

Magnesium toxicity in obstetric patient in labor and delivery suite

Inter-disciplinary Team Simulation

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Educational Rationale:

Magnesium is indicated in preeclamptic patients for the prevention of seizures. It has a safe toxic: therapeutic ratio and is monitored using clinical parameters.[1] Magnesium toxicity is usually of iatrogenic origin, either due to inadvertent rapid intra venous infusion, dosage errors, or administration in a patient with renal impairment. Magnesium toxicity may result in apnea, hypoxia, hypotension and cardiac arrhythmias. Even though the occurrence of cardiac arrest is rare with magnesium toxicity in pregnant patients it has been reported due to inadvertent accidental rapid infusion of magnesium sulfate intravenously.[2, 3] Given the frequency with which we use magnesium in our labor and delivery units, it is prudent for our health care providers to be knowledgeable in the management of magnesium toxicity in the pregnant patient. As magnesium toxicity may result in cardiac arrest, when managing pregnant patients with cardiac arrest secondary to magnesium toxicity, the specific management of magnesium toxicity needs to be incorporated into the pharmacology of the ACLS Protocol. Magnesium toxicity puts the life of the mother and the unborn fetus at grave risk. If such an event occurs, effective management by the anesthesia, obstetric, pediatric and nursing teams in a timely manner is essential. Magnesium toxicity needs to be considered by the obstetric clinical care team in their differential diagnosis of an obtunded obstetric patient.

Target Audiences: Nursing, OB , Anesthesia and other team members

Learning Objectives:

General learning objectives: (Core Competencies), upon completion of this simulation (including debriefing):

- *Medical knowledge:* Learners will be able to list signs, symptoms and causes of magnesium toxicity. Learners will be able to describe the patho physiology of magnesium toxicity.
- *Patient care:* Learners will be able to resuscitate the mother to ensure the best outcome for mother and the fetus.
- *Practice-based learning and improvement:* Learners will be able to utilize drugs,

dosing and management techniques for magnesium toxicity in pregnancy as listed in the literature, and initiate delivery of the fetus if deemed necessary.

- *Interpersonal and communication skills:* Each team will be able carry out their role and, at the same time, be able to integrate it with the roles of other team members to bring about successful resuscitation of the mother and fetus.
- *Professionalism:* Each team will be able to demonstrate mutual respect for the expertise of other teams.
- *Systems-based practice:* At the end of the simulation, all team members will be able to identify existing barriers within the system (such as shortages of equipment, personnel) that needs change in order to improve patient outcome.

Specific Learning Objectives: Upon completion of this simulation (including debriefing):

- 1 Team members will be able to access emergency resuscitation equipment and drugs from within the Labor and Delivery suite, in anticipation of an obstetric emergency.
- 2 Team members will be able to list the specific management techniques for patients with magnesium toxicity.
- 3 Team members will be able to describe ways in which aorto-caval compression can be minimized in the obtunded pregnant patient.
- 4 Team members will demonstrate proficiency in providing basic life support (BLS), including airway support, commencing cardio-pulmonary resuscitation (CPR), and use of automated external defibrillator (AED) as needed.
- 5 The obstetric team will be able describe the steps necessary to initiate a emergency cesarean section if needed.
- 6 The pediatric (neonatal) team will be able to assemble resuscitation equipment in anticipation of resuscitating a neonate of a mother with magnesium toxicity.
- 7 The teams should be able to identify a leader and s/he should be able to delegate tasks to other members of the team.
- 8 The team members should be able to identify a time keeper and a scribe.
- 9 At the conclusion of the simulation, all teams will be able to identify effective and ineffective interventions that occurred during the scenario.

Guided Study Questions:

1. What are the causes of magnesium toxicity in the pregnant patient?
2. What are the signs and symptoms of magnesium toxicity?
3. What are the interventions specific to managing magnesium toxicity?
4. What are techniques pharmacologic and non-pharmacologic that will minimize morbidity and mortality of both the mother and her fetus?
5. Discuss the workflow for initiating an emergency Cesarean delivery. What complications are expected in this patient during Cesarean delivery?
6. What should be conveyed to the pediatrics team for resuscitation of this baby?

Debriefing Instruments:

Debriefing should be based on benchmarks that need to be met in a timely manner. A repeat simulation following debrief and making system changes should aim to show improvement in the times to reach the benchmarks. The following time intervals are to be noted:

Times taken from establishment of an unconscious patient till, if necessary,

- Calling for help
- Securing the maternal airway effectively
- Proper positioning of patient (mother)
- Recognizing magnesium toxicity
- Stopping the magnesium intravenous infusion
- Specific management of magnesium toxicity
- Initiation of cardiopulmonary resuscitation (CPR)
- Decision to perform cesarean section
- Delivering baby

Equipment, personnel and other support needed

Equipment:

Pregnant Mannequin

Audio-Visual Equipment

Running IV infusion labeled Magnesium (rate 2g/hour)

Calcium gluconate vial (given to the team only if the team cannot find one in the L&D suite)

As this is a simulation in situ, other equipment needed should be available at the site. If not their deficiencies should be picked up by the simulation.

Pediatrician/Neonatologist

Voice of Ms. Magpie

Family member; actor

Simulation set up

As this is a simulation in-situ, the day's census of the labor and delivery Unit may be a bottle neck to running this simulation due to the unavailability of a vacant room.

Another constraint to running this simulation is the need to have available at a particular time a large number of participants including the key facilitators of each of team. Each participant though informed of participating in a simulation, the specifics of the simulation are not disclosed. Each participant signs a consent form giving permission to be videotaped during the simulation for the purpose of debriefing. Each participant is given a laminated card that contains their respective roles (ideally they should be

playing the role of themselves), where they will be and what they would be doing at the time the simulation unfolds.

The mannequin will be set up in one of the Labor and delivery suites. She will have a running IV, with a port through which medications can be given. There will be an actor/confederate playing the role of the patient's family member, present in the room. The person plying the voice of the mannequin will be by the head of the mannequin but not visible to the participants. There should be no observers, only participants in the simulation.

Each participant is given the opportunity to visit the simulation room and familiarize themselves with the mannequin and its surroundings prior to the actual start of the simulation. As per the card above, the patient's blood pressure drops and she calls out "I am going to pass out". This will unfold the simulation. The simulation will end with the delivery of the baby. Following the delivery of the baby the mother's vital signs will return to normal. In other words, the mother will not die. The baby will also survive.

Following the simulation there is a debriefing session with the participants led by the content experts of nursing, obstetrics, pediatrics, and anesthesia.

Time Duration

Set-up	20 min
Preparation	10 min
Simulation	10 min
Debrief	15-20 min

Case Stem

26yr old female at 34 weeks in her first pregnancy presents with severe features of preeclampsia. Her blood pressure is normal however she has severe headaches and blurred vision with right upper quadrant pain. Her AST is twice the normal level and her platelets are borderline low to normal. A urine dipstick which showed a moderate amount of protein. She just received a 4 gram bolus of magnesium sulfate followed by an infusion of magnesium at 2 g/hour and a single dose of betamethasone. She has not required any antihypertensives.

Patient has a history of multiple UTIs as a child but has otherwise been healthy. She had no past surgical history. She had recently moved to Iowa from Texas and had limited prenatal care in TX. She is living with her sister at present. She has a history of recreational drug use and smoking.

Currently the patient appears asleep. The patient's sister is standing beside her. Patient has a pulse, the monitor shows the following: heart rate of 58beats/minute, blood pressure of 80/40, respiratory rate of 6/minute, oxygen saturation of 93%, Fetal heart rate of 140beats/minute.

Scenario development

The scenario will start with the OB nurse taking care of Ms Magpie, coming to the bedside of the patient.

Trigger	Patient Condition	Action
The patient appears asleep. Sister says" she won't even open her eyes"	Patient is unresponsive. Patient has a pulse Monitor: HR -58beats BP- 80/40 RR- 6/minute SpO2- 93% FHR- 140 beats/minute	OB nurse will page, or call for help
Patient remains unresponsive Family member gets agitated	Patient unresponsive, Patient has a pulse Monitor shows: HR -58beats/minute BP- 80/40 RR- 6/minute SpO2- 89% FHR- 100 beats/minute	Team members should: Recognize and support Airway, Breathing and Circulation. Position patient in Left lateral tilt, to optimize uteroplacental blood flow Recognize magnesium toxicity; stop the Intravenous infusion of magnesium, call for or obtain and administer calcium gluconate intravenously. Recognize risk of aspiration, apply cricoid pressure, secure airway. Team members should designate delineate tasks to the individual members Someone assigned to take care of family

Patient is now responsive	Patient responsive, Monitor shows: HR increases to 80beats/minute BP- 110/60 RR- 10/minute SpO2- 95% FHR- 120 beats/minute	

1. Sibai, B.M., *Magnesium sulfate prophylaxis in preeclampsia: lessons learned from recent trials*. American journal of obstetrics and gynecology, 2004. **190**(6): p. 1520-1526.
2. Whitty, J.E., *Maternal cardiac arrest in pregnancy*. Clinical obstetrics and gynecology, 2002. **45**(2): p. 377.
3. Swartjes, J., M. Schutte, and O. Bleker, *Management of eclampsia: cardiopulmonary arrest resulting from magnesium sulfate overdose*. European Journal of Obstetrics & Gynecology and Reproductive Biology, 1992. **47**(1): p. 73-75.