

International Society of Blood Transfusion working party on terminology for red cell surface antigens

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Introduction

The Working Party met at the Austrian Red Cross Centre, Vienna, Austria, on 9 July 2000. Some changes to the classification documented in Blood Group Terminology 1995 [1] and updated in 1996 [2] and 1998 [3] were agreed and are described below. The full updated classification can be found on the Working Party web site at: <http://www.iccbba.com/page25.htm>

Blood group systems (Table 1)

010: the Diego System

Two additional antigens have been added to the Diego system: Fr^a (previously 700026) has become DI20; and SW1 (previously 700041) has become DI21. Fr^a represents a single base change in *SLC4A1* encoding a Glu480Lys substitution in band 3, the Diego glycoprotein [4,5]. SW1 is distinguished by Trp646 in band 3 [6]. The DI14 phenotype has been expanded to include Trp646, as antibodies defining DI14 do so regardless of whether Gln or Trp occupies position 646 in band 3 [6]. The DI19 designation for Tr^a is still provisional.

012: the Xg System

CD99, a glycoprotein encoded by a gene on X and Y chromosomes, was initially identified by using monoclonal antibodies [7]. Two alloantibodies have been identified that detect the CD99 antigen [8], and thus CD99 can be allocated an International Society of Blood Transfusion (ISBT) number. As *MIC2*, the structural gene for CD99, is closely linked to *XG* (which spans the pseudoautosomal boundary on Xp) and shares substantial sequence homology with *XG*, *MIC2* and *XG* can belong to the same system. Consequently, CD99 has become XG2.

022: the Knops System

Evidence from molecular genetic studies has shown that the antigens defined by the antibodies known as anti-McC^b [9] and anti-Vil [10] represent amino acid substitutions in CR1, the Knops glycoprotein, associated with the absence of McC^a (KN3) and Sl^a (KN4), respectively [11] (J. M. Moulds, unpublished). Therefore, McC^b has become KN6 and Vil has become KN7.

026: the John Milton Hagen System

This is a new system. The JMH antigen, previously 901007, is the semaphorin CDw108 [12]. The gene encoding CDw108, *SEMA7A*, has been cloned and shown to be located on chromosome 15q23–24 [13]. This distinguishes JMH from all existing blood group systems, so a new system was formed, named John Milton Hagen, numbered 026, and with the symbol JMH. JMH1 represents the antigen detected by antibodies produced by JMH:–1 individuals.

700 and 901 Series

700026 and 700041 have joined the Diego system, and 901007 has become JMH1 of the new John Milton Hagen system (Table 1). 700026, 700041 and 901007 are now obsolete

Cluster of differentiation numbers for red cell surface antigens

At the 7th Workshop and Conference on Human Leucocyte Differentiation Antigens (Harrogate, UK, June 2000), cluster of differentiation (CD) numbers were given to some erythroid surface antigens (<http://gryphon.jr2.ox.ac.uk/>). The new numbers are shown in Table 2. CD numbers previously assigned to antigens present on the red cell surface are also shown in Table 2.

Terminology for glycotopes on the red cell surface

The structures and genetics of carbohydrate antigenic

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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*
002 MNS	002039	MNS39	ENEP	None	GPA Ala65Pro†	[2]*
	002040	MNS40	ENEH	None	GPA Thr28Met†	[2]*
	002041	MNS41	HAG	None	GPA Ala65Pro	[3]*
	002042	MNS42	ENAV	None	GPA Gln63Lys†	[3]*
	002043	MNS43	MARS	None	GPA Gln63Lys	[3]*
004 RH	004052	RH52	BARC	None		[2]*
006 KEL	006025	KEL25	VLAN	None		[2]*
	006026	KEL26	TOU	None	Arg406Gln†	[3]*
007 LE	007004	LE4	Le ^{bH}	None		[3]*
	007005	LE5	ALe ^b	None		[3]*
	007006	LE6	BLe ^b	None		[3]*
010 DI	010005	DI5	Wd ^a	700030	Val557Met	[2]*
	010006	DI6	Rb ^a	700027	Pro548Leu	[2]*
	010007	DI7	WARR	700055	Thr552Ile	[2]*
	010008	DI8	ELO	700051	Arg432Trp	[3]*
	010009	DI9	Wu	700013	Gly565Ala	[3]*
	010010	DI10	Bp ^a	700010	Asn569Lys	[3]*
	010011	DI11	Mo ^a	700022	Arg656His	[3]*
	010012	DI12	Hg ^a	700034	Arg656Cys	[3]*
	010013	DI13	Vg ^a	700029	Tyr555His	[3]*
	010014	DI14	Sw ^a	700004	Arg646Gln or Arg646Trp	[3]*
	010015	DI15	BOW	700046	Pro561Ser	[3]*
	010016	DI16	NFLD	700037	Glu429Asp, Pro561Ala	[3]*
	010017	DI17	Jn ^a	700014	Pro566Ser	[3]*
	010018	DI18	KREP	None	Pro566Ala	[3]*
	010020	DI20	Fr ^a	700026	Glu480Lys	[4,5]
010021	DI21	SW1	700041	Arg646Trp	[6]	
012 XG	012002	XG2	CD99	None		[8]
022 KN	022006	KN6	McC ^b	None		[9,11]
	022007	KN7	Vil	None		[10]‡
024 OK	024001	OK1	Ok ^a	901006	Glu92Lys	[3]*
025 RAPH	025001	RAPH1	MER2	901011		[3]*
026 JMH	026001	JMH1	JMH	901007		[12,13]

*References for antigens numbered at the 1996 and 1998 meetings are given in the Makuhari [2] and Oslo [3] reports, respectively.

†Amino acid substitution responsible for absence of the antigen.

‡J. M. Moulds, unpublished.

determinants are highly complex. A new collection, the glycoconjugate blood-group glycotope (GBG) or 800 collection, has been devised to accommodate carbohydrate epitopes, referred to as glycotopes. A draft of this new terminology will be published as a separate document and comments are invited.

Terminology for epitopes of RH1 (D)

A new terminology for epitopes of RH1 is to be developed. This will be published separately and comments are invited. Further modifications of this terminology will only occur following international workshops.

Applications for ISBT numbers

The 1995 report [1] should be consulted for the criteria and procedures required for acquisition of ISBT numbers. Updated versions of the forms in appendices 1–3 of the 1995 report can be downloaded from the internet (<http://www.iccbba.com/page25.htm>) or can be obtained from Dr G. L. Daniels (see Appendix 1 of the present report).

Acknowledgments

We would like to thank Dr Siegfried Seidl, who has recently retired from the Working Party.

Table 2 Some red cell surface antigens with cluster of differentiation (CD) numbers

CD numbers	Antigen	Blood group system
New		
CD173	H type 2	H
CD175	Tn (cryptantigen)	
CD233	Band 3	DI
CD234	Duffy	FY
CD235A	Glycophorin A	MNS
CD235B	Glycophorin B	MNS
CD236C	Glycophorin C	GE
CD236C/D	Glycophorin C/D	GE
CD238	Kell	KEL
CD239	Lutheran/B-CAM	LU
CD240CE	RhCcEe	RH
CD240D	RhD	RH
CD241	RhAG	
CD242	ICAM-4	LW
Old		
CD35	CR1	KN
CD44	CD44	IN
CD55	DAF	CROM
CD77	P ^k (GLOBO2)	GLOBO collection
CD99	CD99 (XG2)	XG
CDw108	JMH	JMH
CD147	EMMPRIN	OK

References

- Daniels GL, Anstee DJ, Cartron JP, Dahr W, Issitt PD, Jørgensen J, Kornstad L, Levene C, Lomas-Francis C, Lubenko A, Mallory D, Moulds JJ, Okubo Y, Overbeeke M, Reid ME, Rouger P, Seidl S, Sistonen P, Wendel S, Woodfield G, Zelinski T: Blood group terminology 1995: from the ISBT Working Party on terminology for red cell surface antigens. *Vox Sang* 1995; **69**:265-279
- Daniels GL, Anstee DJ, Cartron JP, Dahr W, Henry S, Issitt PD, Jørgensen J, Judd WJ, Kornstad L, Levene C, Lomas-Francis C, Lubenko A, Mallory D, Moulds JM, Moulds JJ, Okubo Y, Overbeeke M, Reid ME, Rouger P, Seidl S, Sistonen P, Wendel S, Zelinski T: Terminology for red cell surface antigens. Makuhari report. *Vox Sang* 1996; **71**:246-248
- Daniels GL, Anstee DJ, Cartron JP, Dahr W, Garratty G, Henry S, Jørgensen J, Judd WJ, Kornstad L, Levene C, Lomas-Francis C, Lubenko A, Moulds JJ, Moulds JM, Moulds M, Overbeeke M, Reid ME, Rouger P, Scott M, Seidl S, Sistonen P, Tani Y, Wendel S, Zelinski T: Terminology for red cell surface antigens. ISBT Working Party Oslo report. *Vox Sang* 1999; **77**:52-57
- McManus K, Lupe K, Coghlan G, Zelinski T: An amino acid substitution in the putative second extracellular loop of RBC band 3 accounts for the Froese blood group polymorphism. *Transfusion* 2000; **40**:1246-1249
- Jarolim P, Reid ME: Molecular basis of the Fr^a blood group antigen. *Transfusion* 2000; **40**:14S: (abstr.)
- Zelinski T, Rusnak A, McManus K, Coghlan G: Distinctive Swann blood group genotypes: molecular investigations. *Vox Sang* 2000; **79**:215-218
- Tippett P, Ellis N: The Xg blood group system: a review. *Transf Med Rev* 1998; **12**:233-257
- Uchikawa M, Tsuneyama H, Tadokoro K, Juji T, Yamada M, Maeda Y: An alloantibody to 12E7 antigen detected in 2 healthy donors. *Transfusion* 1995; **35**:23S: (abstr.)
- Molthan L: The status of the McCoy/Knops antigens. *Med Lab Sci* 1983; **40**:59-63
- Lacey P, Laird-Fryer B, Block U, Lair J, Guilbeau L, Moulds JJ: A new high incidence blood group factor, Sl^a, and its hypothetical allele. *Transfusion* 1980; **20**:632: (abstr.)
- Moulds JM, Kassambara L, Middleton JJ, Baby M, Sagara I, Guindo A, Coulibaly S, Yalcouye D, Diallo DA, Miller L, Doumbo O: Identification of complement receptor one (CR1) polymorphisms in West Africa. *Genes Immun* 2000; **1**:325-329
- Mudad R, Rao N, Angelisova P, Horejsi V, Telen MJ: Evidence that CDw108 membrane protein bears the JMH blood group antigen. *Transfusion* 1995; **35**:566-570
- Yamada A, Kubo K, Takeshita T, Harashima N, Kawano K, Mine T, Sagawa K, Sugamura K, Itoh K: Molecular cloning of a glycosylphosphatidylinositol-anchored molecule, CDw108. *J Immunol* 1999; **162**:4094-4100

Appendix 1

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