EMET ED Airway Workshop

Pre-oxygenation

Learning Objectives

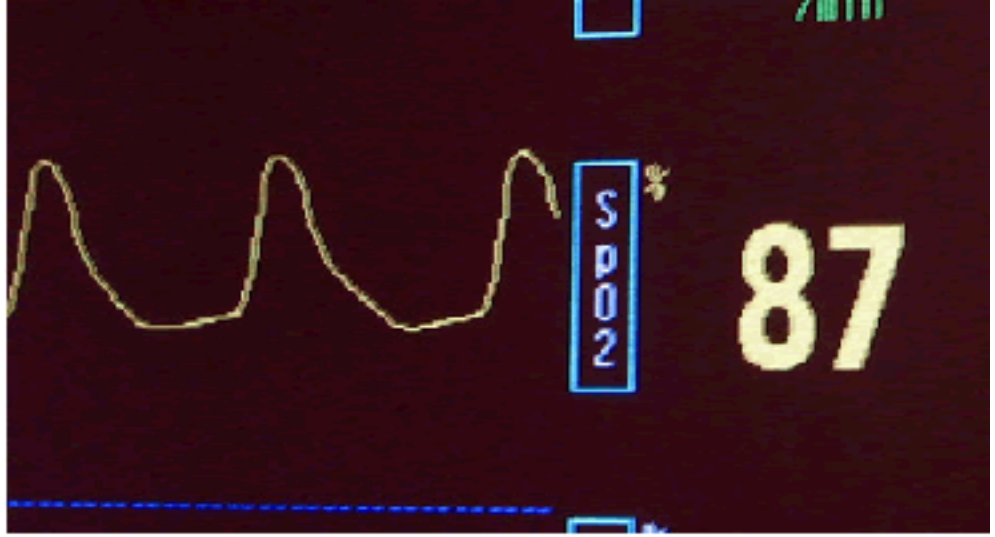
1. You will have an approach to optimising passive preoxygenation.
2. You will have an approach to apneic oxygenation.
3. You will have an approach to active preoxygenation.
4. You will understand the risks of BVM ventilation.
5. You will understand the risks and lack of benefit of cricoid pressure.

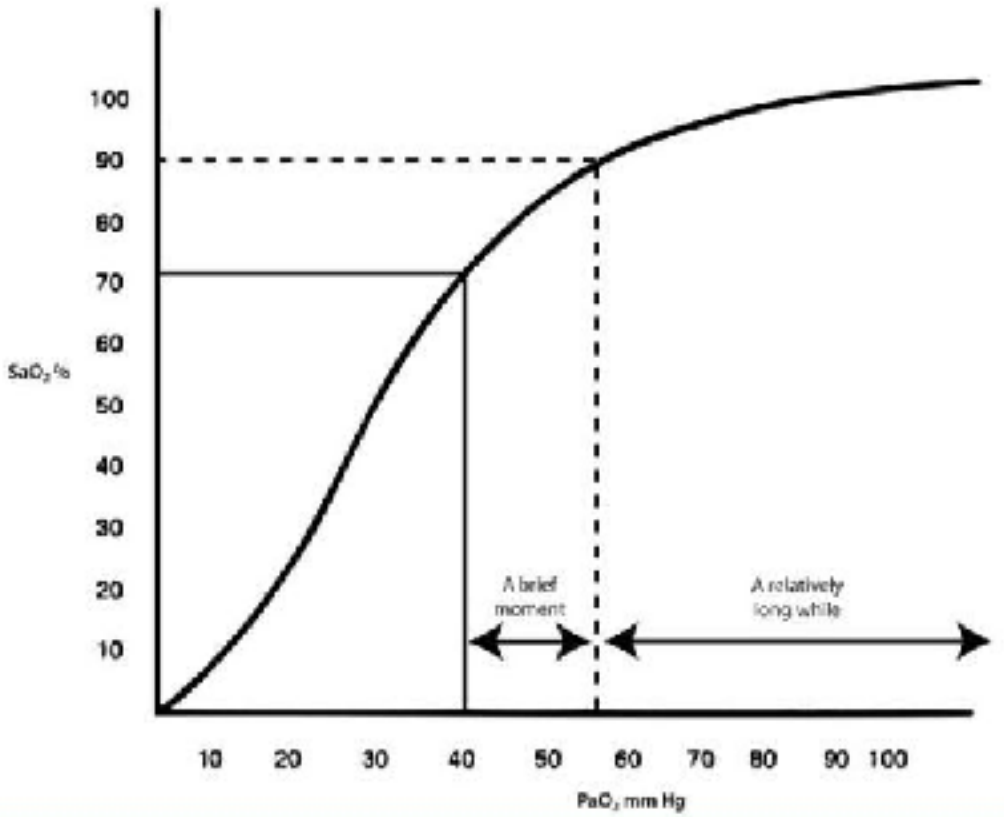
Oxygenation is crucial!

- Maintaining hemoglobin oxygen saturation during airway management is critical to patient safety.
- Desaturation to below 70% puts patients at risk for dysrhythmia, hemodynamic decompensation, hypoxic brain injury, and death.
- The challenge for emergency physicians is to secure a tracheal tube rapidly without critical hypoxia or aspiration.

Preoxygenation

- Preoxygenation extends the duration of safe apnea and is recommended for every ED tracheal intubation.
- It is essential to optimize oxygen delivery to an acutely ill patient.
- If tracheal intubation is attempted with saturations below 90%, these patients can critically desaturate in seconds.





Passive Preoxygenation

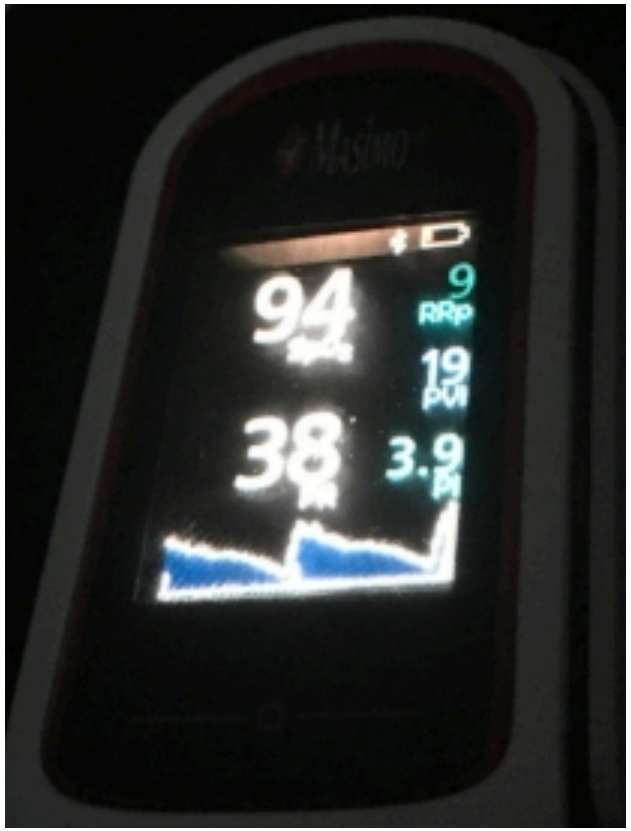
- Low flow passive oxygen delivery devices (nasal cannulae, simple face masks, NRFM) entrain room air. Entrainment of room air defeats optimal oxygenation.
- NRFM at 15 liters delivers 60 – 90% and BVM at 15 liters delivers 100% O2 to a spontaneously breathing person.

Passive Preoxygenation

- If you can preoxygenate someone with a 100% non-rebreather and you have enough flow, you get rid of all the nitrogen in the lungs and replace it with an oxygen reservoir.
- Pre-oxygenation of the spontaneously breathing patient with adequate pre-intubation oxygen saturations can be accomplished by breathing oxygen through a NRFM or BVM at 15 liters flow for three minutes.
- Eight vital capacity breaths of near 100% O2 may also accomplish adequate re-oxygenation in an otherwise healthy adult allowing up to six minutes before critical desaturation occurs during rapid sequence intubation.

Passive Preoxygenation

- Pre-oxygenation will be predictably much less effective in younger paediatric patients, bariatric patients, pregnant patients, geriatric patients and patients with shunt physiology (VQ mismatch).
- 15 liters of oxygen per minute by NRFM is an insufficient flow in a seriously tachypnoeic patient.
- Standard reservoir facemasks with the flow rate of oxygen set as high as possible (flush rate) are the recommended source of high FiO2 for preoxygenation in the ED.



Flush Rate Oxygen for Emergency Airway Preoxygenation.

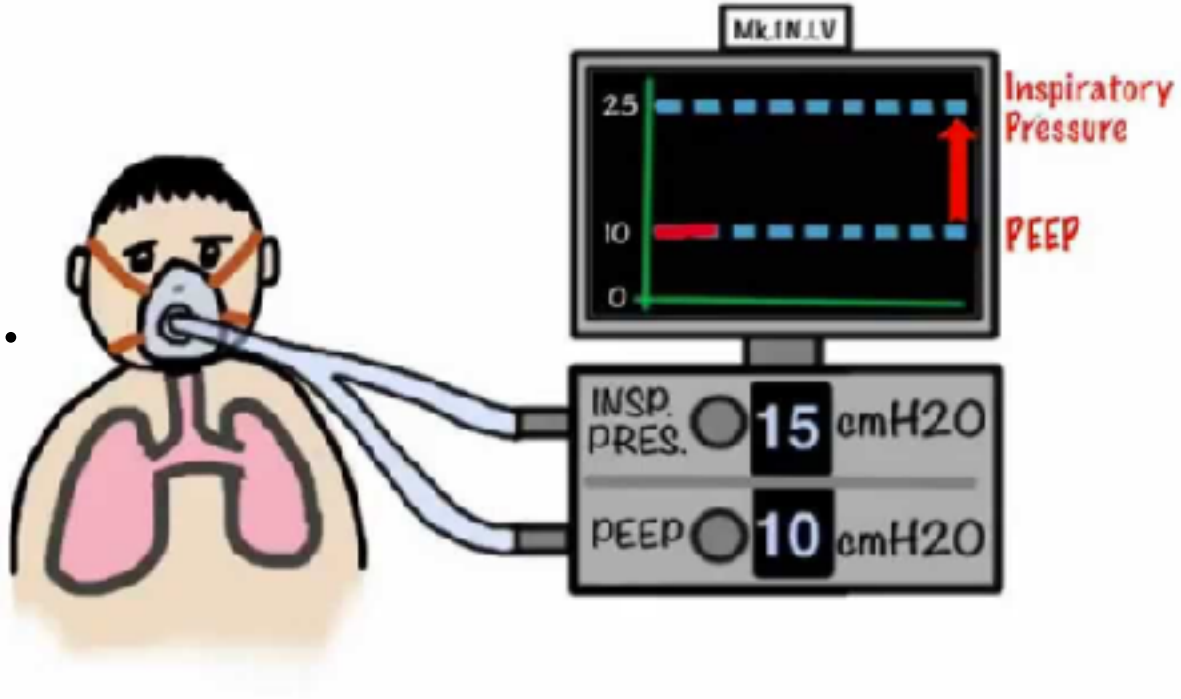
Driver BE, et al. Ann Emerg Med. 2017.

Authors

Driver BE[1], Prekker ME[2], Kornas RL[3], Cales EK[3], Reardon RF[3].

Passive Preoxygenation

- In the short term, shunt physiology can be partially overcome by augmenting mean airway pressure, thereby improving the effectiveness of preoxygenation and extending the safe apnea time.
- Noninvasive ventilation may be used to pre-oxygenate some patients with inadequate pre-intubation oxygen saturations by partially reversing shunt pathophysiology.

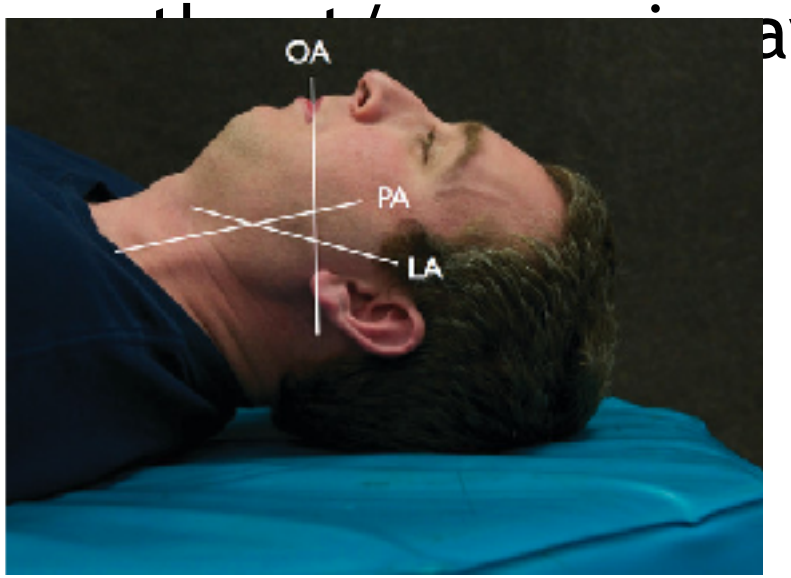


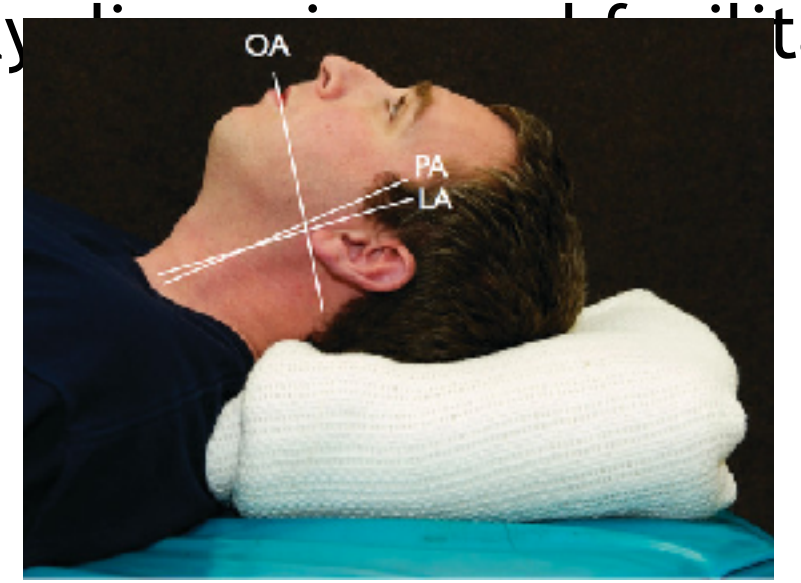
Passive Preoxygenation

- PEEP valves on a bag-valve-mask device should be considered for preoxygenation and ventilation during the onset phase of muscle relaxation in patients who cannot achieve saturations greater than 93% to 95% with high FiO2.

Passive Preoxygenation

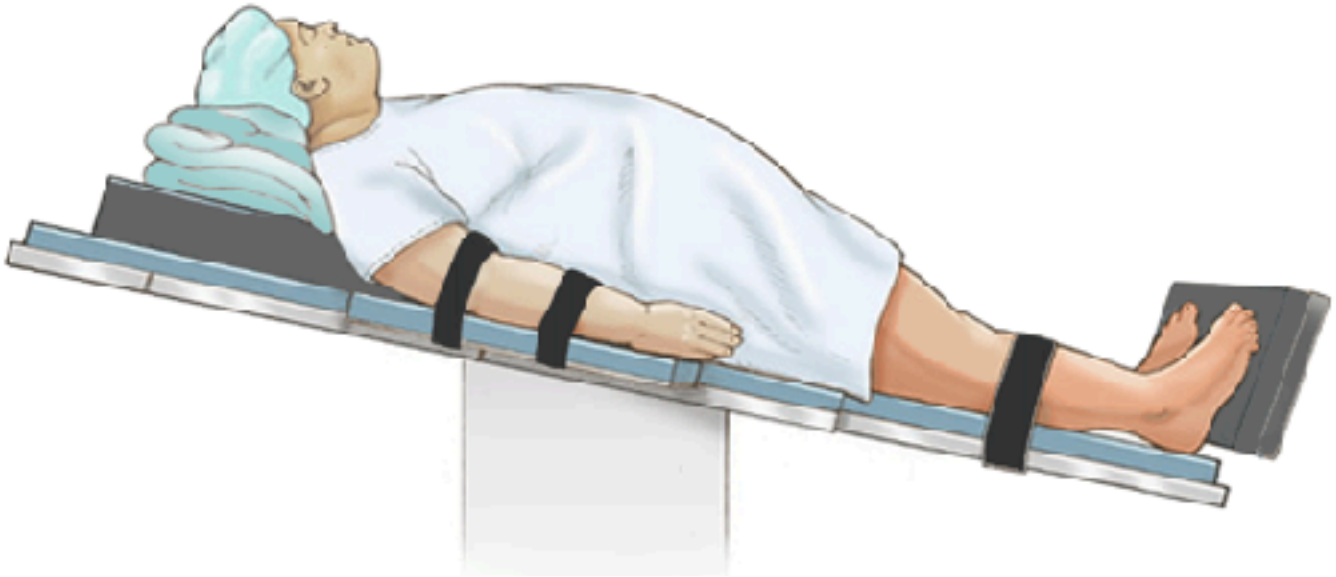
- Once the apneic period begins, the posterior pharyngeal structures should be kept from collapsing backwards by using a jaw thrust.
- Positioning the patient with their external auditory meatus on the same horizontal plane as their sternal notch maximizes jaw





Passive Preoxygenation

- For the obese patient, positioning requires a very large ramp.
- The foot of the stretcher should be tilted downward (reverse trendelenberg) to improve pulmonary function.



J Anesth (2011) 25:189–194
DOI 10.1007/s00540-011-1098-3

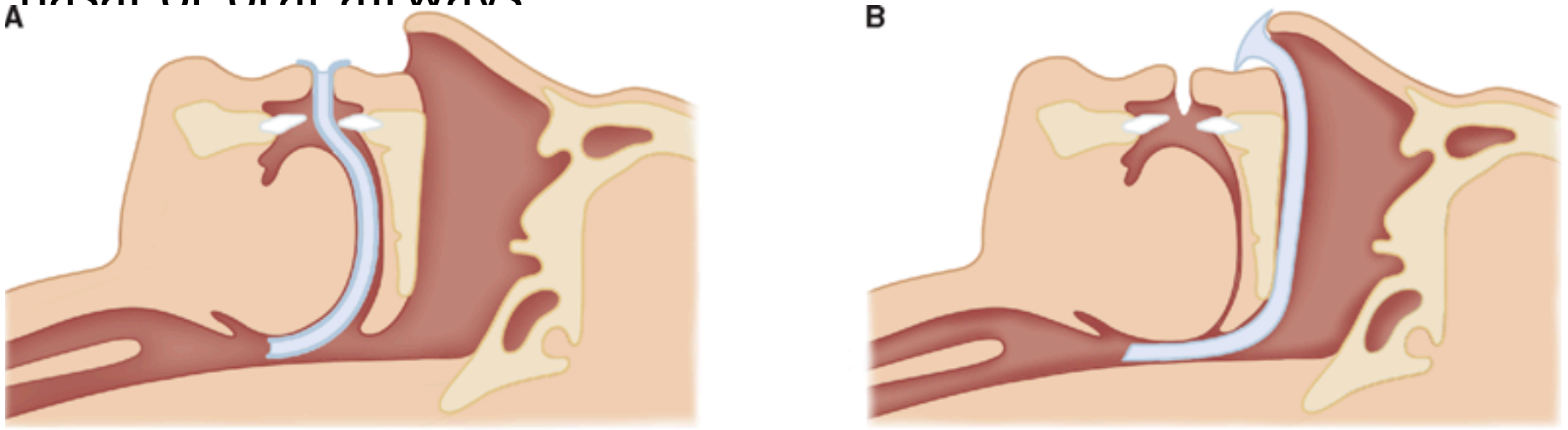
ORIGINAL ARTICLE

Preoxygenation with 20° head-up tilt provides longer duration of non-hypoxic apnea than conventional preoxygenation in non-obese healthy adults

Venkateswaran Ramkumar · Goneppanavar Umesh · Frenny Ann Philip

Passive Preoxygenation

- In some patients, a nasal trumpet or oral airway may also be required.
- Patients with sleep apnea or obesity often need a combination of jaw distraction, lifting of submandibular soft tissue, and nasal or oral airways

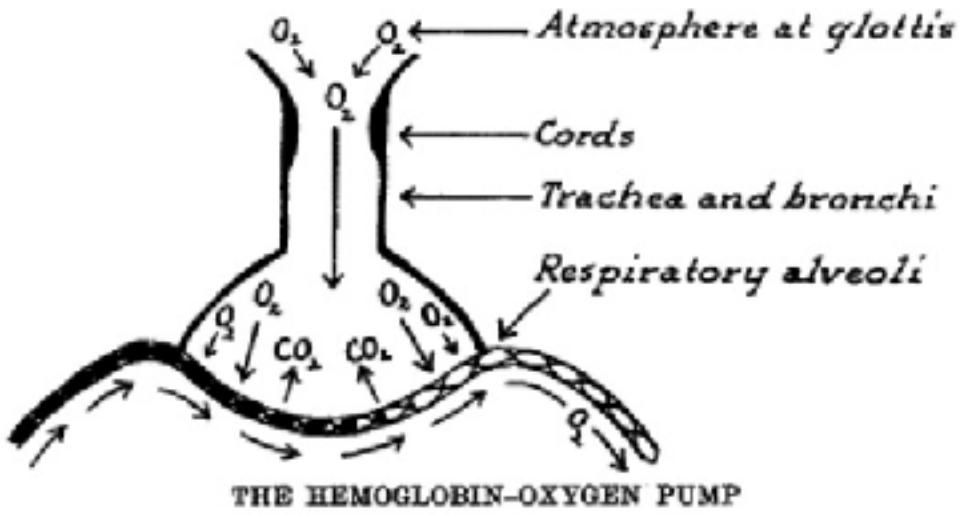


Apnoeic Oxygenation

- Bag-valve-mask devices provide no oxygen to apnoeic patients unless manual ventilations are delivered. Even with manual ventilations, a continuous flow of high-level FiO2 will not be available with this device.
- Providing the apnoeic patient 15 liters of oxygen by nasal cannula under a non-rebreather face mask with “flush” flow oxygen (apnoeic pre-oxygenation) has been shown to significantly prolong the time to critical desaturation during rapid sequence intubation.

Apnoeic Oxygenation

- Nasal cannula devices can be left on during the tracheal intubation attempts. This allows the continued benefits of apneic oxygenation while tracheal intubation techniques are perf



THE HEMOGLOBIN-OXYGEN PUMP

Apnoeic Oxygenation

- In critically ill patients with very high degrees of shunting, apneic oxygenation alone is unlikely to be helpful.
- If patients require CPAP during their preoxygenation period, it may benefit them to have the device left on until the moment of tracheal intubation. Whatever predisposed them to experience shunting will recur during the apneic period if they remain at zero airway pressure.

Active Preoxygenation

- If needed, for the patient demonstrating inadequate pre-oxygenation, assisted BMV may be performed, timed to deliver a positive-pressure breath with the patient's inspiratory effort.
- Ventilation provides 2 potential benefits during the onset phase of muscle relaxation: ventilation and increased oxygenation through alveolar distention and reduction in shunting.

Apnoeic Oxygenation

- If a bag-valve-mask device is used during the onset of muscular relaxation, a PEEP valve will provide sustained alveolar distention.
- PEEP also prevents absorption atelectasis caused by breathing high FiO2 gas level, increasing the efficacy of apneic oxygenation.

Active Preoxygenation

- Ventilations should be delivered slowly (during 1 to 2 seconds), involve a low volume (6 to 7 mL/kg), and be administered at as low a rate as tolerable for the clinical circumstances (6 to 8 breaths/min).
- Bag-valve-mask device inspiratory pressures greater than 25 cm H2 O can overwhelm the esophageal sphincter and put the patient at risk for regurgitation and aspiration. Gastric distention and resulting aspiration is unlikely at pressures below 25 cm H2O.

Active Preoxygenation

- Difficult mask ventilation is usually easily resolved by altering technique, including the early use of an oral airway combined with two person BMV.
- An adequate jaw thrust is the key to effective BMV.

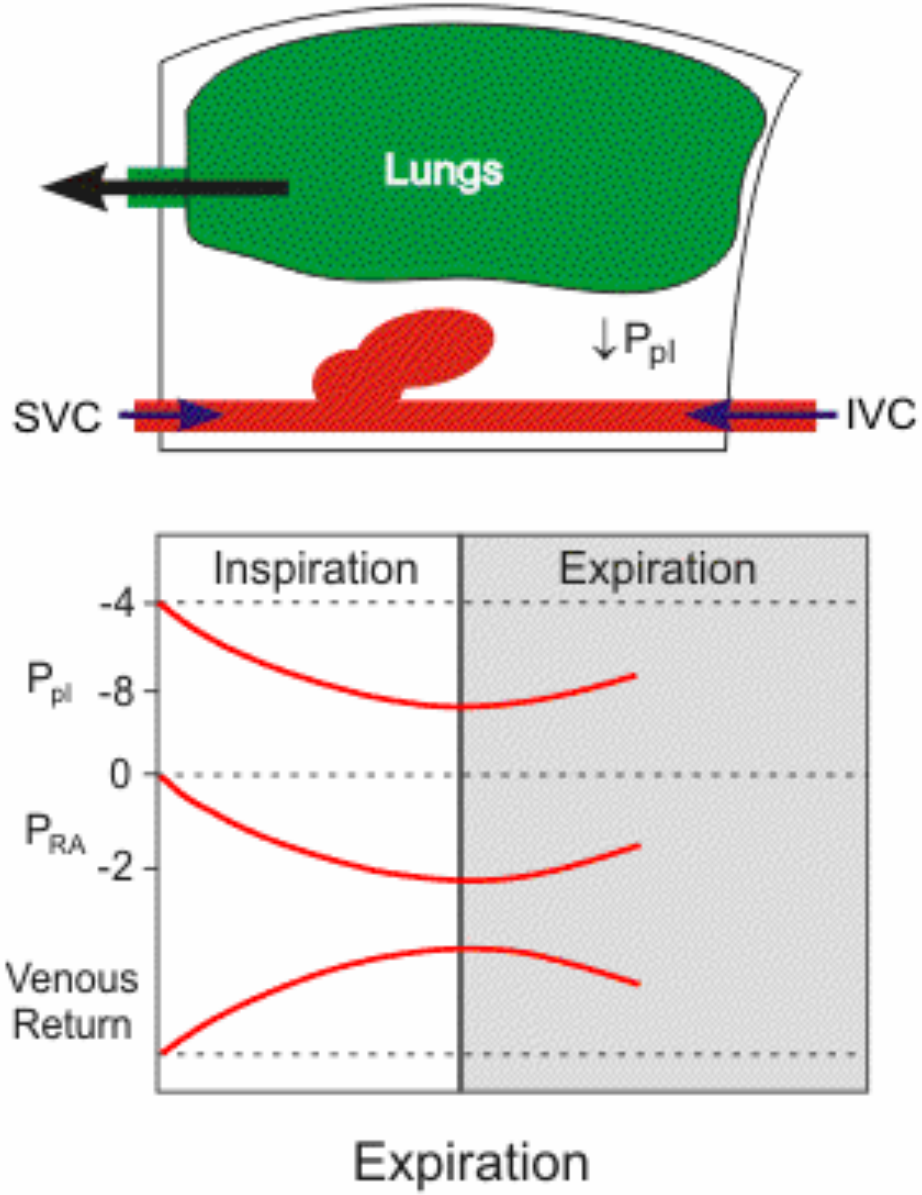
Cricoid Pressure

Numerous ventilation studies have found that cricoid pressure hinders bag valve-mask device ventilation, increases peak inspiratory pressure, and reduces tidal volumes.

For the same reasons that the airway obstruction induced by cricoid pressure may preclude effective manual ventilation, it may limit the effectiveness of apneic oxygenation as well.

Active Preoxygenation

- A significant risk of positive-pressure ventilation in the critically ill patient involves decreased venous return and hypotension. This is especially significant in low flow states from any cause (hypotension), volume depletion, acute respiratory distress syndrome, and obstructive airway disease (with attendant risks of intrinsic PEEP).



Active Preoxygenation

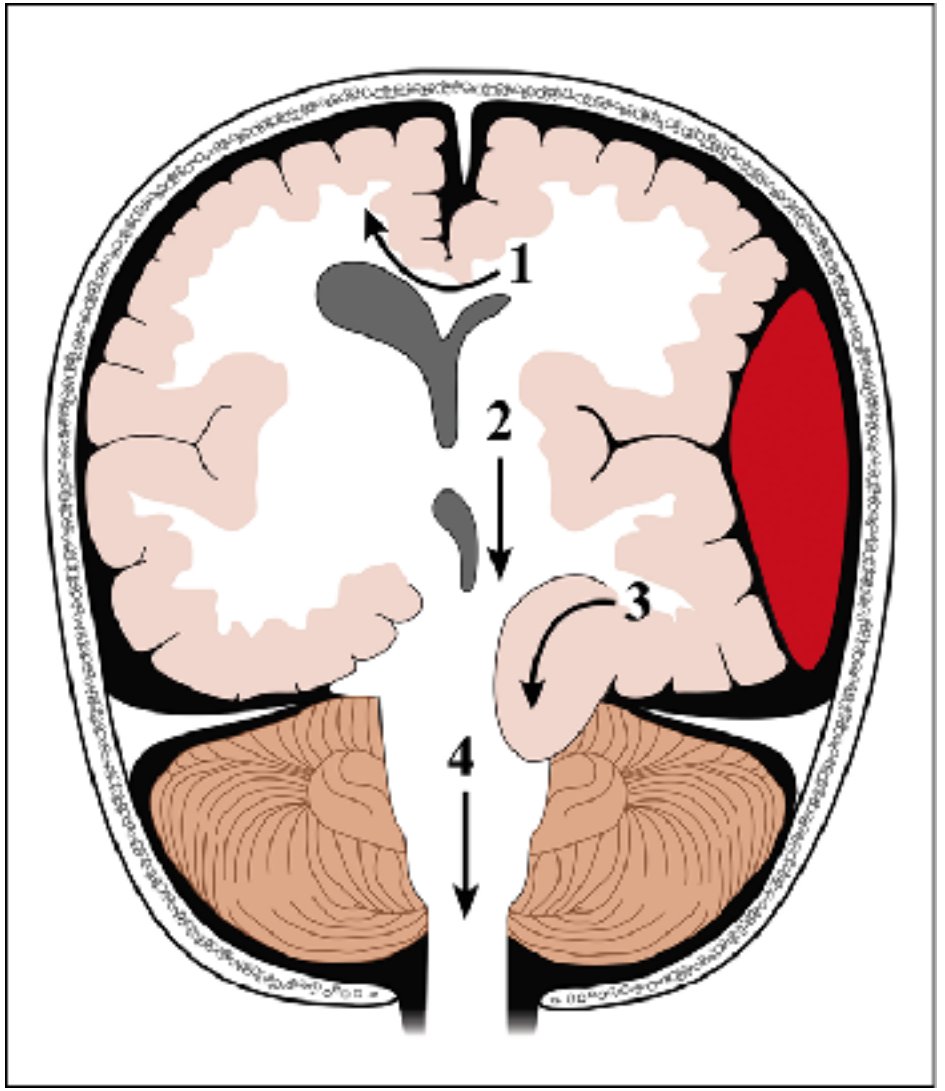
- Overventilation in such patients may precipitate hemodynamic collapse, and clinicians must be mindful of rate, volume, and speed of ventilation in these situations. Relative hypoventilation and resultant permissive hypercapnia may be required to avoid hemodynamic collapse.

Active Preoxygenation

- On average, PaCO2 increases 8 to 16 mm Hg in the first minute of apnea and then approximately 3 mm Hg/minute subsequently. It is rare that this degree of PaCO2 increase and pH decrease will be clinically significant.
- An exception is a profound metabolic acidosis in which patients compensate for the acidosis through hyperpnea and tachypnea. Aggressive ventilation is needed for such patients because cardiovascular collapse with cessation of self-ventilation has been reported.

Active Preoxygenation

- A second exception is in situations of increased intracranial pressure, in which the carbon dioxide increase can lead to cerebral vasodilation, worsening intracranial pressure.



Active Preoxygenation

- The risk/benefit of active ventilation during the onset phase of muscle relaxants must be carefully assessed in each patient.
- In patients at low risk for desaturation (> 95% saturation), manual ventilation is usually not necessary.
- In patients at higher risk (91% to 95% saturation), a risk-benefit assessment should include an estimation of desaturation risk and the presence of pulmonary pathology.

Summary

1. There are defined indications for intubation.
2. Hypoxia is a potentially lethal complication of airway management.
3. Preoxygenation can extend the duration of safe apnea in every RSI.
4. Apneic oxygenation can extend the duration of safe apnea in those at risk of hypoxia.
5. Active preoxygenation may be necessary in hypoxic patients but introduces potential risks.
6. Cricoid pressure introduces more risk than benefit.