, and that is capable of specifically binding to another molecule. Accordingly, the expression "protein ligand" comprises oligopeptides (≤ 100 amino acids) and polypeptides (> 100 amino acids). The expression "protein ligand" also comprises cyclic peptides, irrespective of their size. The expression "protein ligand" particularly encompasses antibodies, antigen-binding fragments of antibodies.

[0036] As used herein, a first compound (e.g. a protein ligand) is considered to "bind" to a second compound (e.g. a target protein), if it has a dissociation constant K_d to said second compound of 1 mM or less, preferably 100 µM or less, preferably 50 µM or less, preferably 30 µM or less, preferably 20 µM or less, preferably 10 µM or less, preferably 5 µM or less, more preferably 1 µM or less, more preferably 900 nM or less, more preferably 800 nM or less, more preferably 700 nM or less, more preferably 600 nM or less, more preferably 500 nM or less, more preferably 400 nM or less, more preferably 300 nM or less, more preferably 200 nM or less, even more preferably 100 nM or less, even more preferably 90 nM or less, even more preferably 80 nM or less, even more preferably 70 nM or less, even more preferably 60 nM or less, even more preferably 50 nM or less, even more preferably 40 nM or less, even more preferably 30 nM or less, even more preferably 20 nM or less, and even more preferably 10 nM or less.

[0037] The term "binding" according to the invention preferably relates to a specific binding. "Specific binding" means that a compound (e.g. a protein ligand) binds stronger to a target such as an epitope for which it is specific compared to the binding to another target. A compound binds stronger to a first target compared to a second target, if it binds to the first target with a dissociation constant (K_d) which is lower than the dissociation constant for the second target. Preferably the dissociation constant (K_d) for the target to which the compound binds specifically is more than 10-fold, preferably more than 20-fold, more preferably more than 50-fold, even more preferably more than 100-fold, 200-fold, 500-fold or 1000-fold lower than the dissociation constant (K_d) for the target to which the compound does not bind specifically.

[0038] As used herein, the term "K_d" (usually measured in "mol/L", sometimes abbreviated as "M") is intended to refer to the dissociation equilibrium constant of the particular interaction between a compound (e.g. a protein ligand) and a target molecule.

[0039] Methods for determining binding affinities of compounds, i.e. for determining the dissociation constant K_D, are known to a person of ordinary skill in the art and can be selected for instance from the following methods known in the art: Surface Plasmon Resonance (SPR) based technology, Bio-layer interferometry (BLI), enzyme-linked immunosorbent assay (ELISA), flow cytometry, isothermal titration calorimetry (ITC), analytical ultracentrifugation, radioimmunoassay (RIA or IRMA) and enhanced chemiluminescence (ECL). Typically, the dissociation constant K_D is determined at 20°C, 25°C, 30°C, or 37°C. If not specifically indicated otherwise, the K_D values recited herein are determined at 20 °C by ELISA.

[0040] An "epitope", also known as antigenic determinant, is the part of a macromolecule that is recognized by the immune system, specifically by antibodies, B cells, or T cells. As used herein, an "epitope" is the part of a macromolecule capable of binding to a compound (e.g. an antibody or antigen-binding fragment thereof) as described herein. In this context, the term "binding" preferably relates to a specific binding. Epitopes usually consist of chemically active surface groupings of molecules such as amino acids or sugar side chains and usually have specific three-dimensional structural characteristics, as well as specific charge characteristics. Conformational and non-conformational epitopes can be distinguished in that the binding to the former but not the latter is lost in the presence of denaturing solvents.

[0041] A "paratope" is the part of an antibody that binds to the epitope. In the context of the present invention, a "paratope" is the part of a compound (e.g. a protein ligand) as described herein that binds to the epitope.

[0042] The term "antibody" typically refers to a glycoprotein comprising at least two heavy (H) chains and two light (L) chains inter-connected by disulfide bonds, or an antigen-binding portion thereof. The term "antibody" also includes all recombinant forms of antibodies, in particular of the antibodies described herein, e.g. antibodies expressed in prokaryotes, unglycosylated antibodies, antibodies expressed in eukaryotes (e.g. CHO cells), glycosylated antibodies, and any antigen-binding antibody fragments and derivatives as described below. Each heavy chain is comprised of a heavy chain variable region (abbreviated herein as VH or V_H) and a heavy chain constant region. Each light chain is comprised of a light chain variable region (abbreviated herein as VL or V_L) and a light chain constant region. The VH and VL regions can be further subdivided into regions of hypervariability, termed complementarity determining regions (CDR), interspersed with regions that are more conserved, termed framework regions (FR). Each VH and VL is composed of three CDRs and four FRs, arranged from amino-terminus to carboxy-terminus in the following order: FR1, CDR1, FR2, CDR2, FR3, CDR3, FR4. The variable regions of the heavy and light chains contain a binding domain that interacts with an antigen. The constant regions of the antibodies may mediate the binding of the immunoglobulin to host tissues or factors, including various cells of the immune system (e.g., effector cells) and the first component (C1q) of the classical complement system.

[0043] The term "antigen-binding fragment" of an antibody (or simply "binding portion"), as used herein, refers to one or more fragments of an antibody that retain the ability to specifically bind to an antigen. It has been shown that the antigen-binding function of an antibody can be performed by fragments of a full-length antibody. Examples of binding fragments encompassed within the term "antigen-binding portion" of an antibody include (i) Fab fragments, monovalent fragments consisting of the VL, VH, CL and CH domains; (ii) $F(ab')_2$ fragments, bivalent fragments comprising two Fab fragments linked by a disulfide bridge at the hinge region; (iii) Fd fragments consisting of the VH and CH domains; (iv) Fv fragments consisting of the VL and VH domains of a single arm of an antibody, (v) dAb fragments (Ward et al., (1989) Nature 341: 544-546), which consist of a VH domain; (vi) isolated complementarity determining regions (CDR), and (vii) combinations of two or more isolated CDRs which may optionally be joined by a synthetic linker. Furthermore, although the two domains of the Fv fragment, VL and VH, are coded for by separate genes, they can be joined, using recombinant methods, by a synthetic linker that enables them to be made as a single protein chain in which the VL and VH regions pair to form monovalent molecules (known as single chain Fv (scFv); see e.g., Bird et al. (1988) Science 242: 423-426; and Huston et al. (1988) Proc. Natl. Acad. Sci. USA 85: 5879-5883). Such single chain antibodies are also intended to be encompassed within the term "antigen-binding fragment" of an antibody. A further example is a binding-domain immunoglobulin fusion protein comprising (i) a binding domain polypeptide that is fused to an immunoglobulin hinge region polypeptide, (ii) an immunoglobulin heavy chain CH2 constant region fused to the hinge region, and (iii) an immunoglobulin heavy chain CH3 constant region fused to the CH2 constant region. The binding domain polypeptide can be a heavy chain variable region or a light chain variable region. The binding-domain immunoglobulin fusion proteins are further disclosed in US 2003/0118592 and US 2003/0133939. These antibody fragments are obtained using conventional techniques known to those skilled in the art, and the fragments are screened for utility in the same manner as are intact antibodies.

[0044] Thus, the term "antibody or antigen-binding fragment thereof', as used herein, refers to immunoglobulin molecules and immunologically active portions of immunoglobulin molecules, i.e. molecules that contain an antigen-binding site that immunospecifically binds an antigen. Also comprised are immunoglobulin-like proteins that are selected through techniques including, for example, phage display to specifically bind to a target molecule or target epitope. The immunoglobulin molecules of the invention can be of any type (e.g., IgG, IgE, IgM, IgD, IgA and IgY), class (e.g., IgG1, IgG2, preferably IgG2a and IgG2b, IgG3, IgG4, IgA1 and IgA2) or subclass of immunoglobulin molecule.

[0045] Antibodies and antigen-binding fragments thereof usable in the invention may be from any animal origin including birds and mammals. Preferably, the antibodies or fragments are from human, chimpanzee, rodent (e.g. mouse, rat, guinea pig, or rabbit), chicken, turkey, pig, sheep, goat, camel, cow, horse, donkey, cat, or dog origin. It is particularly preferred that the antibodies are of human or murine origin. Antibodies of the invention also include chimeric molecules in which an antibody constant region derived from one species, preferably human, is combined with the antigen-binding site derived from another species, e.g. mouse. Moreover, antibodies of the invention include humanized molecules in which the antigen-binding sites of an antibody derived from a non-human species (e.g. from mouse) are combined with constant and framework regions of human origin.

[0046] As exemplified herein, antibodies of the invention can be obtained directly from hybridomas which express the antibody, or can be cloned and recombinantly expressed in a host cell (e.g., a CHO cell, or a lymphocytic cell). Further examples of host cells are microorganisms, such as *E. coli,* and fungi, such as yeast. Alternatively, they can be produced recombinantly in a transgenic non-human animal or plant.

[0047] The term "chimeric antibody" refers to those antibodies wherein one portion of each of the amino acid sequences of heavy and light chains is homologous to corresponding sequences in antibodies derived from a particular species or belonging to a particular class, while the remaining segment of the chain is homologous to corresponding sequences in another species or class. Typically the variable region of both light and heavy chains mimics the variable regions of antibodies derived from one species of mammals, while the constant portions are homologous to sequences of antibodies derived from another. One clear advantage to such chimeric forms is that the variable region can conveniently be derived from presently known sources using readily available B-cells or hybridomas from non-human host organisms in combination with constant regions derived from, for example, human cell preparations. While the variable region has the advantage of ease of preparation and the specificity is not affected by the source, the constant region being human is less likely to elicit an immune response from a human subject when the antibodies are injected than would the constant region from a non-human source. However, the definition is not limited to this particular example.

[0048] The term "humanized antibody" refers to a molecule having an antigen-binding site that is substantially derived from an immunoglobulin from a non-human species, wherein the remaining immunoglobulin structure of the molecule is based upon the structure and/or sequence of a human immunoglobulin. The antigen-binding site may either comprise complete variable domains fused onto constant domains or only the complementarity determining regions (CDR) grafted onto appropriate framework regions in the variable domains. Antigen-binding sites may be wild-type or modified by one or more amino acid substitutions, e.g. modified to resemble human immunoglobulins more closely. Some forms of humanized antibodies preserve all CDR sequences (for example a humanized mouse antibody which contains all six CDRs from the mouse antibody). Other forms have one or more CDRs which are altered with respect to the original antibody.

[0049] Different methods for humanizing antibodies are known to the skilled person, as reviewed by Almagro & Fransson, 2008, Frontiers in Bioscience, 13:1619-1633. The review article by Almagro & Fransson is briefly summarized in US 2012/0231008 A1 which is the national stage entry of international patent application WO 2011/063980 A1.

[0050] As used herein, "human antibodies" include antibodies having variable and constant regions derived from human germline immunoglobulin sequences. The human antibodies of the invention may include amino acid residues not encoded by human germline immunoglobulin sequences (e.g., mutations introduced by random or site-specific mutagenesis *in vitro* or by somatic mutation *in vivo).* Human antibodies of the invention include antibodies isolated from human immunoglobulin libraries or from animals transgenic for one or more human immunoglobulin and that do not express endogenous immunoglobulins, as described for example in U.S. Patent No. 5,939,598 by Kucherlapati & Jakobovits.

[0051] The term "monoclonal antibody" as used herein refers to a preparation of antibody molecules of single molecular composition. A monoclonal antibody displays a single binding specificity and affinity for a particular epitope. In one embodiment, the monoclonal antibodies are produced by a hybridoma which includes a B cell obtained from a non-human animal, e.g. mouse, fused to an immortalized cell.

[0052] The term "recombinant antibody", as used herein, includes all antibodies that are prepared, expressed, created or isolated by recombinant means, such as (a) antibodies isolated from an animal (e.g., a mouse) that is transgenic or transchromosomal with respect to the immunoglobulin genes or a hybridoma prepared therefrom, (b) antibodies isolated from a host cell transformed to express the antibody, e.g. from a transfectoma, (c) antibodies isolated from a recombinant, combinatorial antibody library, and (d) antibodies prepared, expressed, created or isolated by any other means that involve splicing of immunoglobulin gene sequences to other DNA sequences.

[0053] The term "transfectoma", as used herein, includes recombinant eukaryotic host cells expressing an antibody, such as CHO cells, NS/0 cells, HEK293 cells, HEK293T cells, plant cells, or fungi, including yeast cells.

[0054] As used herein, a "heterologous antibody" is defined in relation to a transgenic organism producing such an antibody. This term refers to an antibody having an amino acid sequence or an encoding nucleic acid sequence corresponding to that found in an organism not consisting of the transgenic organism, and being generally derived from a species other than the transgenic organism.

[0055] As used herein, a "heterohybrid antibody" refers to an antibody having light and heavy chains of different organismal origins. For example, an antibody having a human heavy chain associated with a murine light chain is a heterohybrid antibody.

[0056] The antibodies described herein are preferably isolated. An "isolated antibody" as used herein, is intended to refer to an antibody which is substantially free of other antibodies having different antigenic specificities (e.g., an isolated antibody that specifically binds to C5a is substantially free of antibodies that specifically bind antigens other than C5a). An isolated antibody that specifically binds to an epitope, isoform or variant of human C5a may, however, have cross-reactivity to other related antigens, e.g. from other species (e.g. C5a species homologs, such as rat C5a). Moreover, an isolated antibody may be substantially free of other cellular material and/or chemicals. In one embodiment of the invention, a combination of "isolated" monoclonal antibodies relates to antibodies having different specificities and being combined in a well-defined composition.

[0057] The term "naturally occurring", as used herein, as applied to an object refers to the fact that an object can be found in nature. For example, a polypeptide or polynucleotide sequence that is present in an organism (including viruses) that can be isolated from a source in nature and which has not been intentionally modified by man in the laboratory is naturally occurring.

[0058] As used herein, a "cutaneous, neutrophilic, inflammatory disease" refers to any disease that is associated with an inflammation of the skin and with a neutrophilic infiltrate into the skin (e.g. into the epidermis) of an individual afflicted by said disease. The term "cutaneous, neutrophilic, inflammatory disease" particularly refers to hidradenitis suppurativa (HS); PASH (PG, acne and hidradenitis suppurativa); PAPASH (pyogenic arthritis, acne, PG and hidradenitis suppurativa);.

[0059] As used herein, the expression "HS-related disease" comprises without limitation PASH (PG, acne and hidradenitis suppurativa); PAPASH (pyogenic arthritis, acne, PG and hidradenitis suppurativa).

[0060] IFX-1 (alternative name: CaCP 29; InflaRx GmbH, Germany) is an antibody specifically binding to C5a. The CDR sequences and FR sequences of IFX-1 are disclosed in WO 2015/140304 A1 (in Table 3 on page 31)

[0061] INab708 (InflaRx GmbH, Germany) is another antibody specifically binding to C5a. The CDR sequences and FR sequences of INab708 are also disclosed in WO 2015/140304 A1 (in Table 3 on page 31).

[0062] As used herein, a "patient" means any mammal or bird who may benefit from a treatment with the compound described herein (i.e. with an inhibitor of C5a activity described herein). Preferably, a "patient" is selected from the group consisting of laboratory animals (e.g. mouse or rat), domestic animals (including e.g. guinea pig, rabbit, chicken, turkey, pig, sheep, goat, camel, cow, horse, donkey, cat, or dog), or primates including chimpanzees and human beings. It is particularly preferred that the "patient" is a human being.

[0063] As used herein, "treat", "treating" or "treatment" of a disease or disorder means accomplishing one or more of the following: (a) reducing the severity and/or duration of the disorder; (b) limiting or preventing development of symptoms characteristic of the disorder(s) being treated; (c) inhibiting worsening of symptoms characteristic of the disorder(s) being treated; (d) limiting or preventing recurrence of the disorder(s) in patients that have previously had the disorder(s); and (e) limiting or preventing recurrence of symptoms in patients that were previously symptomatic for the disorder(s).

[0064] As used herein, "prevent", "preventing", "prevention", or "prophylaxis" of a disease or disorder means preventing that a disorder occurs in subject.

[0065] An "effective amount" is an amount of a therapeutic agent sufficient to achieve the intended purpose. The effective amount of a given therapeutic agent will vary with factors such as the nature of the agent, the route of administration, the size and species of the animal to receive the therapeutic agent, and the purpose of the administration. The effective amount in each individual case may be determined empirically by a skilled artisan according to established methods in the art.

[0066] "Pharmaceutically acceptable" means approved by a regulatory agency of the Federal or a state government or listed in the U.S. Pharmacopeia or other generally recognized pharmacopeia for use in animals, and more particularly in humans.

Embodiments of the Invention

[0067] The present invention will now be further described. In the following passages the invention is defined in more detail. In particular, any feature indicated as being preferred or advantageous may be combined with any other feature or features indicated as being preferred or advantageous.

[0068] The present invention is directed to a compound for use in the treatment of a cutaneous, neutrophilic, inflammatory disease in a subject, wherein the compound is an inhibitor of C5a activity, and wherein the cutaneous, neutrophilic, inflammatory disease is selected from the group consisting of hidradenitis suppurativa (HS); PASH (PG, acne and hidradenitis suppurativa); PAPASH (pyogenic arthritis, acne, PG and hidradenitis suppurativa), wherein the inhibitor of C5a activity is the IFX-1 antibody or antigen binding fragment thereof comprising a variable heavy chain consisting in the following order of the amino acid sequences of FR1 of SEQ ID NO: 18, CDR1 of SEQ ID NO: 14, FR2 of SEQ ID NO: 19, CDR2 of SEQ ID NO: 10, FR3 of SEQ ID NO: 20, CDR3 of SEQ ID NO: 6 and FR4 of SEQ ID NO: 21 and a variable light chain consisting in the following order of the amino acid sequences of FR1 of SEQ ID NO: 22, CDR1 of SEQ ID NO: 16, FR2 of SEQ ID NO: 23, CDR2 of SEQ ID NO: 12, FR3 of SEQ ID NO: 24, CDR3 of SEQ ID NO: 8 and FR4 of SEQ ID NO: 25..

[0069] The inhibitor of C5a activity specifically binds to a conformational epitope formed by amino acid sequences NDETCEQRA (SEQ ID NO: 2) and SHKDMQL (SEQ ID NO: 3) of human C5a and binds to at least one amino acid within the amino acid sequence DETCEQR (SEQ ID NO: 4) and to at least one amino acid within the amino acid sequence KDM.

[0070] The FR1, CDR1, FR2, CDR2, FR3, CDR3, and FR4 sequences defining the VH domains of IFX-1 and INab708 are shown below in Table 1.

[0071] The FR1, CDR1, FR2, CDR2, FR3, CDR3, and FR4 sequences defining the VL domains of IFX-1 and INab708 are shown below in Table 1.

Table 1: CDR and FR sequences of antibodies IFX-1 and INab708 (Chothia

classification mode)

IFX-1:	**INab708:**
Heavy Chain:	Heavy Chain:
FR1: QVQLQQSGPQLVRPGTSVKIS (= SEQ ID NO: 18)	FR1: VQLLESGAELMKPGASVKIS (SEQ ID NO: 26)
CDR1 : CKASGYSFTTFWMD (= SEQ ID NO: 14)	CDR1: CKATGNTFSGYWTE (= SEQ ID NO: 15)
FR2: WVKQRPGQGLEWIGR (SEQ ID NO: 19)	FR2: WVKQRPGHGLEWIGE (SEQ ID NO: 27)
CDR2: IDPSDSESRLDQ (= SEQ ID NO: 10)	CDR2: ILPGSGSTNYNE (= SEQ ID NO: 11)
FR3: RFKDRATLTVDKSSSTVYMQLSSPTSE DSAVYY (SEQ ID NO: 20)	FR3: KFKGKATLTADTSSNTAYMQLSSLTSE DSAVYY (SEQ ID NO: 28)
CDR3: CARGNDGYYGFAY (= SEQ ID NO: 6)	CDR3: CTRRGLYDGSSYFAY (= SEQ ID NO: 7)
FR4: WGQGTLVTVSS (SEQ ID NO: 21)	FR4: WGQGTLVTVSA (SEQ ID NO: 29)
Light chain:	Light Chain:
FR1: DIVLTQSPASLAVSLGQRATIS (SEQ ID NO: 22)	FR1: DIVLTQSPASLAVSLGQRATIS (SEQ ID NO: 30)
CDR1: CKASQSVDYDGDSYMK (= SEQ ID NO: 16)	CDR1: CKASQSVDYDGDSYMN (= SEQ ID NO: 17)
FR2: WYQQKPGQPPKLL (SEQ ID NO: 23)	FR2: WYQQKPGQPPKLL (SEQ ID NO: 31)
CDR2: TYAASNL (= SEQ ID NO: 12)	CDR2: TYAASNL (= SEQ ID NO: 13)
FR3: QSGIPARFSGSGSGTDFTLNIHPVEEED AATYY (SEQ ID NO: 24)	FR3: GSGIPARFSGSGSGTDFTLNIHPVEEEV AATYY (SEQ ID NO: 32)
CDR3: CQQSNEDPYT (= SEQ ID NO: 8)	CDR3: CQQNNEDPLT (= SEQ ID NO: 9)
FR4: FGGGTKLEIK (SEQ ID NO: 25)	FR4: FGAGTLLELK (SEQ ID NO: 33)

[0072] In some embodiments of the present invention, the compound is to be administered at a dose of 800 mg once per week or at a dose of 800 mg twice per week. In further embodiments,

- the inhibitor of C5a activity is a compound specifically binding to C5a selected from the group consisting of IFX-1 and an antigen-binding fragment thereof; most preferably the inhibitor of C5a activity is IFX-1); and

- the cutaneous, neutrophilic, inflammatory disease is hidradenitis suppurativa (HS); and
- the compound is to be administered at a dose of 800 mg once per week or at a dose of 800 mg twice per week.

[0073] In further embodiments, the inhibitor of C5a activity is to be administered intravenously. In further embodiments, the inhibitor of C5a activity is to be administered twice per week at a dose of 800 mg in the first week of treatment and once per week at a dose of 800 mg in the second and subsequent weeks of treatment. In further embodiments, the total duration of treatment is between 5 and 12 weeks (e.g. 5 weeks, 6, weeks, 7 weeks, 8 weeks, 9 weeks, 10 weeks, 11 weeks, or 12 weeks).

Pharmaceutical compositions and Modes of Administration

[0074] In the practice of the present invention, a compound being IFX-1 or a pharmaceutical composition comprising the compound may be administered to a patient by any route established in the art which provides a sufficient level of the compound in the patient. It can be administered systemically or locally. Such administration may be parenterally, transmucosally, e.g., orally, nasally, rectally, intravaginally, sublingually, submucosally, transdermally, or by inhalation. Preferably, administration is parenteral, e.g., via intravenous or intraperitoneal injection, and also including, but is not limited to, intra-arterial, intramuscular, intradermal and subcutaneous administration. If the compound described herein (e.g. an inhibitor of C5a activity described herein) or a pharmaceutical composition comprising the compound is administered locally, it can be injected directly into the organ or tissue to be treated.

[0075] Pharmaceutical compositions adapted for oral administration may be provided as capsules or tablets; as powders or granules; as solutions, syrups or suspensions (in aqueous or non-aqueous liquids); as edible foams or whips; or as emulsions. Tablets or hard gelatine capsules may comprise lactose, starch or derivatives thereof, magnesium stearate, sodium saccharine, cellulose, magnesium carbonate, stearic acid or salts thereof. Soft gelatine capsules may comprise vegetable oils, waxes, fats, semi-solid, or liquid polyols etc. Solutions and syrups may comprise water, polyols and sugars.

[0076] An active agent intended for oral administration may be coated with or admixed with a material that delays disintegration and/or absorption of the active agent in the gastrointestinal tract (e.g., glyceryl monostearate or glyceryl distearate may be used). Thus, the sustained release of an active agent may be achieved over many hours and, if necessary, the active agent can be protected from being degraded within the stomach. Pharmaceutical compositions for oral administration may be formulated to facilitate release of an active agent at a particular gastrointestinal location due to specific pH or enzymatic conditions.

[0077] Pharmaceutical compositions adapted for transdermal administration may be provided as discrete patches intended to remain in intimate contact with the epidermis of the recipient for a prolonged period of time. Pharmaceutical compositions adapted for topical administration may be provided as ointments, creams, suspensions, lotions, powders, solutions, pastes, gels, sprays, aerosols or oils. For topical administration to the skin, mouth, eye or other external tissues a topical ointment or cream is preferably used. When formulated in an ointment, the active ingredient may be employed with either a paraffinic or a water-miscible ointment base. Alternatively, the active ingredient may be formulated in a cream with an oil-in-water base or a water-in-oil base. Pharmaceutical compositions adapted for topical administration to the eye include eye drops. In these compositions, the active ingredient can be dissolved or suspended in a suitable carrier, e.g., in an aqueous solvent. Pharmaceutical compositions adapted for topical administration in the mouth include lozenges, pastilles and mouthwashes.

[0078] Pharmaceutical compositions adapted for nasal administration may comprise solid carriers such as powders (preferably having a particle size in the range of 20 to 500 microns). Powders can be administered in the manner in which snuff is taken, i.e., by rapid inhalation through the nose from a container of powder held close to the nose. Alternatively, compositions adopted for nasal administration may comprise liquid carriers, e.g., nasal sprays or nasal drops. These compositions may comprise aqueous or oil solutions of the active ingredient. Compositions for administration by inhalation may be supplied in specially adapted devices including, but not limited to, pressurized aerosols, nebulizers or insufflators, which can be constructed so as to provide predetermined dosages of the active ingredient. Pharmaceutical compositions may also be administered via the nasal cavity to the lungs.

[0079] Pharmaceutical compositions adapted for rectal administration may be provided as suppositories or enemas. Pharmaceutical compositions adapted for vaginal administration may be provided as pessaries, tampons, creams, gels, pastes, foams or spray formulations.

[0080] Pharmaceutical compositions adapted for parenteral administration include aqueous and non-aqueous sterile injectable solutions or suspensions, which may contain antioxidants, buffers, bacteriostats and solutes that render the compositions substantially isotonic with the blood of an intended recipient. Other components that may be present in such compositions include water, alcohols, polyols, glycerine and vegetable oils, for example. Compositions adapted for parenteral administration may be presented in unit-dose or multi-dose containers, for example sealed ampules and vials, and may be stored in a freeze-dried (lyophilized) condition requiring only the addition of a sterile liquid carrier, e.g., sterile saline solution for injections, immediately prior to use. Extemporaneous injection solutions and suspensions may be prepared from sterile powders, granules and tablets.

[0081] In a preferred embodiment, a compound being IFX-1 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 such as lidocaine to ease pain at the site of the injection. Generally, the ingredients 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 ampule or sachette indicating the quantity of active agent. Where the composition is to be administered by infusion, it can be dispensed with an infusion bottle containing sterile pharmaceutical grade water or saline. Where the composition is administered by injection, an ampule of sterile saline can be provided so that the ingredients may be mixed prior to administration.

[0082] In another embodiment, for example, a compound being IFX-1 or a pharmaceutical composition comprising the compound can be delivered in a controlled-release system. For example, the compound may be administered using intravenous infusion, an implantable osmotic pump, a transdermal patch, liposomes, or other modes of administration. In one embodiment, a pump may be used (see Sefton (1987) CRC Crit. Ref. Biomed. Eng. 14: 201; Buchwald et al. (1980) Surgery 88:507; Saudek et al. (1989) N. Eng. J. Med. 321: 574). In another embodiment, the compound can be delivered in a vesicle, in particular a liposome (see Langer (1990) Science 249:1527-1533; Treat et al. (1989) in Liposomes in the Therapy of Infectious Disease and Cancer, Lopez-Berestein and Fidler (eds.), Liss, N.Y., 353-365; WO 91/04014; U.S. 4,704,355). In another embodiment, polymeric materials can be used (see Medical Applications of Controlled Release (1974) Langer and Wise (eds.), CRC Press: Boca Raton, Fla.; Controlled Drug Bioavailability, Drug Product Design and Performance, (1984) Smolen and Ball (eds.), Wiley: N.Y.; Ranger and Peppas (1953) J. Macromol. Sci. Rev. Macromol. Chem. 23: 61; see also Levy et al. (1985) Science 228:190; During et al. (1989) Ann. Neurol. 25: 351; Howard et al. (1989) J. Neurosurg. 71: 105).

[0083] In yet another embodiment, a controlled release system can be placed in proximity of the therapeutic target, i.e., the target cells, tissue or organ, thus requiring only a fraction of the systemic dose (see, e.g., Goodson (1984) 115-138 in Medical Applications of Controlled Release, vol. 2). Other controlled release systems are discussed in the review by Langer (1990, Science 249: 1527-1533).

[0084] In a specific embodiment, it may be desirable to administer a compound being IFX-1 or a pharmaceutical composition comprising the compound locally to the area in need of treatment. This may be achieved by, for example, and not by way of limitation, local infusion during surgery, topical application, e.g., in conjunction with a wound dressing after surgery, by injection, by means of a catheter, by means of a suppository, 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.

[0085] Selection of the preferred effective dose will be determined by a skilled artisan based upon considering several factors which will be known to one of ordinary skill in the art. Such factors include the particular form of the pharmaceutical composition and its pharmacokinetic parameters such as bioavailability, metabolism, half-life, etc., which will have been established during the usual development procedures typically employed in obtaining regulatory approval for a pharmaceutical compound. Further factors in considering the dose include the condition or disease to be prevented and or treated or the benefit to be achieved in a normal individual, the body mass of the patient, the route of administration, whether administration is acute or chronic, concomitant medications, and other factors well known to affect the efficacy of administered pharmaceutical agents. Thus the precise dosage should be decided according to the judgment of the practitioner and each patient's circumstances, e.g., depending upon the condition and the immune status of the individual patient, according to standard clinical techniques.

EXAMPLES

[0086] The following Examples are provided for further illustration of the invention. The invention, however, is not limited thereto, and the following Examples merely show the practicability of the invention on the basis of the above description.

1. METHODS

1.1 <u>Preparation of zymosan A stock solution and activated plasma</u>

[0087] Zymosan A was dissolved to 2 mg/ml in 50 ml sterile saline and boiled for 1 h at 100°C. After centrifugation, supernatant was discarded and the pellet was resuspended in 50 ml sterile saline. After a second centrifugation step, pellet was resuspended in 5 ml sterile saline to obtain a 20 mg/ml stock solution. Stock solution was aliquoted and stored at -20°C until use. To activate the plasma, zymosan A stock solution and 100 µl plasma were mixed and incubated at 37°C for 30 min. After incubation, tubes were centrifuged and the supernatant was aliquoted and stored at -20°C until use.

1.2 <u>CD11b assay using rhC5a or ZAP as stimulants</u>

[0088] Human whole blood was stimulated with rhC5a or ZAP. To test blocking activity of IFX-1 and control IgG4 on rhC5a, the antibodies were diluted to final Ab/Ag ratios of 1:1 and 0.5:1. To test the blocking activity of IFX-1 on eC5a, IFX-1 was diluted to reach final Ab/Ag molar ratios of approximately 4:1/3:1/2:1/1:1/0.5:1. Blood only with buffer served as a non-stimulation control to assess baseline CD11b expression. Antibody alone was used to determine the effects of the antibody on non-stimulated human blood. The complete mixture (Ab/Ag/blood) was incubated at 37°C for 20 min to stimulate C5a-induced up-regulation of CD11b, and anti-mouse CD11b:FITC were added and samples were incubated for 30 min on ice to minimize background staining. Granulocytes were gated and mean fluorescence intensity (MFI) of FITC labeled (CD11b expressing) granulocytes was examined by Flow Cytometer.

1.3 CD11b assay using rhC5a or zymosan A in the whole blood

[0089] Human blood was stimulated with rhC5a or zymosan A, and the complete mixture (Ab/Ag/blood) was incubated at 37°C for 20 min to stimulate C5a-induced up-regulation of CD11b. After incubation, 2 µl of anti-mouse CD11b:FITC or isotype control were added and samples were incubated for 30 min on ice to minimize background staining. After lysis, cells were analyzed using the flow cytometer. On the FSC/SSC, granulocytes were gated and mean fluorescence intensity (MFI) of FITC labeled (CD11b expressing) granulocytes was examined for the whole sample set.

1.4 Cytokine IL-8 ELISA

[0090] Human IL-8 ELISA was performed as recommended in the instruction manual under section "Assay procedure" (eBioscience Inc., San Diego, CA). Briefly, coating was performed overnight at 4°C using 100 µl 1x capture antibody. Plates were blocked using 200 µl 1x assay diluents at RT for 1 h. Standard stock solutions were diluted with 1x assay diluents to the desired concentration, followed by 6 serial 1:2 dilutions. Sample supernatants were diluted as required in 1x assay diluents. According to the "Assay procedure", 100 µl of standard dilutions and sample dilutions were added to the coated plate and incubated at RT for 1 h, followed by the incubation with 100 µl 1x detection antibody (RT, 1 h) and 100 µl 1x avidin-HRP (RT, 30 min). Color development was performed with 100 µl TMB substrate solution at RT for 10 min in the dark and was stopped with 100 µl stop solution. Absorbance was read out within 30 min using the plate reader at 450 nm. Zero standard value (blank) was subtracted from all standards and samples. Cytokine concentration of samples was calculated using a log(x) / log(y) standard curve of included standard samples.

1.5 C5a ELISA

[0091] Capture antibody, a purified anti-human C5a monoclonal antibody (InflaRx GmbH, Jena, Germany), was coated overnight with a final concentration of 0.5 µg/mL on the ELISA plate. After blocking, calibration samples (recombinant human C5a, Sigma, Taufkirchen, Germany) and samples diluted in assay diluent (1x PBS, 0.05% Tween20, 2% heat-inactivated FBS) were incubated for 90 minutes at room temperature. Mouse anti-human C5/C5a antibody clone 561 (Hycult Biotech, Uden, The Netherlands) diluted to 2 µg/mL in assay diluent was applied as the primary detection antibody for a 60-minute incubation step at room temperature, followed by 30-minute incubation with a secondary horseradish peroxidase labeled antibody (goat anti-mouse IgG2a polyclonal antibody, SouthernBiotech, Birmingham, USA) diluted to 0.05 µg/mL in assay diluent. Color development was performed with tetramethylbenzidine substrate solution (TMB, Biozol, Eching, Germany) and was stopped with 3.7 N sulfuric acid.

The OD was read at an absorbance of 450 nm by Tecan Infinite® 200 reader and Tecan Magellan™ (Tecan Group, Maennedorf, Switzerland). The in-house developed C5a ELISA was validated according to the EMA guideline on bioanalytical method validation.

[0092] Intra-assay and inter-assay precision tested with five different concentrations showed a coefficient of variance (CV) of 0.65 % to 4.96 % and 1.50 % to 4.88 % for six and 18 repetitions, respectively. Recovery analysis of spiked recombinant human C5a in buffer resulted in recoveries of 86.98 ± 1.20 % (mean ± SD) at the lower limit of quantification and 91.50 ± 3.29 % at the upper limit of quantification. No cross-reactivity for C3, C3a and C4 and cross-reactivity of < 0.01% for C5b-6 was detected. Human IgG4 antibodies did not interfere with the assay. C5a levels from 20 human volunteers in citrate plasma resulting in 17.08 ng/ml ± 6.96 ng/ml with a range of 7.52 ng/mL to 30.17 ng/mL. No difference was identified for the measurements of C5a and C5a-desArg by using this ELISA.

1.6 <u>Measurements of complement activation products</u>

[0093] Concentrations of complement activation products C3a, C5a and membrane attack complex C5b-9 were measured by ELISA method. C3a ELISA (BD OptEIA™ Human C3a ELISA Kit, BD Bioscience, Germany) was conducted according to the manufacturer instruction. C5b-9 concentration was determined using the C5b-9 ELISA validated by InflaRx based on the BD OptEIA™ Human C5b-9 ELISA Set (BD Bioscience). C5a concentration was measured using one C5a ELISA established and validated by InflaRx described above.

1.7 <u>Statistical analysis</u>

[0094] All results were expressed as the mean ± standard deviation. Statistical differences between groups, after baseline correction, were calculated by One-Way-ANOVA, including Tukey s multiple comparison test or by the students t-test for two groups. The p value of 0.05 was used in the calculation to determine whether there were any significant differences between any two groups. Creating of graphs and statistical analysis were performed with GraphPad PRISM® V6.05 (CA, USA).

2. PRECLINICAL RELEVANT DATA

2.1 <u>C5a activation of neutrophils and the blocking effect of IFX-1</u>

[0095] As CD11b up-regulation is a hallmark and a sensitive marker for neutrophil activation, CD11b levels on neutrophils were employed to evaluate the neutrophil activation. The human whole blood model was used to assess the blocking activity of IFX-1 to recombinant human

C5a in this study. Human whole blood was incubated with buffer, antibody alone, rhC5a alone, or combinations of different antibody concentration and rhC5a. After incubation, cells were stained with anti- mouse CD11b:FITC and CD11b MFI was analysed by flow cytometry for activation levels of blood neutrophils. As shown in **Figure 1,** recombinant human C5a strongly stimulates the CD11b up-regulation on human neutrophils. This effect can completely be blocked in presence of the anti-human C5a antibody IFX-1. This inhibition is highly specific and the unspecific human IgG4 antibody did not show any blocking activity.

[0096] As a source for endogenous C5a (eC5a), zymosan-activated plasma (ZAP) from different donors was used to stimulate the blood neutrophils. The amount of eC5a production in the blood after stimulation with ZAP was measured using a commercial C5a-ELISA. The data presented here **(Figure 2)** point out that stimulation of whole blood with eC5a in ZAP induced CD11b up-regulation comparable to rhC5a-induced CD11b up-regulation. The presence of IFX-1 significantly decreased the CD11b expression on human neutrophils, even at an Ab:Ag molar ratio of 0.5:1. The overall blocking activity of IFX-1 to ZAP-induced CD11b up-regulation ranged from 100% to 82% depending on the Ab:Ag ratio. Despite that the high level of eC3a and other complement activation products in ZAP are present in ZAP, IFX-1 could block CD11b upregulation up to 100%. It can therefore be concluded that eC5a is the sole driver for neutrophil activation upon ZAP stimulation, and IFX-1 can completely block it.

2.2 <u>C5a blockade attenuates zymosan-induced inflammatory responses in the human whole blood</u>

[0097] Zymosan A, as an active fungus wall component, can induce strong inflammatory responses in the whole blood as characterized by activation of neutrophils and increased levels of cytokine and chemokines. In this study, human whole blood was spiked with zymosan A in the presence or absence of IFX-1, and CD11b on the blood neutrophils were measured by flow cytometric analysis. As shown in Figure 3, CD11b on blood neutrophils was strongly upregulated when zymosan was spiked in the human whole blood. The increase of CD11b expression by zymosan stimulation can be suppressed by 79% - 93% depending on the concentration of IFX-1 added. As a positive control, the CD11b up-regulation stimulated by rhC5a was 100% blocked by IFX-1. Therefore, it is affirmative that the CD11b up-regulation on blood neutrophils upon zymosan A stimulation is caused primarily by eC5a. In addition, it can be concluded that eC5a, once generated in the whole blood by zymosan A, binds to IFX-1 first, thereby blocking its access to its nature receptors.

[0098] In the same experimental set-up, IL-8 levels were measured and used to assess the inflammatory response as well. IL-8 concentrations after various doses of zymosan A stimulation ranged from 458 pg/ml to 3218 pg/ml in the absence of IFX-1. As shown in **Figure 4,** the presence of IFX-1 significantly reduced IL-8 generation upon stimulation with various concentrations of zymosan A and the reduction rate up to 54% was observed. Thus, in the whole blood setting of inflammation zymosan-induced inflammatory responses are largely dependent on the presence of C5a.

3. CLINICAL RELEVANT DATA

3.1 DATA OBTAINED FROM CLINICAL SAMPLES

3.1.1 Complement activation in HS patients

[0099] A total of 54 patients with HS and 14 healthy volunteers were enrolled in the study. Patients are under follow-up in the Outpatient Department of Immunology of Infectious Diseases of the ATTIKON University Hospital, Greece. The study was approved by the Ethics Committee of the hospital. Written informed consent was provided by all patients. Diagnosis of HS was based on the following criteria: a) onset early after puberty; b) presence of subcutaneous nodules in areas of skin rich in apocrine glands; and c) a compatible history of recurrent drainage of pus from the affected areas.

[0100] Circulating concentrations of complement factors C3a and C5a as well as membrane attack complex sC5b-9 were determined in the plasma of 54 patients and of 14 healthy controls as well as in the pus of seven patients. As shown in **Figure 5,** circulating C5a was significantly greater in patient plasma than in control plasma ($P<0.01$), and differences of C3a and C5b-9 between patients and controls were of similar significance. Therefore, it can be concluded that systemic complement activation occurs in HS. Given the essential role of complement activation in the innate and adaptive immunity, the inventors assumed that targeting of complement activation could be a new therapeutic strategy for the treatment of HS.

[0101] However, from the above results it was not clear which one of C3a, C5a or C5-9b or other complement activation products would be the most promising target for this new therapeutic strategy and whether it would be sufficient to target only one of these factors or whether two or more factors involved in complement activation have to be targeted.

3.1.2 Blocking of CD11b upregulation on blood neutrophils induced by HS plasma

[0102] To determine the role of C5a in the HS plasma sample on the neutrophil activation, the HS plasma samples with high levels of C5a were chosen and assessed by employing the human whole blood model. As shown in **Figure 6,** in contrast to the control plasma samples with low C5a levels (Ctrl008 and Ctrl012), HS plasma samples (pat088 and pat092) with high levels of C5a strongly upregulated CD11b expression on the blood neutrophils. Recombinant human C5a was used as the positive control, while the plasma from healthy volunteers was chosen as the negative control. The CD11b upregulation induced by HS plasma can be 100% suppressed by IFX-1, indicating that C5a is the most important activator in the HS plasma to initiate the neutrophil activation. From these novel results the inventors concluded that blockade of C5a in HS patients is sufficient to achieve a strong suppression of the neutrophil activation.

3.2 DATA OBTAINED FROM CLINICAL TRIAL

3.2.1 Trial Design

[0103] An open label Phase II trial in 11 patients with moderate to severe hidradenitis suppurativa was conducted in Department of Internal Medicine, ATTIKON University Hospital, Greece.

[0104] Primary objective of the trial was to explore the safety and tolerability of IFX-1 administered over 8 weeks. Secondary objectives of the trial were to assess the pharmacokinetics and pharmacodynamics of IFX-1 as well as to generate preliminary data on the efficacy of IFX-1 on clinical endpoints (e.g., HiSCR, DLQI, VAS for disease status, VAS for pain, HS-PGA, modified Sartorius Score) to generate further hypotheses. The enrolled patients were treated with 800 mg IFX-1 twice in the first week and once a week thereafter for the total 8-week treatment; i.e. IFX-1 was administered in nine intravenous doses of 800 mg IFX-1 on days 1, 4, 8, 15, 22, 29, 36, 43, and 50. All patients were followed up for 12 additional weeks.

[0105] Inclusion Criteria at Screening:

1. 1. Male or female patients ≥ 18 years old
2. 2. Written informed consent
3. 3. Diagnosis of HS for at least 1 year
4. 4. HS lesions in at least 2 distinct anatomic areas, one of which is Hurley Stage II or III
5. 5. Total AN (abscesses and nodules) count ≥3
6. 6. Patients with either primary or secondary failure of biological treatment or are not eligible for treatment with other biologicals
   NOTE: a primary failure is defined as an at least 12 week treatment with a biological compound without effect and a secondary failure as achieving an initial response after at least 12 week treatment with a biological compound followed by a relapse.
7. 7. Failure of previous antimicrobial treatments

Exclusion Criteria at Screening:

[0106]

1. 1. Body weight above 150 kg or body weight below 60 kg
2. 2. Has a draining fistula count of greater than 30 at baseline
3. 3. Surgical management planned within the next 24 weeks
4. 4. Occurrence of a flare-up of HS leading to intravenous antimicrobial treatment within the last 14 days
5. 5. Any other disease and condition that is likely to interfere with evaluation of study product, outcome assessment or satisfactory conduct of the study
    1. a) Active infection
    2. b) Severe congestive heart failure (i.e., NYHA Class IV)
    3. c) Depression
    4. d) History of systemic lupus erythematosus or rheumatoid arthritis
    5. e) Any immunodeficiency disease
    6. f) Active hematological or solid malignant tumor
    7. g) Patients must not have had any other active skin disease or condition (e.g., bacterial, fungal, or viral infection) that may have interfered with assessment of HS.
6. 6. One of the following abnormal laboratory results
    1. a) White blood cell count < 2,500/mm^3
    2. b) Neutrophil count < 1000/mm^3
    3. c) Serum creatinine > 3 x Upper Normal Limit (UNL)
    4. d) Total bilirubin > 2 x UNL
    5. e) Alanine-Aminotransferase (ALAT) > 2x UNL
    6. f) Positive screening test for Hepatitis B, Hepatitis C, or HIV 1/2
7. 7. Prior administration of any biological compound in the last 3 months
8. 8. Intake of corticosteroids defined as daily intake of prednisone or equivalent more than 1 mg/kg for the last three weeks;
9. 9. Intake of immunosuppressive drugs within the past 30 days (e.g., cyclosporine, tacrolimus)
10. 10. General exclusion criteria
    1. a) Pregnant (in women of childbearing potential an urine pregnancy test has to be performed) or breast-feeding women
    2. b) Women with childbearing potential (defined as within two years of their last menstruation) not willing to practice appropriate contraceptive measures (e.g., implanon, injections, oral contraceptives, intrauterine devices, partner with vasectomy, abstinence) while participating in the trial
    3. c) Participation in any interventional clinical trial within the last three months
    4. d) Known intravenous drug abuse
    5. e) Employee at the study site, spouse/partner or relative of any study staff (e.g., investigator, sub-investigators, or study nurse) or relationship to the sponsor

3.2.2 <u>Clinical Trial Findings</u>

[0107] IFX-1 is well tolerated in HS patients. There were no drug-related serious adverse events reported over the treatment period.

[0108] A commonly used efficacy parameter in the Hidradenitis Suppurativa Clinical Response (HiSCR). HiSCR is defined by the status of three types of lesions (defining criteria): abscesses (fluctuant, with or without drainage, tender or painful), inflammatory nodules (tender, erythematous, pyogenic granuloma lesion) and draining fistulas (sinus tracts, with communications to skin surface, draining purulent fluid). The proposed definition of responders to treatment (HiSCR achievers) is: (i) at least a 50% reduction in ANs, (ii) no increase in the number of abscesses, and (iii) no increase in the number of draining fistulas from baseline. HiSCR has been validated recently as a responsive and clinically meaningful endpoint of the inflammatory manifestation of HS (Kimball and others, 2014).

[0109] The HiSCR response over the treatment period of 8 weeks was investigated in this study, and 8 out of 11 patients already treated up to Day 56 responded, which represents a response rate of 72.7% and a 95% confidence interval of 43% to 91%. To compare these results with historical data a literature search was performed to detect placebo controlled clinical studies that used HiSCR as an efficacy parameter. The following Table 2 summarizes the five studies that were completed recently:

Table 2

Compound	N	Placebo responder n (%)	Comment
Adalimumab[1]	13	2 (15%)	Post hoc analysis of Phase II trial. Only subgroup of patients with Hurley III
Adalimumab[1]	70	15 (21%)	Study313, subgroup of patients with Hurley III
Adalimumab[1]	76	13 (17%)	Study810, subgroup of patients with Hurley III
Anakinra[2]	10	3 (30%)	All patients. 6 of 10 patients had Hurley III
MABp1[3]	10	1 (10%)	Anti-TNFa treatment failures

[1] Humira EMA assessment report http://www.ema.europa.eu/docs/en_GB/document_library/EPAR_-_Assessment_Report_-_Variation/human/000481/WC500195564.pdf

[2] Anakinra Study (Tzanetakou and others, 2016).

[3] Press release XBiotech (http://investors.xbiotech.com/phoenix.zhtml?c=253990&p=irol-newsArticle&ID=2246777)

[0110] In total, 179 patients have been treated in the placebo group of these studies with a response rate of 19.0% with a 95%-confidence interval of 14% to 25%. As both confidence intervals (e.g., the historical placebo patients and the patients treated with IFX-1) are not overlapping, a significant treatment effect of IFX-1 can be concluded.

[0111] Photographic documentation of the affected areas confirmed these findings by a highly reduced inflammation on the skin, as evidenced by the visual reduction of inflammatory swollenness and redness post treatment.

[0112] Thus, anti-C5a represents a powerful anti-inflammatory agent in the disease setting of HS. This clinical finding demonstrates that blockade of C5a is highly effective to reduce the activation of neutrophils thereby effectively alleviating cutaneous neutrophilic inflammatory disorders.

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<223> IFX-1 CDR1 light chain

<400> 16
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1   5   10   15

<210> 17
<211> 16
<212> PRT
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<211> 21
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1   5   10   15

Ser Val Lys Ile Ser
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<210> 19
<211> 15
<212> PRT
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<400> 19
Trp Val Lys Gln Arg Pro Gly Gln Gly Leu Glu Trp Ile Gly Arg
1   5   10   15

<210> 20
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<400> 20
Arg Phe Lys Asp Arg Ala Thr Leu Thr Val Asp Lys Ser Ser Ser Thr
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Val Tyr Met Gln Leu Ser Ser Pro Thr Ser Glu Asp Ser Ala Val Tyr
            20   25   30

Tyr

<210> 21
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<212> PRT
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Tyr

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[illegible]
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<400> 27
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<210> 28
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1 5 10 15

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20 25 30

Tyr

<210> 29
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<400> 29
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1   5   10

<210> 30
<211> 22
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<220>
<223> INab708 FR1 light chain

<400> 30
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1   5   10   15

Gln Arg Ala Thr Ile Ser
            20

<210> 31
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<400> 31
Trp Tyr Gln Gln Lys Pro Gly Gln Pro Pro Lys Leu Leu
1   5   10

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<400> 32
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1   5   10   15

Phe Thr Leu Asn Ile His Pro Val Glu Glu Glu Val Ala Ala Thr Tyr
            20   25   30

Tyr

<210> 33
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<212> PRT
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<220>
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1               5                   10
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<210> 34
<211> 40
<212> RNA
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<220>
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<220>
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<220>
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<222> (38)..(38)
<223> desoxy cytidine

<400> 34
gcgauguggu ggugaagggu uguugggugu cgacgcacgc 40

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Patentkrav

1. Forbindelse til anvendelse i behandling af en kutan, neutrofil, inflammatorisk sygdom hos en patient, hvor forbindelsen er en hæmmer af C5a-aktivitet, og hvor den kutane, neutrofile, inflammatorisk sygdom vælges fra gruppen bestående af hidradenitis suppurativa (HS); autoinflammatoriske syndromer PASH (Pyoderma gangrenosum (PG), acne og hidradenitis suppurativa) og PAPASH (infektiøs arthrit, acne, PG og hidradenitis suppurativa), hvor hæmmeren af C5a-aktivitet er IFX-1-antistoffet eller antigenbindingsfragmentet deraf, der omfatter en variabel tungkæde bestående af følgende rækkefølge af aminosyresekvenserne af FR1 ifølge SEQ ID NO: 18, CDR1 ifølge SEQ ID NO: 14, FR2 ifølge SEQ ID NO: 19, CDR2 ifølge SEQ ID NO: 10, FR3 ifølge SEQ ID NO: 20, CDR3 ifølge SEQ ID NO: 6 og FR4 ifølge SEQ ID NO: 21 og en variabel letkæde bestående af følgende rækkefølge af aminosyresekvenserne af FR1 ifølge SEQ ID NO: 22, CDR1 ifølge SEQ ID NO: 16, FR2 ifølge SEQ ID NO: 23, CDR2 ifølge SEQ ID NO: 12, FR3 ifølge SEQ ID NO: 24, CDR3 ifølge SEQ ID NO: 8 og FR4 ifølge SEQ ID NO: 25.

2. Forbindelse til anvendelse ifølge krav 1, hvor forbindelsen skal indgives ved en dosis på 800 mg én gang om ugen eller ved en dosis på 800 mg to gange om ugen.

DRAWINGS

Fig. 1

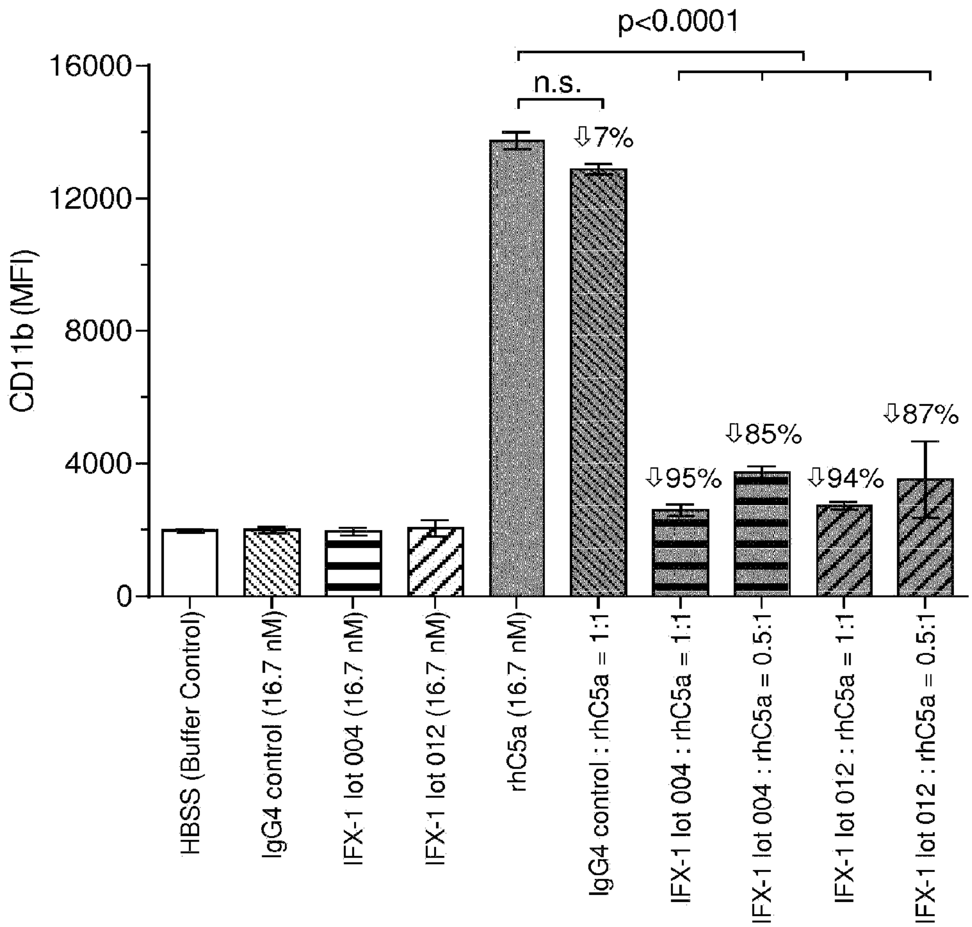
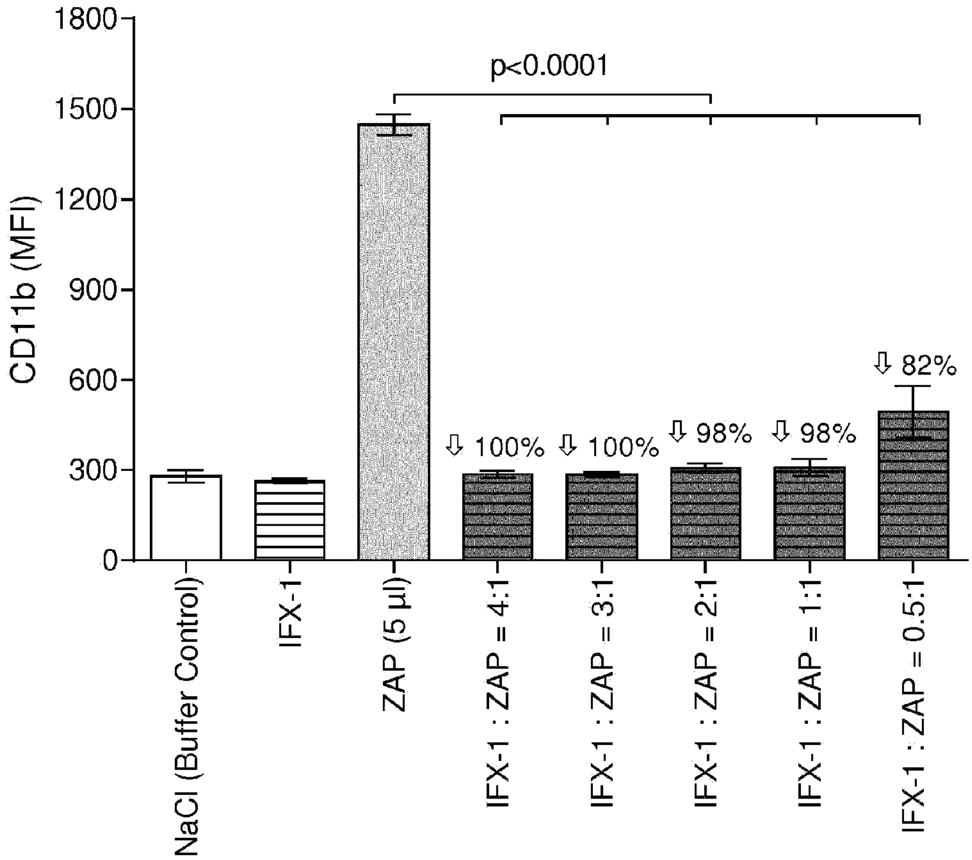
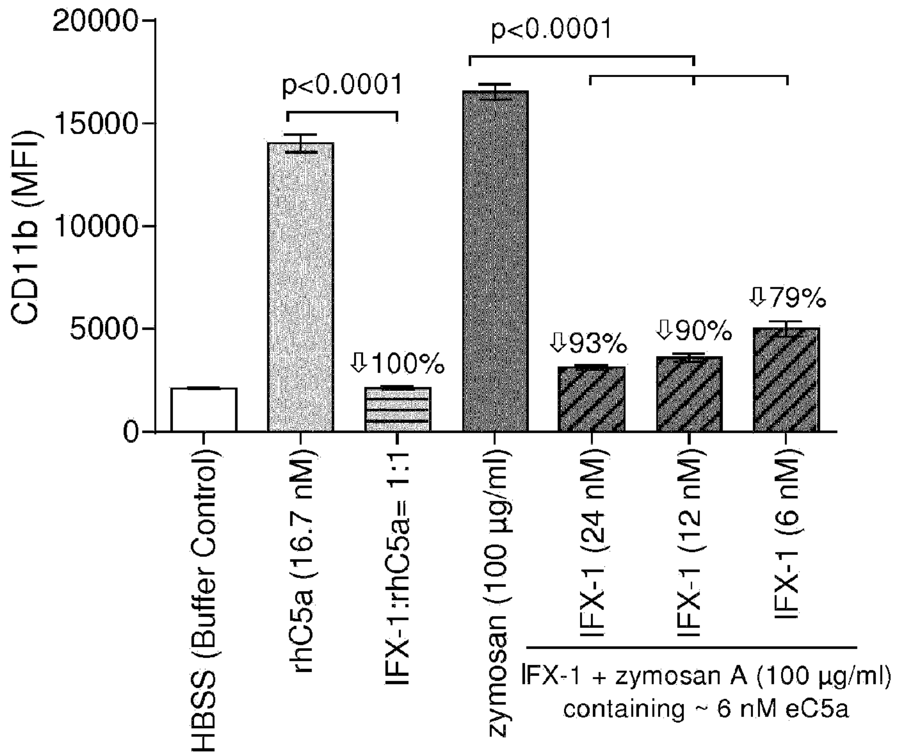


Fig. 2



CD11b (MFI)
0
300
600
900
1200
1500
1800
p<0.0001
⇩ 100%
⇩ 100%
⇩ 98%
⇩ 98%
⇩ 82%
NaCl (Buffer Control)
IFX-1
ZAP (5 µl)
IFX-1 : ZAP = 4:1
IFX-1 : ZAP = 3:1
IFX-1 : ZAP = 2:1
IFX-1 : ZAP = 1:1
IFX-1 : ZAP = 0.5:1

Fig. 3


CD11b (MFI)
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15000
10000
5000
0
p<0.0001
p<0.0001
⇩100%
⇩93%
⇩90%
⇩79%
HBSS (Buffer Control)
rhC5a (16.7 nM)
IFX-1:rhC5a= 1:1
zymosan (100 µg/ml)
IFX-1 (24 nM)
IFX-1 (12 nM)
IFX-1 (6 nM)
IFX-1 + zymosan A (100 µg/ml)
containing ~ 6 nM eC5a

Fig. 4

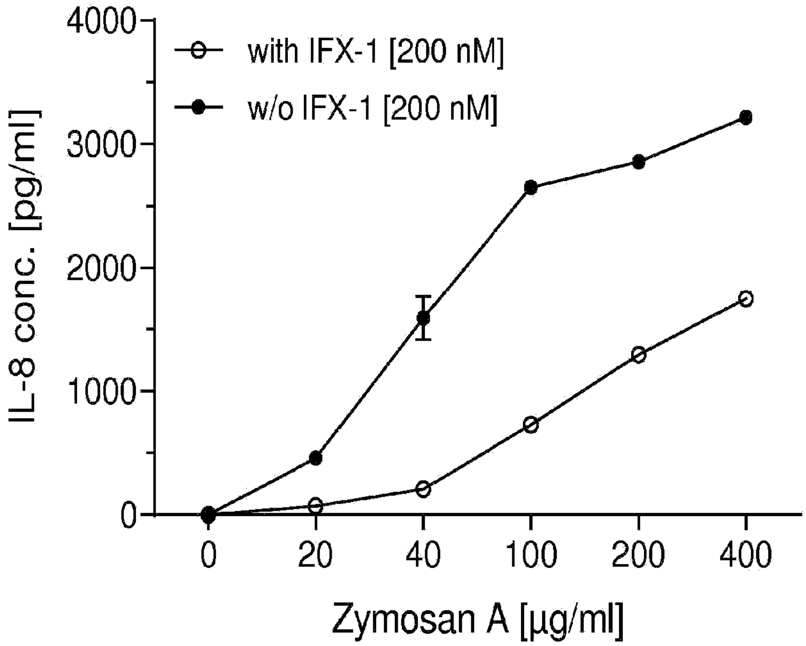

4000
3000
2000
1000
0
IL-8 conc. [pg/ml]
with IFX-1 [200 nM]
w/o IFX-1 [200 nM]
0
20
40
100
200
400
Zymosan A [µg/ml]

Fig. 5

Fig. 5A

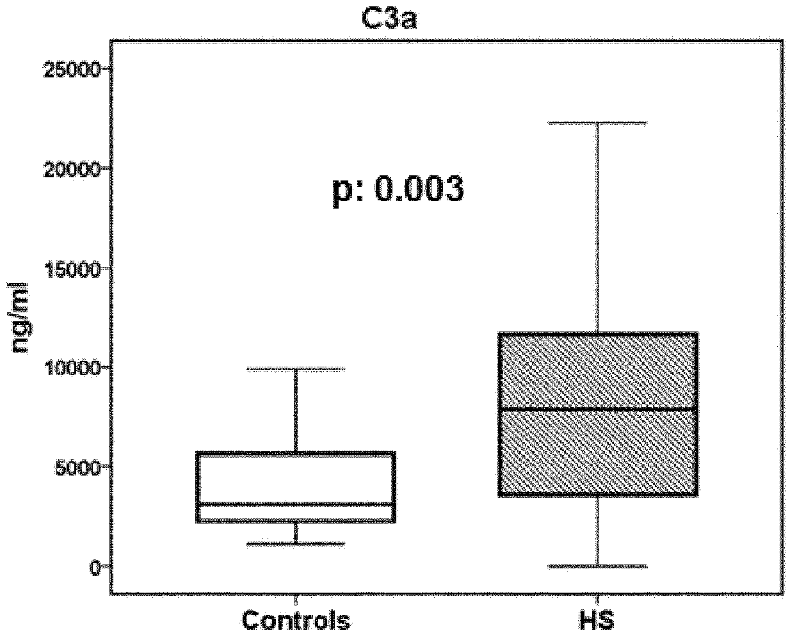


Fig. 5B

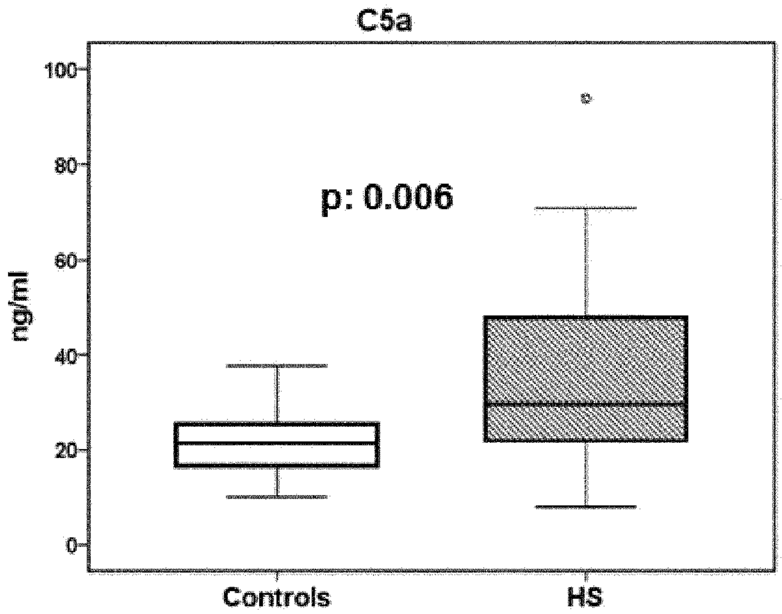


Fig. 5C

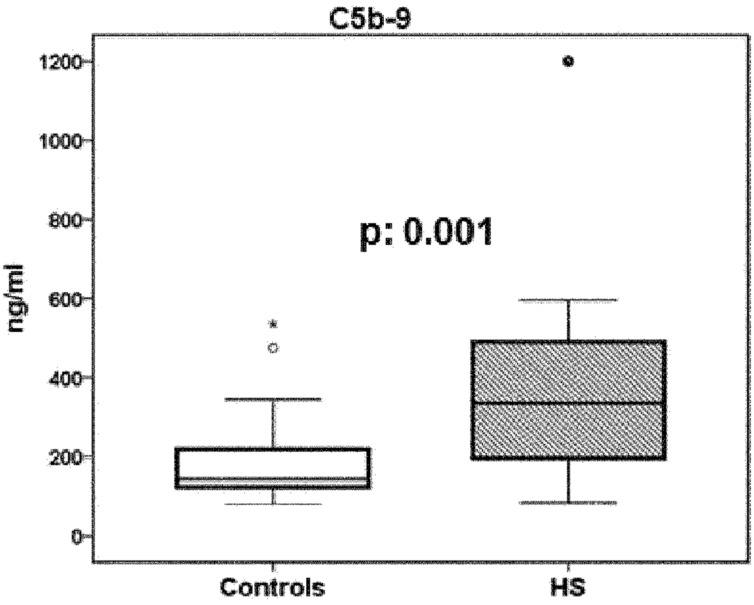
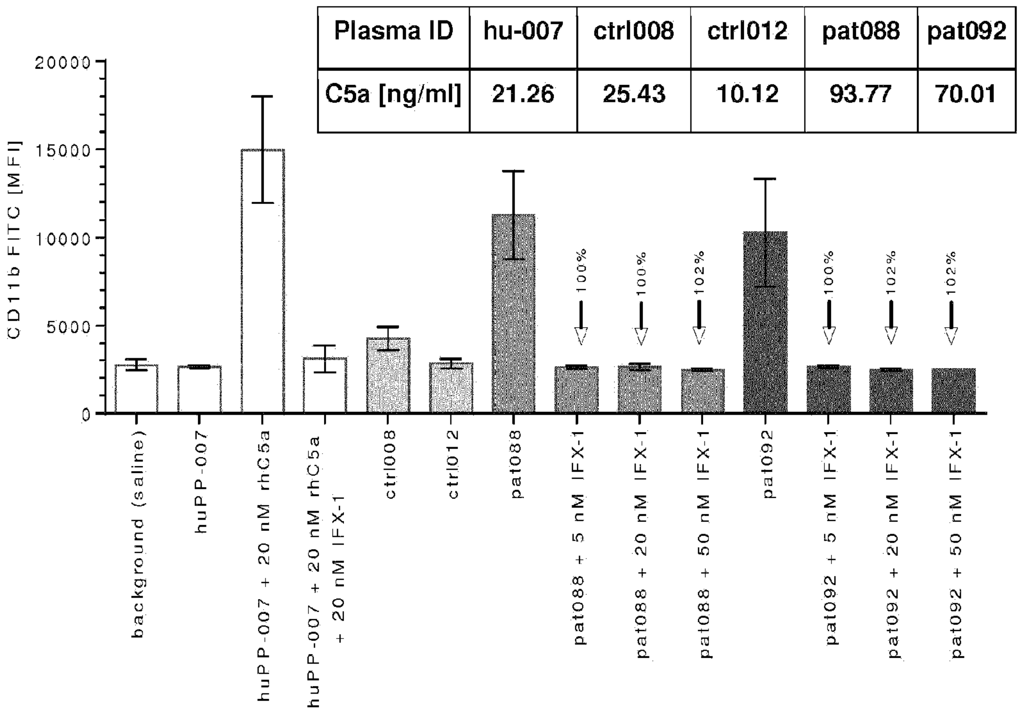


Fig. 6



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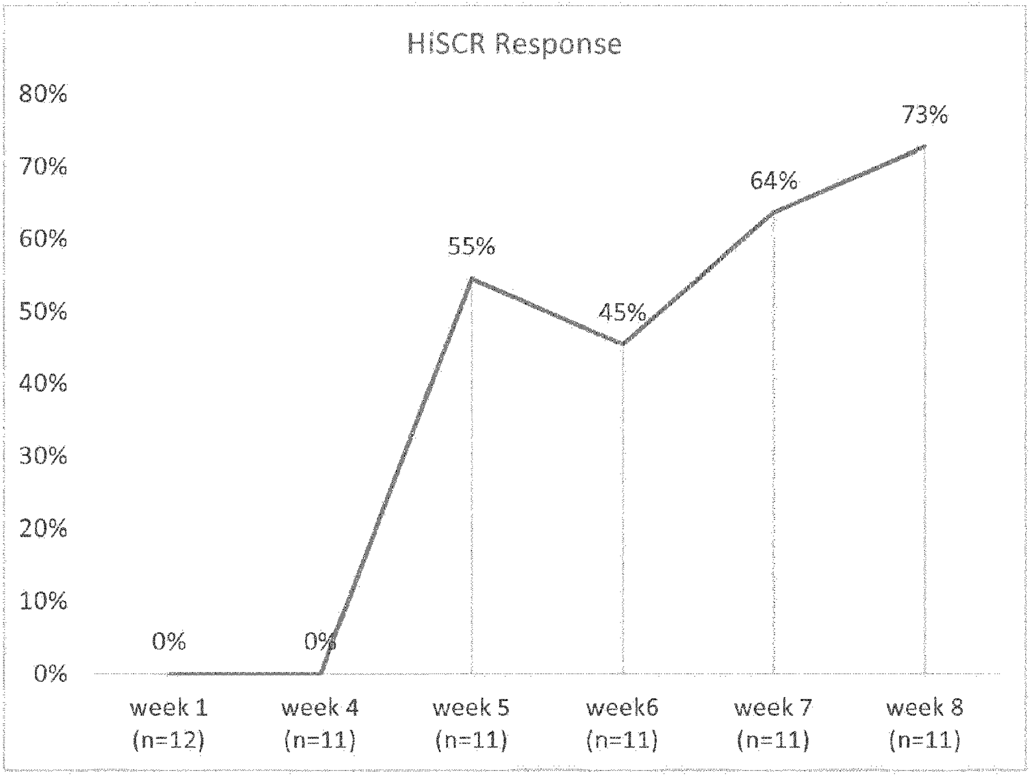
C5a [ng/ml]	21.26	25.43	10.12	93.77	70.01

Fig. 7


HiSCR Response
80%
70%
60%
50%
40%
30%
20%
10%
0%
0%
0%
55%
45%
64%
73%
week 1 (n=12)
week 4 (n=11)
week 5 (n=11)
week6 (n=11)
week 7 (n=11)
week 8 (n=11)