SOAP
Society for Obstetric Anesthesia and Perinatology

Simulation Patient Design (April, 2022)
Case of Maternal Hyponatremia

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Introduction

Hyponatremia is the most common electrolyte abnormality encountered in hospitalized patients, and despite this, hyponatremia in the peripartum period is often unrecognized or underreported.[1,2] Hyponatremia in pregnancy, defined as a serum sodium concentration less than 130 mmol/L, may be dilutional or non-dilutional in etiology.[3,4] The majority of cases of pregnancy-associated hyponatremia are secondary to dilution caused by excessive fluid administration and retention, which could be potentiated by exogenous administration of oxytocin.[2,3,4] The risk of hypervolemic hyponatremia is most common during labor or in the immediate postpartum period, and correlates with the total volume of fluids administered.[2,3] A prospective observational study by Moen et al. reports hyponatremia was present in 26% of patients who received greater than 2500 mL of fluid during labor.[2]

Although clinically significant hyponatremia in pregnancy is rare, hyponatremia has been found to be significantly associated with several obstetric complications, including a prolonged second stage of labor, instrument-assisted delivery, and emergency cesarean delivery.[2] Furthermore, it is often present in preeclampsia (14.6%), and is strongly associated with severe features of preeclampsia, including hemolysis, elevated liver enzymes, and low platelets (HELLP) syndrome, abnormal renal function, and severe hypertension.[5] Severe hyponatremia may lead to maternal seizures which could be misdiagnosed as eclampsia. Maternal hyponatremia is also associated with fetal risks because water concentration rapidly equilibrates across the placenta causing fetal hyponatremia.[4] Adverse fetal complications include low birth weight, respiratory distress, polyhydramnios, hyperbilirubinemia, neonatal cerebral edema/seizures, and an increased incidence of NICU admission.[2,5,6]

In non-obstetric perioperative literature, preoperative hyponatremia has been associated with a 44% increased risk of 30-day perioperative mortality, even when other potential risk factors have been controlled for.[7] It is also associated with an increased risk of perioperative major coronary events, surgical site infections, pneumonia, prolonged hospital stay, and higher direct and indirect medical costs.[7,8]

Educational Rationale: To teach team skills in the management of hyponatremia in the peripartum period
Target Audiences: Nursing, OB providers, anesthesiology providers, emergency medicine providers
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*: Recognize the presentation, risk factors, differential diagnosis, and complications associated with peripartum hyponatremia
- *Patient care*: Evaluate patient-specific risk factors for hyponatremia and make appropriate diagnostic and therapeutic interventions
- *Practice-based learning and improvement*: Improve clinical recognition and treatment of hyponatremic patients and provide patient education, preventative guidance, and support
- *Interpersonal and communication skills*: Demonstrate effective leadership, team management skills, and closed-loop communication to coordinate and provide appropriate care

- *Professionalism*: Work collaboratively in a multidisciplinary team model and demonstrate respect for the value added by each team member
- *Systems-based practice*: Use available clinical resources to treat hyponatremic patients, including recognition of the need for escalation care, when needed

Questions to ask after the scenario:

- Were pre-existing risk factors for hyponatremia identified?
- Was a clear treatment plan communicated to all members of the care team?
- Was closed-loop communication used throughout?
- Was there appropriate escalation of care?
- Was the patient and family updated and supported?
- Were any areas identified as opportunities for improvement?

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

- Patient room or simulation room
- Monitors: EKG, pulse oximetry, NIBP
- Infusion pump (for magnesium sulfate and oxytocin infusions)
- Epidural catheter and pump
- Reflex hammer, pen light

Simulation Scenario Set-up:

The case

Ms. Torres is a 28-year-old primigravida (G1P0) patient at 37 weeks gestation who presented with a persistent headache and rupture of membranes. She has persistently had elevated blood pressures in the range of 160/90 mm Hg in triage, and has been admitted for augmentation of labor secondary to preeclampsia with severe features. Her past medical history is significant for depression for which she takes sertraline, and dyspepsia for which she takes omeprazole. She has been treated with labetalol boluses and a magnesium sulfate infusion has been started for seizure prophylaxis. A labor epidural was placed a couple of hours ago and she required several IV fluid boluses to treat hypotensive episodes after the epidural initiation dose was administered. The epidural catheter was aspirated to exclude intrathecal migration as a cause of the hypotension. She has now been here for 15 hours and her labs show abnormal values that include Na 130 mEq/L and Hgb 9.2 g/dL.

Simulation pre-brief

- OB anesthesiologist at the patient's bedside with the obstetrician, the patient's nurse, and the patient
- Read the scenario and instruct team members on their role during the simulation
- The learners take their places
- Team roles:
    - OB anesthesiologist/resident, OB attending/resident, L&D nurse, patient
    - Confederates

- Patient:
  - Endorse drinking large quantities of water
  - Has been compliant with medications for depression and dyspepsia
  - Endorse lower extremity edema on exam
- L&D Nurse
  - Endorse that the patient has received 2500 mL of IV crystalloid throughout her labor course

Scenario Details

Trigger	Patient Condition	Action	Done	Time	Comments
Patient found to be hyponatremic	Patient is awake + responsive HR 88 bpm BP 145/85 mm Hg SpO_2 96% (air) Resp 16/min Temp 37.0^oC FHT 142/min Cat 1 trace Epidural infusion ongoing Oxytocin infusion at 20 mU/min Mg infusion at 2 g/h	1. OB provider calls the anesthesiologist with concern for hyponatremia 2. Anesthesiologist performs initial evaluation to identify risk factors for hyponatremia ☐ PMH ☐ Medication review ☐ Physical exam ☐ Fluid intake/output (I/Os) 3. Order additional labs for diagnosis ☐ Urine sodium + urine osmolarity ☐ Serum sodium + serum osmolarity 4. Medication review ☐ Consider holding SSRI + PPI (they increase the risk for hyponatremia)			
	Patient complains of nausea + lethargy HR 92 bpm BP 138/75 mm Hg SpO_2 97% (air) Resp 16/min Temp 37.0^oC Lab results from earlier: Na 128 mmol/L Osm 260 mosmol/kg Urine Na 15 mmol/L Urine Osm 90 mosmol/kg	1. Diagnose hyponatremia secondary to polydipsia + potentially treatment of hypotension with IV fluids, worsened in the setting of preeclampsia 2. Enforce strict fluid restriction 3. Closely monitor Na levels 4. Rule out magnesium toxicity ☐ Physical exam, including deep tendon reflexes ☐ Serum Mg level			
	Patient confused + disoriented	1. Neurological exam check ☐ Orientation			

	HR 90 bpm BP 134/72 mm Hg SpO_2 96% (air) Resp 16/min Temp 37.0°C Labs results: Mg 5 mg/dL Na 120 mmol/L	☐ Cranial nerve reflexes ☐ Sensory/motor block with epidural ☐ Deep tendon reflex 2. Confirm I/Os ☐ Limit other unnecessary infusions to limit fluid intake ☐ Reaffirm strict I/Os 3. Consider differential diagnosis ☐ Determine necessity for head imaging or additional testing 4. Discuss with OB about nephrology consult for treatment of symptomatic hyponatremia ☐ Infusion of normal saline vs. hypertonic saline ☐ Goal correction 4-6 mmol/L in first 4 hours[1] ☐ Hourly Na check while treating with Na supplementation 5. Escalate level of care to 1:1 nurse/critical care 6. Explain to family + provide reassurance and support			
0.9% sodium chloride infusion complete (for hyponatremia)	Marked improvement in mental status Lab results: Na 124 mmol/L	1. Reassess patient 2. Continue fluid restriction + close Na monitoring			
Progresses + vaginally delivers an asymptomatic neonate	Patient awake + alert HR 84 bpm BP 132/70 mm Hg SpO_2 96% (air) Resp 16/min Temp 37.0°C APGAR scores: 1 min = 8 5 min = 9 Na 128 mmol/L	1. Notify pediatrics team that neonate may be hyponatremic ☐ Pediatric team to follow neonate's serum Na (may require IV fluids or water restriction) 2. Notify nephrology team that Na has reached 128 mmol/L ☐ Avoid rapid overcorrection of serum Na ☐ Correction should not exceed 10-12 mmol/L in the first 24 hours[1] ☐ Closely monitor serum Na			
Postpartum day 1	Patient doing well Na 135 mmol/L	1. Debrief with care team 2. Debrief with the patient + family			

	Initial neonatal Na 125 mmol/L (treated with water restriction + sodium then normalized)				

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 maternal hyponatremia?

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 maternal hyponatremia?

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 maternal hyponatremia?

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 treatment and sodium correction goals for maternal hyponatremia?

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 with the care of laboring patients with hyponatremia?

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:

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