# Magnesium Sulfate

**Alert**

1 mmol of magnesium (Mg) = 2 mEq of Mg.
1 g magnesium sulfate = 98 mg elemental Mg = 4.06 mmol (8 mEq) of elemental Mg.
Intravenous doses should be diluted to a concentration of Mg 20% or less.
Calcium chloride/calcium gluconate should be available to reverse adverse effects.

**Indication**

- Hypomagnesaemia (acute and chronic).
- Pulmonary hypertension when inhaled nitric oxide is not available.
- Perinatal asphyxia.
- Resuscitation of torsades de pointes.
- Daily maintenance in parenteral nutrition (beyond scope of this guideline).

**Action**

Calcium and NMDA receptor antagonist.

**Drug Type**

Electrolyte, intracellular cation

**Trade Name**

- DBL Magnesium Sulfate Concentrated Injection (Hospira)
- MagMin Tablets (Blackmores)
- Mag-Sup Tablets (Petrus)

**Presentation**

- **IV:** 5 g/10 mL ampoule (50% solution), 2.47 g/5 mL (10 mmol/5 mL)
- **PO:**
  - MagMin 500 mg magnesium aspartate tablets.
  - Mag-Sup 500 mg magnesium aspartate tablets.
  500 mg tablet contains 37.4 mg (1.5 mmol) of elemental magnesium.

**Dosage/Interval**

**Hypomagnesaemia**

- 25–50 mg/kg IV infusion over 30–60 minutes. Repeat if necessary.

**Chronic hypomagnesaemia**

- PO: 187 mg of elemental magnesium per m²/day in divided doses. (Endocrine team, personal email communication)

- **Body Surface Area (BSA) calculation:**

  $$BSA (m^2) = \frac{height (cm) \times weight (kg)}{3600}$$

- **Pulmonary hypertension:**

  - Loading dose of 200 mg/kg over 60 minutes followed by continuous IV infusion 20–50 mg/kg/hour (target serum magnesium between 3.5 and 5.5 mmol/L)
  - **Perinatal asphyxia**

  - 250 mg/kg/dose over 1 hour to be commenced within 6 hours of birth. Total 3 doses at 24 hour intervals.
  - **Torsades de pointes with pulse**

  - 25–50 mg/kg IV over 15–20 minutes.
  - **Pulseless torsades de pointes**

  - 25–50 mg/kg IV/IO over several minutes.

**Route**

IV bolus or infusion.

**Preparation/Dilution**

**Hypomagnesaemia/Torsades de pointes**

- Draw up 0.4 mL (200 mg of magnesium sulfate) of 50% solution and add 7.6 mL sodium chloride 0.9% or glucose 5% to make a final volume of 8 mL with a concentration of 25 mg/mL.

**Pulmonary hypertension IV infusion**

- Loading dose: Draw up 2 mL (1000 mg of magnesium sulfate) of the 50% solution and add 8 mL of sodium chloride 0.9% or glucose 5% to give a final volume of 10 mL with a concentration of 100 mg/mL.
- Maintenance infusion: Draw up 2 mL/kg (1000 mg/kg of magnesium sulfate) of 50% solution and add glucose 5% or sodium chloride 0.9% to make a final volume of 50 mL. Infusing at a rate of 1 mL/hour = 20 mg/kg/hour.

**Perinatal asphyxia**

- Draw up 2 mL (1000 mg of magnesium sulfate) of the 50% solution and add 8 mL of sodium chloride 0.9% or glucose 5% to give a final volume of 10 mL with a concentration of 100 mg/mL.

**Administration**

- IV bolus for hypomagnesaemia: Infused over 30–60 minutes.
- Loading dose for pulmonary hypertension: Administer over 60 minutes.
- IV dose for perinatal asphyxia: Administer over 60 minutes.
- Torsades de pointes: Administer the preparation over several minutes to 20 minutes.
## Magnesium Sulfate

### Monitoring
- ECG and continuous or frequent blood pressure. Monitor magnesium concentrations.

### Contraindications
- Heart block or myocardial damage.

### Precautions
- Use with caution in renal impairment.

### Drug Interactions
- Concurrent use with paralysing agents may enhance neuromuscular blockade (e.g. succinylcholine, vecuronium, rocuronium, etc.).
- Concomitant use with aminoglycosides may cause neuromuscular weakness (respiratory arrest).

### Adverse Reactions
- Hypotension, bradycardia and circulatory collapse with rapid infusion.
- ECG changes (prolonged AV conduction time, sino-atrial block, AV block). Calcium chloride/calcium gluconate should be available to reverse adverse effects.
- Flushing, sweating, respiratory depression (particularly with higher plasma concentrations), abdominal distension, diarrhoea, urinary retention, CNS depression, muscle relaxation, hyporeflexia.

### Compatibility
- Sodium chloride 0.9%, sodium chloride 0.45%/glucose 4%, glucose 5%, parenteral nutrition glucose amino acid solution.

- Y site: Aciclovir, amifostine, amikacin, ampicillin, aztreonam, caspofungin, cefotaxime, cefoxitin, cefazolin, chloramphenicol, cisatracurium, dexametomidine, doripenem, esmolol, gentamicin, granisetron, heparin sodium, hydrocortisone sodium succinate, labeltal, linezolid, metronidazole, mirinone, morphine sulfate, piperacillin-tazobactam (EDTA-free), potassium chloride, remifentanil, sodium nitroprusside, trimethoprim-sulfamethoxazole, vancomycin.

### Incompatibility
- Fat emulsion. Incompatible with soluble phosphates and with alkaline carbonates and bicarbonates.

- Y site: Aminophylline, amiodarone, anidulafungin, azathioprine, calcium chloride, calcium salts, cefepime, ceftriaxone, ciprofloxacin, clindamycin, cyclosporin, dexamethasone, ganciclovir, haloperidol lactate, indometacin, methylprednisolone sodium succinate, pentamidine, phosphate salts, sodium bicarbonate.

### Stability
- Change the IV preparation every 24 hours.

### Storage
- Store at room temperature and protect from light.

### Special Comments
- Serum Mg concentrations do not reflect with whole body stores.
- Renally excreted.

### Evidence summary
- Magnesium is the fourth most abundant cation in the body and is critical for transfer, storage and use of energy in the brain (Adams 2001). Magnesium is important in various enzymes activities, neurochemical transmission and muscle excitability.

**Persistent pulmonary hypertension**

Use of magnesium sulfate for persistent pulmonary hypertension of the newborn has not been tested by randomised controlled trials. Evidence from uncontrolled studies is extremely limited. On the basis of the current lack of evidence and with the availability of inhaled nitric oxide, the use of magnesium sulfate cannot be recommended in the treatment of PPHN. (LOE 1, GOR B).

**Perinatal asphyxia**

Magnesium has been studied in 2 small randomised, controlled trials in neonates with perinatal asphyxia. Bhat et al (Bhat 2009) performed a randomised, prospective, longitudinal, placebo controlled trial to study whether postnatal magnesium sulfate infusion could improve neurologic outcomes at discharge for term neonates with severe perinatal asphyxia. Forty term neonates with severe perinatal asphyxia were assigned randomly to receive either magnesium sulfate infusion at 250 mg/kg per dose (1 mL/kg per dose) over 1 hour, with 2 additional doses repeated at intervals of 24 hours apart (total 3 doses in treatment group) or 3 doses of normal saline infusion (1 mL/kg per dose) 24 hours apart (placebo group). In the treatment group, moderate encephalopathy was present in 35% (7 of 20) of the patients and severe encephalopathy in 65% (13 of 20) of patients at admission. In the placebo group, 40% (8 of 20) of patients had moderate encephalopathy and 60% (12 of 20) of patients had severe encephalopathy. The mean serum magnesium concentration in the treatment group remained at ≥ 1.2 mmol/L for 72 hours after the first infusion. At discharge, 22% (4 of 18) of infants in the treatment group had neurologic
abnormalities, compared with 56% (10 of 18) of infants in the placebo group. Also, neuroimaging (head computed tomography) performed on day 14 yielded abnormal findings for fewer infants in the treatment group than in the placebo group (16% vs 44%). Infants in the treatment group were more likely to be receiving oral feedings (sucking) at discharge than were those in the placebo group (77% vs 37%). Good short-term neurologic outcomes at discharge occurred for 77% of the patients in the treatment group, compared with 37% of the patients in the placebo group.

A similar multicentre RCT conducted in 33 term neonates by Ichiba et al in Japan (Ichiba 2002) tested whether postnatal magnesium sulfate infusion (250 mg/kg per day) for 3 days is both safe and able to improve outcome in infants with severe birth asphyxia; as had been suggested by a small pilot study. Treatment group received 250 mg/kg of magnesium sulfate IV over 1 h within 6 h of birth, with two additional doses repeated at intervals of 24 hours. All doses were given in combination with dopamine infusion (5 microgram/kg per min) to prevent hypotension. No significant differences were observed in duration of clinical seizures or need for assisted ventilation. Survival with normal results for cranial computed tomography, electroencephalography and with establishment of oral feeding by 14 days of age, was significantly more frequent in the treated group than in the control group (12/17 vs 5/16, P = 0.04). No significant differences in blood pressure, heart rate or respiratory rate were observed between groups. Another prospective uncontrolled follow-up study (Ichiba 2006) of 30 neonates reported by the same authors possibly including treatment population from the previous study showed 2 (6.6%) infants died as neonates, while 6 of 28 (21.4%) survivors had severe neurodevelopmental disability and 78.5% of survivors had normal neurodevelopmental outcomes at 18 months.

**Refractory ventricular fibrillation (VF)/pulseless VF (pVF)**

ILCOR 2015 Consensus: Routine use of magnesium is not recommended in adult patients with refractory VF/pVF. No recommendations were made in children.

### References

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