Antigens and Antibodies, Characteristics and Behaviors

Blood Group System (No. of Antigens)	Antigen	Enzyme Effect (Ficin/Papain) Ag + Ab reaction	DTT (Dithiothreitol)	Structure	Immunoglobulin	Naturally Occurring Abs	Demonstrate Dosage	Autoantibody	Complement binding	Optimal Temperature	Clinical Significance of Antibody: HTR	Clinical Significance of Antibody: HDFN	Clinical Significance of Antibody: Delayed	Expression on: Cord RBCs	Expression on: Platelets	Caucasians Frequency*	Neutralization	Remarks
ABO (4)	A	▲	▶	Car.	IgM>IgG	++		R	++	≤RT	0-3	0-2	0-3	Weak	Yes	43%	Saliva from A secretors	usually has low concentration of anti-B in plasma
	B	▲	▶	Car.	IgM>IgG	++		R	++	≤RT	0-3	0-2	0-3	Weak	Yes	9%	Saliva from B secretors	Serum contains ant-A and anti-A1
	AB	▲	▶	Car.	IgM>IgG	++		R	R	≤RT	0-1	0-3	0-1	Weak	Yes	56%	Saliva from A,B or AB secretors	Found in group O and cannot be separated into anti-A & Anti-B
	A1	▲	▶	Car.	IgM>IgG	+		R	R	≤RT	0-1	0	0-1	Weak	Yes	34%	Saliva from A1 secretors	Most found in A_2 and A_2B react at 25°C
Rh (55)	D	▲	▶	Pro.	IgG>IgM	R		+	R	IAT	1-3	1-3	1-3	Yes	No	85%		People with a Partial D can make anti-D even though their RBCs are D+
	C	▲	▶	Pro.	IgG>IgM	+	Yes	++	No	IAT	1-3	1	1-3	Yes	No	68%		Often found mixture with anti-G or anti-D, can affect the expression of D Ags when it comes in trans position
	E	▲	▶	Pro.	IgG>IgM	++	Yes	+	No	RT/IAT	1-2	1	1-2	Yes	No	29%		Often present with sera contain anti-c
	c	▲	▶	Pro.	IgG>IgM		Yes	+	No	IAT	1-3	1-3	1-3	Yes	No	80%		Second most immunogenic Ag of Rh system after D
	e	▲	▶	Pro.	IgG>IgM		Yes	++	No	IAT	1-2	R-2	1-2	Yes	No	98%		Anti-e like Abs may be made by people with e Ag RBCs lacking some e epitopes
	C^w	▲	▶	Pro.	IgG>IgM	+	Yes		No	RT/IAT	1-3	1-2	1-3	Yes	No	2%		C^w + RBCs are almost always C +, but the C antigen associated with C w is weaker than normal C
	V	▶	▶	Pro.	IgG					IAT	1	0	1	Yes	No	1%		Frequently occurs in sera containing Anti-D
	G	▲	▶	Pro.	IgG				No	IAT	0-3	0-3	0-3	Yes	No	84%		Present on red cells expressing C or D antigens
Compound Antigens	cE	▶	▶	Pro.	IgG	+			+	IAT						28%		The Ab is not produced when c and E in *trans* e.g.(DCE/ce)
	F(ce)	▶	▶	Pro.	IgG>IgM			+	No	RT/IAT	2	2	2	Yes	No	65%		The Ab is not produced when c and e in *trans* e.g.(DCe/DcE)
	Ce	▲	▶	Pro.	IgG>IgM				No	IAT	1	1	1	Yes	No	68%		The Ab is not produced when C and e in *trans* e.g.(DCE/DcE) Usually found in sera containing anti-C
	CE	▶	▶	Pro.		+				RT/37°				Yes		<0.01%		The Ab is not produced when C and E in *trans* e.g.(DCe/DcE)
Kell (36)	K	▶	▼	Pro.	IgG>IgM	+		+	R	RT/IAT	1-3	1-3	1-3	Yes	No	9%		Ag-K is Expressed very early during erythropoiesis.
	k	▶	▼	Pro.	IgG>IgM			+	No	IAT	1-2	1-3	1-2	Yes	No	99.8%		Kell Ags expressed primarily in bone marrow, fetal liver & testes
	Kp^a	▶	▼	Pro.	IgG	R			No	IAT	1-2	1-3	1-2	Yes	No	2%		Anti-Kp^a is often found with anti-K Kp^a may suppress another kell antigen
	Kp^b	▶	▼	Pro.	IgG>IgM	+		+	No	IAT	0-2	1-2	0-2	Yes	No	100%		Sera contain anti-Kp^b often contain anti-K
	Js^a	▶	▼	Pro.	IgG>IgM	+			No	IAT	0-2	1-3	0-2	Yes	No	<0.01%		
	Js^b	▶	▼	Pro.	IgG				No	IAT	1-2	1-3	1-2	Yes	No	100%		
Duffy (5)	Fy^a	▼	▶	Pro.	IgG>IgM	R	Yes	+	R	IAT	1-3	1-3	1-3	Yes	No	66%		Ag been expressed on fetal RBCs as early as 6 weeks gestation
	Fy^b	▼	▶	Pro.	IgG>IgM	+	Yes	++	R	IAT	1-3	1	1-3	Yes	No	83%		The Abs is 20 times less immunogenic compare with anti-Fy^b
Kidd (3)	Jk^a	▲	▶	Pro.	IgG=IgM	+	Yes	+	++	IAT	0-3	1-3	0-3	Yes	No	77%		Jk Ags work as urea transporter in RBCs And may act as minor histocompatibility antigens in renal allograft rejection
	Jk^b	▲	▶	Pro.	IgG=IgM		Yes	+	++	IAT	0-3	0-1	0-3	Yes	No	74%		
Lewise (6)	Le^a	▲	▶	Car.	IgM > IgG	++			++	RT/IAT/37°	0-2	0-1	0	No	Yes	22%	Plasma and Isotonic saliva	Lewise Ags are Soluble antigen absorbed from the plasma
	Le^b	▲	▶	Car.	IgM > IgG	+			++	RT/IAT/37°	0	0-1	0	No	Yes	72%		Receptor for Helicobacter pylori in gastric mucosal epithelium
P1PK(3)	P1	▲	▶	Car.	IgM>IgG	+		+	R	≤ RT	0-2	0	R	Weak	Yes	79%	Hydatid cyst fluid, Pigeon egg white	Anti-P is Frequently present with hydatid & liver fluke diseases
MNS (49)	M	▼	▶	Pro.	IgG = IgM	++	Yes	R	0	4°/RT/IAT	0-R	0-R	0	Yes	No	78%		Anti-M common in children & in bacterial infection
	N	▼	▶	Pro.	IgM = IgG	++	Yes	R	0	4°/RT/IAT	0	0	0	Yes	No	72%		Anti-N-like can be found with patient undergo renal dialysis
	S	▲▼	▶	Pro.	IgM > IgG	++	Yes	R	+	RT/IAT	0-2	0-3	0	Yes	No	55%		Sera containing Ant-S frequently contain Abs to low prevalence Ags
	s	▲▼	▶	Pro.	IgG > IgM	0	Yes		R	4°/IAT/RT	0-1	0-3	0	Yes	No	89%		Some anti-s enhanced in pH of 6.0
	U	▶	▶	Pro.	IgG	0		+	0	IAT	1-3	1-3	1-3	Yes	No	99.9%		Patient with S- s- RBCs is U- Ags
Lutheran (25)	Lu^a	▶	▼▶	Pro.	IgM>IgG	+	Yes		R	RT/IAT	0-1	0-1	0-1	Weak	No	8%		Sera containing ant-Lu^a often contain anti-HLA
	Lu^b	▶	▼▶	Pro.	IgG>IgM		Yes		R	RT/IAT	1-2	1	0	Weak	No	99.8%		Lutheran antibodies are adsorbed by placental cells
Xg(2)	Xg^a	▼	▶	Pro.	IgG>IgM	+		R	+	RT/IAT	0	0	0	Weak	Yes	89%		genes are carried on the X chromosome so that males have only one gene
Colton (4)	Co^a	▶	▶	Pro.	IgG>IgM	R		+	+	IAT	0-2	1-3	0-2	Yes	No	99.5%		Work as Transport Proteins
	Co^b	▶	▶	Pro.	IgG				R	IAT	0-2	1	1-2	Yes	No	8%		
Diego (22)	Di^a	▶	▶	Pro.	IgG	R			+	IAT	0-3	1-3	1-3	Yes		0.01%		Located on band 3 which is important in CO_2 and O_2 transport
	Di^b	▶	▶	Pro.	IgG		Yes	+	0	IAT	0-2	1	0-2	Yes	No	100%		
LW (3)	LW^a	▶	▼	Pro.	IgG>IgM			+		IAT/RT	0-1	0-1	0-1	Yes		100%		Ags are weak or absent when RBCs stored in EDTA Ags maybe depressed during pregnancy and some diseases. Behave like anti-D
	LW^b	▲	▼	Pro.	IgG>IgM					IAT/37°	0-1	0-1		Yes		R		
H (1)	H	▲	▶	Car.	IgM > IgG			+	+	4°/RT/IAT	0-3	1-3	0-3	Weak	Yes	99.9%	Saliva, All body fluids except CSF	Anti-H found in Bombay (O^h)with those have no A,B,H Ags Para-Bombay (Hh)

CHARACTERISTIC	IgM	IgG
Optimal Temperature	≤Rt	37°c
Molecular Weight	900.000	150.000
Structure	Pentamer	Monomer
Treatment With DTT	Reduced	Unaffected
Crosses The Placenta	No	Yes
Activation Of Complement	Very Efficient	Not As Efficient
Clearance Of Red Cells	Intravascular	Extravascular
Detection	Immediate-spin	Antiglobulin Test

0	No	E	Enzyme
1	Mild	▼	sensitive
2	Moderate	▶	Resistant
3	Severe	▲	Enhanced
UN	Unknown	▲▼	Variable
R	Rare	Colors	Antithetical antigen
Pro.	Protein	▼▶	▼ In 200 mM / ▶ in 50 mM
Car.	carbohydrate	Ag/Ab	Antigen/Antibody

Number of Blood Group antigens

322 Ags belong to 36 System

(ISBT,2019)

To get more or less expected number of units to be used, use this Equation:

(1 – (Frequency of ethnic group by number))= antigen negative incidence(ANI)

Requested Units ÷ ANI = Required Units

>>*For multiple Abs use* (Requested unit ÷ (ANI1 X ANI2 X ANI3)= Required Units

Example: patient has Anti- **Jk^a** , and he/she needs **4** units of PRBCs, How many units I should test to have units negative for Jk^a?

Answer : 1 – **0.77** = 0.23 -> **4 ÷ 0.23 = 17**

*** That's mean you have to test not less than 17 units to get units negative with Ag Jk^a**

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