

Simulation Patient Design (March, 2020) Drug Error (Magnesium toxicity) on L&D

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Introduction

Magnesium is a commonly administered intravenous medication on labor and delivery units for the prevention of eclampsia in patients with preeclampsia, and for fetal neuroprotection in cases of preterm labor. While reports of acute toxicity are rare, teams caring for high-risk obstetric patients should consider magnesium toxicity in their differential diagnosis, particularly when acute renal insufficiency is present. Another mechanism of magnesium toxicity can be iatrogenic overdose, as magnesium is prepared in 500-1000 mL, 40 gram bags that resemble crystalloids in many institutions. Magnesium toxicity can manifest as ECG changes, reduced deep tendon reflexes, depressed mental status, respiratory depression or paralysis, and in the most severe cases complete heart block or cardiac arrest. Calcium gluconate or calcium chloride administered IV is the first-line treatment for magnesium toxicity, while providing ventilatory and circulatory support, but repeated dosing may be needed. Some have advocated furosemide and insulin/dextrose administration or dialysis in severe cases as magnesium is cleared primarily via the kidney.

Educational Rationale: Teach team skills in early recognition and management of magnesium toxicity, which can result from drug error on labor and delivery

Target Audiences: Nursing, OB, Anesthesiology, and L&D support personnel

Learning Objectives: As per Accreditation Council for Graduate Medical Education (ACGME) Core Competencies

Upon completion of this simulation (include debriefing after the session) learners will be able to:

- **Medical knowledge:** Describe clinical signs, symptoms, and treatment options for magnesium toxicity in a pregnant patient.
- **Patient care:** Describe risk factors that might contribute to magnesium toxicity in a pregnant patient being managed on a labor and delivery unit.
- **Practice-based learning and improvement:** Identify the equipment/medications necessary to medically manage an obstetric patient who develops magnesium toxicity, with recognition and treatment including maternal resuscitation (if indicated).
- **Interpersonal and communication skills:** Designation of a team leader who will effectively communicate with labor and delivery teams in order to provide optimal care to the patient, plus maintain on-going communication regarding the maternal status and need for resuscitation.
- **Professionalism:** Demonstrate mutual respect for the expertise of other team members.
- **Systems-based practice:** Identify that all resuscitation equipment/medications are readily available in delivery locations - including equipment for airway management (plus backup intubation devices), induction/emergency medications, supplies for IV access. Also, identify barriers within the hospital system including staffing, medication(s), equipment, and protocol deficiencies in your hospital in an emergency.

Questions to ask after the scenario:

- Did a leader emerge who then communicated effectively with all team members?
- Were there system modification opportunities identified during this simulation?

Assessment Instruments:

1. Learner Knowledge Assessment form (Appendix 1)
2. Simulation Activity Evaluation form (Appendix 2)

Equipment needed and set up:**In-situ LDR set up**

- Mannequin set up supine, postpartum, with blue drapes on the legs, epidural catheter in-situ connected to a running epidural infusion pump
- 18 g IV in hand with Ringer's lactate solution (IV tubing which contains an access port)
- Infusions of oxytocin and magnesium hanging and connected to patient
- Standard monitors for laboring patient in your institution

Simulation scenario set up:**The case**

Ms. Diaz-Gonzalez is a 28-year-old primigravida at 36 weeks gestation of a singleton pregnancy who was admitted to the antenatal ward for close fetal and maternal observation following abnormal Doppler studies in clinic. This morning, her pregnancy became complicated by preeclampsia with severe features with 24-h urine protein that was elevated to 6 g and blood pressure ranging from 170/110 to 190/110. She required labetalol 400 mg PO t.i.d. to control her blood pressure in the last day. Induction of labor was planned for preeclampsia with severe features. Past medical history is notable for obesity, BMI = 38 (5'0", 90 kg) and mild asthma that has been well-controlled with only occasional prn albuterol inhaler. She is otherwise healthy and has never had surgery or neuraxial anesthesia. She has no known drug allergies.

You interviewed and examined her this morning when labor induction was started. Physical examination revealed a Mallampati Grade 3 airway and unremarkable cardiovascular and respiratory exam. Her blood pressure was 156/89 at the time of your exam, and she was receiving an infusion of magnesium sulfate for preeclampsia with severe features and oxytocin for labor induction. Her initial magnesium sulfate level was 1.9 mg/dL prior to starting the infusion. Her reflexes were intact. During the course of the day, you placed an epidural for labor analgesia uneventfully. Later that evening, magnesium level was checked = 5.8 mg/dL. One hour later, she delivered a healthy infant vaginally.

You are called to the bedside for postpartum hemorrhage. The obstetricians have just finished repairing a second-degree vaginal laceration, but vaginal bleeding continues and is now approximately one liter estimated blood loss. Uterus is boggy and the obstetrician instructed the nurse to open the oxytocin infusion "wide open", but the uterine tone has not improved.

Simulation pre-brief

- Read the scenario and instruct team members on their role during the simulation
- Learner roles: anesthesiologist called to assist, obstetricians called to assist, L&D nurses called to assist
- The learners take their places inside or outside of the LDR
- Patient (embedded participant)
- The L&D nurse (embedded participant) is in the LDR assisting the obstetrician (embedded participant)
- The father of the baby is also at bedside (embedded participant or learner)

Magnesium Toxicity Scenario

Trigger	Patient Condition	Action	Done	Time	Comments
In LDR	Vitals: sinus tachycardia- 110 bpm Mild hypotension: BP: 95/45 – 100/50 100% O ₂ sat Neuro: Tired, responds to verbal stimuli, sluggish deep tendon reflexes	<ol style="list-style-type: none"> 1. L&D nurse is monitoring the patient with BP and pulse oximetry 2. Obstetrician is sewing a laceration repair and has asked the L&D nurse to “wide open” oxytocin infusion due to uterine atony and bleeding 3. L&D nurse inadvertently opens magnesium “wide open” 			
Pt becomes short of breath	Shortness of breath Oxygen Sat: 92% Vital signs are otherwise unchanged More somnolent, difficult to arouse No improvement in uterine tone, ongoing bleeding	<ol style="list-style-type: none"> 1. Notify anesthesiology and OB teams 2. Anesthesiology team member at bedside, examining the patient 3. Assess vital signs 4. Assess mental status 5. Differential for shortness of breath 6. Auscultate lungs 7. Epidural stopped immediately 8. Epidural catheter aspirated 9. Situation explained to patient and her husband 10. Oxygen 			
Pt becomes completely unresponsive, continuing to make respiratory efforts	If they intubate→ bleeding has now stopped, pt is stable on the ventilator If they haven’t intubated yet, pt now unresponsive with weak respiratory efforts. O ₂ Sat drops to 78%	<ol style="list-style-type: none"> 1. Additional help is called for 2. Anesthesiology manages the airway with O₂ via Ambu bag with FiO₂ of 1.00 Team calls for suction set up and advanced airway equipment 3. Patient is placed on continuous monitors (EKG, NIBP q2 min, SpO₂) 4. Intubate with rapid sequence induction 5. Consider differential diagnosis of respiratory failure in a recently postpartum parturient 			

		<ol style="list-style-type: none"> 6. Ask for results of lab samples 7. Do they get a stat head CT? 8. Chest CT? Echo? 9. Blood gas? 10. Initiate treatment for magnesium toxicity? 11. Move pt to ICU? 			
Mag level returns at 12 mg/dL	Patient is hypotensive, intubated	<ol style="list-style-type: none"> 1. Provide hemodynamic support with IVF and vasopressors Treat magnesium toxicity with calcium gluconate (1 gram IV) 2. Additional IV access obtained 3. Arterial line placed for hemodynamic monitoring if continued hypotension 			
OB reports improved uterine tone	Patient hemodynamically stable after calcium therapy under GETA and meets extubation criteria	<ol style="list-style-type: none"> 1. Patient is extubated 2. Continue close monitoring in ICU for 2 hours after isolated CNS event or 4-6 hours after cardiovascular event 			

Appendix 1

Obstetric Interdisciplinary Team Simulation

Name of simulation: _____

Date: _____

OB Nursing Anesthesiology

Each item has two components. The “Before the simulation” column (left side) examines your perspective at the beginning of the simulation. The “End of Simulation” column (right side) is to evaluate your perspective at the completion of the simulation.

1. How would you rate your knowledge of patient risk factors for magnesium toxicity?

BEFORE THE SIMULATION							END OF SIMULATION						
1	2	3	4	5	6	7	1	2	3	4	5	6	7
Little/none					knowledgeable		Little/none					knowledgeable	

2. How would you rate your knowledge of signs and symptoms of magnesium toxicity?

BEFORE THE SIMULATION							END OF SIMULATION						
1	2	3	4	5	6	7	1	2	3	4	5	6	7
Little/none					knowledgeable		Little/none					knowledgeable	

3. How would you rate your knowledge of treatment options for magnesium toxicity?

BEFORE THE SIMULATION							END OF SIMULATION						
1	2	3	4	5	6	7	1	2	3	4	5	6	7
Little/none					knowledgeable		Little/none					knowledgeable	

Appendix 2

SIMULATION ACTIVITY EVALUATION FORM

DATE OF SIMULATION: _____

OCCUPATION: Consultant PG Year 1 2 3 4 STUDENT NURSE MIDWIFE OTHER

SPECIALTY: _____ YEARS IN PRACTICE: _____

Please rate the following aspects of this training program using the scale listed below:

1 = poor 2 = suboptimal 3 = adequate 4 = good 5 = excellent

Use "N/A" if you did not experience or otherwise cannot rate an item

INTRODUCTORY MATERIALS

Orientation to the simulator	1	2	3	4	5	N/A
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PHYSICAL SPACE

Realism of the simulator space	1	2	3	4	5	N/A
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EQUIPMENT

Satisfaction with the mannequin	1	2	3	4	5	N/A
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SCENARIOS

Realism of the scenarios	1	2	3	4	5	N/A
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Ability of the scenarios to test technical skills	1	2	3	4	5	N/A
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Ability of the scenarios to test behavioral skills	1	2	3	4	5	N/A
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Overall quality of the debriefings	1	2	3	4	5	N/A
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DID YOU FIND THIS USEFUL?

To improve your clinical practice?	1	2	3	4	5	N/A
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To improve your teamwork skills?	1	2	3	4	5	N/A
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To improve your VERBAL communication?	1	2	3	4	5	N/A
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To improve your NONVRBAL communication?	1	2	3	4	5	N/A
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FACULTY

Quality of instructors	1	2	3	4	5	N/A
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Simulation as a teaching method	1	2	3	4	5	N/A
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COMMENTS

References

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McDonnell NJ, Muchatuta NA, Paech MJ. Acute magnesium toxicity in an obstetric patient undergoing general anaesthesia for caesarean delivery. *Int J Obstet Anesth.* 2010;19:226-31