



Department of Anesthesia Techniques  
 Title of the lec1: - Homostasis



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## Osmolarity

Osmolarity is defined as the number of particles per liter of fluid. Physiologic blood plasma osmolarity is approximately 286 mOsmoles/L. Less than this is hypoosmotic, and greater is hyperosmotic. Cellular osmotic concentration gradients are maintained largely through the active pumping of transmembrane ionic transport proteins. In addition to ionic components, osmolarity is partially composed of proteins such as albumin in the serum. another important osmotically active component to consider is glucose.

### Physiology of Potassium of total body potassium:

approximately 135-150mmol/l is present intracellularly, compared to plasma levels of 3.5-5.5mmol/l. The daily requirement is about 1mmol/kg/day, which is absorbed from the small intestine by diffusion. Potassium Homeostasis The kidney is the main organ involved in potassium regulation.

aldosterone which is the main hormone involved in potassium regulation secreted from adrenal gland. Because of the relative permeability of the cell membrane to potassium compared to sodium, this results in holding potassium intracellularly against Potassium and, its chemical gradient, which is balanced by the action of the Na<sup>+</sup> /K<sup>+</sup> ATPase pump which in turn maintains the resting membrane potential.

-Hypokalaemia This is typically taken as being a potassium level of less than 3.5mmol/l, though symptoms may not occur until the level is less than 2.5mmol/l. The total body deficit may be up to 500mmol. On average plasma potassium decreases by 0.3mmol/l for each 100mmol reduction in total body stores.

-Hypokalaemia and Anaesthesia It used to be thought that because of the risk of developing arrhythmias, a healthy patient undergoing surgery with a potassium level of less than 3.0mmol/l should have their operation postponed if possible and have replacement therapy to normalize the plasma potassium.



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**Hyperkalaemia** This is defined as a plasma level of greater than 5.5mmol/l. The chronic causes are renal failure, Addisonís disease .

**Hyperkalaemia and Anaesthesia** The decision to treat hyperkalaemia is easier and is based on the degree of elevation and the symptoms and signs present. If there are ECG changes or the concentration is greater than 6.5mmol/l the incidence of serious cardiac compromise is high and rapid intervention is necessary. A plasma potassium of less than 5.9mmol/l has been suggested before an elective operation. The cause should be investigated and corrected if possible.

Hyper- and hypokalaemia can result in serious cardiac compromise.

### 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 .**

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 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.



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- 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 local anaesthetic 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. The calcium ion is essential for many biological processes that include cardiac automaticity; excitation±contraction coupling in myocardial, smooth and skeletal muscle; blood coagulation; neuronal conduction; synaptic transmission; hormone secretion and mitotic division. Calcium is also a major intracellular messenger needed for normal cellular function and required by many enzymes for full activity.

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

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.

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.

Hypermagnesemia & Hypomagnesemia

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

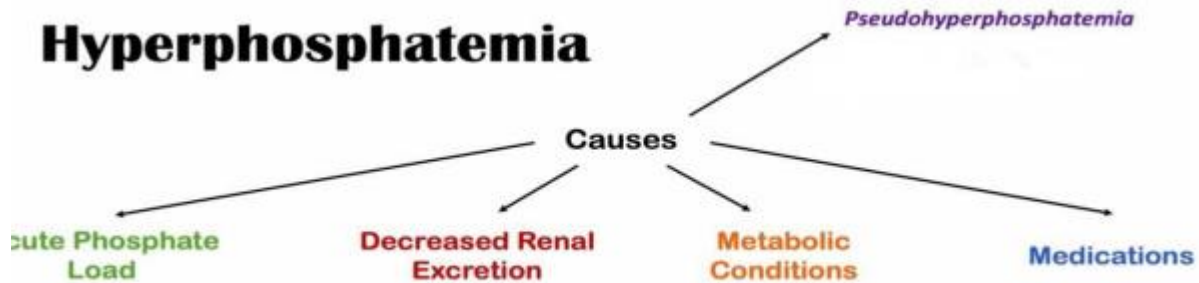


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**Hypomagnesemia** on the other hand, is a blood magnesium level less than 1.7 mg/dL. Hypomagnesaemia often occurs as the result of the prolonged use of diuretics, uncontrolled diabetes, hypoparathyroidism.

### 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



**Hypophosphatemia**: which is defined as a phosphate level less than 0.81 mmol/L .