



Simulation Patient Design (September 2022) Case of Hypotension after Neuraxial Anesthesia

Authors: Priscilla White, MD, and David L. Stahl, MD, Ohio State University Wexner Medical Center, Columbus, OH

Editors: Kokila Thenuwara, MD, MME MHCD, Jessica Sheeran, MD

Introduction

Hypotension is the most frequent side effect of neuraxial anesthesia, occurring in up to 75% of cases.^{1,2,4} Spinal-induced hypotension is primarily sympathetomy caused by local anesthetic medications in the intrathecal space promote vasodilation up to two dermatomal levels higher than the concomitant sensory blockade (and often before the motor or sensory effects are felt). This decrease in systemic vascular resistance can further lead to reduced ventricular filling and stroke volume. Cardiac output may also decline due to bradycardia, which can be worsened by either high spinal anesthetic level or the contribution of the Bezold-Jarsich reflex. Severe bradycardia is more likely to occur in patients with pre-existing bradycardia or AV-nodal block. Without swift recognition and treatment, spinal-induced hypotension can progress to full hemodynamic collapse.

In patients undergoing cesarean section, early recognition and treatment of hypotension is critical to promote uterine blood flow and improved fetal outcomes. Unfortunately, there is mixed data on the ideal regimen to prevent or reduce hypotension after spinal anesthesia.¹⁻³ Early studies found phenylephrine to be more effective than ephedrine in preventing hypotension and fetal acidosis in low-risk parturients; however, a 2019 meta-analysis did not find the same evidence for high-risk cases.⁴ The American Society of Anesthesiologists provides a consensus statement on the interventions most likely to improve outcomes for all parturients: thorough patient evaluation prior to neuraxial placement, pre-loading or co-loading of IV fluids, and the early use of a vasopressor (either ephedrine or phenylephrine as first-line) to maintain uterine perfusion.⁵

Educational Rationale: To improve prevention and early recognition of hypotension after neuraxial anesthesia, employ early effective treatment, and promote efficient communication within a multidisciplinary team.

Target Audience: Obstetric Anesthesiology Team, Obstetric Team, Nursing Team

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: Define the mechanism of hypotension after neuraxial anesthesia in parturients; Describe the differential diagnosis and treatment options for hypotension after neuraxial anesthesia in parturients

Patient Care: Apply evidence-based interventions to prevent and treat hypotension after neuraxial anesthesia in parturients

Practice-Based Learning & Improvement: Analyze opportunities for improvement in the management of hypotension in parturient including implementation of protocols

Interpersonal and Communication Skills: Utilize a team-based approach to maternal hypotension during neuraxial anesthesia including clear communication and task distribution

Professionalism: Demonstrate mutual respect for all members of the care team

Systems-Based Practice: Utilize a multidisciplinary protocol for managing maternal hypotension

Questions to ask after the scenario:

1. Were the participant(s) able to identify the development of hypotension and employ the correct treatments?
2. What was the differential diagnosis for hypotension?
3. Did the participants identify risk factors for hypotension (long NPO time, pre-existing bradycardia, 1st-degree AV block) and increased risk for high spinal due to obesity? What is the mechanism for hypotension/bradycardia?
4. Did the team employ effective communication regarding patient's clinical condition or vitals?
5. Did participant(s) call for help early?
6. What went well and what can be improved upon in the management of this scenario?

Assessment Instruments:

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

Equipment Needed and Set-Up:

- Location: L&D surgical suite/OR setup

-Personnel: Parturient mannequin or actor/actress, labor and delivery nurse, obstetrician, obstetric anesthesiologist

-Equipment:

-Monitors: NIBP, EKG, pulse oximetry, fetal Doppler/tocometer

-Airway equipment: NC/EtCO₂, Ambu-bag, Anesthesia machine with suction, intubation supplies including laryngoscope, 6.0 ETT, and RSI medications

-IV fluids in situ, additional IV start kits (Optional: arterial line kit)

-Medications: phenylephrine, ephedrine, vasopressin, atropine, glycopyrrolate, epinephrine (Optional: code/crash cart, defibrillator)

Simulation Scenario:

The Case

Ms. Vivi Dagal is a 24 yo G1P0 at 39w gestation who presents for primary cesarean section due to failure to progress in labor. She underwent spontaneous rupture of membranes 18 hours ago but cervical examination has remained at 5cm for past 12 hours. She has been NPO over 12 hours, received one dose of sodium citrate 30 minutes ago, and has reassuring fetal heart rate tracing. Patient is an obese (BMI=40) but otherwise healthy patient with an uncomplicated pregnancy. She has no epidural in place and has never had neuraxial anesthesia. The nursing team is actively transporting her to the OR.

Vivi Dagal, 24yoF

Weight: 105kg

Height: 162.5cm

BMI: 40

Access: 18G L forearm

Baseline labs (drawn at admission): Hb 10.9g/dL, Plt 243x10³/μL, draw and hold

Pain level: 6/10 with contractions (irregular)

HEENT/Airway: Mallampati 2, full neck ROM, good dentition

CV: Grade 2/6 mid-systolic murmur without radiation, cap refill <2 secs

Resp: Clear to auscultation

Abd: Gravid uterus, otherwise soft, non-tender

Ext: Trace pedal edema

Neuro: Alert and oriented, no focal deficits

Simulation Pre-brief:

1. Orient the participant(s) to the OR/simulation suite and allow time to review the supplies and equipment
2. Review the scenario as a team and assign roles for each team member during the simulation (anesthesiologist, circulating RN, OB surgeon)
3. Encourage the suspension of disbelief and the treatment of the manikin as a real patient
4. Encourage thinking “out loud” and verbally describing any interventions, medication dosages, or equipment being used
5. Optional: Show the participant(s) how to employ closed-loop communication and ask for help if needed

Scenario Details

Trigger	Patient Condition	Action	Done	Time	Comments
Patient arrives in OR for primary cesarean section	Patient is assisted to table by circulating RN, vitals show sinus bradycardia and long PR interval on EKG HR 58 BP 109/58 SpO2 98% RR 18	<ol style="list-style-type: none">1. Identify patient and procedure2. Confirm necessary equipment in room (including ambu-bag)3. Place monitors and obtain baseline vitals4. Ensure IV access and initiate fluid bolus			

	T36.8 FHR 135				
Beginning of Spinal procedure	Patient is nervous HR 91 BP 110/60 SpO2 99% RR 28 FHR 138	<ol style="list-style-type: none"> 1. Ensure fluids running 2. Coach patient to take measured breaths and avoid hyperventilation 3. Assist patient to supine position after spinal placement 			Note: the spinal anesthetic can be simulated or verbally described to avoid having to move the manikin
Patient moved to Supine (with LUD) position after spinal	Patient "feels funny"; worries that she can "still move my legs" HR 118 (prior to LUD) HR 68 (after LUD) BP 90/59 SpO2 95% RR 20 FHR 118	<ol style="list-style-type: none"> 1. Tachycardia improves with LUD 2. Continue fluid bolus (on pressure bag or wide open) 3. Ensure sequential compression devices in place 4. Start phenylephrine infusion 5. Ask for FHR to be checked. 6. Notify obstetrical team of potential maternal hypotension. 			
Worsening SBP	Patient reports nausea, diaphoresis, NIBP cuff cycles without reporting a number HR 60 BP (cycles) SpO2 94%	<ol style="list-style-type: none"> 1. Administer vasopressor bolus 2. Increase frequency of NIBP measurement (q1 min or STAT) 3. Consider early administration of ondansetron 4. Continue or increase vasopressor infusion 			

	RR 20 FHR 109	5. Consider supplemental O2 via NC (2-6L/min) or mask (6-10L/min) due to FHR decrease			
[If needed move to this trigger, before all steps in previous trigger are complete] Severe maternal bradycardia	SBP 79/47 HR 38 FHR 96	<ol style="list-style-type: none"> 1. Alert all team members of impending emergency 2. Administer atropine (0.2-0.5 mg), glycopyrrolate (0.2 mg) and/or epinephrine (10-20 mcg bolus, repeat as needed) 3. Obtain extra IV access (or ask for help in doing so) 4. Consider arterial line placement 5. Prepare for potential need for ACLS- call for emergency intubation equipment 			
SBP improves after treatment for bradycardia	Patient feels better HR 88 BP 104/69 SpO2 100% RR 18 FHR 140	<ol style="list-style-type: none"> 1. Return to supine with LUD as able 2. Continue to monitor BP and titrate infusions as needed 3. Continue to assess patient for spinal level and signs of high spinal 			
Cesarean section begins	Vitals stable	<ol style="list-style-type: none"> 1. Assess adequate spinal level 2. Communicate to Obstetrics and nursing team 			

		readiness to proceed 3. Surgical time-out and incision			
--	--	---	--	--	--

Appendix 1

Learner Knowledge Assessment Labor and Delivery Multidisciplinary Team Simulation

Name of simulation: Hypotension after neuraxial Date: _____ Role: OB Nursing Anes OR Tech

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 ability to delineate etiology of hypotension after neuraxial anesthesia?

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 ability to recognize hypotension after spinal anesthesia?

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 confident are you in your ability to monitor and treat hypotension during c-section under spinal anesthesia?

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 vasopressor medications and dosing?

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 comfort with team communication during a c-section?

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

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
------------------------------	---	---	---	---	---	-----

PHYSICAL SPACE

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

EQUIPMENT

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

SCENARIOS

Realism of the scenarios	1	2	3	4	5	N/A
--------------------------	---	---	---	---	---	-----

Ability of the scenarios to test technical skills	1	2	3	4	5	N/A
---	---	---	---	---	---	-----

Ability of the scenarios to test behavioral skills	1	2	3	4	5	N/A
--	---	---	---	---	---	-----

Overall quality of the debriefings	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
---------------------------------	---	---	---	---	---	-----

References

1. Neal JM. Hypotension and bradycardia during spinal anesthesia: Significance, prevention, and treatment. *Techniques in Regional Anesthesia and Pain Management*, Volume 4, Issue 4, 2000, Pages 148-154, ISSN 1084-208X, <https://doi.org/10.1053/trap.2000.20600>.
2. Heesen M, Rijs K, Hilber N, Ngan Kee WD, Rossaint R, van der Marel C, Klimek M. Ephedrine versus phenylephrine as a vasopressor for spinal anaesthesia-induced hypotension in parturients undergoing high-risk caesarean section: meta-analysis, meta-regression and trial sequential analysis. *Int J Obstet Anesth*. 2019 Feb;37:16-28. doi: 10.1016/j.ijoa.2018.10.006. Epub 2018 Oct 19. Erratum in: *Int J Obstet Anesth*. 2019 Aug;39:152. PMID: 30477997.
3. Sahoo T, SenDasgupta C, Goswami A, Hazra A. Reduction in spinal-induced hypotension with ondansetron in parturients undergoing caesarean section: a double-blind randomised, placebo-controlled study. *Int J Obstet Anesth*. 2012 Jan;21(1):24-8. doi: 10.1016/j.ijoa.2011.08.002. Epub 2011 Nov 18. PMID: 22100822.
4. Chooi C, Cox JJ, Lumb RS, Middleton P, Chemali M, Emmett RS, Simmons SW, Cyna AM. Techniques for preventing hypotension during spinal anaesthesia for caesarean section. *Cochrane Database Syst Rev*. 2017 Aug 4;8(8):CD002251. doi: 10.1002/14651858.CD002251.pub3. Epub ahead of print. Update in: *Cochrane Database Syst Rev*. 2020 Jul 1;7:CD002251. PMID: 28976555; PMCID: PMC6483677.
5. Practice Guidelines for Obstetric Anesthesia: An Updated Report by the American Society of Anesthesiologists Task Force on Obstetric Anesthesia and the Society for Obstetric Anesthesia and Perinatology. *Anesthesiology* February 2016, Vol. 124, 270–300. <https://doi.org/10.1097/ALN.0000000000000935>