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(54) Title: IL1RA DERIVED PEPTIDES FOR TREATMENT OF DIABETIC NEPHROPATHY

(57) Abstract: The present disclosure relates to peptides derived from IL-1R antagonist protein (IL1RA) for treatment of diabetic nephropathy and for use in treating diabetic nephropathy.



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IL1RA derived peptides for treatment of diabetic nephropathy

Technical field

5 The present disclosure relates to peptides derived from IL-1R antagonist protein (IL1RA) for treatment of diabetic nephropathy.

Background

10 Interleukin 1 (IL-1) is a general name for two distinct pro-inflammatory cytokines proteins, IL-1 alpha and IL-1 beta. IL-1 exerts its effects by binding to specific transmembrane receptors (IL-1R) on multiple cell types. The effects of IL-1 are counteracted by natural inhibitors such as soluble IL-1 receptors and IL-1R antagonist protein (IL1RA). IL1RA inhibits the effect of IL-1 by blocking its interaction with the cell surface receptors.

15 Therapeutic approaches for targeting IL-1 for anti-inflammatory purposes have been addressed in the art. These include administration of recombinant IL-1R antagonist protein, IL-1 trap fusion proteins, anti-IL-1 antibodies, anti-IL-1RI and soluble IL-1RI and II in experimental models of arthritis (reviewed in Gabay C et al. 2010).

20 Anakinra (US5075222) is a recombinantly produced protein that contains the *N*-terminal, methionylated, nonglycosylated version of human IL-1RA, which blocks the actions of IL-1 without any detectable agonist activity. Anakinra has been tested for the treatment of rheumatoid arthritis, adult-onset Still's disease, systemic onset juvenile idiopathic arthritis, osteoarthritis and type 2 diabetes mellitus. Anakinra is approved for
25 treatment of rheumatoid arthritis; it is delivered as an injection concentrate with 100 mg in each dose; it is prepared from genetically modified *E. coli* using recombinant DNA technology; and it has a high molecular weight.

30 WO 2012/122985 and WO 2017/063657 discloses a 10-amino acid peptide derived from of IL1RA: SGRKSSKMQA (SEQ ID NO:1), and its use in treating various disorders. SEQ ID NO:1 has previously been shown to inhibit interleukin 1 β -induced NF-kB signaling and macrophage secretion of TNF α , and hence is a potent inhibitor of inflammatory responses (Klementiev 2014).

Diabetic kidney disease (DKD), also known as diabetic nephropathy, has not historically been considered as an immune-mediated disease as metabolic and haemodynamic factors have been thought to be the main causes of the renal injuries. However, recent studies support a role for the innate immune system in both the development and progression of DKD. Association with both systemic and local renal inflammation and an increased number of pro- and anti-inflammatory cytokines including IL-1 and IL-4 have been found in the kidney and some also in peripheral blood from patients with diabetic nephropathy in comparison to healthy control individuals (Hickey 2018, Araújo 2020, Murakoshi 2020).

The progressive non-infectious inflammation involves glomerular and tubular cells resulting in gradual loss of kidney function. The blood glucose and blood pressure shall be kept as normal as possible which will delay loss of kidney function. However, no specific treatment of this innate inflammation is developed and the declining glomerular filtration and tubular function does not stop, and loss of renal function continue. At the end stage renal failure, the treatment will be chronic dialysis and in some cases kidney transplantation. Hence, interventions that prevent or halt the predestined inflammatory induced decline in all functions of nephrons focus on inhibition of the renal inflammation is needed.

Patients are diagnosed with diabetic nephropathy by measuring albumin in urine. Urine albumin is often measured in spot urine and corrected for creatinine in the same urine sample, ACR mg/g. The ACR are divided in three groups, normo-albuminuria ACR < 30 mg/g, micro-albuminuria ACR > 30 mg/g < 300 mg/g and macro-albuminuria ACR > 300 mg/g. There is clinical evidence that the higher ACR is the more advanced is the kidney damage.

Urine albumin and Kidney Injury Molecule-1 (KIM-1) are both biomarkers of kidney innate inflammation as seen in various autoimmune diseases which involve the kidneys as well as in other non-autoimmune diseases (Coca 2017, Cai 2019, Levey 2019). Human renal biopsies have confirmed the presence of inflammatory cells in both glomeruli, the tubuli and the interstitium at all stages of diabetic nephropathy (Kahn 2019, Calle 2021).

Summary

It is shown herein that peptides derived from IL1RA according to the present disclosure significantly reduce urinary albumin corrected for creatinine (ACR) and the kidney-injuring molecule corrected for creatinine (KIM-1/CR). Urine albumin and KIM-1 are both biomarkers of kidney innate inflammation as seen in various diseases which involve the kidneys, including diabetic nephropathy.

As diabetic nephropathy has not historically been considered as an immune-mediated disease, there is a need for compounds and medicaments addressing the immune-mediated and renal inflammation aspects of diabetic nephropathy.

On the basis of the experimental data provided herein, peptides and compounds derived from IL4RA according to the present disclosure are likely to be able to prevent or halt the predestined inflammatory induced decline in various functions of nephrons of the kidney.

On the basis of the experimental data provided herein, peptides and compounds derived from IL4RA according to the present disclosure are likely to be able to inhibit renal inflammation which is observed in diabetic nephropathy.

According to an aspect, the present disclosure concerns a method for treatment of diabetic nephropathy, the method comprising administering an effective amount of a compound to an individual in need thereof, wherein the compound is a peptide derived from an IL-1R antagonist protein (IL1RA), or a variant thereof being at least 70% identical to the peptide derived from IL1RA.

According to an aspect, the present disclosure concerns a compound for use in the treatment of diabetic nephropathy, wherein the compound is a peptide derived from an IL-1R antagonist protein (IL1RA), or a variant thereof being at least 70% identical to the peptide derived from IL1RA.

According to an aspect, the present disclosure concerns use of a compound for the manufacture of a medicament for treating diabetic nephropathy, wherein the compound is a peptide derived from an IL-1R antagonist protein (IL1RA), or a variant thereof being at least 70% identical to the peptide derived from IL1RA.

According to an aspect, the present disclosure concerns a method for treatment of diabetic nephropathy, the method comprising administering an effective amount of a compound to an individual in need thereof, wherein the compound comprises one or more peptides, each peptide consisting of the amino acid sequence SGRKSSKMQA (SEQ ID NO:1), or a variant of SEQ ID NO:1 comprising one, two or three amino acid substitutions.

According to an aspect, the present disclosure concerns a compound for use in the treatment of diabetic nephropathy, wherein the compound comprises one or more peptides, each peptide consisting of the amino acid sequence SGRKSSKMQA (SEQ ID NO:1), or a variant of SEQ ID NO:1 comprising one, two or three amino acid substitutions.

According to an aspect, the present disclosure concerns use of a compound for the manufacture of a medicament for treating diabetic nephropathy, wherein the compound comprises one or more peptides, each peptide consisting of the amino acid sequence SGRKSSKMQA (SEQ ID NO:1), or a variant of SEQ ID NO:1 comprising one, two or three amino acid substitutions.

According to an aspect, the present disclosure concerns a method for treatment of diabetic nephropathy, the method comprising administering an effective amount of a multimeric compound to an individual in need thereof, wherein the multimeric compound comprises at least two peptides, each peptide consisting of the amino acid sequence SGRKSSKMQA (SEQ ID NO:1), or a variant of SEQ ID NO:1 comprising one, two or three amino acid substitutions.

According to an aspect, the present disclosure concerns a multimeric compound for use in the treatment of diabetic nephropathy, wherein the multimeric compound comprises at least two peptides, each peptide consisting of the amino acid sequence SGRKSSKMQA (SEQ ID NO:1), or a variant of SEQ ID NO:1 comprising one, two or three amino acid substitutions.

According to an aspect, the present disclosure concerns use of a multimeric compound for the manufacture of a medicament for treating diabetic nephropathy, wherein the multimeric compound comprises at least two peptides, each peptide consisting of the

amino acid sequence SGRKSSKMQA (SEQ ID NO:1), or a variant of SEQ ID NO:1 comprising one, two or three amino acid substitutions.

5 According to an aspect, the present disclosure concerns a method for treatment of diabetic nephropathy, the method comprising administering an effective amount of a compound to an individual in need thereof, wherein the compound is a peptide consisting of the amino acid sequence of SEQ ID NO:1 (SGRKSSKMQA); or a variant of SEQ ID NO:1 comprising one or two conservative amino acid substitutions.

10 According to an aspect, the present disclosure concerns a compound for use in the treatment of diabetic nephropathy, wherein the compound is a peptide consisting of the amino acid sequence of SEQ ID NO:1 (SGRKSSKMQA); or a variant of SEQ ID NO:1 comprising one or two conservative amino acid substitutions.

15 According to an aspect, the present disclosure concerns use of a compound for the manufacture of a medicament for treating diabetic nephropathy, wherein the compound is a peptide consisting of the amino acid sequence of SEQ ID NO:1 (SGRKSSKMQA); or a variant of SEQ ID NO:1 comprising one or two conservative amino acid substitutions.

20 According to an aspect, the present disclosure concerns a method for treatment of diabetic nephropathy, the method comprising administering an effective amount of a multimeric compound to an individual in need thereof, wherein the multimeric compound consists of

- 25 i) two or more peptides wherein each of the two or more peptides consists of 10 to 14 consecutive amino acid residues derived from IL1RA, each peptide:
- a. consisting of the amino acid sequence of SEQ ID NO:1 and optionally additional amino acid residues up to a total length of 11 to 14 amino acid residues; or
 - 30 b. consisting of a variant of SEQ ID NO:1, the variant comprising one conservative amino acid substitution, and optionally additional amino acid residues up to a total length of 11 to 14 amino acid residues, and
- ii) optionally one or more linker groups.

According to an aspect, the present disclosure concerns a multimeric compound for use in the treatment of diabetic nephropathy, wherein the multimeric compound consists of

- 5 i) two or more peptides wherein each of the two or more peptides consists of 10 to 14 consecutive amino acid residues derived from IL1RA, each peptide:
 - a. consisting of the amino acid sequence of SEQ ID NO:1 and optionally additional amino acid residues up to a total length of 11 to 14 amino acid residues; or
 - 10 b. consisting of a variant of SEQ ID NO:1, the variant comprising one conservative amino acid substitution, and optionally additional amino acid residues up to a total length of 11 to 14 amino acid residues, and
- ii) optionally one or more linker groups.

15 According to an aspect, the present disclosure concerns use of a multimeric compound for the manufacture of a medicament for treating diabetic nephropathy, wherein the multimeric compound consists of

- i) two or more peptides wherein each of the two or more peptides consists of 10 to 14 consecutive amino acid residues derived from IL1RA, each peptide:
 - 20 a. consisting of the amino acid sequence of SEQ ID NO:1 and optionally additional amino acid residues up to a total length of 11 to 14 amino acid residues; or
 - b. consisting of a variant of SEQ ID NO:1, the variant comprising one conservative amino acid substitution, and optionally additional amino acid residues up to a total length of 11 to 14 amino acid residues, and
- 25 ii) optionally one or more linker groups.

Description of Drawings

Figure 1 shows urinary albumin corrected for creatinine (ACR) in a urine sample after treatment with vehicle, 3 mg/kg SER140, 10 mg/kg SER140 and 20 mg/kg SER140 of
30 Renin AAV Uni-nephrectomized db/db (Renin AAV UNx) mice for a period of 77 days. Figure 1 shows the medians of the different groups. See Example 1.

Figure 2 shows urinary KIM-1 corrected for creatinine (KIM-1/CR) in a urine sample after treatment with 3 mg/kg SER140, 10 mg/kg SER140 and 20mg/kg SER140 of

Renin AAV Uni-nephrectomized (Renin AAV UNx) mice for a period of 77 days. Figure 2 shows the means of the different groups. See Example 1.

Definitions and abbreviations

5 ACR: Albumin corrected for creatinine

DKD: Diabetic kidney disease.

IL1RA or IL1Ra: IL-1 receptor antagonist protein, may also be denoted IL-1 receptor antagonist herein.

IL-1: Interleukin 1.

10 IL1R1 or IL1R1: IL1 receptor type 1.

KIM-1: Kidney Injury Molecule-1

KIM-1/CR: KIM-1 corrected for creatinine

ReninAAV UNx mice: Renin AAV uninephrectomized db/db mice

15 The terms “diabetic nephropathy” and “diabetic kidney disease (DKD)” are used interchangeably to refer to the same disease. Diabetic nephropathy is a type of progressive kidney disease that may occur in individuals with diabetes mellitus. It affects individuals with type 1 and type 2 diabetes, and risk increases with the duration of the disease and other risk factors like high blood pressure and a family history of
20 kidney disease.

The term “individual” refers to vertebrates, particular members of the mammalian species, preferably primates including humans. As used herein, ‘subject’ and ‘individual’ may be used interchangeably.

25

An “individual in need thereof” refers to an individual who may benefit from the present disclosure. In one embodiment, the individual in need thereof is a diseased individual. In one embodiment, the individual in need thereof is a diseased individual, in particular an individual with diabetes mellitus, type 1 or 2.

30

"Co-administering" or "co-administration" of compounds of the present disclosure and other medicaments, as used herein, refers to the administration of one or more compounds of the present disclosure and another medicament within a certain time period. The time period might be less than 72 hours, such as 48 hours, for example
35 less than 24 hours, such as less than 12 hours, for example less than 6 hours, such as

less than 3 hours. However, these terms also mean that the compound and a therapeutic composition can be administered together. Co-administration may be simultaneous, separately or sequentially.

5 An "effective amount" of a compound can be administered in one administration, or through multiple administrations of an amount that total an effective amount, for instance within a 24-hour period. It can be determined using standard clinical procedures for determining appropriate amounts and timing of administration. It is understood that the "effective amount" can be the result of empirical and/or
10 individualized (case-by-case) determination on the part of the treating health care professional and/or individual.

"Sequence identity" as used herein is the number of amino acid residues which match exactly between two different sequences to be compared. If a variant is 90% identical
15 to a sequence having ten amino acid residues, the variant can differ from the sequence by one amino acid substitution.

The terms "treating", "treatment" and "therapy" as used herein refer equally to curative therapy, prophylactic or preventative therapy and ameliorating or palliative therapy. The
20 term includes an approach for obtaining beneficial or desired physiological results, which may be established clinically. For purposes of this disclosure, beneficial or desired clinical results include, but are not limited to, alleviation of symptoms, diminishment of extent of disease, stabilized (i.e., not worsening) condition, delay or slowing of progression or worsening of condition/symptoms, amelioration or palliation
25 of the condition or symptoms, and remission (whether partial or total), whether detectable or undetectable. The term "palliation", and variations thereof, as used herein, means that the extent and/or undesirable manifestations of a physiological condition or symptom are lessened and/or time course of the progression is slowed or lengthened, as compared to not administering compositions of the present disclosure.

30 A "treatment effect" or "therapeutic effect" is manifested if there is a change in the condition being treated, as measured by the criteria constituting the definition of the terms "treating" and "treatment." There is a "change" in the condition being treated if there is at least 5% improvement, alternatively 10% improvement, alternatively at least
35 25%, alternatively at least 50%, such as at least 75%, alternatively at least 100%

improvement. The change can be based on improvements in the severity of the treated condition in an individual, or on a difference in the frequency of improved conditions in populations of individuals with and without treatment with the compound, or with the compound in combination with a pharmaceutical composition of the present disclosure.

5

A treatment according to the disclosure may be prophylactic, ameliorating or curative.

The term "variant" means that the peptide sequence may be modified, for example by substitution of one or more of the amino acid residues. Both L-amino acids and D-amino acids may be used. Other modification may comprise derivatives such as esters, sugars, etc., for example methyl and acetyl esters, as well as polyethylene glycol modifications.

10

Furthermore, an amine group of the peptide may be converted to amides, wherein the acid part of the amide is a fatty acid.

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The groups of conservative amino acids are as the following:

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A, G (neutral, weakly hydrophobic),
Q, N, S, T (hydrophilic, non-charged)
E, D (hydrophilic, acidic)
H, K, R (hydrophilic, basic)
L, P, I, V, M, F, Y, W (hydrophobic, aromatic)
C (cross-link forming)

Conservative substitutions may be introduced in any position of a preferred predetermined peptide for use according to the disclosure. It may however also be desirable to introduce non-conservative substitutions, particularly, but not limited to, a non-conservative substitution in any one or more positions.

25

The peptide sequences of the present disclosure may be prepared by any conventional synthetic methods, recombinant DNA technologies, enzymatic cleavage of full-length proteins which the peptide sequences are derived from, or a combination of said methods.

30

Formulations of the compounds of the disclosure can be prepared by techniques known to the person skilled in the art. The formulations may contain pharmaceutically

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acceptable carriers and excipients including microspheres, liposomes, microcapsules, nanoparticles or the like. The active compound may be formulated as neutral or salt forms.

5 Detailed description

According to an embodiment, the present disclosure concerns a method for treatment of diabetic nephropathy, the method comprising administering an effective amount of a compound to an individual in need thereof, wherein the compound is a peptide derived from an IL-1R antagonist (IL1RA) protein, or a variant thereof being at least 70% identical to the peptide derived from IL1RA.

According to an embodiment, the present disclosure concerns a compound for use in the treatment of diabetic nephropathy, wherein the compound is a peptide derived from an IL-1R antagonist (IL1RA) protein, or a variant thereof being at least 70% identical to the peptide derived from IL1RA.

According to an embodiment, the present disclosure concerns use of a compound for the manufacture of a medicament for treating diabetic nephropathy, wherein the compound is a peptide derived from an IL-1R antagonist protein (IL1RA), or a variant thereof being at least 70% identical to the peptide derived from IL1RA.

In one embodiment of the present disclosure, the IL1RA protein has a sequence selected from SEQ ID NOs: 2-5. In one embodiment of the present disclosure, the IL1RA protein has a sequence selected from SEQ ID NOs: 2-4.

In one embodiment of the present disclosure, the IL1RA protein is SEQ ID NO:1.
In one embodiment of the present disclosure, the IL1RA protein is SEQ ID NO:2.
In one embodiment of the present disclosure, the IL1RA protein is SEQ ID NO:3.
In one embodiment of the present disclosure, the IL1RA protein is SEQ ID NO:4.

In another embodiment of the present disclosure, the compound for use is a peptide consisting of 5 to 35 contiguous amino acid residues derived from an IL1RA protein sequence selected from SEQ ID NOs: 2-5, or a variant thereof being at least 70% identical to the peptide derived from an IL1RA protein sequence selected from SEQ ID NOs:2-5.

In another embodiment of the present disclosure, the peptide consists of at most 30 contiguous amino acid residues, alternatively at most 25 contiguous amino acid residues, alternatively at most 20 contiguous amino acid residues, alternatively at most 15 contiguous amino acid residues, alternatively 10 contiguous amino acid residues derived from an IL1RA protein sequence selected from SEQ ID NOs:2-5.

In another embodiment of the present disclosure, the peptide consists of 5 to 35 contiguous amino acid residues derived from an IL1RA protein sequence selected from SEQ ID NOs:2-5, alternatively 5-30, alternatively 5-25, alternatively 5-20, alternatively 5-15, alternatively 10-20, alternatively 8-18 contiguous amino acid residues derived from an IL1RA protein sequence selected from SEQ ID NOs:2-5.

In another embodiment of the present disclosure, the peptide consists of 5 to 35 contiguous amino acid residues derived from an IL1RA protein sequence selected from SEQ ID NOs:2-5, such as 5-6, such as 6-7, such as 7-8, such as 8-9, such as 9-10, such as 10-11, such as 11-12, such as 12-13, such as 13-14, such as 14-15, such as 15-20, such as 20-25, such as 25-30, such as 30-35 contiguous amino acid residues derived from an IL1RA protein sequence selected from SEQ ID NOs:2-5.

In another embodiment of the present disclosure, the variant is at least 75%, alternatively 80%, alternatively 85%, alternatively 90%, alternatively 95% identical to the peptide derived from an IL1RA protein sequence selected from SEQ ID NOs:2-5.

In another embodiment of the present disclosure, the variant is at least 71-80% identical, alternatively 81-85% identical, alternatively 86-90% identical, alternatively 91-95% identical, such as 96-99% identical to the peptide derived from an IL1RA protein sequence selected from SEQ ID NOs:2-5.

In some embodiments of the present disclosure, the compound for use is a peptide consisting of 5 to 35 contiguous amino acid residues derived from an IL1RA protein sequence selected from SEQ ID NOs: 2-5, or a variant thereof being at least 70% identical to the peptide derived from an IL1RA protein sequence selected from SEQ ID NOs:2-5, wherein said peptide comprises at least the amino acid sequence

SGRKSSKMQA (SEQ ID NO:1), or a variant of SEQ ID NO:1 comprising one, two or three amino acid substitutions.

5 In some embodiments of the present disclosure, the compound for use is a peptide consisting of 5 to 20 contiguous amino acid residues derived from an IL1RA protein sequence selected from SEQ ID NOs: 2-5, or a variant thereof being at least 70% identical to the peptide derived from an IL1RA protein sequence selected from SEQ ID NOs:2-5, wherein said peptide consist of the amino acid sequence SGRKSSKMQA (SEQ ID NO:1), or a variant of SEQ ID NO:1 comprising one, two or three amino acid
10 substitutions, and optionally additional amino acid residues up to a total length of 11 to 20 amino acid residues, such as 11, 12, 13, 14, 15, 16, 17, 18, 19 or 20 amino acid residues.

15 In some embodiments of the present disclosure, the peptide binds to Interleukin 1 receptor, type 1 (IL1R1), and/or interferes with the binding of IL-1 to IL1R1.

According to an embodiment, the present disclosure concerns a method for treatment of diabetic nephropathy, the method comprising administering an effective amount of a compound to an individual in need thereof, wherein the compound comprises one or
20 more peptides, each peptide consisting of the amino acid sequence SGRKSSKMQA (SEQ ID NO:1), or a variant of SEQ ID NO:1 comprising one, two or three amino acid substitutions, and optionally additional amino acid residues up to a total length of 11 to 20 amino acid residues, such as 11, 12, 13, 14, 15, 16, 17, 18, 19 or 20 amino acid residues.

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According to an embodiment, the present disclosure concerns a compound for use in the treatment of diabetic nephropathy, wherein the compound comprises one or more peptides, each peptide consisting of the amino acid sequence SGRKSSKMQA (SEQ ID NO:1), or a variant of SEQ ID NO:1 comprising one, two or three amino acid
30 substitutions, and optionally additional amino acid residues up to a total length of 11 to 20 amino acid residues, such as 11, 12, 13, 14, 15, 16, 17, 18, 19 or 20 amino acid residues.

35 According to an embodiment, the present disclosure concerns a method for treatment of diabetic nephropathy, the method comprising administering an effective amount of a

compound to an individual in need thereof, wherein the compound comprises one or more peptides, each peptide consisting of the amino acid sequence SGRKSSKMQA (SEQ ID NO:1), or a variant of SEQ ID NO:1 comprising one, two or three amino acid substitutions.

5

According to an embodiment, the present disclosure concerns a compound for use in the treatment of diabetic nephropathy, wherein the compound comprises one or more peptides, each peptide consisting of the amino acid sequence SGRKSSKMQA (SEQ ID NO:1), or a variant of SEQ ID NO:1 comprising one, two or three amino acid substitutions.

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According to an embodiment, the present disclosure concerns use of a compound for the manufacture of a medicament for treating diabetic nephropathy, wherein the compound comprises one or more peptides, each peptide consisting of the amino acid sequence SGRKSSKMQA (SEQ ID NO:1), or a variant of SEQ ID NO:1 comprising one, two or three amino acid substitutions.

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In some embodiments of the present disclosure, the peptide binds to IL-1 receptor type 1 (ILR1), and/or interferes with the binding of IL-1 beta to IL1R1.

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In some embodiments of the present disclosure, the variant of SEQ ID NO:1 comprises one or two amino acid substitutions. In some embodiments of the present disclosure, the variant of SEQ ID NO:1 comprises one amino acid substitution.

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In another embodiment of the present disclosure, the amino acid substitution(s) is a conservative amino acid substitution.

In some embodiments of the present disclosure, the variant of SEQ ID NO:1 comprises one, two or three conservative amino acid substitutions.

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In another embodiment of the present disclosure, the one or more peptides each consists of

- i) the amino acid sequence of SEQ ID NO:1, and/or
- ii) a fragment consisting of 5 or more consecutive amino acid of SEQ ID NO:1, and/or

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- iii) a variant of SEQ ID NO:1 having at least 90% identity to SEQ ID NO:1, and/or
- iv) a variant of SEQ ID NO:1 comprising one amino acid substitution.

5 In some embodiments of the present disclosure, said one or more peptides consist of a fragment consisting of 5 or more consecutive amino acid of SEQ ID NO:1.

In some embodiments of the present disclosure, said one or more peptides consist of a fragment consisting of 5, 6, 7, 8 or 9 consecutive amino acid of SEQ ID NO:1.

10 In some embodiments of the present disclosure, said one or more peptides consist of the amino acid sequence SGRKSSKMQA (SEQ ID NO:1), and optionally additional amino acid residues up to a total length of 11 to 20 amino acid residues, such as 11, 12, 13, 14, 15, 16, 17, 18, 19 or 20 amino acid residues.

15 In some embodiments of the present disclosure, said one or more peptides consist of the amino acid sequence of SEQ ID NO:1, or a variant having 1 amino acid substitution.

20 In some embodiments of the present disclosure, said one or more peptides consist of a variant of SEQ ID NO:1 having 1 amino acid substitution.

In some embodiments of the present disclosure, said one or more peptides consist of the amino acid sequence of SEQ ID NO:1.

25 According to an embodiment, the present disclosure concerns a method for treatment of diabetic nephropathy, the method comprising administering an effective amount of a compound to an individual in need thereof, wherein the compound is a peptide consisting of the amino acid sequence of SEQ ID NO:1 (SGRKSSKMQA); or a variant of SEQ ID NO:1 comprising one or two conservative amino acid substitutions.

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According to an embodiment, the present disclosure concerns a compound for use in the treatment of diabetic nephropathy, wherein the compound is a peptide consisting of the amino acid sequence of SEQ ID NO:1 (SGRKSSKMQA); or a variant of SEQ ID NO:1 comprising one or two conservative amino acid substitutions.

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According to an embodiment, the present disclosure concerns use of a compound for the manufacture of a medicament for treating diabetic nephropathy, wherein the compound is a peptide consisting of the amino acid sequence of SEQ ID NO:1 (SGRKSSKMQA); or a variant of SEQ ID NO:1 comprising one or two conservative amino acid substitutions.

In another embodiment of the present disclosure, the C-terminal amino acid exists as the free carboxylic acid ("OH"). In another embodiment, the C-terminal amino acid is an amidated derivative ("NH₂"). In another embodiment, the N-terminal amino acid comprises a free amino-group ("H-"). In another embodiment, the N-terminal amino acid is the acetylated derivative ("Acetyl" or "COCH₃").

In some embodiments of the present disclosure, the compound for use is a monomer. In some embodiments of the present disclosure, the compound is a monomer comprising one peptide according to the present disclosure.

In some embodiments of the present disclosure the compound for use is a multimer. In some embodiments of the present disclosure the compound for use is a multimer comprising at least two peptides, such as two or more peptides, according to the present disclosure.

In some embodiments of the present disclosure the compound for use is a multimer.

In some embodiments of the present disclosure the compound for use is a multimer comprising two or more peptides, each peptide consisting of SEQ ID NO:1, or a variant of SEQ ID NO:1 comprising one, two or three amino acid substitutions

In some embodiments of the present disclosure, the compound is a dimer, a trimer or a tetramer.

In some embodiments of the present disclosure, the compound for use is a dimer comprising two peptides, each peptide consisting of SEQ ID NO:1, or a variant of SEQ ID NO:1 comprising one, two or three amino acid substitutions.

In some embodiments of the present disclosure, the compound for use is a tetramer comprising four peptides, each peptide consisting of SEQ ID NO:1, or a variant of SEQ ID NO:1 comprising one, two or three amino acid substitutions.

5 In some embodiments, the compound is a dendrimer. In some embodiments, the dendrimer is a dimeric dendrimer. In some embodiments, the dendrimer is a tetrameric dendrimer.

10 Dendrimers are highly ordered, branched polymeric molecules. Typically, dendrimers are symmetric about the core, and often adopt a spherical three-dimensional morphology.

In some embodiments of the present disclosure, the compound for use is a dimeric dendrimer comprising two peptides, each peptide consisting of SEQ ID NO:1, or a
15 variant of SEQ ID NO:1 comprising one, two or three amino acid substitutions.

In some embodiments of the present disclosure, the compound for use is a tetrameric dendrimer comprising four peptides, each peptide consisting of SEQ ID NO:1, or a
20 variant of SEQ ID NO:1 comprising one, two or three amino acid substitutions.

In some embodiments of the present disclosure, the two or more peptides are linked via a peptide bond.

25 In some embodiments of the present disclosure, the two or more peptides are linked via a linker group.

In some embodiments of the present disclosure, the linker group is a lysine backbone, such as a lysine backbone comprising one or more lysine residues, such as a plurality of lysine residues.

30 In some embodiments of the present disclosure, the linker group comprises one or more lysine residues.

35 In some embodiments of the present disclosure, the compound for use is a dimeric dendrimer comprising two peptides, each peptide consisting of SEQ ID NO:1, or a

variant of SEQ ID NO:1 comprising one, two or three amino acid substitutions, and a lysine backbone.

5 In some embodiments of the present disclosure, the compound for use is a tetrameric dendrimer comprising four peptides, each peptide consisting of SEQ ID NO:1, or a variant of SEQ ID NO:1 comprising one, two or three amino acid substitutions, and a lysine backbone.

10 In some embodiments of the present disclosure, the peptide is a tetrameric dendrimer consisting of four peptides, each peptide consisting of SEQ ID NO:1, and a lysine backbone.

In another embodiment of the present disclosure, the linker group is a polymer carrier, such as a protein carrier.

15

According to an embodiment, the present disclosure concerns a method for treatment of diabetic nephropathy, the method comprising administering an effective amount of a multimeric compound to an individual in need thereof, wherein the multimeric compound comprises at least two peptides, each peptide consisting of the amino acid sequence SGRKSSKMQA (SEQ ID NO:1), or a variant of SEQ ID NO:1 comprising one, two or three amino acid substitutions.

20

According to an embodiment, the present disclosure concerns a multimeric compound for use in the treatment of diabetic nephropathy, wherein the multimeric compound comprises at least two peptides, each peptide consisting of the amino acid sequence SGRKSSKMQA (SEQ ID NO:1), or a variant of SEQ ID NO:1 comprising one, two or three amino acid substitutions.

25

According to an embodiment, the present disclosure concerns use of a multimeric compound for the manufacture of a medicament for treating diabetic nephropathy, wherein the multimeric compound comprises at least two peptides, each peptide consisting of the amino acid sequence SGRKSSKMQA (SEQ ID NO:1), or a variant of SEQ ID NO:1 comprising one, two or three amino acid substitutions.

30

In some embodiments of the present disclosure, the multimeric compound is dendrimer.

5 In some embodiments of the present disclosure, the multimeric compound is a dimer, trimer or tetramer.

In some embodiments of the present disclosure, the multimeric compound is a dimer.

10 In some embodiments of the present disclosure, the multimeric compound is a tetramer.

In another embodiment of the present disclosure, the at least two peptides are identical.

15 According to an embodiment, the present disclosure concerns a method for treatment of diabetic nephropathy, said method comprising administering an effective amount of a multimeric compound to an individual in need thereof, wherein said multimeric compound comprises four peptides, each peptide consisting of the amino acid sequence SGRKSSKMQA (SEQ ID NO:1), or a variant of SEQ ID NO:1 comprising
20 one, two or three amino acid substitutions.

According to an embodiment, the present disclosure concerns a multimeric compound for use in the treatment of diabetic nephropathy, wherein said multimeric compound comprises four peptides, each peptide consisting of the amino acid sequence
25 SGRKSSKMQA (SEQ ID NO:1), or a variant of SEQ ID NO:1 comprising one, two or three amino acid substitutions.

In some embodiments of the present disclosure said four peptides are linked via a peptide bond.
30

In some embodiments of the present disclosure said four peptides are linked via a linker group.

35 In some embodiments of the present disclosure said linker group is a lysine backbone comprising one or more lysine residues, such as a plurality of lysine residues.

In some embodiments of the present disclosure the four peptides are identical.

5 In some embodiments each of the four peptides are defined according to the present disclosure.

According to an embodiment, the present disclosure concerns a multimeric compound for use in the treatment of diabetic nephropathy, wherein the multimeric compound consists of

- 10 i) two or more peptides wherein each of the two or more peptides consists of 10 to 14 consecutive amino acid residues derived from IL1RA, each peptide:
- a. consisting of the amino acid sequence of SEQ ID NO:1 and optionally additional amino acid residues up to a total length of 11 to 14 amino acid residues; or
 - 15 b. consisting of a variant of SEQ ID NO:1, the variant comprising one conservative amino acid substitution, and optionally additional amino acid residues up to a total length of 11 to 14 amino acid residues, and
- ii) optionally one or more linker groups.

20 In another embodiment of the present disclosure, the compound is formulated as a pharmaceutical composition.

In another embodiment of the present disclosure, the peptide or the compound decreases the urine albumin to creatinine ratio (ACR). In another embodiment, the
25 peptide or the compound decreases the urine albumin to creatinine ratio (ACR) in a dose dependent manner.

In another embodiment of the present disclosure, the peptide or the compound decreases the urine level of the biomarker Kidney Injury Molecule-1 (KIM-1). In another
30 embodiment, the peptide or the compound decreases the urine KIM-1 to creatinine ratio (KIM-1/CR). In another embodiment, the urine level of KIM-1 or the urine KIM-1 to creatinine ratio (KIM-1/CR) is decreased in a dose dependent manner.

The method or compound for use according to any of the preceding items, wherein the level of KIM-1 is measured in a urine sample, such as a urine sample from the individual.

5 In another embodiment of the present disclosure, the individual has diabetes mellitus, has ACR levels above 30, and/or has increased blood pressure. In another embodiment, the individual has normal blood pressure. In another embodiment, the individual has type I diabetes mellitus or type II diabetes mellitus.

10 In another embodiment of the present disclosure, the individual is treated with antidiabetics. In another embodiment, the individual is treated with antihypertensives.

In another embodiment of the present disclosure, the compound is administered in combination with an effective amount of an antidiabetic compound and/or an
15 antihypertensive compound. In another embodiment, the antihypertensive compound is an ACE inhibitor or angiotensin receptor antagonist.

In another embodiment of the present disclosure, the method further comprises a step of administering an effective amount of an antidiabetic compound and/or an
20 antihypertensive compound to the individual.

In another embodiment of the present disclosure, the antidiabetic compound and/or the antihypertensive compound is administered simultaneously, before or after administering the compound according to the present disclosure.

25

ITEMS

1. A method for treatment of diabetic nephropathy, said method comprising
30 administering an effective amount of a compound to an individual in need thereof, wherein said compound is a peptide derived from an interleukin-1 (IL-1) receptor antagonist (IL1RA) protein, or a variant thereof being at least 70% identical to said peptide derived from an IL1RA protein.

2. A compound for use in the treatment of diabetic nephropathy, wherein said compound is a peptide derived from an IL-1 receptor antagonist (IL1RA) protein, or a variant thereof being at least 70% identical to said peptide derived from an IL1RA protein.
3. The method or compound for use according to any of the preceding items, wherein said IL1RA protein has a sequence selected from SEQ ID NOs: 2-5.
4. The method or compound for use according to any of the preceding items, wherein said compound is a peptide consisting of 5 to 35 contiguous amino acid residues derived from an IL1RA protein selected from SEQ ID NOs: 2-5, or a variant thereof being at least 70% identical to said peptide derived from an IL1RA protein selected from SEQ ID NOs:2-5.
5. The method or compound for use according to any of the preceding items, wherein said peptide consists of at most 30 contiguous amino acid residues, alternatively at most 25 contiguous amino acid residues, alternatively at most 20 contiguous amino acid residues, alternatively at most 15 contiguous amino acid residues, alternatively 10 contiguous amino acid residues derived from an IL1RA protein sequence selected from SEQ ID NOs:2-5.
6. The method or compound for use according to any of the preceding items, wherein said peptide consist of 5 to 35 contiguous amino acid residues derived from an IL1RA protein sequence selected from SEQ ID NOs:2-5, alternatively 5-30, alternatively 5-25, alternatively 5-20, alternatively 5-15, alternatively 10-20, alternatively 8-18 contiguous amino acid residues derived from an IL1RA protein sequence selected from SEQ ID NOs:2-5.
7. The method or compound for use according to any of the preceding items, wherein said peptide consist of 5 to 35 contiguous amino acid residues derived from an IL1RA protein sequence selected from SEQ ID NOs:2-5, such as 5-6, such as 6-7, such as 7-8, such as 8-9, such as 9-10, such as 10-11, such as 11-12, such as 12-13, such as 13-14, such as 14-15, such as 15-20, such as 20-25, such as 25-30, such as 30-35 contiguous amino acid residues derived from an IL1RA protein sequence selected from SEQ ID NOs:2-5.

8. The method or compound for use according to any of the preceding items, wherein said variant is at least 75%, alternatively 80%, alternatively 85%, alternatively 90%, alternatively 95% identical to said peptide derived from an IL1RA protein sequence selected from SEQ ID NOs:2-5.
9. The method or compound for use according to any of the preceding items, wherein said variant is at least 71-80% identical, alternatively 81-85% identical, alternatively 86-90% identical, alternatively 91-95% identical, such as 96-99% identical to said peptide derived from an IL1RA protein sequence selected from SEQ ID NOs:2-5.
10. The method or compound for use according to any of the preceding items, wherein said IL1RA protein has a sequence selected from SEQ ID NOs: 2-4.
11. The method or compound for use according to any of the preceding items, wherein said peptide comprises at least the amino acid sequence SGRKSSKMQA (SEQ ID NO:1), or a variant of SEQ ID NO:1 comprising one, two or three amino acid substitutions.
12. The method or compound for use according to any of the preceding items, wherein said peptide consist of the amino acid sequence SGRKSSKMQA (SEQ ID NO:1), or a variant of SEQ ID NO:1 comprising one, two or three amino acid substitutions, and optionally additional amino acid residues up to a total length of 11 to 20 amino acid residues, such as 11, 12, 13, 14, 15, 16, 17, 18, 19 or 20 amino acid residues.
13. A method for treatment of diabetic nephropathy, said method comprising administering an effective amount of a compound to an individual in need thereof, wherein said compound comprises one or more peptides, each peptide consisting of the amino acid sequence SGRKSSKMQA (SEQ ID NO:1), or a variant of SEQ ID NO:1 comprising one, two or three amino acid substitutions, and optionally additional amino acid residues up to a total length of 11 to 20 amino acid residues, such as 11, 12, 13, 14, 15, 16, 17, 18, 19 or 20 amino acid residues.

14. A compound for use in the treatment of diabetic nephropathy, wherein said compound comprises one or more peptides, each peptide consisting of the amino acid sequence SGRKSSKMQA (SEQ ID NO:1), or a variant of SEQ ID NO:1 comprising one, two or three amino acid substitutions, and optionally additional amino acid residues up to a total length of 11 to 20 amino acid residues, such as 11, 12, 13, 14, 15, 16, 17, 18, 19 or 20 amino acid residues.
15. A method for treatment of diabetic nephropathy, said method comprising administering an effective amount of a compound to an individual in need thereof, wherein said compound comprises one or more peptides, each peptide consisting of the amino acid sequence SGRKSSKMQA (SEQ ID NO:1), or a variant of SEQ ID NO:1 comprising one, two or three amino acid substitutions.
16. A compound for use in the treatment of diabetic nephropathy, wherein said compound comprises one or more peptides, each peptide consisting of the amino acid sequence SGRKSSKMQA (SEQ ID NO:1), or a variant of SEQ ID NO:1 comprising one, two or three amino acid substitutions.
17. The method or compound for use according to any of the preceding items, wherein said peptide binds to IL-1 receptor type 1 (ILR1), and/or interferes with the binding of IL-1 beta to IL1R1.
18. The method or compound for use according to any of the preceding items, wherein said variant comprises one or two amino acid substitutions.
19. The method or compound for use according to any of the preceding items, wherein said variant comprises one amino acid substitution.
20. The method or compound for use according to any of the preceding items, wherein said one or more amino acid substitutions is/are a conservative amino acid substitution.

21. The method or compound for use according to any of the preceding items, wherein said one or more peptides consist of a fragment consisting of 5 or more consecutive amino acid of SEQ ID NO:1.
- 5 22. The method or compound for use according to any of the preceding items, wherein said one or more peptides consist of a fragment consisting of 5, 6, 7, 8 or 9 consecutive amino acid of SEQ ID NO:1.
- 10 23. The method or compound for use according to any of the preceding items, wherein said one or more peptides consist of the amino acid sequence SGRKSSKMQA (SEQ ID NO:1), and optionally additional amino acid residues up to a total length of 11 to 20 amino acid residues, such as 11, 12, 13, 14, 15, 16, 17, 18, 19 or 20 amino acid residues.
- 15 24. The method or compound for use according to any of the preceding items, wherein said one or more peptides consist of the amino acid sequence of SEQ ID NO:1, or a variant having 1 amino acid substitution.
- 20 25. The method or compound for use according to any of the preceding items, wherein said one or more peptides consist of a variant of SEQ ID NO:1 having 1 amino acid substitution.
- 25 26. The method or compound for use according to any of the preceding items, wherein said one or more peptides consist of the amino acid sequence of SEQ ID NO:1.
- 30 27. A method for treatment of diabetic nephropathy, said method comprising administering an effective amount of a compound to an individual in need thereof, wherein said compound is a peptide consisting of the amino acid sequence of SEQ ID NO:1 (SGRKSSKMQA); or a variant of SEQ ID NO:1 comprising one, two or three conservative amino acid substitutions.
28. A compound for use in the treatment of diabetic nephropathy, wherein said compound is a peptide consisting of the amino acid sequence of SEQ ID NO:1

(SGRKSSKMQA); or a variant of SEQ ID NO:1 comprising one, two or three conservative amino acid substitutions.

- 5 29. The method or compound for use according to any of the preceding items,
 wherein said peptide binds to IL-1 receptor type 1 (ILR1), and/or interferes with
 the binding of IL-1 beta to IL1R1.
- 10 30. The method or compound for use according to any of the preceding items,
 wherein said variant comprises one or two amino acid substitutions.
31. The method or compound for use according to any of the preceding items,
 wherein said variant comprises one amino acid substitution.
- 15 32. The method or compound for use according to any of the preceding items,
 wherein said one or more amino acid substitutions is/are a conservative amino
 acid substitution.
- 20 33. The method or compound for use according to any of the preceding items,
 wherein the C-terminal amino acid of said peptide exists as the free carboxylic
 acid ("OH").
- 25 34. The method or compound for use according to any of the preceding items,
 wherein the C-terminal amino acid of said peptide is an amidated derivative ("NH₂").
35. The method or compound for use according to any of the preceding items,
 wherein the N-terminal amino acid of said peptide comprises a free amino-
 group ("H").
- 30 36. The method or compound for use according to any of the preceding items,
 wherein the N-terminal amino acid of said peptide is the acetylated derivative ("Acetyl" or "COCH₃").

37. The method or compound for use according to any of the preceding items, wherein said compound is a monomer, such as a monomer comprising one peptide.
- 5 38. The method or compound for use according to any of the preceding items, wherein said compound is a multimer, such as a multimer comprising two or more peptides.
- 10 39. The method or compound for use according to any of the preceding items, wherein said compound is a dimer, trimer or tetramer.
- 15 40. The method or compound for use according to any of the preceding items, wherein said compound is a dimer comprising two peptides, each peptide consisting of SEQ ID NO:1, or a variant thereof comprising one, two or three amino acid substitutions.
- 20 41. The method or compound for use according to any of the preceding items, wherein said compound is a tetramer comprising four peptides, each peptide consisting of SEQ ID NO:1, or a variant thereof comprising one, two or three amino acid substitutions
42. The method or compound for use according to any of the preceding items, wherein said compound is a dendrimer.
- 25 43. The method or compound for use according to any of the preceding items, wherein said dendrimer is a dimeric dendrimer or tetrameric dendrimer.
- 30 44. The method or compound for use according to any of the preceding items, wherein said compound is a dimeric dendrimer comprising two peptides, each peptide consisting of SEQ ID NO:1, or a variant thereof comprising one, two or three amino acid substitutions.
45. The method or compound for use according to any of the preceding items, wherein said compound is a tetrameric dendrimer comprising four peptides,

each peptide consisting of SEQ ID NO:1, or a variant thereof comprising one, two or three amino acid substitutions

5 46. The method or compound for use according to any of the preceding items, wherein said two or more peptides are linked via a peptide bond.

10 47. The method or compound for use according to any of the preceding items, wherein said two or more peptides are linked via a linker group, such as one or more linker groups.

48. The method or compound for use according to any of the preceding items, wherein said linker group is a lysine backbone comprising one or more lysine residues, such as a plurality of lysine residues.

15 49. The method or compound for use according to any of the preceding items, wherein said peptide is a tetrameric dendrimer consisting of four peptides, each peptide consisting of SEQ ID NO:1, and a lysine backbone.

20 50. The method or compound for use according to any of the preceding items, wherein said linker group is a polymer carrier, such as a protein carrier.

25 51. A method for treatment of diabetic nephropathy, said method comprising administering an effective amount of a multimeric compound to an individual in need thereof, wherein said multimeric compound comprises at least two peptides, each peptide consisting of the amino acid sequence SGRKSSKMQA (SEQ ID NO:1), or a variant of SEQ ID NO:1 comprising one, two or three amino acid substitutions.

30 52. A multimeric compound for use in the treatment of diabetic nephropathy, wherein said multimeric compound comprises at least two peptides, each peptide consisting of the amino acid sequence SGRKSSKMQA (SEQ ID NO:1), or a variant of SEQ ID NO:1 comprising one, two or three amino acid substitutions.

53. The method or multimeric compound for use according to any of the preceding items, wherein said multimeric compound is a dimer, trimer or tetramer.
54. The method or multimeric compound for use according to any of the preceding items, wherein said multimeric compound is a tetramer.
55. The method or multimeric compound for use according to any of the preceding items, wherein said at least two peptides are identical.
56. A method for treatment of diabetic nephropathy, said method comprising administering an effective amount of a multimeric compound to an individual in need thereof, wherein said multimeric compound comprises four peptides, each peptide consisting of the amino acid sequence SGRKSSKMQA (SEQ ID NO:1), or a variant of SEQ ID NO:1 comprising one, two or three amino acid substitutions.
57. A multimeric compound for use in the treatment of diabetic nephropathy, wherein said multimeric compound comprises four peptides, each peptide consisting of the amino acid sequence SGRKSSKMQA (SEQ ID NO:1), or a variant of SEQ ID NO:1 comprising one, two or three amino acid substitutions.
58. The method or compound for use according to any of the preceding items, wherein said four peptides are linked via a peptide bond.
59. The method or compound for use according to any of the preceding items, wherein said four peptides are linked via a linker group.
60. The method or compound for use according to any of the preceding items, wherein said linker group is a lysine backbone comprising one or more lysine residues, such as a plurality of lysine residues.
61. The method or multimeric compound for use according to any of the preceding items, wherein said at least two peptide, or said four peptides, are defined in any one of the preceding items.

62. The method or compound for use according to any of the preceding items, wherein said compound is formulated as a pharmaceutical composition.
- 5 63. The method or compound for use according to any of the preceding items, wherein said peptide or said compound decreases the urine albumin to creatinine ratio (ACR).
- 10 64. The method or compound for use according to any of the preceding items, wherein said peptide or said compound decreases the urine albumin to creatinine ratio (ACR) in a dose dependent manner.
- 15 65. The method or compound for use according to any of the preceding items, wherein said peptide or said compound decreases the urine level of the biomarker Kidney Injury Molecule-1 (KIM-1).
66. The method or compound for use according to any of the preceding items, wherein said peptide or said compound decreases the urine KIM-1 to creatinine ratio (KIM-1/CR).
- 20 67. The method or compound for use according to any of the preceding items, wherein the urine level of KIM-1 or the urine KIM-1 to creatinine ratio (KIM-1/CR) is decreased in a dose dependent manner.
- 25 68. The method or compound for use according to any of the preceding items, wherein the level of KIM-1 is measured in a urine sample, such as a urine sample from said individual.
- 30 69. The method or compound for use according to any of the preceding items, wherein said individual has diabetes mellitus, has ACR levels above 30, and/or has increased blood pressure.
70. The method or compound for use according to any of the preceding items, wherein said individual has normal blood pressure.

71. The method or compound for use according to any of the preceding items,
wherein said individual has type I diabetes mellitus or type II diabetes mellitus.
- 5 72. The method or compound for use according to any of the preceding items,
wherein said individual is treated with antidiabetics.
73. The method or compound for use according to any of the preceding items,
wherein said individual is treated with antihypertensives.
- 10 74. The method or compound for use according to any of the preceding items,
wherein said compound is administered in combination with an effective amount
of an antidiabetic compound and/or an antihypertensive compound.
- 15 75. The method or compound for use according to any of the preceding items,
wherein said antihypertensive compound is an ACE inhibitor or angiotensin
receptor antagonist
- 20 76. The method according to any of the preceding items, further comprising a step
of administering an effective amount of an antidiabetic compound and/or an
antihypertensive compound to said individual.
- 25 77. The method or compound for use according to any of the preceding items,
wherein said antidiabetic compound and/or said antihypertensive compound is
administered simultaneously, before or after administering the compound
according to any of the preceding items.

Examples

Example 1: Effect of IL1RA derived peptide on markers of diabetic nephropathy

5 **Materials and methods**

Animals

56 female mice (BKS.Cg-Dock7m +/- Leprad^b/db BLKS, 5 weeks of age) were transferred to the Gubra Research animal unit. The animals were group housed until uni-nephrectomies, then single housed. Throughout the habituation and study period
10 the animals were in a light-, temperature- and humidity-controlled room with free access to food and water. All animal experiments were conducted in accordance with Gubra bioethical guidelines, which are fully compliant to internationally accepted principles for the care and use of laboratory animals.

15 Animals were terminated on day 77; blood was taken for later analysis, body weight was recorded, and spot urine was collected.

Compounds

SER140 was provided by Phlogo ApS, Copenhagen, Denmark (10mg/ml miliQ water
20 diluted to the different dose formulations). SER140 is a dendrimer composed of four monomeric peptides each with the sequence SGRKSSKMQA (SEQ ID NO:1), and coupled to a lysine backbone. Vehicle was miliQ:PBS 1:5.

In vivo procedures

25 After one week of acclimatization the mice received an IV injection of Renin adenosin-associated virus (AAV). One week later all mice were uni-nephrectomized. Two weeks after the Renin AAV iv injection the mice were randomized according to blood glucose to four groups: a vehicle group (n=14), a 3 mg/kg SER140 group, a 10 mg/kg SER140 and a 20 mg/kg SER140 group. The compound as well as the vehicle was
30 administered subcutaneously once daily.

Biochemical analysis

All blood samples were taken from the mice tail in heparinized tubes, plasma was separated and stored at minus 80 C until analysis. Non-fasting BG (blood glucose) was
35 measured using BIOSEN c-line glucose meter (EKF-diagnostics, Germany), blood for

HbA1c analysis was immediately suspended in Hemolyzing Reagent and stored until analysis using autoanalyzer Cobas C-111 with commercial kit (Roche Diagnostics, Germany), plasma urea using commercial kits (Roche Diagnostics).

5 Urine samples were stored at minus 80 C until analysis. Urine for measurement of albumin and creatinine were centrifuged at 2000 g for 2 min prior to analysis Urine albumin was measure using a commercial ELISA kit (Bethyl Laboratories, Inc.), according to the manufacturer's instructions, and urine creatinine was measured using a commercial kit (Roche Diagnostics) on the Cobas c 501 autoanalyzer, according to
10 the manufacturer's instructions. Urinary KIM-1 was measured using a commercial ELISA kit (R&D Systems), according to the manufacturer's instructions.

Results

The tested compound SER140 decreased ACR mg/g (Figure 1) and KIM-1/CR pg/g
15 (Figure 2) significantly in a dose dependent manner.

There were no changes in HbA1c% between vehicle and SER140 treatment, indicating that the effect of SER140 on ACR and KIM-1 are not mediated via an effect on HbA1c.

20 Discussion

ReninAAV UNx db/db mice is described as one of the best pharmacological models to describe development of diabetic kidney disease (DKD, diabetic nephropathy) and to elucidate compounds influence on the progression of the disease (Nguyen 2019, Sembach 2020). Recent studies indicate that immune system activation and imbalance
25 of immune homeostasis play an important role in the development and progression of diabetic nephropathy.

It is well known that IL-1 cytokine consists of three different forms, the IL-1 α , IL-1 β , both IL-1 receptor agonists and IL-1Ra, a natural IL-1 receptor antagonist. All are ligands to
30 the same IL-1R1 receptor. Both IL-1 α and IL-1 β are pro-inflammatory cytokines and are activating downstream while IL-1Ra binds to the IL-1R1 receptor without activating and thus act as a receptor antagonist and modulates a variety of IL-1 related immune and inflammatory responses (Arend 2000, Dinarello 2012, Park 2015).

Urine albumin and KIM-1 are both biomarkers of kidney innate inflammation as seen in various autoimmune diseases which involve the kidneys. Human renal biopsies have confirmed the presence of inflammatory cells in both glomeruli, the tubuli and the interstitium at all stages of diabetic nephropathy (Kahn 2019, Calle 2021).

5

SER140 is a peptide derived from the human IL-1RA N-terminal domain, which is involved in interactions with IL-1R1. SER140 has been shown to inhibit receptor binding of IL-1 β and therefore reduce the downstream activation of among other the macrophages liberation of TNF α (Klementiev 2014).

10

SER140 is shown herein to significantly reduced both urinary albumin, a biomarker of cellular damage of mainly glomerular endothelial and podocyte, and KIM-1, a biomarker of damage of the apical membrane of the proximal renal tubule. These biomarkers are undetectable in urine from patients with normal kidney but detectable is response to ischemic or toxic insults, including diabetes (Alderson 2016, Treacy 2019).

15

Sequence overview

SEQ ID NO:1

20

SGRKSSKMQA

SEQ ID NO:2 (IL1RA isoform 1)

MEICRGLRSHLITLLLFLFHSETICRPSGRKSSKMQAFRIWDVNQKTFYLRNNQLVAG
YLQGPNVNLEEKIDVVPIEPHALFLGIHGGKMCLSCVKSGDETRLQLEAVNITDLSNR
KQDKRFAFIRSDSGPTTSFESAACPGWFLCTAMEADQPVSLTNMPDEGVMVTKFYF
QEDE

25

SEQ ID NO:3 (IL1RA isoform 2)

MALETICRPSGRKSSKMQAFRIWDVNQKTFYLRNNQLVAGYLQGPNVNLEEKIDVVPI
EPHALFLGIHGGKMCLSCVKSGDETRLQLEAVNITDLSNRKQDKRFAFIRSDSGPTT
SFESAACPGWFLCTAMEADQPVSLTNMPDEGVMVTKFYFQEDE

30

SEQ ID NO:4 (IL1RA isoform 3)

MALADLYEEGGGGGGEGEDNADSKETICRPSGRKSSKMQAFRIWDVNQKTFYLRNN
QLVAGYLQGPNVNLEEKIDVVPIEPHALFLGIHGGKMCLSCVKSGDETRLQLEAVNITD

35

LSEN RKQDKRFAFIRSDSGPTTSFESAACPGWFLCTAMEADQPVSLTNMPDEGVMV
TKFYFQEDE

SEQ ID NO:5 (IL1RA isoform 4)

5 MQAFRIWDVNQKTFYLRNNQLVAGYLQGPNVNLEEKIDVVPIEPHALFLGIHGGKMCL
SCVKSGDETRLQLEAVNITD LSEN RKQDKRFAFIRSDSGPTTSFESAACPGWFLCTA
MEADQPVSLTNMPDEGVMVTKFYFQEDE

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Claims

1. A compound for use in the treatment of diabetic nephropathy, wherein said compound is a peptide derived from an IL-1R antagonist (IL1RA) protein
5 selected from SEQ ID NOs: 2-5, or a variant thereof being at least 70% identical to said peptide derived from IL1RA.
2. The compound for use according to claim 1, wherein said compound is a peptide consisting of 5 to 35 contiguous amino acid residues derived from an
10 IL1RA protein selected from SEQ ID NOs: 2-5, or a variant thereof being at least 70% identical to said peptide derived from an IL1RA protein selected from SEQ ID NOs:2-5.
3. The compound for use according to any of the preceding claims, wherein said peptide comprises at least the amino acid sequence SGRKSSKMQA (SEQ ID
15 NO:1), or a variant of SEQ ID NO:1 comprising one, two or three amino acid substitutions.
4. The compound for use according to any of the preceding claims, wherein said peptide consist of the amino acid sequence SGRKSSKMQA (SEQ ID NO:1), or
20 a variant of SEQ ID NO:1 comprising one, two or three amino acid substitutions, and optionally additional amino acid residues up to a total length of 11 to 20 consecutive amino acid residues, such as 11, 12, 13, 14, 15, 16, 17, 18, 19 or 20 consecutive amino acid residues.
25
5. The compound for use according to any of the preceding claims, wherein said peptide consist of the amino acid sequence SGRKSSKMQA (SEQ ID NO:1), or
a variant of SEQ ID NO:1 comprising one, two or three amino acid substitutions.
6. The compound for use according to any of the preceding claims, wherein said
30 compound comprises one or more peptides, each peptide consisting of the amino acid sequence SGRKSSKMQA (SEQ ID NO:1), or a variant of SEQ ID NO:1 comprising one, two or three amino acid substitutions.

7. The compound for use according to any of the preceding claims, wherein said variant of SEQ ID NO:1 comprises one or two amino acid substitutions.
- 5 8. The compound for use according to any of the preceding claims, wherein said variant of SEQ ID NO:1 comprises one amino acid substitution.
9. The compound for use according to any of the preceding claims, wherein said variant of SEQ ID NO:1 comprises one or more conservative amino acid substitutions.
- 10 10. The compound for use according to any of the preceding claims, wherein said peptide binds to IL-1 receptor type 1 (ILR1), and/or interferes with the binding of IL-1 beta to IL1R1.
- 15 11. The compound for use according to any of the preceding claims, wherein said compound comprises one or more peptides, each peptide consisting of the amino acid sequence SGRKSSKMQA (SEQ ID NO:1).
- 20 12. The compound for use according to any of the preceding claims, wherein said compound is a monomer comprising one peptide according to any one of the preceding claims.
- 25 13. The compound for use according to any of the preceding claims, wherein said compound is a multimer comprising at least two peptides according to any one of the preceding claims.
- 30 14. The compound for use according to any of the preceding claims, wherein said compound is a multimeric dendrimer comprising at least two peptides according to any one of the preceding claims.
- 35 15. The compound for use according to any of the preceding claims, wherein said compound is a tetrameric dendrimer comprising four peptides, each peptide consisting of SEQ ID NO:1, or a variant of SEQ ID NO:1 comprising one, two or three amino acid substitutions.

- 5
16. The compound for use according to any of the preceding claims, wherein said compound is a tetrameric dendrimer comprising four peptides, each peptide consisting of SEQ ID NO:1, or a variant of SEQ ID NO:1 comprising one, two or three amino acid substitutions, and further comprising a lysine backbone.
- 10
17. The compound for use according to any of claims 15-16, wherein said compound is a tetrameric dendrimer comprising four peptides, each peptide consisting of SEQ ID NO:1, or a variant of SEQ ID NO:1 comprising one or two amino acid substitutions.
- 15
18. The compound for use according to any of claims 15-16, wherein said compound is a tetrameric dendrimer comprising four peptides, each peptide consisting of SEQ ID NO:1, or a variant of SEQ ID NO:1 comprising one amino acid substitution.
- 20
19. The compound for use according to any of claims 15-16, wherein said compound is a tetrameric dendrimer comprising four peptides, each peptide consisting of SEQ ID NO:1.
- 25
20. The compound for use according to any of the preceding claims, wherein said compound decreases the urine albumin to creatinine ratio (ACR), and/or decreases the urine level of the biomarker Kidney Injury Molecule-1 (KIM-1), and/or decreases the urine KIM-1 to creatinine ratio (KIM-1/CR).
- 30
21. The compound for use according to any of the preceding claims, wherein said compound is to be administered in combination with an effective amount of an antidiabetic compound and/or an antihypertensive compound.

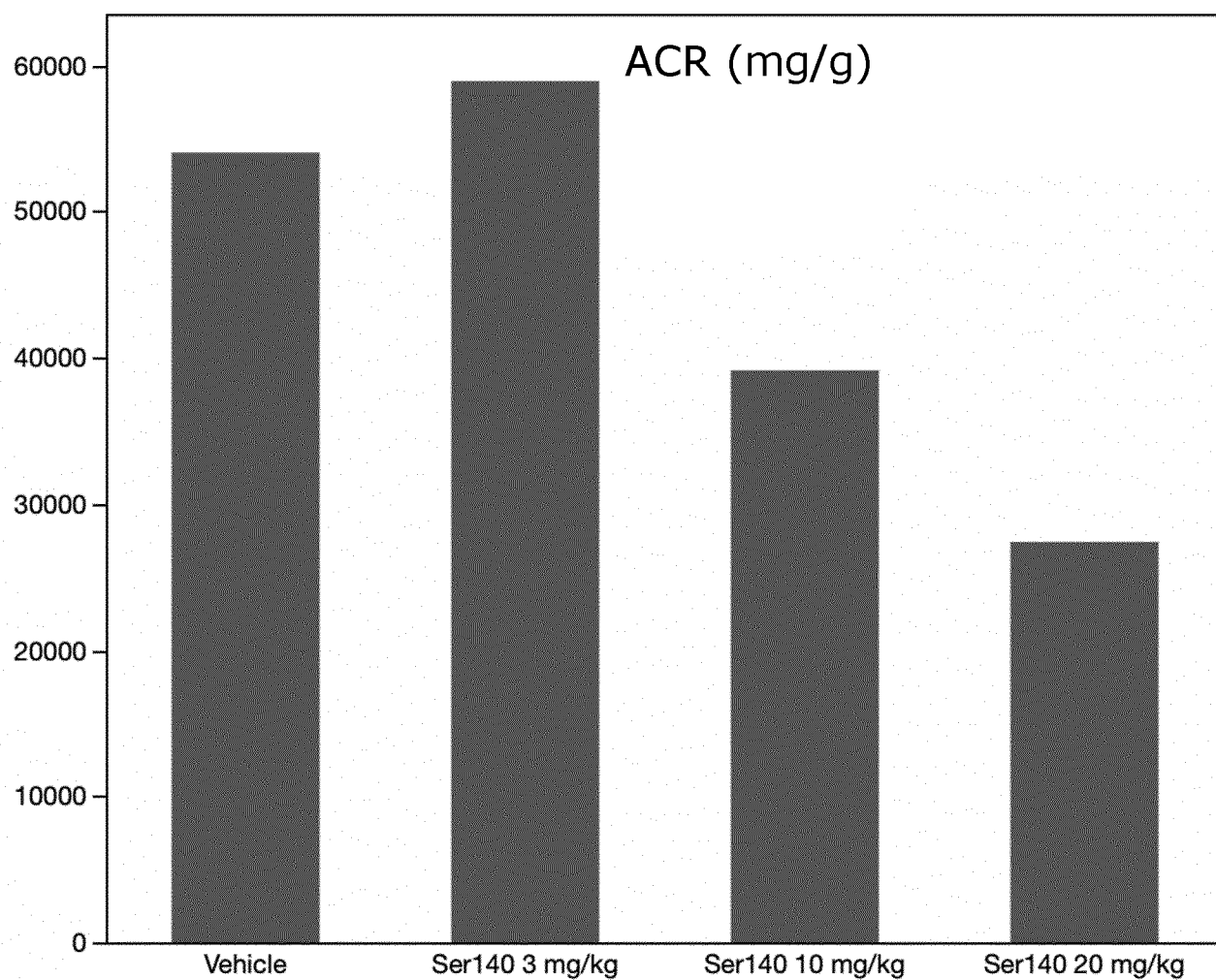


Fig. 1

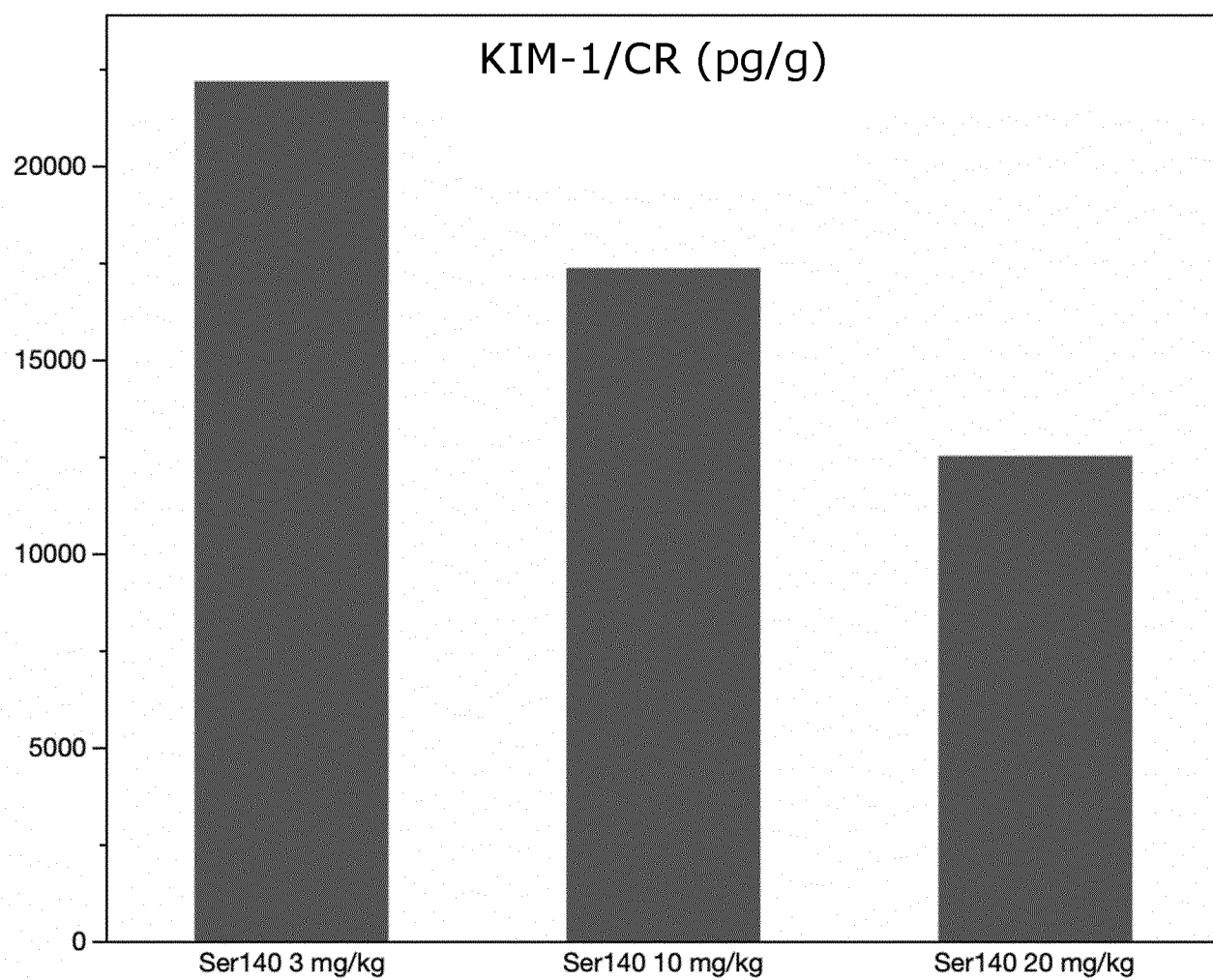


Fig. 2

INTERNATIONAL SEARCH REPORT

International application No.

PCT/EP2021/069450

Box No. I Nucleotide and/or amino acid sequence(s) (Continuation of item 1.c of the first sheet)

1. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international search was carried out on the basis of a sequence listing:
 - a. ☒ forming part of the international application as filed:
 - ☒ in the form of an Annex C/ST.25 text file.
 - ☐ on paper or in the form of an image file.
 - b. ☐ furnished together with the international application under PCT Rule 13ter.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.
 - c. ☐ furnished subsequent to the international filing date for the purposes of international search only:
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 - ☐ on paper or in the form of an image file (Rule 13ter.1(b) and Administrative Instructions, Section 713).
2. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
3. Additional comments:

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A. CLASSIFICATION OF SUBJECT MATTER

INV. A61K38/08 A61P13/12 A61P3/10 A61K38/20
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

A61K A61P

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, BIOSIS, COMPENDEX, EMBASE, FSTA, INSPEC, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	SHAHZAD KHURRUM ET AL: "Nlrp3-inflammasome activation in non-myeloid-derived cells aggravates diabetic nephropathy", KIDNEY INTERNATIONAL, vol. 87, no. 1, 1 January 2015 (2015-01-01), pages 74-84, XP055881761, GB ISSN: 0085-2538, DOI: 10.1038/ki.2014.271	1, 3, 10, 12, 20, 21
Y	the whole document figure 5	1-21
X	US 2018/030412 A1 (WALSH KENNETH [US] ET AL) 1 February 2018 (2018-02-01)	1, 3, 10, 12, 20, 21
Y	paragraph [0117]; claims 1-30	1-21
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Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

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Date of the actual completion of the international search

1 March 2022

Date of mailing of the international search report

11/03/2022

Name and mailing address of the ISA/

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Authorized officer

Fayos, Cécile

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2021/069450

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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International application No
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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