

Name of Scenario: **Air Embolism in an Infant**

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Learning Objectives of Scenario

Cognitive

- 1) Recognize the signs and symptoms of venous air embolism
- 2) Discuss the pathophysiology of venous air embolism
- 3) Formulate a differential diagnosis of conditions that have similar presentation to venous air embolism
- 4) Outline the treatment of venous air embolism
- 5) Demonstrate use of the cognitive aid (SPA Critical Events Checklist)

Technical (for medium and high fidelity simulators)

- 1) Demonstrate the proper management of a patient with a venous air embolus

Behavioral

- 1) Recognize the need to be aware of actions of other providers in the operating room (especially when those actions may inadvertently worsen the patient's situation)
- 2) Effective communication with the surgeon during the critical event

Patient Description: The patient is a 1½ month old infant who is scheduled for insertion of a VP shunt for hydrocephalus under general anesthesia.

History: The patient weighs 3 kg, and has a diagnosis of meningomyelocele and hydrocephalus with Arnold Chiari Malformation type II and has not undergone any previous anesthetics [1].

Allergies: NKDA

Meds: Levetiracetam

Baseline Vital Signs: T 36.5 HR 145 BP 75/40 SaO2 98% on RA

PE: Sleeping, a scar from a previous meningomyelocele repair on back. CTAB, S1 S2, < 2-second capillary refill

Labs: None

Target Trainees (Learners): Anesthesia residents

Anticipated Duration: 45 minutes

Scenario Time: 15 minutes

Debriefing Time (typically 2-3x scenario length) 30 minutes

Scenario Set-up (high or medium fidelity)

Room Configuration (set up): Set up as an operating room with sterile table for surgical instruments, anesthesia workstation, and drug cart. Infant simulator mannequin supine with the right shoulder propped up under a towel and the head turned to the left, intubated with a 3.0 microcuff tube taped at 10 cm at the lips, breathing spontaneously with TV 30, RR 24, sevoflurane 3%. Bladder of saline taped to the head under the drape, syringe with needle that the 'surgeon' can drain CSF from. IV in place, attached to a bag of crystalloid solution.

Equipment Needed:

Standard OR monitors in place

IV bag and IV start kit in room

Anesthesia machine with pediatric capable ventilator, pediatric circuit and bag

Airway management tools (ETT, mask, laryngoscope, oral airway)

Suction tubing with Yankauer suction

Anesthesia/Emergency Medications (drawn up on tabletop) – Standard

Fentanyl 3cc, 50 mcg/ml	Epinephrine 1cc, 100 mcg/ml
Midazolam 1cc, 5mg/ml	Epinephrine 10cc,100 mcg/ml
Propofol 10cc, 10mg/ml	Atropine 1cc, 0.4 mg/ml
Succinylcholine 1cc, 20 mg/ml	Atropine 3cc, 0.4 mg/ml
Succinylcholine 10cc, 20 mg/ml	NS flush 10 cc
Albuterol inhalation aerosol	

Oxygen tank and neonatal self-inflating ventilation bag

Mannequins/ Task trainers/ Standardized Patients Needed: Need SimBaby or similar mannequin. Confederates play the roles of surgeon, OR nurse, and 1-2 anesthesia colleagues who arrive when help is requested.

Patient Medical Chart Information: Full term birth, history of seizures now well controlled on levetiracetam

Demonstration Items needed for Scenario and Debriefing:

PediCrisis Critical Events Checklists:

<http://www.pedsanesthesia.org/wp-content/uploads/2018/03/SPACriticalEventsChecklists.pdf>

Scenario Logistics

Expected Scenario Flow:

Point at which scenario starts: The scenario will start with a handoff from another anesthesiologist after induction of general anesthesia but before the surgical procedure has commenced.

Anesthetic and patient position at start of scenario: At the start of the scenario, the patient is being maintained with 60% nitrous oxide and oxygen and sevoflurane. He is supine with the right shoulder propped up under a towel and the head turned to the left [1].

Participant enters simulation scenario: The ‘anesthesiologist’ will give report and hand-off patient to the participant.

First event: Scenario continues with the ‘surgeon’ inserting the shunt and draining CSF (from a bladder that is under the drape, with a syringe).

Second event: As the surgeon is draining CSF, suddenly, the SaO₂ drops from 98% to 84% and the EtCO₂ decreases from 30 to 26 mmHg. Also, blood pressure drops from 75/40 to 65/37 along with heart rate from 145 to 119.

Key actions: The participant will place patient on 100% oxygen, decrease the sevoflurane concentration, administer fluid bolus or indicate intention for this episode of ‘minor air embolus’.

Response: The patient’s vital signs will gradually recover over the next several minutes.

Optional Challenges for higher-level learners: First ‘anesthesiologist’ will return and turn N₂O back on (without participant’s knowledge, if possible). During report of air embolus event by relief anesthesiologist, another ‘major air embolus’ event occurs with precipitous drop in SaO₂ from 97% to 54% and ETCO₂ from 35 to 19 mmHg over several minutes.

Key actions:

1. Call for help
2. Inform surgeon – interrupt procedure, stop entrainment of air
3. Participant will increase oxygen concentration to 100%, turn off sevoflurane, increase fluid administration rate or give bolus
4. Administer epinephrine and/or direct the administration of epinephrine
5. Position baby into the left lateral decubitus position if possible
6. Direct roles and responsibilities of those responding to code
7. Refer to PediCrisis cognitive aid as indicated for resuscitation for venous air embolism and/or cardiac arrest (depend on progression of case)

AIR EMBOLUS IN AN INFANT – Clinical Skills Assessment

Date: _____ **Trainee:** _____

Evaluator: _____

Action	Grade	Notes
Assesses patient initially and review H and P	Not Done Done Partial Credit	
Checks anesthesia setup	Not Done Done Partial Credit	
Calculates doses of emergency drugs before accepting handoff	Not Done Done Partial Credit	
Quickly recognizes decreased EtCO₂, SaO₂	Not Done Done Partial Credit	
Formulates a differential diagnosis for decreased EtCO₂	Not Done Done Partial Credit	
Recognizes air embolism as most likely cause of decreased EtCO₂	Not Done Done Partial Credit	
Calls for help	Not Done Done Partial Credit	
Places patient on 100% O₂	Not Done Done Partial Credit	
Recognizes that ‘anesthesiologist’ has placed the patient back on N₂O	Not Done Done Partial Credit	
Starts epinephrine for cardiovascular collapse	Not Done Done Partial Credit	

Air Embolism in an Infant Debrief Review

- 1) How was this scenario similar and different to other scenarios you have encountered (simulation and 'real life')?
- 2) Have you read about or seen(!) a case of air embolism? How was it different from or similar to this case?
- 3) Would you have managed this case differently? No N2O from beginning?
- 4) For which cases would you use a long-arm CVP catheter?
- 5) What did you think of the 'anesthesiologist' coming in and turning the N2O back on? Have you had a situation where someone comes in to the OR and does something without telling you? Was there an adverse consequence for the patient? How did you deal with the situation? Did you speak with the person at the time? Later?
- 6) If two trainees participating at once: how was the communication? How was the teamwork?

References:

1. Pandia MP, Chablani DD, Bithal PK, Rath GP. Atypical presentation of air embolism in an infant undergoing ventriculoperitoneal shunt surgery. *Paediatr Anaesth* 2013; **23**: 201-2.