

Lecture-10

Plasma proteins

Blood proteins, also termed **plasma proteins**, are proteins present in blood plasma. They serve many different functions, including transport of lipids, hormones, vitamins and minerals in activity and functioning of the immune system. Other blood proteins act as enzymes, complement components, protease inhibitors or kinin precursors. Contrary to popular belief, haemoglobin is not a blood protein, as it is carried within red blood cells, rather than in the blood serum.

Serum albumin accounts for 55% of blood proteins, is a major contributor to maintaining the oncotic pressure of plasma and assists, as a carrier, in the transport of lipids and steroid hormones. Globulins make up 38% of blood proteins and transport ions, hormones, and lipids assisting in immune function. Fibrinogen comprises 7% of blood proteins; conversion of fibrinogen to insoluble fibrin is essential for blood clotting. The remainder of the plasma proteins (1%) are regulatory proteins, such as enzymes, proenzymes, and hormones. All blood proteins are synthesized in liver except for the gamma globulins.

Separating serum proteins by electrophoresis is a valuable diagnostic tool as well as a way to monitor clinical progress. Current research regarding blood plasma proteins is centered on performing proteomics analyses of serum/plasma in the search for biomarkers.

Families of blood proteins

Blood protein	Normal level	%	Function
<u>Albumins</u>	3.5-5.0 g/dl	55%	create and maintain <u>osmotic pressure</u> ; transport insoluble molecules
<u>Globulins</u>	2.0-2.5 g/dl	38%	participate in <u>immune system</u>
<u>Fibrinogen</u>	0.2-0.45 g/dl	7%	Blood <u>coagulation</u>
<u>Regulatory proteins</u>		<1%	Regulation of gene expression
<u>Clotting factors</u>		<1%	Conversion of fibrinogen into fibrin

Clinical significance of plasma proteins

Abnormal Protein Concentration

- The liver synthesizes of albumin, fibrinogen, prothrombin and most of the globulins particularly alpha and beta globulins.
- The gamma globulins are synthesized in the lymphoid organs.
- The normal range of total protein levels in most of the animals ranges between 5 and 8 g/dL.
- Edema develops when the total protein concentration in plasma falls below 5g/dL.

Hypoproteinemia: (decreased protein concentration)

- Hypoalbuminemia with hypoglobulinemia: It may be due to decreased concentrations of albumin, globulin or both.
- Blood loss
- Due to proportional loss of all blood constituents, interstitial fluid moves into the circulatory system and dilutes the remaining blood causing a decrease in the level of albumin and globulin.
- Protein losing entropy
- During a variety of intestinal lesions both albumin and globulin leak from the intestinal wall into the intestinal lumen and then are digested or excreted.
- Severe exudative skin disease
- This results from vascular permeability that allows both albumin and globulin to escape from the blood.
- Severe burns: These cause increased vascular permeability that can result in loss of both albumin and globulin.
- Effusive disease: This results in the accumulation of body cavity fluids with high protein concentrations that can result in decreased albumin and globulin concentrations.
- The decrease depends on the degree of increased vascular permeability.
- Hypoalbuminemia with normal to increased globulin concentrations.
- The decreased albumin concentration can result from either decreased production or increased loss of albumin.
- If the concentration of globulin is increased the total protein level may be normal.
- Decreased production of Albumin can occur in the following disorders:
 - Hepatic Failure
 - Starvation
 - Gastrointestinal Parasitism
 - Malabsorption
 - Exocrine pancreatic insufficiency (EPI)
 - Inadequate digestion of dietary proteins can result from EPI, in which amino acids are not liberated from the protein by digestion in the intestine, so they are not available for absorption.
 - Decreased albumin production.
 - Increased loss of proteins can occur in the following disorder

- Glomerular Diseases: Albumin are smaller than globulin, they leak more readily through damaged glomerular membrane.

Hyperproteinemia: (Increased Protein Concentration)

Hyperalbuminemia and Hyperglobulinemia

Causes:

- Loss of water from the blood causes an increased concentrations of albumin and globulin.
- The albumin : globulin ratio is not altered because both fractions are concentrated equally.
- Hyperglobulinemia: It depends on the type of globulin that is increased: Increased gamma globulin concentration.
- Acute inflammation is the most common cause.
- Concentrations of several proteins in the globulin fraction (e.g., Ceruloplasmin, haptoglobin, and alpha 2 macroglobulin) are increased.
- These proteins are collectively called as acute phase proteins.
- Increased beta globulin concentrations can occur with acute inflammation, nephrotic syndrome, liver disease and immune response.
- Concentrations of several acute phase proteins in this fraction (e.g., C-reactive proteins, complement, ferritin) increase during acute inflammation.
- Increased gamma globulin concentration: This fraction includes most of the immunoglobulins.
- Increases in gamma globulin concentration are termed as gammopathies and they are divided in to polyclonal (have broad based peak in the beta and gamma regions) and monoglomal gammopathies (have a narrow based electrophoretic peak in the beta and gamma regions), which suggests chronic inflammatory diseases (e.g., chronic bacterial, viral, fungal or rickettsial disorder, parasitism (cutaneous parasites), cancer and immune mediated diseases.
- Multiple myeloma is due to the proliferation of single clone of B lymphocytes. This clone produces a homogenous type (monoclonal immunoglobulin) of protein called as paraprotein or M-component.

A/G ratio: A/G ratio provides a systematic approach to the interpretation of protein values.

- Normal A/G ratio: Dehydration with water loss results in hyperproteinemia with out a change in the A/G ratio.
- Albumin and globulin fractions are increased proportionately. Excess fluid intake or fluid therapy is a simple cause of hypoproteinemia. This is due to the dilution.
- **Decreased A/G ratio:** It is generally due to decreased level of albumin and increased level of globulins. The conditions resulting in the reduced level of albumin and increased level of globulins have been discussed earlier.
- **Increased A/G ratio:** Generally albumin is not produced in excess. Any increase in the level of albumin is due to hemoconcentration as a result of dehydration.
- Decreased globulins: Newborn animals are physiologically hypoglobulinemic (failure of passive transfer of cholostral antibodies).
- When there is a failure in the formation of gamma globulins (Immunosuppression or immunodeficiency).