

## Fetal Bradycardia after a Neuraxial Labor Analgesia Procedure

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### Introduction

Neuraxial analgesia is the most effective mode for labor analgesia. Intrathecal drug administration as part of a combined spinal-epidural (CSE) procedure can result in rapid pain relief compared to other modalities for labor analgesia (for example, epidural labor analgesia).<sup>1</sup> Maternal hypotension can occur as a result of vasodilation from the CSE and uterine hypertonus can occur as a consequence of rapid pain relief, both of which can have adverse effects on the fetus due to reduced placental perfusion which can cause fetal heart rate (FHR) changes, for example fetal bradycardia. Uterine hypertonus is thought to occur due to a transient imbalance of maternal catecholamines.<sup>2</sup> Research on the effects of catecholamines on the gravid uterus have shown that epinephrine has dose-dependent effects, for example at higher concentrations (as seen in labor) it has a tocolytic effect, while norepinephrine has uterine stimulating effects via alpha-adrenergic stimulation.<sup>3</sup> Following initiation of neuraxial labor analgesia, the circulating level of maternal epinephrine decreases significantly, while the level of norepinephrine also decreases but not as significantly, which explains why the loss of the tocolytic effect of epinephrine after neuraxial labor analgesia can lead to profound uterine hypertonus and fetal bradycardia.<sup>4</sup>

Multiple studies have been published that compare the incidence of FHR abnormalities between CSE and epidural labor analgesia. Abrão et al. recorded uterine contractions using an intrauterine pressure catheter and FHR in laboring patients who received epidural or CSE labor analgesia, and FHR abnormalities were more common in the CSE group ( $p < 0.01$ ), as well as uterine hypertonus ( $p = 0.018$ ).<sup>2</sup> Logistic regression analysis showed that the type of analgesia was the only independent predictor of uterine hypertonus (OR 3.53, 95% CI 1.21-10.36,  $p = 0.022$ ). Additionally, uterine hypertonus was an independent predictor of the occurrence of FHR abnormalities (OR 18.62, 95% CI 4.46-77.72;  $P < 0.001$ ).<sup>2</sup> A meta-analysis of 41 randomized control trials comparing CSE to epidural labor analgesia included close to 8000 patients and reported the CSE group had an increased risk of fetal bradycardia with a relative risk (RR) of 2.38 (95% CI 1.57-3.62,  $P < 0.001$ ).<sup>5</sup> A previous systematic review and meta-analysis that compared CSE with epidural labor analgesia reported an increased risk of non-reassuring fetal heart rate tracing with a RR of 1.31 (95% CI 1.02-1.67,  $P = 0.03$ ).<sup>6</sup>

It is important for anesthesiologists and other healthcare providers on Labor and delivery (L&D) to understand the potential for adverse maternal and fetal effects when administering neuraxial labor analgesia. Awareness, preparation, recognition and immediate treatment are vital. Management of fetal bradycardia includes interventions to improve uteroplacental perfusion and fetal oxygenation, such as positioning the patient with left uterine displacement (e.g. left lateral decubitus position) to relieve aortocaval compression, administration of IV fluids and vasopressors to correct maternal hypotension, maternal oxygen supplementation, in association with evaluation for uterine hypertonus or tachysystole.<sup>7</sup> Oxytocin infusions should be discontinued, and the use of tocolytic medication such as nitroglycerin (400-800 mcg SL, or 100-200 mcg IV) or terbutaline (250 mcg SC or IV) may be necessary to treat uterine hypertonus. All patients should have direct observation and monitoring (maternal and fetal) immediately after placement of neuraxial labor analgesia to detect any side effects that require immediate treatment/intervention.<sup>7</sup>

**Educational rationale:** To teach team skills in early recognition and management of fetal deceleration after labor neuraxial analgesia

**Target audiences:** Nursing, OB, Anesthesiology, OR personnel

**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:* Recognize fetal deceleration after neuraxial labor analgesia is an emergency and describe management
- *Patient care:* List tasks in managing fetal deceleration after neuraxial labor analgesia, including administration of drugs, assessment of maternal hemodynamics and assessment of the fetus; identify factors that may influence the decision for an emergent cesarean deliver
- *Practice-based learning and improvement:* Identify equipment and skills necessary to recognize and medically manage a patient with acute fetal deceleration
- *Interpersonal and communication skills:* Designate a team leader and effectively communicate with the L&D team utilizing closed-loop communication
- *Professionalism:* Demonstrate mutual respect for the expertise of other team members
- *Systems-based practice:* Ensure all resuscitation equipment, drugs, and protocols are readily identifiable and available in delivery locations including airway management, vascular access, and emergency drugs; identify barriers within the hospital system to carrying out maternal and fetal resuscitation

**Questions to ask after the scenario:**

1. What are differential diagnoses for the etiology of fetal deceleration after neuraxial labor analgesia?
2. How was the response to the crisis managed?
3. Did each team member have a well-defined role?
4. Was it clear which steps needed to be taken by the team?
5. Was all necessary equipment available?
6. Were any barriers identified when caring for this patient?
7. What is the treatment for fetal deceleration?
8. What factors would lead you to intervene with this patient's airway?
9. What factors might influence the decision for an emergent cesarean delivery?

**Assessment Instruments:**

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

**Equipment needed and set up:**

**In-situ L&D suite setup**

Mannequin with fetal monitoring in place

18 g IV connected to IV fluid

Epidural catheter in-situ, connected to an epidural infusion

Oxygen with a non-rebreather face mask and an Ambu bag

Suction with a suction catheter

Monitors: Pulse oximetry, blood pressure, EKG

Airway equipment in airway box

Ability to transfer to an OR where standard anesthesia setup is ready

## **Simulation Scenario set up:**

### **The case**

Mrs. Brynn Smith is a healthy 34-year-old G3P2 at 38 weeks gestation who was admitted in active labor after spontaneous rupture of membranes at home. She has been augmented with IV oxytocin and has had a category 1 FHR tracing. Her pain increased to 9/10 and her cervical exam was 8 cm/75%/0 and she requested pain relief so a CSE (with 1 mL 0.25% bupivacaine administered intrathecally) was placed approximately 5 min ago and the epidural infusion was started, after which her pain decreased to 0/10. However, her nurse is calling you into the room because she is concerned about the FHR tracing.

### **NKDA**

Weight 94.3 kg (207 lbs), height 158 cm (5'2"), BMI 38

Airway exam: Mallampati class 1, full ROM neck, normal mouth opening and thyromental distance

### **Simulation pre-brief**

- Read the scenario and instruct team members on their role during the simulation
- The learners take their places inside and outside of the labor room
- One nurse is at the bedside with the rest of the team outside
- Simulation driver plays the patient
- Confederate plays the patient's partner

## Scenario Details

Trigger	Patient Condition	Action	Done	Time	Comments
<p>Patient in labor bed with the epidural catheter in-situ and epidural infusion running</p> <p>Fetal bradycardia</p>	<p>Awake, alert</p> <p>Pain 0/10</p> <p>FHR = 60s</p>	<ol style="list-style-type: none"> <li>1. Evaluate patient: Request vital signs</li> <li>2. Perform left uterine displacement</li> <li>3. Administer oxygen via nasal cannula or facemask to the patient</li> <li>4. Stop the epidural infusion and oxytocin infusion</li> <li>5. Administer terbutaline (250 mcg SC or IV)</li> </ol>			
<p>Fetal bradycardia persists</p>	<p>Patient is scared: "Is my baby ok?"</p> <p>Maternal HR = 110 bpm</p> <p>BP = 98/58 mm Hg</p> <p>Oxygen sat = 97%</p> <p>RR = 18/min</p> <p>FHR = 60s</p>	<ol style="list-style-type: none"> <li>1. OB and anesthesiologist discuss next steps (including urgency)</li> <li>2. Anesthesia team discuss most appropriate mode of anesthesia (e.g. use existing epidural catheter or induce general anesthesia)</li> </ol>			
<p>Decision made to proceed with a stat CD</p> <p>Epidural catheter is accidentally pulled out during transfer and OB Attending explains need to proceed with general anesthesia</p>	<p>Supine, awake, oriented</p> <p>After placement of OR monitors:</p> <p>HR = 110 bpm</p> <p>BP = 106/70 mm Hg</p> <p>Oxygen sat = 96%</p> <p>RR 18/min</p>	<ol style="list-style-type: none"> <li>1. Inform OR team</li> <li>2. Transfer patient to the OR and move her from the labor bed onto the OR table</li> <li>3. Anesthesiology team discuss with OB team if there is time for a replacement block, or general anesthesia</li> <li>4. Apply monitors</li> <li>5. Perform left uterine displacement</li> <li>6. Prepare anesthesia equipment and drugs</li> </ol>			

General anesthesia	HR = 110 bpm BP = 105/58 mm Hg Oxygen sat = 99% with preoxygenation and decreases to low 90s after intubation, but increase back to 98% with manual ventilation	<ol style="list-style-type: none"> <li>1. Preoxygenate with 10L/min via anesthesia circuit</li> <li>2. Perform rapid sequence intubation with cricoid pressure</li> <li>3. Confirm correct tube placement</li> <li>4. Give verbal permission to the OB to start</li> <li>5. Set volatile agent and N<sub>2</sub>O</li> </ol>			
OB is having difficulty delivering the baby and asks for nitroglycerin		<ol style="list-style-type: none"> <li>1. Administer nitroglycerin spray 400-800 mcg SL (or nitroglycerine 50-100 mcg IV)</li> <li>2. Anticipate poor uterine tone and ask for additional uterotonic drugs to be brought to the OR (use closed-loop communication)</li> </ol>			
After delivery the OB states that the uterus is "boggy"  Minimal blood loss	HR = 108 bpm BP = 102/68 mm Hg Oxygen sat = 100% RR = Ventilated Temp = 36.2 °C	<ol style="list-style-type: none"> <li>1. Decrease volatile agent and increase N<sub>2</sub>O</li> <li>2. Administer oxytocin bolus (1-3 units IV) after delivery and titrate an oxytocin infusion (30 units in 0.9% NaCl 500 mL) to effect</li> <li>3. Administer 2<sup>nd</sup>-line uterotonic medication (e.g. methylergonovine 0.2 mg IM)</li> </ol>			
Uterine tone improves	HR = 96 bpm BP = 110/74 mm Hg Oxygen sat = 98% RR = Ventilated Temp = 36.4 °C	<ol style="list-style-type: none"> <li>1. Discuss postoperative analgesia options - consider TAP blocks</li> </ol>			

## Appendix 1

### Obstetric Interdisciplinary 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 the differential diagnosis for fetal decelerations?

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 risk factors for fetal decelerations after neuraxial labor analgesia?

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 managing fetal deceleration after neuraxial labor analgesia?

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 the location of emergency drugs closest to the labor rooms?

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 unit's ability to efficiently transfer a patient to the OR in an emergency?

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 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
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#### **PHYSICAL SPACE**

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

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