

CLAIMS

1. A single chain antibody specifically binding to a human GPC3 (glypican-3)-derived polypeptide consisting of the amino acid sequence represented by SEQ ID NO: 155, for use as a single chain antibody in a chimeric antigen receptor (CAR) for expression on a cell surface of an immunocompetent cell in a cancer immunotherapy, wherein the single chain antibody

(1-1) comprises a heavy chain complementarity determining region (CDR) 1 consisting of the amino acid sequence represented by SEQ ID NO: 1, a heavy chain CDR2 consisting of the amino acid sequence represented by SEQ ID NO: 2, and a heavy chain CDR3 consisting of the amino acid sequence represented by SEQ ID NO: 3, and

a light chain CDR1 consisting of the amino acid sequence represented by SEQ ID NO: 4, a light chain CDR2 consisting of the amino acid sequence represented by SEQ ID NO: 5, and a light chain CDR3 consisting of the amino acid sequence represented by SEQ ID NO: 6; or

(2-1) comprises a heavy chain CDR1 consisting of the amino acid sequence represented by SEQ ID NO: 11, a heavy chain CDR2 consisting of the amino acid sequence represented by SEQ ID NO: 12, and a heavy chain CDR3 consisting of the amino acid sequence represented by SEQ ID NO: 13, and

a light chain CDR1 consisting of the amino acid sequence represented by SEQ ID NO: 14, a light chain CDR2 consisting of the amino acid sequence represented by SEQ ID NO: 15, and a light chain CDR3 consisting of the amino acid sequence represented by SEQ ID NO: 16; or

(3-1) comprises a heavy chain CDR1 consisting of the amino acid sequence represented by SEQ ID NO: 21, a heavy chain CDR2 consisting of the amino acid sequence represented by SEQ ID NO: 22, and a heavy chain CDR3 consisting of the amino acid sequence represented by SEQ ID NO: 23, and

a light chain CDR1 consisting of the amino acid

sequence represented by SEQ ID NO: 24, a light chain CDR2 consisting of the amino acid sequence represented by SEQ ID NO: 25, and a light chain CDR3 consisting of the amino acid sequence represented by SEQ ID NO: 26; or

(4-1) comprises a heavy chain CDR1 consisting of the amino acid sequence represented by SEQ ID NO: 31, a heavy chain CDR2 consisting of the amino acid sequence represented by SEQ ID NO: 32, and a heavy chain CDR3 consisting of the amino acid sequence represented by SEQ ID NO: 33, and

a light chain CDR1 consisting of the amino acid sequence represented by SEQ ID NO: 34, a light chain CDR2 consisting of the amino acid sequence represented by SEQ ID NO: 35, and a light chain CDR3 consisting of the amino acid sequence represented by SEQ ID NO: 36; or

(5-1) comprises a heavy chain CDR1 consisting of the amino acid sequence represented by SEQ ID NO: 41, a heavy chain CDR2 consisting of the amino acid sequence represented by SEQ ID NO: 42, and a heavy chain CDR3 consisting of the amino acid sequence represented by SEQ ID NO: 43, and

a light chain CDR1 consisting of the amino acid sequence represented by SEQ ID NO: 44, a light chain CDR2 consisting of the amino acid sequence represented by SEQ ID NO: 45, and a light chain CDR3 consisting of the amino acid sequence represented by SEQ ID NO: 46; or

(6-1) comprises a heavy chain CDR1 consisting of the amino acid sequence represented by SEQ ID NO: 51, a heavy chain CDR2 consisting of the amino acid sequence represented by SEQ ID NO: 52, and a heavy chain CDR3 consisting of the amino acid sequence represented by SEQ ID NO: 53, and

a light chain CDR1 consisting of the amino acid sequence represented by SEQ ID NO: 54, a light chain CDR2 consisting of the amino acid sequence represented by SEQ ID NO: 55, and a light chain CDR3 consisting of the amino acid sequence represented by SEQ ID NO: 56; or

(7-1) comprises a heavy chain CDR1 consisting of the amino acid sequence represented by SEQ ID NO: 61, a heavy

chain CDR2 consisting of the amino acid sequence represented by SEQ ID NO: 62, and a heavy chain CDR3 consisting of the amino acid sequence represented by SEQ ID NO: 63, and

a light chain CDR1 consisting of the amino acid sequence represented by SEQ ID NO: 64, a light chain CDR2 consisting of the amino acid sequence represented by SEQ ID NO: 65, and a light chain CDR3 consisting of the amino acid sequence represented by SEQ ID NO: 66; or

(8-1) comprises a heavy chain CDR1 consisting of the amino acid sequence represented by SEQ ID NO: 71, a heavy chain CDR2 consisting of the amino acid sequence represented by SEQ ID NO: 72, and a heavy chain CDR3 consisting of the amino acid sequence represented by SEQ ID NO: 73, and

a light chain CDR1 consisting of the amino acid sequence represented by SEQ ID NO: 74, a light chain CDR2 consisting of the amino acid sequence represented by SEQ ID NO: 75, and a light chain CDR3 consisting of the amino acid sequence represented by SEQ ID NO: 76; or

(9-1) comprises a heavy chain CDR1 consisting of the amino acid sequence represented by SEQ ID NO: 81, a heavy chain CDR2 consisting of the amino acid sequence represented by SEQ ID NO: 82, and a heavy chain CDR3 consisting of the amino acid sequence represented by SEQ ID NO: 83, and

a light chain CDR1 consisting of the amino acid sequence represented by SEQ ID NO: 84, a light chain CDR2 consisting of the amino acid sequence represented by SEQ ID NO: 85, and a light chain CDR3 consisting of the amino acid sequence represented by SEQ ID NO: 86; or

(10-1) comprises a heavy chain CDR1 consisting of the amino acid sequence represented by SEQ ID NO: 91, a heavy chain CDR2 consisting of the amino acid sequence represented by SEQ ID NO: 92, and a heavy chain CDR3 consisting of the amino acid sequence represented by SEQ ID NO: 93, and

a light chain CDR1 consisting of the amino acid sequence represented by SEQ ID NO: 94, a light chain CDR2 consisting of the amino acid sequence represented by SEQ ID

N0: 95, and a light chain CDR3 consisting of the amino acid sequence represented by SEQ ID N0: 96; or

(11-1) comprises a heavy chain CDR1 consisting of the amino acid sequence represented by SEQ ID N0: 101, a heavy chain CDR2 consisting of the amino acid sequence represented by SEQ ID N0: 102, and a heavy chain CDR3 consisting of the amino acid sequence represented by SEQ ID N0: 103, and

a light chain CDR1 consisting of the amino acid sequence represented by SEQ ID N0: 104, a light chain CDR2 consisting of the amino acid sequence represented by SEQ ID N0: 105, and a light chain CDR3 consisting of the amino acid sequence represented by SEQ ID N0: 106.

2. The single chain antibody according to claim 1, wherein the single chain antibody

(1-2) comprises a heavy chain variable region consisting of an amino acid sequence having at least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID N0: 7, and a light chain variable region consisting of an amino acid sequence having at least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID N0: 8; or

(2-2) comprises a heavy chain variable region consisting of an amino acid sequence having at least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID N0: 17, and a light chain variable region consisting of an amino acid sequence having at least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID N0: 18; or

(3-2) comprises a heavy chain variable region consisting of an amino acid sequence having at least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID N0: 27, and a light chain variable region consisting of an amino acid sequence having at least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID N0: 28; or

(4-2) comprises a heavy chain variable region consisting of an amino acid sequence having at least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID NO: 37, and a light chain variable region consisting of an amino acid sequence having at least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID NO: 38; or

(5-2) comprises a heavy chain variable region consisting of an amino acid sequence having at least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID NO: 47, and a light chain variable region consisting of an amino acid sequence having at least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID NO: 48; or

(6-2) comprises a heavy chain variable region consisting of an amino acid sequence having at least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID NO: 57, and a light chain variable region consisting of an amino acid sequence having at least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID NO: 58; or

(7-2) comprises a heavy chain variable region consisting of an amino acid sequence having at least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID NO: 67, and a light chain variable region consisting of an amino acid sequence having at least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID NO: 68; or

(8-2) comprises a heavy chain variable region consisting of an amino acid sequence having at least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID NO: 77, and a light chain variable region consisting of an amino acid sequence having at least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID NO: 78; or

(9-2) comprises a heavy chain variable region

consisting of an amino acid sequence having at least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID NO: 87, and a light chain variable region consisting of an amino acid sequence having at least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID NO: 88; or

(10-2) comprises a heavy chain variable region consisting of an amino acid sequence having at least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID NO: 97, and a light chain variable region consisting of an amino acid sequence having at least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID NO: 98; or

(11-2) comprises a heavy chain variable region consisting of an amino acid sequence having at least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID NO: 107, and a light chain variable region consisting of an amino acid sequence having at least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID NO: 108.

3. The single chain antibody according to claim 1 or 2, wherein the single chain antibody

(1-3) comprises an amino acid sequence having at least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID NO: 165; or

(2-3) comprises an amino acid sequence having at least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID NO: 166; or

(3-3) comprises an amino acid sequence having at least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID NO: 167; or

(4-3) comprises an amino acid sequence having at least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID NO: 168; or

(5-3) comprises an amino acid sequence having at least

80% or higher sequence identity to the amino acid sequence represented by SEQ ID NO: 169; or

(6-3) comprises an amino acid sequence having at least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID NO: 170; or

(7-3) comprises an amino acid sequence having at least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID NO: 171; or

(8-3) comprises an amino acid sequence having at least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID NO: 172; or

(9-3) comprises an amino acid sequence having at least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID NO: 173; or

(10-3) comprises an amino acid sequence having at least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID NO: 174; or

(11-3) comprises an amino acid sequence having at least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID NO: 175.

4. The single chain antibody according to claim 1 or 2, wherein the single chain antibody

(1-3'-1) comprises an amino acid sequence having at least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID NO: 178; or

(1-3'-2) comprises an amino acid sequence having at least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID NO: 179; or

(1-3'-3) comprises an amino acid sequence having at least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID NO: 180; or

(2-3'-1) comprises an amino acid sequence having at least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID NO: 181; or

(2-3'-2) comprises an amino acid sequence having at

least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID NO: 182; or

(2-3'-3) comprises an amino acid sequence having at least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID NO: 183; or

(2-3'-4) comprises an amino acid sequence having at least 80% or higher sequence identity to the amino acid sequence represented by SEQ ID NO: 184.

5. A chimeric antigen receptor (CAR) comprising the single chain antibody according to any one of claims 1 to 4, a transmembrane region fused with a carboxyl terminus of the single chain antibody, and an immunocompetent cell activation signal transduction region fused with a carboxyl terminus of the transmembrane region, wherein the CAR is for expression on a cell surface of an immunocompetent cell in a cancer immunotherapy.

6. The CAR according to claim 5, comprising the amino acid sequence represented by any of SEQ ID NOs: 185 to 187.

7. An immunocompetent cell expressing the CAR according to claim 5 or 6, for use in a cancer immunotherapy.

8. The immunocompetent cell according to claim 7, further expressing interleukin 7 (IL-7) and chemokine ligand 19 (CCL19).

9. A single chain antibody gene encoding the single chain antibody according to any one of claims 1 to 4 for use as a single chain antibody in a chimeric antigen receptor (CAR) for expression on a cell surface of an immunocompetent cell in a cancer immunotherapy, or a CAR gene encoding the CAR according to claim 5 or 6 for expression on a cell surface of an immunocompetent cell in a cancer immunotherapy.

10. A vector comprising a promoter, and the single chain antibody gene according to claim 9 or the CAR gene encoding the CAR according to claim 9 operably linked downstream of the promoter, wherein the vector is for expression of a chimeric antigen receptor (CAR) on a cell surface of an immunocompetent cell in a cancer immunotherapy.

11. A host cell in which the vector according to claim 10 has been introduced.