Claims

[Claim 1] An anti-human Igβ antibody comprising a heavy chain variable region comprising CDR1 consisting of the amino acid sequence of amino acid numbers 31 to 35 of SEQ ID NO: 2, CDR2 consisting of the amino acid sequence of amino acid numbers 50 to 65 of SEQ ID NO: 2, and CDR3 consisting of the amino acid sequence of amino acid numbers 98 to 108 of SEQ ID NO: 2, a light chain variable region comprising CDR1 consisting of the amino acid sequence of amino acid numbers 24 to 38 of SEQ ID NO: 4, CDR2 consisting of the amino acid sequence of amino acid numbers 54 to 60 of SEQ ID NO: 4, and CDR3 consisting of the amino acid sequence of amino acid numbers 93 to 101 of SEQ ID NO: 4, and a heavy chain constant region which is a human Igγ1 constant region having amino acid mutations of S239D, H268D, and L328W.

[Claim 2] The anti-human Igβ antibody according to claim 1, selected from the group consisting of the following (1) to (4):

(1) an anti-human Igβ antibody comprising a heavy chain variable region consisting of the amino acid sequence of amino acid numbers 1 to 119 of SEQ ID NO: 6, a light chain variable region consisting of the amino acid sequence of amino acid numbers 1 to 112 of SEQ ID NO: 8, and a heavy chain constant region which is a human Igγ1 constant region having amino acid mutations of S239D, H268D, and L328W;

(2) an anti-human Igβ antibody comprising a heavy chain variable region consisting of the amino acid sequence of amino acid numbers 1 to 119 of SEQ ID NO: 2, a light chain variable region consisting of the amino acid sequence of amino acid numbers 1 to 112 of SEQ ID NO: 4, and a heavy chain constant region which is a human Igγ1 constant region having amino acid mutations of S239D, H268D, and L328W;

(3) an anti-human Igβ antibody comprising a heavy chain variable region consisting of the amino acid sequence of amino acid numbers 1 to 119 of SEQ ID NO: 10, a light chain variable region consisting of the amino acid sequence of amino acid numbers 1 to 112 of SEQ ID NO: 12, and a heavy chain constant region which is a human Igγ1 constant region having amino acid mutations of S239D, H268D, and L328W; and

(4) an anti-human Igβ antibody which is derived from posttranslational modification of the anti-human Igβ antibody of any one of (1) to (3) above, wherein the posttranslational modification is pyroglutamylation at the N terminal of the heavy chain variable region and/or deletion of lysine at the C terminal of the heavy chain.

[Claim 3] The anti-human Igβ antibody according to claim 2, selected from the group consisting of the following (1) to (4):

(1) an anti-human Igβ antibody comprising a heavy chain consisting of the amino acid sequence shown by SEQ ID NO: 6 and a light chain consisting of the amino acid sequence shown by SEQ ID NO: 8;

(2) an anti-human Igβ antibody comprising a heavy chain consisting of the amino acid sequence shown by SEQ ID NO: 2 and a light chain consisting of the amino acid sequence shown by SEQ ID NO: 4;

(3) an anti-human Igβ antibody comprising a heavy chain consisting of the amino acid sequence shown by SEQ ID NO: 10 and a light chain consisting of the amino acid sequence shown by SEQ ID NO: 12; and

(4) an anti-human Igβ antibody which is derived from posttranslational modification of the anti-human Igβ antibody of any one of (1) to (3) above, wherein the posttranslational modification is pyroglutamylation at the N terminal of the heavy chain variable region and/or deletion of lysine at the C terminal of the heavy chain.

[Claim 4] The anti-human Igβ antibody according to claim 3, selected from the group consisting of the following (1) to (5):

(1) an anti-human Igβ antibody comprising a heavy chain consisting of the amino acid sequence of amino acid numbers of 1 to 448 of SEQ ID NO: 6 in which glutamine of amino acid number 1 is modified to pyroglutamic acid and a light chain consisting of the amino acid sequence shown by SEQ ID NO: 8;

(2) an anti-human Igβ antibody comprising a heavy chain consisting of the amino acid sequence shown by SEQ ID NO: 2 and a light chain consisting of the amino acid sequence shown by SEQ ID NO: 4;

(3) an anti-human Igβ antibody comprising a heavy chain consisting of the amino acid sequence of amino acid numbers 1 to 448 of SEQ ID NO: 2 and a light chain consisting of the amino acid sequence shown by SEQ ID NO: 4;

(4) an anti-human Igβ antibody comprising a heavy chain consisting of the amino acid sequence shown by SEQ ID NO: 10 and a light chain consisting of the amino acid sequence shown by SEQ ID NO: 12; and

(5) an anti-human Igβ antibody comprising a heavy chain consisting of the amino acid sequence of amino acid numbers 1 to 448 of SEQ ID NO: 10 and a light chain consisting of the amino acid sequence shown by SEQ ID NO: 12.

[Claim 5] A polynucleotide selected from the group consisting of the following (1) to (2):

(1) a polynucleotide comprising a base sequence encoding the heavy chain of the anti-human Igβ antibody according to (1) to (3) of claim 2; and

(2) a polynucleotide comprising a base sequence encoding the light chain of the anti-human Igβ antibody according to (1) to (3) of claim 2.

[Claim 6] A polynucleotide selected from the group consisting of the following (1) to (2):

(1) a polynucleotide comprising a base sequence encoding the heavy chain of the anti-human Igβ antibody according to claim 3 (1); and

(2) a polynucleotide comprising a base sequence encoding the light chain of the anti-human Igβ antibody according to claim 3 (1).

[Claim 7] An expression vector comprising the following (1) and/or (2):

(1) a polynucleotide comprising a base sequence encoding the heavy chain of the anti-human Igβ antibody according to (1) to (3) of claim 2; and/or

(2) a polynucleotide comprising a base sequence encoding the light chain of the anti-human Igβ antibody according to (1) to (3) of claim 2.

[Claim 8] An expression vector comprising the following (1) and/or (2):

(1) a polynucleotide comprising a base sequence encoding the heavy chain of the anti-human Igβ antibody according to claim 3 (1); and/or

(2) a polynucleotide comprising a base sequence encoding the light chain of the anti-human Igβ antibody according to claim 3 (1).

[Claim 9] A host cell selected from the group consisting of the following (a) to (b):

(a) a host cell transformed with an expression vector comprising a polynucleotide comprising a base sequence encoding the heavy chain of the anti-human Igβ antibody according to (1) to (3) of claim 2 and a polynucleotide comprising a base sequence encoding the light chain of the antibody according to (1) to (3) of claim 2; and

(b) a host cell transformed with an expression vector comprising a polynucleotide comprising a base sequence encoding the heavy chain of the anti-human Igβ antibody according to (1) to (3) of claim 2 and an expression vector comprising a polynucleotide comprising a base sequence encoding the light chain of the antibody according to (1) to (3) of claim 2.

[Claim 10] A host cell selected from the group consisting of the following (a) to (b):

(a) a host cell transformed with an expression vector comprising a polynucleotide comprising a base sequence encoding the heavy chain of the anti-human Igβ antibody according to claim 3 (1) and a polynucleotide comprising a base sequence encoding the light chain of the antibody according to claim 3 (1); and

(b) a host cell transformed with an expression vector comprising a polynucleotide comprising a base sequence encoding the heavy chain of the

anti-human Igβ antibody according to claim 3 (1) and an expression vector comprising a polynucleotide comprising a base sequence encoding the light chain of the antibody according to claim 3 (1).

[Claim 11] A method for producing an anti-human Igβ antibody comprising culturing host cell(s) selected from the group consisting of the following (a) to (b) to express the anti-human Igβ antibody:

(a) a host cell transformed with an expression vector comprising a polynucleotide comprising a base sequence encoding the heavy chain of the anti-human Igβ antibody according to (1) to (3) of claim 2 and a polynucleotide comprising a base sequence encoding the light chain of the antibody according to (1) to (3) of claim 2; and

(b) a host cell transformed with an expression vector comprising a polynucleotide comprising a base sequence encoding the heavy chain of the anti-human Igβ antibody according to (1) to (3) of claim 2 and an expression vector comprising a polynucleotide comprising a base sequence encoding the light chain of the antibody according to (1) to (3) of claim 2.

[Claim 12] A method for producing an anti-human Igβ antibody comprising culturing host cell(s) selected from the group consisting of the following (a) to (b) to express the anti-human Igβ antibody:

(a) a host cell transformed with an expression vector comprising a polynucleotide comprising a base sequence encoding the heavy chain of the anti-human Igβ antibody according to claim 3 (1) and a polynucleotide comprising a base sequence encoding the light chain of the antibody according to claim 3 (1); and

(b) a host cell transformed with an expression vector comprising a polynucleotide comprising a base sequence encoding the heavy chain of the anti-human Igβ antibody according to claim 3 (1) and an expression vector comprising a polynucleotide comprising a base sequence encoding the light chain of the antibody according to claim 3 (1).

[Claim 13] A pharmaceutical composition comprising an anti-human Igβ antibody selected from the group consisting of the following (a) to (c), and a pharmaceutically acceptable excipient:

(a) an anti-human Igβ antibody comprising a heavy chain consisting of the amino acid sequence shown by SEQ ID NO: 6 and a light chain consisting of the amino acid sequence shown by SEQ ID NO: 8, and/or an anti-human Igβ antibody comprising a heavy chain consisting of the amino acid sequence of amino acid numbers of 1 to 448 of SEQ ID NO: 6 in which glutamine of amino acid number 1 is modified to pyroglutamic acid and a light chain consisting of the amino acid sequence shown by SEQ ID NO: 8;

(b) an anti-human Igβ antibody comprising a heavy chain consisting of the amino acid sequence shown by SEQ ID NO: 2 and a light chain consisting of the amino acid sequence shown by SEQ ID NO: 4, and/or an anti-human Igβ antibody comprising a heavy chain consisting of the amino acid sequence of amino acid numbers 1 to 448 of SEQ ID NO: 2 and a light chain consisting of the amino acid sequence shown by SEQ ID NO: 4; and

(c) an anti-human Igβ antibody comprising a heavy chain consisting of the amino acid sequence shown by SEQ ID NO: 10 and a light chain consisting of the amino acid sequence shown by SEQ ID NO: 12, and/or an anti-human Igβ antibody comprising a heavy chain consisting of the amino acid sequence of amino acid numbers 1 to 448 of SEQ ID NO: 10 and a light chain consisting of the amino acid sequence shown by SEQ ID NO: 12.

[Claim 14] A pharmaceutical composition comprising:

(1) an anti-human Igβ antibody comprising a heavy chain consisting of the amino acid sequence shown by SEQ ID NO: 6 and a light chain consisting of the amino acid sequence shown by SEQ ID NO: 8; and/or

(2) an anti-human Igβ antibody comprising a heavy chain consisting of the amino acid sequence of amino acid numbers of 1 to 448 of SEQ ID NO: 6 in which glutamine of amino acid number 1 is modified to pyroglutamic acid and a light chain consisting of the amino acid sequence shown by SEQ ID NO: 8, and
a pharmaceutically acceptable excipient.

[Claim 15] The pharmaceutical composition according to claim 14, which is a pharmaceutical composition for preventing or treating an autoimmune disease.

[Claim 16] The pharmaceutical composition according to claim 15, wherein the autoimmune disease is systemic lupus erythematosus, rheumatoid arthritis, or idiopathic thrombocytopenic purpura.

[Claim 17] (1) An anti-human Igβ antibody comprising a heavy chain consisting of the amino acid sequence shown by SEQ ID NO: 6 and a light chain consisting of the amino acid sequence shown by SEQ ID NO: 8, and/or (2) an anti-human Igβ antibody comprising a heavy chain consisting of the amino acid sequence of amino acid numbers of 1 to 448 of SEQ ID NO: 6 in which glutamine of amino acid number 1 is modified to pyroglutamic acid and a light chain consisting of the amino acid sequence shown by SEQ ID NO: 8 for use in preventing or treating an autoimmune disease.

[Claim 18] Use of (1) an anti-human Igβ antibody comprising a heavy chain consisting of the amino acid sequence shown by SEQ ID NO: 6 and a light chain

consisting of the amino acid sequence shown by SEQ ID NO: 8, and/or (2) an anti-human Igβ antibody comprising a heavy chain consisting of the amino acid sequence of amino acid numbers of 1 to 448 of SEQ ID NO: 6 in which glutamine of amino acid number 1 is modified to pyroglutamic acid and a light chain consisting of the amino acid sequence shown by SEQ ID NO: 8 for manufacture of a pharmaceutical composition for preventing or treating an autoimmune disease;

wherein the autoimmune disease is systemic lupus erythematosus, rheumatoid arthritis, or idiopathic thrombocytopenic purpura.

[Claim 19] The anti-human Igβ antibody according to claim 2, which is a fused form of the antibody and another peptide or protein, or a modified form to which a modifying agent binds, wherein the modifying agent is selected from a group of polyethylene glycol, sugar chains, phospholipids, liposomes and low-molecular compounds.