CONVERTING FROM AN ENDOTRACHEAL TUBE TO TRACHEOSTOMY: DESCRIPTION OF A PROPOSED ALTERNATIVE APPROACH

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Replacing an existing endotracheal (ET) tube with a tracheostomy tube can be a challenging and high-risk procedure for the patient, surgeon, anesthetist, and operating room staff. This article describes an approach designed to reduce the risks involved and, at the same time, provide a safe, efficient, and simplified approach to surgically securing the airway. Before surgical entry into the trachea, the ET tube is advanced just proximal to the carina and the ET cuff re-inflated. This approach has been used extensively at an academic medical center’s operating room without reports of outcome failure or complications. A review of the literature revealed occasional, unreferenced mention of “advancing the tube forward,” but the current report is the first detailed description of the procedure to appear in the literature.

Key words: Airway fire, elective tracheostomy, long-term ventilation, surgical airway.

Replacing an existing endotracheal (ET) tube with a tracheostomy tube can be a challenging and high-risk procedure for the patient, surgeon, anesthetist, and operating room staff. Some of the major acute risks include trauma to the airway, loss of the airway, plugging the airway with debris, and fire. This article describes a previously unpublished, detailed approach designed to reduce the risks involved in surgically securing the airway.

The management of a patient undergoing a tracheostomy with an ET tube in place is usually uneventful unless a surgical instrument lacerates the cuff of the ET tube. In this situation, the ensuing haste to secure the airway creates additional complexity and hazard. To reduce the risk, most texts and references recommend the anesthesia provider deflate the ET cuff and withdraw the ET tube so the cuff is not in the course of the scalpel.1-4 This approach is associated with several undesirable attributes, including the following:

- The ability to apply positive pressure ventilation is compromised or lost.
- Inadvertent extubation may occur.
- The surgeon is under “time pressure” to insert the tracheostomy tube.
- A risk of fire is present when using electrocautery in an oxygen-enriched environment.
- Blood and sputum may be aerosolized if the oxygen flush button is activated.
- Staff is exposed to anesthetic gas released through the open trachea.

This article describes an alternative technique based on my clinical experience. The method, which involves the anesthesia provider and others, is as follows:

- Before surgical instrumentation, deflate the ET cuff.
- Advance the ET tube until a main bronchus is entered, as determined by a change in breath sounds or chest movement with ventilation. Then withdraw the ET tube until breath sounds are heard bilaterally, and secure the position.
- Reinflate the ET cuff (tight, no leak), resecuring the airway.
- Surgically prepare the neck and upper portion of the chest for tracheostomy tube insertion.
- When the surgeon is ready to insert the tracheostomy tube, deflate the ET cuff and withdraw the ET tube to a point just proximal to the surgical entry point.
- Insert the surgical airway.
- Assess the adequacy of ventilation.

The preceding method achieves the following goals:

1. Uninterrupted positive pressure ventilation is achieved.
2. If desired, 100% inspired oxygen can be maintained as long as the ET cuff is inflated (with no leak) and distal to the incision.
3. There is no gas leak into the surgical suite until the ET tube is pulled back.
4. Electrocautery can be used with less risk of tracheal fire.
5. The surgeon can open the trachea without concern for the position of the ET cuff.
6. The risk of losing the airway is reduced.
7. The risk of aerosolized blood and secretions is minimized.
8. There is less time pressure to secure the airway.
Discussion
Most surgical and anesthesia textbooks and references describing tracheostomy recommend that when the trachea is entered surgically, the anesthesia provider should deflate the ET cuff and withdraw the ET tube.\textsuperscript{1-4} The goal of this maneuver is to protect the integrity of the cuff from the surgeon's knife. Often, this step fails to protect the ET cuff, and the ability to provide positive-pressure ventilation and an enriched oxygen mixture to the patient may be compromised or lost. A review of the literature failed to identify a detailed description of the approach proposed in this article.

\begin{itemize}
\item **Anatomical considerations.** The adult trachea will accommodate the advancement of an otherwise routine and properly placed ET tube\textsuperscript{5-8} (Figure 1). The pharynx is about 12 cm long, connecting the oral and nasal cavities with the esophagus and the larynx. Beyond the larynx, the trachea is about 12 cm long and about 25 mm in diameter in an adult. At the base of the trachea, the airway branches into 2 primary bronchi. The right main stem bronchus angles off the trachea at about 25\textdegree, compared with the left main stem bronchus, which takes off at about 45\textdegree. This favors the ET tube moving into the wider right main stem bronchus. The right bronchus adds an additional 2 to 5 cm of length to the airway (a total of 26-29 cm) into which the ET tube might safely, if temporarily, be advanced and still permit ventilation.

\item **Diameter.** The diameter of the adult airway easily accommodates the outer diameter of standard ET tubes used all the way down to the bronchi (Table). Notice that the largest outer diameter of the ET tube in almost every case is less than the smallest internal diameter of both male and female bronchi. In the male, the smallest measurement of the bronchus (12 mm) is 0.2 mm smaller than the 12.2-mm outer diameter of the ET tube. Remembering this is a range of measurements, the largest 14-mm inner diameter easily accommodates the 12.2-mm outer diameter of the ET tube. Clinicians using good judgment can safely and effectively advance the ET tube using only gentle pressure.
\end{itemize}

Detailed description and rationale for the procedure
Note: Deflating the cuff and advancing the ET tube can be done at any time before the airway is entered surgically. If possible, the anesthesia provider should advance the ET tube and check for bilateral breath sounds before surgical field preparation.

\textbf{Step 1.} Administer 100\% oxygen, and reconfirm breath sounds.

\textbf{Step 2.} Request that the surgeons inform you when they plan to open the airway so that the ET cuff can be positioned properly for surgical entry.

\textbf{Step 3.} Before the surgeons open the airway, remove the tape securing the ET tube. This makes it easy to advance the ET tube. Once the tape is removed, hold the ET tube and prepare to deflate the ET cuff.

\textbf{Step 4.} Deflate the ET cuff, and advance the ET tube until it enters a main bronchus, as determined by a change in breath sounds or chest movement with ventilation. Then withdraw the ET tube until breath sounds are heard bilaterally, and secure the position (Figure 2).

\begin{itemize}
\item When advancing the ET tube, it is possible that the ET tube, softened by the patient's body heat, may kink in the patient's oropharynx and will not advance down the trachea as intended. Placing the index and middle fingers on either side of the ET tube in the oral cavity permits guiding its advancement.
\item When advancing the tube, have the ET tube num-
\end{itemize}

**Table. Measurements of the trachea and bronchus and endotracheal tubes\textsuperscript{5-7}**

<table>
<thead>
<tr>
<th>Human parameters</th>
<th>Endotracheal tube parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID (mm)</td>
<td>ID (mm)</td>
</tr>
<tr>
<td>Female (physiological)</td>
<td>13-18</td>
</tr>
<tr>
<td>Trachea: 13-18</td>
<td>8.0</td>
</tr>
<tr>
<td>Bronchus: 12-14</td>
<td>7.0</td>
</tr>
<tr>
<td>Male (physiological)</td>
<td>13-18</td>
</tr>
<tr>
<td>Trachea: 13-18</td>
<td>7.0</td>
</tr>
<tr>
<td>Bronchus: 12-14</td>
<td>9.0</td>
</tr>
</tbody>
</table>

ID indicates inner diameter; OD, outer diameter.
bers facing the right side of the patient’s mouth. This places the small cuff inflation tube running down the side of the ET tube in a position that will not be compromised by the scalpel coming in contact with the ET tube.

Step 5. Reinflate the ET cuff, such that the peak inspiratory pressure required for adequate ventilation does not result in a leak of any kind past the ET cuff. Confirm the presence of end-tidal carbon dioxide bilateral breath sounds. Inform the surgeons that they may surgically enter the airway at any time. Continue positive-pressure ventilation with whatever fraction of inspired oxygen the patient requires. Electrocautery use may continue because the trachea is open to room air, and any oxygen-enriched air is isolated below the operative site. The ET tube itself should not be contacted by the electrocautery device in case the device is hot enough to melt the ET tube and cause an airway fire.

Step 6. Once the trachea is opened, the tracheostomy tube is readied for insertion (the ET tube itself serves as an “artificial anatomical landmark”). Slide a suction catheter down the ET tube, deflate the cuff, and slowly withdraw the ET tube while continuing to suction. Ask the surgeons to let you know when they see the tip of the ET tube pass the surgical opening, and make sure they do not mistake the suction catheter for the ET tube.

Step 7. Once the ET tube is just out of the surgical field, stop withdrawing the ET tube. Remove the suction catheter, but leave the ET tube in the trachea just proximal to the surgical opening in the trachea (Figure 3). In case the tracheostomy tube is malpositioned, it is easy to reinsert the ET tube, reinflate the ET cuff, and have a secure airway.

Step 8. Pass the breathing circuit up under the drapes to the surgical field. Once the circuit is attached to the tracheostomy tube, bilateral chest movement is visualized and end-tidal carbon dioxide confirmed. Only when adequacy of ventilation and oxygenation is confirmed should the ET tube be removed fully from the airway.

Caveats
Passing a suction catheter down the ET tube before withdrawing the ET tube past the surgical site facilitates removing blood, tissue, and other foreign bodies from the airway. This ensures that the first ventilatory efforts made through the tracheostomy tube will have a minimum of blood and tissue contamination.

Auscultation of breath sounds after advancing the ET tube will determine whether the tube is in a main stem bronchus. Intentional placement of the ET tube in a main stem bronchus results in breath sounds heard on only one side. Then deflating the ET tube cuff and slowly withdrawing the ET tube while checking for bilateral breath sounds ensures that the ET tube is just above the carina. In this position, the cuff will not encroach into the surgical field.

If fiberoptic technology is available, it would be a good to take a look and visually confirm placement of the ET tube just above the carina. The presence or lack of fiberoptic technology, however, is not essential to this technique.

Precautions, concerns, and contraindications
Use of this ET tube-advancement technique may not be appropriate when there are mass lesions that exist below the ET cuff. Attempting to advance the ET tube
under these circumstances must be considered carefully in discussion with the surgeon.

When the surgeon opens the airway, the recessed ET cuff inflation tube located along the side of the ET tube can be violated with one swipe of a scalpel. Making sure that the ET tube numbers are facing the right corner of the patient’s mouth will ensure the ET cuff inflation channel is on the posterior surface of the trachea away from the surgeon’s knife. This lowers the risk of inadvertent laceration of the ET cuff inflation channel.

A major concern during tracheostomy-related surgery is decreasing the risk of electrocautery-related fire. To minimize risk of this potentially catastrophic event, take the following steps:

1. Keep the fraction of inspired oxygen as low as the patient’s physiological condition will allow.
2. Make sure that the ET cuff is tight, with no leak at peak inspiratory pressures.
3. Warn the surgeons of the potential fire hazard from contacting the ET tube with the electrocautery device.

This technique will not work for patients who have nasotracheal tubes. Trying to advance the ET tube in this case does not move the cuff far enough down the trachea to be out of the possible path of the scalpel.

For a visual demonstration of the “Trach Trick,” please go to http://ahp1.sahp.vcu.edu/nrsa/chuck/trick.htm.

REFERENCES


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