Neonatal Procedural Skills Lab and Real Life High Stakes Scenarios for Pediatric Hospitalists

Shawn Smith, MD, FAAP
Leslie Caldarelli, MD, FAAP
Sarah Donahue, MD, FAAP
Arika Gupta, MD, FAAP

Pediatric Hospital Medicine 2016
Chicago, IL

Disclosures

- We have no relevant financial relationships with the manufacturers(s) of any commercial products(s) and/or provider of commercial services discussed in this CME activity.
- We do not intend to discuss an unapproved/investigative use of a commercial product/device in this presentation.

Introductions

Shawn Smith, MD (Pediatrics)
Leslie Caldarelli, MD (Neonatology)
Sarah Donahue, MD (Pediatrics)
Arika Gupta, MD (Neonatology)
Carmel Eiger (KidSTAR)
Daniel McNerney (KidSTAR)

Participant Introduction

- Name
- Role
- Hospital
- Motivation for attending this workshop

Ann & Robert H. Lurie Children's Hospital of Chicago

Emergent Procedures

- 1. Positive Pressure Ventilation (PPV)
- 2. Endotracheal Intubation (ETT)
- 3. Laryngeal Mask Airway (LMA)
- 4. Emergent Umbilical Venous Catheter (UVC)
- 5. Needle Aspiration of Tension Pneumothorax

Ann & Robert H. Lurie Children's Hospital of Chicago

Objectives

By the end of the workshop each participant will:

- 1. Identify indications and contraindications for the following:
  - *positive pressure ventilation (PPV)
  - *endotracheal intubation (ETT)
  - *laryngeal mask airway (LMA)
  - *emergent umbilical venous catheter placement (UVC)
  - *needle aspiration of a tension pneumothorax
- 2. Identify the equipment needed for PPV, Intubation, LMA emergent UVC placement and needle aspiration

Objectives

- 3. Identify the steps of PPV, ET placement, LMA and emergent UVC placement and needle aspiration
- 4. Identify possible complications of PPV, ET placement, LMA, emergent UVC placement and needle aspiration
- 5. Participate in the simulation of a high risk delivery
- 6. Observe the simulation of a high risk delivery

Positive Pressure Ventilation (PPV)

What are the Indications?

- PPV ("bagging") is often necessary in medical emergencies during respiratory insufficiency or apnea
- NRP: Apnea, gasping or heart rate ≤ 100 bpm

Ann & Robert H. Lurie Children's Hospital of Chicago

Contraindications

- Rarely contraindicated as it is a life saving procedure
- Caution advised in patients with severe facial trauma and eye injuries
- Foreign material (e.g., gastric contents) in the airway may lead to aspiration pneumonitis

Ann & Robert H. Lurie Children's Hospital of Chicago

Equipment

- Self or Flow inflating bag
- Neonatal Face Mask
- Pressure gauge
- Oxygen source and tubing

Ann & Robert H. Lurie Children's Hospital of Chicago

Procedure

- Adjust flow to 10 L/min
- Initiate at PIP of 20-25 cm H_2O
- Use PEEP of 5 cm H_2O
- When PPV begins, consider using electronic cardiac monitor for assessment of heart rate
- When PPV begins, a team member listens for increasing heart rate for the first 15 seconds of PPV

Ann & Robert H. Lurie Children's Hospital of Chicago

Complications

- Gastric Insufflation
- Aspiration
- Hypoventilation
- Volutrauma
- Barotrauma
- Pneumothorax

Endotracheal Intubation

What are the Indications?

- When prolonged Positive Pressure Ventilation (PPV) is required
- Prior to initiation of chest compressions
- To provide mechanical respiratory support
- To alleviate upper airway obstruction
- Management of recurrent or persistent apnea

Contraindications

- Complete airway obstruction (requiring surgical airway)
- Loss of facial or oropharyngeal landmarks requiring surgical airway

Ann & Robert H. Lurie Children's Hospital of Chicago

Equipment

- Endotracheal tubes:
  - 2.5 ETT for infants <1kg
  - 3.0 ETT for infants 1-3kg
  - 3.5 ETT for infants >3kg
- Laryngoscope and Blade (Miller 00, 0, 1)
- Stylet
- Colorimetric Carbon dioxide detector
- Suction catheter
- Stethoscope

Ann & Robert H. Lurie Children's Hospital of Chicago

Procedure

- Place head in the "sniffing" position, a common error is **over-extension** of the upper airway.

- Pass laryngoscope blade gently along the side of the mouth and gently pull tongue and epiglottis forward/up by lifting the blade. If the vocal cords and epiglottis do not come into view, pull the laryngoscope back gradually until the cords are visualized. This is important in avoiding intubation of the esophagus. Application of cricoid pressure may be helpful to bring the larynx into view.

Ann & Robert H. Lurie Children's Hospital of Chicago

Procedure

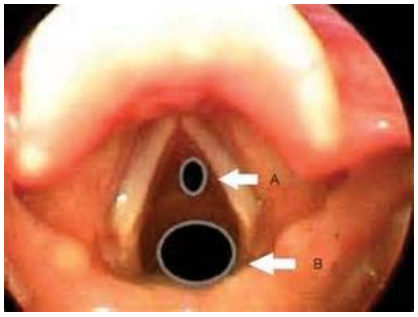
- If the infant remains bradycardic >30 seconds during the procedure and intubation is not near complete, remove the ETT and ventilate via PPV until the heart rate, color and oxygen saturation are within normal limits/at baseline, before attempting intubation again.
- Confirm and secure ETT position. The tip should lie midway between the vocal cords and the carina. Hold the tube in position until secured.

Ann & Robert H. Lurie Children's Hospital of Chicago

Complications

- Hypoxia, apnea or bradycardia during procedure
- Acute trauma
- Chronic trauma
- Disturbed oral development
- Infection
- Aspiration

Tracheal Landmarks

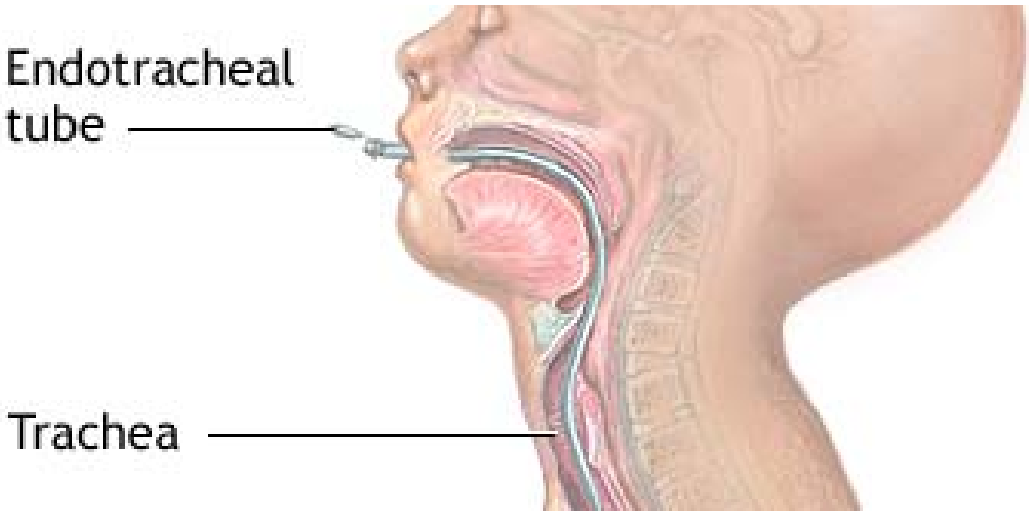


Trachea

Esophagus

nlm.nih.gov

Proper Endotracheal Tube Placement



nlm.nih.gov

Endotracheal Intubation and Laryngeal Masks

Ann & Robert H. Lurie Children's Hospital of Chicago

Intubation is strongly recommended prior to beginning chest compressions. If intubation is not successful or not feasible a laryngeal mask may be used.

Ann & Robert H. Lurie Children's Hospital of Chicago

Laryngeal Mask Airway (LMA)

What are the indications?

- Ineffective face mask ventilation in neonates with the following:
  - Abnormal facial anatomy
  - Unstable cervical spine
  - Upper airway obstruction
- Temporary airway after unsuccessful intubation
- Short term PPV in the NICU
- Resuscitation

Ann & Robert H. Lurie Children's Hospital of Chicago

Limitations

- Cannot suction meconium
- Cannot give medications
- Cannot provide long-term ventilator support
- Cannot use in less than <1500 g

Ann & Robert H. Lurie Children's Hospital of Chicago

Equipment

- Appropriate LMA size
- Water soluble lubricant
- 5 mL syringe
- Gloves

Ann & Robert H. Lurie Children's Hospital of Chicago

Procedure

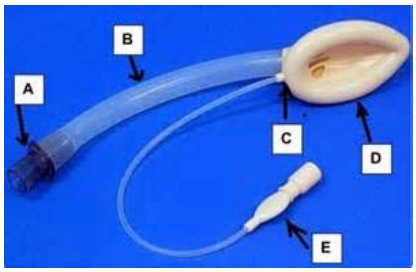
- Hold the LMA like a pen, with the index finger of the dominant hand at the junction of the mask and the tube
- Slide the LMA along the hard palate, pushing back against the palate while advancing toward the hypopharynx. This prevents the tip from folding over on itself and reduces interference from the tongue.
- Advance with gentle pressure until resistance is met.
- Once in place, inflate the cuff without holding the LMA to allow it to acquire its natural position.

Ann & Robert H. Lurie Children's Hospital of Chicago

Complications

- Malposition - Hearing a large leak or neck bulge can signal malposition
- Air leak around LMA can cause poor ventilation
- Abdominal distension or aspiration
- Laryngospasm or bronchospasm
- Soft tissue trauma

LMA



nlm.nih.gov

Emergent Umbilical Vein Catheterization

What are the Indications?

- Emergency vascular access for:
  - Intravenous fluid administration
  - Medication administration
  - Blood sampling

Contraindications

- Omphalitis
- Omphalocele
- Necrotizing Enterocolitis (NEC)
- Peritonitis

Equipment

- Umbilical catheter:
  - 3.5 French (weight <1.2kg)
  - 5.0 French (weight >1.2kg)
- Umbilical line tray
- 3 way stopcock
- Sterile field
- Sterile gloves
- Normal saline flushes (+/- heparin)

Ann & Robert H. Lurie Children's Hospital of Chicago

Procedure

- Sterile field
- Tie umbilical tape around base of umbilicus to provide hemostasis
- Attach stopcock to umbilical line and flush catheter with normal saline +/- heparin
- Cut umbilical stump about 1cm above abdominal surface
- Identify umbilical vein and insert catheter with forceps
- Advance ~1-2cm beyond blood return (about 4-5cm in a full term infant)
- Administer emergent fluids or medications, as needed

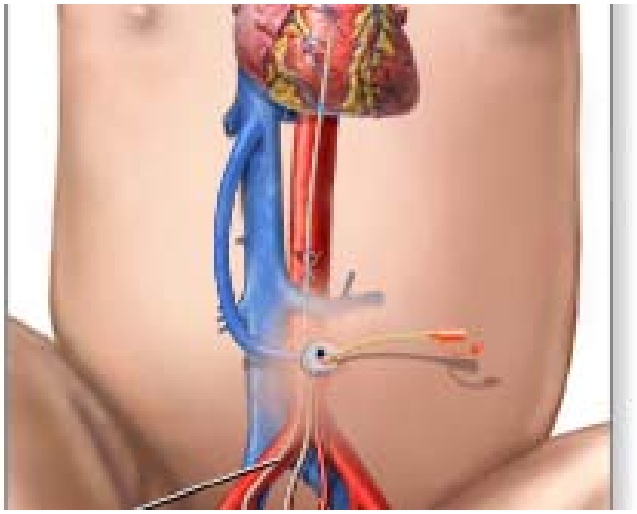
Ann & Robert H. Lurie Children's Hospital of Chicago

Complications

- Infection
- Hemorrhage
- Vessel perforation
- Hepatic abscess or necrosis
- Air embolism
- Portal venous thrombosis
- Dysrhythmia, pericardial tamponade

Ann & Robert H. Lurie Children's Hospital of Chicago

Umbilical Vascular Supply

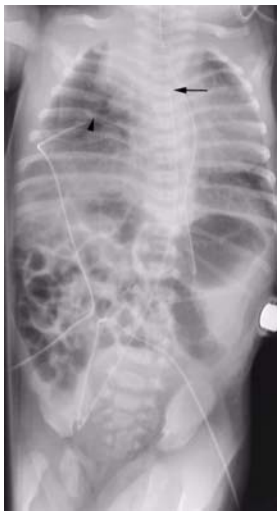


nlm.nih.gov

Ann & Robert H. Lurie Children's Hospital of Chicago

Centrally-placed UVC

UVC



nlm.nih.gov

Needle Aspiration for Tension Pneumothorax

Ann & Robert H. Lurie Children's Hospital of Chicago

What are the Indications?

- Emergency evacuation of a tension pneumothorax

Ann & Robert H. Lurie Children's Hospital of Chicago

Contraindications

- Small air or fluid collection
- Spontaneous pneumothorax that is likely to resolve without intervention

Ann & Robert H. Lurie Children's Hospital of Chicago

Equipment

- Gloves
- Antiseptic solution
- 21-23 gauge butterfly needle
- Three-way stopcock
- 10 and 20ml syringes

Ann & Robert H. Lurie Children's Hospital of Chicago

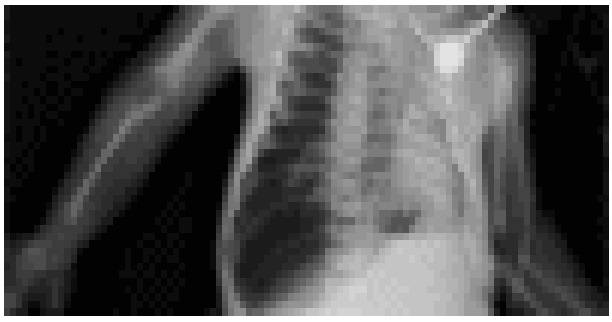
Procedure

- Locate anatomical landmarks
- Sterile field
- Butterfly needle should be placed in the 2nd intercostal space, just superior of the 3rd rib at the midclavicular line
- As needle is advanced beyond skin surface, one pulls back on the attached syringe and stops advancing needle once air is retrieved
- Pull back on syringe until no further air evacuation occurs
- Remove needle slowly and cover site with a small sterile dressing

Complications

- Trauma
  - Lung laceration or perforation
  - Perforation or laceration of vessel
  - Puncture of organ
  - Residual scarring
  - Damaged breast tissue
- Infection
- Subcutaneous emphysema
- Loss of content of pleural fluid

Photo



ncbi.nlm.nih.gov

Simulation Intro and Ground Rules

Ann & Robert H. Lurie Children's Hospital of Chicago

Two Groups

1st Scenario (Designated Role-MD, RN, or RT)
2nd Scenario (Designated Observer)

Simulation Ground Rules

Ann & Robert H. Lurie Children's Hospital of Chicago

- Basic premise
  - Everyone is smart, capable, doing their best, and want to improve
  - We all want to save kids
- No one is perfect
- Everyone has something to contribute
- What happens in simulation, stays in simulation

Changes You May Wish to Make in Practice

Ann & Robert H. Lurie Children's Hospital of Chicago

- Ensure all faculty and staff are NRP providers, recertify every 2 years
- Commit to having "Mock Codes" for your faculty and staff yearly
- Set up/ Hire Simulation Training Sessions (KidSTAR)
- Assure that emergency supplies, drugs and equipment are current and all staff knows how to access and use in emergency

Thank You

Ann & Robert H. Lurie Children's Hospital of Chicago

- Carmel Eiger (KidSTAR)
- Daniel McNerney (KidSTAR)
- Craig Garfield, MD (Pediatrics)
- Erik Johnson (AAP)
- Georgie Perry, RN
- Facilitators

Robyn Bockrath, MD
Chariya Christmon, MD
Kiran Kulkarni, MD
Molly Shane, MD
Jaclyn Winikoff, MD

References

- Caldarelli, Leslie. Trainee Simulation Based Training Presentation. 2015
- Raghuveer, Talkad et al. Neonatal Resuscitation: An Update. Am Fam Physician. 2011 Apr 15;83(8):911-918
- American Academy of Pediatrics and American Heart Association. NRP Neonatal Resuscitation Textbook 6th Edition. 2011
- Bosson, Nichole et al. Bag-Valve-Mask Ventilation. Medline. Dec 2015
- Bosson, Nichole et al. Laryngeal Mask Airway. Medline. Aug 2014
- Magnan, John et al. Umbilical Vein Catheterization. Medline. Sept 2015
- Kim, SA et al. Tension Pneumothorax in a newborn after Cesarean-section delivery-A case report. Korean J Anesthesiology. 2010 Dec; 59(6);420-424
- Lafferty et al. Rapid Sequence Intubation. Medline. Apr 2014
- Ortega, R et al. Positive-Pressure Ventilation with a Face mask and a Bag-Valve Device. NEJM 2007;357:e4
- National Institute of Health (NIH) images website

Questions & Answers

- Enjoy the remainder of the conference!