emDocs

The EM Educator Series

The High-risk Intubation (Peri- and Post-intubation)

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Case #1:
A 77-year-old male with history of COPD presents with severe shortness of breath, difficulty with ambulation, productive cough, and fevers. He has felt weak and feels his normal activity is severely limited. He has also needed to increase his baseline oxygen from 2L to 5L, though it isn't helping. His VS include RR 28, HR 110, BP 89/48, T 38C, and Sats 82%. What should you consider regarding this patient's airway and respiratory status?

Case #2:
A 23-year-old male is brought in by EMS with head trauma after a motorcycle crash. He was not helmeted, and his GCS is 4. He is hypertensive, bradycardic, and has a dilated pupil on the right. What airway and intubation considerations are required?

Case #3:
A 55-year-old female with severe respiratory distress and diffuse interstitial infiltrates on chest x-ray has been intubated. She is receiving empiric treatment for pneumonia with antibiotics, as she was febrile, tachycardic, and tachypneic with productive cough. Her ETT was confirmed with ETCO2 and X-ray. You are concerned about ARDS, but what ventilator settings should you utilize?

Questions for Learners:

What do you need to know regarding the airway and physiology in intubation and ventilation for these patients?

- COPD / asthma
- Metabolic acidosis (e.g. DKA, salicylate tox)
- Shock e.g. septic, cardiogenic
- Pulmonary hypertension
- Elevated ICP
- Upper GI bleed
- PE
- Cardiac tamponade
- Anaphylaxis / angioedema
- Aortic stenosis
- Morbid obesity
- Pregnancy
- ARDS
- Post-intubation crash

Suggested Resources:

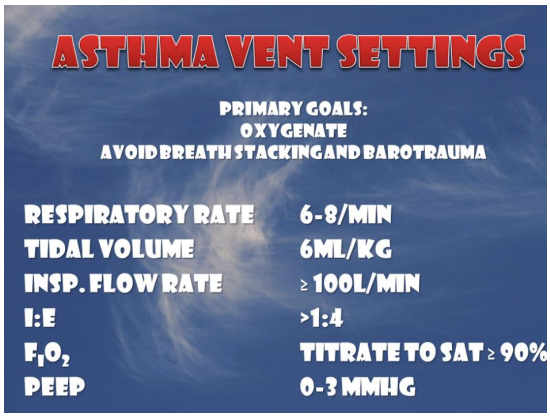
- ✓ Articles:
  - emDOCs – High Risk Post Intubation Patients
  - emDOCs – Intubating the Critically Ill Patient
  - emDOCs – The Difficult Airway: Common Errors During Intubation
  - emDOCs – The Crashing Pulmonary Hypertension Patient
  - emDOCs – The Sphincter Series: A Scary Airway Review
  - emDOCs – The Scary Airway Series Part II: Mastering Obesity, Peds, and Burns
  - emDOCs – Acute respiratory distress syndrome (ARDS): who's at risk and ED-relevant management
  - First 10 EM – Post-intubation deterioration in asthma
  - PulmCrit – Eight pearls for the crashing patient with massive PE
  - PulmCrit – PulmCrit: Fighting refractory ARDS with physiologic jujitsu
  - UMEM Educational Pearls – The risks of intubation with pericardial tamponade
  - LITFL – Trauma and Pregnancy
  - R.E.B.E.L. EM
    - Critical Care Updates: Resuscitation Sequence Intubation – Hypotension Kills (Part 1 of 3)
    - Critical Care Updates: Resuscitation Sequence Intubation – Hypoxemia Kills (Part 2 of 3)
    - Critical Care Updates: Resuscitation Sequence Intubation – pH Kills (Part 3 of 3)
  - EMCrit – The Crashing Ventilated Patient Handout – Zero to Hero Handout

- ✓ Podcasts:
  - EMCrit – Podcast 129 – LAMW: The Neurocritical Care Intubation
  - EMCrit – EMCrit Podcast 5 – Intubating the Critical GI Bleeder
  - EM Basic – Anaphylaxis Part 2- Airway
  - EM Cases – Episode 69 Obesity Emergency Management
  - R.E.B.E.L. EM – REBEL Cast Ep 46b: Vent Management in the Crashing Patient with Haney Mallemat

Answers for Learners:

What do you need to know regarding the airway and physiology in intubation and ventilation for these patients?

- **COPD / asthma**
  - Consider ketamine or propofol as the induction agent
    - Both have bronchodilatory effects
  - Consider rocuronium as the paralytic
    - Longer paralysis time can help with vent synchrony
  - Use a larger endotracheal tube
  - Use low tidal volumes – 6-8 ml/kg IBW
  - Decrease respiratory rate – start with 10 bpm
  - Decrease I:E ratio – 1:3–1:5
  - Consider heliox – asthma only
    - Heliox is oxygen mixed with helium instead of nitrogen (room air), creating a mixed gas that has a lower density. Some studies have shown that it can decrease airway resistance and improve outcomes in patients with asthma (but not COPD), but studies have been limited. If using heliox in a ventilated patient, make sure to adjust settings carefully, as some ventilators will require pressure-cycle rather than volume-cycle.
  - Consider disconnecting from ventilator and pushing on the chest if patient is breath-stacking
  - High peak airway pressure (PIP) is better tolerated than high plateau pressure. High plateau pressure reflects alveolar pressure and causes lung injury if it is above 30 cmH2O. Therefore, maintain plateau pressure <30 cmH2O by reducing respiratory rate. You will likely need to reset the alarm for high PIP to ensure the ventilator continues to provide breaths.
  - Accept mild hypercapnia and acidemia.



- **Metabolic acidosis (e.g. DKA, salicylate tox)**
  - Optimize cardiovascular status before intubating – Provide IV fluids and vasopressors if needed
  - Use noninvasive ventilation such as BiPAP for pre-oxygenation

- Avoid apnea if at all possible by using a delayed sequence technique with ketamine as induction agent to allow patient to spontaneously ventilate
- Consider shorter acting paralytic such as succinylcholine
- Increase respiratory rate to 30 – or at least match the patient's rate before intubation
- Use tidal volume closer to 8 ml/kg IBW
- Check frequent arterial or venous blood gases with ventilator setting adjustments

- **Shock e.g. septic, cardiogenic**
  - Fluid resuscitate prior to intubation
  - Begin vasopressors prior to intubation, if needed5
  - Have bolus doses of vasopressor at bedside, for example 5 to 20 mcg boluses of epinephrine
  - Lower the dose of etomidate8,9 or ketamine10 as the induction agent by 50%, and use the highest dose of paralytic (shock states mean preferred blood flow to CNS [induction agent] but lower flow to muscles/motor end plate [paralytic]). Propofol can be used at a lower dose (again, < 50%), but beware its hypotensive effects
  - Lower PEEP to decrease intrathoracic pressure
  - Repeat blood pressure measurements frequently after intubation
  - Place an arterial line if requiring vasopressors

- **Pulmonary hypertension**
  - Consider pre-medicating with fentanyl to blunt the hypertensive response to laryngoscopy
  - Consider etomidate as the induction agent
  - Use low tidal volume – 4-6 ml/kg IBW
  - Lower PEEP
  - How to monitor for success
  - Maintain plateau pressure < 30 cmH2O
  - Check frequent blood gases to monitor for hypercapnia
  - These patients are not candidates for permissive hypercapnia since acidemia causes vasoconstriction, increasing pulmonary arterial pressure
  - Avoid hypoxemia since this also causes vasoconstriction and worsens right ventricular afterload

- **Elevated ICP**
  - Pre-treatment optional (not evidence-based): Lidocaine 1.5 mg/kg 3 min prior then fentanyl 3 mcg/kg if not hypotensive
  - Induction: Etomidate 0.3 mg/kg or ketamine 1-2 mg/kg if hypo or normotensive
  - Paralysis: Succinylcholine preferred (rocuronium is ok too)
  - Hyperventilate temporarily if patient continues to deteriorate after osmotic agents

- **Upper GI bleed**
  - Empty the stomach
  - Intubate with HOB at 45 degree
  - Pre-Ox like mad
  - Intubation Meds – reduced induction, high paralytics.
  - Gather equipment to optimize 1st pass success
  - Gentle and slow bagging if necessary

- If patient vomits, trendelenberg
- Meconium Aspirator
- No abx for aspiration → chemical pneumonitis
- SIRS – Sepsis like syndrome from aspiration, where they need fluids and pressor support

- **PE**
  - Judicious fluids with early pressor initiation
  - Inhaled NO if you have it
  - Avoid intubation if possible
  - Consider early thrombolytics if no contraindications
  - Plan for failure → know how to code an arresting PE patient

- **Cardiac tamponade**
  - Positive-pressure ventilation (e.g., mechanical ventilation) increases intrathoracic pressure potentially reducing venous return, right-ventricular filling, and cardiac output.
  - Pericardial tamponade similarly causes hemodynamic compromise through increased pericardial pressure which reduces right-ventricular filling and cardiac output.
  - When mechanically ventilating a patient with known or suspected pericardial tamponade the mechanisms above may be additive, causing cardiovascular collapse and possibly PEA arrest.
  - For the patient with known or suspected pericardial tamponade consider draining the pericardial effusion prior to intubation or delaying intubation until absolutely necessary.
  - If intubation is unavoidable, consider maintaining the intrathoracic pressure as low as possible (by keeping the PEEP and tidal volumes to a minimum) to ensure adequate cardiac filling and cardiac output.

- **Anaphylaxis / angioedema**
  - In some cases, ED observation as opposed to definitive airway management may be preferable.
  - Airway intervention in angioedema is typically a case-by-case call, with no set guidelines on when to intervene.
  - If you do decide to intubate the patient, and you have available advanced airway specialists in your hospital, they should be called. These “advanced airway” specialists can be another ED physician to help, but also consider other available resources such as anesthesia, general surgery, or ENT.
    - In the ED, if you have access to anesthesia for intubation in a more controlled setting, and the patient can be/has time to be/is not in too much extremis to be transferred there, this may be the time to swallow your airway pride, rally the troops, and engage your anesthesia and surgical colleagues for an intubation in the OR setting.
  - Prior to intubation, examine the airway. These airways can be precarious, and prolonged manipulation can precipitate increases in swelling.
  - Mark the neck in the “just in case” failed airway scenario, in the event that you have to emergently progress to a surgical airway.
  - Prepare everything at the bedside, including multiple back-up airway options with video laryngoscopy if available, bougie, and supraglottic devices, and also always including a surgical option. Avoid manipulation of the airway or oropharynx until everything is prepared.

- Preoxygenate the patient as much as possible. Administration of heliox (80% helium and 20% oxygen), which has less density and less turbulent flow than oxygen, may help you obtain acceptable oxygen saturations even through the very tight or nearly occluded airway.
- Try not to transfer the patient with angioedema anywhere, even for a short distance, without a secured airway, (or without a babysitter like yourself, a resident, etc. armed with intubation meds/airway equipment, who can rapidly intubate the patient if needed) as they are unpredictable and can be rapidly progressive. Be wary that the external exam may not be indicative of the degree of swelling in the hypopharynx or laryngeal structures, and a somewhat benign external exam does not mean that there isn't swelling at the level of the airway. Similarly speaking, profound lip swelling can be quite impressive and intimidating on initial exam, but does not always correlate with hypopharynx or laryngeal edema. In all cases, err on the side of caution.
- Currently, consensus of the literature seems to recommend that if the resources are available, an awake airway exam with fiberoptics or flexible endoscopy should be performed, and if there is found to be severe base of the tongue edema or laryngeal edema, the preferred method for intubation is via fiberoptics in a controlled environment such as the operating room. If intubation must be completed in the ED, flexible endoscopy can serve as a conduit for intubation.
- RSI techniques in these patients should be reserved for those that you are highly confident orotracheal intubation is likely to be successful, as well as confident that the patient can be bagged in the event of a failed orotracheal attempt.
- Alternatively, you can proceed with awake investigations, or primary cricothyrotomy, if the obstruction is suspected to be complete or rapidly progressive and the likelihood of orotracheal intubation/RSI success is low. Remember that these are rarely straightforward cases.

- **Aortic stenosis**
  - Pre-load dependent, so caution should be used on induction agent.

- **Morbid obesity**
  - **B.I.G. R.A.M.P**
    - **BUY TIME**
    - **INDICATION FOR INTUBATION**
    - **GET HELP**
    - **RAMP**
    - **APNOEIC OXYGENATION**
    - **MINIMAL DRUGS**
    - **PRE-OXYGENATE WITH NIV**
    - **PARALYSIS**
    - **PLAN FOR FAILURE**
    - **POST INTUBATION CARE**

- **Pregnancy**
  - Potentially difficult airway due to increased soft tissue edema, and breast enlargement may impede laryngoscopy — to facilitate intubation consider the use of:
    - a laryngoscope with a short or tilted handle.
    - a bougie.

        - video laryngoscopy.
    - Cricothyroidotomy may be more difficult due to soft tissue changes.
    - Aspiration risk is higher because of increased intrabdominal pressure and delayed gastric emptying — use cricoid pressure during intubation and decompress the stomach early.

- **ARDS**
    - In the ED, the primary focus is supportive care, with several other treatments:
    - Supplemental O2
        - Treat the underlying condition (pneumonia, sepsis, etc.)
        - Tempered diuresis – non-cardiogenic pulmonary edema takes much longer to respond to treatment than cardiogenic CHF, so avoid being overly aggressive with diuresis, as this may worsen underlying shock and increase likelihood of multi-organ failure4
        - Conservative fluid management strategy – for ARDS patients not in shock, the goal to obtain zero fluid balance4
        - Be cautious when using non-invasive positive pressure ventilation – the benefit of NIPPV in the initial management of ARDS remains controversial. An observational cohort study by Dr. Rana has shown that there is a high failure rate of the initial NIPPV therapy in medical critically ill patients (underlying shock, metabolic acidosis and severe hypoxemia) with ARDS/ALI, and it shows that NIPPV is associated with twice the mortality rate5,6
        - Consider intubation
    - Mechanical ventilation7,8,9
        - Use low tidal volume (6-8 mL/kg)* to avoid barotrauma
        - Avoid excessive oxygen exposure (clinical goals: $FiO_2 < 0.40$, $SpO_2 > 88$-90%, $PaO_2 > 55$-60 mmHg)
        - Maintain head of bed elevation while mechanically ventilated to reduce the risk of developing pneumonia
    - * Ideal body weight (not actual body weight) should be used to calculate ventilator tidal volume.

- **Post-intubation crash**

Diagnosing the Problem

- Use “D.O.P.E.S.”
    - **D**isplacement of ETT, cuff adjustment
    - **O**bstructed tube
    - **P**neumothorax
    - **E**quipment malfunction
    - **S**tacking (“breath-stacking” or “auto-PEEP” as explained above)

Treating the Problem

- Use “D.O.T.T.S.”
    - **D**isconnect the patient from the vent
    - **O**xygenate (use BVM on 100%)
    - **T**ube position (reposition the ET tube)
    - **T**weak the ventilator settings (especially if auto-PEEP is suspected)

- **S**onogram (ultrasound the lungs to r/o pneumothorax)

A Patient with Hemodynamic and Ventilator Collapse

- First, do the "quick check"
  - Patient biting the tube
  - Check vent connections
- Then, think back – "focused H&P"
  - Who intubated? Were there any complications?
  - What meds were used?
  - What are the current oxygen saturations & ETCO2? What is the ABG?
  - Have you checked for PTX?
- Waveform analysis
  - Is there evidence of auto-PEEP?
    - If so, perform an end-expiratory hold to determine autoPEEP
  - Respiratory Mechanics
    - Evaluate if the problem is due to resistance or compliance
      - Evaluate peak pressure & plateau pressure. Find the difference between the two measures.
        - If low, the problem is likely due to a compliance issue
          - Consider volume overload, acute lung injury (like ARDS), pneumothorax, neuromuscular dysfunction, abdominal compartment syndrome
        - If high, the problem is likely due to a resistance issue
          - Consider bronchoconstriction, dislodged ET tube, biting tube, mucus plug in tube