Cardiac Arrest in an Obstetric Patient
A Simulated Emergency

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DEMOGRAPHICS

Case Title: Cardiac Arrest in an Obstetric Patient: A Simulated Emergency
Patient Name: Jane Winters
Case Description and Diagnosis: A healthy 32-year-old pregnant woman develops pulseless electrical activity (PEA) arrest at 33-weeks gestation.
Simulation Scenario Developers: Amanda Burden, MD; Greg Staman, RN; and Erin Pukenas, MD
Target Audience: Anesthesia and obstetrics (OB) and gynecology, as well as certified registered nurse anesthetists

CURRICULUM INFORMATION

Educational Rationale
Cardiac arrest during pregnancy is a rare and catastrophic event. More than 50% of reported maternal deaths had some aspect of substandard care inconsistent with current national guidelines.1 Strict adherence to accepted American Heart Association guidelines, including the modifications that account for changes during pregnancy, is essential.1 Cardio-pulmonary arrests in OB require that the provider manage a critical situation that most will have never experienced during training.2

Both new and experienced caregivers find cognitive aids (eg, checklists) helpful when managing this type of rare high-risk situation; however, these aids are often not used.3 Despite demonstrated benefits of cognitive aids in medicine and critical care, the integration of those into practice has not been widespread.4

In an OB cardiac arrest, there are 2 patients. The best possible outcome for the fetus is the survival of the mother.5 This hybrid scenario, using both a standardized patient (SP) and a high-fidelity mannequin, highlights maternal physiologic changes and the unique elements and knowledge required to adequately resuscitate the parturient.

Learning Objectives
1. Review and address Accreditation Council for Graduate Medical Education core competencies: patient care, medical knowledge, practice-based learning and improvement, interpersonal and communication skills, professionalism, and systems-based practice.
2. Review physiology of term pregnancy: recognize the potential for airway compromise, changes in volume status, and supine hypotension syndrome (medical knowledge).
3. Review and practice basic management of PEA: identify the signs, symptoms, and differential diagnosis of PEA. Review Advanced Cardiac Life Support (ACLS) protocol—identify unresponsive patient, announce urgency of situation and call for help, begin cardio-pulmonary resuscitation (CPR), ventilate, and intubate. Treat with appropriate drugs (medical knowledge, patient care, practice-based learning, and improvement).
4. Review and practice management of OB cardiac arrest: PEA is reviewed in the setting of a pregnant patient. Key issues involve recognition of the need for left uterine displacement (LUD), airway changes, and cri-coid pressure during ventilation and intubation. The location for CPR will be discussed, as is the need for c-section after 4 to 5 minutes of unsuccessful resuscitation (medical knowledge, patient care, professionalism, systems-based practice, and interpersonal and communication skills).
5. Apply crisis management skills: the learners will demonstrate leadership, assess resources, communicate, distribute the workload, call for help, repeatedly reassess and reevaluate, avoid action and fixation errors, and document (patient care, interpersonal and communication skills, systems-based practice, professionalism, and practice-based learning).
Debriefing Objectives
1. Define leadership: review resuscitation leadership establishment, recognition and declaration of emergency, calling for help, role and responsibility assignment, and managing conflict and disparate priorities.
2. Address team collaboration: explore recognition and integration of team input, briefing the team continually, and error recognition and correction.
3. Discuss communication practices: review call-outs of critical information, callbacks for confirmation of information, and clarity of roles and responsibilities.
4. Review situational awareness: discuss continued patient reassessment, plan development and execution, task prioritization (ACLS vs. people management), workload assessment, team member cross-monitoring, and requests for assistance.
5. Discuss professionalism: strategize regarding maintaining professionalism in the face of conflict and team member difficulties and for working with a difficult patient and staff.
6. Review the physiology of pregnancy, diagnosis and treatment of PEA, and clinical management of maternal cardiac arrest.

Questions to Guide the Debriefing
- What is the initial response to an unresponsive parturient?
- What is the diagnosis and treatment of PEA?
- What is different about PEA in a parturient?
- How do you communicate with the team?
- Who should lead the team during the resuscitation of a parturient?
- Who should communicate with the family during resuscitation?

Roles/Teams
Patient
Anesthesiologist (learner)
Obstetrician (optional learner)
Labor and delivery nurses
Confederates/code team (other course participants) or confederates (actors) sent in as help is requested
Observer(s) to be the primary debrief team—at least 2, one to watch the video and be prepared to show segments of the video during debriefing and one to watch the scene
Computer operator—this scenario is preprogrammed and videotaped

PREPARATION
Monitors Required
External fetal monitor

Equipment Required
Standardized patient and mannequin should wear the same items:
Standardized patient in hospital gown, with pregnancy bump and intravenous (IV) tubing taped to her arm
Mannequin with pregnancy bump, wig, gown, and IV tubing taped to arm
Two sets of Lactated Ringer’s (LR) fluid and IV tubing (one for the SP and one for the mannequin) on pump at 100 mL/H
Noninvasive blood pressure cuff (NIBP)
Pulse oximeter
Adult code cart with defibrillator available in hallway
Epidural cart
Epidural pump and tubing
Oxygen tubing
Bag-valve-mask (Ambu) bag
Laryngoscope (in epidural and code cart)
Endotracheal tube (in epidural and code cart)
Drug syringes (in code cart)
Stethoscope
Electronic medical record/patient chart (including prenatal flow sheet, history and physical/emergency department chart, and epidural note as they would be in your hospital)
Scalpel

Duration
Before simulation: 10–15 minutes
Simulation: 20–25 minutes
Debrief: 30–45 minutes

Room/Mannequin Setup
This scenario requires 2 distinct setups. The scenario begins with an SP lying in bed in the OB ward monitored with an NIBP and a pulse oximeter available for use during epidural placement. The SP has a pregnancy bump concealed by her gown and a secured forearm peripheral IV line with LR solution on a pump at 100 mL/H. Fetal monitors are placed on the patient and set to normal screen.

The mannequin is to be setup on the bathroom floor and programmed for “OB Code” scenario. The “NIBP” screen is paused. The mannequin needs an IV line with the same setup as the patient, that is, LR solution through a pump at 100 mL/H. The mannequin also needs a wig, a pregnancy bump attachment with abdominal overlay for surgical intervention, and a small stuffed doll hidden under the bump. Fetal monitors are on the mannequin, and the fetal heart rate (HR) is normal until code.

Initial patient(s) state:
SP is on bed talking on a cell phone.
IV is taped to the arm.
Fetal monitor is attached to the SP.
She is wearing a pregnancy bump concealed by a gown.

Stem for the Learner and Observers
The patient is a 32-year-old woman, gravida 2, para 1, at 33-weeks gestation who was admitted to the OB unit with vague complaints of nausea and vomiting, headaches, and fever. Her first pregnancy was uncomplicated. She is otherwise healthy and takes only vitamins. She has not had any prior surgery.

Allergies: Penicillin

Physical examination: the patient has a gravid uterus, otherwise normal. Laboratory results are pending. Vital signs are as follows: HR, 82 beats per minute; BP, 118/55 mm Hg;
responsive, and the case transfers to the mannequin. This will
demands to go to the bathroom, where she becomes unre-
At the end of this phase
make accusations throughout the interview about the poor
patient and before an epidural is placed, the patient will demand
have another patient who is about to deliver. If the anesthe-
scenario begins as the obstetrician calls by telephone to tell the
anesthesiologist about the patient. The obstetrician will ex-
begin an oxytocin infusion and will then ask the anesthesiol-
the SP collapses in the bathroom with PEA.

The learners must discuss when and where to deliver the
fetus. It will be important to discuss the indications for
performing a cesarean section and the ideal location for this
procedure. One confederate nurse will be responsible for
providing equipment (ie, scalpel) to the obstetrician but will
need to leave the room to retrieve it.

**Information for Scenario Director and Simulation Crew**

The anesthesiologist (learner) will interview the OB pa-
tient who is going to develop a pulmonary embolus and
progress to PEA during the interview. The patient will first
be played by an SP and will be replaced by a mannequin once
the SP collapses in the bathroom with PEA.

One student is designated as the anesthesiologist. The
scenario begins as the obstetrician calls by telephone to tell the
anesthesiologist about the patient. The obstetrician will ex-
plain that they plan to rupture the patient’s membranes and to
begin an oxytocin infusion and will then ask the anesthesiol-
gist to place an epidural.

The labor and delivery unit is very busy with 2 to 3 con-
federates acting as labor nurses. The nurses busily enter and exit
the labor room, talking loudly of other patients who are being
admitted and are requesting epidurals. They are not addressing
the anesthesiologist specifically. The anesthesiologist begins to
interview the SP.

If the anesthesiologist asks the nurse to assist while he
talks with the patient and prepares to place the epidural, the
nurses will say that they will be in after the interview—they
have another patient who is about to deliver. If the anesthesiol-
gist insists that a nurse be present, one will stay.

During the anesthesiologist’s consultation with the pa-
tient and before an epidural is placed, the patient will demand
to go to the bathroom. While the learner looks for the nurse to
help the patient, the SP goes to the bathroom, where she
collapses, and is replaced by the mannequin on the floor. The
mannequin is unresponsive and has progressed to PEA. The
anesthesiologist must manage the simulated patient.

The learners must discuss when and where to deliver the
fetus. It will be important to discuss the indications for
performing a cesarean section and the ideal location for this
procedure. One confederate nurse will be responsible for
providing equipment (ie, scalpel) to the obstetrician but will
need to leave the room to retrieve it.

**Instructions to Confederates**

**Patient**

This role is played by a difficult patient who is a poor
historian. She did not seek prenatal care during pregnancy and
has been in the emergency department for 12 hours before
being brought to the OB unit. She has been vomiting and has
a headache. The patient is going to be very difficult—angry,
nauseated, complaining and feeling generally unwell. She will
make accusations throughout the interview about the poor
care at the hospital and poor quality of hospital employees.

At the end of this phase—approximately 3 to 5 minutes, she
demands to go to the bathroom, where she becomes unre-
sponsive, and the case transfers to the mannequin. This will
happen when she moves to the bathroom. She does not wait
for someone to help her to the bathroom, and she goes alone.
While she is there, she moans 3 times and collapses.

**OB Nurse**

It is a busy day on service, the labor unit is full, and the
OB nurse has 2 patients. The other patient is about to push,
and her baby has been experiencing late decelerations. The
nurse wants to take care of that patient and will be in after
the anesthesiologist interviews the patient to help with the
epidural. The nurse continues to leave the room to check on
the other patient.

The anesthesiologist is left alone with this patient, and
the nurse waits for him (or her) to call for help. After the arrest,
the nurses arrive to assist. The nurse will help call the code and
will go to find the code cart when asked. The nurse takes a full
minute to get the code cart and then goes out again to find the
patient’s chart. The nurse should only act under specific
instructions.

**Obstetrician**

This role is played by either a course participant or a
confederate, depending on the demographics of the course
on any given day. The OB physician is here to deliver the
other patient and is covering the labor unit, so he/she will
help with this case. After the arrest, the obstetrician will be
called to the room.

**Code Team**

After the patient arrests, a code will be called. As many
people as possible should arrive at the code, so that the an-
esthesiologist needs to conduct crowd control. Use of several
laboratory volunteers and instructors is recommended. They
should arrive and remain in the room until they are asked
3 times to leave. Ultimately, the actual code team members are
the other participants in the course. They must run the code.
They are expected to pick a leader and instruct all confederate
members in the code team. The goal is to get them to work
together as a team during this crisis to make the diagnosis of
PEA, run through the differential diagnosis, and initiate and
manage the resuscitation.

**SCENARIO PROGRESSION AND FLOW**

The anesthesiologist must recognize that the patient is
unresponsive, get help, and begin to resuscitate the patient. If
the anesthesiologist calls for help, other students are sent in.
If the anesthesiologist calls a “code,” as many confederates
as available that day will be sent in. None of the confederates
can lead the code, nor will they offer helpful suggestions. The
students in the course are the only people who can run the
code; confederates must be told what to do.

Once an appropriate resuscitation for PEA is underway,
the patient becomes difficult to ventilate. If the students do
not ask (after approximately 5–7 minutes), one of the con-
federates asks if they would like to see the patient’s chart.
Similarly, if the students do not ask, one of the confederates
asks if they would like the code cart and if they would like
additional help.

If the students fail to diagnose the rhythm as PEA, one of
the confederates (this role is discussed among the confederates
before beginning the scenario) will continue to ask questions
Cardiac Arrest in an Obstetric Patient

DEBRIEFING GUIDE

Note that this scenario is based on a real case, is taken from closed claims information, and follows the events of that case as closely as possible.

We begin with questions designed to encourage the participants to talk about the experience and their actions. The goal is to discuss both clinical management issues and crisis resource management issues. Clinical management issues include PEA diagnosis and treatment and OB cardiac arrest. Specifically, we review maternal physiologic changes such as higher incidence of difficult airway, increased risk of aspiration, and faster onset of hypoxemia due to decreased functional residual capacity and increased oxygen demand. The importance of placing the mother in LUD, need for adequate IV access, and anticipated airway difficulties (eg, edema) are reviewed. Pulseless electrical activity in the setting of arrest (minutes 13–20) is reviewed. Early management of arrest (minutes 8–12) is reviewed. The student must recognize distress, get help, perform CPR, and begin to treat. The student must also identify special considerations for OB arrest—LUD, location CPR, and airway changes. The student should address airway with ventilation using cricoid pressure—patient may have aspirated; lungs are stiff with coarse breath sounds.

Parts of the scenario are replayed on video, and the timing of critical actions is discussed among the group. The conversation centers on the following actions: recognize and declare an emergency, call for help, communicate with others in the room, establish roles, assess the situation, collaborate in a professional manner with key personnel from other disciplines, and recognize patient/family-specific issues. Focus on decision-making moments—acting under uncertainty while continually reevaluating and managing ambiguity.

Supplemental Material

We have provided references6–13 as supplemental materials that may help with the debriefing and may also help the diagnosis and appropriate treatment, including immediate delivery of the fetus via cesarean section. The timing and efficiency of beginning CPR is discussed, as are special considerations of resuscitation in a pregnant woman, such as delivering chest compressions higher on the sternum and removing the external fetal monitor before defibrillation.

Crisis resource management principles are also reviewed. Issues of CRM and calling for help are discussed in debriefing.

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**TABLE 1. Scenario Events**

<table>
<thead>
<tr>
<th>Scenario Flow</th>
<th>Vital Signs</th>
<th>Sim Computer</th>
<th>Key Cues and Actions</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management of patient interview; angry SP (approximately 5–8 min)</td>
<td>Only fetal HR is monitored. Rate is 130s with good variability Patient is not monitored at this time</td>
<td>No mannequin yet—SP Fetal heart monitor—reassuring tracing with rate in 130s SimMan with wig and pregnancy bump slumped on the bathroom floor. No patient monitors yet; these must be requested</td>
<td>Confederate obstetrician gives a brief, hurried report by telephone. No background or case history is given unless specifically requested.</td>
<td>The SP has many complaints and is agitated. After discussion with the anesthesiologist and before epidural placement, she goes to the bathroom, where she arrests.</td>
</tr>
<tr>
<td>Patient moves to the bathroom, moans, and then arrests. Management of early arrest—recognition and summon resources (minutes 8–12)</td>
<td>PEA (no pulse) NIBP keeps cycling Pulse oximeter does not record Fetal heart still reassuring HR, 110–130 beats per min</td>
<td>Unassesseable HR, 80s beats per min</td>
<td>The student must recognize: distress, get help, begin CPR, place monitors, diagnose PEA, and begin to treat. The student must also identify special considerations for OB arrest—LUD, location CPR, and airway changes.</td>
<td>If help is requested, send more students and confederates. Do they want to move the patient to her bed or proceed with the arrest in the bathroom? Pulses will not resolve unless c-section was performed. Students should declare the need for section and ask for an obstetrician/surgeon to perform section.</td>
</tr>
<tr>
<td>Early management of arrest (minutes 13–15)</td>
<td>HR, 80s beats per min and slowing Fetal HR, 80–90 beats per min Saturation were not recorded but were 85%–90%. NIBP does not record</td>
<td>Unless the patient was placed in LUD and CPR was performed in an appropriate position, it is not effective. Lung compliance is decreased, and there are coarse breath sounds</td>
<td>Sim crew informs the student whether there is a pulse with compressions. The crew should address airway with ventilation using cricoid pressure—patient may have aspirated; lungs are stiff with coarse breath sounds.</td>
<td>Send in more help if more help is asked for explicitly.</td>
</tr>
<tr>
<td>Continued management of arrest (minutes 16–20)</td>
<td>HR slowing to 50s Fetal HR slowing 60s</td>
<td>Continue in PEA If the students are managing the case expertly, faculty may create a difficult airway to add complexity If the students experience difficulty with managing the case, faculty and confederates may begin to steer them toward correct diagnosis and management</td>
<td>If students are floundering, simulation crew begins to ask pointed questions to arrive at diagnosis and treatment options</td>
<td>For advanced students, complexity may be added in the form of interactions with the obstetrician or family. These confederates may exhibit a variety of distracting behaviors and will be upset by the situation. For a team that is experiencing difficulty with the scenario, confederates may make proper loud suggestions.</td>
</tr>
<tr>
<td>Late management of arrest—resolution or imminent death (minutes 21–25)</td>
<td>PEA begins to resolve or worsen</td>
<td>If resolved, HR will be in 80s, there will be carotid and femoral pulses, BP will be 70/40 mm Hg If airway was addressed, saturation will be 92%–95%</td>
<td>Simulation crew will continue to help and provide questions and suggestions to resolve the PEA</td>
<td>Issues of CRM and calling for and using help are discussed in debriefing.</td>
</tr>
</tbody>
</table>
student review information. We also include the following information regarding OB cardiac events and PEA as supplemental information given to course participants, along with the referenced articles. We recommend that the maternal cardiac arrest algorithm contained in Hui et al.9 and Vanden Hoek et al10 be used (Table 2). It contains the “BEAU-CHOPS” cognitive aid, which we think will prove useful when discussing possible contributing factors and their treatment in maternal arrest.

### REVIEW MATERNAL PHYSIOLOGIC CHANGES

- Place the mother in left lateral decubitus position
- Give 100% oxygen
- Intravenous access and fluid bolus
- Look for reversible causes
- Supine hypotension—more than 20 weeks uterine compression IVC and aorta
  - Decreases venous return and cardiac output
  - Impedes chest compression effectiveness
  - Can lead to arrest in a sick patient
- Airway
  - Hormonal changes lead to insufficient GES
  - Airway edema: small tube; early intubation
  - Use carbon dioxide detector to confirm
- Breathing
  - Hypoxemia develops quickly
  - Low functional residual capacity
  - Increased oxygen demand
- Chest compressions
  - Higher on sternum

### TABLE 2. Checklist: OB Cardiac Arrest

<table>
<thead>
<tr>
<th>Action</th>
<th>Time Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Call for help</td>
<td></td>
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<tr>
<td>Airway management</td>
<td></td>
</tr>
<tr>
<td>Ventilate and prepare to intubate</td>
<td></td>
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<tr>
<td>Get help with the airway (likely to be difficult)</td>
<td></td>
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<tr>
<td>Timing of LUD</td>
<td></td>
</tr>
<tr>
<td>Displace uterus (if not already done)</td>
<td></td>
</tr>
<tr>
<td>Place patient in LUD</td>
<td></td>
</tr>
<tr>
<td>Timing of chest compressions (should be performed as soon as pulseless state is identified and should be performed continually, ideally without interruption (eg, for intubation))</td>
<td></td>
</tr>
<tr>
<td>Chest compressions position</td>
<td></td>
</tr>
<tr>
<td>Pulse/no pulse</td>
<td></td>
</tr>
<tr>
<td>Rhythm identified</td>
<td></td>
</tr>
<tr>
<td>Treat rhythm</td>
<td></td>
</tr>
<tr>
<td>Search for and treat possible contributing factors*</td>
<td></td>
</tr>
<tr>
<td>Please see BEAU-CHOPS* cognitive aid</td>
<td></td>
</tr>
<tr>
<td>Timing (should be performed within 5 min after parturient arrest)</td>
<td></td>
</tr>
<tr>
<td>Get help for this procedure</td>
<td></td>
</tr>
<tr>
<td>Perform hysterotomy</td>
<td></td>
</tr>
</tbody>
</table>

*Search for and treat possible contributing factors: the BEAU-CHOPS (Bleeding/ disseminated intravascular coagulation (DIC), Embolism: coronary/pulmonary/ amniotic fluid embolism, Anaesthetic complications, Uterine atony, Cardiac disease (myocardial infarction/ischaemic/aortic dissection/cardioischemia), Hypertension/ preeclampsia/eclampsia, Other: differential diagnosis of standard ACLS guidelines, Placenta abruption/previa, Sepsis) cognitive aid is useful for this checklist (please see Hui et al9 and Vanden Hoek et al10 as supplemental materials).

### PEA DISCUSSION

#### Diagnosis

- Pulse or no pulse
- Type of rhythm (is the rhythm shockable?)
- Pulseless electrical activity
- Electrical activity and no pulse
  - Prognosis very poor
- Many potentially treatable causes that must be identified to treat and manage the patient
  - Severe hypovolemia
  - Obstruction to circulation
  - Tension pneumothorax
  - Cardiac tamponade
  - Massive pulmonary embolism
  - Pump failure
  - Hypoxia
  - Acidosis
  - Hypokalemia/hyperkalemia
  - Hypoglycemia
  - Hypothermia
  - Toxins
  - Drugs

#### Get help, start basic life support, and attach monitor
- Not shockable rhythm
- Give epinephrine 1 mg IV/intraosseous (IO) or vaso-pressor 40 μg mL IV/IO
- Repeat epinephrine every 3 to 5 minutes
- Delivery of fetus helps the mother
  - >20 weeks
  - 4 to 5 minutes after arrest
  - Empties uterus and relieves obstruction to venous return and compression of aorta
- Leader needs to think about from start:
  - Can you do it?
  - Do you have neonatal intensive care unit/high-risk neonatal service?

### REFERENCES


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**ERRATUM**

Research Abstracts to be Presented at the 13th Annual International Meeting on Simulation in Healthcare, January 26th–30th, 2013 Orlando, Florida: Erratum

In abstract 1396 entitled “Simulation Training Improves Fundoscopic Examination Skills in Third Year Medical Students” which appeared on page 528 of volume 7, issue 6, the author name appeared incorrectly for Dr Silbiger. It was listed as Sharon Silberger and should appear as Sharon Silbiger, MD.

**REFERENCE**