

Management of Hypomagnesemia in Peritoneal Dialysis Patients

Magnesium is the fourth most abundant cation in the body and the second most common intracellular cation. It is essential for normal cellular function and processes.¹ Magnesium balance is regulated through dietary intake, homeostasis mechanisms within the body, and elimination by the kidneys.² In end-stage renal disease (ESRD), hypermagnesemia is frequently seen due to decreased renal excretion of magnesium.³ However, in peritoneal dialysis (PD) patients, continuous magnesium losses via the dialysate dwells, use of low magnesium PD solutions, inadequate dietary intake of magnesium-rich foods, and pre-existing malnutrition may lead to the development of hypomagnesemia (serum magnesium level <0.7 mmol/L).⁴ A study of all PD patients in the province of British Columbia (BC) demonstrated that the 1-year prevalence of hypomagnesemia was 28% among the PD patients who had a serum magnesium level checked and 4% of all PD patients were prescribed a magnesium supplement. The true prevalence of hypomagnesemia may have been underestimated as serum magnesium levels were not monitored in 40% of patients during the study period.

Hypomagnesemia frequently occurs together with hypokalemia. If the magnesium deficiency is not treated, this may result in a refractory response to potassium replacement. Symptoms of hypomagnesemia may be difficult to differentiate from those of hypocalcemia or hypokalemia as these electrolyte abnormalities often occur concurrently. Signs and symptoms of hypomagnesemia are usually neuromuscular and/or cardiovascular in nature. Symptoms of hypomagnesemia may include nausea/vomiting, apathy, weakness, anorexia and mental retardation. Cardiac abnormalities may include prolonged QT, cardiac arrhythmias, decreased myocardial contractility, hypertension, and sudden death in more severe cases of magnesium deficiency. Symptoms of hypomagnesemia may not be apparent until serum magnesium level is <0.4 mmol/L.^{5,6}

Hypomagnesemia can contribute to significant morbidity and mortality in PD patients. In a study by Cai et al⁷ of 253 incident PD patients over a 10-year study period, 36 patients (14.2%) were found to have hypomagnesemia, which was defined as a serum magnesium level <0.7 mmol/L. Cardiovascular and all-cause mortality rates were higher in the hypomagnesemia group than in the normal magnesium group, and hypomagnesemia was found to be an independent risk factor for cardiovascular mortality in PD patients, especially in female patients.

The first step in the management of hypomagnesemia is to identify and treat the underlying cause of the low serum magnesium level. The dietitian should be contacted for a thorough review of the patient's dietary magnesium intake. For the treatment of mild hypomagnesemia, i.e. serum magnesium level of 0.5 to <0.7 mmol/L, dietary intervention should be trialed first. However, for moderate-to-severe hypomagnesemia, i.e. serum magnesium level <0.5 mmol/L, or if the patient is symptomatic, then magnesium supplementation may be required along with dietary intervention.

Non-Pharmacological Management

Non-Pharmacological Strategies (serum magnesium <0.7 mmol/L)

Refer patients to dietitian for high magnesium nutrition teaching:

- Encourage inclusion of high magnesium foods, including:⁸
 - Whole grain cereals
 - Green vegetables
 - Beans, legumes, nuts, and seeds (especially pumpkin seeds)
 - Seafood
- Ensure patients aim for 350 mg per day of magnesium from dietary sources^{8,9}
- Check serum magnesium level after one month and move to pharmacological strategies if hypomagnesemia persists

Pediatric Management of Hypomagnesemia:

10-20 mg elemental mg/kg/dose PO BID-QID

Magnesium formulations available:

Magnesium oxide 420mg (252 mg elemental Mg) tablet
 Magnesium gluconate 500mg (29 mg elemental Mg) tablet
 Magnesium glucoheptonate 100mg/mL (5 mg elemental Mg/mL) oral solution

Pharmacological Management

In the chronic treatment of hypomagnesemia, the oral route of magnesium supplementation is generally preferred. However, in the setting of severe, symptomatic hypomagnesemia, i.e. serum magnesium level < 0.5 mmol/L, which may be life-threatening, intravenous magnesium sulfate administration may be more appropriate. The intraperitoneal route may be considered in patients who have chronic hypomagnesemia and are intolerant to oral magnesium supplementation.⁴ Patient compliance with oral magnesium replacement is poor due to gastrointestinal-related side effects, mainly abdominal pain and diarrhea; thus, oral supplementation should be prescribed only if the patient remains hypomagnesemic after an adequate trial of dietary change.

Magnesium citrate is the most bioavailable of all the magnesium salts; thus, if patients are able to tolerate a higher dose of magnesium, this would be the best magnesium salt to supplement with.^{10,11} It is commercially available as a 150 mg elemental magnesium tablet. However, if there is concern of diarrhea, then magnesium complex, which is available at a lower strength of 50 mg of elemental magnesium per tablet, could be prescribed instead. For patients who are unable to swallow tablets whole, magnesium glucoheptonate liquid 100 mg/mL, which contains 5 mg/mL of elemental magnesium may be ordered. Costs of the various oral magnesium supplements as well as parenteral magnesium sulfate are outlined in Table 1 below.

For the treatment of hypomagnesemia, the dose and frequency of magnesium supplementation will be limited by patient tolerability. If the patient has mild hypomagnesemia (serum magnesium level of 0.5 to <0.7 mmol/L), an initial lower dose of magnesium complex 50 mg/day may be appropriate and if tolerated, dose up titration to 100 mg/day or higher could be considered. If there are no concerns with bowel movements or the patient is constipated, consideration could be given to the prescription of magnesium citrate 150 mg/day. If the patient is intolerant to oral magnesium replacement after a sufficient trial, consider arranging for intravenous magnesium sulfate replacement 2 or 5 g IV every 1-2 weeks in the peritoneal dialysis unit based on serum magnesium levels or training the patient for home intraperitoneal magnesium sulfate administration 4 g IP 1-3x/week.

Table 1: Magnesium Supplement Unit Costs

Magnesium Supplement	Unit Cost
Magnesium citrate (Webber Naturals) <ul style="list-style-type: none"> Elemental magnesium 150 mg 	\$0.17/tab
Magnesium complex (Jamieson): (magnesium citrate, fumarate, maleate, oxide and succinate) <ul style="list-style-type: none"> Elemental magnesium 50 mg Elemental magnesium 100 mg Elemental magnesium 250 mg 	\$0.13/tab \$0.17/tab \$0.25/tab
Magnesium glucoheptonate (Ratio) 100 mg/mL <ul style="list-style-type: none"> Elemental magnesium 5 mg/mL 	\$0.11/5 mL (Full Pharmacare benefit)
Magnesium sulfate 5 g vial (injectable) <ul style="list-style-type: none"> Elemental magnesium 490 mg 	\$7.68/vial

Note: pricing obtained from Macdonald's Renal Pharmacy and Laurel Pharmacy

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