

Biochemistry

Plasma proteins

- Over 300 proteins have been detected in plasma but relatively few are estimated routinely.
- The total concentration of proteins in plasma is 6 – 8 g/dL.
- Most plasma proteins are glycoproteins (the amount of carbohydrate varying from 1% in albumin to approximately 40% in α_1 – acid glycoprotein). Plasma proteins may also simple proteins, lipoproteins, nucleoproteins; all these proteins contain disulphide bonds and few free thiol (– SH) group: this characteristic is important in preventing denaturation of proteins in plasma, which would occur due to the high oxygen tension.
- The concentration of plasma proteins is determined by three main factors: -
 - 1. Rate of synthesis.** [Most plasma proteins are synthesized in the liver, some example like immunoglobulin are produced at other sites in lymphocytes, apolipoproteins produced by enterocytes].
 - 2. Rate of catabolism:** most proteins are degraded after being taken up by cells within the body.

3. The volume of fluid in which proteins are distributed: the proteins distribution in fluid compartments and loss into third space (ascites, pleural exudate) or to the outside (proteinurea).

Functions of plasma proteins: -

1. Transport substance: many substances are transported in blood bound to proteins such as: -

Substance	Bound to	Protein
Thyroxin	→→→→→	Albumin, prealbumin, and globulin
Cortisol	→→→→→	albumin, transcortin
Ca	→→→→→	Albumin
Fe	→→→→→	Transferrin

Drug	Bound to	Protein
Phenyton	→→→→→	Albumin
Salicylates	→→→→→	Albumin
Sulphonamides	→→→→→	Albumin
Cholesterol, triglycerides	→→→→→	Lipoproteins
Vitamin A	→→→→→	Retinol – binding
Bilirubin	→→→→→	Albumin
Non esterified fatty acid (NEFA)	→→→→→	Albumin

Note: many of these substances are toxic in free form or insoluble or hemolysis.

2. Maintaining plasma oncotic pressure (the osmotic pressure due to protein): the plasma proteins (albumin responsible for 80% of plasma oncotic pressure) are the major determinant of

the distribution of fluid between the intravascular and extravascular components and thus plasma volume.

3. Buffering pH changes: plasma proteins “particularly albumin” have some buffering capacity also they do not make a major contribution to acid – base balance.

4. Enzyme activity.

5. Clotting and the acute inflammatory response.

6. Immunity.

Plasma proteins are separated into 3 major groups which are: -

1. Albumin.
2. Fibrinogen.
3. Globulin.

Serum albumin (Alb)

- Albumin is present in high concentration than other plasma proteins (4 g/dL in normal adults). It is synthesized in the liver and has a half life of approximately 20 days.
- Plasma albumin concentration is insensitive indicator of nutritional status, since the rate of catabolism also falls during starvation.
- The main functions of albumin are: maintenance of plasma oncotic pressure, buffering pH, changes and transport substances like calcium, drugs, hormones, NEFA and bilirubin. In hyperbilirubinaemic neonates acidosis may weaken the binding of bilirubin, this increasing the possibility that bilirubin may cross the blood – brain barrier, causing **kernicterus**.

Hyperalbuminaemia: is rare and is usually caused by dehydration lead to volume depletion.

Hypoalbuminaemia: may be due to physiological or pathological factors. Physiological causes include the later stages of pregnancy; in which the volume of distribution is increased. The levels of albumin are lower in recumbency than the posture for a similar reason.

Pathologically: **malabsorption** (impaired hepatocyte function may result in impaired synthesis of albumin in chronic liver disease) may cause hypoalbuminaemia where the synthesis is sensitive to the supply of amino acids.

- Albumin determinations of clinical significance for estimation protein synthesis.
- Hypoalbuminaemia occur in cirrhosis, severe burns, trauma, nephrotic syndrome and hemorrhage.
- Albuminemia: have edema since the colloidal osmotic pressure is only half of normal {diagnostic investigation of edematous states}.

Serum globulins

Are protein molecules with a heterogeneous complex mixture, designed as: -

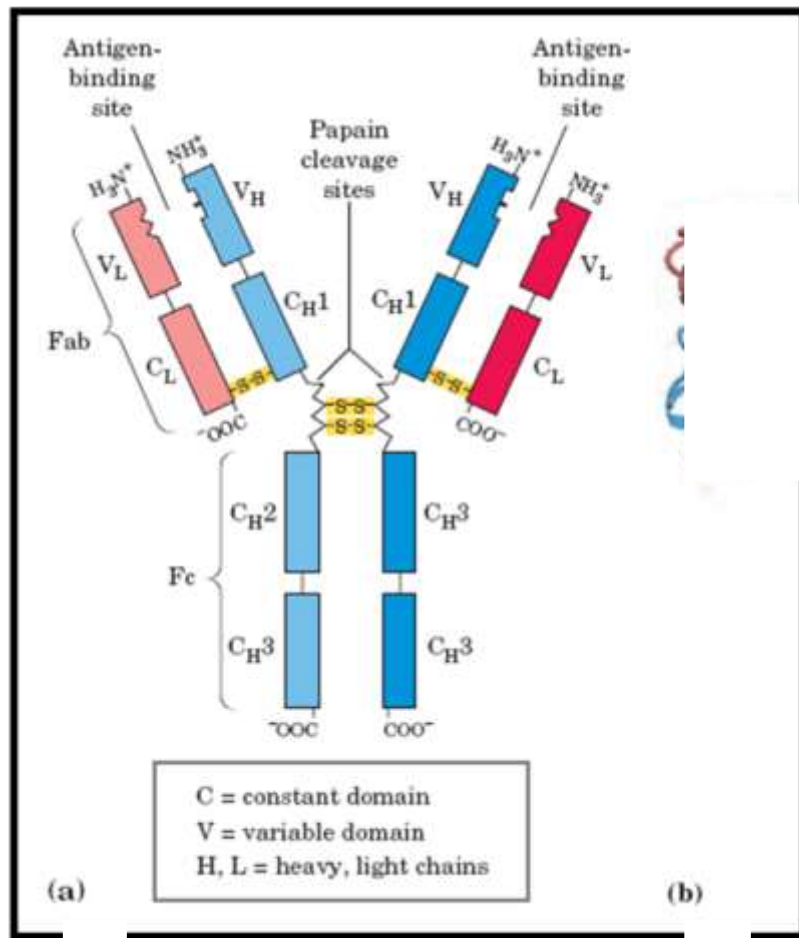
α , β and γ – globulins >>> this classification based on their electrophoresis mobility. Another classification may be due to function or structure.

Immunoglobulins (Igs)

They are effectors of humoral immune response. They bind to specific antigens to form immune complexes. These trigger defense mechanism, e.g. activation complements system or phagocytes which are antibodies, heterogeneous plasma proteins produced by B – lymphocytes. Most are found in the γ region on electrophoresis although some occur in the β and α_2 regions.

- Five classes of immunoglobulins are recognized: -

	<i>IgG</i>	<i>IgA</i>	<i>IgM</i>	<i>IgD</i>	<i>IgE</i>
<i>Heavy chains</i>	γ	α	μ	δ	ϵ
<i>Light chains</i>	κ, λ	κ, λ	κ, λ	κ, λ	κ, λ



- Each Ig consists of four polypeptides; two heavy chains which are one of (γ , α , μ , δ , and ϵ) and two are light chains (κ , λ) which occur in all Ig classes.

- Approximately 75% of plasma Ig are IgG which are produce antibodies (Ab) during secondary immune responses. They nuetralize bacterial toxins and bind to microorganisms, enhancing phagocytosis.

