

Classes of Immunoglobulin

Based on the amino acid differences in the carboxyl terminal of the heavy chain in human and the higher mammals, five major groups (termed as classes or isotypes) have been defined : Immunoglobulin G(I_gG), I_gA, I_gM, I_gD, I_gE. In humans ,there are four subclasses of I_gG, and two subclasses of I_gA.

The five different classes of antibodies are determined by the type of heavy chain involved (termed $\Upsilon, \alpha, \mu, \delta,$ and ϵ I_gG , I_gA, I_gM, I_gD, I_gE respectively).

Immunoglobulin G

The chief characteristics of immunoglobulin G are :

- Molecular weight -150,000 Da
- Sedimentation coefficient – 7S
- Number of basic four peptide units – one
- Heavy chain – γ type
- Four human I_gG subclasses are identified :I_gG1, I_gG2, I_gG3 and I_gG4. The subclasses are distinguished by differences in the amino acid sequence of γ chains and numbered according to their decreasing average serum concentration ;that is I_gG1 has the highest serum concentration and I_gG4 the lowest.
- 80 % of the total serum immunoglobulin
- Functions- most abundant immunoglobulin of internal body fluids where it combats microorganisms and their toxins. IgG1, I_gG3, I_gG4 can cross the placenta and impart neonatal immunity.The complex of I_gG and bacteria activates the complement pathway
I_gG3 is the most potent in activating complement, followed by IgG1. IgG enhances phagocytosis by opsonisation . IgG1, I_gG3 are the most important opsonins . I_gG4 and I_gG2 have low affinity for F_c receptor and hence are not good opsonins.

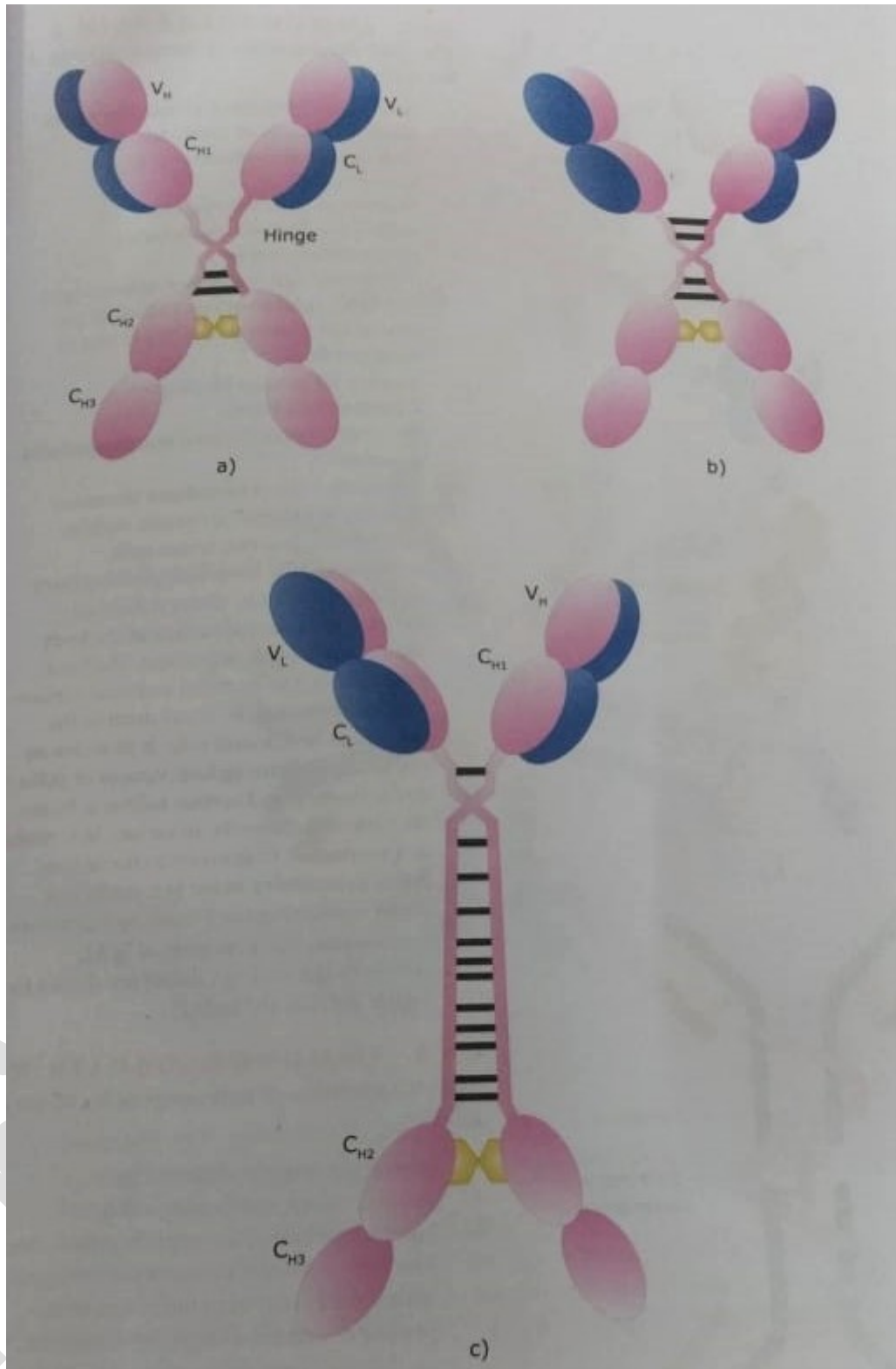


Fig. no. – 01 : Domain structures of IgG1 & IgG2 in (a) & (b); (c) shows the detailed structure of IgG3.

Immunoglobulin A

- Monomeric (160,000 Da) and sometimes dimeric, trimeric or tetrameric.
- Sedimentation coefficient – 9 S (monomeric)
- Number of basic four peptide units- one (in monomeric form).
- Heavy chain α type.
- Two human I_gA subclasses known- I_gA1 and I_gA2. I_gA2 constitutes about 20% of I_gA in serum , but 50% in secretory fluids.
- Valency of antigen binding -2 (monomeric form) 10-15% of the total immunoglobulin in serum .
- Functions- the predominant immunoglobulin in external secretions such as saliva, tears, mucous, breast milk, secretion of the bronchial, genitourinary and digestive tracts , where it defends the exposed external surface of the body against pathogenic organisms. The binding of the I_gA to bacterial and viral surface antigens prevents the attachment of the pathogens to mucosal cells. It provides an important defence against viruses of polio and influenza , and certain coliform bacteria such as *Salmonella*. In serum , I_gA exists as a monomer . In contrast to the serum form , in secretory fluids, I_gA exist as a dimer containing the J chain and secretory component.

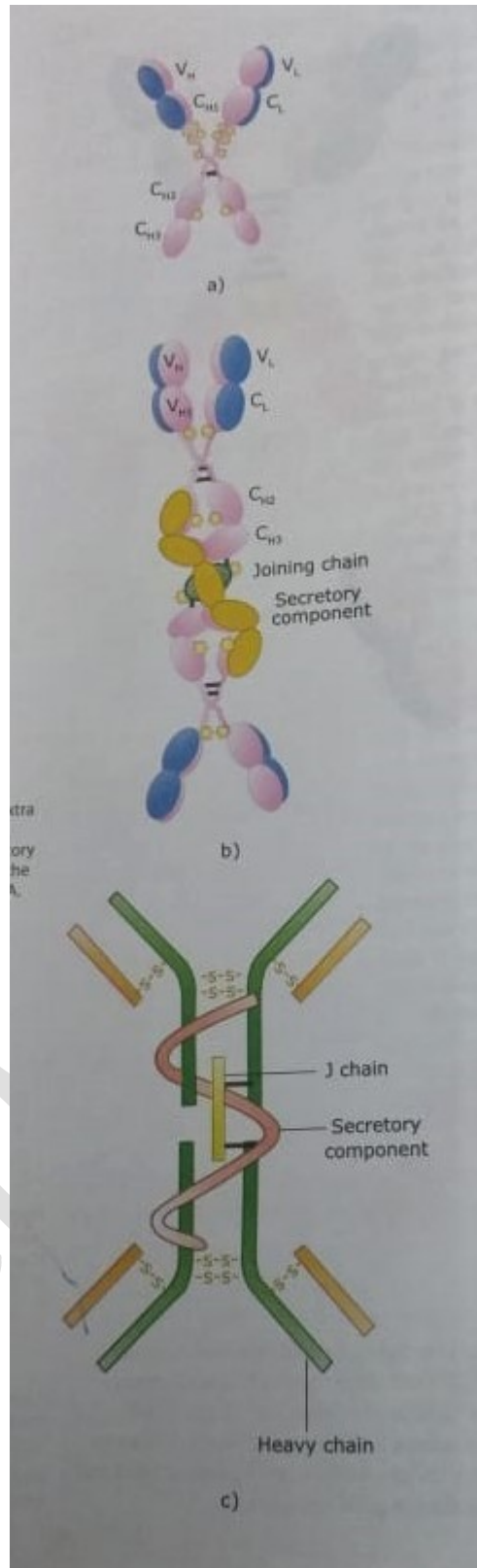


Fig. no. – 02 : (a) Domain structure of IgA1, (b) Secretory component of IgA & (c) Schematic representation of secretory IgA.

Immunoglobulin M

- Molecular weight -900,000 Da.
- Sedimentation coefficient -19 S
- Number of basic four peptide units – five, the five monomer subunits are arranged with their F_c region in the centre of the pentamer and ten antigen – binding sites on the periphery of the molecule. Each pentamer contains additional F_c linked polypeptide called J chain , which is disulphide linked to two of the ten μ chains.
- Heavy chain μ type
- No human I_gM subclasses known.
- Valency for antigen binding is 10. However , because of steric hindrance only five or fewer molecules of larger antigens can be bound.
- 5-10% of the total immunoglobulin .
- Functions- the first immunoglobulin class that is produced in a primary immune response; and also the first immunoglobulin to be synthesized by a newborn ;very effective agglutinin; and effective first line of defence against bacterial or viral invasion . More efficient in activating complement than I_gG.
- It is believed that I_gM is the first to appear in ontogeny and is phylogenetically oldest antibody.

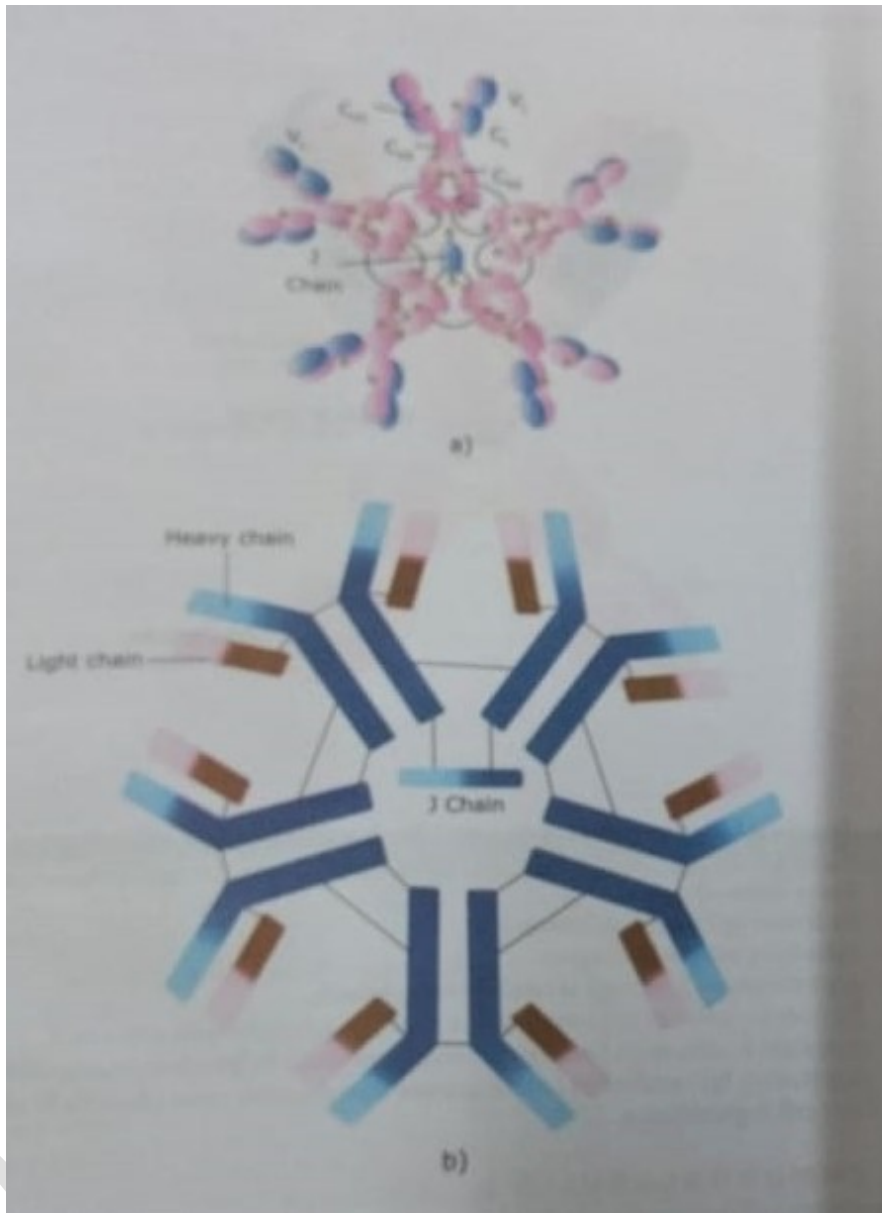


Fig. no. – 03 : Arrangement of monomeric IgM in pentameric structure.

Immunoglobulin D

- Molecular weight -180,000 Da.
- Sedimentation coefficient -7 S
- Number of basic four peptide units – one.
- Heavy chain – δ type
- No human subclasses known .
- Valency for antigen binding -2
- Approximately 0.2% of total immunoglobulin.
- Functions- function not established ; a major immunoglobulin expressed on mature B cell, apart from I_gM; probably involved in lymphocyte activation and suppression; I_gD antibodies cannot activate complement , cross placenta, or cause mast cell degranulation .

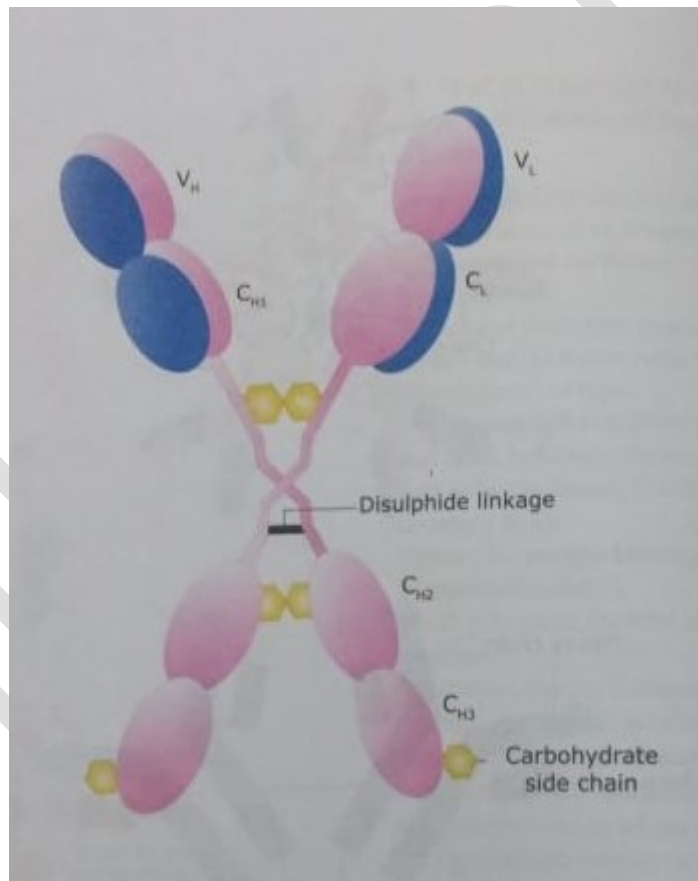


Fig. no.- 04 : Domain structure of IgD.

Immunoglobulin E

- Molecular weight -190,000 Da .
- Sedimentation coefficient – 9 S
- Number of basic four polypeptide unit – one
- Heavy chain – ϵ type
- Valency for antigen binding -2
- Represents 0.002% of total immunoglobulins .
- Functions- Protection of the external mucosal surface ; a major immunoglobulin that is involved in type 1 hypersensitivity reaction ; I_gE binds to F_c receptors present on the surface of mast cells and basophils .The aggregation of F_c receptor when I_gE binds the provoking antigen, results in degranulation of mast cells. Pharmacological active mediators that are present in these granules mediate allergic manifestations.

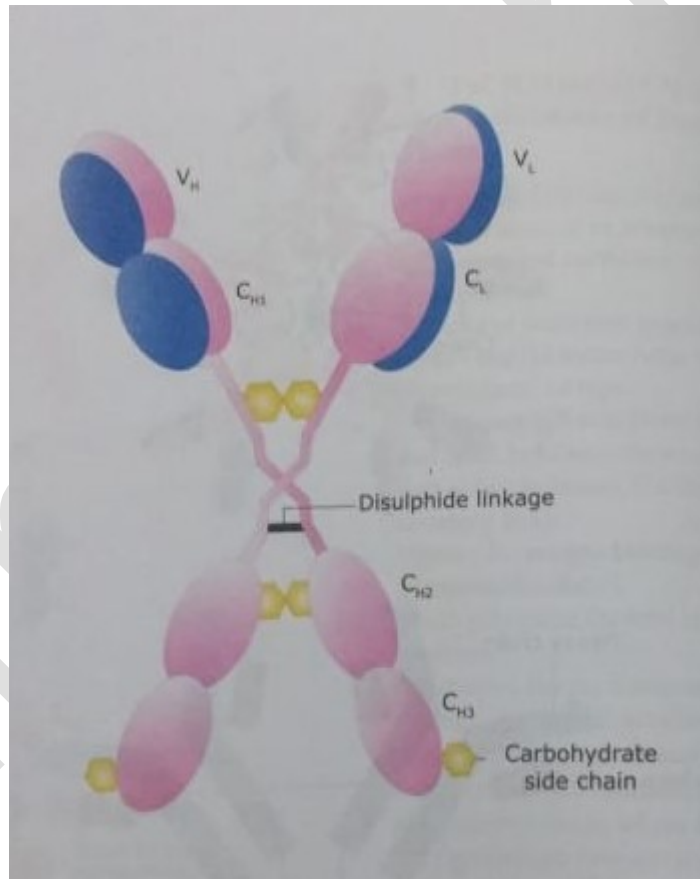


Fig. no. – 05 : Domain structure of IgE.

Ref. Book : F.H. Khan.