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Airway Exchange Catheters

Simple Concept, Potentially Great Danger

AIRWAY exchange catheters (AEC) can be used to increase the safety of changing endotracheal tubes (ETTs).[1-3] An AEC is a long, small ID, hollow, semirigid catheter that is inserted through an *in situ* ETT before tracheal extubation. After the ETT is withdrawn over the AEC, the AEC serves as a conduit to administer oxygen manually, by insufflation, or by jet ventilation and as a stylet for repeated intubation. Because the repeated intubation rate is as high as 19% in extubated patients in the surgical ICU,[4-6] the airway management options provided by an AEC are extremely important and are well recognized by the American Society of Anesthesiologists.[7] Many types of AECs have been used[3]; however, the most widely used are the multiple-sized, appropriately adapted, centimeter-depth-marked, commercial variety made by Cook Critical Care (Bloomington, IN), Sheridan Catheter Corporation (Argyle, NY), and CardioMed Supplies (Gormley, Ontario, Canada).

This issue of ANESTHESIOLOGY includes a case report[8] that reminds us that although the concept of using an AEC is simple, failure to strictly adhere to a few simple principles and clinical details can result in life-threatening complications. These complications can be divided into two broad categories: (1) barotrauma resulting from air entry exceeding air exit (*e.g.*, as in the case report in this issue) and (2) failure to successfully pass the new ETT over the AEC.

This Editorial View accompanies the following article: Baraka AS: Tension pneumothorax complicating jet ventilation *via* a Cook airway exchange catheter. ANESTHESIOLOGY 1990; 91:557-8.

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Key words: Barotrauma; endotracheal tube; laryngoscopy; jet stylet; jet ventilation; pneumothorax.

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When air entry exceeds air exit, the inevitable sequence of events consists of lung hyperinflation, tension pneumothorax, pneumomediastinum, and subcutaneous emphysema. This will occur whenever air entry is relatively great and the space for air exit is relatively small. Air entry with jet ventilation through an AEC initially should be limited by presetting the jet ventilator at 25 pounds per square inch (psi) by using an additional in-line regulator and by limiting inspiratory time to less than 1 s.[9] For even the smallest AECs, a 1-s inspiratory time at 25 psi with a inspired oxygen fraction near 1.0 (air entrainment is minimal when a long catheter is placed in the trachea)[10] will provide life-sustaining ventilatory support.[10,11] Using a jet ventilator with an additional in-line regulator allows for breath-by-breath increases in tidal volume when clinical judgment indicates this is necessary.

If the equivalent annular air exit space that surrounds the AEC is less than a 4-mm ID ETT, ventilation will not be possible because exhalation time will become markedly prolonged.[12] Figure 1 shows that the number of ETT-AEC combinations is limited wherein the annular space around the AEC exceeds this minimally acceptable limit.[13] Thus, jet ventilation through an AEC should not be used when the ETT-AEC combination is in the white area of figure 1 (which includes the ETT-AEC combination used in the case report in this issue of the journal). In addition, when jetting through an AEC that is placed inside the trachea alone (rather than inside an ETT), the natural airway must be kept maximally patent with bilateral jaw thrust and oropharyngeal or nasopharyngeal (or both) airways. Finally, the AEC user must be cognizant of the depth of insertion of an AEC; not only does increasing the depth of insertion directly increase the risk of perforation of the tracheobronchial tree[14,15] but it also progressively decreases the annular air exit space surrounding the AEC. A prudent rule to follow is never to allow the centimeter calibration on the AEC to exceed a depth of 26 cm in an adult and never to insert an AEC when resistance is encountered. Two perforations of the tracheobronchial tree have been reported, and in both cases the tear was beneath the carina.[14,15]

Given the finding that even experienced users of AECs can have an 11% incidence (in 5 of 45 instances) of barotrauma when the AEC is used with 50 psi jet ventilation,[3,16] and even one instance of barotrauma has been reported at 20 psi,[17] the barotrauma considerations of low psi values, short inspiratory time, long expiratory time, and avoidance of excessive depth of insertion are extremely important. In addition, the anesthesia provider must be vigilant in keeping the upper airway maximally patent and must not use jet ventilation during phonation.

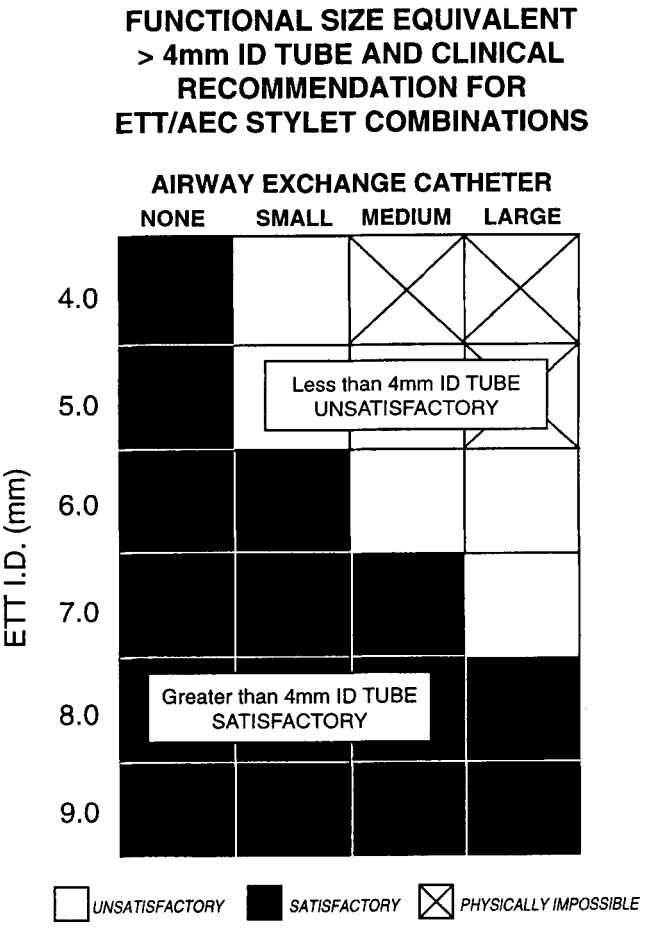

Fig. 1. Recommendations for endotracheal tube (ETT)–airway exchange catheter (AEC) combinations for functional size equivalent of annular space around the AEC when its inner diameter is more than 4 mm. (Modified with permission from Takata *et al.*[13])

The risk of failure to pass an ETT over an AEC can be minimized greatly if a laryngoscope is used concomitantly whenever possible. Optimal laryngoscopy will help to clear the supraglottic pathway the ETT must take over the AEC and may allow the endoscopist to visualize or understand where resistance is being encountered and how to address it. Failure of the ETT tip to pass the laryngeal inlet usually occurs because the tip has engaged the right vocal cord or arytenoid; the correct maneuver is a 90-degree counterclockwise rotation of the ETT (which rotates the tip from a 3 o'clock to a 12 o'clock position).[18,19] The risk that an ETT will fail to pass the laryngeal inlet is minimized

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when a relatively small ETT and a relatively large AEC are used.

There are many benefits to using an AEC. However, certain principles and details must be appreciated to use it safely and successfully. As with many procedures, simplicity plus an awareness of how to minimize the risk of serious complications is an efficacious combination.

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