

Simulation Patient Design (February, 2021) Case of Neonatal Respiratory Depression

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Introduction

The primary responsibility of an obstetric anesthesiologist is to take care of the mother, however the anesthesiologist may be required to assist with neonatal resuscitation. A study published in 2001 reported that the majority of anesthesiologists (regardless of fellowship training) who work on labor and delivery (L&D) have been involved in the resuscitation of a newborn, but only 16% had Neonatal Resuscitation Program (NRP) training.¹ For this reason, since 2011, the Accreditation Council for Graduate Medical Education (ACGME) program requirements for obstetric anesthesiology fellowship have included completing a course in neonatal resuscitation through the American Academy of Pediatrics/American Heart Association NRP. Recent studies have shown that anesthesiologists in general have poor knowledge and comfort with NRP.^{2,3} Therefore, the goal of this simulation scenario is to improve the knowledge and comfort with NRP for anesthesiologists who work on L&D.

Pre-scenario didactics

Review the neonatal resuscitation algorithm (Appendix 3) and the top 10 take-home messages from the 2020 NRP update:^{4,5}

1. Newborn resuscitation requires anticipation and preparation by providers who train individually and as teams
2. Most newly born infants do not require immediate cord clamping or resuscitation and can be evaluated and monitored during skin-to-skin contact with their mothers after birth
3. Inflation and ventilation of the lungs are the priority in newly born infants who need support after birth
4. A rise in heart rate is the most important indicator of effective ventilation and response to resuscitative interventions
5. Pulse oximetry is used to guide oxygen therapy and meet oxygen saturation goals
6. Chest compressions are provided if there is a poor heart rate response to ventilation after appropriate ventilation corrective steps, which preferably includes endotracheal intubation
7. The heart rate response to chest compressions and medications should be monitored electrocardiographically
8. If the response to chest compressions is poor, it may be reasonable to provide epinephrine, preferably via the intravenous route
9. Failure to respond to epinephrine in a newborn with history or examination consistent with blood loss may require volume expansion
10. If all steps of resuscitation are effectively completed and there is no heart rate response by 20 minutes, redirection of care should be discussed with the team and family

Educational Rationale: To improve basic neonatal resuscitation knowledge, skills and provider comfort, and practice leadership and communication skills while working within a multidisciplinary team

Target Audiences: Nurses, anesthesiologists, OR personnel

Learning Objectives: As per the ACGME Core Competencies, upon completion of this simulation (including the debrief) learners will be able to:

- *Medical knowledge:* Know the steps of the neonatal resuscitation algorithm, reproduce and explain the rationale behind the algorithm, and be able to identify and prioritize the most important elements
- *Patient care:* Perform high quality positive pressure ventilation, airway management, chest compressions, line placement and fluid and drug administration
- *Practice-based learning and improvement:* Continually improve skills in neonatal resuscitation by reviewing the NRP algorithm and participating in simulation-based training, discuss the latest update in neonatal resuscitation
- *Interpersonal and communication skills:* Effectively communicate the current state to other team members, listen and take feedback from other team members, work together as a team to perform appropriate next steps in neonatal resuscitation
- *Professionalism:* Work collaboratively to provide safe care, following the latest neonatal resuscitation guidelines
- *Systems-based practice:* Outline local resources, be able to escalate care and use available resources to ensure best outcome, utilize debriefing to reflect on performance and identify opportunities for team and system learning

Questions to Ask After the Scenario:

- Did the team have a shared mental model? Were recaps used to keep the team on track?
- Were the latest guidelines followed during the resuscitation?
- Did the team follow the NRP algorithm? If not, what were the deviations?
- Were the tasks clear? Were they delegated or randomly chosen by team members? Was there a leader? Was the leader involved with tasks or supervisory? Was there closed-loop communication?
- How could the team have improved communication during critical portions of the resuscitation?
- What is the overall impression of the team regarding their performance? Did they have the necessary knowledge, skills, equipment, back-up help as needed? What were gaps and what were opportunities for improvement?

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

- Neonatal mannequin
- Monitors: neonatal pulse oximeter, neonatal EKG
- Baby warmer, baby blankets, timer, target O₂ table
- Positive pressure ventilation (PPV) equipment
 - Neonatal face masks, flow or self-inflating bag mask devices, O₂ blender
- Neonatal stethoscope
- Bulb syringe, suction catheters, wall suction set up, meconium aspirator
- Intubation equipment
 - Laryngoscope with Miller size 0 and 1
 - ETT 2.5/3.0/3.5
 - Size 1 LMA
 - Stylet
 - CO₂ detector
 - Tape and scissors
- Drugs (epinephrine 0.1 mg/mL, 10 mL syringe), umbilical line supplies, code cart

Simulation Scenario Set-up:

The case

Ms. Smith is a 38 year-old, G2P1 at 35 weeks and 5 days gestation with a history of velamentous cord insertion and low-lying placenta. Her obstetrician had planned for an elective repeat cesarean delivery (CD) at 36 weeks gestation, however, she has been admitted in spontaneous labor. Her first CD was for breech presentation. The patient has been taken to the OR where spinal anesthesia has been administered by the resident. During the Foley placement, a gush of fluid and a small amount of vaginal bleeding was noted and the fetal heart rate dropped from 150s/min to 90s/min and then to the 60s/min. The maternal vital signs are stable with adequate spinal anesthesia (T5 bilaterally) and the obstetrician wants to proceed with a stat CD. You are asked to prepare to receive the baby as the neonatal team are busy with a complex delivery in a labor room.

Simulation Pre-brief

- Read the scenario and instruct team members on their role during the simulation
- Orient the learners to the supplies and equipment, and how to call for help
- Orient the learners to the NRP algorithm, set up expectations
- Learners are asked to think out loud, work as a team, and suspend disbelief
- The learners take their places in the OR
- Team roles:
 - Anesthesiologist and resident or CRNA, L&D nurse, OR tech

Scenario Details

Trigger	Patient Condition	Action	Done	Time	Comments
Team brief + equipment check		<ol style="list-style-type: none"> 1. Form team mental model + anticipate status of the neonate (confirm gestational age) 2. Turn on warmer, obtain sterile warm blankets 3. Set up the flow inflating bag (10 L O₂ at F_iO₂ 0.21 (room air), set APL (PIP 20-25 cmH₂O + PEEP 5) 4. Check suction + intubation equipment (e.g. ETT 3.0 at 36 wks) 5. Bring code cart 6. If team suspects vasa previa and fetal hemorrhage, ask nurse to request emergency release blood 			
Delivery	Neonate white, pale, limp, with no respiratory effort	<ol style="list-style-type: none"> 1. Assess tone + resps 2. Defer delayed cord clamping 3. Dry and stimulate, assess HR 4. Move through initial steps within 30 sec 			
Assess resps + HR	<p>No palpable HR</p> <p>No resp effort</p> <p>No signal on pulse oximeter</p>	<ol style="list-style-type: none"> 1. Start positive pressure ventilation within 1 min of delivery (positive pressure ventilation 30-60/min, bag should look full but not hyperinflated, I:E ratio 1:2) 2. Place pulse oximeter on right wrist 3. Consider EKG 4. Evaluate ventilation, consider MR SOPA ventilation correction steps (e.g. mask adjustment, reposition airway, suction mouth and nose, open mouth, pressure increase, alternate airway) 			
Reassess resps + HR (after 30 sec)	HR 0 bpm	<ol style="list-style-type: none"> 1. Start chest compressions, coordinate with respirations (3:1 ratio, 120 events/min) 2. Increase F_iO₂ to 1.0 3. Place alternate airway (ETT or LMA) 4. Confirm tube position/LMA placement by breath sounds and CO₂ exchange 5. Place EKG 6. Obtain umbilical vein access 7. Ask for NICU back-up, assign a team member to code cart 8. Call for blood 			
Reassess HR in 45-60 sec	HR 50 bpm	<ol style="list-style-type: none"> 1. Continue chest compressions 2. Place UV line 			

	O ₂ Sat 70%	<ol style="list-style-type: none"> 3. Administer epinephrine (e.g. 10-30 mcg/kg = 0.01-0.03 mg/kg = 0.1-0.3 ml/kg, of the 100 mcg/ml epinephrine solution) 4. Administer volume (e.g. 10 ml/kg normal saline or emergency release blood) 			
Reassess HR	HR 120 bpm Resp 40/min Sats 90%	<ol style="list-style-type: none"> 1. Stop chest compressions 2. Continue PPV 3. Asses for spontaneous breathing 4. Prepare for NICU transfer, discuss post-resuscitation care including cooling 			
NICU team arrives	HR 130 bpm Resp 40/min Sats 95%	<ol style="list-style-type: none"> 1. Give sign out to NICU 			

Appendix 1

Learner Knowledge Assessment Labor and Delivery Multidisciplinary Team Simulation

Name of simulation: _____

Date: _____

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 knowledge of the latest neonatal resuscitation algorithm?

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 the location of neonatal resuscitation supplies (including code cart)?

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 the neonatal resuscitation set-up?

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 drug doses/routes used in neonatal resuscitation?

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 participating in a neonatal resuscitation scenario?

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: Attending Resident (PGY 1, 2, 3, or 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

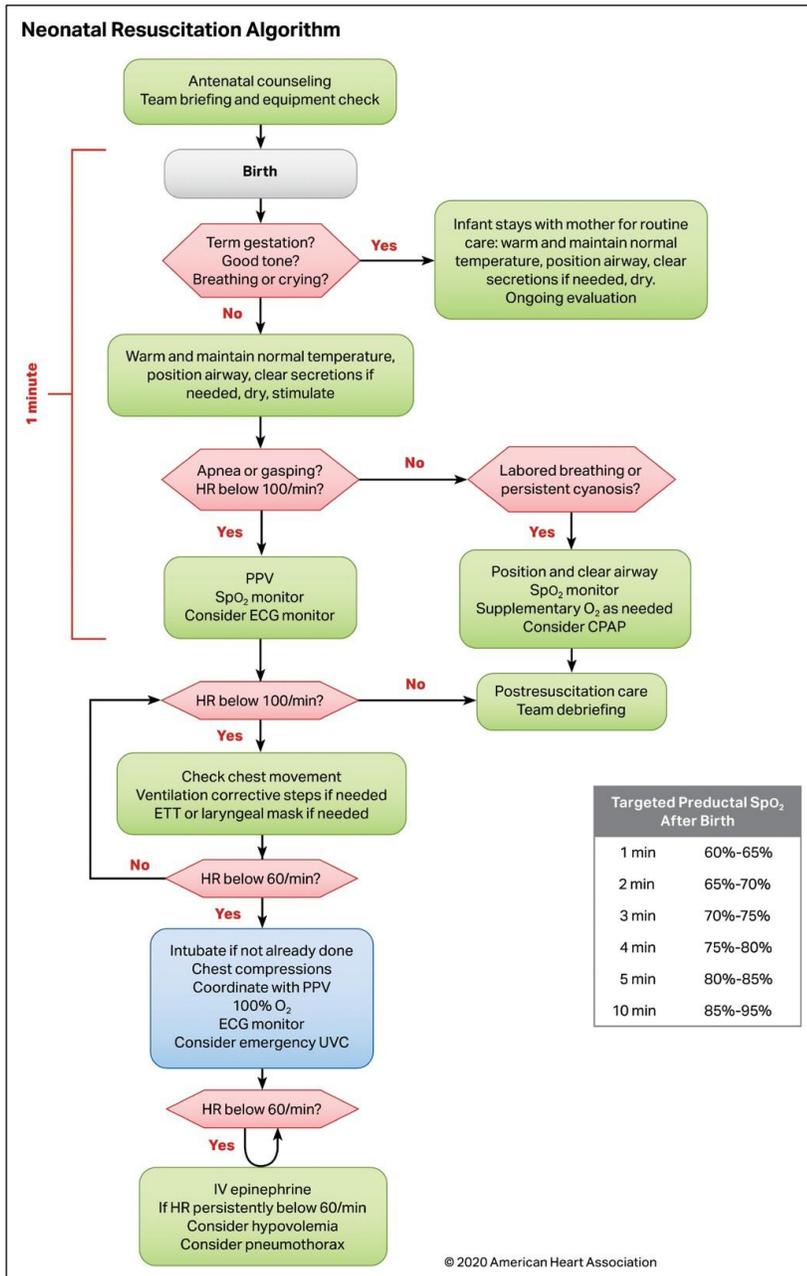
Quality of instructors	1	2	3	4	5	N/A
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Simulation as a teaching method	1	2	3	4	5	N/A
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COMMENTS/SUGGESTIONS:

Appendix 3

NRP Algorithm



References:

1. Gaiser R, Lewin SB, Cheek TG, Guttsche BB. Anesthesiologists' interest in neonatal resuscitation certification. *J Clin Anesth.* 2001;13:374-6
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4. Weiner MDFGM: NRP Textbook of Neonatal Resuscitation, 8th edition. Itasca, American Academy of Pediatrics, 2021
5. Aziz K, Lee HC, Escobedo MB, Hoover AV, Kamath-Rayne BD, Kapadia VS et al. Part 5: Neonatal Resuscitation: 2020 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care. *Circulation.* 2020;142:S524-S550