Clinical Guideline for the Management of Hypomagnesaemia in adults

<table>
<thead>
<tr>
<th>Policy Number</th>
<th>Ratifying Committee</th>
<th>Date Ratified</th>
<th>Next Review Date</th>
<th>Accountable Director</th>
<th>Policy Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Drug and Therapeutics Group</td>
<td>Feb 2012</td>
<td>Feb 2015</td>
<td>Medical Director</td>
<td>Dr F Geoghegan, Consultant Raymond Guirguis, Pharmacist</td>
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<table>
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<tr>
<th>Policy Application</th>
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<tr>
<td>Trust-wide</td>
<td>EHT Preeclampsia &amp; Eclampsia Guidelines</td>
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<table>
<thead>
<tr>
<th>List of Staff for Circulation</th>
<th>Equality impact assessment (EIA) completed</th>
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<tbody>
<tr>
<td>All Clinical Staff</td>
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</table>
In developing this guideline the following legislation have been duly considered:

**Data Protection Act 1998**
Data Protection issues have been considered with regards to this policy. Adherence to this policy will therefore ensure compliance with the Data Protection Act 1998 and internal Data Protection Policies.

**Diversity & Equality Policies**
Equality issues have been considered with regards to this policy. Adherence to this policy will therefore ensure compliance with Equal Opportunity legislation and internal Equal Opportunity policies.

**Freedom of Information Act 2000**
Freedom of Information issues have been considered with regards to this policy. Adherence to this policy will therefore ensure compliance with the Freedom of Information Act 2000 legislation and internal Freedom of Information policies.

**Health and Safety Act 1974**
Health and Safety issues have been considered with regards to this policy. Adherence to this policy will therefore ensure compliance with Health and Safety legislation and internal Health and Safety policies.

**Human Rights Act 1998**
The Human Rights Act 1998 has been considered with regards to this policy. Proportionally has been identified as the key to Human Rights compliance. This means striking a fair balance between the rights of the individuals and those of the rest of the community. There must be a reasonable relationship between the aim to be achieved and the means used.

**Race Relations Amendment Act 2000**
The Race Relations Amendment Act 2000 has been considered with regards to this policy. Adherence to this policy means that the Trust will eliminate discrimination on the grounds of race and will promote race equality and good race relations.

**Equalities Act 2006**
The Equalities Act 2006 requires all public sector bodies to have a general duty in the exercise of their public functions to pay due regard to the need to eliminate unlawful discrimination.

**The Mental Capacity Act 2005**
The Mental Capacity Act provides a statutory framework to empower and protect vulnerable people who are not able to make their own decisions.
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1.0 Introduction:

1.1 Magnesium is the second most abundant intracellular cation. It is essential for a wide variety of metabolically important reactions, particularly those involving ATP.

1.2 Disturbances of magnesium rarely occur alone, and may result in potassium, calcium or other electrolyte disturbances.

1.3 Serum magnesium concentrations are a poor indicator of total active ionised magnesium levels. The plasma contains only approximately 0.5% of total body magnesium and the relationship between serum magnesium concentration and total magnesium stores has not been clearly defined.

2.0 Aims:

The aim of this article is to provide guidance on the treatment of Hypomagnesaemia.

3.0 Definitions:

3.1 The reference range for serum magnesium used in Ealing Hospital NHS Trust is:

| 0.70 - 1.05 mmol/L |

3.2 For the purposes of this guideline, hypomagnesaemia is defined as a serum magnesium concentration < 0.7 mmol/L. Severe hypomagnesaemia is defined as serum magnesium of < 0.5 mmol/L.

3.3 This monograph aims to provide guidance only. The dose of magnesium to correct hypomagnesaemia must be established on an individual patient basis.

3.4 Hypermagnesaemia is defined as serum magnesium > 1.0 mmol/L. Hypermagnesaemia is less likely to occur with oral magnesium supplementation, except in renal failure. Symptoms include respiratory depression, loss of deep tendon reflexes, nausea, vomiting, flushing of the skin, thirst, hypotension due to peripheral vasodilatation, drowsiness, confusion, slurred speech, double vision, muscle weakness, bradycardia, coma, and cardiac arrest.¹

4.0 Scope:

4.1 This clinical guideline concerns the acute issues around the management of hypomagnesaemia on general adult wards. The use of magnesium for other indications is outside the scope of this guideline.

4.2 Magnesium treatment in pre-/eclampsia is not covered in this guideline. Please see severe pre-eclampsia and eclampsia guidelines on the intranet.

4.3 Magnesium treatment in acute asthma is not covered in this guideline. Please see EHT Acute Asthma ICP and Asthma BTS guidelines 2011.
5.0 Symptoms

5.1 Most of the symptoms of hypomagnesaemia are non-specific and symptomatic magnesium depletion is usually associated with additional electrolyte abnormalities such as hypocalcaemia, hypokalaemia or metabolic alkalosis.

5.2 Symptoms of magnesium deficiency may include:
- muscle weakness
- depression
- psychosis
- vertigo
- ataxia
- tremor
- carpopedal spasm
- seizures
- hyperinsulinism
- ECG abnormalities
- ventricular arrhythmias
- osteoporosis

5.3 Note: Hypocalcaemia may mimic symptoms those of hypomagnesaemia

6.0 Causes

6.1 Magnesium deficiency has been associated with:
- gastrointestinal loss; diarrhoea
- malabsorption
- malnutrition
- acute pancreatitis
- alcohol excess
- lactation
- diabetic ketoacidosis
- hyperaldosteronism
- renal tubular reabsorption defects
- intravenous nutrition or long-term parenteral fluid therapy
- drug therapy e.g. diuretics, gentamicin, omeprazole, ciclosporin, foscarnet, amphotericin B, pentamidine, cancer chemotherapy particularly cisplatin
7.0 Treatment Options

7.1 Oral replacement of magnesium should be considered first, as a sudden rise in serum magnesium concentration (as seen following intravenous replacement) partially removes the stimulus for magnesium retention, and up to 50% of the infused magnesium is excreted in the urine.

7.1 Asymptomatic patients or serum magnesium 0.5 - 0.7mmol/ L:
7.1.1 The oral route is preferred for the treatment of asymptomatic or chronic magnesium deficiency (Note: all oral magnesium supplements are unlicensed)
7.1.2 Up to a maximum of Magnesium 50mmol oral can be given in daily divided doses over few days
7.1.3 Diarrhoea is the dose-limiting side effects
7.1.4 The following oral magnesium preparations are available at EHT:

<table>
<thead>
<tr>
<th>Oral Magnesium Preparations</th>
<th>Magnesium Content</th>
<th>Suggested Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnesium Glycerophosphate Tablets</td>
<td>4mmol per Tablet</td>
<td>1 - 2 tablets BD-TDS</td>
</tr>
<tr>
<td>Magnesium Glycerophosphate Suspension</td>
<td>5mmol per 5mL</td>
<td>5– 10mL BD-TDS</td>
</tr>
</tbody>
</table>

7.2 Symptomatic patients or serum magnesium less than 0.5mmol/ L:
7.2.1 The Intravenous route is preferred for severe or symptomatic hypomagnesaemia or when rapid correction is required
7.2.2 Careful monitoring of plasma magnesium and other electrolytes is essential at least once daily.
7.2.3 Renal function and urine output should be monitored since plasma magnesium can rise quickly in renal impairment
7.2.4 BP and ECG monitoring is generally recommended if available
7.2.5 Monitor respiratory rate and for signs of hypermagnesaemia
8.0 Intravenous Magnesium Administration

8.1 General guidance
8.1.1 Magnesium must be prescribed in “mmols” to minimise conversion errors
8.1.2 20mmol magnesium is equivalent to 5g magnesium sulphate which is equivalent to 10mL of Magnesium sulphate 50%.
8.1.3 After initial intravenous administration, it may be appropriate to give oral magnesium supplements to correct the deficiency and replenish the magnesium stores.
8.1.4 Magnesium is compatible with glucose 5% or sodium chloride 0.9%.
8.1.5 When magnesium sulphate is administered IV, the onset of action is immediate and the duration of action is about 30 minutes.
8.1.6 For intravenous administration, a concentration of 20% or less should be used; the rate of injection not exceeding 1.5ml/minute of a 10% solution or its equivalent.
8.1.7 Up to a total of 160mmol magnesium may be required over up to 5 days to correct the deficiency.

8.2 Routine Replacement
8.2.1 The recommended magnesium infusion for routine replacement via a peripheral administration is:

- **Magnesium Sulphate 20mmol in at least 250mL over 2-6hours**

8.2.2 In fluid-restricted patients who would not tolerate this volume should be considered for Magnesium supplementation in smaller volumes but ECG monitoring may be required

8.2.3 Magnesium levels should be re-checked and further supplementation are given if required

8.3 Rapid Replacement
8.3.1 All recommended Rapid Replacements recommendations require a mandatory ECG monitoring

8.3.2 The recommended magnesium infusions for rapid replacement is:

- **Magnesium Sulphate 8mmol in 50mL over 20min via a peripheral or central line or**
- **Magnesium Sulphate 20mmol in 100mL over 60min via a central line**

8.3.3 Magnesium is typically used for the emergency treatment of some arrhythmias such as torsade de pointes and those associated with hypokalaemia.

8.3.3.1 The usual dose is 8 mmol of magnesium (2 g of magnesium sulphate) given intravenously over 10 to 15 minutes and repeated once if necessary.

8.3.3.2 This can be followed by an infusion:

- **Magnesium Sulphate 64mmol in 100mL Dextrose 5% over 24hours**
  - Note: 4 hourly bloods are recommended in this case
9.0 Cautions and Contraindications:

9.1 Parenteral magnesium salts should be avoided in patients with heart block, severe renal impairment or myocardial damage.¹
9.2 Magnesium salts should be used with caution in myasthenia gravis, patients with hepatic impairment at risk of developing renal impairment, and respiratory insufficiency.¹
9.3 Magnesium is renally excreted. Special care must be taken in patients with renal impairment.¹

10.0 Monitoring

10.1 Daily Serum Magnesium, Potassium, Calcium
10.2 Blood Pressure, Respiratory rate, renal functions, tendon reflexes

11.0 Reference

2. AHFS, Drug Information, Accessed online, Jan 12
3. BNF 62
4. SPC of Magnesium Sulphate Injection 50%, UCB Pharma, Revision date Sep 2010
5. Medusa, Magnesium Sulphate IV Monograph
6. Care of the Critically ill medical patient, S. Bonner
7. Medicines Q&A, Hoe is acute hypomagnesaemia treated in adults, UKMI, Dec 2010

12.0 Implementation

12.1 The guideline will be available via the Trust intranet for download as required
<table>
<thead>
<tr>
<th>Magnesium Level</th>
<th>Recommendation</th>
<th>Dose/ concentration</th>
<th>Route</th>
<th>Duration/ frequency</th>
<th>ECG requirement</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5-0.7mmol/L (asymptomatic)</td>
<td></td>
<td>4-8 mmol (i.e. 1-2 tablet) Magnesium Glycerophosphate</td>
<td>Orally</td>
<td>BD- TDS</td>
<td>Not required</td>
<td>(unlicensed)</td>
</tr>
<tr>
<td>0.5-0.7mmol/L (asymptomatic)</td>
<td></td>
<td>5-10mmol/L (i.e. 5-10mls) Magnesium Glycerophosphate Suspension</td>
<td>Orally</td>
<td>BD-TDS</td>
<td>Not required</td>
<td>(unlicensed) Only use if unable to swallow tablets</td>
</tr>
<tr>
<td>&lt;0.5mmol/L (or symptomatic)</td>
<td></td>
<td>20mmol in 250ml normal saline 0.9% or Dextrose 5%</td>
<td>IV (peripheral or central line)</td>
<td>2-6 hours</td>
<td>recommended</td>
<td>Routine supplementation</td>
</tr>
<tr>
<td>&lt;0.5mmol/L (or symptomatic)</td>
<td></td>
<td>8mmol in 50ml normal saline 0.9% or Dextrose 5%</td>
<td>IV (peripheral or central line)</td>
<td>20min</td>
<td>recommended</td>
<td>Rapid supplementation in acute emergency</td>
</tr>
<tr>
<td>&lt;0.5mmol/L (or symptomatic)</td>
<td></td>
<td>20mmol in 100ml normal saline 0.9% or Dextrose 5%</td>
<td>IV (central line)</td>
<td>60min</td>
<td>Mandatory</td>
<td>Rapid supplementation in acute emergency</td>
</tr>
<tr>
<td>&lt;0.5mmol/L (or symptomatic)</td>
<td></td>
<td>64mmol in 100ml normal Dextrose 5%</td>
<td>IV (central line)</td>
<td>24 hours</td>
<td>Mandatory</td>
<td>Rapid supplementation in acute emergency of arrhythmia associated with hypokalaemia</td>
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</tbody>
</table>