

## Simulation Patient Design (November, 2022) Case of Bronchospasm in a Parturient

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### Introduction

Bronchospasm is a reversible reflex spasm or contraction of the smooth muscle in the bronchi. Bronchospasm is vagally mediated. It is typically triggered by a noxious stimuli such as endotracheal intubation. The noxious stimulus activates afferent sensory fibers in the vagus nerve that stimulate neurons within the nucleus of the solitary tract. These neurons then stimulate efferent fibers through the vagus nerve to bronchiolar smooth muscle. Released acetylcholine neurotransmitters then bind to the M3 muscarinic receptor, resulting in an increase in cyclic guanosine monophosphate and inducing bronchiolar smooth muscle contraction. Other mediators precipitating the reflex include histamine, tachykinins, vasoactive intestinal peptide, and calcitonin gene-related peptide. It is not uncommon to encounter bronchospasm during anesthesia especially in asthmatic patients. There are multiple obstetric-specific causes for bronchospasm that providers must consider in addition to non-obstetric causes. It is critical to recognize and treat bronchospasm immediately to prevent hypoxemia, brain damage, and death.

Prostaglandins, as second-line uterotonics, are widely used in obstetric practice. The PGs used in postpartum hemorrhage include carboprost, sulprostone, and misoprostol representing analogs of  $\text{PGF}_{2\alpha}$ ,  $\text{PGE}_2$ , and  $\text{PGE}_1$ , respectively. PGs play a critical role in uterine contractions, but also contract (or relax) smooth muscle in tissue outside of the uterus. There are multiple case reports of life-threatening bronchospasm associated with carboprost.<sup>2,3</sup> It is recommended to avoid carboprost in patients with asthma; however, it should be acknowledged there are reports of significant bronchospasm in patients with no known history of asthma.<sup>3</sup> It is critical to aware of the risk of bronchospasm following carboprost administration.

**Educational Rationale:** To teach team skills in managing bronchospasm on labor and delivery.

**Target Audiences:** OB/MFM team, OB anesthesiology team, L&D nursing

**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:* Describe pathophysiology, etiology, and recognize the clinical signs of bronchospasm.
- *Patient care:* List the critical steps for treatment of bronchospasm, recognize the need for escalation of care, and outline a plan for any additional testing or follow-up needed following a bronchospasm event.
- *Practice-based learning and improvement:* Reflects on performance during scenario. Provides and seeks constructive feedback for improvement.
- *Interpersonal and communication skills:* Utilizes closed-loop communicate throughout the scenario.
- *Professionalism:* Demonstrates respect for all team members.
- *Systems-based practice:* Demonstrates a plan of care to transition the patient and debrief with family following the event.

### Questions to ask after the scenario:

1. Was there prompt recognition and management of the given clinical situation?
2. What is the differential diagnosis for high peak airway pressures in intubated parturient?

3. What is the treatment for initial and persistent bronchospasm?
4. Was a leader identified? Did each team member have well defined roles?
5. How was the overall communication during the scenario? Was closed-loop communication utilized?
6. Was all the necessary equipment available?

**Assessment Instruments:**

1. Learner Knowledge Assessment form (Appendix 1)
2. Simulation Activity Evaluation form (Appendix 2)

**Equipment Needed and Set-up:**

**In-situ OR set-up**

1. Mannequin on OR table as patient
2. Blood pressure, pulse oximeter, and ECG
3. 2 peripheral IV's in place with IV fluids
4. Medications (standard medications for general anesthesia and cesarean delivery)

**Simulation Scenario Set-up:**

**The case**

A 34-year-old patient (G2P1) at 32 weeks with past medical history of hypertension, is on the OR table under GA for an emergency cesarean delivery for acute bleeding concerning for placental abruption. She underwent RSI with propofol and succinylcholine and was intubated without difficulty (Grade 1 view with Mac 3 blade). The baby was delivered five minutes prior with uncomplicated removal of the placenta. Oxytocin 3U bolus at cord clamping followed by an infusion at 15U per hour has been initiated. The patient is now having increased bleeding secondary to uterine atony.

Quantitative blood loss was 400mL prior to start of the case. A CBC, coagulation panel, and type and screen are pending from before delivery.

Vital signs: HR 96, BP 125/85, SpO<sub>2</sub> (40%) 98%, Vent PS 15/5, RR 22, Temp 36.5°C

**Simulation Pre-brief**

- Read the scenario and instruct team members on their role during the simulation
- The learners take their places. Providers are coming in to relieve the overnight team.
- Confederate is a member of the obstetrical surgical team.

**Scenario Details**

Trigger	Patient Condition	Action	Done	Time	Comments
Patient in OR suite, intubated	HR 96 bpm BP 125/85 mm Hg	<input type="checkbox"/> Team assesses need to administer uterotonics			
Baby is delivered at warmer, vigorous	SpO <sub>2</sub> 98% (40%) Resp 25 bpm Pressure support 15/5 Temp 36.5°C	<input type="checkbox"/> Reviews medical history for contraindications to specific uterotonics <input type="checkbox"/> Ensure adequate IV access <input type="checkbox"/> Continue IV fluid for resuscitation			

<p>OB states concern about ongoing bleeding with poor uterine tone</p> <p>Surgical team requests second line uterotonic agents</p>		<ul style="list-style-type: none"> <li><input type="checkbox"/> Quantify blood loss</li> <li><input type="checkbox"/> Administer carboprost given history of gHTN</li> <li><input type="checkbox"/> 1 gram TXA administered</li> </ul>			
<p>Uterine tone is improving in response to carboprost</p> <p>QBL including 400mL prior to case start is 1200mL</p>	<p>Labs (pre-op labs resulted)</p> <p>Hgb: 9.1 g/dL Plt: 188 x 10<sup>9</sup>/L</p> <p>PT: 11.5 s PTT 35.5 s Fibrinogen: 315 mg/dL</p> <p>HR: 110 BP: 98/67 SpO<sub>2</sub> 97% (40%) RR 30 bpm Pressure support 15/5 Temp 36.5°C</p>	<p>1. Team to discuss further management</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Repeat laboratory values</li> <li><input type="checkbox"/> Assess fluid status – QBL, fluids given, urine output</li> <li><input type="checkbox"/> Prepare IV vasopressor infusion (phenylephrine or norepinephrine)</li> <li><input type="checkbox"/> Consider ordering blood</li> <li><input type="checkbox"/> Consider viscoelastic coagulation testing (ROTEM or TEG)</li> </ul>			
<p>Patient begins to desaturate</p> <p>High peak airway pressures noted</p>	<p>HR: 108 BP: 103/62 SpO<sub>2</sub> 88-90% (40%) RR 27 bpm Temp 36.5°C</p> <p>Peak airway pressures 42 cmH<sub>2</sub>O TV: 250mL</p>	<p>1. Team recognizes the concern for bronchospasm</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Hand ventilation initiated</li> <li><input type="checkbox"/> Administer 100% FiO<sub>2</sub></li> <li><input type="checkbox"/> Assess CO<sub>2</sub> waveform</li> <li><input type="checkbox"/> Auscultate lung fields</li> <li><input type="checkbox"/> Deepen anesthetic (bolus propofol, increase inhalational agent, consider opioid or neuromuscular blockade)</li> <li><input type="checkbox"/> Suction ET tube</li> </ul> <p>2. Notify OB Team</p> <p>3. Call for Help</p> <p>4. Consider DDX</p> <p>5. Refer to emergency cognitive aid</p>			
<p>Persistent bronchospasm</p> <p>Oxygen saturations remain 88-90% despite initial interventions</p>	<p>HR: 112 bpm BP: 110/70 mmHg SpO<sub>2</sub>: 90% (100%) Temp: 37.0°C</p> <p>Inspiratory pressures 45-50 cmH<sub>2</sub>O</p>	<p>1. Continued Management</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Epinephrine 10-100mcg (infusion 0.01-0.1 mcg/kg/min)</li> <li><input type="checkbox"/> Albuterol via breathing circuit 4-8 puffs</li> <li><input type="checkbox"/> Hydrocortisone 100mg IV</li> </ul>			

	Tidal volumes: ~200mL	<ul style="list-style-type: none"> <li>or Methylprednisolone 40-80mg IV</li> <li><input type="checkbox"/> Consider magnesium 2 g IV or ketamine 10-50mg IV</li> </ul> <p>2. Continued evaluation</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> ABG</li> <li><input type="checkbox"/> Consider POCUS TTE</li> <li><input type="checkbox"/> Assess ongoing bleeding</li> </ul>			
<p>Response noted to epinephrine</p> <p>There has been minimal additional bleeding noted (an extra 50 ml bringing QBL to 1250 ml)</p> <p>Uterine tone remains adequate</p>	<p>HR: 135 bpm BP: 150/90 mmHg SpO<sub>2</sub>: 96% (100%) Temp: 37.0°C</p> <p>Peak airway pressures 30 cmH<sub>2</sub>O TV: 450mL</p> <p>ABG 7.18, PaO<sub>2</sub> 120 mmHg, PaCO<sub>2</sub> 56 mmHg, bicarbonate 19 mEq/L Hgb: 8.0 g/dL</p> <p>TTE normal RV/LV function, normal chamber size</p>	<p>1. Post-event management</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Plan to repeat ABG</li> <li><input type="checkbox"/> Discuss disposition with surgical team</li> <li><input type="checkbox"/> Consider DDx and further evaluation – carboprost administration, light anesthesia, AFE, anaphylaxis</li> </ul>			
Patient disposition		<p>1. Discuss disposition with team</p> <ul style="list-style-type: none"> <li><input type="checkbox"/> Plan to extubate if no ongoing concerns</li> </ul> <p>2. Address need to debrief with family</p>			

## 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 bronchospasm?

BEFORE THE SIMULATION							END OF SIMULATION						
1	2	3	4	5	6	7	1	2	3	4	5	6	7
Little/none							Knowledgeable						
Knowledgeable							Little/none						

#### 2. How would you rate your knowledge of differential diagnosis of bronchospasm?

BEFORE THE SIMULATION							END OF SIMULATION						
1	2	3	4	5	6	7	1	2	3	4	5	6	7
Little/none							Knowledgeable						
Knowledgeable							Little/none						

#### 3. How would you rate your knowledge of recognition and management of bronchospasm?

BEFORE THE SIMULATION							END OF SIMULATION						
1	2	3	4	5	6	7	1	2	3	4	5	6	7
Little/none							Knowledgeable						
Knowledgeable							Little/none						

#### 4. How would you rate your knowledge of side effect profile of uterotonic medications?

BEFORE THE SIMULATION							END OF SIMULATION						
1	2	3	4	5	6	7	1	2	3	4	5	6	7
Little/none							Knowledgeable						
Knowledgeable							Little/none						

#### 5. How would you rate your overall confidence when confronted with bronchospasm encountered on the labor and delivery unit?

BEFORE THE SIMULATION							END OF SIMULATION						
1	2	3	4	5	6	7	1	2	3	4	5	6	7
Little/none							Knowledgeable						
Knowledgeable							Little/none						

## 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
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#### **PHYSICAL SPACE**

Realism of the simulator space	1	2	3	4	5	N/A
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#### **EQUIPMENT**

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

Realism of the scenarios	1	2	3	4	5	N/A
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Ability of the scenarios to test technical skills	1	2	3	4	5	N/A
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Ability of the scenarios to test behavioral skills	1	2	3	4	5	N/A
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Overall quality of the debriefings	1	2	3	4	5	N/A
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#### **DID YOU FIND THIS USEFUL?**

To improve your clinical practice?	1	2	3	4	5	N/A
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To improve your teamwork skills?	1	2	3	4	5	N/A
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To improve your VERBAL communication?	1	2	3	4	5	N/A
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To improve your NONVERBAL communication?	1	2	3	4	5	N/A
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#### **FACULTY**

Quality of instructors	1	2	3	4	5	N/A
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Simulation as a teaching method	1	2	3	4	5	N/A
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#### **COMMENTS/SUGGESTIONS:**

## References:

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