

Scenario Overview

Name of the scenario: Tension Pneumothorax

Learning objectives:

Cognitive:

1. Discuss the differential diagnosis when presented with increasing airway pressures under anesthesia in an infant.
2. Describe the initial management of an infant with increasing airway pressures
2. Describe the clinical presentation of tension pneumothorax.
3. Describe the management of tension pneumothorax when the patient is hemodynamically stable
4. Describe the management of tension pneumothorax when the patient is hemodynamically unstable

Technical:

1. Perform a needle thoracocentesis in a simulated patient with an unstable pneumothorax.
2. Describe the use of ultrasound in diagnosis of pneumothorax

Behavioral:

1. Recognize the need to communicate with surgical colleagues in the event of a critical event in the operating room
2. Recognize the need to communicate with appropriate staff in the operating room to access resources to aid in the treatment of unstable pneumothorax

Patient Description:

A 3-day-old neonate, born at 35 weeks gestation, weighing 1.6 kg, with dysmorphic facial features was scheduled for repair of a meningomyelocele. She arrives to the operating room with 24g IV in her right hand.

Allergies: NKDA

Meds: none

Baseline Vital Signs: T 36.6, HR 135, BP 72/45, SpO2 97% on RA, RR 45/min

Physical exam: dysmorphic facial features, adequate thyromental distance, RS: CTAB,
CVS: regular rhythm

Baseline Lab Values: all within normal levels

Target Trainees: Pediatric anesthesia providers

Anticipated duration: 30 mins

Scenario time: 15 mins

Debriefing time: 30 mins

Scenario Set-UP

Room Configuration (set up):

Set up as operating room with sterile table for surgical instruments, anesthesia workstation and drug cart

Equipment needed:

Standard OR monitors in place

IV buretrol, IV start kit, with 24 and 22G IV cannula, pediatric extension (T-piece)

22/21G butterfly needle available

Anesthesia machine

Airway management tools (2.5, 3.0 uncuffed ETT, mask, miller blade 0,1, oral airway)

Suction tubing with 14F soft tip suction attached, 5/6F soft tip suction catheter available

Induction and emergency medications available, (glycopyrrolate, atropine in 1cc syringes drawn up, epinephrine 1 mcg/ml in 10 cc syringe)

Mannequin:

Neonatal sized mannequin, intubated with a 3.0 ETT and connected to the anesthesia machine with increased airway pressure

Demonstration items needed for Debriefing:

Society for Pediatric Anesthesia PediCrisis Checklists

[http://www.pedsanesthesia.org/wp-](http://www.pedsanesthesia.org/wp-content/uploads/2018/03/SPACriticalEventsChecklists.pdf)

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Confederates:

Anesthesiologist who does the handoff to the 'learner', operating room nurse, surgeon (if possible)

Scenario Logistics

Expected Scenario Flow

The scenario begins with the patient under general anesthesia with sevoflurane and rocuronium, with the airway secured with a 2.5 uncuffed endotracheal tube and the patient in the prone position. The scenario begins as the confederate anesthesiologist hands off the case to the learner.

First event:

SpO₂ is now 92%. HR 140/min and BP stable at 62/34 mmHg. Peak airway pressure is 28

Expected action:

Participant must auscultate, decreased breath sounds are heard on the left side.

Participant should withdraw the ETT gradually without extubating. Participant is expected to hand ventilate then auscultate again. No improvement in oxygenation is seen.

Second event:

SpO₂ now decreases to 90%, but increases to 92 - 94% with hand ventilation. Peak airway pressure is 38

Expected action:

Participant must suction the ETT, if the participant doesn't do this, the confederate resident/surgeon suggests suctioning the ETT.

Again, the SaO₂ temporarily goes up to 94%. On auscultation, decreased breath sounds are heard on the left side.

The participant must verbalize differential diagnosis – or should be prompted to do so. This differential should include endobronchial intubation, esophageal intubation, bronchospasm, obstruction of the ET tube with secretions, kinking of the tube, and pneumothorax) If participant requests an X-ray, inform him or her that the radiology technician is on the way.

Third event: The SpO₂ decreases to 88%, HR to 90-100/min, BP 42/32 mmHg. The confederate suggests changing the ETT to a 3.0, if the ETT is replaced with a 3.0, no change in breath sounds is heard, The HR now decreases to 60/min, BP to 34 systolic. Peak airway pressure is 48

Expected action:

The participant should recognize a tension pneumothorax, call for help, have the surgeon cover the surgical site and flip the patient prone (if not already done), have equipment ready to perform a needle thoracocentesis and discuss the site of needle insertion (midclavicular line in the 2nd interspace) for the thoracocentesis. Air will be released with a gush as soon as the thoracocentesis is performed and child stabilizes. The next step will be for the surgeon to put in a chest tube.

If a tension pneumothorax not recognized, the patient's condition progresses to PEA and PALS is initiated. When the pneumothorax is recognized and needle thoracocentesis is done, return of spontaneous circulation occurs.

Participant and surgeon formulate a plan to postpone surgery.

Expected endpoint: Diagnosis and treatment of tension pneumothorax

Distractors within Scenario:

Attending surgeon frequently interjecting and asking to check on the ETT

Optional Challenges for Higher Level Learners:

If tension pneumothorax is recognized early, chest X-ray can be performed.

If the learner asks for ultrasound as a diagnostic aid, pneumothorax can be diagnosed, and as the child continues to deteriorate then needle thoracocentesis needs to be performed.

Transillumination can also be used in infants to diagnose pneumothorax (ref Parekh et al).

Roles of Confederates:

Attending surgeon: keeps asking if the ETT is correctly positioned or is in place, distracting the participant away from the diagnosis of pneumothorax

Circulating nurse: assists in calling for help, getting the needle for thoracocentesis, obtains the crash cart

Debriefing points: As above

Scenario Support Materials, pre and Post Test Evaluations

Reference List:

1. Parekh UR, Maguire AM, Emery J, Martin PH. Pneumothorax in neonates: Complication during endotracheal intubation, diagnosis, and management. *J Anaesthesiol Clin Pharmacol*. 2016 Jul-Sep;32(3):397-9
2. Glaisyer H, Way C. Neonatal pneumothorax — An unexpected perioperative complication. *Paediatr Anaesth* 2005;15:997-1000.
3. Volpicelli G. Sonographic diagnosis of pneumothorax. *Intensive Care Med* 2011;37:224-32.

4. Kuhns LR, Bednarek FJ, Wyman ML, Roloff DW, Borer RC. Diagnosis of pneumothorax or pneumomediastinum in the neonate by transillumination. *Pediatrics* 1975;56: 355-60.

Pre-test: None

Post-test: None

Evaluations: Standard