

Intubation

This is a general review of issues relevant to intubation. While the hand skills necessary for performing intubation do take a certain amount of practice, the decision of when to intubate and the choice of technique is of at least equal importance, and is often ignored. While you may not acquire significant "hands on" training in intubating non-neonates during your pediatric residency, you will have the opportunity to learn how to decide when someone should be intubated, as well as the potential complications and problems that may be encountered. *THIS KNOWLEDGE MAY BE LIFE-SAVING.*

Indications for intubation--Thinking about the indications will help you decide on a technique

1. Maintaining an airway
 - Comatose patient with $GCS \leq 8$
 - Patient with upper airway obstruction
 - Trauma
 - Airway protection during surgery or significant procedure
2. Respiratory failure
 - Inability to adequately ventilate or oxygenate despite noninvasive positive pressure ventilation (i.e. BIPAP, CPAP, vapotherm)
3. Significant cardiovascular compromise, shock
 - Intubation with mechanical ventilation can reduce the metabolic oxygen cost of breathing and allow improved oxygen delivery to other areas of the body with marginal perfusion.
4. Therapeutic Hyperventilation
 - For impending herniation

Techniques

1. Awake, without drugs
2. Sedated but not paralyzed
3. Anesthetized-+/- rapid sequence induction

Considerations in determining technique used for intubation

1. Airway anatomy--if primary airway problem, ie, croup, epiglottitis, foreign body, abnormal anatomy, etc.

--**DO NOT BURN BRIDGES.** These *patients should not be paralyzed.* Paralysis relaxes the pharyngeal muscles, which may obscure landmarks in the difficult airway, and may make bag-mask ventilation difficult. Sedation, along with local anesthetics (ie, lidocaine spray) may be used to facilitate intubation.

2. Cardiovascular stability--hemodynamically unstable patients (ie, sepsis, toxic shock, certain ingestions) may become even more unstable when sedated, due to loss of sympathetic tone. Any drugs used should be used in smaller doses and titrated to effect.

3. Cardiopulmonary arrest--there is no reason to use any pharmacologic intervention. Bag-mask ventilation with cricoid pressure and intubation can generally be accomplished without difficulty.

4. "Full stomach"--risk of pulmonary aspiration. These patients should be intubated "awake" to preserve airway protective reflexes, or by rapid sequence induction with cricoid pressure.

Patients considered to have a "full stomach":

- Recent oral intake
- Delayed gastric emptying from ascites, peritonitis, bowel obstruction
- Swallowed blood from trauma
- Increased intra-abdominal pressure from masses or ascites
- Abnormal lower esophageal tone-pregnancy
- Gastro-esophageal reflux
- Altered level of consciousness

5. Head injury-laryngoscopy and intubation may lead to increased intracranial pressure in the unanesthetized patient with an evolving head injury.

6. Trauma victims are frequently hypovolemic. Drugs and doses used need to be carefully considered.

The "awake" intubation

Indications (all relative)

- Cardiopulmonary arrest
- Airway anomalies, acute severe upper airway disease
- Cervical spine injury
- Facial Trauma
- Significant hemodynamic instability
- Any suspicion of difficulty intubating, for any reason.

Technique

Local anesthetic sprays can be used to topicalize the tongue and pharynx. Nebulized lidocaine (2cc 1% lidocaine in nebulizer) will decrease the laryngospasm and bronchospasm with intubation. Laryngoscopy and intubation should proceed firmly but gently, with attention to the teeth and tongue if the child is struggling.

The sedated intubation

Indications

- Potentially difficult airway
- Lung disease with moderate to high O₂ requirement (may desaturate during period of apnea necessary for rapid sequence intubation)

Technique

Carefully titrated drugs, watching for hemodynamic as well as sedative effects. If hemodynamics are stable, more drug can be given if necessary.

DRUGS:

Versed 0.05-0.1 mg/kg. Use lower doses in the setting of hypovolemia, sepsis, or poor cardiac function.

Ketamine 1.0-2.0 mg/kg. Indirect sympathomimetic, preserves cardiac output and systemic BP in acutely hypovolemic patients. Direct bronchodilatory properties. Potent sialogogue (*premedicate with atropine or glycopyrrolate*). Co-administration of a small dose of benzodiazepine will reduce emergence phenomenon. **Contraindicated in head injury or eye injury—raises ICP and intraocular pressure**

OR

Versed 0.05-0.1 mg/kg

Morphine 0.1-0.2 mg/kg or **fentanyl** 1-2 mcg/kg Careful with morphine in hemodynamically unstable patients—it can cause histamine release which may cause vasodilation and cause more cardiovascular compromise. You must deliver fentanyl slowly—over 1 min. Quickly pushing fentanyl will cause *rigid chest*. If that happens, you have no choice but to muscle relax the patient.

Monitor degree of sedation carefully. Watch for signs of impending vomiting or respiratory depression. Gentle ventilatory assistance through cricoid pressure is sometimes necessary in extremely hypoxic or unstable patients.

The anesthetized intubation--rapid sequence induction

Indications

"Full stomach" conditions

- Head injury
- Asthma
- Last po intake is unknown

Common theme-Desire to blunt undesirable physiologic response to intubation-hypertension, tachycardia, bronchospasm, increased intracranial pressure.

Contraindication--anticipated difficulty with securing airway, ie, anatomic abnormality or airway pathology. ***NEVER sacrifice airway safety for the sake of pharmacologic intervention.***

Technique

Rapid sequence refers to rapid infusion of medications, followed by a brief period where airway protective reflexes are lost, followed by ideal intubating conditions.

1. Patient is preoxygenated with 100% FiO₂.
2. From the moment medications are given, *cricoid pressure is applied and positive pressure ventilation is avoided*. **REPEAT: do not bag-mask-ventilate!** This only forces more air into the stomach and can cause vomiting and aspiration—which you are trying to avoid at all costs.
3. NG (if present) to suction. Have suction (LARGE Yankauer) available!!!

4. Medication sequence--cricoid pressure should be applied from the moment drugs are given until the ETT is confirmed to be in the proper position. No positive pressure ventilation.

--Sedation/Analgesia. Can use Versed with Morphine or Fentanyl

--Paralysis—Use Rocuronium or Succinylcholine. You want a fast acting agent.

**--SEDATION/ANALGESIA/AND PARALYSIS MEDS GIVEN
SIMULTANEOUSLY!!!**

5. When fully relaxed, intubate.

If difficulty with intubation arises, or the patient had more lung disease than you anticipated and desaturates significantly without positive pressure ventilation, **GENTLY BAG MASK VENTILATE** the patient, get the saturations up, and try again. ***It is important to realize this:*** If you are able to bag mask, then you can continue to do that until someone is able to secure an airway.

Drugs to facilitate intubation

Atropine 0.02 mg/kg, minimum 0.1 mg

Sedation/analgesia-Benzodiazepine, thiopental, etomidate +/- narcotic, or ketamine

Versed 0.05-0.1 mg/kg

Ketamine 1-2 mg/kg

Thiopental 2-6 mg/kg (will drop blood pressure—careful in unstable patients)

Etomidate 0.2-0.4mg/kg Useful in hemodynamically unstable patients. Extremely short half life. Can cause adrenal suppression.

Morphine 0.1-0.2 mg/kg or **fentanyl** 1-2 mcg/kg Careful with morphine in hemodynamically unstable patients—it can cause histamine release which may cause vasodilation and cause more cardiovascular compromise. You must deliver fentanyl slowly—over 1 min. Quickly pushing fentanyl will cause rigid chest. If that happens, you have no choice but to muscle relax the patient.

Paralysis

Rocuronium 1.2 mg/kg, achieves intubating conditions in 60 seconds. *Duration of paralysis 30-60 minutes.* Should not be used if there is any anticipated difficulty achieving intubation.

Succinylcholine 1-2 mg/kg, achieves intubating conditions in 45 seconds. *Duration of paralysis 5-8 minutes.*

Untoward effects of succinylcholine

--Cardiovascular-succinylcholine stimulates the vagus nerve and sympathetic ganglia leading to bradycardia, hypertension, or hypotension. Atropine prior to administration may prevent bradycardia.

--Hyperkalemia-With depolarization there is opening of acetylcholine receptor channels, allowing efflux of potassium from the cell through receptors in the muscle end-plate and extra-junctional receptors. In normal patients, there is a rise in serum potassium of 0.5 meq with a dose of succinylcholine. In certain disease processes, there is an upregulation of acetylcholine receptors, and hence, a massive increase in serum potassium with the administration of succinylcholine. These include:

1. Burns (3 days to 6 months after injury), spinal cord injury (3 days to 1 year after injury), tetanus, severe intra-abdominal infections

2. Guillain-Barre syndrome, Duchenne's Muscular Dystrophy, Myotonic Dystrophy, multiple sclerosis, many progressive neuromuscular diseases.

3. Malignant hyperthermia-Succinylcholine is one of the agents that "trigger" MH, a hypermetabolic response to a triggering agent characterized by fever, tachycardia, tachypnea, acidosis, hyperkalemia, ventricular dysrhythmias, and rhabdomyolysis. The mortality is high. Risk factors include positive family history, Duchene's Muscular Dystrophy, and certain myopathies.

4. Increased intraocular pressure

5. Rhabdomyolysis and myoglobinuria

Equipment

For any and all intubations, have available:

1. Large suction catheter "Yankauer" and reliable suction.

--**DO** 2 suction setups if bleeding.

--**DO NOT** use small suction catheters.

--*The suction must be hooked up.*

2. Bag and appropriate sized mask

3. Oxygen source

4. Cardiorespiratory monitor

5. SaO₂ monitor

6. Endotracheal tubes--one up, one down from anticipated size needed

-- $(16 + \text{age in years}) / 4$ for children > 1

--ETT size approximates the size of the patient's little finger

--Generally in children, use uncuffed ETT. This is because the narrowest part of the pediatric airway is just below the glottis at the cricoid ring. The subglottic airway is also round in shape, in contrast to an adult airway, which is elliptical—why adults need cuffed ETT.

7. Laryngoscopes—at least 2, preferable 1 straight blade, one curved blade.

--**CHECK LIGHTS**

8. Stylet, with lubrication

--Make sure end of stylet is not poking out of ETT

9. Oropharyngeal airways

10. Tape

11. CO₂ monitoring device—must give 6 breaths prior to placement of device. This is because there can be CO₂ in the stomach secondary to bag-mask ventilation—giving 6 breaths will “wash out” any CO₂ present in the stomach in the event of an esophageal intubation.

12. NG tube. If an NG is in place before intubation, it is a nice indicator of where not to place the ETT (i.e. the esophagus). If not placed prior to intubation, should place one after to decompress the stomach—it may have become distended during bag-mask-ventilation.

Insertion depth

1. Good rule of thumb—3 x ETT size in cm is the depth of insertion at the lip.

2. Most ETT have marks near the tip. Some have just one, where others have 1, 2, and 3 marks. If you are able to visualize the ETT passing through the cords, insert the ETT to the depth where 2 marks are just below the vocal cords (or the single mark in ETT with just 1 mark).
3. Auscultate for bilateral symmetric breath sounds.
4. CO₂ monitoring device—must give 6 breaths prior to placement of device. This is because there can be CO₂ in the stomach secondary to bag-mask ventilation—giving 6 breaths will “wash out” any CO₂ present in the stomach in the event of an esophageal intubation.
5. CXR. Look for tip of ETT between level of T2-T4 and below the clavicles.