

Basics of Clinical Chemistry

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Basics of Clinical Chemistry

Clinical chemistry also known as chemical pathology, clinical biochemistry or medical biochemistry, it is laboratory unit of clinical pathology that is generally concerned with analysis of body fluids like blood, cerebrospinal fluid (CSF), urine, transudate and exudate, but mostly deal with analysis of serum or plasma.

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Biochemical constituents measured in blood include:

- **Total proteins and its fractions.**
- **Lipid profile and glucose.**
- **Serum enzymes activities.**
- **Serum electrolytes levels.**
- **Serum minerals levels.**
- **Serum bilirubin, Blood urea nitrogen and creatinine.**
- **Hormones.**

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- Usually measured serum proteins include total proteins, albumin and globulins. The latter can be separated by electrophoresis in α -globulin, β -globulin and γ -globulins.
- Total proteins level measured in plasma is higher than that measured in serum, this because another protein present in plasma, which is fibrinogen.
- Commercially supplied kits are able to measure total proteins and albumin only, the globulin level is calculated mathematically by subtracting the albumin levels from total proteins levels.

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Total proteins and its fractions

- Total proteins and its fractions are helpful in diagnosis of a variety of diseases. Inflammatory diseases are associated with hyperproteinaemia, hyperglobulinaemia and hypoalbuminaemia.
- Increased serum total proteins and its fractions especially albumin level occurs in dehydration.
- Other causes for hypoproteinemia include; renal protein loss, intestinal protein loss, hemorrhage, dietary protein deficiency, mal-absorption of proteins.

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Lipid profile and glucose

- Lipids are insoluble in water but are carried in the body fluids as soluble protein complexes known as lipoproteins.
- Cholesterol is an essential structural component of mammalian cell membranes and is required to establish proper membrane permeability.
- Cholesterol also serves as a precursor for the biosynthesis of steroid hormones, bile acids and vitamin D.
- Serum lipids and glucose variables are measured using spectrophotometer

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Lipid profile and glucose

- Serum lipid profile include measurements of total lipids, phospholipids, triglycerides, total cholesterol, high density lipoprotein cholesterol (HDL-C), low density lipoprotein cholesterol (LDL-C) and Very low density lipoprotein cholesterol (VLDL-C). HDL-C transports cholesterol from cells to liver (anti-risky). LDL-C transport cholesterol to cells. VLDL-C transports triglycerides from the liver to cells.
- Glucose in blood is the first source of energy in the body, especially for the brain.
- Serum lipids and glucose variables are measured using spectrophotometer

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Serum enzymes levels

Enzymes that are mostly measured in blood for diagnosis of different diseases including:

- **Creatine phosphokinase (CK)**
- **Aspartate aminotransferase (AST)**
- **Alanine aminotransferase (ALT)**
- **Lactate dehydrogenase (LDH)**
- **Gamma glutamyl transferase (GGT)**
- **Alkaline phosphatase (ALP).**

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Serum electrolytes levels

- Sodium, potassium and chloride are the three electrolytes most commonly considered in veterinary medicine, while bicarbonate is measured much less frequently. These ions are all freely diffusible throughout the entire ECF (plasma, interstitial fluid, lymph).
- Serum sodium and potassium levels can be determined using flame photometer or spectrophotometer. The latter also used for measuring serum chloride level.

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Serum electrolytes levels

- Hypernatraemia occur when loss of a low-sodium fluid occurs, as in vomiting, excessive panting, and diabetes insipidus. It is also seen when restricted water intake prevents normal sodium excretion.
- Hyponatraemia occurs when loss of a high-sodium fluid occurs - the most common instance of this is in renal failure when the kidney cannot concentrate the urine

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Serum electrolytes levels

- Hyperkalaemia is caused by a failure of the kidney to excrete potassium.
- Hypokalaemia occurs most commonly due to persistent loss of a high-potassium fluid. Diarrhea is considered to be the classic instance.
- Hypokalaemia will also be seen in patients on long-term fluid therapy being given potassium-free fluids such as dextrose saline or isotonic saline.

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Serum minerals levels

- Common measured minerals in serum include calcium, phosphorus, magnesium, iron, copper and zinc.
- Serum minerals are measured using spectrophotometer.

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Calcium

- Calcium is of major importance in transmission at the neuromuscular junction and in the propagation of the contraction impulse within the muscle. It is also a major component of bone.
- About half of the plasma calcium is free, and this is the active proportion, while the other half is inactive, bound to albumin.

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Calcium

- Mild hypercalcaemia may be due to raised plasma albumin concentration.
- Hypercalcaemia is almost always due to some type of hyperparathyroidism
- Hypocalcaemia occurs in hypoalbuminaemia, acute pancreatitis, chronic renal failure, hypoparathyroidism.

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Serum bilirubin

- Bilirubin is a by-product of hem breakdown. In its initial form it is not water-soluble and when in the plasma it is bound to albumin.
- There are two forms of bilirubin in the blood circulation, which are direct or conjugated and indirect or unconjugated bilirubin. The increase of any one of them result in increased the total bilirubin level, which cause the yellowish color of skin.
- Normally total bilirubin level in adult animals is below 1 mg/dl, Jaundice occurs when the total bilirubin level become above 3 mg/dl.

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Jaundice

There are three types of Jaundice; pre-hepatic (Hemolytic), hepatic jaundice and post-hepatic (Obstructive) Jaundice.

Prehepatic (Hemolytic) jaundice

- Occurs in case of hemolytic anemia.
- Total bilirubin level is increased due to increased blood indirect bilirubin level.
- The color of urine remains normal, because indirect bilirubin is bind to albumin, and subsequently unable to pass the glomerular filter.

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Jaundice

Hepatic jaundice

- Occurs in case of hepatitis.
- Total bilirubin level increased due to increase of both direct and indirect bilirubin.
- Dark brown color of urine, as a result of excretion of direct bilirubin in urine.
- Normal color of feces.
- Normal urobilinogen level.

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Jaundice

Post-hepatic (Obstructive) Jaundice

- Occurs in case of obstruction of main bile duct.
- Total bilirubin increased due to increase blood direct bilirubin level.
- Dark brown color of urine.
- Clay color of feces.
- Absence of urobilinogen from urine.

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Blood urea nitrogen and creatinine

- Urea is a nitrogenous waste product which is formed in the liver as the end product of amino acid breakdown. After the urea has been formed in the liver it is transported in the plasma to the kidneys where it is excreted in the urine.
- Creatinine, like urea, is a nitrogenous waste product, but it is a product not of amino acid breakdown but of breakdown of creatine. Creatine is a substance present in the muscle which is involved in high energy metabolism.

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