THYMIC STROMAL LYMPHOPOIETIN RECEPTOR-SPECIFIC CHIMERIC ANTIGEN RECEPTORS AND METHODS USING SAME

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This patent application claims the benefit of U.S. Provisional Patent Application No. 61/912,948, filed December 6, 2013 and U.S. Provisional Patent Application No. 61/991,697, filed May 12, 2014, each of which is incorporated herein by reference in its entirety.

INCORPORATION-BY-REFERENCE OF MATERIAL SUBMITTED ELECTRONICALLY

[0002] Incorporated by reference in its entirety herein is a computer-readable nucleotide/amino acid sequence listing submitted concurrently herewith and identified as follows: One 58,011 Byte ASCII (Text) file named "718601ST25," created on September 11, 2014.

BACKGROUND OF THE INVENTION

[0003] Cancer is a public health concern. Despite advances in treatments such as chemotherapy, the prognosis for many cancers continues to be poor. Accordingly, there exists an unmet need for additional treatments for cancer.

BRIEF SUMMARY OF THE INVENTION

[0003a] In one aspect, there is provided a chimeric antigen receptor (CAR) comprising an antigen binding domain specific for TSLPR, a transmembrane domain, and an intracellular T cell signaling domain, wherein the antigen binding domain comprises the light chain variable region comprising the sequences of SEQ ID NOS: 18, 20, 22, 24, 25, 27, and 29 or SEQ ID NOS: 19, 21, 23, 24, 26, 28, and 29.

[0003b] In another aspect, there is provided a chimeric antigen receptor (CAR) comprising an antigen binding domain specific for TSLPR, a transmembrane domain, and an intracellular T cell signaling domain, wherein the antigen binding domain comprises the heavy chain

variable region comprising the sequences of SEQ ID NOS: 6, 7, 9, 10, 11, 13, and 15 or SEQ ID NOS: 6, 8, 9, 10, 12, 14, and 16.

[0004] The ~~invention~~ disclosure provides chimeric antigen receptors (CARs) comprising an antigen binding domain specific for thymic stromal lymphopoietin receptor (TSLPR), a transmembrane domain, and an intracellular T cell signaling domain. The CAR may further comprise a 4-1BB intracellular domain, a spacer, or both.

[0004a] In yet another aspect, there is provided a nucleic acid comprising a nucleotide sequence encoding the CAR as described herein.

[0004b] In yet another aspect, there is provided a recombinant expression vector comprising the nucleic acid as described herein.

[0004c] In yet another aspect, there is provided an isolated host cell comprising the recombinant expression vector as described herein.

[0004d] In yet another aspect, there is provided a population of cells comprising at least one host cell as described herein.

[0004e] In yet another aspect, there is provided an antibody, or antigen binding portion thereof, which specifically binds to a CAR as described herein.

[0004f] In yet another aspect, there is provided a pharmaceutical composition comprising the CAR as described herein, the nucleic acid as described herein, the recombinant expression vector as described herein, the host cell as described herein, the population of cells as described herein, or the antibody, or antigen binding portion thereof, as described herein, and a pharmaceutically acceptable carrier.

[0005] ~~Further embodiments of the invention provide related~~Also disclosed are nucleic acids, recombinant expression vectors, host cells, populations of cells, antibodies, or antigen binding portions thereof, and pharmaceutical compositions relating to the CARs of the invention.

[0005a] In yet another aspect, there is provided a method of detecting the presence of cancer, comprising: (a) contacting a sample comprising one or more cells with the CAR as described herein, the nucleic acid as described herein, the recombinant expression vector as described herein, the host cell as described herein, the population of cells as described herein, or the antibody, or antigen binding portion thereof, as described herein, or the pharmaceutical

composition as described herein, thereby forming a complex, and (b) detecting the complex, wherein detection of the complex is indicative of the presence of cancer.

[0005b] In yet another aspect, there is provided a method of determining whether a subject with a proliferative disorder is a candidate for treatment with a chimeric antigen receptor comprising an antigen binding domain specific for TSLPR, the method comprising: measuring TSLPR expression levels in a biological sample from the subject; and determining if the TSLPR expression levels of the biological sample are increased compared to a sample from a control subject without the proliferative disorder.

[0006] ~~Additional embodiments of the invention provide~~ Also disclosed are methods of detecting the presence of a proliferative disorder, e.g., cancer, and methods of treating or preventing a proliferative disorder, e.g., cancer, in a mammal.

CLAIM(S):

1. A chimeric antigen receptor (CAR) comprising an antigen binding domain specific for TSLPR, a transmembrane domain, and an intracellular T cell signaling domain.

2. The CAR according to claim 1, wherein the antigen binding domain comprises the light chain variable region comprising the sequences of SEQ ID NOS: 18, 20, 22, 24, 25, 27, and 29 or SEQ ID NOS: 19, 21, 23, 24, 26, 28, and 29.

3. The CAR according to claim 1 or 2, wherein the antigen binding domain comprises the heavy chain variable region comprising the sequences of SEQ ID NOS: 6, 7, 9, 10, 11, 13, and 15 or SEQ ID NOS; 6, 8, 9, 10, 12, 14, and 16.

4. The CAR according to any one of claims 1-3, wherein the antigen binding domain comprises the linker sequence of SEQ ID NO: 17.

5. The CAR according to any one of claims 1-4, wherein the antigen binding domain comprises SEQ ID NO: 1.

6. The CAR according to any one of claims 1-5, wherein the transmembrane domain comprises a CD8 amino acid sequence.

7. The CAR according to any one of claims 1-6, wherein the transmembrane domain comprises CD8 amino acid sequence comprising the CD8α hinge sequence of SEQ ID NO: 35 and the transmembrane domain of sequence SEQ ID NO: 36.

8. The CAR according to any one of claims 1-7, wherein the intracellular T cell signaling domain comprises 4-1BB, CD3 zeta, or both.

9. The CAR according to any one of claims 1-8, wherein the intracellular T cell signaling domain comprises the 4-1BB amino acid sequence of SEQ ID NO: 37.

10. The CAR according to any one of claims 1-9, wherein the intracellular T cell signaling domain comprises the CD3 zeta amino acid sequence of SEQ ID NO: 38.

11. The CAR according to any one of claims 1-10, wherein the CAR further comprises the spacer comprising SEQ ID NOS: 30-33.

12. The CAR according to claim 1, wherein the CAR comprises any one of the sequences of SEQ ID NO: 39-46.

13. A nucleic acid comprising a nucleotide sequence encoding the CAR according to any one of claims 1-12.

14. The nucleic acid according to claim 13, wherein the nucleotide sequence is codon-optimized.

15. A recombinant expression vector comprising the nucleic acid according to claim 13 or 14.

16. The recombinant expression vector according to claim 15, wherein the recombinant expression vector is a lentiviral vector.

17. An isolated host cell comprising the recombinant expression vector of claim 15 or 16.

18. A population of cells comprising at least one host cell of claim 17.

19. An antibody, or antigen binding portion thereof, which specifically binds to a CAR according to any one of claims 1-12.

20. A pharmaceutical composition comprising the CAR any one of claims 1-12, the nucleic acid of claim 13 or 14, the recombinant expression vector of claim 15 or 16, the host cell of claim 17, the population of cells of claim 18, or the antibody, or antigen binding portion thereof, of claim 19, and a pharmaceutically acceptable carrier.

21. A method of detecting the presence of cancer, comprising:

(a) contacting a sample comprising one or more cells with the CAR any one of claims 1-12, the nucleic acid of claim 13 or 14, the recombinant expression vector of claim 15 or 16, the host cell of claim 17, the population of cells of claim 18, or the antibody, or antigen binding portion thereof, of claim 19, or the pharmaceutical composition of claim 20, thereby forming a complex, and

(b) detecting the complex, wherein detection of the complex is indicative of the presence of cancer.

22. The method of claim 21, wherein the cancer is BCP-ALL.

23. The CAR of any one of claims 1-12, the nucleic acid of claim 13 or 14, the recombinant expression vector of claim 15 or 16, the host cell of claim 17, the population of cells of claim 18, or the antibody, or antigen binding portion thereof, of claim 19, or the pharmaceutical composition of claim 20, for use in the treatment or prevention of cancer in a mammal.

24. The CAR, nucleic acid, recombinant expression vector, host cell, population of cells, antibody, or antigen binding portion thereof, or pharmaceutical composition of claim 23, wherein the cancer is BCP-ALL.

25. The CAR of any one of claims 1-12, the nucleic acid of claim 13 or 14, the recombinant expression vector of claim 15 or 16, the host cell of claim 17, the population of cells of claim 18, or the antibody, or antigen binding portion thereof, of claim 19, or the pharmaceutical composition of claim 20, for use in the treatment or prevention of a proliferative disorder in a mammal, wherein the proliferative disorder is associated with a mutation in the IKZF gene.

26. A method of determining whether a subject with a proliferative disorder is a candidate for treatment with a chimeric antigen receptor comprising an antigen binding domain specific for TSLPR, the method comprising: measuring TSLPR expression levels in a biological sample from the subject; and determining if the TSLPR expression levels of the

biological sample are increased compared to a sample from a control subject without the proliferative disorder.

CLAIM(S):

1. A chimeric antigen receptor (CAR) comprising an antigen binding domain specific for TSLPR, a transmembrane domain, and an intracellular T cell signaling domain, wherein the antigen binding domain comprises the light chain variable region comprising the sequences of SEQ ID NOS: 18, 20, 22, 24, 25, 27, and 29 or SEQ ID NOS: 19, 21, 23, 24, 26, 28, and 29.

2. A chimeric antigen receptor (CAR) comprising an antigen binding domain specific for TSLPR, a transmembrane domain, and an intracellular T cell signaling domain, wherein the antigen binding domain comprises the heavy chain variable region comprising the sequences of SEQ ID NOS: 6, 7, 9, 10, 11, 13, and 15 or SEQ ID NOS; 6, 8, 9, 10, 12, 14, and 16.

3. The CAR according to claim 1 or 2, wherein the antigen binding domain comprises the linker sequence of SEQ ID NO: 17.

4. The CAR according to any one of claims 1-3, wherein the antigen binding domain comprises SEQ ID NO: 1.

5. The CAR according to any one of claims 1-4, wherein the transmembrane domain comprises a CD8 amino acid sequence.

6. The CAR according to any one of claims 1-5, wherein the transmembrane domain comprises CD8 amino acid sequence comprising the CD8α hinge sequence of SEQ ID NO: 35 and the transmembrane domain of sequence SEQ ID NO: 36.

7. The CAR according to any one of claims 1-6, wherein the intracellular T cell signaling domain comprises 4-1BB, CD3 zeta, or both.

8. The CAR according to any one of claims 1-7, wherein the intracellular T cell signaling domain comprises the 4-1BB amino acid sequence of SEQ ID NO: 37.

9. The CAR according to any one of claims 1-8, wherein the intracellular T cell signaling domain comprises the CD3 zeta amino acid sequence of SEQ ID NO: 38.

10. The CAR according to any one of claims 1-9, wherein the CAR further comprises the spacer comprising SEQ ID NOS: 30-33.

11. The CAR according to claim 1 or 2, wherein the CAR comprises any one of the sequences of SEQ ID NO: 39-46.

12. A nucleic acid comprising a nucleotide sequence encoding the CAR according to any one of claims 1-11.

13. The nucleic acid according to claim 12, wherein the nucleotide sequence is codon-optimized.

14. A recombinant expression vector comprising the nucleic acid according to claim 12 or 13.

15. The recombinant expression vector according to claim 14, wherein the recombinant expression vector is a lentiviral vector.

16. An isolated host cell comprising the recombinant expression vector of claim 14 or 15.

17. A population of cells comprising at least one host cell of claim 16.

18. An antibody, or antigen binding portion thereof, which specifically binds to a CAR according to any one of claims 1-11.

19. A pharmaceutical composition comprising the CAR any one of claims 1-11, the nucleic acid of claim 12 or 13, the recombinant expression vector of claim 14 or 15, the host cell of claim 16, the population of cells of claim 17, or the antibody, or antigen binding portion thereof, of claim 18, and a pharmaceutically acceptable carrier.

20. A method of detecting the presence of cancer, comprising:

(a) contacting a sample comprising one or more cells with the CAR any one of claims 1-11, the nucleic acid of claim 12 or 13, the recombinant expression vector of claim 14 or 15, the host cell of claim 16, the population of cells of claim 17, or the antibody, or antigen

binding portion thereof, of claim 18, or the pharmaceutical composition of claim 19, thereby forming a complex, and

(b) detecting the complex, wherein detection of the complex is indicative of the presence of cancer.

21. The method of claim 20, wherein the cancer is BCP-ALL.

22. The CAR of any one of claims 1-11, the nucleic acid of claim 12 or 13, the recombinant expression vector of claim 14 or 15, the host cell of claim 16, the population of cells of claim 17, or the antibody, or antigen binding portion thereof, of claim 18, or the pharmaceutical composition of claim 19, for use in the treatment or prevention of cancer in a mammal.

23. The CAR, nucleic acid, recombinant expression vector, host cell, population of cells, antibody, or antigen binding portion thereof, or pharmaceutical composition of claim 22, wherein the cancer is BCP-ALL.

24. The CAR of any one of claims 1-11, the nucleic acid of claim 12 or 13, the recombinant expression vector of claim 14 or 15, the host cell of claim 16, the population of cells of claim 17, or the antibody, or antigen binding portion thereof, of claim 18, or the pharmaceutical composition of claim 19, for use in the treatment or prevention of a proliferative disorder in a mammal, wherein the proliferative disorder is associated with a mutation in the IKZF gene.

25. A method of determining whether a subject with a proliferative disorder is a candidate for treatment with a chimeric antigen receptor comprising an antigen binding domain specific for TSLPR, the method comprising: measuring TSLPR expression levels in a biological sample from the subject; and determining if the TSLPR expression levels of the biological sample are increased compared to a sample from a control subject without the proliferative disorder.