

## MAGNESIUM SULFATE

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### BACKGROUND

Magnesium sulfate is the primary medication used in the prevention and management of eclamptic seizures and exerts its effect by depressing the central nervous system.<sup>1</sup>

In the setting of severe preeclampsia, magnesium sulfate has been shown to significantly reduce the rate of eclampsia compared to placebo, phenytoin, nimodipine, or diazepam. In the setting of eclampsia, magnesium sulfate has been demonstrated to be superior to diazepam, phenytoin, or lytic cocktails in reducing the risk of recurrent seizures as well as reducing the risk of maternal death.<sup>2-7</sup> However, controversy surrounds the use of magnesium in the setting of preeclampsia without severe features (mild) with some studies finding no difference and others alluding to a potential benefit.<sup>8,9</sup> The Magpie Trial demonstrated the numbers of women who needed to be treated in order to prevent one seizure was 63 in subjects with severe preeclampsia and 109 in those with preeclampsia without severe features (mild).<sup>2</sup> A similar rate of eclampsia (1.1%) was observed when magnesium sulfate was not used in women with less severe disease.<sup>10</sup>

The current ACOG Hypertension in Pregnancy publication has the following statement regarding magnesium sulfate therapy for preeclampsia without severe features:<sup>11</sup>

“For women with preeclampsia with systolic BP of less than 160 mm HG and a diastolic BP less than 110 mm HG and no maternal symptoms, it is suggested that magnesium sulfate not be administered universally for the prevention of eclampsia.” (Quality of Evidence: Low; Strength of recommendation: Qualified)

“When the task force has made a ‘qualified’ recommendation the health care provider and patient are encouraged to work together to arrive at a decision based on the values and judgment and underlying health condition of a particular patient in a particular situation.”

Currently, the use of magnesium sulfate in severe preeclampsia and eclampsia is supported by The American Congress of Obstetricians and Gynecologists (ACOG),<sup>12</sup> World Health Organization (WHO),<sup>13</sup> Society of Obstetricians and Gynaecologists of Canada (SOGC),<sup>14</sup> and the National Institute for Health and Clinical Excellence (NICE).<sup>15</sup> Of these, the SOGC and WHO provide statements that support the use of magnesium sulfate in the setting of preeclampsia without severe features (mild).<sup>13,14</sup>

Magnesium sulfate is listed by the Institute of Safe Medication Practices (ISMP) as a high-alert medication.<sup>16</sup> In 2004, published data about Medication Errors in Labor, Delivery, Recovery, and Postpartum (LDRP's), magnesium sulfate was identified as the second most common product to be mismanaged in the Labor, Delivery and Recovery (LDR) area.<sup>16</sup>

The Association of Women's Health Obstetric and Neonatal Nurses (AWHONN) updated their nurse staffing guidelines in 2010.<sup>17</sup> Specific guidelines are identified for magnesium sulfate throughout the inpatient stay as follows:

- **High-Risk Antepartum Care:** A woman who is receiving IV magnesium sulfate should have one (1) nurse in continuous bedside attendance for the first hour of administration. Women receiving IV magnesium sulfate who are not in labor require a minimum of one (1) nurse to two (2) women.
- **During labor of women with medical or obstetric complications:** Women in labor who are receiving magnesium sulfate should have one (1) nurse in continuous bedside assistance for the first hour of administration and one (1) nurse to one (1) woman thereafter.
- **Mother-Baby Care:** Nurses caring for women receiving magnesium sulfate during the postpartum period should not have more than one (1) other mother-baby couplet.

#### **RECOMMENDATIONS FOR QUALITY IMPROVEMENT:**

1. Mark magnesium sulfate as a high-alert medication.
2. Administer loading dose from an admixture bag and not from the maintenance solution.
3. Clearly label IV solutions, tubings and connections.
4. Use luer-lock connectors at all points.
5. Require independent verification by two nurses of magnesium sulfate IV pump infusion settings.
6. Standardize the ordering, storage, preparation, and administration of magnesium sulfate.
7. Improve access to information concerning indications, risks and benefits, and treatment of toxicity.

In 2011 the Joint Commission recommended that magnesium sulfate be written out and not abbreviated as MgSO<sub>4</sub>, as this designation can be misinterpreted as MS or MSO<sub>4</sub>, which are abbreviations for morphine sulfate.<sup>18</sup>

Table 1: Steps for Preparation, Storage, Ordering and Administration of Magnesium Sulfate

|                              |   |
|------------------------------|---|
| Step 1: Preparation          | <ul style="list-style-type: none"> <li>a. Purchase commercially prepared standard concentrations of magnesium sulfate.</li> <li>b. Use standard premixed magnesium sulfate infusions in a volume different than Oxytocin to prevent accidental loading dose.</li> <li>c. Pharmacy should prepare any non-commercially prepared solutions.</li> <li>d. Use a piggy-back bag for magnesium sulfate loading doses, do not use the main infusion bag</li> </ul> |
| Step 2: Storage              | <ul style="list-style-type: none"> <li>a. Label bags with a High Alert Sticker or distinctive colored label.</li> <li>b. Loading dose bags should be stored in a separate pharmacy area to prevent mix-ups.</li> </ul>  |
| Step 3: Order/<br>Transcribe | <ul style="list-style-type: none"> <li>a. Use preprinted orders and order sets with the entire medication spelled out when prescribing magnesium sulfate.</li> <li>b. Utilize a High Alert warning on the automated dispensing machine (ADM) when magnesium sulfate is withdrawn.</li> </ul>  |
| Step 4: Administration       | <ul style="list-style-type: none"> <li>a. Label tubing used for infusing magnesium sulfate appropriately.</li> <li>b. An infusion pump should always be used. A 'smart' infusion pump with patient safety software activated should be used when available.</li> </ul> <p><b>NOTE: An independent double check should be performed by two nurses when magnesium sulfate is initiated, dose is changed and at change of shift.</b></p>                       |
| Step 5: Discontinuation      | <ul style="list-style-type: none"> <li>a. Disconnect tubing from main line immediately when magnesium sulfate is discontinued.</li> </ul>   |

Table 2: Protocol for Administration of Magnesium Sulfate

A. Magnesium Sulfate Loading and Maintenance Dosage

|                            | <b>Loading (gm)</b> | <b>Infusion Rate (min)</b> | <b>Maintenance</b>                             |
|----------------------------|---------------------|----------------------------|--|
| Preeclampsia and Eclampsia | 4-6                 | 15-20                      | Infuse at 1-2 grams per hour via infusion pump |
| Recurrent Eclampsia        | 2                   | 5                          |  |

B. Side Effects and Toxicity and Nursing Intervention

| <b>Side Effect/Toxicity</b>   | <b>Nursing Intervention</b>  |
|---|--|
| Cutaneous flushing, sweating, malaise, weakness, drowsiness                             | Keep room and patient cool (provide fan), educate patient about potential side effects; monitor patient movement and assist with getting out of bed              |
| Transient decreased amplitude and frequency of contractions at the time of loading dose | Continuous external fetal and uterine monitoring   |
| Soreness at IV site   | Warm soaks or ice to site PRN  |
| Decreased rate and depth of respiration, shortness of breath (SOB)                      | Discontinue treatment if SOB not relieved with oxygen  |
| Diuresis  | Strict Input & Output; document output per orders; magnesium sulfate is excreted exclusively in urine and an output of < 30 ml/hr may lead to magnesium toxicity |
| Disappearance of deep tendon reflexes   | Notify physician if absent or significant change in baseline assessment  |
| Heart block (decreased PR interval, increased QRS), chest pain                          | Avoid use in patients with cardiac conduction abnormalities  |
| Pulmonary edema   | Strict input and output, fluid restrict as ordered (usually 60-100 ml/hour)  |

Nursing care and assessment: (refer to Ante, Intra, Postpartum Nursing Management and Assessment of Preeclampsia: Maternal/Fetal Assessment and Monitoring Recommendations chapter, pg. 35)

***Increase frequency of assessments as indicated by patient condition.***

If magnesium sulfate is unavailable, alternative anti-seizure medications such as a benzodiazepine (e.g., midazolam, lorazepam, or diazepam) or phenytoin should be used in the setting of eclampsia. Consultation with neurology is suggested to discuss continued medical prophylaxis for seizures if magnesium sulfate is unavailable. If a patient has

preeclampsia without severe features (mild) and there is no magnesium sulfate available, we suggest observation alone.

### KEY LEARNING POINTS

1. Magnesium sulfate dosage: Loading dose of 4-6 gm over 15-20 minutes. Maintenance dose of 1-2 g/hr.
2. Signs of magnesium toxicity: discontinue magnesium sulfate infusion and obtain a stat serum magnesium level in the following situations: hypotension, new-onset loss of DTRs, respiratory depression respiratory arrest, oliguria, shortness of breath, chest pains, electrocardiographic changes<sup>1,19</sup>
3. Magnesium levels: A specific therapeutic level is not known; however, serum magnesium levels may need to be monitored in certain circumstances (e.g., renal insufficiency, absent deep tendon reflexes). In such cases, magnesium levels between 4.8-8.4 mg/dL (4-7 mEq/L) is recommended. Symptoms of magnesium sulfate toxicity are seen with the following maternal serum concentrations: loss of deep tendon reflexes (9.6-12 mg/dL) (> 7 mEq/L), respiratory depression (12-18 mg/dL) (> 10 mEq/L), and cardiac arrest (24-30mg/dL) (> 25mEq/L).
4. Calcium gluconate: the antidote for magnesium toxicity is calcium gluconate 1 g IV over 3 minutes. Repeat doses may be necessary. Calcium chloride can also be used in lieu of calcium gluconate. The suggested dose for calcium chloride for magnesium toxicity is 500 mg of 10% calcium chloride IV given over 5-10 minutes.
5. In the setting of severe preeclampsia, magnesium sulfate should be administered upon diagnosis, continued intraoperatively and until 24 hours after birth.<sup>11</sup>
  - a. However, if the patient shows no improvement in her symptoms of preeclampsia, clinical judgment is advised and magnesium sulfate administration may need to be provided for an extended period of time.
  - b. If the patient is stabilized and remote from term and being expectantly managed, we advise continuing magnesium sulfate during the course of administering corticosteroids for fetal lung maturity. Upon completion of administration of the corticosteroids, magnesium sulfate can be stopped. Magnesium sulfate should be resumed if there are escalating signs of worsening preeclampsia, eclampsia, or plans are made to proceed with delivery.
6. In the setting of preeclampsia without severe features (mild) the use of magnesium sulfate for seizure prophylaxis can be considered. Recent ACOG Executive Summary suggests that magnesium sulfate not be administered universally for the prevention of eclampsia.<sup>11</sup> However, not all health care organizations are in agreement with this recommendation.<sup>14,20</sup>

7. If an eclamptic seizure occurs postpartum and the patient is not being treated with magnesium sulfate, it should be re-administered for at least 24 hours after the last seizure.
8. If a patient has recurrent seizures despite already being on magnesium sulfate the first therapy we recommend is an additional loading dose of magnesium sulfate 2g IV over 5 minutes. If the patient continues to have seizures despite a repeat loading dose of magnesium sulfate, alternative anti-convulsants should be considered:
  - a. Lorazepam (Ativan) 4 mg IV over 2-5 minutes (can repeat in 5-15 minutes) to maximum of 8 mg in 12 hours
  - b. Diazepam (Valium) 5-10 mg IV slowly (can repeat every 15 minutes up to 30 mg)
  - c. Midazolam (Versed) 1-2 mg IV (can repeat in 5 -10 minutes)
  - d. Phenytoin (Dilantin) 1000 mg IV over 20 minutes
  - e. Use of other agents such as Propofol will be institution specific
9. Consideration of severe central nervous system events must be entertained for recurrent or persistent seizures.
10. Renal insufficiency: magnesium sulfate should be used with caution in women with renal insufficiency/failure (i.e. serum creatinine greater than 1.2 mg/dL). In these patients, if they are naive to magnesium therapy, a loading dose can be administered. A lower maintenance dose can be considered with serial serum magnesium levels to guide therapy (e.g. 1 g per hour).
11. Myasthenia Gravis: magnesium sulfate is contraindicated in patients with myasthenia gravis.

#### EVIDENCE GRADING

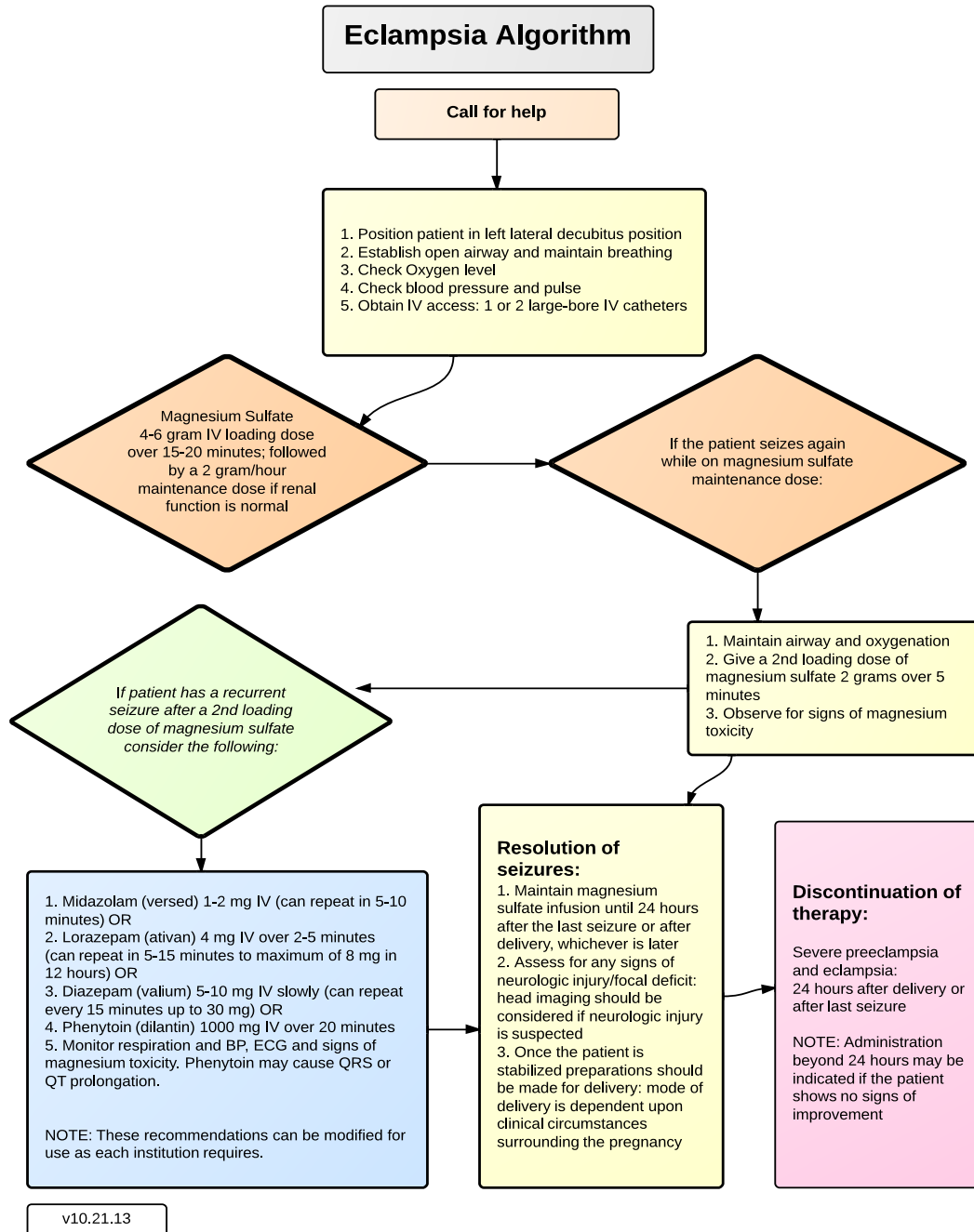
Level of Evidence: I-A, I-B, II-B, III, IV

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## ECLAMPSIA ALGORITHM





## SAMPLE PREECLAMPSIA MEDICATION BOX

Each institution should prepare its own medication box specific to its protocols.

| <b>L&amp;D Severe Preeclampsia &amp; Eclampsia Box – Content and Dose Guideline</b> |   |
|---|---|
| Magnesium 20 grams/500 ml bag   | <b>IV (Use Magnesium Sulfate Continuous Infusion under L&amp;D protocol in Alaris Pump Library):</b><br><i>Initial (Loading Dose):</i> 4-6 g (100 ml – 150 ml) over 20 minutes<br><i>Maintenance Dose:</i> 1-2 g/hour (25 ml/hr – 50 ml/hr) continuous infusion |
| Labetalol 100 mg/20 ml vial   | <b>Initial: Draw 4 ml from the vial.</b><br><b>20 mg (4 ml)</b> IV bolus followed by <b>40 mg (8 ml)</b> if not effective within 10 minutes; then <b>80 mg (16 ml)</b> every 10 minutes (maximum total dose of 300 mg/60 ml)                                    |
| Hydralazine 20mg/ml vial  | <b>Initial: Draw 0.25 ml from the vial.</b><br><b>5-10 mg (0.25-0.5 ml)</b> doses IV every 15-20 minutes  |
| Esmolol 100 mg/10 ml vial<br><b>(By Anesthesiologists ONLY)</b>                     | <b>1-2 mg/kg (0.1-0.2 ml/kg)</b> IV over 1 minute   |
| Propofol 10 mg/ml, 20 ml vial<br><b>(By Anesthesiologists ONLY)</b>                 | <b>30-40 mg (3-4 ml)</b> IV bolus   |
| Calcium gluconate<br>1000 mg/10 ml vial   | 1000 mg/10ml IV over 2-5 minutes  |
| Labetalol 200 mg tablets  | 200 mg PO and repeated in 30 minutes if needed  |
| Nifedipine 10 mg PO   | 10 mg PO and repeated in 30 minutes if needed   |
| Supply contents   | 3 ml, 10 ml, and 20 ml syringes, appropriate needles and appropriate tubing sets  |

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