

Bicarbonate

..... 22–32 mmol/L

When used with the other electrolytes, bicarbonate levels are an indicator of acidosis and alkalosis. However, the acid-base status can only be accurately assessed by measuring serum pH, as part of arterial blood gases. A low serum bicarbonate is generally associated with an elevated serum potassium, whereas an elevated bicarbonate is usually associated with a low serum potassium. These changes in potassium levels occur as a result of potassium movement in and out of cells in response to extracellular hydrogen ion concentrations.

Calcium

Total calcium 2.10–2.60 mmol/L
 Corrected calcium..... 2.15–2.60 mmol/L
 Ionised calcium..... 1.16–1.30 mmol/L

Calcium is the most abundant mineral in the body and is involved in bone metabolism, protein absorption, fat transfer, muscular contraction, transmission of nerve impulses, blood clotting and cardiac function.

Calcium occurs in plasma in ionised, complexed and protein bound forms. It can be expressed as total calcium, ionised calcium or corrected calcium (in which total calcium is corrected, usually in relation to the patient’s albumin level).¹

$$\begin{aligned} &\text{Corrected calcium (mmol/L)} \\ &= \text{total calcium (mmol/L)} \\ &+ [(40 - \text{serum albumin (g/L)}) \times 0.02] \end{aligned}$$

Calcium levels are influenced by magnesium, iron and phosphorus and by hormonal activity, vitamin D levels, alkalinity and acidity, and many drugs.

Hypocalcaemia—symptoms when corrected calcium <2.15 mmol/L:

- neurological features—tingling, tetany and mental changes
- cardiovascular system—abnormal ECG and reduced cardiac output
- cataracts.

Hypercalcaemia—symptoms when corrected calcium >2.85 mmol/L:

- neuropsychiatric—lethargy, confusion, irritability, depression
- gastrointestinal—anorexia, abdominal pain, nausea, vomiting and constipation
- renal—thirst, polyuria and renal calculi
- cardiac arrhythmias.

Corrected calcium levels >3.50 mmol/L are considered life-threatening.

Chloride

..... 95–110 mmol/L

Chloride is the most abundant extracellular anion, but intracellular concentrations are low. It is involved in maintaining cellular integrity through its influence on osmotic pressure. Serum chloride values may be used to assess fluid balance and acid–base abnormalities. As is the case with sodium, a change in serum chloride does not necessarily indicate a change in total body chloride; rather, it indicates alterations in fluid status and/or acid–base balance. Elevated chloride levels are seen in both metabolic and respiratory acidosis and in cases of dehydration. In metabolic alkalosis, renal excretion of chloride is increased and hence serum chloride decreases. Hypochloreaemia is seen in patients who are overhydrated.

Copper

..... 13–22 micromol/L

Copper is essential to many functions in the biological system. Copper deficiency in infants may arise due to chronic diarrhoea, a malabsorption syndrome or a high-milk diet. In adults, it occurs in patients on long-term hyperalimentation low in copper or with certain malabsorption syndromes (coeliac disease and ulcerative colitis), protein-losing enteropathies and nephrotic syndrome. Copper excess is usually iatrogenic. Wilson’s disease causes excessive accumulation of copper, leading to chronic hepatitis, neurological disorders and renal failure.

Lead

Desirable goal <0.48 micromol/L⁵

Lead poisoning may arise through abnormal ingestion (especially lead-containing paint, sniffing lead petrol), occupational exposure (metal smelters, miners, welders, printing workers, oil refinery workers, paint manufacturers) and retained bullets.³ Blood lead levels >0.72 micromol/L require intervention.^{4,5}

Children are more susceptible to lead poisoning than adults and may show neurological symptoms with blood lead levels >2.17 micromol/L.

Chronic lead poisoning is usually associated with moderate anaemia with basophilic stippling. Acute lead poisoning is rare and is associated with abdominal pain and constipation.

Magnesium

..... 0.8–1.0 mmol/L

Magnesium is essential for a wide range of neuromuscular functions and enzyme systems.