S1. The known rare *ABO* subgroup alleles found in this study

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Allele **a** | critical nucleotide **b** | Main Amino acid change(s) | NO.(R)**c** | phenotype |
| *ABO\*A2.01*  | 467C>T; 1061delC | P156L; P354Rfs\*23  | 3 | A2, A2B |
| *ABO\*A2.05*  | 467C>T; 1009A>G | P156L; R337G | 5 | A2, Aw, A2B |
| *ABO\*A2.08*  | 467C>T; 539G>C | P156L;R180P | 13(2) | A2,AxB,A2B |
| *ABO\*A3.07*  | 467C>T; 745C>T | P156L; R249W | 3 | Ax, Aw |
| *ABO\*AW.37*  | 940A>G | K314E | 1 | Ax |
| *ABO\*AW.new1(Aw30)***d** | 467C>T; 565A>G | P156L; M189V | 1 | Ax |
| *ABO\*Aw.new8 d (Aw35)* | 467C>T; 626G>A | P156L; C209Y | 1 | Ax |
| *ABO\*BW.new10 (B119)* | 701C>T | P234L | 2 | B(A) |
| *ABO\*AEL.01*  | 804dupG  | Phe269Valfs\*124  | 2(2) | Ael |
| *ABO\*AEL.02* | 467C>T; 646T>A; 681G>A | P156L; F216I; G235S | 1 | Ael |
| *ABO\*BA.02* | 700C>G | P234A | 13(2) | AxB, A2B |
| *ABO\*BA.03* | 297A>G;526C>G;657C>T;796C>A;803G>C;930G>A | R176G; L266M; G268A  | 1 | AxB |
| *ABO\*BA.04* | 640A>G | M214V | 8 | AxB, A2B, AxB |
| *ABO\*BA.new2(B(A)06)*  | *803C>G* | A268G | 1 | A2B |
| *ABO\*B3.01*  | 1054C>T | R352W | 2 | ABw |
| *ABO\*B3.05*  | 425T>C | M142T | 3(2) | Bx、B3 |
| *ABO\*B3.new3( B310）*  | 28G>A | G10R | 7(2) | B3, Bw, ABw |
| *ABO\*BW.03*  | 721C>T | R241W | 10 | Bw, ABx |
| *ABO\*BW.07*  | 1055G>A | R352Q | 3 | ABw |
| *ABO\*BW.11*  | 695T>C | L232P | 2 | Bw |
| *ABO\*BW.12* | 278C>T | P93L | 1 | Bx |
| *ABO\*BW.new13(Bw33)* | 796A>C | 266L | 1 | ABw |
| *ABO\*BW.19*  | 646T>A; 681G>A | F216I; G235S | 6 | ABw, Bx |
| *ABO\*BW.27*  | 905A>G | D302G | 3(2) | Bx, Bw |
| *ABO\*BW.28*  | 541T>C | G235S | 1 | Bx |
| *ABO\*BW.32*  | 808T>A | F270I | 1 | ABx |
| *ABO\*BW.34*  | 889G>A | E297K | 2(2) | Bx, ABx |
| *ABO\*cisAB.01*  | 467C>T; 803G>C | P156L; G268A | 6 | ABw |
| *ABO\*cisAB.03*  | 297A>G;526C>G;657C>T;700C>T;703G>A;796C>A;803G>C; 930G>A  | R176G; P234S; G235S; L266M; G268A  | 2 | AxB, ABx |
| *ABO\*cisAB.new4***(** *cis-AB01var***)** | 467C>T; 803G>C; 1009A>G | P156L; G268A; R337G | 1 | ABw |
| *ABO\*O.01.04*  | 261delG; 579T>C | Thr88Profs\*31  | 3(2) | O |

**a** The alleles of *A* and *B* were named by ISBT，which were cited from Erythrogene.(. https://doi.org/10.1182/bloodadvances.2016001867)

**b**The main nucleotide and amino acid changes of the *ABO\*A* , *ABO\*cisAB* and *ABO\*O* alleles were compared to the consensus *ABO\*A1.01, ABO\*B* and *ABO\*BA* alleles were compared to *ABO\*B.01* allele.

**c** The number of the sample identified in this study. R=the number of related family member

**d** The alleles were not named by ISBT currently, but have been detected by the other laboratories and named according to the nomenclature used in the dbRBC of NCBI before(Patnaik et al, 2012).