Simulation Patient Design (June 2022)
Case of Peripartum Cardiomyopathy

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Introduction

Cardiovascular disease is steadily increasing in the United States (US) and is one of the leading causes of maternal mortality.[1] In addition to people with congenital heart disease having improved survival, there is increased frequency of cardiovascular risk factors in people of child-bearing age which have led to an overall increase in people with pre-existing cardiac disease having children.[1,2] Pregnant patients with cardiovascular disease can be risk stratified using the CARPREG II score (Cardiac disease in pregnancy study), which is a risk calculator to determine the potential for an adverse event, for example >4 points can result in a 41% increased risk of an adverse event.[3] Risk factors included in this score are a history of prior cardiac events, baseline New York Heart Association (NYHA) class 3-4 or cyanosis, presence of a mechanical valve, baseline reduced ejection fraction, high risk valve disease or left ventricular outflow tract (LVOT) obstruction, pulmonary hypertension, coronary artery disease (CAD), lack of cardiac intervention before pregnancy and late pregnancy assessment.[3] The most common cardiac complications in the CARPREG II study were arrhythmias followed by heart failure.[3]

In addition to people with pre-existing disease, there is a subset of people who develop an idiopathic form of cardiomyopathy. Peripartum cardiomyopathy (PPCM) is defined as weakness in the myocardium, often with unclear etiology, with left ventricular (LV) systolic dysfunction (e.g. ejection fraction <45%) towards the end of pregnancy or following delivery.[4] Unfortunately, PPCM has been found to account for approximately 10% of pregnancy-related deaths that occur in hospitals in the US.[5] These cardiac conditions can gravely affect maternal hemodynamics, oxygenation and fetal status, therefore managing the underlying cardiac pathology is crucial while considering the usual physiologic changes of pregnancy for safe vaginal or cesarean delivery.

The etiology of PPCM is not well understood, and likely has many contributing factors that play a role in disease progression. Several risk factors have been identified which include preeclampsia, multiple gestation pregnancies, age >30 years, and African American race.[6,7] Patients often present with signs and symptoms consistent with heart failure, including dyspnea, peripheral edema or chest tightness. Unfortunately, these sequelae can often be confused with normal signs or symptoms of the third trimester in healthy patients and so the timing of diagnosis and immediate treatment of cardiomyopathy is critical to optimize outcomes.

Delays in diagnosis can result preventable complications which can lead to increased mortality.[8] Diagnostic evaluation with echocardiography is crucial for assessment of LV function, atrial enlargement and valve integrity. Simulation involving identification, differential diagnoses, testing and treatment of PPCM has the potential to improve outcomes for these patients.

Educational Rationale: To teach team skills in recognizing and managing PPCM
Target Audiences: Anesthesiologists, Resident Physicians, Obstetricians, L&D Nurses, Medical Students
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*: Explain the signs and symptoms of PPCM and formulate a treatment plan
- *Patient care*: Identify underlying risk factors associated with PPCM during the preoperative history and formulate a hemodynamically appropriate anesthetic plan for delivery
- *Practice-based learning and improvement*: Identify equipment and medications necessary to treat a patient with PPCM, including the use of transthoracic echocardiography
- *Interpersonal and communication skills*: Use closed-loop communication to discuss differential diagnoses and treatment with the patient, as well as with the OB team, nurses and support staff
- *Professionalism*: Demonstrate concern for the patient and effectively communicate the diagnosis and management with the patient. Additionally, respect all members of the team by encouraging communication and team collaboration.
- *Systems-based practice*: Develop a multidisciplinary plan for the safe delivery of patients with cardiomyopathy

Questions to ask after the scenario:

1. Was there a team leader?
2. Were tasks appropriately delegated to team members?
3. Was there good communication amongst team members?
4. Were there any breakdowns in communication?

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

- Mannequin in labor room on stretcher with left uterine displacement
- 18 gauge IV in place
- Monitors: BP cuff, pulse oximeter, nasal cannula, EKG leads, fetal heart rate monitor

Simulation Scenario Set-up:
The case
Karen Jones is a 42-year-old patient (G3P1) who has presented to labor and delivery at 37 weeks and 3 days gestation with new-onset dyspnea at rest for the past 7 days, which has worsened over the last 3 days. No cough or other symptoms suggestive of COVID-19 infection. She is currently mildly contracting, and has a history of one vaginal delivery 3 years ago, during which she was diagnosed with preeclampsia. This current pregnancy has been complicated by gestational diabetes and obesity (BMI 40) and she has no other medical history.

Simulation Pre-brief

- Read the scenario and instruct team members on their role during the simulation
- The learners take their places at bedside
- Support person at bedside (confederate)

Scenario Details

Trigger	Patient Condition	Action	Done	Time	Comments
Patient in L&D bed	Patient awake + responsive but tachypneic HR 110 bpm BP 91/46 mm Hg SpO_2 93% (air) Resp 25/min Temp 37.2C FHR: 160, good variability Physical exam of patient: decreased breath sounds bilaterally, pitting edema, increased JVP	L&D nurse performs initial evaluation + examination ☐ Call the OB to assess the patient's tachypnea (MEWS protocol triggered) ☐ Place non-rebreather face mask (10 L/min O_2) on the patient ☐ Inform the anesthesiology team ☐ Place continuous fetal heart rate monitor OB + anesthesiology team at the bedside ☐ Team considers differential diagnoses: preeclampsia, PE, PPCM, arrhythmia, MI, pneumothorax ☐ Place 2nd large bore IV ☐ Send labs (CBC, CMP, ABG, BNP, troponin) ☐ Order EKG			
Non-reassuring fetal heart trace	Patient stable FHR 160s with reduced variability + intermittent late decelerations	1. OB team decides to proceed with an urgent cesarean delivery due to category 2 tracing 2. OR team informed + OR prepped ☐ Consider method of anesthesia: neuraxial (epidural, CSE, spinal) vs. GA			
Patient transferred to OR	Awake + oriented, remains dyspneic HR 121 bpm BP 92/54 mm Hg SpO_2 93% (air) Resp 22/min	Prepare + plan for urgent CD ☐ Call for help/additional staff ☐ Place monitors on patient (if not already done) including 5 lead EKG ☐ Place arterial line ☐ Consider TTE ☐ Have code cart in room ☐ Place epidural and SLOWLY dose with local anesthetic (if places spinal, patient becomes hemodynamically unstable)			
Delivery of fetus (requires resuscitation by NICU)	Patient becomes restless, increasing dyspnea	High suspicion for cardiomyopathy ☐ Diagnosis of pulmonary edema ☐ Increase O_2 therapy to non-invasive ventilation (or consider			

	HR 130 bpm with frequent PVCs BP 90/50 mm Hg SpO_2 88% on O_2 (10 L/min) Resp 32/min Focused TTE: decreased LV EF (~25%), bi-atrial enlargement, engorged IVC, B-lines B/L lung fields	intubation) ☐ Administer furosemide IV ☐ Administer beta blocker IV ☐ Starts inotropic agents (e.g. epinephrine, norepinephrine) ☐ Transfer neonate to NICU			
OB notifies team of uterine atony	Improvement in respiratory status after diuresis + respiratory support HR 130 bpm BP 87/45 mm Hg SPO_2 93% (on BiPAP) RR 26/min	Appropriate fluid management + management of atony ☐ Administer oxytocin ☐ Administer misoprostol PR ☐ Consider TXA ☐ Avoid methylergonovine + carboprost ☐ Limit crystalloid volume (consider blood transfusion)			
OB reports adequate tone + hemostasis, begins to close	HR 105 bpm BP 95/56 mm Hg SpO_2 94% on non-rebreather Resp 20/min	Medical management ☐ Cardiology consult ☐ Consider formal TTE			
Disposition		☐ Prepare transfer to ICU ☐ Explain events + disposition to patient (plus support person)			

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 PPCM?

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 differential diagnosis of PPCM?

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 signs and symptoms of PPCM?

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

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

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

5. How would you rate your overall confidence when confronted with PPCM involving respiratory distress and impending delivery of fetus?

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

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. Creanga AA, Syverson C, Seed K, Callaghan WM. Pregnancy-related mortality in the United States, 2011–2013. Obstet Gynecol. 2017;130:366-373
2. Connolly HM. Pregnancy in women with congenital heart disease. Curr Cardiol Rep. 2005; 7: 305-309
3. Silversides CK, Grewal J, Mason J, et al. Pregnancy Outcomes in Women with Heart Disease: The Carpreg II Study. 2018. Journal of the American College of Cardiology;71(21):2419-2430.
4. Davis M, Arany Z, McNamara D, Goland S, Elkayam U. Peripartum Cardiomyopathy: JACC State-Of-The-Art Review. JACC. 2020;75(2):207-221
5. Mogos MF, Piano MR, McFarlin BL, Salemi JL, Liese KL, Briller JE. Heart failure in pregnant women: a concern across the pregnancy continuum. Circ Heart Fail. 2018;11(1):e004005
6. Mielniczuk LM, Williams K, Davis DR, et al. Frequency of peripartum cardiomyopathy. Am J Cardiol. 2006;97:1765-1768
7. Brar S.S., Khan S.S., Sandhu G.K., et al. Incidence, mortality, and racial differences in peripartum cardiomyopathy. Am J Cardiol. 2007;100:302-304
8. Fett JD. Earlier detection can help avoid many serious complications of peripartum cardiomyopathy. Future Cardiol. 2013;9:809-816