Using Simulation-Based Learning to Prepare for a Potential Cardiac Emergency on the Labor Unit

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Abstract: Cardiac arrest on the labor unit is a rare event, but it can have significant effects on a woman and her fetus, as well as on the clinicians providing health care. Our labor team was challenged to provide care for a woman with a rare cardiac condition that can cause a wide range of events, from fainting to cardiac arrest. This article describes our use of simulation-based learning to prepare for potential scenarios.

Keywords: cardiac arrest, catecholaminergic polymorphic ventricular tachycardia, obstetric emergency, pregnancy, simulation-based learning
In an obstetric emergency, optimal outcomes depend on rapid assessment, diagnosis, and implementation of interventions by the entire obstetric health care team. Cardiac arrest on labor and delivery (L&D) units is rare. In the United States, cardiac arrest occurs in 1 in 12,000 admissions during hospitalization for childbirth (Lipman et al., 2014). Early and aggressive interventions with resuscitation and birth may improve outcomes in the event of cardiopulmonary arrest (Jeejeebhoy et al., 2015). However, there are challenges in preparing obstetric health care teams for such a high-risk yet rarely occurring event. Individual obstetric team members vary from day to day and shift to shift. Labor is unplanned and can occur any day at any time. This article describes how an interdisciplinary team at an academic community Magnet hospital used the Plan, Do, Study, Act approach (Bushell, 1992) and a labor and birth simulation to create a strategic plan of care for a pregnant woman with cardiac complications.

**Benefits of Interdisciplinary Simulation-Based Learning**

Obstetric training for nurses and physicians typically occurs on the same unit but not as a joint endeavor. Residents learn from experienced physicians, whereas novice nurses are trained by experienced nursing staff. When obstetric emergencies occur, a team approach to patient care is required. Interdisciplinary simulation provided a collaborative opportunity to teach and practice interpersonal skills such as communication and teamwork to all members of the interdisciplinary team. Residents face multiple challenges to learning at the bedside. With their work hours reduced, residents’ time in the clinical arena is decreased. Certain obstetric emergencies are rare, and the potential for legal liability makes dependence on learning at the bedside with real-life events both impractical and a potential threat to patient safety. Simulation has become a viable
alternative teaching strategy to learn new skills as well as to practice and maintain skills (Ennen & Satin, 2010).

Simulation also affords teams an opportunity to explore patient care processes and problem-solve as a team in a controlled environment. During simulation, less experienced members of the team can take charge of the situation without risk to a woman, fetus, or members of the health care team. Simulation provides a safe environment in which to make mistakes and learn from those mistakes (Fisher et al., 2010) and an opportunity for repeated practice of appropriate interventions and mastery of critical skills in a safe clinical setting (Daniels et al., 2010).

**Using Principles of Adult Learning**

Adult learning is the “process of adults gaining knowledge and expertise” (Knowles, Holton, & Swanson, 2005, p. 174). According to Knowles et al., there are six principles of adult learning that facilitators can use when developing simulation activities (see Box 1). Simulation can be stressful for seasoned staff who are not accustomed to this method of active learning and are more comfortable with passive learning through lecture, and experienced staff may feel vulnerable when expected to act out their role in front of peers. Therefore, facilitators are responsible for creating a safe learning environment in which participants know what is expected from them.

A safe learning environment contains established ground rules as defined by the participants. Examples of ground rules include not discussing erroneous events made during a simulation activity outside the simulation area. These errors enhance learning yet are not discussed with
colleagues beyond the team. Participants must be aware that the purpose of simulation is to learn, not to evaluate individual performance. Clear attainable goals help learners know what is expected of them during the simulation drill (see Box 2). Topics relevant to their practice motivate staff to learn. Education before simulation provides participants with the knowledge needed to perform their roles during the drill. A repeat drill after the debrief session gives the team a chance to use the knowledge and skill gained through debriefing. Post-drill debriefing provides staff with the opportunity to reflect on their experience, think through the process of care, identify positive attributes, and problem-solve areas of concern, as well as to make plans for improvement. In general, staff will accept changes in practice more readily when they participate in developing the process changes. New processes can then be further tested in simulation.

**Plan, Do, Study, Act**

*Plan*

Our obstetric program conducts regularly scheduled multidisciplinary team meetings that provide a format to discuss and plan for complicated obstetric cases. These team meetings led to the development of standardized plans of care to ensure that consultations are coordinated for prenatal visits. For this specific case, our multidisciplinary team met after a woman’s initial consultation at 16 weeks gestation to discuss her unique plan of care. The woman was 27 years old, had not previously given birth, and had catecholaminergic polymorphic ventricular tachycardia (CPVT). CPVT is a rare genetic disorder characterized by polymorphic bidirectional ventricular tachycardia. Increased catecholamines related to physical or emotional stress can cause a person with CPVT to experience a range of events from syncope to ventricular
tachycardia and death (Beery, Shah, & Benson, 2009). For this woman, the process of labor and birth was considered a potentially stressful event.

The committee included care providers from cardiology, maternal–fetal medicine, general obstetrics, anesthesia, and nurse leaders from critical care, the progressive coronary unit, obstetrics, and anesthesia. A plan of care was developed for each phase of pregnancy including the antepartum, intrapartum, and postpartum periods. The teams identified resources needed to care for the woman in the L&I unit during the intrapartum phase. Obstetric nurses and physicians are experts at reading the fetal monitor, but most are not experts with cardiac monitoring. One of the team’s goals was to ensure that resources were available to the woman at any time. High-quality and cost-effective resources provide for early recognition of problems and timely interventions.

A plan was made to have telemetry on L&I comanaged by a nurse from the progressive coronary unit, which is in close proximity to the L&I unit. The plan also involved notification of a rapid response team, a clinical resource specialist, a nursing supervisor, and the code blue team. Additional support staff included a primary cardiologist for the day shift and a cardiac fellow covering night shift. Contact numbers for these resources were added to the plan of care. With the plan in place and available in the woman’s online medical record, it was time to test the plan using prescheduled simulations.

Do
Our hospital performs scheduled obstetric case simulations for maternal code blue drills. They are attended by obstetric nurses, residents, and attending physicians. Individuals on the teams vary depending on scheduling. Drills are scheduled for three dates at the hospital’s simulation center and are run by obstetric physicians and nurses. Team members decided to use the previously described case scenario as background for the simulated code blue scenario. The actual case information was used to stimulate the learners’ need to learn, to prepare the staff for a potential code blue, and to introduce the rare cardiac condition to the staff to fully prepare to care for this woman. A multidisciplinary simulation team prepared the case for the drill. The obstetric and cardiac experts reviewed the details to ensure accuracy and appropriateness of interventions. The simulation drills were used to test the proposed plan of care. Everyone who attended the simulation had the potential for caring for the woman with the rare cardiac condition. Each staff member needed to be aware of the plan of care, know available resources, and understand his/her role in the event of a cardiac emergency. This clinical scenario involving a future patient activated the multidisciplinary team’s internal desire to succeed, which motivated their desire to participate in this learning experience. By the time the last simulation drill was scheduled, several nurses wanted to be involved. Initially, three nurses were required to fill the role of bedside nurse, charge nurse, and recorder. To accommodate additional nurse participation, two emergency response nurses were added. The participants not actively involved in the simulation activity were given articles discussing cardiac arrest in pregnancy, CPVT, and the specific plan of care. Supplemental learning, including an online review of cardiac arrest in pregnancy, was assigned to all staff members. Future maternal code simulation drills were planned, and dates were posted on the unit for voluntary participation.
At each drill, participants were introduced to the high-fidelity manikin that was dressed as a pregnant woman. Stethoscopes were provided to listen to breath sounds and apical heart rate. Available equipment was identified, and the monitoring unit used in simulation was reviewed. The manikin did not provide the opportunity for fetal monitoring, so another program was loaded into a laptop and adjusted manually as the case progressed. A member of the simulation team playing the role of a nurse was used to keep the team on track. This nurse ensures that no adverse events affect the woman and offers unsolicited reports of clinical cues to further the team response. Participants were encouraged to treat the simulator and environment as reality. Each simulation drill was completed twice, allowing members to use best practices and reinforce appropriate interventions.

The critical actions for the participants focused on skills and tasks as well as teamwork behaviors. A script was prepared for the simulation technician running the high-fidelity manikin. Specific frames of activities were identified to move through the drill. The frames started with greeting the woman and obtaining an initial assessment. The next frame involved the resident obtaining additional history and evaluating the woman. From there the scenario unfolded to the woman having shortness of breath, chills, and agitation. The scenario escalated as the woman showed diaphoresis and difficulty breathing. The role of the simulation technician was to display the vital signs as called for by the staff and to change the cardiac rhythm to include tachycardia with premature ventricular contractions. The woman became unresponsive and pulseless. The next several frames included activation of code blue and basic life support maneuvers, establishing a team leader, administering shock and medications as indicated, and preparing for a bedside cesarean birth. The team was expected to shock twice, with continued chest
compressions between each shock episode. Chest compressions and ventilation were monitored for effectiveness using the high-fidelity manikin. The code ends with the woman revived and the staff communicating with the family. After the drill was completed, immediate debriefing of all team members took place in an adjacent room.

**Study**

Debriefing offered the team an opportunity to explore their experience, reflect on the events, and learn from their experience. Each participant was asked to his/her reaction to the drill. Common themes centered on feelings of discomfort during the code blue situation, chaos, role confusion, and questions about leadership. Negative staff responses to this simulation were explored in an effort to find the root cause of the participant’s dissatisfaction. For example, when vulnerability was identified as the root cause of dissatisfaction, discussion centered on the role of the obstetric nurse and doctor during a cardiac arrest. The team explored their value of knowing the physiologic changes in pregnancy, potential causes of code blue in pregnancy, and specialized needs of a pregnant woman experiencing a cardiac arrest. Obstetric staff voiced concerns related to resources, equipment, keeping staff informed, and the care of a pregnant woman with a cardiac complication.

Our hospital is a large academic facility with several buildings. Staff members were concerned with the amount of time it would take for nonobstetric emergency staff to get to the L&D unit. After discussion, a decision was made to alert emergency teams when the woman arrived on the L&D unit. During the debriefing sessions, staff discussed equipment needs and suggested a central location for storing equipment for ease of access upon the woman’s arrival. A cart was
placed on the unit and stocked with equipment potentially needed for her. The goal was to have
the cart in the room during the woman’s labor, birth, and postpartum period. The plan of care
stated that the woman will labor with defibrillator pads in place for quick access in the event of
sudden cardiac arrest. Because epinephrine is contraindicated in the treatment of CPVT during
cardiac arrest, two neon green signs reading “NO EPINEPHRINE” will be placed at the head of
the woman’s bed and on the code cart outside her room. The woman will be paced on telemetry
with central monitoring. Samples of polymorphic ventricular tachycardia, ventricular
tachycardia, premature ventricular contractions, and premature atrial contractions will be placed
in the bedside cabinet drawer as a reference for staff. In the bottom of the same cabinet was
placed a cesarean birth tray containing a disposable scalpel for quick access. The plan included
having the progressive coronary unit charge nurse notified to assist with setting up patient-
appropriate telemetry parameters. The progressive coronary unit nurse also assisted with the
setup of dual telemetry monitoring for the L&D and progressive coronary units. The telemetry
goal was observation for premature ventricular contractions and upper limit of woman’s heart
rate not to exceed 130 beats per minute.

A final major concern expressed by staff was care for a woman with cardiac arrest on the
obstetric unit. Major elements of care were discussed during the simulation debrief. The cardiac
fellow played a pivotal role explaining step by step how to care for an unresponsive patient,
including an algorithm displayed on a whiteboard outlining the difference of care provided when
there is a pulse versus no pulse. The algorithm flow chart also became part of the woman’s plan
of care. Key points for this woman with CPVT with a potential for cardiac arrest required
simultaneous actions to call a code blue, not administer epinephrine, remove fetal monitor before
shock, and use the back board during cardiopulmonary resuscitation. Attempts to remove the fetal monitor should never distract from or impede chest compressions. Fetal heart rate monitoring is unnecessary and only distracts the team during a code blue (Lipman et al., 2014). Because the woman was pregnant, the left uterine displacement with a wedge or manual displacement would be achieved by pulling the gravid uterus to the left. (Left uterine displacement is best achieved through manual displacement.) Compression-to-ventilation rate was 30:2, with hand placement during chest compressions at midsternum and with a change in the person preforming chest compression every 2 minutes (Jeejeebhoy et al., 2015). Compressions should be delivered fast, at a rate of 100 beats per minute, and deep (approximately 5 cm), allowing for the chest to recoil (Lipman et al., 2014). Circulation stops each time compressions stop, so breaks in compressions should be limited to analyzing by automated external defibrillator and compressions should begin immediately after shock is delivered or after analyzing if no shock is required and cardiopulmonary resuscitation is still required. The pause to analyze for shock should be limited to less than 5 seconds (Lipman et al., 2014). Airway management should be aggressive bag mask to endotracheal intubation as soon as possible. A specific person should note the time of arrest and call out every minute. A perimortem cesarean birth should occur at the bedside at 4 minutes to effect birth at 5 minutes after failed resuscitative efforts. This time interval was chosen to minimize the risks of neurologic damage, which begins after 4 to 6 minutes of anoxic cardiac arrest. Cardiopulmonary resuscitation continues during perimortem cesarean birth. Planning for perimortem cesarean birth begins when the cardiac arrest is called; appropriate teams will be mobilized and equipment assembled for the birth and newborn resuscitation (Jeejeebhoy et al., 2015). The focus is on basic
life support with an understanding that advanced cardiac life support will be instituted by the code blue team.

**Act**

Six simulation drills occurred during a 3-month period. The plan of care was evaluated and updated after each session to incorporate process issues and resolutions identified by the clinical staff. The pregnant woman arrived in labor on a Friday afternoon at 4 p.m. The plan was activated, and care was provided. The care team included a clinical nurse with critical care and obstetric experience, a senior obstetric resident, and a maternal–fetal medicine physician in the role of the provider. Included on this team was also a cardiologist, an anesthesiologist, and a nurse anesthetist. Additionally, the charge nurse notified the rapid response team and the code blue team to be on standby. Included on these teams were a medical intensivist, a senior resident, critical care nurses, and respiratory therapists.

The outcome was positive for the woman, her newborn, her family, and the clinical staff providing care. The woman was calm, the staff was prepared, and the emergency teams were alerted; however, there was not a need to activate the support teams. The woman progressed in labor without difficulties and gave birth via caesarian because of fetal indications. She and her newborn were discharged together after an uncomplicated postpartum course. Box 3 summarizes lessons we learned from this experience.

**Conclusion**
Maternal cardiac disease affects 0.5% to 4.0% of all pregnancies (Troiano, Harvey, & Flood Chez, 2013). For these rare cases, an interdisciplinary team should convene to create a specific plan of care for the childbirth of a woman with a history of cardiac disease. Simulation is ideal to test the processes and amend care based on recommendations made by all participants. Preparing for the worst through use of simulation empowered our interprofessional obstetric team to ensure positive outcomes when faced with a potential cardiac emergency.
Box 1. Knowles’s Principles of Adult Learning

1. Learner’s need to know
2. Self-concept of the learner
3. Prior experience of the learner
4. Readiness to learn of the learner
5. Orientation to learning
6. Motivation to learn

Box 2. Learning Objectives for the Simulation Drill

1. Explore the risk factors and differential diagnosis for maternal cardiac arrest.

2. Recognize the unresponsive woman, activate the code team, perform basic life support measures on the pregnant woman, and assemble the appropriate team and equipment.

3. Use situation, background, assessment, and recommendation (SBAR) communication with the arriving team.

4. Demonstrate proper use of the defibrillator and prepare for a bedside cesarean birth at 4 minutes into the cardiac arrest.
Box 3. Lessons Learned

1. **Be willing to ask for help.** As obstetric clinicians, we need to recognize our expertise and our limitations. Collaborating with the cardiology unit to develop a plan of care and facilitate simulations for the obstetric team was key. We recognized the need for help and asked for it while keeping the woman as our main focus.

2. **Define the available resources and establish processes to access, activate, and mobilize in a timely manner.** Placing a list of resources, including contact numbers, directly on the plan of care offered ease of access. Testing the plan of care gave participants a chance to work through a potential emergency in a safe environment without harm to the woman or staff. During simulation and debriefing, facilitators need to remain open to questions. It is essential for educators to encourage exploration of process, problem solve, and be willing to alter the plan of care on the basis of clinical input. Staff members from all shifts were included in the simulation experience, prompting discussion of available resources. This ensured that the plan would be functional whenever labor began.

3. **Involve bedside clinicians.** Involving the cardiac clinician stimulated learning by both experts and participants. The cardiac fellow was introduced to a potential code blue on a pregnant woman and all the special considerations needed for women during pregnancy. The obstetric staff benefited from the cardiac fellow’s experience with code blue emergencies and valued the opportunity to learn from an expert. By the end of each simulation, bedside clinicians were familiar with CPVT, understood the plan of care, and were prepared for the woman’s arrival.
References


