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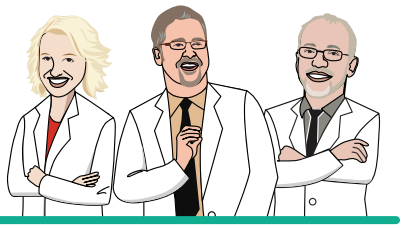
Continous Core Content



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C3 – AIRWAY BASICS – PART 2: PREOXYGENATION, PARALYSIS AND PLACEMENT

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**Drug doses are a guide only, always check a second source and follow local practice guidelines*

Take Home Points:

- **Preoxygenation is critical to prevent desaturation during intubation; it can be achieved using a non-rebreather mask with high-flow oxygen for 3 minutes prior to paralytic administration.**
- **The technique of direct and video laryngoscopy are critical motor skills in emergency medicine.**
- **Cricoid pressure during direct laryngoscopy is no longer recommended.**
- **Post-intubation analgesia and sedation should be planned prior to intubation so that they may be instituted immediately after intubation.**

Background

Last month on C3, we began our examination of airway management and rapid sequence intubation (RSI). After a discussion of how airway management in the ED differs from the operating room, we covered the first steps of RSI, preparation and positioning. This month, we continue with preoxygenation, paralysis, placement with proof, and finally, post-intubation management.

Preoxygenation

Preoxygenation is perhaps the most important step in RSI. By preoxygenation, we mean that we are replacing the patient's reservoir of nitrogen, the predominant gas in air, with one of oxygen. This reservoir is mainly in the lungs (the alveoli and the dead space) with a small component in the bloodstream itself. Once a patient is paralyzed and apneic, this reservoir of oxygen will serve to maximize the time we have to secure the airway without the patient desaturating during the attempt to place the endotracheal tube.

- Preoxygenation is critical to prevent desaturation during intubation.
- It can be achieved by supplying a high concentration of O_2 via a non-rebreather mask (NRB) at high flow (>15 L/min) to the breathing patient prior to the administration of a paralytic and the onset of apnea.
  - Studies have shown that maximum preoxygenation can be achieved by having the awake, cooperative patient take 8 giant (tidal volume) breaths or, alternatively, by remaining on the NRB for at least 3 minutes prior to paralytic administration.

- In the patient with normal physiology, full preoxygenation can provide as much as 8 minutes of apnea time before the patient begins to desaturate (i.e., the O_2 saturation drops below 90% and then rapidly downward thereafter).
- In sick patients, especially those with pulmonary disease, this time period is markedly reduced, and may be less than 1 minute. This is also true in children, obese, and pregnant patients.
- Technique
  - Preoxygenation should be done with the head elevated.
    - This prolongs safe apnea time.
    - If c-spine is immobilized, the reverse Trendelenburg (30°) position may be used.
  - Non-rebreather mask (NRB)
    - A flow rate of 15 L/min achieves an FiO_2 of 60-70%.
    - If you turn up the dial past the maximum marking (e.g. 15 L/min) it can go up to flow rates of 30-60 L/min, which may achieve an FiO_2 >90%.
  - Apneic oxygenation
    - Even without ventilation, providing the patient with high flow oxygen by nasal cannula (NC) will allow for passive gas exchange and prolong the time to desaturation, adding a further element of safety to RSI.
    - High flow rates of NC may also provide some minimal degree of positive end expiratory pressure (PEEP).
    - This is initiated during the preoxygenation phase by placing NC on or under the NRB; the NC flow rate is only turned up to high (≥ 15 L/min) after the patient is unconscious.
    - Another way to provide apneic oxygenation is by applying a BVM equipped with a PEEP valve with a good seal.
    - EMA Links:
      - *EMA 2018 January - Abstract 29 - ED Use Of Apneic Oxygenation In RSI: The ENDAO Trial*
      - *EMA 2016 October - Abstract 24 - First Pass Success Without Hypoxemia is increased With The Use Of Apneic Oxygen During RSI*

Paralysis with Induction (Medication Administration)

In this critical step, an induction agent is administered, immediately followed by a paralytic agent. There are many induction agents and several paralytic agents available for RSI. The choice of each may vary depending on institutional custom and practice but thorough familiarity with more than one agent is important when contraindications arise and alternatives are needed.

- Induction agents (See Table 1)
  - These are generally sedatives given at a high dose.
  - In ill, hypotensive patients, sedative doses are adjusted downward (e.g. half dose).
  - Midazolam, fentanyl and thiopental are now less commonly used for RSI.
- Paralytics agents (See Table 2)
  - These are neuromuscular blockers, either depolarizing (succinylcholine) or non-depolarizing.
  - In ill, hypotensive patients, paralytic doses are adjusted upward (e.g. at least full dose).

Tables

TABLE 1. INDUCTION AGENTS FOR RSI

	IV Dose Standard	Suggested Dose 70 Kg adult	IV Dose Shock	Onset	Duration	Pros	Cons
Ketamine	1 to 2 mg/Kg (3 to 4 mg/Kg IM)*	140 mg (2 mg/Kg)	1 mg/Kg	60 to 90 sec	5 to 15 min	Good for: • Hemodynamically unstable • Bronchospasm	• Increases secretions • Caution in hypertensive patients • Nausea, vomiting
Etomidate	0.2 to 0.6 mg/Kg	20 mg (0.3 mg/Kg)	0.2 mg/Kg	15 to 45 sec	3 to 10 min	Good for: • Most intubations	• Myoclonus • Adrenal suppression (unclear if clinically relevant) • Pain with injection • Nausea, vomiting
Propofol	1 to 2 mg/Kg	105 mg (1.5 mg/Kg)	0.2 mg/Kg starting dose and titrate	15 to 45 sec	5 to 10 min	Good for: • Bronchospasm • Seizures	• Lowers blood pressure • Caution in head injury (drops MAP and CPP) • Caution in hemo-dynamically unstable • Allergy to egg or soy • Pain on injection

* Intramuscular administration may significantly delay onset *(Caro, 2018; Nickson, 2016, Micromedex)*

TABLE 2. PARALYTIC AGENTS FOR RSI

	IV Dose Standard	Suggested Dose 70 Kg adult	Onset	Duration	Pros	Cons
Succinylcholine	1.5 mg/Kg (2 mg/Kg in infants and small children) (3 to 4 mg/Kg IM)*	105 mg (1.5 mg/Kg)	45 to 60 sec (2 to 3 min IM)	6 to 10 min	• Shorter duration allows return of neuro exam	(See list below)
Rocuronium	0.6 to 1.2 mg/Kg	70 mg (1 mg/Kg)	60 to 120 sec	15 to 85 min	• Good for most intubations	• Long duration may delay return of neuro exam • Can be reversed by sugammadex (expensive and not widely available)

* Intramuscular administration may significantly delay onset

Placement With Proof

- The following apply to the adult patient who is not in c-spine precautions; coming episodes will deal with the pediatric airway.
- Opening the airway
  - Head tilt/chin lift maneuver
    - Tilting the head to the sniffing position by lifting from under the patient's jaw.
  - Jaw thrust maneuver
    - Pushing the mandible anteriorly by pressing behind the angle of the mandible.
    - Purpose of both of these maneuvers is the displace the tongue anteriorly to open the airway.
- Direct Laryngoscopy *(Fig. 1.)*
  - How to hold the laryngoscope
    - Place the handle in the palm of your left hand with the base of the blade in your hypothenar eminence.
  - Scissor technique *(Fig. 2.)*
    - With your right hand, use your thumb and index finger to open the patient's mouth by scissoring your fingers with your thumb on their lower teeth and index finger on their upper teeth.
  - Fish Hook *(Fig. 3.)*
    - Have an assistant pull the cheek to the side to increase the operator's field of view.
  - Tongue sweep
    - Insert the laryngoscope blade from your right, gently sweeping the tongue to the left side as you slowly insert the blade.
  - Epiglottoscopy
    - Locating the epiglottis is the key to finding the cords.
    - As the blade slowly goes in, first identify the uvula.
    - The uvula points to the epiglottis.
    - Macintosh (curved) blade
      - Place the tip of your blade just above the epiglottis in the vallecula.
      - Lift up and you should see the glottis and vocal cords *(Fig. 4.)*
    - Miller (straight) blade
      - Place the tip of the blade under the epiglottis and lift
  - Head lift
    - Some patients need additional lift to get a good view.
    - If not in c-spine precautions, with your left hand still in the same place, take your right hand and lift up the patient's head by their occiput.

Photo courtesy of Jessica Mason, MD

Fig. 1. Holding the laryngoscope

Photos courtesy of Jessica Mason, MD, & James McCue, MD

Fig. 2. Scissor technique for intubation

Photo courtesy of Jessica Mason, MD, & James McCue, MD

Fig. 3. Fish hook technique for intubation

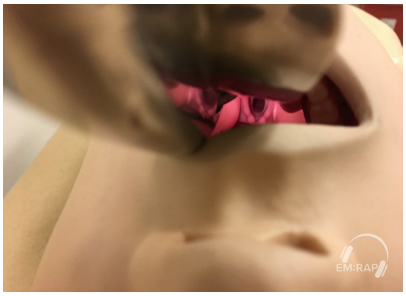

Photo courtesy of Jessica Mason, MD

Fig. 4. View of the larynx

- This maneuver solves the problem most of the time.
- Once you get a view have a helper hold the head in that position. *(Fig. 5.)*

Photo courtesy of Jessica Mason, MD

Fig. 5. Lifting the head by the occiput often improves the view of the larynx

- Tube (or bougie) comes in from right corner of mouth
  - You are looking down a narrow passage and do not want anything blocking your view, including the tube.
  - Bring the tube in from the right lower corner of the mouth and keep it to the side until it reaches the glottis.
- Cricoid pressure
  - Cricoid pressure (the Sellick maneuver) is intended to push the cricoid posteriorly to occlude the esophagus and prevent aspiration
    - Unfortunately, cricoid pressure tends to displace the esophagus laterally rather than compress it.
    - In addition, cricoid pressure may relax the lower esophageal sphincter and may worsen your view.
    - *EMRAP 2015 April - Medical Myths- Cricoid Pressure*

Photo courtesy of Jessica Mason, MD, & James McCue, MD

Fig. 6. Bimanual laryngoscopy

- Bimanual laryngoscopy *(Fig. 6.)*
  - Most experts now advocate this technique, where the operator uses their free hand (the one not holding the laryngoscope) to optimize their view of the airway, and then has an assistant maintain that position while the operator passes the tube.
    - Take your right hand and gently hold the larynx between your thumb and fingers.
    - Make small movements with your right hand side to side or even posteriorly until the glottis comes into view.
    - Once you get a view have a helper hold the larynx in that position.
    - You can put your hand over theirs to demonstrate the direction and amount of pressure you need.
  - This is different (and more effective) than cricoid pressure.

- Video laryngoscopy
  - Video laryngoscopy (VL) has many advantages and is an important skill in addition to direct laryngoscopy (DL).
    - Technique is the same with some small changes.
    - Look at the mouth until the blade passes the tongue, then look at the screen.
    - If you only look at the screen immediately the tube can get caught on the mouth.
    - Blade shapes vary, some being hyperangulated; in general, these blades do not need to be inserted as deeply as with DL to visualize the larynx.
    - A rule of thumb is to only fill the upper half of the screen with the larynx; this way you can still see your tube coming in and see if it snags.
  - Proof of placement
    - Waveform capnography is considered a gold standard; a good CO_2 waveform indicates that the tube is either in the trachea or just at the outlet of the cords. *(Fig. 7.)*
    - Other techniques, which all may be falsely positive in some cases, include:

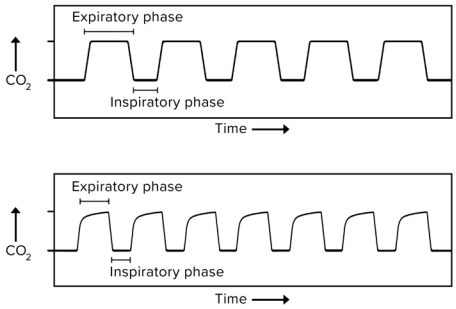

Fig. 7. End-title capnography waveform

- Colorimetric (qualitative) CO_2 detector; need 7-10 bagged breathes demonstrating color change
- Listening to lungs for bilateral breath sounds and over the abdomen for the absence of gastric insufflation
- Moisture in the tube
- O_2 saturation rising

- Right mainstem intubation is common; if breath sounds are greater over the right side, you may need to pull the tube back a few centimeters.

Common Pitfalls And Pearls

- Communication with team
  - Speak your plan out loud so that the whole team is on the same page
  - Here is an example:
    - "We are almost ready to intubate. We have 2 working IVs, oxygen, suction. We're going to use ketamine and rocuronium. My first attempt will be DL. We have a bougie and VL here as backup. Our post-intubation sedation plan will be propofol and fentanyl. Okay, we are ready to push the meds."
- Check your equipment, position the patient, get things ready in order and do this calmly.
- Wait the full 60 seconds after the paralytic is administered before taking a look.
  - Attempting to intubate too soon may trigger the gag reflex and make the patient vomit.
  - Often the tip of the blade goes into the sides of the glottis in the aryepiglottic folds, which can look like it might be esophagus but has a blind end; this is less likely to happen if the blade is introduced slowly and the epiglottis is identified first.
  - If the patient begins to desaturate, bag-valve-mask (BVM) ventilation should be initiated; continued efforts to pass the tube without ventilation are dangerous.
    - Subsequent attempts are unlikely to yield success if nothing is adjusted or changed: the blade, the patient's position, etc.
- Cannot see cords?
  - The problem is likely the mechanics of your view.
    - Did you slowly insert the laryngoscope identifying anatomy as you
    - go?Identify what you are looking at.
      - Soft palate or hypopharynx? Often fixed by head lift or bimanual laryngoscopy.
      - Something pink and soft? Maybe you went too deep are you are in the esophagus. Slowly back out. Don't insert the blade so forcefully and deeply.
      - Often times you're seeing the aryepiglottic folds which means you are lateral.
        - Angle to the sides or try bimanual laryngoscopy to bring the larynx into view.

  Could be a problem with patient's anatomy (e.g. angioedema).
- Fluids in airway
  - Emesis, blood, pulmonary edema, secretions
  - Suction

    - The Yankauer suction was designed for surgical bleeding and its narrow tip only allows for suctioning fluids, not solid material.
    - Suction solid matter using an ET tube or a DuCanto catheter (larger bore).
    - Use double suction when lots of fluids are present. One may be left in the pharynx.
- Tube stuck at laryngeal inlet
    - "Rings Right, inLet Left" -Rich Levitan
    - Sometimes you can see the cords and the tube is right there at the cords but is getting stuck at the laryngeal inlet.
    - Rotate the tube 90° to the left (counterclockwise).
        - This moves the bevel from the left side to the bottom.
        - It is less likely for the point of the tube to snag on the aryepiglottic folds which scoop upwards.
- Tube stuck at tracheal rings
    - You passed the tube through the cords but it won't go down further.
    - It is likely that the tube is snagging on those anterior tracheal rings.
    - Rotate the tube 90° to the right (clockwise).
        - This moves the bevel from the left side to the top so it can slide more easily down the rings.
- Good view but cannot pass tube.
    - Consider using the bougie or downsizing the tube.
- See the epiglottis and arytenoid cartilages only?
    - Once you look at the anatomy enough times you know the airway is just above the arytenoids and can intubate even if you don't see the cords.
- Cannot intubate and cannot ventilate
    - A surgical airway is needed - we will cover this in an upcoming episode.

POST INTUBATION MANAGEMENT

- Sedation and analgesia are critical in the post-intubation period; medications should be prepared and ready prior to intubation.
- Chest x-ray is standard to assess tube depth (chest x-ray is not used to confirm tracheal placement).
- Soft restraints are also critical to prevent the patient from inadvertently self-extubating.
- Ventilator settings
    - Arterial blood gases (ABGs) are obtained to assist with ventilator management.
    - This will be addressed in future episodes.

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