ISBT Working Party

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Terminology for Red Cell Surface Antigens

ISBT Working Party Oslo Report

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The Working Party met at Sjølyst Congress Center, Oslo, Norway on 27 June 1998. Some changes to the classification documented in Blood Group Terminology 1995 [1] and updated in 1996 [2] were agreed and are described below. Table 1 includes all modifications to the blood group systems since the 1995 publication [1].

Blood Group Systems (table 1)

002, the MNS System

Three new antigens have been added: two of low incidence and one of high incidence. The low-incidence antigen MNS41 (HAG) is associated with an Ala65Pro substitution in glycophorin A (GPA) [3]. This substitution also results in absence of MNS39 (ENEP) and with abnormal expression of DI4 (Wr^b) [3]. MNS42 (ENAV, previously AVIS) is a high-incidence antigen and MNS43 (MARS) its low-incidence antithetical antigen. A Gln63Lys substitution in GPA results in absence of MNS42, presence of MNS43, and abnormal expression of DI4 (Wr^b) [4].

006, the Kell System

One new antigen has been added: KEL26 (TOU), a high incidence antigen absent from Kell glycoprotein with an Arg 406Gln substitution [5].

007, the Lewis System

Three new antigens have been added to this system. Although all three have been known for many years, they have not previously received numbers. LE4 (Le^{bH}) is defined by antibodies that react with LE:2 [Le(b+)] cells, but only when H1 (H) is strongly expressed (group O and A_2 phenotypes). LE5 (ALe^b) and LE6 (BLe^b) are expressed when LE2 (Le^b) is modified by the product of an *A* or *B* gene [6].

010, the Diego System

Diego is a rapidly expanding system with the addition of 11 new antigens, DI8 to DI18 (table 1), all of low incidence and associated with mutations in the gene encoding band 3, the red cell anion exchanger [7–13]. In all cases at least two unrelated persons with antigen-positive red cells were shown to have the associated mutation in the band 3 gene, with the exception of DI13 (Vg^a) and DI18 (KREP), in which the antigen-positive phenotype and associated mutation were found in two related persons [8, 11]. DI11 (Mo^a) and DI12 (Hg^a) represent different amino acid substitutions at the same position [8], as do DI17 (Jn^a) and DI18 [11, 13]. Two amino acid substitutions are associated with DI16 (NFLD), both in members of a Canadian Caucasian kindred and in a Japanese person [12]. DI9 (Wu), DI15 (BOW), and DI16 (NFLD) are serologically related [14], as are DI17 and DI18 [11, 13], with cross-reactivity occurring between some examples of the antibodies. There is no report of a similar serological relationship between DI11 and DI12.

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Table 1. Antigens assigned to blood group systems since the 1995 report [1]

System	Number	Symbol	Previous number	Amino acid substitution	Ref.[1]
002 MNS	002039 MNS39	ENEP	none	GPA Ala65Pro[2]	2[1]
	002040 MNS40	ENEH	none	GPA Thr28Met	2[1]
	002041 MNS41	HAG	none	GPA Ala65Pro	3
	002042 MNS42	ENAV	none	GPA Gln63Lys[2]	4
	002043 MNS43	MARS	none	GPA Gln63Lys	4
004 RH	004052 RH52	BARC	none		2[1]
006 KEL	006025 KEL25	VLAN	none		2[1]
	006026 KEL26	TOU	none	Arg406Gln[2]	5
007 LE	007004 LE4	Le^{bH}	none		6
	007005 LE5	ALe^{b}	none		6
	007006 LE6	BLe^{b}	none		6
010 DI	010005 DI5	Wd^{a}	700030	Val557Met	2[1]
	010006 DI6	Rb^{a}	700027	Pro548Leu	2[1]
	010007 DI7	WARR	700055	Thr552Ile	2[1]
	010008 DI8	ELO	700051	Arg432Trp	7, 8
	010009 DI9	Wu	700013	Gly565Ala	8, 9
	010010 DI10	Bp^{a}	700010	Asn569Lys	8
	010011 DI11	Mo^{a}	700022	Arg656His	8
	010012 DI12	Hg^{a}	700034	Arg656Cys	8
	010013 DI13	Vg^{a}	700029	Tyr555His	8
	010014 DI14	Sw^{a}	700004	Arg646Gln	10
	010015 DI15	BOW	700046	Pro561Ser	8, 11, 12
	010016 DI16	NFLD	700037	Glu429Asp, Pro561Ala	12
	010017 DI17	Jn^{a}	700014	Pro566Ser	13
	010018 DI18	KREP	none	Pro566Ala	11
024 OK	024001 OK1	Ok^{a}	901006	Glu92Lys	16
025 RAPH	025002 RAPH1	MER2	901011		17, 18

[1] References for antigens numbered at the 1996 meeting are given in the Makuhari report [2].
[2] Amino acid substitution responsible for absence of the antigen.

014, the Dombrock System

The gene controlling Dombrock expression has been provisionally assigned to chromosome 12p12.1-p13.2 [15].

New Systems (table 1)

024, the Ok System

The very high incidence antigen Ok^{a} (previously 901006, now 024001 or OK1) achieved system status following identification of the gene encoding the protein and of the amino acid substitution (Glu92Lys) responsible for the Ok(a–) phenotype [16].

025, the RAPH System

MER2 (previously 901011, now 025001 or RAPH1) has an incidence of about 92% in Caucasians [17]. It is defined by murine monoclonal antibodies and human alloantibodies [17, 18]. Distinction of RAPH from the other blood group systems was demonstrated by family studies or by the position of the *MER2* locus at 11p15.5 [17].

701 Series

700004, 700010, 700013, 700014, 700022, 700029, 700034, 700037, 700046, and 700051 have joined the Diego system and so these numbers are now obsolete (table 1).

901 Series

There is one new antigen: 901016, MAM. Three American Caucasian women lacking this antigen of very high incidence have been identified, two of whom are sibs. All three have been pregnant and have anti-MAM [19, 20].

901006 and 901011 have become systems and these numbers are now obsolete (table 1).

Terminology for Serological Phenotypes to Be Used as an Alternative to the Numerical Terminology

Listed below are examples of phenotype designations that are recommended as an alternative to the ISBT numerical terminology. These phenotype designations are for use with the 'popular', alternative terminology described on page 268 and in table 3 of Blood Group Terminology 1995 [1]. Generally, *either* the ISBT numerical terminology *or* the alternative terminology, for antigens and phenotypes, should be used; they should not be mixed. However, some names of phenotypes, such as Mi.III, GP.Mur, Rh_{null}, Inab phenotype, which do not have ISBT numbers, are suitable for use together with the numerical terminology. Examples of phenotypes in ISBT numerical terminology are shown in square brackets.

ABO

A [ABO:1,–2,3]; B [ABO:–1,2,3]; O [ABO:–1,–2,–3]; AB [ABO:1,2,3]; A_1.[ABO:1,–2,3,4]; A_2 [ABO:1,–2,3,–4].

MNS

M+ N+ S– s+ U+ He– Mi(a+) (in ISBT order) [MNS:1,2,–3,4,5,–6,7]. Alternatively, use Miltenberger [21] or GP terminology [22]: e.g. Mi.III or GP.Mur. Null phenotypes: M^K [MNS:–1,–2,–3,–4,–5, etc.]; En(a–)[MNS: –1,–2,3,4,5, etc.];U–or S–s–U– [MNS:1,2,–3,–4,–5, etc.].

P

P1+ [P:1]; P1– [P:–1]. P_2 can only be used as an alternative to P1– when the cells have been shown to be P+.

Rh

D+ C+ E– c+ e+ C^w– Rh:–32,33 Be(a–) (in ISBT order) [RH:1,2,–3,4,5,–8,–32,33,–36]. The order D C c E e would be an acceptable alternative. It is also acceptable to use probable genotypes as phenotypes, providing it is made clear that they are only probable genotypes based on haplotype frequencies. E.g. R_1R_2 or DCe/DcE; R_1r C^w+ or DCe/dce C^w+. Null and mod phenotypes: Rh_{null} [RH: –1,–2,–3,–4,–5,–29, etc.]; Rh_{mod}.

Lutheran

Lu(a–b+) Lu:3,4 [LU:–1,2,3,4]. Null phenotype: Lu_{null} or Lu(a–b–) [LU:–1,–2,–3, etc.].

Kell

K– k+ Kp(a–b+c–) Ku+ Js(a–b+) K:11,12,13,–17 [KEL:–1,2,–3,4,5,–6,7,11,12,13,–17,–21]. Null and mod phenotypes: K_0 (zero) or $Kell_{null}$ [KEL:–1,–2,–3,–4,–5, etc.]; K_{mod}.

Lewis

Le(a–b+) Le(ab+) [LE:–1,2,3]; Le(a–b–) Le(ab–) [LE:–1,–2,–3].

Duffy

Fy(a+b+) Fy:3 [FY:1,2,3]; Fy(a–b–) Fy:–3 [FY:–1,–2,–3]. Fy^x may be used as a phenotype.

Kidd

Jk(a+b–) Jk:3 [JK:1,–2,3]; Jk(a–b–) Jk:–3 [JK:–1,–2,–3].

Diego

Di(a+b+) Wr(a–b+) Wd(a–) Rb(a–) WARR– [DI:1,2,–3,4,–5,–6,–7].

Yt

Yt(a+b–) [YT:1,–2].

Xg

Xg(a+) [XG:1].

Scianna

Sc:1,–2,3 [SC:1,–2,3].

Dombrock

Do(a+b+) Gy(a+) Hy+ Jo(a+) [DO:1,2,3,4,5].

Colton

Co(a+b–) Co:3 [CO:1,–2,3]; Co(a–b–) Co:–3 [CO:–1,–2,–3].

Landsteiner-Wiener

LW(a+b–) LW(ab+) [LW:5,6,–7]; LW(a–b–) LW(ab–) [LW:–5,–6,–7].

Chido/Rodgers

Ch:1,2 WH– Rg:1,2 [CH/RG:1,2,–7,11,12].

Hh

H+; H–. The symbol O_h may be used for the true Bombay phenotype (red cells totally H-deficient, ABH non-secretors). Otherwise, the terms 'red cell H-deficient secretor' and 'red cell H-deficient non-secretor' are recommended.

Kx

Kx+ [XK:1]; Kx– or McLeod [XK:–1].

Gerbich

Ge:2,3,4 Wb– Ls(a–) An(a–) Dh(a–) [GE:2,3,4,–5,–6,–7,–8]. Gerbich phenotype may be used instead of Ge:–2,–3,4 [GE:–2,–3,4]; Yus phenotype may be used instead of Ge:–2,3,4 [GE:–2,3,4]; Leach phenotype may be used instead of Ge:–2,–3,–4 [GE:–2,–3,–4].

Cromer

Cr(a+) Tc(a+b–c–) Dr(a+) Es(a+) IFC+ WES(a–b+) UMC+ [CROM:1,2,–3,–4,5,6,7,–8,9,10]. Null phenotype: Inab phenotype [CROM:–1,–2,–3,–4,–5,–6,–7,–8,–9,–10].

Knops

Kn(a+b–) McC(a+) Sl(a+) Yk(a+) [KN:1,–2,3,4,5]. 'Null' phenotype: Helgeson phenotype.

Indian

In(a–b+) [IN:–1,2].

Ok

Ok(a+) [OK:1].

RAPH

MER2+ [RAPH:1].

Cost

Cs(a+b–) [COST:1,–2].

Ii

I adult; i adult; cord. The numerical designations for these phenotypes have not been provided as they are to be modified in the near future.

Er

Er(a+b–) [ER:1,–2].

GLOB

p; P_1^k; P_2^k; LKE+. The numerical designations for these phenotypes have not been provided as they are to be modified in the near future.

700 Series

By– Chr(a–) Bi– Bx(a–) (listed in ISBT order) [700:–2,–3,–5,–6].

901 Series

Vel+ Lan+ At(a+) Jr(a+) (listed in ISBT order) [901:1,2,3,5].

ABO Terminology – Letter O or Number Zero?

A problem has arisen in the standardisation of computer terminology for ABO blood groups. In some countries the letter O is used for the ABO phenotype, in others zero is used. The Working Party recommends that the letter O be used for the O phenotype and in the symbol ABO. This is based on a consensus and is in line with Landsteiner's recommendations reported in 1927 [23].

Terminology for the Glycoprotein Associated with the Rh Proteins

A glycoprotein, often referred to as Rh50, is closely associated with the Rh proteins in the red cell membrane and is essential for expression of Rh antigens [24]. Absence of this glycoprotein from red cells results in the regulator type of Rh_{null} [25]. The Working Party agreed that Rh50 is not a suitable symbol for this glycoprotein, as RH50 is the symbol for the FPTT antigen. As the official symbol for the gene is *RHAG*, the symbol RhAG (Rh-associated glycoprotein) was agreed for the glycoprotein and *RHAG* for the gene encoding it. No human antibody defining RhAG has been identified.

Applications for ISBT Numbers

The 1995 report [1] should be consulted for the criteria and procedures required for acquisition of ISBT numbers. The necessary forms will be found in appendices 1–3 of that report [1]. The following changes must be made. Appendix 1: add MNS41, MNS43, RH52, KEL25, KEL26, DI5 to DI18; delete 700004, 700010, 700013, 700014, 700022, 700027, 700030, 700034, 700037, 700046, 700051 and 700055. Appendix 2: add MNS39, MNS40, MNS42, OK1, RAPH1, 901015, and 901016; delete 901006 and 901011.

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