

A Quick Reference on Magnesium

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KEYWORDS

• Magnesium • Veterinary • Dog • Cat • Critical care

KEY POINTS

- Magnesium is a predominantly intracellular ion and supports electrolyte gradients as a cofactor for many ATPase pumps.
- Magnesium deficit is difficult to diagnose because of its intracellular distribution, and supplementation is often based on clinical suspicion.
- Patients with polyuria, diarrhea, or anorexia and those with concurrent hypokalemia should be suspected of magnesium deficit and supplemented accordingly.
- Common clinical scenarios where magnesium supplementation should be considered: congestive heart failure patients on furosemide, those with diabetic ketoacidosis, and ventricular arrhythmia patients refractory to potassium supplementation.

INTRODUCTION

Distribution of magnesium

- In human beings, 1% of the total body magnesium is in the extracellular fluid, whereas the remaining 99% is intracellular.^{1,2}
- Approximately two-thirds of body magnesium is stored with calcium and phosphorus in bones, 20% in muscles, and 11% in soft tissues other than muscles.
- Like calcium, extracellular magnesium is present in 3 forms:
 - Ionized or free form (55%) thought to constitute the biologically active fraction
 - Protein-bound form (20%–30%)
 - Complexed form (15%–25%)
- Magnesium is only 20% to 30% bound to protein, less affected by changes in albumin concentration than calcium.

Magnesium handling

- The primary site of magnesium absorption seems to be the ileum, but the jejunum and colon also contribute substantially to net absorption.
- The kidneys control and regulate magnesium balance.

The author has nothing to disclose.

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- Various segments of the nephron play an important role in magnesium homeostasis.
- Of the filtered magnesium
 - 10% to 15% of magnesium is reabsorbed within the proximal tubule.
 - 60% to 70% is reabsorbed in the cortical thick ascending limb of the loop of Henle.
 - 10% to 15% is reabsorbed in the distal convoluted tubule.
- The final concentration of magnesium in the urine is determined at the distal convoluted tubule under hormonal and nonhormonal control.

Magnesium role

- Within the cell, magnesium functions as a cofactor for most ATPase enzymes.
- Magnesium, therefore, is critical in supporting electrolyte movement and creation and maintenance of electrochemical gradients that drive many cellular activities and functions.

ANALYSIS

- Currently, there is no consensus regarding the best assay for diagnosis.
- Serum magnesium concentration does not correlate well with magnesium deficit based on clinical signs or with serum ionized magnesium concentration.
 - Serum reference intervals reported vary but generally are in the range of 0.6 mmol/L to 1.2 mmol/L (1.5–3.0 mg/dL)
 - Reference intervals reported for ionized magnesium concentration vary but generally are in the range of 0.4 mmol/L to 0.8 mmol/L (1–1.9 mg/dL)
- Ionized serum magnesium and total serum magnesium may be useful when results are low and are consistent with clinical suspicion of a magnesium deficit.
- The magnesium retention test may be useful but due to requirements for urine collection over 24 hours has not found widespread clinical use.

MAGNESIUM DEFICIT

Causes

See [Box 1](#).

Clinical Signs

Cardiovascular

- Intracellular and extracellular magnesium concentrations play an important role in cardiac excitability, contraction, and conduction through regulatory effects on calcium movement.
- Magnesium may act as an antiarrhythmic agent by limiting intracellular calcium overload and by supporting intracellular potassium repletion and correction of hypokalemia.

Neuromuscular

- Magnesium depletion enhances neuronal excitability and neuromuscular transmission.
- Magnesium may act as an analgesic by blocking *N*-methyl-D-aspartate receptors within the central nervous system.

Electrolyte disturbances

- Depletion of magnesium has a permissive effect on potassium exit from cells, leading to extracellular accumulation of potassium.

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