BLOOD GROUP ANTIGEN

FactsBook

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THE BLOOD GROUP ANTIGEN

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Third Edition

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The Blood Group Antigen FactsBook

Preface

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In compiling the entries for this text we were again impressed by the rapid pace with which new information became available. We have done our best to be consistent, accurate, and up-to-date (as of going to press). We encourage comments from readers on any errors, omissions, and improvements. Please email the authors:

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Abbreviations

AChE Acetylcholinesterase

AET 2-aminoethylisothiouronium bromide AIDS Acquired immune deficiency syndrome

AIHA Autoimmune hemolytic anemia

ART ADP-ribosyltransferase
BCAM Basal cell adhesion molecule
BGM Blood group modified

bp Base pair

CAT Column agglutination technology
CCP Complement control protein
CD Cluster of differentiation

CDA Congenital dyserythropoietic anemia CDG Congenital disorder of glycosylation

cDNA complementary DNA

Cer Ceramide

CHAD Cold hemagglutinin disease
CHIP Channel-forming integral protein

CHO Carbohydrate moiety

CGD Chronic granulomatous disease

COOH Carboxyl terminus
CR1 Complement receptor 1
CSF Cerebrospinal fluid
CTH Ceramide trihexoside
DAF Decay accelerating factor
DAT Direct antiglobulin test
DNA Deoxyribonucleic acid

DTT Dithiothreitol ep epitope

ER-Golgi Endoplasmic reticulum-Golgi apparatus

Fuc L-fucose
Gal D-galactose

GalNAc N-acetyl-D-galactosamine

Glc Glucose

GlcNAc N-acetyl-D-glucosamine

GP Glycophorin

GPI Glycosylphosphatidylinositol

GYP Glycophorin gene HA Hemolytic anemia

HDFN Hemolytic disease of the fetus and newborn

HLA Human leukocyte antigen

HEMPAS Hereditary erythoblastic multinuclearity with positive acidified serum test

HUS Hemolytic uremic syndrome IAT Indirect antiglobulin test Ig Immunoglobulin

ISBT International Society of Blood Transfusion

ITP Immune thrombocytopenia

kbp Kilo base pair

LAD Leukocyte adhesion deficiency LISS Low-ionic strength solution

MAb Monoclonal antibody

MAIEA Monoclonal antibody immobilization of erythrocyte antigens

2-ME 2-Mercaptoethanol

MDS Myelodysplastic syndromes M_r Apparent relative molecular mass

NeuNAc N-acetyl neuraminic acid

NH₂ Amino terminus

NSAID Nonsteroidal anti-inflammatory drug

NT/nt Nucleotide

ORF Open reading frame

PCH Paroxysmal cold hemoglobinuria

PEG Polyethylene glycol

PNH Paroxysmal nocturnal hemoglobinuria R Remainder of carbohydrate chain

RBC Red blood cell
RT Room temperature
SCD Sickle cell disease
SCR Short consensus repeat

SDS-PAGE Sodium dodecyl sulfate-polyacrylamide gel electrophoresis

Se/se Secretor/non-secretor SGP Sialoglycoprotein

SLE Systemic lupus erythematosus SNP Single nucleotide polymorphism SSEA Stage-specific embryonic antigen

Useful Websites

The easiest and quickest way is to access via a search engine.

dbRBC (for information about all blood group systems)

nybloodcenter.org (for information about RHCE alleles)

Rhesus Base (for information about RHD alleles)

www.genenames.org/ (for HUGO gene names)

www.isbt-web.org (for information about terminology and all blood group systems) www.emina.med.uni-muenchen.de or http://www.euro-hd.net/html/na/registry (for information about McLeod syndrome).

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Section I

The Introductory Chapters



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.

System name	ISRT cymbol A	ISRT	Number of	Gene names	Chromosome	CD number
33	i koli	number	antigens	a od salvado a od	location	
ABO	ABO	100	4	ABO	9q34.2	
WNS	MNS	000	46	GYPA, GYPB, GYPE	4q31.21	CD235
P1PK	P1PK	003	3	A4CALT	22q13.2	CD77 (Pk)
Rh. In a series	КН	004	52	RHD, RHCE	1p36.11	CD240
Lutheran	In	500	20	LU, BCAM	19q13.32	CD239
Kell met	KEL	900	34	KEL T T T T T T T T T T T T T T T T T T T	7q34	CD238
Lewis	IE GI	200	nda hada 9	FUT3	19p13.3	
Duffy	± ±	800	5 11 15	FY, DARC	1923.2	CD234
Kidd and a supply	M M	600	3 2	JK, SLC14A1	18q12.3	
Diego	DI	010	22	DI, SLC4A1	17q21.31	CD233
A to more than the same than t	Y	011 = = =	2 2 2 2 2	YT, ACHE	7q22.1	
Xg	XG	012	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	XC+ To the state of the state o	Xp22.33	66CD
Scianna	SC ST	013	1 1 1 1	SC, ERMAP	1p34.2	
Dombrock	DO	014	8 11	DO, ART4	12p12.3	CD297
Colton	00	015	not be to be	CO, AQP1	7p14.3	
Landsteiner-Wiener	EW M	016	3 2 8 2 8	LW, ICAM4	19p13.2	CD242
Chido/Rodgers	CH/RG	017	6	CH/RG, C4A, C4B	6p21.32	
日本日日日日日日	1 2 8 工	018	Par Barre	FUTI E B B - HUT	19q13.33	CD173

System name	ISBT symbol^	ISBT	Number of antigens	Gene names	Chromosome location	CD number
X	XK	019		XK	Xp21.1	100 E
Gerbich	CE SE SE SE	020		GE, GYPC	2q14.3	CD236
Cromer	CROM	021	17	CROM, CD55	1q32.2	CD55
Knops	N N	022	6	KN, CR1	1932.2	CD35
Indian	Z	023	4	IN, CD44	11p13	CD44
ŏ	OK NO	024	3	OK, BSC	19p13.3	CD147
Raph	RAPH	025		RAPH, CD151	11p15.5	CD151
John Milton Hagen	JMH	026	9	JMH, SEMA7A	15924.1	CD108
	STEE STEE STEE STEE STEE STEE STEE STEE	027	100000000000000000000000000000000000000	GCN72	6p24.2	
Globoside	GLOB	028	Aut and a	B3CALNT1	3q26.1	
Cill	THE PROPERTY NO.	029	To the second second	GIL, AQP3	9p13.3	
Rh-associated glycoprotein	RHAG	030	A SIN	RHAG	6p12.3	CD241
Forssman	FORS	031		CBC71	9q34.2	
JR	JR on The	032		JR, ABCG2	4q22.1	CDw338
LAN	LAN	033		LAN, ABCB6	2q36	

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

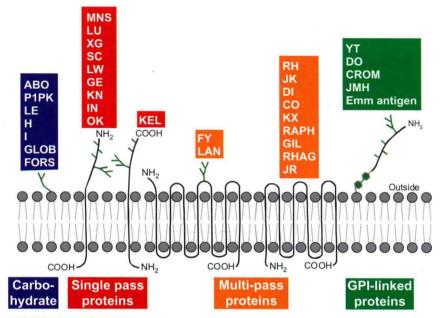


FIGURE 1.1 Model of RBC membrane components that carry blood group antigens. Not shown is the Ch/Rg blood group system. Ch/Rg antigens are carried on C4d, which is adsorbed from plasma onto RBC membrane components.

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
ana dispression di	FY.	FY*N, FY*01N or FY*02N
Genotype	Fy ^a Fy ^a	FY*01/FY*01 or FY*A/FY*A
NY MALANA PARI	Fy ^a Fy	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 alleles⁴. 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.

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