Simulation Patient Design (December 2023)
Case of Hypoglycemia in a Parturient

Author(s): Kyle Sullivan, MD, Alaeldin Darwich, MD, New York-Presbyterian/Weill Cornell Medical Center
Editors: Sonal Zambare, MD, FASA; Jessica Sheeran, MD

Introduction
During pregnancy, tight glucose control is essential to managing pregestational diabetes mellitus (DM) regardless of whether it is Type 1 or Type 2. The American College of Obstetricians and Gynecologists recommend a glucose range between 70-110 mg/dL during the labor process.[1] The reason for this tight range is to avoid neonatal hypoglycemia which if prolonged to devastating consequences such as permanent neuron damage, alterations in metabolism, pulmonary, and cardiovascular sequelae. [2] Therefore, the importance of avoiding prolonged hypoglycemia can not be overstated. However, with increasingly tight glucose control, comes the higher chance of developing hypoglycemia. Hypoglycemic episodes can occur in patients with Type 1 DM at a rate close to 20%, while patients with Type 2 DM only experience hypoglycemic episodes at a rate of 0.2%.[2]

Normal counter regulatory mechanisms like the release of epinephrine and glucagon during hypoglycemic episodes are diminished in pregnant women with diabetes compared to non-pregnant diabetic women.[3] Insulin sensitivity decreases in pregnant patients starting in the first trimester. In the third trimester, insulin resistance continues to increase.[4] Furthermore, the insulin requirements change depending on the stage of labor. There is a decrease in insulin requirements during the first stage of labor compared to the third trimester. However, during the second stage of labor, there is an increase in insulin requirements compared to the first stage of labor. In the postpartum stage, patients with diabetes need 35% less insulin.[5] This may lead to hypoglycemic episodes going unnoticed or recognized late due to a less than classic presentation such as tremors and diaphoresis.

More commonly now, patients are using continuous insulin pumps to better control their blood glucose. Recently, studies have demonstrated that continuous glucose monitoring leads to better glucose control for both type 1 and 2 patients.[4]

Educational Rationale: To teach team skills in managing type one diabetes mellitus and more specifically hypoglycemia.
Target Audiences: Nursing, OB, Anesthesiology, OR personnel
Learning Objectives: As per Accreditation Council for Graduate Medical Education (ACGME) Core Competencies
Upon completion of this simulation (including the debrief) learners will be able to:

- Medical knowledge: Recall signs and symptoms, definition, and causes of hypoglycemia.
- Patient care: Incorporate glycemic management in the intrapartum care delivery. Modify the anesthetic plan to adapt changes in maternal and fetal conditions.
- Practice-based learning and improvement: Develop and adjust plan of care through multidisciplinary discussion, evaluation, and management.
- Interpersonal and communication skills: Demonstrate effective communication skills (i.e., closed

loop communication, debriefing, recapping) to promote a shared mental model.
- Professionalism: Engage all members of the interdisciplinary team by assigning appropriate roles, maintaining open dialogue on status updates, and soliciting feedback.
- Systems-based practice: Incorporate and review institutional policies for escalating care (if applicable) and related workflows.

Questions to ask after the scenario:

1. What was your differential diagnosis after the patient became unarousable/unconscious?
2. What is your differential diagnosis for a seizing parturient on the labor floor?
3. What are your goals for glucose management during labor?
4. How do insulin requirements change with stages of labor?
5. Were there any barriers or system issues identified when caring for the patient?
6. Were opportunities for improvement(s) identified during the scenario?

Assessment Instruments:

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

Equipment Needed and Set-up:

In-situ set-up

- Personnel: Labor and delivery nurse, obstetrician, obstetric anesthesiologist/nurse anesthetist
-Location: Standard obstetric operating room set-up
- Equipment:
    - o Pregnant mannequin
    - o Neuraxial supplies, back-trainer (if available)
    - o Standard monitors: blood pressure, heart rate, pulse oximeter, EKG
    - o IV catheter, fluids
    - o Intubation supplies, anesthesia machine, induction medications
    - o Resuscitation medications to stabilize hemodynamics

Simulation Scenario Set-up:

The case

Ms. Saunders is a 34 y.o G2P1001 at 37 weeks presenting for elective repeat cesarean section. Patient has a significant past medical history of Chronic Kidney Disease Stage 3 and Type 1 DM controlled with a continuous glucose monitor and insulin pump, which automatically adjust the insulin given based on glucose levels. Patient's own insulin pump and glucose monitor are continued intra-op with the plan to switch to an insulin infusion post-operatively in the PACU. Blood glucose levels have been tightly controlled between 80-110 mg/dL during this pregnancy. Patient was ruled in for pre-eclampsia with severe features based on pre-op labs. A 4g Mg bolus has been completed and an infusion of Mg at 2g/hr is started in pre-op area.

Pre-operative vitals:
HR: 80 bpm
RR: 16/min
BP: 150/65 mmHg
SpO2: 98%

Labs:
Hbg/Hct: 12.0/36.2
Platelets: 203 k
Blood Glucose 95mg/dL
EFW: 3500g, >95% percentile

Simulation Pre-brief

- Read the scenario and instruct team members on their role during the simulation.
- The learners take their places.

Scenario Details

Trigger	Patient Condition	Action	Done	Time	Comments
Patient enters OR	Patient is awake and responsive HR 85 bpm BP 165/75 mm Hg SpO_2 99% (air) Resp 16/min Temp 37.1^oC	1. Anesthesiology team initiates plan of care 2. Patient positioned for neuraxial block on OR table 3. Standard ASA monitors applied 4. Vitals assessed: Recognition of severe range blood pressures a. Consider first-line IV antihypertensive agents (labetalol 20mg, hydralazine 5-10mg)			
Patient in OR and neuraxial anesthesia (CSE) placed with hyperbaric bupivacaine	3 minutes post-spinal anesthesia placement, patient begins complaining of vague nausea. HR 105 bpm BP 100/50 mm Hg SpO_2 97% (air) Resp 15/min Temp 36.9^oC FHR: 130 bpm	1. IV Lactated Ringers solution co-load started on pressure bag 2. Phenylephrine infusion started. Increase titration as needed. 3. Check magnesium infusion for appropriate dosing 4. Can consider sending labs including Glucose either from finger stick or ABG and/or Mg level			
2 minutes later- After fluid bolus or vasopressor infusion increased	Patient is awake and alert HR 90 bpm BP 125/60 mm Hg SpO_2 97% (air) Resp 15/min	1. Check spinal block level with either loss of sensation to sharp or cold 2. Admisister Antibiotics			

	Temp 36.9^{o}C Glucose 70mg/dL Mg 4.1mg/dL				
Live infant delivered and handed off to delivery team.	Patient complains about feeling drowsy and falls asleep. Is easily arousable with occasional non-sensical response to questions. Episodic altered mentation. HR 95 bpm BP 122/70 mm Hg SpO_2 94% (air) Resp 14/min Temp 36.2^{o}C APGARs: 8, 9	1. Order labs (i.e. ABG, finger stick, Mg level, repeat Pre-eclampsia labs) 2. Start oxytocin infusion after delivery of placenta 3. Discuss uterine tone with OB team 4. O2 administered using nasal cannula with end tidal nasal cannula			
10 minutes later incision is closed. Patient begins to slur her words and then vomits.	Continued deterioration in patient's mental status with incoherent mumbiling and responding to only her name. Airway reflexes remain intact. HR 102 bpm BP 110/58 mm Hg SpO_2 95% Temp 36.1^{o}C Glucose 57mg/dL Mg 3.9mg/dL	1. OB and anesthesia teams discuss differential diagnoses 2. Begin empiric treatment with 12.5-25g IV Dextrose and/or 1g IV Calcium 3. Can consider CT/neurological exam/ consult Neurology 4. Active warming			
After patient given IV dextrose	Patient becomes alert and orientated HR 90 bpm BP 136/76 mm Hg SpO_2 98% Temp 36.5^{o} C	1. Patient transferred to PACU 2. Check glucose every 30 minutes and place patient on an insulin pump with D5 Saline carrier 3. Consult endocrinology for insulin guidance 4. Family updated			

Appendix 1

Learner Knowledge Assessment
Labor and Delivery Multidisciplinary Team Simulation

Name of simulation: _____ Date: _____

OB Nursing Anes

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 risk factors for hypoglycemia?

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

2. How would you rate your knowledge of differential diagnosis of hypoglycemia?

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

3. How would you rate your knowledge of signs and symptoms of hypoglycemia?

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

4. How would you rate your knowledge of delivery planning for hypoglycemia?

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

5. How would you rate your overall confidence when confronted with hypoglycemia involving massive obstetric hemorrhage and coagulopathy?

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

Appendix 2

Simulation Activity Evaluation

DATE OF SIMULATION:

OCCUPATION: Consultant PG Yr 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
PHYSICAL SPACE						
Realism of the simulator space	1	2	3	4	5	N/A
EQUIPMENT						
Satisfaction with the mannequin	1	2	3	4	5	N/A
SCENARIOS						
Realism of the scenarios	1	2	3	4	5	N/A
Ability of the scenarios to test technical skills	1	2	3	4	5	N/A
Ability of the scenarios to test behavioral skills	1	2	3	4	5	N/A
Overall quality of the debriefings	1	2	3	4	5	N/A
DID YOU FIND THIS USEFUL?						
To improve your clinical practice?	1	2	3	4	5	N/A
To improve your teamwork skills?	1	2	3	4	5	N/A
To improve your VERBAL communication?	1	2	3	4	5	N/A
To improve your NONVERBAL communication?	1	2	3	4	5	N/A
FACULTY						
Quality of instructors	1	2	3	4	5	N/A
Simulation as a teaching method	1	2	3	4	5	N/A

COMMENTS/SUGGESTIONS:

References:

1. Rakefet Yoeli-Ullman, Ayala Maayan-Metzger, Roni Zemet, Nimrod Dori Dayan, Shali Mazaki-Tovi, Ohad Cohen, Lotem Weiss & Tali Cukierman-Yaffe (2020) The association between novel glucose indices in parturients with type 1 diabetes mellitus and clinically significant neonatal hypoglycemia, Gynecological Endocrinology, 36:7, 615-619, DOI: 10.1080/09513590.2019.1698027
2. Whiteman, Valerie E., et al. “Management of hypoglycemia and diabetic ketoacidosis in pregnancy.” Obstetrics and Gynecology Clinics of North America, vol. 23, no. 1, 1996, pp. 87–107, https://doi.org/10.1016/s0889-8545(05)70246-1.
3. Diamond M.P., Reece E.A., Caprio S., et al. Impairment of counterregulatory hormone responses to hypoglycemia in pregnant women with insulin-dependent diabetes mellitus. Am J Obstet Gynecol. 1992; 166: 70-77
4. Pregestational diabetes mellitus. ACOG Practice Bulletin No. 201. American College of Obstetricians and Gynecologists. Obstet Gynecol 2018;132:e228–48
5. Ioannis Tsakiridis, Apostolos Mamopoulos, Apostolos Athanasiadis, Anargyros Kourtis & Themistoklis Dagklis (2022) Management of pregestational diabetes mellitus: a comparison of guidelines, The Journal of Maternal-Fetal & Neonatal Medicine, 35:3, 423-432, DOI: 10.1080/14767058.2020.1719481