Magnesium (Mg) is involved in more than 300 enzymatic reactions and is essential for life. Magnesium deficiency has been reported in 20% to 65% of patients in an intensive care unit (ICU) setting compared with those who are not Mg deficient.

Magnesium is the second most abundant intracellular cation, potassium being the first. The normal adult total body Mg content is approximately 25 g (2000 mEq or 1 mol). About 53% of total Mg stores are in bone, 27% in muscle, 19% in soft tissues, 0.5% in erythrocytes, and 0.3% in the serum. The serum Mg concentration is the most common form of assessing Mg status. However, because serum only contains 0.3% of the total body Mg, it is a poor reflection of total magnesium homeostasis.

Magnesium homeostasis involves the kidney, small bowel, and bone. Absorption occurs along the entire intestinal tract but primarily occurs along the jejunum and ileum. From 30% to 50% of dietary Mg is absorbed under normal dietary conditions.

Magnesium may be required for substrate formation, as an allosteric activator of enzyme activity, and for membrane stabilization. Adenylate cyclase and the sodium-potassium-adenosine triphosphatase (Na, K-ATPase) are enzymes that are critically dependent on Mg.

**Importance of Magnesium**

- Magnesium is hypothesized to play a role in sepsis and shock.
- By regulating smooth muscle tone, Mg may play a role in critical illnesses such as acute myocardial infarction (AMI), acute cerebral ischemia, and asthma exacerbation. Smooth muscle tone is determined by calcium-dependent phosphorylation of myosin light chain.

**Causes of hypomagnesaemia**

(i) Acute Myocardial Infarction
- Three major trials define our understanding to date regarding Mg therapy in AMI: the Second Leicester Intravenous Magnesium Intervention Trial (LIMIT-2), the Fourth International Study of Infarct Survival (ISIS-4) and the Magnesium in Coronaries (MAGIC) Trial.
- The overall evidence from clinical trials does not support the routine application of adjunctive Mg therapy in patients with AMI. Prior studies may have shown benefit, but they were smaller and possibly more prone to type I statistical errors of chance. Both the ISIS-4 and MAGIC Trials were large in number, and both found no benefit of adjunctive Mg therapy.

(ii) Acute Cerebral Ischemia
- Human studies on Mg therapy and acute cerebral ischemia have been few in number and in size. A systematic review of 4 trials suggested a reduction in the end point of death or dependence, but the small numbers failed to reach statistical significance (odds ratio: 0.67, 95% confidence interval: 0.35-1.16).
- A large trial, the Intravenous Magnesium Efficacy in Stroke (IMAGES) Trial, enrolled several thousand participants and randomized them to receive Mg or placebo within 12 hours of stroke with limb weakness. This trial showed no benefit from magnesium in acute ischaemic stroke and thus it cannot be recommended.

(iii) Asthma
- The use of Mg as adjunctive therapy in asthma was originally proposed in 1936; however, the use of intravenous Mg therapy for acute asthma exacerbations has shown conflicting results in clinical trials.
- The results of a large trial with varying degrees of illness severity did not show any benefit of Mg therapy. However, several studies focusing on the most severe cases of asthma exacerbation found benefit. More clinical studies specifically examining the ICU patient are needed.

(iv) Preeclampsia
- The MAGPIE Trial was the largest trial to date examining hypertensive disease in preeclamptic women. More than 10,000 women with preeclampsia were randomized to receive Mg therapy or placebo. The Mg therapy group experienced eclampsia significantly less than the placebo group (0.8% vs 1.3%; relative risk: 0.42; 95% confidence interval: 0.29-0.60). Moreover, the relative risk for death in the Mg therapy group was lower (relative risk: 0.56; 95% confidence interval: 0.26-1.14).
- Magnesium therapy is clearly indicated for women with preeclampsia. It has been shown to decrease the incidence of eclampsia and likely decreases overall mortality.
- The MAGPIE Trial administered 16 mmol initially, followed by 4 mmol per hour in women with preeclampsia.

**Magnesium disorders**

- Caution should be taken with Mg therapy in patients with any degree of renal failure. If a decrease in glomerular filtration rate exits, the dose of Mg should be halved, and the serum Mg concentration must be monitored daily.
- Signs of Mg intoxication occur at Mg levels greater than 1.5-2.0 mmol/L. Mg intoxication. In mild cases, discontinuation of Mg therapy will suffice.
- Intravenous calcium (100-200 mg over 5-10 minutes) antagonizes the severe effect of Mg intoxication. In mild cases, discontinuation of Mg therapy will suffice.

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**Therapeutic uses of magnesium**

- For torsade de points, the ACLS Guidelines recommend a loading dose of 8 mmol of Mg over 15 minutes followed by 4 mmol an hour.

**Signs of magnesium toxicity**

- Caution should be taken with Mg therapy in patients with any degree of renal failure. If a decrease in glomerular filtration rate exits, the dose of Mg should be halved, and the serum Mg concentration must be monitored daily.
- Signs of Mg intoxication occur at Mg levels greater than 1.5-2.0 mmol/L. Mg intoxication. In mild cases, discontinuation of Mg therapy will suffice.