This lecture was done by 432 Physiology Team

10
/11

Blood Groups

432 ***Hematology*** *Team*

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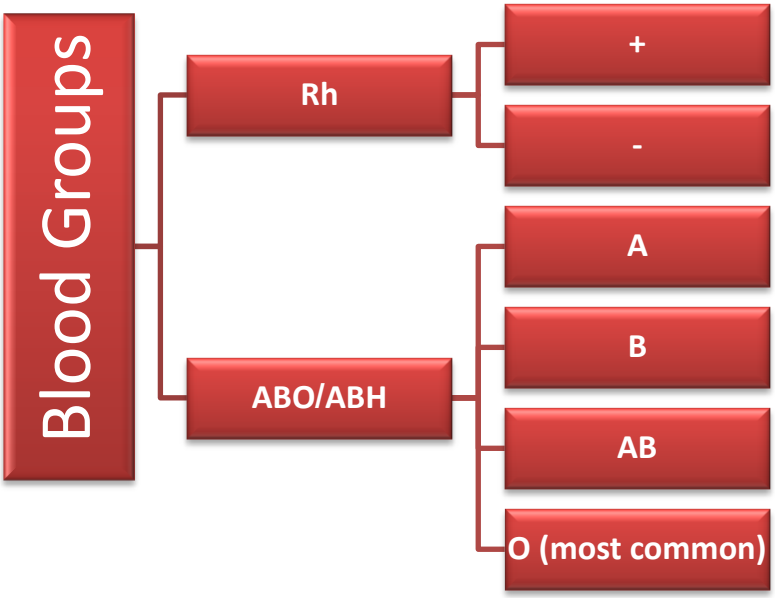
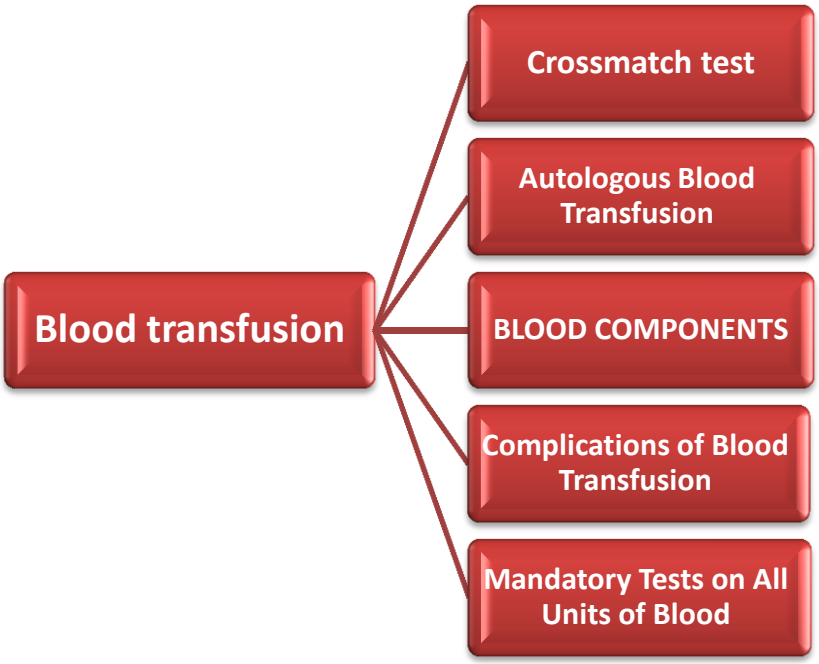
Color Index:Female notes are in Green. Male notes are in Blue. Red is important. Orange is explanation.

Blood Groups

Mind Map:





Check out this video to review your knowledge about the topic
http://www.youtube.com/watch?v=KXTF7WehgM8

GENERAL EXAMINATION OF BLOOD DONORS

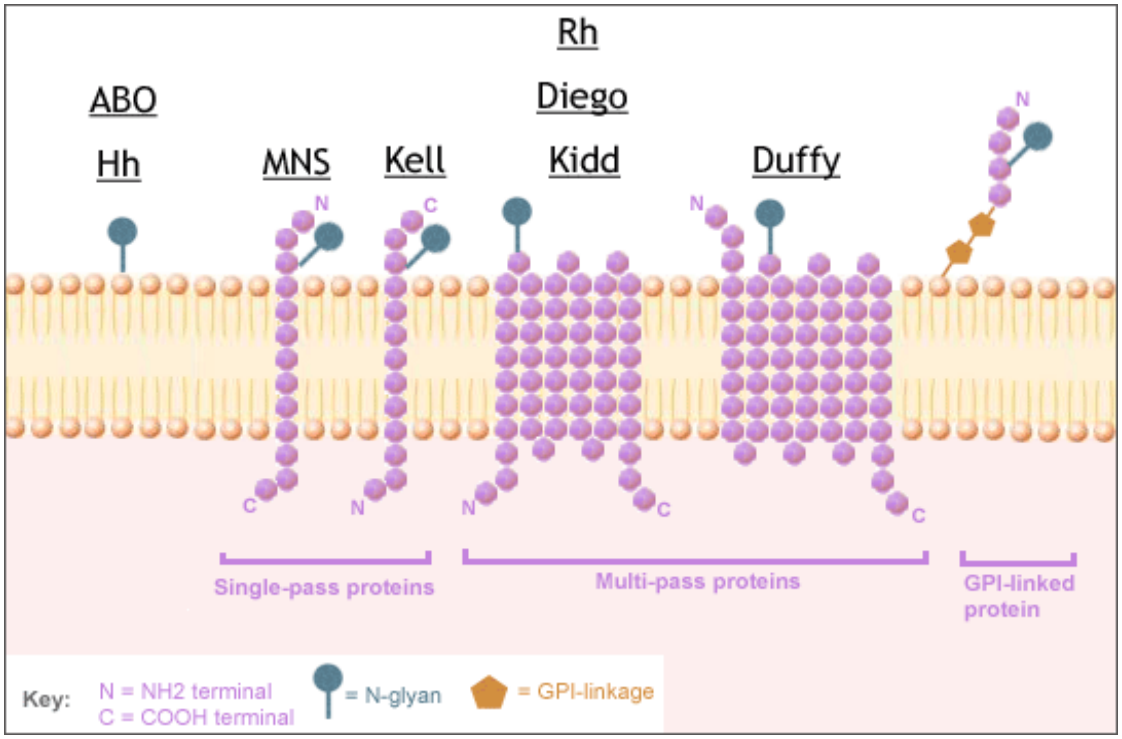
Blood Donors:

1. Voluntary
2. Non-Voluntary

GENERAL EXAMINATION:

- Vital signs.
- Donors age (17-70).
- Healthy (doesn't have a major illness).
- Weight more than 50kg.
- Normal hemoglobin (males>13, females>12).

BLOOD GROUPS



NOTE: ABO=most important Blood group, Rh= 2nd most important

Exp: About 32 blood-group systems have been identified, including the ABO and Rh systems. Many of the blood group systems were named after the patients in whom the corresponding antibodies were initially encountered. Some of the antigens are not normal, associated with inheritance of some diseases (like McLeod syndrome: Kell antigen).

Antibody specificities related to the mechanism of immune hemolytic destruction:

Blood group system	Intravascular hemolysis	Extra vascular hemolysis
ABO,H ABO is the same as ABH	A,B,H	
Rh		All

*The doctor said the rest is only for your information. You can read the whole table if you want in slide No.16

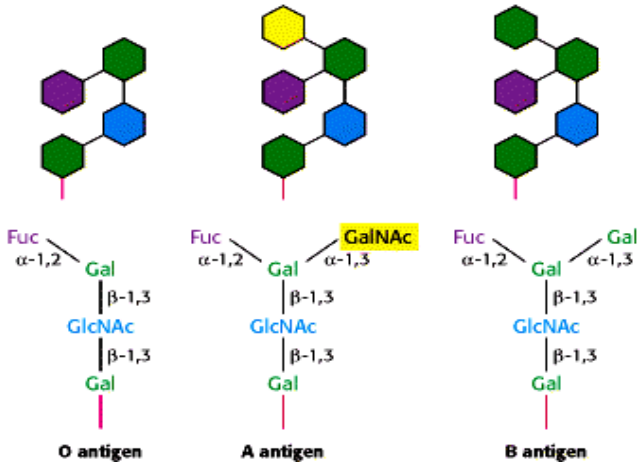
Glycosyltransfereases produced by genes encoding for antigens within the ABO, H, and Lewis blood group system:

Gene	Allele	Transferase
FUT1	H H	α-2-L-fucosyltransferase None
A	A	α-3-N-acetyl-D-galactosaminyltransferase
B	B	α-3-D-galactosyltransferase
O	O	None
FUT2	Se se	α-2-L-fucosyltransferase None
FUT3	Le le	α-3/4-L-fucosyltransferase None

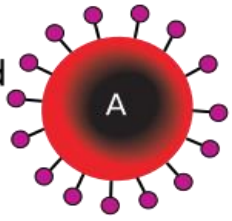
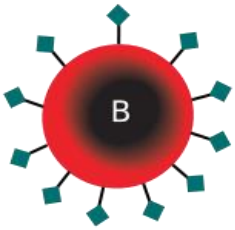
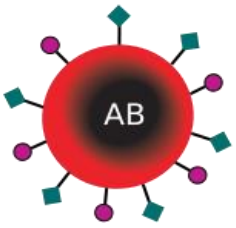
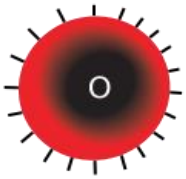
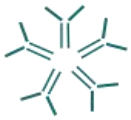
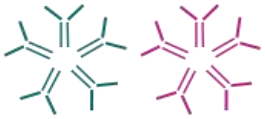
O: Doesn't have an additional group

A: Has a galactosamin group **(GalNAc)**

B: Galactos



ABO Blood Group:

	Group A	Group B	Group AB	Group O
Red blood cell type				
Antibodies present	 Anti-B	 Anti-A	None	 Anti-A and Anti-B
Antigens present	 A antigen	 B antigen	 A and B antigens	None

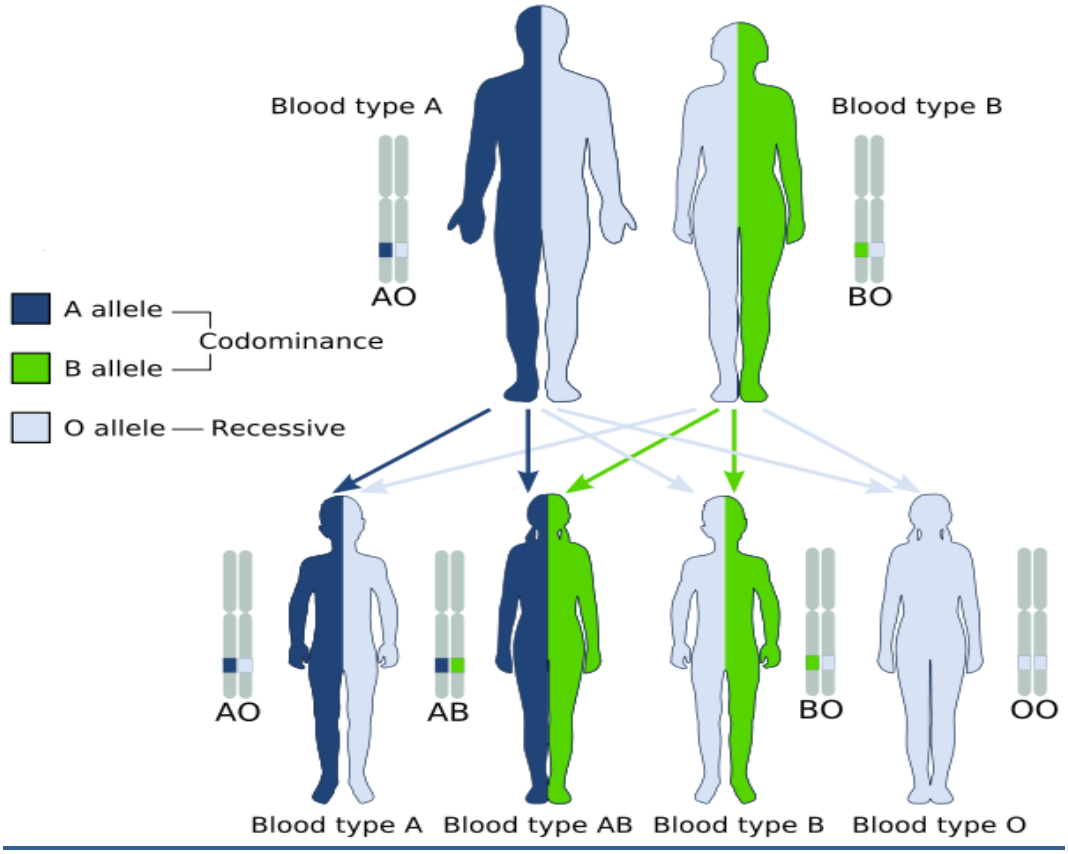
NOTE:

- Commonest blood group is O with 46% of the population then group A.
- O receives transfusion from O only and donates to all the other types.
- AB receives transfusion from all types but only donates to AB.
- Rh+ groups can receives blood from Rh- groups but Rh- groups can't receive blood from Rh+ groups (a reaction against Rh antigen will happen).

ABO Blood Groups Genotype

Blood group	Antigen(s) present on the red blood cells	Antibodies present in the serum	Genotype(s)
A	A antigen	Anti-B	AA or AO
B	B antigen	Anti-A	BB or BO
AB	A antigen and B antigen	None	AB
O	None	Anti-A and Anti-B	OO

ABO Blood Groups Inheritance: example



ABO blood system subgroups:

Blood group	Subgroup	Antigens on red cells	Antibodies in plasma
A	A1 A2	A + A1 A	Anti-B (Anti- A1)*
B	-	B	Anti-A, Anti- A1
AB	A1B A2B	A + A1 + B A + B	None (Anti- A1)*
O	-	(H)†	Anti-A Anti- A1 Anti-B Anti-A,B†

*** Anti- A1 found in 1-2% of A2 subjects and 25-30% of A2B subjects.**
† The amount of H antigen is influenced by the ABO group; O cells contain most H and A1B cells least. Anti-H may be found in occasional A1 and A1B subject (see text).
† Crosse activity with both A and B cells.

BLOOD TRANSFUSION

Blood Compatibility Testing (Crossmatch):

1. The "**Front Type**" determines which **antigens** ("flags") in the ABO blood group system are on the patient's Red Blood Cells as follows:

A antigen only	Type A
B antigen only	Type B
A and B antigens	Type AB
Neither A or B	Type O

2. The "**Back Type**" identifies the isohaemagglutinin (Naturally Occurring **Antibody**) in the patient's serum and should correspond to the antigens found on the Red Blood Cells as follows:

Anti-B	Type A
Anti-A	Type B
Anti-A and anti-B	Type O
Neither anti-A or anti-B	Type AB

- **In addition, RBCs are Rh typed and identified as "D" positive or negative.**
- **The Front Type (antigens) method is preferable.**

ABO Grouping				
Reactions of				
Blood Group	Cells with		Serum with	
	Anti-A	Anti-B	A Cells	B Cells
	(forward grouping)		(reverse grouping)	
0	0	0	+	+
A	+	0	0	+
B	0	+	+	0
AB	+	+	0	0

*for further understanding.

Video:
Here's a video that will help you in understanding **Crossmatch Test**.

Rh phenotypes:

The most common Rh phenotypes with possible genotypes and frequencies in an English population (accounting for >99% of all Rh genotypes in this population).

NOTE:

- **2 genes control it: D and Ce (D is dominant)**
- **If it's a capital D → Positive**
- **If it's a small d → Negative/Absent**
- **(-) receives only (-)**
- **(+) receives both (+ and -)**

Reaction with anti-					Phenotype/most probable genotype	Possible genotypes	Frequency
D	C	c	E	e			
+	+	+	-	+	**DCe/dce/R_1**	**DCe/dce/R^1r**	**32.68**
						DCe/Dce/R^1R^O	**2.16**
						DCe/dCe/R^0r'	**0.05**

*the doctor said the first one is the only important thing to memorize it because it's common. You can read the whole table in the lecture slide No. 31

The Rh haplotypes in order of frequency (Fisher nomenclature) in Caucasians and the corresponding short notations:

Fisher	Short notations	Approximate frequency (%)
CDe	**R^1**	**41**

*The doctor only focused on the first one. You can read the whole table in the lecture slide No. 32

Mandatory Tests on All Units of Blood:

- ABO group and Rh type
- Screening for blood-group antibodies
- Serologic test for syphilis
- Serologic tests for human retroviruses including:
  - ✓ HIV-1 antibody
  - ✓ HIV-2 antibody
  - ✓ HIV p24 antigen
  - ✓ HTLV I antibodies
- Serologic tests for hepatitis including:
  - ✓ Hepatitis B core antibody (HBcAb).
  - ✓ Hepatitis B surface antigen (HBsAg).
  - ✓ Hepatitis C antibody.

BLOOD COMPONENTS

Preparation:

After donation, we take the blood bags and put it in the Cytospin to separate the blood components.

- **RBCs stored in fridge in 4 to 6 degrees for 35 days**
- **Platelet stored in room temperature 37 degrees for 5 days**
- **Plasma stored in the freezer -30 degree for 1 year. (Clotting factors)**

Autologous Blood Transfusion:

- **Predeposited:**
  Blood is collected in the weeks prior elective surgery. (The person gives himself the blood (The safest).
- **Haemodilution:**
  Blood is collected immediately before surgery to be re-infused at the end of the operation.
- **Salvage:**
  Heavy blood loss during operation is collected to be re-infused.

Complications of Blood Transfusion

Immediate Transfusion Reactions:

- Hemolytic Reactions
- Allergic Reactions
- Febrile Reactions
- Transfusion related acute lung injury (TRALI)
- Bacterial Contamination
- Circulatory Overload
- Citrate toxicity
- Air embolism
- Alloimmunization: (immune response to foreign antigens)
  - ✓ RBCs
  - ✓ Platelets

***Infection and wrong blood transfusion are most serious complication.**

Delayed Transfusion Reactions

- Graft Versus Host Disease (GVHD)
- Transfusion-associated graft versus host disease (TAGVHD)
- Post-transfusion purpura
- Haemosiderosis (Iron overload)
- H.D.N. (Hemolytic Disease of the Newborn)

Delayed Transfusion Reactions (Cont…)

Transmitted Diseases

- Hepatitis B
- Hepatitis C
- Human Immunodeficiency Virus (HIV)
- Human T-lymphocytotrophic Virus (HTLV-1)
- Cytomegalovirus (CMV)
- Kaposi's sarcoma and human herpes virus-8 (KS & HHV-8)
- Malaria
- Leishmaniasis
- Others:
  - ✓ Babesiosis.
  - ✓ Lyme disease.
  - ✓ Chagas' disease
  - ✓ Creutzfeldt-Jakob Disease (CJD)
  - ✓ Toxoplasmosis.

Investigation of a Hemolytic Transfusion Reaction:

- **Evidence of Hemolysis:**

Examine patient's plasma and urine for hemoglobin and its derivatives.

Blood film may show spherocytosis.

- **Evidence of incompatibility:**
  - ✓ Clerical checks. An identification error will indicate the type incompatibility.
  - ✓ If no evidence of **clerical error** (wrong blood transfusion) , proceed as follows:
    - Repeat ABO and Rh D groups of patient and donor unit and screen for antibodies.
    - Use patient's pre-and post-transfusion samples.
    - Repeat compatibility tests, using patient's pre-and post –transfusion serum.
    - Direct antiglobulin test on post-transfusion red cells may indicate antibody and/or complement.

- **Evidence of bacterial infection of donor blood**

Gram stain and culture donor blood.

Summary

- ABO and Rh are the most important blood groups systems.
- Glycosyltransfereases:
  A = α-3-N-acetyl-D-**galactosamin**yltransferase
  B = α-3-D-**galactos**yltransferase
  O =none
- Group AB has no antibodies so it **receives** transfusion from all types.
- Group O has no antigens so it **donates** to all the other types.
- **Blood Compatibility Testing (Crossmatch**) can be taken by 2 ways:
  - The Front Type (antigens)
  - The Back Type (antibodies)
- **Rh phenotypes**:
  - 2 genes control it: **D** and **Ce** (D is dominant)
  - If it's a capital D → Positive
  - If it's a small d → Negative/Absent
  - (-) receives only (-)
  - (+) receives both (+ and -)
- **Important Mandatory Tests on All Units of Blood: Syphilis, HIV, Hepatitis.**
- **RBCs** stored in fridge in 4 to 6 degrees **for 35 days.**
- **Platelet** stored in room temperature 37 degrees for **5 days**.
- **Plasma** stored in the freezer -30 degree for **1 year.**
- Complications of Blood Transfusion:
  - **Immediate Transfusion Reactions:** Bacterial Contamination and Alloimmunization are most serious complication.
  - **Delayed Transfusion Reactions:** Haemosiderosis.
  - **Transmitted Diseases.**

- Investigation of a Hemolytic Transfusion Reaction:
  - **Evidence of Hemolysis :**
    Examine patient's plasma and urine for hemoglobin and its derivatives.
  - **Evidence of incompatibility**
  - **Evidence of bacterial infection of donor blood:** Gram stain and culture donor blood**.**

Questions

1. A woman with blood group O married a man with blood group O, their child's genotype is?
   A. AO
   B. AB
   C. OO
   D. BO

2. A young man is brought into the emergency room and needs a blood transfusion His blood type is B+. Which one of the following blood groups we should give to him?
   A. B -
   B. AB+
   C. AB-
   D. A+

3. Which two genes control the Rh phenotypes?
   A. D and e
   B. E and Ce
   C. D and E
   D. D and Ce

Answers:
- 1- C
- 2- A
- 3- D

اللهم إني استودعك ما قرأت و ما حفظت و ما تعلمت فرده عليَ عند حاجتي إليه انك على كل شيء قدير

If there is any mistake or feedback please contact us on: 432PathologyTeam@gmail.com

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*Good Luck ^_^*