Department of Anesthesia Techniques
Title of the lecture:- Homeostasis of Body Fluid & Electrolytes Related to Anesthesia

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Impact of Anesthesia

Understanding basic fluid and electrolyte physiology is essential to good perioperative fluid management .

Anesthesia and critical care patients are often fasted and under physiological stress. Therefore, homoeostatic regulation of fluid balance is impaired .

A disturbance in normal fluid balance induces a physiological 'stress' response via :

1. Metabolic
2. Neuroendocrine
3. Immune-mediated systems

- The characteristic response to anesthesia and surgery is sodium and water retention .

Excess ADH secretion in the postoperative period is largel in response to hypovolaemia.

Potassium Balance

The total amount of potassium in the ECF is less than the average daily intake (50—200 mmol), so a potassium load must be cleared rapidly from this compartment.

The physiological mechanisms:-

1. Release of both insulin and glucagon.
2. Releases of aldosterone.
3. K+ regulation is inversely related to PH.

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Hypokalaemia & Hyperkalaemia

Hypokalemia

Causes: Anorexia (loss of appetite), nausea, muscle weakness and cardiac conduction abnormalities (ECG) .

Treatment: potassium supplements and treatment of the underlying causes.

Hyperkalemia

Causes: cardiac arrhythmias

Treatment: calcium gluconate , glucose and insulin, sodium bicarbonate.

Chloride

Chloride is the main anion in the ECF. It is important in :

1. Maintaining a normal acid-base state (exchangeable with bicarbonate).
2. Normal renal tubular function.
3. Formation of gastric acid.

Chloride intake: Absorption from the upper part of the small intestine

Chloride loss: From the stomach, bile, pancreatic and intestinal secretions .

Regulation of chloride is passively related to sodium and inversely related to plasma bicarbonate .

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- About 70% of the bicarbonate produced will diffuse into the plasma and chloride shifts into the cell to maintain electrochemical neutrality.
- The reverse occurs when the blood reaches the lungs.

Bicarbonate

- Bicarbonate has two main physiological functions. It forms the main buffer and facilitates the carriage of carbon dioxide in the blood (80% as bicarbonate).
- Decreasing latency of local anesthetic blocks.
- The onset and duration of action of local anesthetic.
- blocks can be increased by alkalinisation of local anesthetics.
- The proposed mechanism is that the alkaline pH promotes the localanaesthetic to remain in the unionised state , in which from it crosses the neural membrane.

Calcium

The normal level of calcium is between 8.5 - 10.6 mg/dL

The levels of calcium in the body are managed by calcitonin which decreases calcium levels and parathyroid hormone which increases the calcium levels.

Calcium is essential for bone health and other functions

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Hypercalcemia

which is a calcium level of more than 10.6 mg/dL, is most often associated with

the endocrine disorder of hyperparathyroidism,

some forms of cancer such as breast cancer and cancer of the lungs, with multiple myeloma

The treatment of hypercalcemia can include intravenous fluid hydration and medications like diuretics

Hypocalcemia

which is a calcium level less than 8.5 mg/dL, can occur as the result of renal disease inadequate dietary calcium, a vitamin D deficiency because vitamin D is essential for the absorption of calcium

a low level of magnesium, pancreatitis, hypoparathyroidism

an eating disorder, and certain medications such as anticonvulsants

The treatment of hypocalcemia includes the monitoring of the patient respiratory and cardiac status in addition to providing the patient with calcium supplements coupled with vitamin D because vitamin D is necessary for the absorption of calcium.

Magnesium

The normal level of magnesium in the blood is 1.7 to 2.2 mg/dL.

Magnesium plays an important role in enzyme activities, brain neuron activities, the contraction and relaxation of muscles. Magnesium also plays a role in the metabolism of calcium, potassium and sodium.

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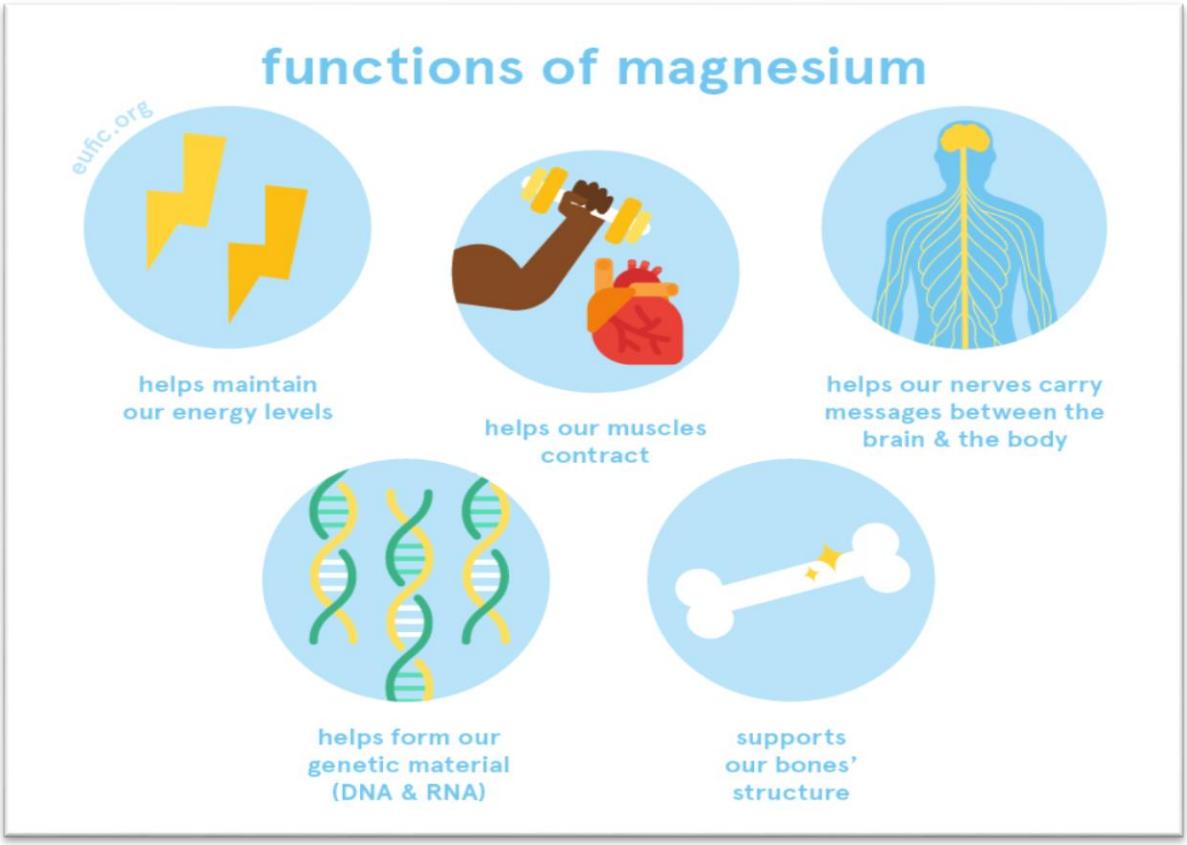
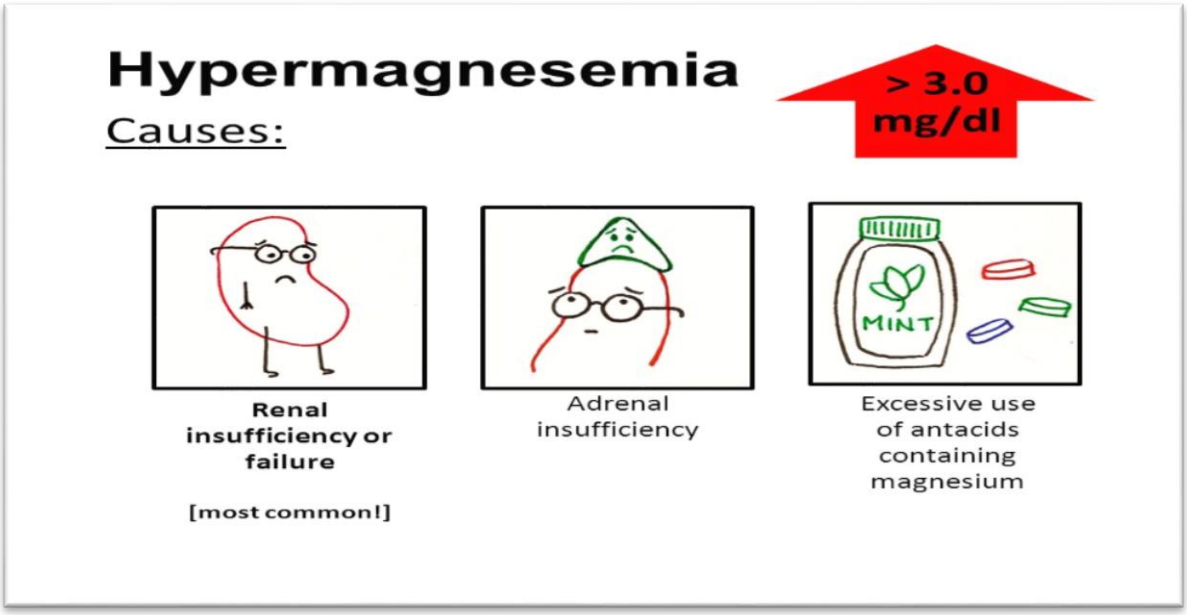


Hypermagnesemia & Hypomagnesemia

Hypermagnesemia which is a blood magnesium level of more than 2.2 mg/dL.



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The **treatment** for hypermagnesemia typically includes the cessation of causative medications like magnesium containing laxatives, renal dialysis, and the administration of calcium gluconate, calcium chloride and/or intravenous dextrose.

Hypomagnesemia on the other hand, is a blood magnesium level less than 1.7 mg/dL. Hypomagnesaemia often occurs as the result of the prolonged use of diuretics, uncontrolled diabetes, hypoparathyroidism, diarrhea and gastrointestinal disorders such as Charon's disease, severe burns, malnutrition.

The **treatment** of hypomagnesaemia can include medications to decrease pain, administration of intravenous fluids and magnesium.

Phosphate

The normal level of serum phosphate is from 0.81 to 1.45 mmol/L. Hyperphosphatemia is defined as a phosphate level greater than 1.45 mmol/L. The greatest risk factor for hyperphosphatemia is severe and advanced renal disease, but other risk factors can include hypoparathyroidism, diabetic ketoacidosis, serious systemic infections, and rhabdomyolysis which is the destruction of muscular tissue.

Hyperphosphatemia can be asymptomatic and may be patient have signs and symptoms of muscular spasms and cramping, weakness of the bones, tetany, and crystal accumulations in the circulatory system and in the body's tissue that can lead to calcifications in the subcutaneous tissue.

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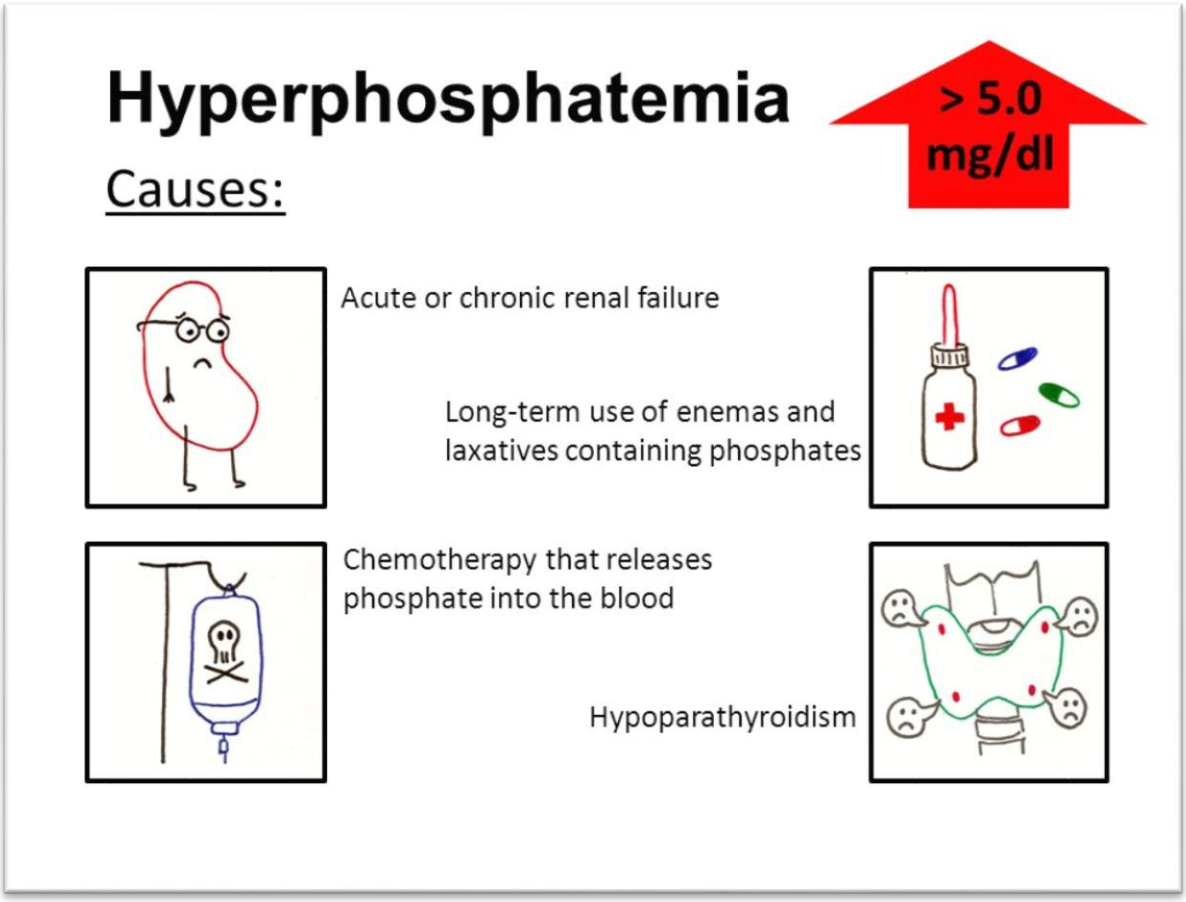

The **treatment** of hyperphosphatemia includes the restriction of dietary food products containing phosphates including foods like milk and egg yolks.

Hypophosphatemia, which is defined as a phosphate level less than 0.81 mmol/L is associated with risk factors such as

- chronic diarrhea
- severe burns
- hyperparathyroidism
- severe malnutrition

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- alcoholism
- lymphoma, leukemia
- hepatic failure

Treatments for hypophosphatemia include cardiac monitoring, oral and intravenous potassium phosphate, and the encouragement of high phosphorous foods like milk and egg.