

The Keys to Switching Over to Positive Pressure Ventilations

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The consensus of most emergency and acute care providers is that over-ventilation is probably the most dangerous and harmful consequence of manual ventilations during a resuscitation. Some even refer to conventional adult sized, one and a half to two liter, bag valve mask ventilators (BVM) as “the bag of death”; others have dubbed it one of the “most dangerous tools” in a provider’s tool box. Pulmonary physiology can be a lifelong study, but a few simple truths can be explained quite simply.

Traumatize any of the body’s tissues or organs enough and it will fail, especially our lung tissue, specifically the alveolus. Under normal circumstances, this is the key to our respiration, the place where the magic of diffusion occurs, oxygen in and carbon dioxide out. It’s an impressive system actually, our diaphragm contracts, flattens out, increases the volume of our chest, dropping the intrathoracic pressure and allowing air to fill our lungs; this is the basis for negative pressure ventilation or how we breath as healthy animals. Now in disease states when we are unable to breath on our own or our alveoli are collapsed, filled with junk or destroyed, we then run into real potential problems.

Positive pressure ventilation is usually needed when we are too sick to breathe normally. With positive pressure breaths, we push instead of pull air into our lungs. This is fine if you do it right, like anything else in this world. Push too hard or too much and bad things happen to our pulmonary system. Too much volume, too much pressure, too much variation from normal all lead to damage and destruction of the alveolus. Key things to remember when we need to switch over to positive pressure ventilations:

- 1. Always control the rate.** Use of a metronome or the respiration rate on the capnograph will help control our intrinsic need for speed, remember speed kills, especially with fast artificial respiratory rates. Even small volume breaths, times too many per minute, lead to excessive minute volumes and pressures. When left unchecked, lead to over pressured alveoli, increased intrathoracic pressures, barotrauma, hypotension, ischemic cardiopulmonary tissue, ARDS and a death spiral. Normal adult respiratory rates are 12-20 bpm, half that if in cardiac arrest.

- 2. Always control the volume.** Use a pediatric 400 or 500 mL BVM, squeeze an adult sized (one-liter) for chest rise or better yet, set the correct tidal volume on a ventilator to act as your BVM during a resuscitation. Tidal volumes are based on a patient’s height not weight. Most adults need 6-8 mL per kilogram of IDEAL BODY WEIGHT, which is based on height and gender, [Ideal Body Weight (Devine formula): (IBW) (men) = 50 kg + 2.3 kg x (height, in - 60); (IBW) (women) = 45.5 kg + 2.3 kg x (height, in - 60)]. So, a 6-foot-tall man needs approximately 500mL and a 5-foot-tall lady needs only 300mL tidal volume with healthy lungs, less if diseased, obstructed or ARDS.

- 3. Always use PEEP if you are failing to oxygenate the blood.** The number of functional alveoli is directly proportional to the to the pO₂. The more open and working air sacks available for diffusion will increase the lungs ability to oxygenate the blood and decrease the CO₂. Positive end expiratory pressure (PEEP) is simply the pressure artificially maintained after you exhale to splint the airway open, from the lips to alveoli. Once the alveolus is open it needs to stay open, because each time you collapse and alveoli it is much more difficult to reopen it. Recruitment is the process of opening and maintaining the alveoli open for gas exchange. Increases to FiO₂ and PEEP should work together; as you notice hypoxia, increase FiO₂ AND PEEP together to optimize your patients.

So, our recommendations, for all of your patients, to keep them safe and moving in the right directions, are to watch your rate, volume and use PEEP early and often during artificial respirations.

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