

DRUG GUIDELINE

MAGNESIUM SULFATE (non-obstetric)



SCOPE (Area): FOR USE IN: All Ward Areas

EXCLUSIONS: Paediatrics (seek Paediatrician advice), Pre-eclampsia and Eclampsia patients

SCOPE (Staff): Medical, Nursing and Pharmacy

These guidelines do not refer to the use of magnesium in pre-eclampsia or eclampsia, instead refer to Magnesium Sulfate (Obstetric) Drug Guideline (DRG0036).

BRAND NAMES

No brand names.

PHARMACOLOGY AND PHARMACOKINETICS

Magnesium is essential for normal energy storage and transfer, as well as skeletal development, nerve conduction and muscle contraction. The effect on cardiac muscle is to slow the rate of sinoatrial node impulse formation and prolong conduction time. Centrally, magnesium has a depressant effect and may block neuromuscular transmission, producing anticonvulsant effects. Peripherally, magnesium produces vasodilatation with flushing and sweating at moderate doses and lower blood pressure at higher doses. Onset of action after intravenous administration is virtually immediate and lasts for approximately 30 minutes. Magnesium is mainly renally cleared.

INDICATIONS

- Hypomagnesaemia.
- Torsades de pointes and supraventricular arrhythmias.
- Digoxin toxicity (accompanied by life-threatening ventricular arrhythmias, cardiac arrest or hypotension from bradyarrhythmias).
- Severe asthma attack (if poor response to other treatments).

Not covered by this guideline

- Prevention of neuropathy with oxaliplatin administration – seek advice from Oncology or Oncology Pharmacist.
- Treatment of hypomagnesaemia associated with cisplatin administration - seek advice from Oncology or Oncology Pharmacist.

CONTRAINDICATIONS

- **Hypermagnesaemia.**
- **Heart block** – magnesium can exacerbate.

PRECAUTIONS

- **Renal impairment** – increased risk of hypermagnesaemia, dose reduction may be required, seek Specialist advice.
- **Myasthenia gravis** – magnesium interferes with neuromuscular transmission and may increase in muscle weakness (especially respiratory), monitor closely.
- **Hypotension** – systolic BP less than 90 mmHg as this may be worsened, especially with faster rates of administration.
- **Monitor for signs of hypermagnesaemia** – see Monitoring and Adverse Effects. Calcium gluconate should be available whenever magnesium is given, to reverse the effects of magnesium toxicity.

PREGNANCY AND BREASTFEEDING

Seek specialist advice before prescribing, information may update regularly. See Magnesium Sulfate (Obstetric) Drug Guideline (DRG0036).

DRUG INTERACTIONS

- **Digoxin** – use magnesium cautiously as excessive dosing requires the use of calcium which can lead to serious changes in cardiac conduction via the synergistic action of digoxin and calcium.
- **Neuromuscular blocking agents (suxamethonium, rocuronium, atracurium, cisatracurium, mivacurium, pancuronium, rocuronium and vecuronium)** - magnesium can potentiate their effect leading to excessive neuromuscular blockade. Monitor respiratory function.
- **Aminoglycosides (gentamicin, tobramycin, amikacin and streptomycin)** – may have an additive neuromuscular blockade with magnesium.
- **Calcium channel blockers (nifedipine, felodipine, amlodipine, nicardipine, nimodipine, clevidipine, diltiazem, verapamil)** - can exaggerate magnesium's effects. Monitor for hypotension and muscle weakness, especially in renal failure.
- **Central nervous system depressants** - can have enhanced central nervous system effects when used with magnesium.

DOSAGE AND ADMINISTRATION

Administer slowly via CVC or a large peripheral vein. Sites such as the back of the hand are not to be used except in emergency management until alternative IV access is obtained.

Always dilute vials as outlined below before use. Rapid administration may precipitate hypotension.

When giving magnesium sulfate, calcium gluconate may be required as treatment for hypermagnesaemia. See Calcium Gluconate Drug Guideline (DRG0005).

Magnesium sulfate is available as 2.5 g (5 mL = 10.3 mmol) vials or 2.465 g (5 mL = 10 mmol) ampoules. For ease of use in this guideline the vials are quoted as 2.5 g (5 mL = 10 mmol). The two slightly different strengths can be viewed as interchangeable.

Subacute sites will transfer patients with severe hypomagnesaemia to the acute site, prior to replacement.

Hypomagnesaemia

****Doses given in this table are for normal renal function, seek specialist advice in renal impairment to avoid hypermagnesaemia****

Rapid complete correction of severe abnormality can be dangerous, partial correction is generally the best immediate option.

Mild and moderate hypomagnesaemia (asymptomatic)

Serum magnesium 0.4-0.75 mmol/L.

ECG monitoring is not required unless treating Medical Officer determines the patient has an elevated risk of arrhythmia. If uncertainty exists, discuss with Intensive Care Unit Medical Staff.

(Note: Hypokalaemic patients not responding to multiple potassium IV infusions may require dosing with magnesium as outlined here even if normomagnesaemic.)

Enteral administration (should be used in preference to IV administration where practical)

Magnesium aspartate (MagMin[®] or MagSup[®]) 500 mg tablets 500-1000 mg enterally tds with food. Each 500 mg tablet = 1.6 mmol magnesium. Bioavailability is up to 30%.

Ideally administered with food/feeds and give in divided doses to minimise gastric side effects, especially diarrhoea. Many medications lessen magnesium absorption, seek Pharmacy advice or separate 2 hours from medication. Calcitriol may increase oral magnesium absorption, especially in renal failure – use cautiously in these patients.

IV administration

May be required where enteral administration is impractical, but at a lower dose and slower rate than for severe hypomagnesaemia.

GENERAL WARDS and CORONARY CARE UNIT (via large peripheral vein or CVC)

Magnesium sulfate 10 mmol (2.5 g = 5 mL from ONE vial) diluted with 100 mL of sodium chloride 0.9%, administer by IV infusion over 1 hour.

Total volume: 105 mL.

Rate of infusion: 105 mL/hr.

INTENSIVE CARE UNIT, ED, THEATRE, CVS (via CVC)

Magnesium sulfate 10 mmol (2.5 g = 5 mL from ONE vial) diluted with 100 mL of sodium chloride 0.9%, administer by IV infusion over 1 hour.

Total volume: 105 mL.

Rate of infusion: 105 mL/hr.

Severe or symptomatic hypomagnesaemia

Serum magnesium less than 0.4 mmol/L.

Hypomagnesaemia signs and symptoms are often due to accompanying hypocalcaemia and hypokalaemia and include lethargy, tetany, muscle weakness, tremor, arrhythmias and seizures.

GENERAL WARDS and CORONARY CARE UNIT (via large peripheral vein or CVC)

**** Commence infusion (as above for moderate hypomagnesaemia on General Wards) as soon as is practicable, and if clinically warranted Home Team to discuss management, ECG monitoring and possible transfer to Intensive Care Unit with Intensive Care Unit Medical Staff****

Whilst consulting with Intensive Care Unit Medical Staff, the following faster rate may be commenced with Medical Staff in attendance.

Magnesium sulfate 10 mmol (2.5 g = 5 mL from ONE vial) diluted with 100 mL of sodium chloride 0.9%, administer by IV infusion over 20-60 minutes.

Total volume: 105 mL.

Maximum rate of infusion: 315 mL/hr.

Severe or symptomatic hypomagnesaemia (continued)

INTENSIVE CARE UNIT, ED, THEATRE, CVS (via CVC)

****REQUIRES CONTINUOUS ECG MONITORING, RESTRICTED TO INTENSIVE CARE UNIT, ED, THEATRE, CVS OR MET****

Magnesium sulfate 10 mmol (2.5 g = 5 mL from ONE vial) diluted with 100 mL of sodium chloride 0.9%, administer by IV infusion over 20 minutes.

Total volume: 105 mL.

Rate of infusion: 315 mL/hr.

OR

Magnesium sulfate 20 mmol (5 g = 10 mL from TWO vials) diluted with 100 mL of sodium chloride 0.9%, administer by IV infusion over 40 minutes.

Total volume: 110 mL.

Rate of infusion: 165 mL/hr.

Note: for fluid restricted ICU patients with a CVC see DRG0048: Antibiotic and Electrolyte volumes for fluid restricted ICU patients (via CVC only).

If still symptomatic post dose seek Medical advice. Repeat blood tests (see Monitoring) and/or dose if clinically indicated.

Hypomagnesaemia co-existing with drug-induced QT prolongation

****REQUIRES CONTINUOUS ECG MONITORING, RESTRICTED TO INTENSIVE CARE UNIT, ED, THEATRE, CVS, CODE BLUE OR MET****

Magnesium sulfate 10-20 mmol (2.5-5 g = 5-10 mL from ONE to TWO vials) diluted with 100 mL of sodium chloride 0.9%, administer by IV infusion over 30-60 minutes.

Severe asthma attack (if response poor to other treatments)

****REQUIRES CONTINUOUS ECG MONITORING, RESTRICTED TO INTENSIVE CARE UNIT, ED, THEATRE, CVS OR MET****

Magnesium sulfate 10 mmol (2.5 g = 5 mL from ONE vial) diluted with 100 mL sodium chloride 0.9%, administer by IV infusion over at least 20 minutes.

Emergency use considered for the following indications

- **Severe hypomagnesaemia with cardiac arrhythmias.**
- **Supraventricular arrhythmias.**
- **Torsades de pointes** (may require infusion after – see Therapeutic Guidelines <https://tgldcdp.tg.org.au.acs.hcn.com.au>).
- **Digoxin toxicity (accompanied by life-threatening ventricular arrhythmias, cardiac arrest or hypotension from bradyarrhythmias).**

****REQUIRES CONTINUOUS ECG MONITORING, RESTRICTED TO INTENSIVE CARE UNIT, ED, THEATRE, CVS, CODE BLUE OR MET****

Magnesium sulfate 5-10 mmol (1.25-2.5 g = 2.5-5 mL from ONE vial) diluted with 10 mL sodium chloride 0.9%, administer by slow IV push over 2-5 minutes.

General Administration Information

- **Infusion preparation:**
Mix infusion thoroughly after adding magnesium sulfate to avoid inadvertently giving a more concentrated dose.

Other compatible infusion fluid may be substituted for sodium chloride 0.9% when deemed necessary by the Medical Officer.

Infusion stable for 24 hours.

- **Infusion pump:** Alaris® LVP with Guardrails.
- **Routes of administration:**
 - IV injection: Yes, slow after appropriate dilution. Not covered in this guideline.
 - IV intermittent infusion (15-60 minutes): Yes
 - IV continuous infusion: Yes
 - IM injection: Yes, rarely indicated. Not covered in this guideline.
 - Subcut injection: No
- **Compatible/incompatible IV drugs/fluids:**

Note: Incompatible with calcium and phosphate.

Consult the Australian Injectable Drugs Handbook ('Yellow book') in your ward area. **Assume all unlisted drugs and IV fluids are incompatible – contact Pharmacy for further advice.**

MONITORING (INCLUDING BLOOD TESTS)

- **Continuous ECG Monitoring** – see Dosage and Administration regarding when required.
- **Hypomagnesaemia**
 - Serum magnesium, calcium, urea and electrolytes should be monitored at baseline and post IV dose (if patient still symptomatic seek Medical advice immediately, or if asymptomatic repeat bloods at 6-12 hours. For asymptomatic patients with renal impairment repeat bloods at 6 hours). Aim to achieve and maintain serum magnesium > 0.4 mmol/L.
 - Often co-exists with hypocalcaemia, hypokalaemia and metabolic acidosis. Correct any co-existing electrolyte abnormalities.
 - As magnesium is renally excreted, monitor urea and electrolytes as above, together with urine output. Urine output should be at least 100 mL in the 4 hours preceding the commencement of every dose. See Dosage and Administration regarding renal impairment.
 - Monitor for any signs of hypermagnesaemia (see Adverse Effects). Disappearance of the patellar reflex can indicate the onset of magnesium toxicity, and this should be checked before repeat doses of magnesium are given. Hypermagnesaemia can cause respiratory depression and the respiratory rate must be at least 16 per minute before each dose is given. Calcium gluconate can be given as an antidote to hypermagnesaemia (see Calcium Gluconate Drug Guideline DRG0005).
- For indications other than hypomagnesaemia, magnesium serum levels may be normal before administration.

NURSING PRACTICE POINTS

- Administer via a CVC or a large peripheral vein. See Dosage and Administration.
- Where ECG monitoring is required, begin as soon as practicable and monitor continuously during magnesium sulfate administration. See Dosage and Administration.
- Monitor blood pressure hourly during an infusion.
- The patient should be warned that they might experience transient hot flushing.
- Report any signs of hypermagnesaemia (see Adverse Effects) to the Medical Officer.
- Monitor urine output. Total every 4 hours and report to Medical Officer if less than 100 mL.
- Blood tests as ordered by the Medical Officer – see Monitoring.
- All injections and infusions are to be labelled as per CPP0022 User Applied Labelling of Injectable Medicines, Fluids and Lines.

ADVERSE EFFECTS

- **Related to hypermagnesaemia** – important signs are loss of deep tendon reflexes and respiratory depression. Common signs are flushing, nausea and vomiting. Other signs and symptoms include thirst, hypotension, muscle weakness or paralysis, renal failure, blurred vision, drowsiness, bradycardia, coma and cardiac arrest. May occur at serum magnesium levels above 2 mmol/L.
 - **Infrequent** – headache and dizziness.
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DRUG PRESENTATIONS AND STORAGE

Magnesium sulfate 2.5 g in 5 mL (50%) vials and 2.465 g in 5 mL (49.3%) ampoules.

Contains 10.3 mmol of magnesium per 5 mL vial, and 10 mmol per 5 mL ampoule.

Store below 25°C. Do not refrigerate.
