Simulation Patient Design (August 2020)
Case of Emergency Cesarean Delivery with General Anesthesia

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Introduction
Due to concerns of general anesthesia-related maternal morbidity and mortality, the percentage of patients undergoing cesarean delivery (CD) with general anesthesia (GA) has significantly decreased within recent years.[1,2] This has important implications for training in obstetric anesthesia, as trainees may gain little to no exposure during their training.[1]
As a consequence, educators recommend the use of surrogate training modalities such as simulation-based training.[2] Scavone et al. proposed a simulation scenario for performing GA for emergency CD on a high-fidelity patient simulator.[3] The simulation protocol included a validated scoring system reliably evaluating the trainee's performance (Appendix 1). When randomizing trainees to undergo simulation-based training with a 'usual' GA protocol, trainees have shown better performance when undergoing the obstetric anesthesia-specific protocol.[4] With repetitive exposure to the simulation scenario, trainees achieved a competency level similar to experienced obstetric anesthesia providers over a prolonged period. Assessing the performance in a cohort of anesthesia providers not regularly exposed to obstetric anesthesia, specific obstetric anesthesia tasks could be identified that should be retrained on a regular basis.[1]

Educational rational: Providing GA in a pregnant woman undergoing emergency CD has clear and important differences compared to a GA performed in a non-pregnant patient. If not recognized, these differences can lead to increased morbidity and mortality for the mother and/or fetus.

Target audience: Nursing, OB, Anesthesiology, OR personnel

Learning objectives: The simulation protocol includes a validated scoring system reliably evaluating the trainee's performance. The scoring system consists of a checklist of 48 tasks, each weighted on a scale of importance from 1 to 5, with a total possible score of 198.5 points. The 48 tasks are organized into 6 subcategories: preoperative assessment, preoperative patient care, equipment availability check, induction/intubation, intraoperative management before delivery, and intraoperative management after delivery (Appendix 1). Using a similar simulation protocol a minimum passing score has been defined based on the performance achieved by experienced obstetric anesthesia faculty in an academic setting, and has been defined to lie at a score of 159.5 (± 11) points.[3]

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*: Describe how physiologic changes of pregnancy affect GA care, e.g. gastrointestinal, cardiopulmonary, and airway changes
- *Patient care*: Determine appropriate intraoperative patient monitoring
  Ascertain appropriate patient positioning (left uterine displacement)
  Maintain hemodynamic stability

- *Practice-based learning and improvement*: Evaluate drug dosing for pregnant women undergoing emergency CD
List anesthesia drug effects on the fetus
Evaluate drug dosing of uterotonic drugs, and understand indications and contraindications
- *Interpersonal and communication skills*: Effectively communicate anesthesia management with the patient during an emergency scenario
Effectively communicate with the obstetric provider when to perform surgical incision
Effectively communicate with the obstetric provider how to escalate if there is uterine atony and/or postpartum hemorrhage
- *Professionalism*: Execute safe care and be able to listen to the patient and all members of the delivery team
Perform a well-structured: preoperative assessment, preoperative patient care, equipment availability check, induction/intubation, intraoperative management before and after delivery
- *Systems-based practice:* Describe how to set up the anesthesia work space for emergency CD
Demonstrate how to use the pre-anesthesia checklist

Questions to ask after the scenario to guide the debrief
Did the learner:
1. Perform an airway exam prior to induction of anesthesia?
2. Perform left uterine displacement?
3. Turn suction on prior to rapid sequence induction (RSI)?
4. Optimally position patient prior to RSI?
5. Not allow the surgeons to start surgery prior to confirming a secure airway?
6. Administer nitrous oxide at 50:50 prior to delivery of the fetus, and 70:30 after delivery?
7. Decrease the volatile agent after delivery of the fetus?
8. Immediately administer oxytocin after delivery of the fetus?
9. Confirm the patient is fully awake prior to extubation?

Assessment Instruments:
Appendix 1: Performance Tasks for General Anesthesia for Emergency Cesarean Delivery
Appendix 2: Learner Knowledge Assessment form
Appendix 3: Simulation Activity Evaluation form

Equipment needed and set-up:
Mannequin with fetal monitoring in place
Monitors: EKG, BP, Pulse oximetry
18 g IV connected to IV fluid
Blanket roll for left uterine displacement
Anesthesia machine (simulated) with circuit attached
Suction with Yankeur (not turned on)
Airway equipment
Anesthetic drugs, vasoactive drugs, uterotonic drugs

Simulation Scenario Set-up:
The case
Mrs. Smith is 27 years old, G1P0 at 39 weeks and 5 days gestation. She has a long history of asthma, but is otherwise healthy. She has been in labor for less than 4 hours and has not asked for an epidural yet. Her membranes have just ruptured and the fetal heart rate has dropped to 60 bpm and has not recovered so she has been taken to the OR for an emergency CD.
(If resident enquires about sodium citrate, "She received sodium citrate from the nurse prior to moving to the OR"). The Obstetrician has requested a stat CD with GA as there is not enough time for a neuraxial anesthetic technique.

NKDA.
Weight 85 kg (187 lbs), height 165cm (5' 5"), BMI 31.
Vital signs, BP 110/84 mm Hg, HR 75/min, oxygen saturation 97%, resp 16/min.
Clear cardiac and lung exam normal.
Airway exam, Mallampati class I, full ROM neck, normal mouth opening and thyromental distance.

Simulation Prebrief:
- Read the scenario and instruct team members on their role during the simulation
- The learners take their places inside and outside of the OR
- One nurse and one OB in the OR
- Confederate plays the role of the patient's voice

Scenario Details:

Trigger	Patient Condition	Action	Done	Time	Comments
Patient in OR	HR 105/min (Only after EKG applied) BP 135/85 mm Hg (Only after cuff applied) Sat 97% on air (Only after probe applied) Patient is scared: "What are you doing?" "Is my baby OK?" "Where's my husband, can he be here?" "Do I have to drink that stuff?" (if sodium-citrate given)	1. Left uterine displacement performed 2. Monitors applied and functionality confirmed 3. Anesthetic machine circuit checked, suction checked, drugs setup			
Preparation for rapid sequence induction		1. Oxygen administered 2. Assistance with cricoid pressure requested 3. Confirm OB team are ready (e.g. patient prepped and OB ready with scalpel in hand)			
Induction of anesthesia Just after administering induction drugs, the OB asks, "Can I start, I need to get going?"	HR 85/min BP 105/55 mm Hg Sat 100% if pre-O_2 (quickly drops to 92% if no pre-O_2)	1. Induction drugs administered (correct doses) 2. Appropriate time given for drugs to circulate 3. Following intubation, and the correct position of the endotracheal tube is confirmed, the OB is given permission to start			
Surgery starts	HR 140/min (Ramp up after surgery starts) BP 145/90 mm Hg (Ramp up after surgery starts)	1. Volatile anesthetic set at correct concentration 2. Vasopressor administered when/if appropriate			

	Sat 96% (if N_2O 50:50) Sat 100% (if FiO_2 1.0) Or If additional meds for BP and HR given, change VS to: HR 105/min BP 110/75 mm Hg				
After delivery The OB says, "This uterus is boggy, can you help me out?"	If volatile anesthetic not decreased, and/or uterotonic(s) not administered: HR 145/min BP 90/40 mm Hg Sat 100% If volatile anesthetic decreased, and/or uterotonic(s) administered: HR 105/min BP 100/75 mm Hg Sat 100 %	1. Volatile anesthetic decreased and N_2O increased 2. Oxytocin administered (correct dose) 3. 2nd-line uterotonic medications offered - methylergonovine (correct dose) Carboprost correctly identified as being contraindicated			
Case ends soon after delivery		1. Discuss postoperative analgesia options 2. Discuss patient disposition 3. Discuss follow-up			

Appendix 1. Performance Tasks for General Anesthesia for Emergency Cesarean Delivery (from Reference 5)

	Weight		Weight
Preoperative assessment			
Introduce self	3	Apply cricoid pressure	5
Obtain pertinent OB history	4.5	Administer induction agent	5
Past medical history	4	Administer succinylcholine	5
Medication history	4	Wait for medication effect	5
Allergy history	5	Direct laryngoscopy	5
Previous anesthetic/family	4	Pass endotracheal tube	5
anesthetic history		Inflate cuff	5
Perform airway exam	5	Confirm end-tidal CO_2	5
Preoperative patient care		Notify OB team to proceed	5
Administer sodium citrate	4	Release cricoid pressure	3.5
Administer 100% O_2 by mask	5	Confirm bilateral breath sounds	4
Provide left uterine displacement	5	Secure endotracheal tube	3.5
Ensure working IV catheter	5	**Intraoperative management before delivery**	
Apply BP Cuff	5	Initiate mechanical ventilation	5
Apply pulse oximeter	5	Appropriate TV/RR	3
Apply ECG	3	$N_2O:O_2$ 50:50 (FiO_2 ≥0.5)	4
Equipment availability check		Peripheral nerve stimulator placed	2.5
Quick circuit check	5	Inhaled Agent ≥1 MAC	3.5
Endotracheal tube	4.5	Protect eyes	3.5
Syringe for endotracheal tube	4	Orogastric tube placed and	2
Stylet	4	suctioned	
Laryngoscope with functional light	5	Esophageal stethoscope placed	2
Functional suction	5	Temperature monitored	2
Induction and intubation		**Intraoperative management after delivery**	
Pulse oximeter audible	5	Oxytocin added to IV fluids	4
BP cycling -	3	Administer opioid, N_2O, hypnotic	3
ECG Functioning	3	and paralytic as needed	
Verify OB team readiness	5	Inhaled agent ≤0.5 MAC	3
TOTAL			198.5

OB = obstetric; IV = intravenous; BP = blood pressure; ECG = electrocardiogram; TV = tidal volume; RR = respiratory rate; MAC = minimum alveolar concentration

Appendix 2

<p style="text-align:center">Learner Knowledge Assessment
Labor and Delivery Multidisciplinary Team Simulation</p>

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 the correct steps to take when performing general anesthesia for cesarean delivery?

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 the correct induction agents (and dosing) to administer for general anesthesia for cesarean delivery?

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 the correct concentration of volatile anesthetics to maintain anesthesia during cesarean delivery (before and after delivery)?

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 the correct uterotonic drugs to administer (dosing, administration routes, contraindications etc.) for cesarean delivery?

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 knowledge of postoperative analgesia options for patients undergoing cesarean delivery with general anesthesia (without neuraxial opioids)?

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 3

SIMULATION ACTIVITY EVALUATION FORM

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 simulation	1	2	3	4	5	N/A

PHYSICAL SPACE

Realism of the simulation space	1	2	3	4	5	N/A

EQUIPMENT

Satisfaction with the mannequin	1	2	3	4	5	N/A

SCENARIOS

Realism of the scenario	1	2	3	4	5	N/A
Ability of the scenario to test *technical* skills	1	2	3	4	5	N/A
Ability of the scenario to test *behavioral* skills	1	2	3	4	5	N/A
Overall quality of the debriefing	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

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