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PATHOLOGIC CALCIFICATION

Deposition of calcium salts in tissues other than osteoid or enamel is called pathologic or heterotopic calcification.

Two distinct types of pathologic calcification are recognised:

Dystrophic calcification, which is characterised by deposition of calcium salts in dead or degenerated tissues with normal calcium metabolism and normal serum calcium levels.

Dystrophic calcification may occur due to 2 types of causes:

- Calcification in dead tissue
- Calcification of degenerated tissue

Metastatic calcification, on the other hand, occurs in apparently normal tissues and is associated with deranged calcium metabolism and hypercalcaemia.

Since metastatic calcification occurs in normal tissues due to hypercalcaemia, its causes would include one of the following two conditions:

- Excessive mobilisation of calcium from the bone.
- Excessive absorption of calcium from the gut.

Pathogenesis of Dystrophic Calcification

The process of dystrophic calcification has been likened to the formation of normal hydroxyapatite in the bone involving 2 phases:

- Initiation and propagation:

Initiation is the phase in which precipitates of calcium phosphate begin to accumulate intracellularly in the
mitochondria, or extracellularly in membrane-bound vesicles.

Propagation is the phase in which minerals deposited in the initiation phase are propagated to form mineral crystals.

Pathogenesis of metastatic calcification

Metastatic calcification occurs due to excessive binding of inorganic phosphate ions with calcium
ions, which are elevated due to underlying metabolic derangement. This leads to formation of precipitates of calcium phosphate at the preferential sites. Metastatic calcification is reversible upon correction of underlying metabolic disorder.

GANGRENE

Gangrene is a form of necrosis of tissue with superadded putrefaction. The type of necrosis is usually coagulative due to ischaemia (e.g. in gangrene of the bowel, gangrene of limb). On the other
hangda, gangrenous or necrotising inflammation is characterised by primarily inflammation provoked by
virulent bacteria resulting in massive tissue necrosis. Thus, the end-result of necrotising inflammation
and gangrene is the same but the way the two are produced, is different. The examples of necrotising
inflammation are: gangrenous appendicitis, gangrenous stomatitis (noma, cancrum oris).
There are 2 main forms of gangrene—dry and wet, and a variant form of wet gangrene called gas
gangrene. In all types of gangrene, necrosis undergoes liquefaction by the action of putrefactive bacteria.

ELECTROLYTE IMBALANCE

Electrolytes are nutrients that are important for a variety of essential functions in our body including
brain, nerve and muscle function.
Keeping our electrolyte levels balanced is necessary for our health and well-being.
Electrolytes include sodium, potassium, magnesium, calcium, chloride and other minerals. Each plays
a specific role in our body.
Sodium – helps to maintain fluid balance, nerve signaling, blood pressure and muscle contractions.
Potassium – helps with stable blood pressure, muscle functions, bone health, nerve impulses and
regulating heart contractions.
Magnesium – helps with muscle contraction, nerve functioning, bone building, bone strength, regulating heart rhythms, maintain blood glucose levels, sustaining a stable protein-fluid balance.
Calcium – helps our body with muscle contractions, muscle movement, cell division, nerve signaling,
blood clotting and by forming and maintaining bones & teeth.
Chloride – helps to maintain fluid balance and a healthy pH.
Phosphate – helps to strengthen your bones and teeth and production of energy for tissue growth
and repair.

Intracelluar compartment has higher concentration of potassium, calcium, magnesium and phosphate ions than

the blood, while extracellular fluid (including serum) has higher concentration of sodium, chloride, and bicarbonate
ions.
In health, for electrolyte homeostasis , the concentration of electrolytes in both these compartments should be
within normal limits.
Normal serum levels of electrolytes are maintained in the body by a careful balance of 4 processes: their intake,
absorption, distribution and excretion.
Disturbance in any of these processes in diverse pathophysiologic states may cause electrolyte imbalance .
Among the important components in electrolyte imbalance, abnormalities in serum levels of sodium (hypo and
hypernatraemia), potassium (hypo- and hyperkalaemia), calcium (hypo- and hypercalcaemia) and magnesium
(hypo and hypermagnesaemia) are clinically more important.
A few general principles on electrolyte imbalances are as under:
1. Electrolyte imbalance in a given case may result from one or more conditions.
2. Resultant abnormal serum level of more than one electrolyte may be linked to each other. For example,
abnormality in serum levels of sodium and potassium; calcium and phosphate.
3. Generally, the reflection of biochemical serum electrolyte levels is in the form of metabolic syndrome and
clinical features rather than morphological findings in organs.
4. Clinical manifestations of a particular electrolyte imbalance are related to its pathophysiologic role in that organ or tissue.

SODIUM

Sodium, or Na , is one of the most important electrolytes in the body and is responsible for a number of important functions, mostly related to fluid and water regulation. The normal accepted range for sodium is 134 to 145 mEq/L.
Hyponatraemia is considered to be a serum sodium below 134 mEq/L.

Etiology:

A common cause of hyponatraemia is water retention due to cardiac or renal or hepatic failure.
Other causes of hyponatraemia include some medicines,
psychogenic polydipsia (excessive water intake),
syndrome of inappropriate ADH (antidiuretic hormone) secretion,
chronic or severe vomiting and diarrhoea.
Clinical manifestations:
Confusion, agitation, nausea and vomiting, muscle weakness, spasms or cramps.

Hypernatraemia is defined as a serum sodium greater than 145 mEq/L.
Etiology:

Anything that leads to excessive water loss or salt gain. For example, water depletion or dehydration may be caused by vomiting or diarrhoea.
Excessive ingestion of sodium is rare, but the administration of infusions containing sodium such as sodium chloride or sodium bicarbonate may lead to hypernatraemia.
Clinical manifestations:
fever, irritability, drowsiness, irritability, lethargy and confusion.

Potassium
Potassium, or K , is responsible for the functioning of excitable tissues such as skeletal and cardiac muscle and nerves. The normal range for potassium is 3.5 to 5.0 mmol/L.
Hypokalaemia is defined as a serum potassium less than 3.5 mmol/L.
Etiology:
Decreased oral intake, increased renal or gastrointestinal loss of potassium, or a shift of potassium within the body's fluid compartments (from outside the cell where it should be, to inside the cell).
Clinical manifestations:
Range from muscle weakness and ileus (lack of peristalsis), to serious cardiac arrhythmias such as ventricular tachycardia.

Hyperkalaemia is defined as a serum potassium greater than 5.0 mmol/L.
Etiology:
excessive intake, tissue damage from burns or trauma, medicines such as potassium sparing diuretics, and most commonly, due to renal failure.
Clinical manifestations:
muscle weakness, hypotension, bradycardia and loss of cardiac output, and ECG changes may include peaked T waves and flattened P waves.

Magnesium
Magnesium, o rMg , is another element that has a strong effect on muscle contractions.
The normal plasma range for magnesium is 0.70 to 0.95 mmol/L.
Hypomagnesaemia , is as a plasma magnesium level less than 0.70 mmol/L.
Etiology:
decreased intake or increased loss of magnesium.
Clinical manifestations:
confusion, irritability, delirium, muscle tremors and tachyarrhythmias.

Hypermagnesaemia is when the level of magnesium in the blood is above the normal range (0.95 mmol/L) Fortunately, this is uncommon.
Etiology:
excessive administration of magnesium and lithium therapy, often in the presence of renal failure.
Clinical manifestations:
poor reflexes,low BP, respiratory depression, and cardiac arrest.

Calcium

Calcium, or Ca , is an important element in the body as it helps to control nerve impulses,muscle contractions and has a role in clotting. The serum calcium range should be between 2.20 to 2.55
mmol/L when normal.

Hypocalcaemia , is defined as low serum calcium levels (less than 2.20mmol/L).

Etiology:

It is relatively rare because the bones always act as a reservoir for this electrolyte.
Parathyroid disease, vitamin D deficiency, septic shock and acute pancreatitis can cause this problem.

Clinical manifestations:

tetany (involuntary muscle contraction), mental changes and decreased cardiac output.

Hypercalcaemia , is elevated levels of calcium in the blood (serum calcium level above 2.55mmol/L)

Etiology:

It again arises from parathyroid problems and vitamin D issues.

Clinical manifestations:

nausea, vomiting, polyuria, muscular weakness and mental disturbance.

Phosphate

Phosphate, or P , is an electrolyte used in several functions throughout the body. Although a phosphate
imbalance isn't as well known as some of the other imbalances, it can still cause problems with the
patient's condition.

The normal range of phosphate in the plasma is generally between 0.8 to 1.3 mmol/L.

Hypophosphataemia , is when levels of phosphate in the blood are below the normal range(0.8mmol/L)

Clinical manifestations:

muscle weakness, heart failure, seizure, and coma.

Etiology:

Vitamin D deficiency, hyperparathyroidism, or alcoholism. Hypophosphataemia may also be present, in
addition to other electrolyte disturbances, in re-feeding syndrome, which is associated with the commencement of Total Parenteral Nutrition.

Hyperphosphataemia , is levels of phosphate in the blood above the normal range (1.3mmol/L)

Etiology:

Kidney disease, parathyroid issues, and metabolic or respiratory acidosis.

Clinical manifestations:

Symptoms are usually not present, and they are related to hypocalcaemia. Renal patients can experience hardened calcium deposits when this condition goes untreated.