Introduction to immunohematology

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Outline

- blood transfusion
- Types of immunity
- Complements
- what are antibodies, antigens
- how to detect Ag-Ab reaction

Immunohematology

- Combines aspects of; haematology, immunology & genetics.
- Immunologic reactions

Clinical Uses

1. **Blood transfusion**

Donor **Recipient**

The science of Blood Transfusion is mainly concerned with how to provide patients with:

SAFE BLOOD

(No transfusion reaction)

EFFECTIVE therapy

(Haemoglobin increment)

The science of saving lives.

Clinical uses

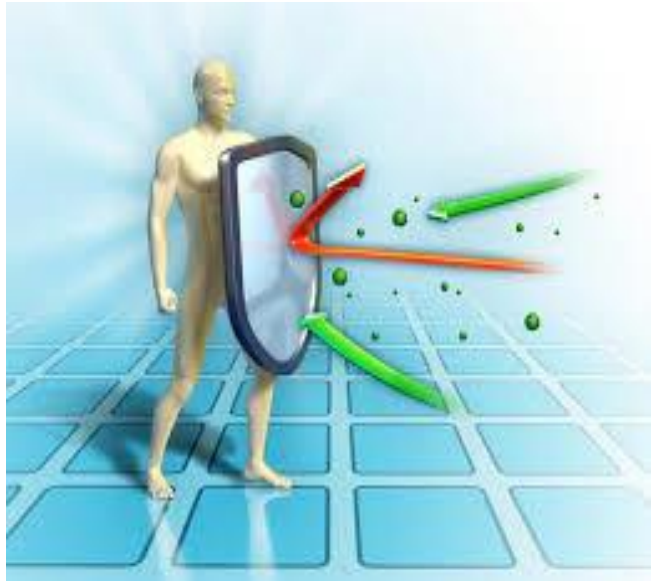
2. **Pregnancy:**

Prevent haemolytic disease of the new born and fetus.

3. **Autoimmune Haemolytic Anaemia**

Immunology

- The study of how the body defence itself against infections & diseases
- Immune system = defence ministry
- Various mechanisms .. Why?



Tow types of immunity

1. Natural immunity

(Primary):

a. non specific

b. fast

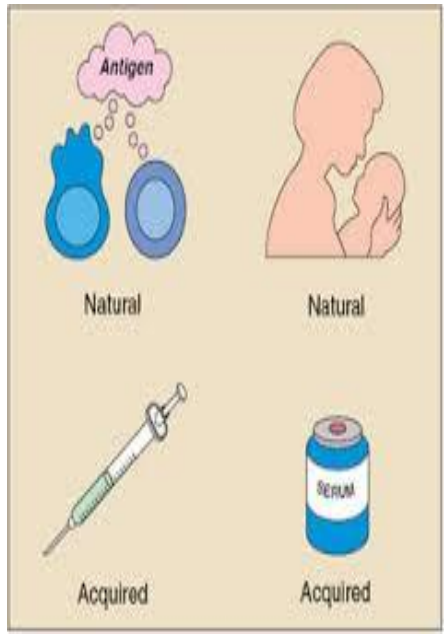
2. Acquired immunity

(Secondary):

a. specific

b. takes time

c. more effective



Natural immunity (primary)

- first line of defence
- fast, non specific
- examples:

  a. physical barriers,

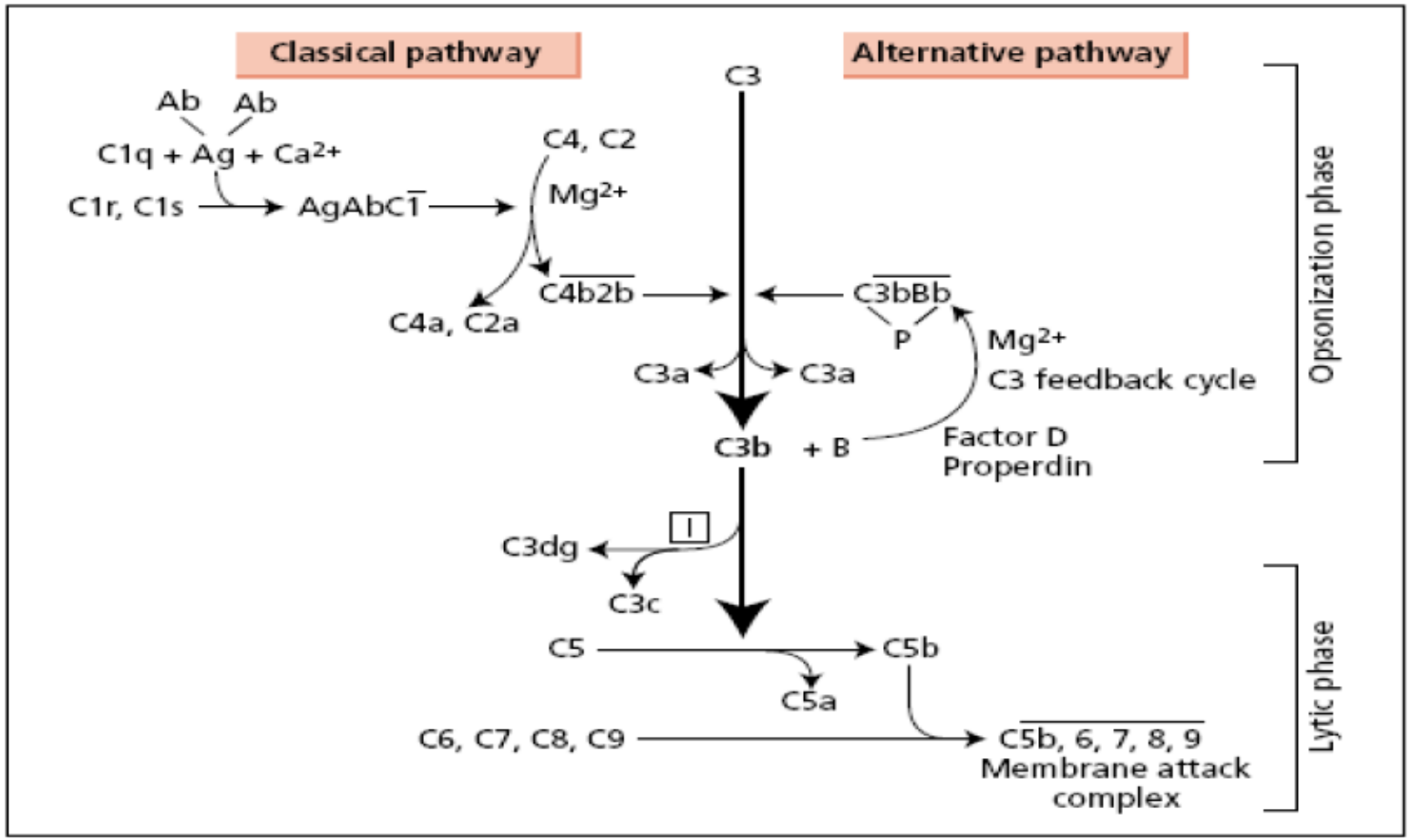
  b. biochemical effectors (complement)

  c. some immune cells ?

Complement

- 20 proteins
- present in BLOOD in an inactive form (proenzymes)
- can be activated by multiple pathways
- when activated undergo a serious of reactions

activation of C3 protein → results in cell lysis

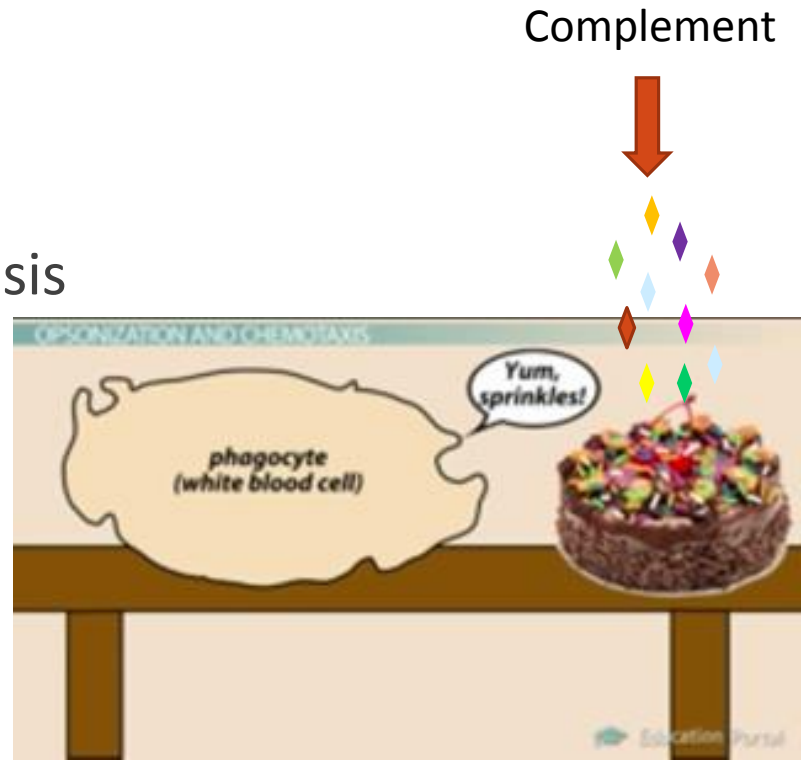

Classical pathway
Alternative pathway
C3
Ab Ab
C1q + Ag + Ca2+
C1r, C1s
AgAbC1
C4, C2
Mg2+
C4a, C2a
C4b2b
C3bBb
P
Mg2+
C3 feedback cycle
C3a
C3a
C3b + B
Factor D
Properdin
I
C3dg
C3c
C5
C5b
C5a
C6, C7, C8, C9
C5b, 6, 7, 8, 9
Membrane attack complex
Opsonization phase
Lytic phase

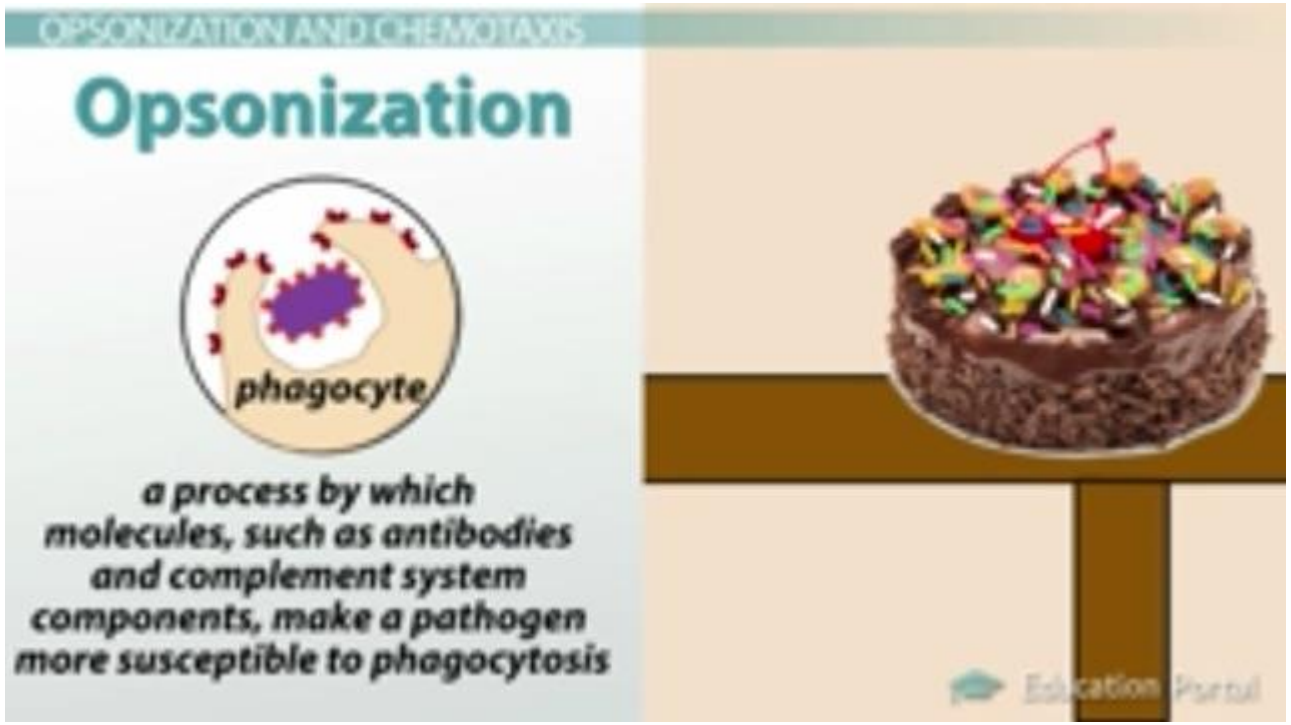
Complement

1. final lysis of invading cells

2. opsonisation of invading cells to facilitate phagocytosis

3. mediation of inflammation




OPSONIZATION AND CHEMOTAXIS
Opsonization
phagocyte
a process by which molecules, such as antibodies and complement system components, make a pathogen more susceptible to phagocytosis

Acquired immunity

- The second line of defence
- protect the body against a repeated attack by the same agent (eg. Vaccination)
- specific, takes time but more effective
- Eg: lymphocytes

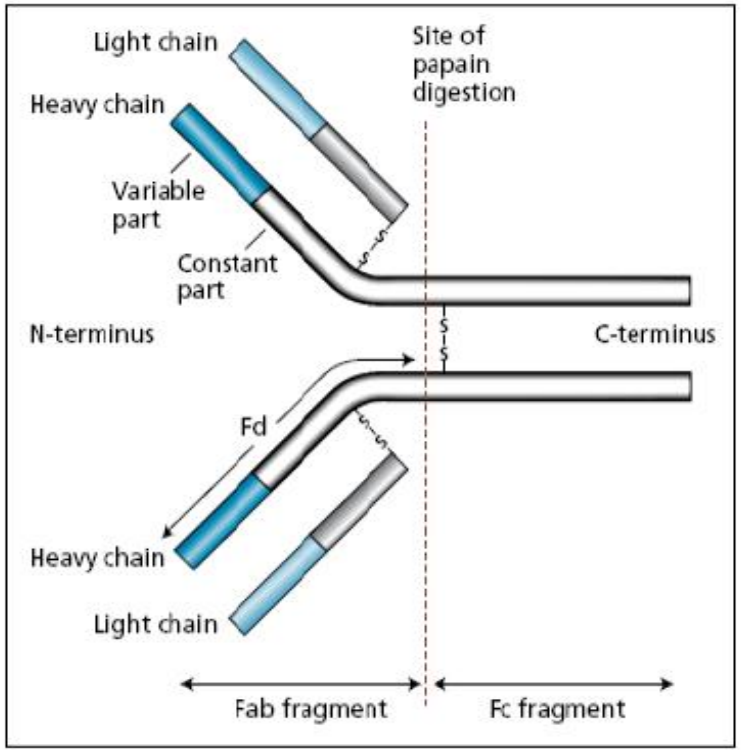
  and **antibody** formation

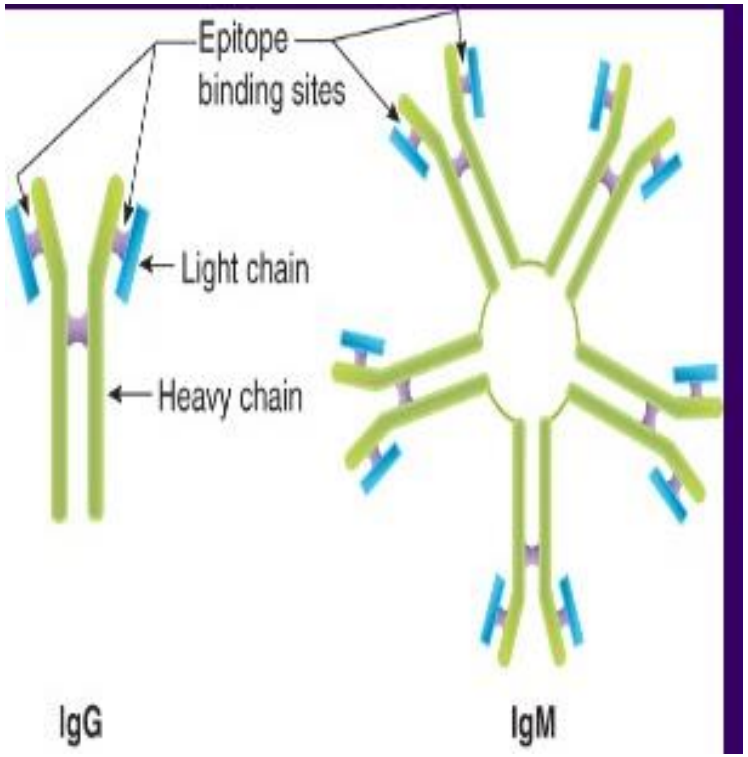
Antibodies (what is an antibody)

- is a **specifically** reactive immunoglobulin (Ig) produced in response to immunogenic stimulus (foreign)

Immuno: because of their function

Globin: because of their nature (composition)


Light chain
Site of papain digestion
Heavy chain
Variable part
Constant part
N-terminus
C-terminus
S
S
Fd
Heavy chain
Light chain
Fab fragment
Fc fragment


Epitope binding sites
Light chain
Heavy chain
IgG
IgM

Antibodies

- produced by B cells (plasma cells) in response to stimulation by a specific agent (antigen).

- react specifically (only) with the agent resulted in their production;

Antibody (specific)

Ab produced for HIV ✘ Hep B

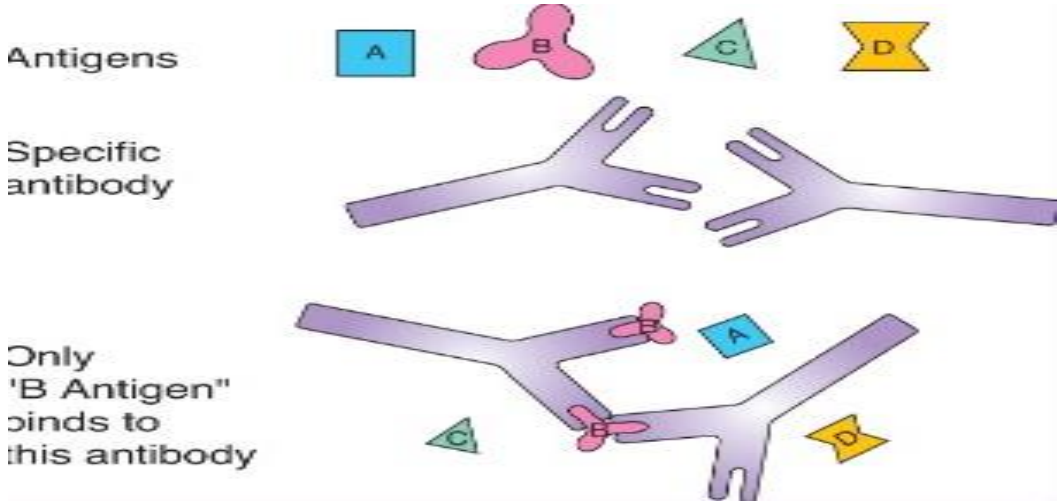
Ab produced for A type RBC ✘ B type RBC

Antibodies

- react with foreign Ag not present on pt own RBCs.
- Most produced as a result of immune stimulation via transfusion or pregnancy
- reacts with Ag on pt own cells (autoimmune reaction)

Antibodies

Bind to the invader (Ag), then inactivate (or destroy) it and the cells to which the Ag is bound to



Antibodies

- **Alloantibodies:** produced as result of immune stimulation with Ag of the same species (human to human)

eg; transfusion or pregnancy

React with foreign Ag not present on pt's own RBC

Antibodies

- **Autoantibodies:**
  - produced by Ag of self
  - react with Ag on pt's own cells (auto immune reaction) &
    with same Ag on cells of other individuals

Antibodies

- **Heteroantibodies:**

  Ab produced from Ag of other species

  eg; vaccination

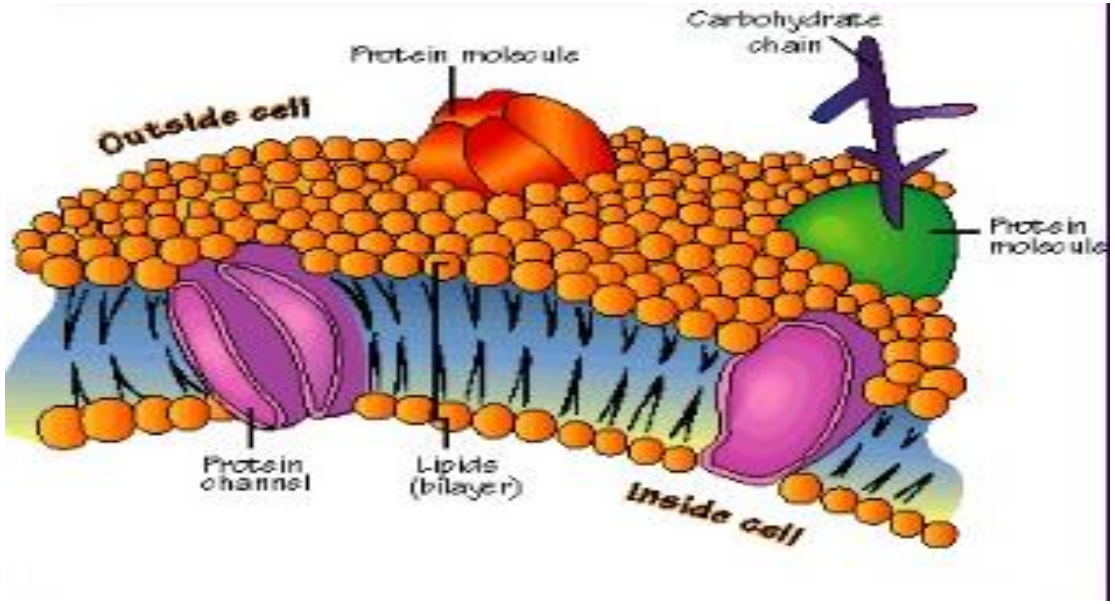
Antigens

- A foreign substance that can stimulate production of specific Ab and/or sensitized lymphocytes.

- mostly of biological origin; proteins, polysaccharides, lipids or nucleic acids

Antigens

- often coupled to a carrier cells (ABO to RBC membrane)



Antigens (terms)

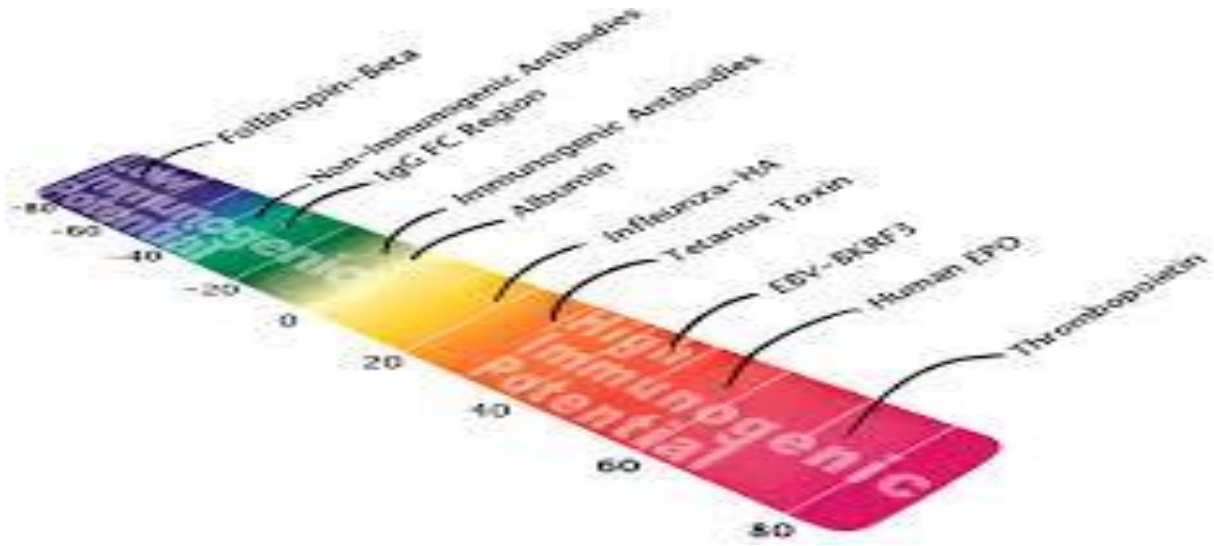
- Ag that are able to induce immune response; **Immunogens**

  (Ag > 500,000 MW)

- Ag are varies in their **Immunogenicity;** the degree of immune response they can induce

Immunogenicity of blood gp Ag

- A, B and D .. Highly immunogenic
- Duffy; Fya, Fyb
- Kidd; Jka, Jkb



Levels of immunogenicity

- Glycoproteins & lipoproteins – most potent
- pure polysaccharides – not immunogenic (exp in humans mice)
- pure lipids & nucleic acids - not immunogenic but can be antigenic **(haptens)** ??

RBC antigens

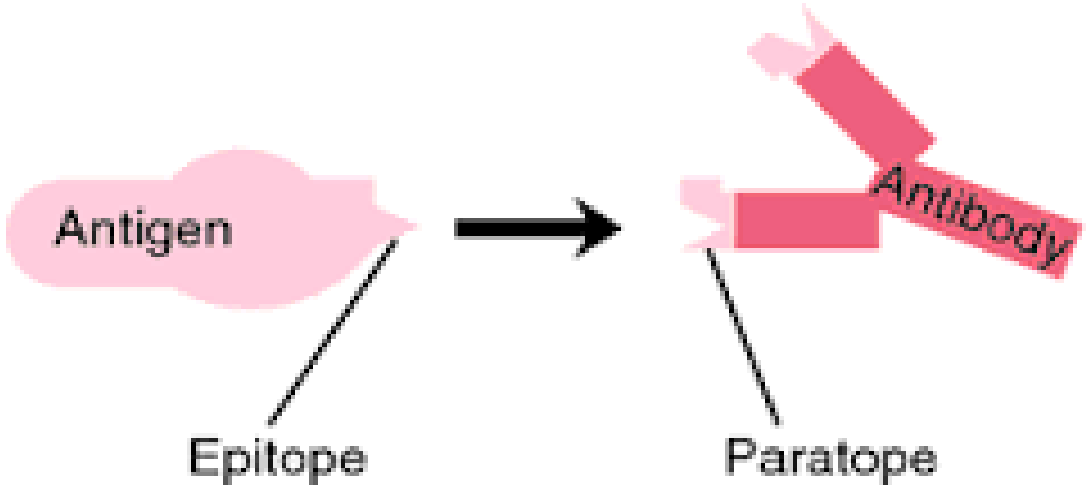
- 400 RBC gp Ags
- Individuals lack particular Blood gp Ag – Abs reacting with that Ag (transfusion reaction)

Blood gp Abs

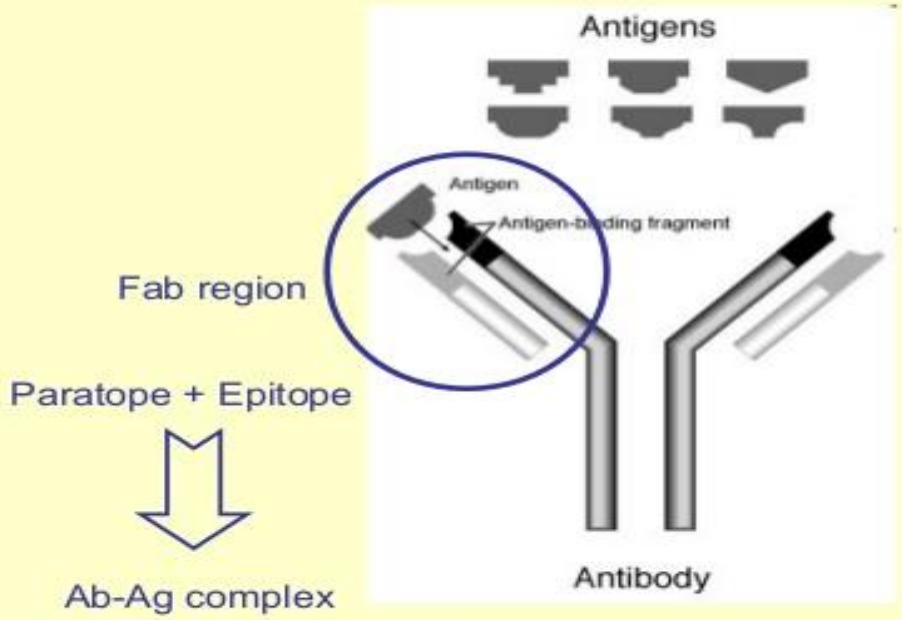
- ABO Abs - naturally occurring … when ??
- non- red cells stimulated
- if an Ag is missing .. the corresponding Ab is always present

Ag-Ab reaction

- antigenic determinants (epitope) ?
- Paratopes ?



Antibodies and Antigens



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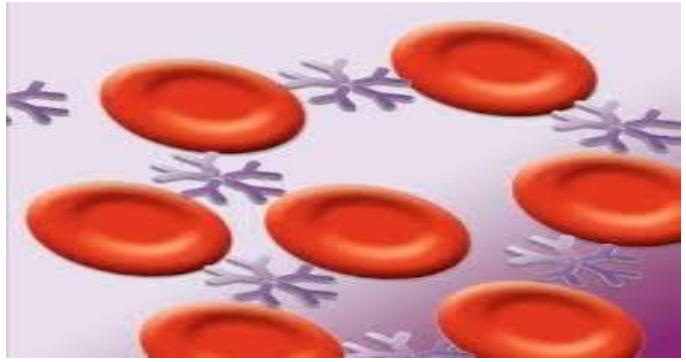
Ag-Ab reaction

- detected by observing agglutination (in blood gp serology)

so;

Agglutination: the result of cross-linking of individual RBC by Ab molecule



Blood group serology

- the study of antigenic molecules present on various cellular & soluble components of whole blood, together with Abs and lectins recognize them and their interactions

- In practice, this term is restricted to RBC surface Ag and their interaction with specific Abs

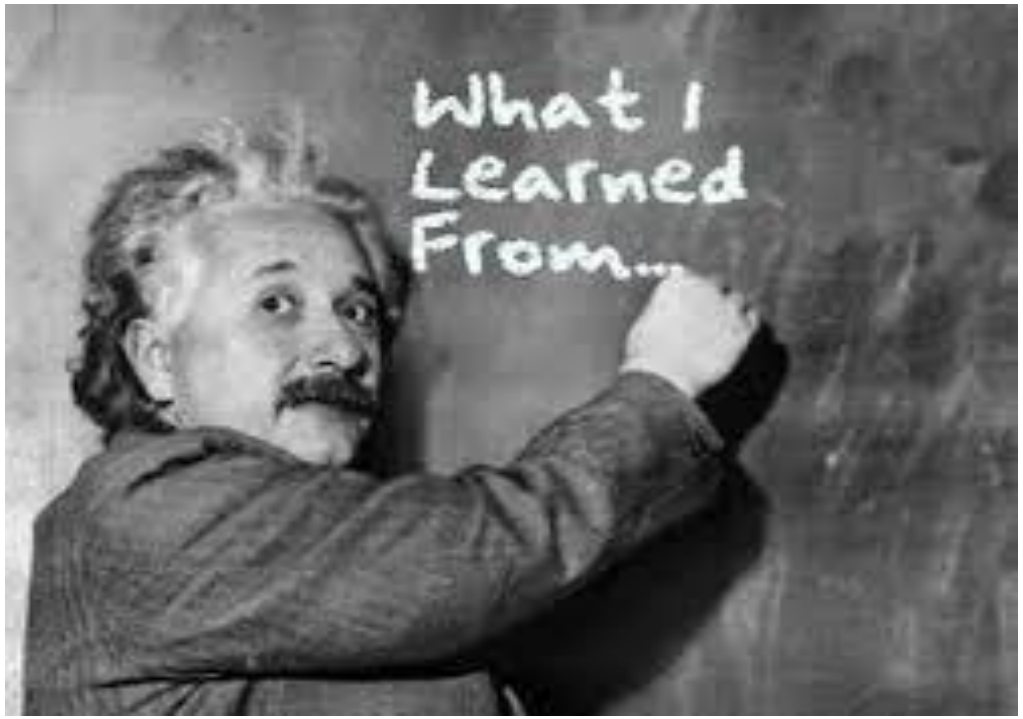
Purpose of serology

1. Determination of RBC phenotype ;
   (by known Abs & reagents)

2. Search for and identify Ab ;
   (by RBCs of known phenotype)

3. Compatibility testing ;
   (Pt serum with donor cells of same ABO & Rh)

Take home messages



- ✓ Tow types of immunity;
  Natural (non specific + fast) Acquired (specific, takes time but effective)

- ✓ Complements;
  tow pathways …. Resulted in activation of C3 – cell lysis

- ✓ Antibodies
  proteins
  produced in response to stimulation by Ag (from B cells)
  specific for that Ag
  3 different types

- ✓ Antigens
  RBC surface
  levels of immunogenicity

- ✓ Ag-Ab reaction – agglutination

FUNDAMENTAL RULE OF BLOOD BANK

- Antigens are found of the surface of red blood cells
- Antibodies are found in the serum or plasma

Thanks for your attention