ET Tube Cuff Pressures: Avoiding the Avoidable Airway Disaster

You are on scene with your partner performing an intubation. Your partner announces that he sees the tube pass through the cords and almost seamlessly you inflate the cuff with 10 mL of air while he pulls the laryngoscope blade and attaches the bag valve mask (BVM) with end-tidal CO^2 ($ETCO^2$). Up to this point it seems like everything has been performed exceptionally; however, there is one major flaw hidden in these actions. Have you ever considered the pressure that should go into the endotracheal tube (ET) cuff? If you follow National Registry teaching, perpetual practices, and the way the manikin taught us, then odds are no. But why is this important? Below are two examples of cases which I was consulted on that will change your practice tomorrow.

The first case is a teenage patient that presented in status epilepticus. The crew decided to perform rapid sequence intubation (RSI), and called for additional help, pre-oxygenated, prepared their equipment, pushed the drugs, and intubated the patient without any difficulty or issues. The intubation was performed by video laryngoscopy and placement was confirmed by two people. There was no doubt the tube was in the trachea. Patient $ETCO^2$ rapidly decreased, but to a perfectly formed waveform (Fig. 1) and there was noticeable neck and chest swelling rapidly emerging.

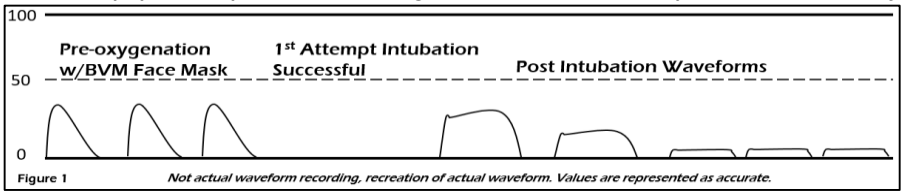

Figure 1 *Not actual waveform recording, recreation of actual waveform. Values are represented as accurate.*

This perfectly formed waveform, 7-8 mmHg, persisted for the remainder of care and did not present like a slurred esophageal intubation would. The crew rapidly confirmed placement, again, with video laryngoscopy; however, swelling and redness rapidly presented in the neck and chest area. The crew thought this was an allergic reaction to the RSI drugs and began giving Benadryl, Solu-Medrol, and transported immediately. Blood pressure (BP) remained unchanged and auscultation of lung sounds was unreliable during transport. SpO^2 continued to drop and as they arrived to the hospital where the patient arrested.

The second case was a mid-60-year-old male who presented in severe respiratory distress secondary to congestive heart failure CHF. Initial treatments were ineffective and RSI was chosen as the course of action. Again, additional help, pre-oxygenated the patient, drugs were pushed, the patient was intubated without any difficulties, and the ET tube cuff was inflated. Placement was confirmed by video laryngoscopy. $ETCO^2$ waveform was perfect and based on lung sounds identified to be a right main stem. The ET tube was deflated and retraced 3-4 cm, reinflated, and bilateral breath sounds confirmed. However, the waveform presented almost identical to the case in Fig. 1. Video confirmed the placement again; however, oxygen saturation began to drop and BP remained unchanged. This was presumed to be an $ETCO^2$ equipment malfunction. The patient arrested just before arriving to the hospital.

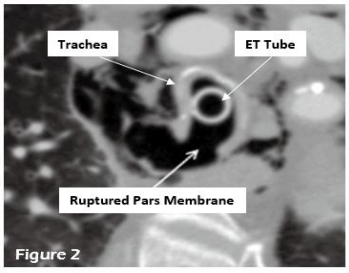

Figure 2
CT showing full perforation of the Pars membrane resulting in mediastinal emphysema
Site: Ovari et.al (2014) Journal of Thoracic Disease

It was determined that both of these patient's share a commonality…tracheal rupture caused by hyperinflation of the ET tube's bulb within the trachea. In the first case, a pediatric with a smaller airway received 10 mL of cuff inflation which ruptured the upper portion of the trachea. What was mistaken for an allergic reaction was subcutaneous emphysema. The second case was a right main in mediastinal emphysema, which is difficult to detect until it manifests into a tension pneumothorax. These outcomes are mainly due to our lack of appreciation for the ET tube compared to the tracheal size that differs between all patients demonstrated in Fig. 3. Both represent the same size tube; however, two different size trachea requiring two different mL of air.

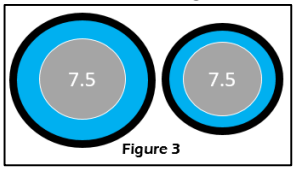

Figure 3

Our historical practices, training, and education failed the providers. In both cases, these outcomes could have been avoided had the providers known to pay attention to ET tube cuff pressure with the same reverence we pay attention to $ETCO^2$ and SPO^2. **The blind inflation of 10mL into the ET cuff should be immediately abolished**. **Safe cuff pressure is 20-30 cmH_20**. Sengupta, et. al., (2004) demonstrated that even trained anesthesiologists over-inflate the ET tube cuff pressure by 2-3 times the needed pressure. Anecdotally, I have tested this similar theory with many field paramedics and found a typical pressure of 70-90 cmH_20 when intentionally palpating the piolet bulb and commonly over-inflate to 100 cmH_20 when performing in a scenario situation by "slamming 10mL". Even if the trachea does not rupture, which often does not, cuff hyperinflation results in almost immediate ischemia of the tracheal tissue, and if left for a prolonged time puts the patient at risk for tracheal tissue infarction.

So, what do we do with this? I have no conflicts of interest and only interested in the safe treatment of the patients we encounter. The use of a manometer device, such as a syringe manometer (Fig. 4), to measure the actual cuff pressure is key to this success. If your service cannot afford one for every intubation bag, it should be part of airway training to experience the accurate tactile firmness which achieves the 20-30 cmH20. We owe it to our patients and ourselves to abandon a dangerous, habitual, thoughtless practice and to strive to provide accurate, intentional, and thoughtful medicine.

Figure 4

By: Eric Steffel, NRP, BSEMSA.
Clinical Educator, Northwest Community Health, Inc.
Tomball, Texas. Eric.Steffel1@gmail.com

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Sengupta, et. al., (2004). Endotracheal tube cuff pressure in three hospitals, and the volume required to produce an adequate cuff pressure. *BMC Anesthesiology.* *https://www.ncbi.nlm.nih.gov/pmc/articles/PMC535565/*