fragments of the antigens comprising the T cell epitopes, are useful for inducing specific immune responses against tumor cells expressing these antigens and for treating or preventing cancer.

In one aspect, the present disclosure provides a pharmaceutical composition or pharmaceutical kit comprising a polypeptide that comprises a fragment of no more than 50 consecutive amino acids of a gastric cancer-associated antigen selected from DPPA2, CAGE-1, TSP50, HIWI, SURVIVIN, 5T4, PRAME, KK-LC-1, MAGE-A2, MAGE-A3, LAGE-1, MAGE-A10, MAGE-A1 and SSX1, wherein the fragment comprises an amino acid sequence selected from any one of SEQ ID NOs: 1 to 30, optionally wherein the fragment is flanked at the N and/or C terminus by additional amino acids that are not part of the sequence of the gastric cancer-associated antigen.

In another aspect, the present disclosure provides a pharmaceutical composition or pharmaceutical kit comprising a nucleic acid that encodes a polypeptide, wherein the polypeptide comprises a fragment of no more than 50 consecutive amino acids of a gastric cancer-associated antigen selected from DPPA2, CAGE-1, TSP50, HIWI, SURVIVIN, 5T4, PRAME, KK-LC-1, MAGE-A2, MAGE-A3, LAGE-1, MAGE-A10, MAGE-A1 and SSX1, wherein the fragment comprises an amino acid sequence selected from any one of SEQ ID NOs: 1 to 30, optionally wherein the fragment is flanked at the N and/or C terminus by additional amino acids that are not part of the sequence of the gastric cancer-associated antigen.

In another aspect, the present disclosure provides a pharmaceutical composition or pharmaceutical kit comprising a panel of two or more polypeptides, or comprising nucleic acid that encodes a panel of two or more polypeptides, as described herein, wherein each polypeptide comprises a different amino acid sequence selected from SEQ ID NOs: 1 to 30.

In yet another aspect, the present disclosure provides a pharmaceutical composition or pharmaceutical kit as described herein, for use in therapy for vaccination, providing immunotherapy or inducing a cytotoxic T cell response in a subject, wherein the pharmaceutical composition is to be administered to the subject, optionally wherein the therapy is prophylactic and/or for treating or preventing cancer, optionally gastric cancer.

In yet another aspect, the present disclosure provides use of the pharmaceutical composition as described herein in the manufacture of a medicament for treating or preventing cancer, optionally gastric cancer.

In yet another aspect, the present disclosure provides a method of identifying a human subject who is predicted to have a cytotoxic T cell response to administration of the pharmaceutical composition, or the polypeptides or polypeptides encoded by the nucleic acid of a pharmaceutical composition or kit as described herein, the method comprising (i) determining that the active ingredient polypeptide(s) of the pharmaceutical composition or kit comprise a sequence that is a T cell epitope capable of binding to at least three HLA class I molecules of the subject; and (ii) identifying the subject as predicted to have a cytotoxic T cell response.

In yet another aspect, the present disclosure provides a method of identifying a subject who is predicted to have a clinical response to the administration of a pharmaceutical composition, or the polypeptides or nucleic acids of a pharmaceutical kit as described herein, the method

comprising (i) determining that the active ingredient polypeptide(s) of the pharmaceutical composition or kit comprise two or more different amino acid sequences each of which is a. a T cell epitope capable of binding to at least three HLA class I molecules of the subject; and b. a fragment of a cancer-associated antigen expressed by cancer cells of the subject, optionally wherein the cancer-associated antigen is present in a sample obtained from the subject; and (ii) identifying the subject as predicted to have a clinical response to the use.

In yet another aspect, the present disclosure provides a method of determining the probability that a specific human subject will have a clinical response to the administration of a pharmaceutical composition, or the polypeptides or nucleic acids of a pharmaceutical kit as described herein, wherein one or more of the following factors corresponds to a higher probability of a clinical response: (a) presence in the active ingredient polypeptide(s) of a higher number of amino acid sequences and/or different amino acid sequences that are each a T cell epitope capable of binding to at least three HLA class I of the subject; (b) a higher number of target polypeptide antigens, comprising at least one amino acid sequence that is both A. comprised in an active ingredient polypeptide; and B. a T cell epitope capable of binding to at least three HLA class I of the subject; optionally wherein the target polypeptide antigens are expressed in the subject, further optionally wherein the target polypeptides antigens are in one or more samples obtained from the subject; (c) a higher probability that the subject expresses target polypeptide antigens, optionally a threshold number of the target polypeptide antigens and/or optionally target polypeptide antigens that have been determined to comprise at least one amino acid sequence that is both A. comprised in an active ingredient polypeptide; and B. a T cell epitope capable of binding to at least three HLA class I of the subject; and/or (d) a higher number of target polypeptide antigens that the subject is predicted to express, optionally a higher number of target polypeptide antigens that the subject expresses with a threshold probability, and/or optionally the target polypeptide antigens that have been determined to comprise at least one amino acid sequence that is both A. comprised in an active ingredient polypeptide; and B. a T cell epitope capable of binding to at least three HLA class I of the subject.

In a further aspect, the present disclosure refers to a use as described herein, wherein the medicament is manufactured for a specific subject, and the subject has been identified as predicted to have a clinical response or as having above a threshold minimum probability of having a clinical response to the treatment by a method as described herein. In a further aspect, the present disclosure refers to a method of identifying a human subject who is predicted not have a clinical response to the administration of a pharmaceutical composition, or the polypeptides or nucleic acids of a pharmaceutical kit as described herein, the method

CLAIMS

1. A pharmaceutical composition or pharmaceutical kit comprising a polypeptide that comprises a fragment of no more than 50 consecutive amino acids of a gastric cancer-associated antigen selected from DPPA2, CAGE-1, TSP50, HIWI, SURVIVIN, 5T4, PRAME, KK-LC-1, MAGE-A2, MAGE-A3, LAGE-1, MAGE-A10, MAGE-A1 and SSX1, wherein the fragment comprises an amino acid sequence selected from any one of SEQ ID NOs: 1 to 30, optionally wherein the fragment is flanked at the N and/or C terminus by additional amino acids that are not part of the sequence of the gastric cancer-associated antigen.

2. A pharmaceutical composition or pharmaceutical kit comprising a nucleic acid that encodes a polypeptide, wherein the polypeptide comprises a fragment of no more than 50 consecutive amino acids of a gastric cancer-associated antigen selected from DPPA2, CAGE-1, TSP50, HIWI, SURVIVIN, 5T4, PRAME, KK-LC-1, MAGE-A2, MAGE-A3, LAGE-1, MAGE-A10, MAGE-A1 and SSX1, wherein the fragment comprises an amino acid sequence selected from any one of SEQ ID NOs: 1 to 30, optionally wherein the fragment is flanked at the N and/or C terminus by additional amino acids that are not part of the sequence of the gastric cancer-associated antigen.

3. The pharmaceutical composition or pharmaceutical kit according to claim 1 or claim 2, wherein the polypeptide, or the polypeptide encoded by the nucleic acid,

a. is a fragment of a gastric cancer-associated antigen selected from DPPA2, CAGE-1, TSP50, HIWI, SURVIVIN, 5T4, PRAME, KK-LC-1, MAGE-A2, MAGE-A3, LAGE-1, MAGE-A10, MAGE-A1 and SSX1, wherein the fragment comprises an amino acid sequence selected from any one of SEQ ID NOs: 1 to 30; or
b. comprises or consists of two or more fragments of one or more gastric cancer associated antigens selected from DPPA2, CAGE-1, TSP50, HIWI, SURVIVIN, 5T4, PRAME, KK-LC-1, MAGE-A2, MAGE-A3, LAGE-1, MAGE-A10, MAGE-A1 and SSX1, wherein each fragment comprises a different amino acid sequence selected from any one of SEQ ID NOs: 1 to 30,

optionally wherein the fragments overlap or are arranged end to end in the polypeptide.

4. The pharmaceutical composition or pharmaceutical kit according to any one of claims 1 to 3, wherein the polypeptide, or the polypeptide encoded by the nucleic acid, comprises or consists of fragments of at least two different cancer-associated antigens, wherein the cancer-associated antigens are selected from DPPA2, CAGE-1, TSP50, HIWI, SURVIVIN, 5T4, PRAME, KK-LC-1, MAGE-A2, MAGE-A3, LAGE-1, MAGE-A10, MAGE-A1 and SSX1; and wherein each fragment comprises a different amino acid sequence selected from SEQ ID NOs: 1 to 30.

5. The pharmaceutical composition or pharmaceutical kit according to any one of claims 1 to 4, wherein the polypeptide, or the polypeptide encoded by the nucleic acid, comprises or consists of one or more amino acid sequences selected from SEQ ID NOs:31 to 60.

6. The pharmaceutical composition or kit according to any one of claims 1 to 5, wherein the polypeptide, or the polypeptide encoded by the nucleic acid, comprises or consists of the amino acid sequence of any one of SEQ ID NOs: 61 to 75.

7. A pharmaceutical composition or pharmaceutical kit comprising a panel of two or more polypeptides, or comprising nucleic acid that encodes a panel of two or more polypeptides, according to any one of claims 1 to 6, wherein each polypeptide comprises a different amino acid sequence selected from SEQ ID NOs: 1 to 30.

8. The pharmaceutical composition or pharmaceutical kit according to claim 7, wherein the panel of polypeptides, or the panel of polypeptides encoded by the nucleic acid, comprises fifteen peptides having the amino acid sequences of SEQ ID NOs: 61 to 75.

9. A pharmaceutical composition or pharmaceutical kit according to claims 1 to 8, for use in therapy for vaccination, providing immunotherapy or inducing a cytotoxic T cell response in a subject, wherein the pharmaceutical composition is to be administered to the

subject, optionally wherein the therapy is prophylactic and/or for treating or preventing cancer, optionally gastric cancer.

10. Use of the pharmaceutical composition of claim 9 in the manufacture of a medicament for treating or preventing cancer, optionally gastric cancer.

11. A method of identifying a human subject who is predicted to have a cytotoxic T cell response to administration of the pharmaceutical composition, or the polypeptides or polypeptides encoded by the nucleic acid of a pharmaceutical composition or kit, according to any one of claims 1 to 8, the method comprising

(i) determining that the active ingredient polypeptide(s) of the pharmaceutical composition or kit comprise a sequence that is a T cell epitope capable of binding to at least three HLA class I molecules of the subject; and

(ii) identifying the subject as predicted to have a cytotoxic T cell response.

12. The method of claim 11 further comprising using population expression data for each antigen that

(a) is selected from DPPA2, CAGE-1, TSP50, HIWI, SURVIVIN, 5T4, PRAME, KK-LC-1, MAGE-A2, MAGE-A3, LAGE-1, MAGE-A10, MAGE-A1 and SSX1; and

(b) comprises an amino acid sequence that is

i. a fragment of an active ingredient peptide of the pharmaceutical composition or kit; and

ii. a T cell epitope capable of binding to at least three HLA class I molecules of the subject;

to determine the probability that the subject will have a CD8+ T cell response that targets one or more polypeptide antigens that are expressed by cancer cells of the subject.

13. A method of identifying a subject who is predicted to have a clinical response to administration of a pharmaceutical composition, or the polypeptides or nucleic acids of a pharmaceutical kit, according to any one of claims 1 to 8, the method comprising

(i) determining that the active ingredient polypeptide(s) of the pharmaceutical composition or kit comprise two or more different amino acid sequences each of which is

a. a T cell epitope capable of binding to at least three HLA class I molecules of the subject; and
b. a fragment of a cancer-associated antigen expressed by cancer cells of the subject, optionally wherein the cancer-associated antigen is present in a sample obtained from the subject; and

(ii) identifying the subject as predicted to have a clinical response to the use.

14. A method of determining the probability that a specific human subject will have a clinical response to administration of a pharmaceutical composition, or the polypeptides or nucleic acids of a pharmaceutical kit, according to any one of claims 1 to 8, wherein one or more of the following factors corresponds to a higher probability of a clinical response:

(a) presence in the active ingredient polypeptide(s) of a higher number of amino acid sequences and/or different amino acid sequences that are each a T cell epitope capable of binding to at least three HLA class I of the subject;

(b) a higher number of target polypeptide antigens, comprising at least one amino acid sequence that is both

A. comprised in an active ingredient polypeptide; and

B. a T cell epitope capable of binding to at least three HLA class I of the subject;

optionally wherein the target polypeptide antigens are expressed in the subject, further optionally wherein the target polypeptides antigens are in one or more samples obtained from the subject;

(c) a higher probability that the subject expresses target polypeptide antigens, optionally a threshold number of the target polypeptide antigens and/or optionally target polypeptide antigens that have been determined to comprise at least one amino acid sequence that is both

A. comprised in an active ingredient polypeptide; and

B. a T cell epitope capable of binding to at least three HLA class I of the subject;

and/or

(d) a higher number of target polypeptide antigens that the subject is predicted to express, optionally a higher number of target polypeptide antigens that the subject expresses with a threshold probability, and/or optionally the target polypeptide antigens that have been determined to comprise at least one amino acid sequence that is both

A. comprised in an active ingredient polypeptide; and

B. a T cell epitope capable of binding to at least three HLA class I of the subject.

15. The method of claim 14, wherein the method comprises

(i) identifying which polypeptide antigens targeted by the active ingredient polypeptide(s) comprise an amino acid sequence that is both

A. comprised in an active ingredient polypeptide; and

B. a T cell epitope capable of binding to at least three HLA class I of the subject;

(ii) using population expression data for each antigen identified in step (i) to determine the probability that the subject expresses one or more of the antigens identified in step (i) that together comprise at least two different amino acid sequences of step (i); and

(iii) determining the probability that the subject will have a clinical response to administration of the pharmaceutical composition, kit or panel of polypeptides, wherein a higher probability determined in step (ii) corresponds to a higher probability of clinical response.

16. The method of claim 15, wherein the at least two different amino acid sequences are comprised in the amino acid sequence of two different polypeptide antigens targeted by the active ingredient polypeptide(s).

17. The method of any one of claims 13 to 16 further comprising selecting or recommending administration of the pharmaceutical composition or the peptides, polynucleic acids or vectors of the kit for the subject.

18. The use according to claim 10, wherein the medicament is manufactured for a specific subject, and the subject has been identified as predicted to have a clinical response or as having above a threshold minimum probability of having a clinical response to the treatment by a method according to any one of claims 13 to 16.

19. The pharmaceutical composition for use of claim 9 or the use of claim 10 or claim 18 wherein the medicament is to be administered in combination with chemotherapy, targeted therapy or a checkpoint inhibitor.

20. A method of identifying a human subject who is predicted not have a clinical response to administration of a pharmaceutical composition, or the polypeptides or nucleic acids of a pharmaceutical kit, according to any one of claims 1 to 8, the method comprising

(i) determining that the active ingredient peptide(s) of the pharmaceutical composition do not comprise two or more different amino acid sequences each of which is a T cell epitope capable of binding to at least three HLA class I molecules of the subject; and

(ii) identifying the subject as predicted not to have a clinical response to the use.