

Claims

1. A peptide consisting of an amino acid sequence selected from the group consisting of SEQ ID NOs: 3, 7, 11; or a pharmaceutically acceptable salt thereof.
2. The peptide or the salt thereof according to claim 1, wherein said peptide has the ability to bind to an MHC class-I, and wherein said peptide, when bound to said MHC, is capable of being recognized by CD8 T cells.
3. The peptide or the salt of the peptide according to claim 1 or 2, wherein said peptide includes non-peptide bonds.
4. A fusion protein, comprising the peptide of according to any of claims 1 to 3, in particular comprising the N-terminal amino acids of the HLA-DR antigen-associated invariant chain (Ii).
5. A binding molecule that specifically recognizes the peptide according to any one of claims 1 to 3, or the peptide according to any one of claims 1 to 3 when bound to an MHC molecule.
6. The binding molecule of claim 5, being
 - (i) an antibody, soluble or membrane-bound, or a fragment thereof, or
 - (ii) a T-cell receptor (TCR), or a fragment thereof, that is reactive with an HLA ligand, the HLA ligand being the peptide according to any one of claims 1 to 3, or the peptide according to any one of claims 1 to 3 when bound to an MHC molecule.
7. The binding molecule of claim 6, wherein (i) the antibody is a monoclonal antibody, a chimeric antibody and/or a humanized antibody, or a fragment thereof, (ii) the antibody binds to said peptide when bound to an MHC molecule and is a bi-specific antibody or a fragment thereof and/or (iii) wherein the T-cell receptor is soluble or membrane-bound.
8. The binding molecule of claim 6 or 7, wherein said soluble T-cell receptor or said antibody carries a further effector function such as an immune stimulating domain or toxin.
9. A nucleic acid, encoding the peptide of any one of claims 1 to 2, or the binding molecule according to any one of claims 6 to 8, optionally linked to a heterologous promoter sequence, or an expression vector expressing said nucleic acid.

10. A recombinant host cell comprising the peptide according to any one of claims 1 to 3, the binding molecule according to any one of claims 6 to 8, the nucleic acid or the expression vector according to claim 9,
wherein said host cell is (i) an antigen presenting cell, such as a dendritic cell, (ii) a T cell or (iii) an NK cell.
11. An *in vitro* method for producing activated T lymphocytes, the method comprising contacting *in vitro* T cells with antigen loaded human class I MHC molecules expressed on the surface of a suitable antigen-presenting cell or an artificial construct mimicking an antigen-presenting cell for a period of time sufficient to activate said T cells in an antigen specific manner, wherein said antigen is the peptide according to any one of claims 1 to 2.
12. An activated T lymphocyte, produced by the method of claim 11, that selectively recognizes a cell which presents a polypeptide comprising an amino acid sequence given in any one of claims 1 to 2.
13. A pharmaceutical composition comprising at least one active ingredient selected from the peptide or salt thereof according to any one of claims 1 to 3, the fusion protein according to claim 4, the binding molecule according to any one of claims 5 to 8, the nucleic acid or the expression vector according to claim 9, the recombinant host cell according to claim 10, or the activated T lymphocyte according to claim 12, and a pharmaceutically acceptable carrier, and/or a pharmaceutically acceptable excipient.
14. The pharmaceutical composition according to claim 13, wherein (i) the pharmaceutical composition further comprises an adjuvant, and/or (ii) wherein the pharmaceutical composition is a vaccine or a cellular therapy.
15. The pharmaceutical composition according to claim 13, wherein the adjuvant is an interleukin, including IL-2, IL-15 or a combination thereof.
16. A method for producing the peptide according to any one of claims 1 to 2 or the binding molecule according to any one of claims 6 to 8, the method comprising culturing the recombinant host cell according to claim 10, and isolating the peptide or the binding molecule from said host cell and/or its culture medium.
17. The peptide or salt thereof according to any one of claims 1 to 3, the fusion protein according to claim 4, the binding molecule according to any one of claims 5 to 8, the nucleic acid or

the expression vector according to claim 9, the recombinant host cell according to claim 10, the activated T lymphocyte according to claim 12 or the pharmaceutical composition according to any one of claims 13 to 15 for use

in the treatment and/or diagnosis of cancer or the manufacture of a medicament for treating cancer, wherein said cancer shows an overpresentation of a peptide having a sequence of any one of SEQ ID NOs: 3, 7, 11.

18. An effective number of activated T cells as defined in claim 12 for use in killing target cancer cells in a patient, which target cancer cells present the peptide according to any one of claims 1 to 3.

19. The peptide or salt thereof, fusion protein, binding molecule, nucleic acid, expression vector, recombinant host cell, activated T lymphocyte or pharmaceutical composition for use of claim 17, wherein said cancer is selected from the group of acute myeloid leukemia, breast cancer, cholangiocellular carcinoma, chronic lymphocytic leukemia, colorectal cancer, gallbladder cancer, glioblastoma, gastric cancer, hepatocellular carcinoma, head and neck squamous cell carcinoma, melanoma, non-Hodgkin lymphoma, lung cancer (including non-small cell lung cancer adenocarcinoma, squamous cell non-small cell lung cancer, and small cell lung cancer), ovarian cancer, esophageal cancer, pancreatic cancer, prostate cancer, renal cell carcinoma, urinary bladder carcinoma, uterine and endometrial cancer.

20. A kit comprising:

(a) a container comprising a pharmaceutical composition containing the peptide or salt thereof according to any one of claims 1 to 3, the fusion protein according to claim 4, the binding molecule according to any one of claims 5 to 8, the nucleic acid or the expression vector according to claim 9, the recombinant host cell according to claim 10, or the activated T lymphocyte according to claim 12, in solution or in lyophilized form;

(b) optionally, a second container containing a diluent or reconstituting solution for the lyophilized formulation;

(c) optionally, at least one further peptide selected from the group consisting of SEQ ID NO: 1 to SEQ ID NO: 518.

21. The kit according to claim 20, further comprising one or more of (i) a buffer, (ii) a diluent, (iii) a filter, (iv) a needle, (vii) a syringe, or (viii) an adjuvant.

22. A method for producing a personalized anti-cancer vaccine or a compound-based and/or cellular therapy for an individual patient, said method comprising:

a) identifying a tumor-associated peptide (TUMAP) presented by a tumor sample of said individual patient;

b) comparing the peptide as identified in a) with a warehouse of peptides that have been pre-screened for immunogenicity and/or over-presentation in tumors as compared to normal tissues;

c) selecting at least one peptide from the warehouse that matches the TUMAP identified in the sample of the patient; and

d) manufacturing and/or formulating the personalized vaccine or compound-based or cellular therapy based on step c);

wherein said warehouse comprises a peptide that has a sequence according to any one of SEQ ID NOs: 3, 7, 11.

23. The method according to claim 22, wherein said TUMAP is identified by:

a1) comparing expression data from the tumor sample to expression data from a sample of normal tissue corresponding to the tissue type of the tumor sample to identify proteins that are over-expressed or aberrantly expressed in the tumor sample; and

a2) correlating the expression data with sequences of MHC ligands bound to MHC class I molecules in the tumor sample to identify MHC ligands derived from proteins over-expressed or aberrantly expressed by the tumor.

24. The method according to claim 22 or 23, wherein the sequences of MHC ligands are identified by eluting bound peptides from MHC molecules isolated from the tumor sample and sequencing the eluted ligands.

25. The method according to any of claims 22 to 24, wherein the normal tissue corresponding to the tissue type of the tumor sample has been obtained from the same patient.

26. The method according to any of claims 22 to 25, wherein the immunogenicity of the peptides included in the warehouse is determined by a method comprising *in vitro* immunogenicity assays, MHC multimer staining, ELISPOT assays and/or intracellular cytokine staining.

27. The method according to any of claims 22 to 26, further comprising identifying at least one mutation that is unique to the tumor sample relative to normal corresponding tissue from the

individual patient, and selecting a peptide that correlates with the mutation for inclusion in the vaccine or for the generation of cellular therapies, wherein said at least one mutation is optionally identified by whole genome sequencing.