

ABO Blood Groups and investigation

Routine Testing

ABO Group	ADULT				Referencells			
	Anti-A	Anti-B	Anti-A,B	Neg Control	A ₁ cells	A ₂ cells	B cells	O cells
O	0	0	0	0	3 - 4	2 - 4	3 - 4	0
A	4	0	4	0	0	0	3 - 4	0
B	0	4	4	0	3 - 4	2 - 4	0	0
AB	4	4	4	0	0	0	0	0

ABO Group	NEONATE			
	Anti-A	Anti-B	Anti-A,B	Neg Control
O	0	0	0	0
A	2 - 4	0	2 - 4	0
B	0	2 - 4	2 - 4	0
AB	2 - 4	2 - 4	2 - 4	0

Investigation

ABO Group	SUBGROUPS				Referencells				Auto Control	Anti-A ₁	Anti-H	Recommendations / Next steps
	Anti-A	Anti-B	Anti-A,B	Neg Control	A ₁ cells	A ₂ cells	B cells	O cells				
O	0	0	0	0	3 - 4	2 - 4	3 - 4	0	0	0	4	Plasma contains anti-A ₁ , anti-A ₂ , anti-B and anti-A,B, mostly IgG isotype
O _h	0	0	0	0	4	4	4	4	0	0	0	'Bombay or para-Bombay' types usually react positive with all normal RBCs due to anti-H. All crossmatches and antibody screening / identification reactions with normal (non O _h) RBCs are usually positive Auto-control is negative. Confirm anti-H in the patient's plasma/serum using known O _h cells (expected negative reaction)
A ₁	4	0	4	0	0	0	3 - 4	0	0	3 - 4	0	Approx 80% of Group A Europeans are subtype A ₁ . Plasma anti-B is mostly IgM isotype.
A _{int}	4	0	4	0	0	0	3 - 4	0	0	1 - 2	2 - 3	Reacts with both Anti-A ₁ and Anti-H
A ₂	4	0	4	0	0 - 2	0	3 - 4	0	0	0	2 - 3	Most Group A individuals who are not A ₁ are A ₂ . Rarely has anti-A ₁ in plasma/serum (1 - 8% of A ₂ individuals). Anti-A ₁ is usually present in plasma/serum
A ₃	1-3/mf	0	1-3/mf	0	0 - 2	0	3 - 4	0	0	0	3 - 4	Testing with 'Anti-A Hel' lectin from Helix pomatia distinguishes A ₁ /A ₂ from A ₃ and weaker subgroups. If A ₃ cells react positive, confirm presence of anti-A ₁ using A ₂ cells which are expected to react negative
A ₄	0 - w	0	w - 2	0	0 - 3	0	3 - 4	0	0	0	4	Plasma usually contains anti-A ₁
A _{end}	1/mf	0	1/mf	0	0 - 1	0	3 - 4	0	0	0	4	Very weak reactions with Anti-A and Anti-A,B (compare with A ₁)
A _{bantu}	w/mf	0	w/mf	0	0 - 1	0	3 - 4	0	0	0	4	
A _m or A _y	0 - w	0	0 - w	0	0	0	3 - 4	0	0	0	4	Confirm by absorption/elution using Anti-A/A,B. If a secretor, A and H substances in saliva.
A _{ul}	0 - w	0	0 - w	0	2	0 - 1	3 - 4	0	0	0	4	If a secretor, H substance only in saliva
B	0	4	4	0	4	3	0	0	0	0	0 - 1	Plasma anti-A is mostly IgM isotype
B ₃	0	2/mf	2/mf	0	4	3	0	0	0	0	4	
B ₄	0	0 - w	w - 2	0	4	3	w	0	0	0	4	
A ₁ B	4	4	4	0	0	0	0	0	0	2 - 4	0	
A ₂ B	2 - 4	4	4	0	0 - 2	0	0	0	0	0	1 - 2	Anti-A ₁ is present in plasma/serum of 22-35% of A ₂ B individuals
A ₃ B	1/mf	4	4	0	0 - w	0	0	0	0	0	+	Rarely has anti-A ₁ in plasma/serum
A ₄ B	0 - w	4	4	0	1 - 2	0	0	0	0	0	0	Anti-A ₁ is usually present in plasma/serum

ABO Group	HYPOGAMMAGLOBULINEMIA				Referencells				Auto Control	Anti-A ₁	Anti-H	Recommendations / Next steps
	Anti-A	Anti-B	Anti-A,B	Neg Control	A ₁ cells	A ₂ cells	B cells	O cells				
O	0	0	0	0	0 - 2	0 - 1	0 - 2	0	0	0	4	Plasma/serum has weak or missing isoagglutinins due to reduced immunoglobulin levels (hypogammaglobulinaemia), usually in elderly or immunocompromised patients or after massive transfusion of plasma expanders
A	4	0	4	0	0	0	0 - 2	0	0	0 - 4	0 - 3	Perform reverse grouping test at 4°C, with enzyme-treated cells, increase serum to cell ratio or use extended incubation time.
B	0	4	4	0	0 - 2	0 - 1	0	0	0	0	0 - 1	

ABO Group	COLD-REACTIVE AUTOANTIBODIES				Referencells				Auto Control	Anti-A ₁	Anti-H	Recommendations / Next steps
	Anti-A	Anti-B	Anti-A,B	Neg Control	A ₁ cells	A ₂ cells	B cells	O cells				
O	1-4	1-4	1-4	1-4	3 - 4	3 - 4	3 - 4	1 - 4	1-4	1-4	4	Unwashed Plasma/serum contains cold-reactive IgM autoantibody. Agglutination in the forward grouping test is caused by cold agglutinin carried into the test.
A	4	1-4	4	1-4	1-4	1-4	3 - 4	1 - 4	1-4	1 - 4	1 - 4	Washed Retest after washing the cells. It may be necessary to wash the cells in saline at 37°C to remove the cold autoagglutinin.
B	1-4	4	4	1-4	3 - 4	3 - 4	1 - 4	1 - 4	1-4	1-4	4	Unwashed
AB	4	4	4	1-4	1-4	1-4	1 - 4	1 - 4	1-4	1 - 4	1 - 4	Unwashed

ABO Group	COLD-REACTIVE ALLOANTIBODIES				Referencells				Auto Control	Anti-A ₁	Anti-H	Recommendations / Next steps
	Anti-A	Anti-B	Anti-A,B	Neg Control	A ₁ cells	A ₂ cells	B cells	O cells				
O	0	0	0	0	3 - 4	2 - 4	3 - 4	0 - 4	0	0	4	Plasma/serum contains cold-reactive IgM alloantibody. Reactivity pattern depends on specificity and antigens represented on reverse grouping cells.
A	4	0	4	0	0 - 4	0 - 4	3 - 4	0 - 4	0	0 - 4	0 - 3	Repeat ABO typing at 37°C. Identify alloantibody by testing with a panel of typed cells. Select antigen-negative A ₁ and B cell for reverse grouping.
B	0	4	4	0	3 - 4	3 - 4	0 - 4	0 - 4	0	0	0 - 1	
AB	4	4	4	0	0 - 4	0 - 4	0 - 4	0 - 4	0	0 - 4	0 - 2	

KEY	
AGGLUTINATION	
0	Negative / No agglutination
w	weak
1	1+ / +
2	2+ / ++
3	3+ / +++
4	4+ / ++++
mf	Mixed field / double population

NOTES

- Not all ABO sub-groups and abnormal conditions are listed
- Consider the possibility of mixed field reactions if the patient has been transfused with non-identical blood
- Reactions are those expected with monoclonal Anti-A, B and A,B antisera
- Bold text in the reaction table indicates reactions that are characteristic of the particular subgroup or abnormal condition

REFERENCES

- John D Roback ed. (2008) AABB Technical Manual, 16th Edition Chapter 12
- John D Roback ed. (2011) AABB Technical Manual, 17th Edition Chapter 12
- Harvey G. Klein and David J. Anstee (2005) Mollison's Blood Transfusion in Clinical Medicine, 11th Edition Chapter 4
- Geoff Daniels (2002) Human Blood Groups, 2nd Edition



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