The EMS-Delivered Airway

by Rich Levitan, MD on August 23, 2011
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The EMS-delivered tube presents specific challenges for EPs and always requires rapid assessment on arrival

When a tubed patient is delivered by EMS with good oximetry and capnographic readings (clear repeating wave forms), plus bilateral breath sounds over the axillae and easy ventilation through the tube, thank your EMS personnel for a job well done. Check the depth of tube placement (21 cm for adult females, 23 cm for adult males at the teeth) and that the pilot balloon is intact. Inspect the CXR and monitor the ventilator for proper tidal volume return and appropriate peak pressures. Finally, at some point tube cuff pressures should be checked; mucosal injury to the trachea may occur from over inflation. This is common in field-placed airways and aeromedical transport.

Tube depth should always be verified before shooting the chest radiograph. Large scale studies have verified the reliability of 21 cm for woman and 23 cm for men at the teeth (or dental line). The tube tip should be visible on the CXR over the second thoracic vertebrae and above the carina. On occasion the tube can be curled in the mouth, seemingly correct at the teeth but not be far enough in. This can result from patient transport or maneuvering as well. This occurred in a case in which a patient was turned post-intubation for a lumbar puncture. After the procedure was done the pulse oximeter reading remained adequate but the nurse noted the cuff was soft and added air. The patient had increasing sedation requirements (increased heart rate and BP despite many doses of benzodiazepines; the patient had also received a long-acting muscle relaxant). Breath sounds were present but on a chest radiograph the tube was not visible. With laryngoscopy a massively dilated tube cuff, the size of a baseball, was at the level of the larynx. Removing the over-inflated cuff from the larynx, and replacing the tube, caused vital signs to normalize, but the patient ended up with a large aspiration in his dependent lung. Over-insertion of a tracheal tube into a mainstem bronchi can cause hyperinflation of one lung, collapse of the contralateral lung and hemodynamic deterioration. I have also seen the same effect from mucous plugging causing unilateral lung collapse. Combining an inspection of tube depth at the teeth, checking the mouth, ascultation of the lungs, CXR, and capnography can help sort out these perintubation pitfalls.

With a poor pulse oximeter reading (with palpable pulses) there is a long list of possible problems. Verify end-tidal CO2 in every patient, ideally using capnometry and capnography; misplaced tubes have been reported in as many as 25% of EMS placed tubes. Verify that the oxygen tubing going to the BVM is connected; this happens surprisingly often in the chaos of transferring the patient and getting report. The tube may be in the trachea but the patient has an effective right-to-left shunt that is not overcome by a fiO2 of 100%. Fluids in the tube, trachea or lung will prevent oxygen delivery to the alveoli. This is usually visible through the tube and audible on auscultation. Suction through the tube, beyond the tube, and treat underlying pathology such as CHF. PEEP will maintain alveolar distention throughout the entire ventilatory cycle, maximizing oxygenation. Positioning is critical; at a minimum all patients should have their heads elevated to horizontally align the ear to their sternal notch. This translates to approximately 20-25 degrees head elevation. In the sickest patients a more upright position (i.e. sitting) may be needed. The morbidly obese can have significant atelectasis from supine positioning and may not be able to be ventilated when flat due to limitations of diaphragmatic excursion. For the cervical spine immobilized, tilt the foot of the bed lower than the head.

In patients with difficult bag ventilation, listen over the lungs and the neck and check for crepitus (i.e. subcutaneous emphysema). Consider COPD, asthma, and pneumothorax. High peak pressures in asthma or COPD should prompt evaluation for auto-PEEP, or air trapping, causing decreased venous return and hypotension. The pulse oximeter reading will deteriorate with decreasing blood pressure. If not improved with decreasing minute ventilation, disconnecting the ventilatory circuit, or pressing on the chest to expel air, clinicians should have a low threshold to decompress the chest. Needle decompression is not entirely

reliable to relieve pneumothorax but can be done quickly while preparing for bilateral chest tubes. Auto-PEEP and barotrauma are the primary correctable causes of PEA arrest in patients with asthma and COPD. Be suspicious of these processes in any hypotensive asthmatic or COPD patient.

If there is an absence of air getting to the lungs, and noises over the neck with difficult bag ventilation, consider tube obstruction. There have been numerous case reports of field intubations and subsequent ventilation difficulty that resulted from tracheal tube obstruction from chewing gum or teeth. It is presumed patients aspirated the foreign body when they collapsed, and subsequent intubation and ventilation (or patient coughing) then caused the object to be propelled upward into the tube. Tube obstruction will be evident with attempted suctioning through the tube by inability to pass a suction catheter.

With absent pulses, determination of tube position is not reliable based on auscultation, moisture in the tube, or colormetric end-tidal detectors. Some studies have demonstrated that capnographic and capnometric end-tidal devices can distinguish tracheal from esophageal placement, even in cardiac arrest. If exposed to room air the colorimetric CO2 detector will be initially yellow (and not cycle from purple to yellow); this will falsely suggest a tracheal placement even if the tube is in the esophagus. I have seen this occur when patients have a delayed arrival after a radio notification, and the detector was opened too early.

It can also occur when the detector package has an air leak. An esophageal intubation detector (EID), such as a self-inflating bulb or syringe, can detect tracheal vs. esophageal placement but has some pitfalls. They may have indeterminate results (slow refilling) when there is a lot of fluid or stomach contents in the trachea, or in morbid obesity. If the connection between the EID and the tube is not tight, air is sucked in and the bulb will reinflate regardless of location. The better devices have a rubber ring to prevent this error from occurring. Regardless of what additional verification method is used, I still listen high in the axillae and over the stomach, and check to see if the abdomen is tympanitic. I once received a VF-asystolic arrested patient with a distended abdomen and audible flatulence with every squeeze of the bag from esophageal intubation. Though not subjected to a case series, suffice it to say that flatulence is not a recommended means of checking tube placement.

There is no reason not to check tube location in cardiac arrest by direct laryngoscopy or with a video laryngoscope. With direct laryngoscopy, use bimanual laryngoscopy and side-to-side laryngeal displacement to observe the tube passing immediately beneath the epiglottis, adjacent to the cords, and above the posterior cartilages and interarytenoid notch. Video laryngoscopy of a previously placed tube is very fast; the location of the camera and wide panorama of the larynx makes determination of tube location very straightforward, although laryngeal manipulation may be helpful here as well. Ultrasound enthusiasts have advocated checking tube location directly over the neck or by observing a sliding lung sign over the chest with ventilation. While I am an advocate of ultrasound in cardiac arrest I want to see the tube going through the larynx, and I think no ED physician should ever pass up the opportunity to view the larynx.
The EMS Delivered Airway Part Two will discuss patients who present with Combitube and King LT airways.

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