Electrolytes

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A blood calcium test : In most cases, it is a good reflection of the amount of free calcium present in the blood since the balance between free and bound is usually stable and predictable normal value 1.11 - 1.30 mmol/L.

Tests are often performed to measure ionized calcium:

- If the blood calcium is abnormal measuring calcium and PTH together can help determine whether the parathyroid glands are functioning normally.
- testing for vitamin D, phosphorus, and/or magnesium can help determine whether other deficiencies or excesses exist. Frequently, the balance among these different substances. For evaluate the effectiveness of treatments such as calcium or vitamin D supplements.
- Measuring urine calcium can help determine whether the kidneys are excreting the proper amount of calcium,
- someone has symptoms of kidney stones, such as a sharp pain in

the person's side or back around the kidneys, **because low calcium is especially common in those with kidney failure.**

- Bone disease
- thyroid disease,
- malabsorption, or malnutrition
- Cancer: (particularly breast, lung, head and neck, kidney, or multiple myeloma)
- Neurologic disorders: numbness around the mouth and in the hands and feet and muscle spasms in the same areas
- critically ill patients, those who are receiving blood transfusions or intravenous fluids, patients undergoing major surgery, and people with blood protein abnormalities like low albumin.
- Large fluctuations in ionized calcium can cause the heart to slow down or to beat too rapidly, can cause muscles to go into spasm (tetany), and can cause confusion or even coma.
- It is typically included in the comprehensive metabolic panel

(CMP) and the basic metabolic panel (BMP), two sets of tests as part of a routine health.

- **Calcium absorption, use, and excretion are regulated and stabilized by a feedback loop involving** PTH, Calcitonin and vitamin D.
- **Symptoms of very low calcium** such as abdominal cramps, muscle cramps, or tingling fingers.

most common cause of low total calcium is:

- Low blood protein levels, especially a low level of albumin, which can result from liver disease or malnutrition, With low albumin, only the bound calcium is low. Ionized calcium remains normal, and calcium metabolism is being regulated appropriately.
- Underactive parathyroid gland (hypoparathyroidism) Inherited resistance to the effects of parathyroid hormone.
- Extreme deficiency in dietary calcium
- Decreased levels of vitamin D
- Magnesium deficiency

- Increased levels of phosphorus
- Acute inflammation of the pancreas (pancreatitis)
- Renal failure

Symptoms of high calcium: such as fatigue, weakness, loss of appetite, nausea, vomiting, constipation, abdominal pain, urinary frequency, and increased thirst

Hypercalciuria: A high level of calcium in the urine may lead to the formation of crystals or calculi (stones) in the kidneys. About 75% of kidney stones contain calcium.

Taking thiazide diuretic drugs, this drug-induced reason for a high calcium level. Taking lithium or tamoxifen may also increase a person's calcium level.

Newborns, especially premature and low birth weight infants, often few days of life for neonatal hypocalcemia using the test for ionized calcium. This can occur because of an immature parathyroid gland The condition may resolve itself or may require treatment with supplemental calcium.

- Blood and urine calcium measurements cannot tell how much

calcium is in the bones. A test similar to an X-ray, called a bone density or "Dexa" scan, is used for this purpose.

Phosphorus test: ordered along with calcium, parathyroid hormone (PTH), and/or vitamin D, most commonly performed on blood samples, phosphorus is sometimes measured in urine samples to monitor its elimination by the kidneys, normal value 2.6 - 4.5 mg/dl.

phosphorus testing is performed in follow up to :

- an abnormal calcium test and/or when symptoms of abnormal calcium such as fatigue, muscle weakness, cramping, or bone problems are present.
- with other tests when symptoms suggest kidney and gastrointestinal disorders.
- When someone has diabetes or signs of an acid-base imbalance.

Low levels of phosphorus (hypophosphatemia) in the blood due to or associated with:

- Increased blood calcium (hypercalcemia),

- hyperparathyroidism
- Overuse of diuretics ,
- Alcoholism,
- Diabetic ketoacidosis (after treatment)
- Hypothyroidism ,
- Decreased blood potassium (hypokalemia)
- Rickets and osteomalacia (due to vitamin D deficiencies)
- Malnutrition
- Severe burns
- Chronic antacid use

Hyperphosphatemia: Higher than normal levels of phosphorus This is rare, that lead to cardiovascular disease or osteoporosis in the blood may be due to or associated with:

- Kidney failure
- Liver disease
- Hypoparathyroidism
- Diabetic ketoacidosis (when first seen)
- Increased dietary intake (Soft drinks and pre-packaged food)

Abnormally high levels of phosphorus can lead to organ damage due to calcification, deposits of calcium phosphate in the tissues.

- Phosphate levels are normally higher in children than in adults because their bones are actively growing. Low phosphate levels in children can inhibit bone growth and high levels may be an indication of a condition that disrupts the body's balance of minerals.

❖ **Drug may be affected on levels of phosphorus such as**: enemas and laxatives containing sodium phosphate, excess dietary vitamin D supplements, and intravenous glucose administration.

A chloride blood test:

It works with other electrolytes, such as potassium, sodium, and bicarbonate, normal value 101 - 111 mmol/L , to help regulate the amount of fluid in the body and maintain the acid-base (pH) balance. Tests are often performed to evaluated:

- If an acid-base imbalance is suspected and helps to guide treatment.
- It is usually ordered as part of an electrolyte panel, used to

- monitor treatment of certain problems, including high blood pressure (hypertension), heart failure, and liver and kidney disease

hyperchloremia : An increased level of blood chloride usually indicates dehydration, or cause by high blood sodium, such as Cushing syndrome or kidney disease. also occurs when too much base is lost from the body (producing metabolic acidosis) or when a person hyperventilates (causing respiratory alkalosis).

Hypochloremia: decreased level of blood chloride occurs with any disorder that causes low blood sodium, also occurs with congestive heart failure, prolonged vomiting or gastric suction, Addison disease, emphysema or other chronic lung diseases (causing respiratory acidosis), and with loss of acid from the body (called metabolic alkalosis).

An increased level of urine chloride can indicate dehydration, starvation, Addison disease, or increased salt intake.

A decreased level of urine chloride can be seen with Cushing syndrome, Conn syndrome, congestive heart failure, malabsorption, syndrome, and diarrhea. with increased certain hormones such as cortisol or aldosterone that can affect electrolyte elimination.

- Drugs that affect sodium blood levels will also cause changes in chloride.

Sodium blood test: is used to detect abnormal concentrations of sodium, including low sodium (hyponatremia) and high sodium (hypernatremia). normal value 136 - 144 mmol/L. Sodium is an electrolyte present in all body fluids and is vital to normal body function, like nerve and muscle function. It helps cells function normally and helps regulate the amount of fluid in the body. A blood sodium test may also be used to:

- detect the cause and help monitor treatment in people with dehydration, excess fluid (edema), or with a variety of symptoms (e.g., weakness, confusion, thirst and/or diarrhea, vomiting, excessive sweating, dry mucous membranes).

- To identify an electrolyte imbalance or if there are symptoms of illness involving the brain, lungs, liver, heart, kidney, thyroid, or adrenal glands.
- To monitor the effectiveness of treatment or to monitor people taking medications that can affect sodium levels, such as diuretics.

symptoms of low sodium:

such as weakness, confusion, and lethargy, or even fall into a coma.

symptoms of high sodium:

such as thirst, dry mucous membranes (e.g., mouth, eyes), less frequent urination, muscle twitching, and/or agitation

A urine sodium test may be ordered when a blood sodium test is low

(Hyponatremia) may be due to losing too much sodium, most commonly from conditions such as:

use of diuretics, kidney disease or low levels of cortisol, aldosterone and sex hormones (Addison disease) ,Drinking too much water ,Excess fluid accumulation in the body (edema) caused by heart failure, cirrhosis, and kidney diseases that cause protein loss (nephrotic syndrome) or malnutrition.

(Hypernatremia): is caused by losing too much water (dehydration) without drinking enough water. may be due to increased salt intake without enough water, Cushing syndrome, or a condition caused by too little ADH called diabetes insipidus.

- Certain **drugs** such as anabolic steroids, antibiotics, corticosteroids, laxatives, cough medicines, and oral contraceptives may cause increased levels of sodium.
- Other drugs such as ACE inhibitors, diuretics, carbamazepine, heparin, and tricyclic antidepressants may cause decreased levels of sodium. increased salt intake without enough water, Cushing syndrome, or a condition caused by too little ADH called diabetes insipidus

❖A potassium test :

It helps transport nutrients into cells and removes waste products out of cells. It is also important in muscle function, helping to transmit messages between nerves and muscles, and is important to heart function. normal value 3.7 - 5.2 mmol/L. test is used to detect :

- if metabolic acidosis is suspected, or if there is high blood pressure or other symptoms of illness present.
- to monitor effects of drugs that can cause the kidneys to lose potassium, particularly diuretics, or drugs that decrease potassium elimination from the body.
- Kidney disease(kidna patient receiving dialysis, diuretic therapy, or intravenous fluids

Urine potassium levels :

Urine potassium testing is also used for people with abnormal kidney disease.

(Hyperkalemia): increased potassium in blood.

Symptoms such as muscle weakness cardiac arrhythmia seen in conditions such as:

- Kidney disease
- Injury to tissue
- Diabetes ketoacidosis
- anorexia, or muscle damage
- Consuming too much potassium
- In patients on intravenous (IV) fluids, excessive IV potassium.
- Addison disease
- Infection
- Dehydration

➢ Certain **drugs** can also cause hyperkalemia:

non-steroidal anti-inflammatory drugs (NSAIDs), beta blockers (such as propanolol and atenolol), angiotensin-converting enzyme inhibitors (such as captopril, enalapril, and lisinopril), and potassium-sparing diuretics (such as triamterene, amiloride, and spironolactone), corticosteroids, beta-adrenergic agonists such as isoproterenol, alpha-adrenergic antagonists such as clonidine, antibiotics such as gentamicin and carbenicillin, and the antifungal agent amphotericin B.

Hyperkalemia symptoms : the most common cause diarrhea and vomiting, excessive sweating, or with a variety of symptoms.

Hypokalemia: decreased potassium in blood accrue in:

- Conn syndrome (hyperaldosteronism)
- A complication of acetaminophen overdose
- In diabetes.

➢ if someone is clenching and relaxing his or her fist, If blood samples are delayed in getting to the lab or the blood tubes are subjected to vigorous shaking or rough handling in transit, potassium may leak from red blood cells all caused falsely elevate the potassium.