1

Introduction

Aims of this FactsBook

The purpose of this FactsBook is to provide key information relating to the erythrocyte membrane components carrying blood group antigens, the genes encoding them, the molecular basis of the antigens and phenotypes, characteristics, and the clinical significance of blood group antibodies. Only key references are given to allow the interested reader to obtain more details. The book is designed to be a convenient, easy-to-use reference for those involved in the field of transfusion medicine, as well as medical technologists, students, physicians, and researchers interested in erythrocyte blood group antigens.

This FactsBook contains information about the blood group antigens that have been numbered by the International Society of Blood Transfusion Working Party on Red Cell Immunogenetics and Blood Group Terminology[1–4]. The blood group systems and the antigens within each system are listed by their traditional name, and are arranged in the same order as described by the ISBT Working Party for Red Cell Immunogenetics and Blood Group Terminology. See Table 1.1 for an overview of the blood group systems. Those antigens not in a blood group system are accommodated in Collections (200 series), in the 700 Series of Low-Incidence Antigens or in the 901 Series of High-Incidence Antigens (for latest ISBT terminology, see www.isbt-web.org).

Selection of entries

Blood group antigens are surface markers on the outside of the red blood cell (RBC) membrane. They are proteins and carbohydrates attached to lipid or protein. A model for the types of membrane components carrying blood group antigens is shown in Figure 1.1. A blood group antigen is defined serologically by antibodies made by a human, and in order to be assigned a number by the ISBT Working Party the antigen must be shown to be inherited. Historically, antigens associated with forms of polyagglutination have not been numbered by the ISBT; however, in Section III we have included a table summarizing the characteristics of T, Tn, Tk, and Cad.

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TABLE 1.1 Blood group systems with gene name and chromosome location

System name	ISBT symbol^	ISBT number	Number of antigens	Gene names	Chromosome location	CD number
ABO	ABO	001	4	*ABO*	9q34.2	
MNS	MNS	002	46	*GYPA, GYPB, GYPE*	4q31.21	CD235
P1PK	P1PK	003	3	*A4GALT*	22q13.2	CD77 (P^k)
Rh	RH	004	52	*RHD, RHCE*	1p36.11	CD240
Lutheran	LU	005	20	*LU, BCAM*	19q13.32	CD239
Kell	KEL	006	34	*KEL*	7q34	CD238
Lewis	LE	007	6	*FUT3*	19p13.3	
Duffy	FY	008	5	*FY, DARC*	1q23.2	CD234
Kidd	JK	009	3	*JK, SLC14A1*	18q12.3	
Diego	DI	010	22	*DI, SLC4A1*	17q21.31	CD233
Yt	YT	011	2	*YT, ACHE*	7q22.1	
Xg	XG	012	2	*XG*	Xp22.33	CD99
Scianna	SC	013	7	*SC, ERMAP*	1p34.2	
Dombrock	DO	014	8	*DO, ART4*	12p12.3	CD297
Colton	CO	015	4	*CO, AQP1*	7p14.3	
Landsteiner-Wiener	LW	016	3	*LW, ICAM4*	19p13.2	CD242
Chido/Rodgers	CH/RG	017	9	*CH/RG, C4A, C4B*	6p21.32	
H	H	018	1	*FUT1*	19q13.33	CD173

System name	ISBT symbol^	ISBT number	Number of antigens	Gene names	Chromosome location	CD number
Kx	XK	019	1	*XK*	Xp21.1	
Gerbich	GE	020	11	*GE, GYPC*	2q14.3	CD236
Cromer	CROM	021	17	*CROM, CD55*	1q32.2	CD55
Knops	KN	022	9	*KN, CR1*	1q32.2	CD35
Indian	IN	023	4	*IN, CD44*	11p13	CD44
Ok	OK	024	3	*OK, BSG*	19p13.3	CD147
Raph	RAPH	025	1	*RAPH, CD151*	11p15.5	CD151
John Milton Hagen	JMH	026	6	*JMH, SEMA7A*	15q24.1	CD108
I	I	027	1	*GCNT2*	6p24.2	
Globoside	GLOB	028	1	*B3GALNT1*	3q26.1	
Gill	GIL	029	1	*GIL, AQP3*	9p13.3	
Rh-associated glycoprotein	RHAG	030	4	*RHAG*	6p12.3	CD241
Forssman	FORS	031	1	*GBGT1*	9q34.2	
JR	JR	032	1	*JR, ABCG2*	4q22.1	CDw338
LAN	LAN	033	1	*LAN, ABCB6*	2q36	

^For up to date HUGO gene names see http://www.genenames.org/

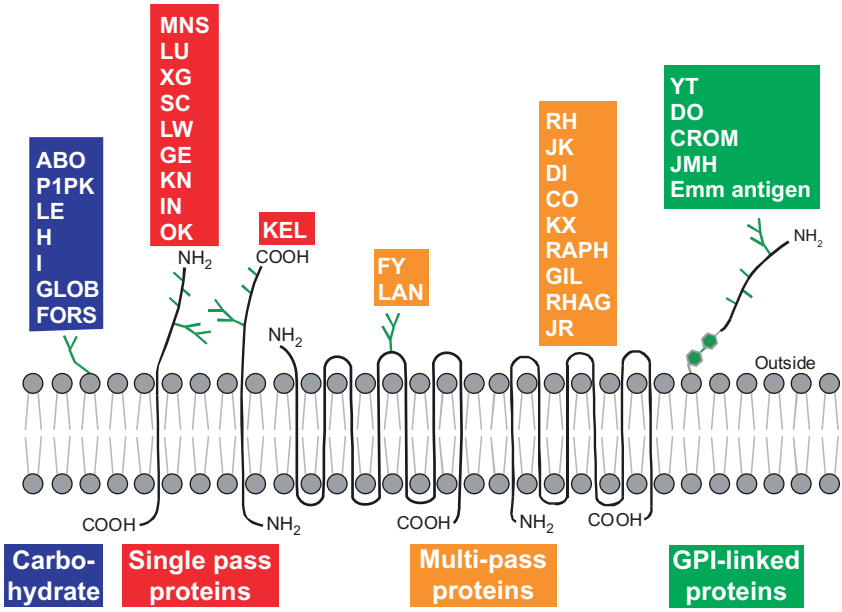

FIGURE 1.1 Model of RBC membrane components that carry blood group antigens. Not shown is the Ch/Rg blood group system. Ch/Rg antigens are carried on C4d, which is adsorbed from plasma onto RBC membrane components.

Terminology

The nomenclature used for erythrocyte blood group antigens is inconsistent. While several antigens were named after the proband whose RBCs carried the antigen or who made the first known antibody, others were assigned an alphabetical or a numerical notation. Even within the same blood group system, antigens have been named using different schemes, and this has resulted in a cumbersome terminology for describing phenotypes. The ISBT Working Party established a system of upper case letters and numbers to represent blood group systems and blood group antigens in a format that will allow both infinite expansion and computer-based storage. These symbols and numbers are designed for use in computer databases (no lower case letters) and are short (for column headings). A comprehensive review of terminology and its recommended usage can be found in Garratty, et al.[5].

Throughout this book, the systems and antigens are named by the traditional name, but we also give the ISBT symbol, the ISBT number, and obsolete names that have been used in the literature. We have included a brief description of how the blood group systems and antigens were named.

The following are examples of how to write antigens, antibodies, phenotypes, and genotypes.

List of antigens: M, N, P1, K, Kp^b, K11, Fy^a, Fy^b, Lu3
List of antibodies: Anti-M, anti-K, anti-Fy^a, anti-Jk3 or Anti-M, -K, -Fy^a, -Jk3 or antibodies directed against M, K, Fy^a, and Jk3 antigens
Phenotype: D+C–E–c+e+; M+N–S–s+,Vw+; K+k–K11–; Fy(a+b+); Jk(a+b–) or RH:1,–2,–3,4,5; MNS:1,–2,–3,4,9; KEL:1,–2,–11; FY:1,2; JK:1,–2

	Traditional	ISBT
Antigen	Fy^a	FY1, 008001 or 8.1
Phenotype	Fy(a+b–)	FY:1,–2
Gene	*Fy^a*	*FY*01* or *FY*A*
	FY	*FY*N*, *FY*01N* or *FY*02N*
Genotype	*Fy^aFy^a*	*FY*01/FY*01* or *FY*A/FY*A*
	Fy^aFy	*FY*01/FY*N* or *FY*A/FY*N*

In addition to the ISBT terminology for antigens and traditional allele names, the ISBT Working Party recently agreed on a proposed terminology for blood group alleles[4]. Since the introduction of a new naming system for thousands of alleles is a complicated and cumbersome procedure, it is anticipated that certain changes to the new terminology are unavoidable. Despite this, we have used the currently agreed nomenclature to familiarize the reader with the new allele names. However, we encourage the use of the official and constantly updated lists of allele names found at *www.isbt-web.org*. These allele names are restricted to those with a phenotypic effect and intended for use in Transfusion Medicine. Their use does not require sequencing of the entire allele. The rules for naming alleles and for obtaining a number for a new allele may be found at *www.isbt-web.org*.

References

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[5] Garratty, G., et al., 2000. Terminology for blood group antigens and genes: Historical origins and guidelines in the new millennium. Transfusion 40, 477–489.