CRITICALLY APPRAISED TOPICS

Is the esophageal detector device or end-tidal CO_2 measurement superior in confirming endotracheal tube placement?

Article chosen

Bozeman WP, Hexter D, Liang HK, Kelen GD. Esophageal detector device versus detection of end-tidal CO_2 level in emergency intubation. Ann Emerg Med 1996;27:595-9.

Clinical bottom line

The esophageal detector device (EDD) is easy to learn, simple to use, and is a useful and inexpensive adjunct to help confirm tube placement. It is as accurate as end-tidal CO_2 ($ETCO_2$) monitoring in identifying correct endotracheal tube (ETT) placement in patients with spontaneous circulation, and is more accurate than $ETCO_2$ in the setting of cardiac arrest. In this study, the EDD provided false-negative results (indicated that a well-positioned tube was malpositioned) in 1 of 99 patients, while $ETCO_2$ did so in 13 of 99 patients — 2 with pulmonary edema and 11 with cardiac arrest. A false-negative result means that, if the tube cannot be visualized passing through the cords or if there is not a dramatic clinical improvement in the patient's condition after intubation, the ETT may need to be replaced without the certainty that it was initially malpositioned.

The search

National Library of Medicine, Pub Med MEDLINE
Search terms: "esophageal" AND "detector" AND "equipment and supplies"
Yield: 22 citations

The evidence

Design: Prospective study.
Population: 100 adult prehospital intubations (99 tracheal, 1 esophageal).
Intervention: Endotracheal tube position assessed by EDD and $ETCO_2$ detector (waveform, not colorimetric).
Outcomes measured: Accuracy of ETT placement based on predetermined positive and negative responses from the two detectors, using clinical correlation as the gold standard.

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Results: Both the EDD and the $ETCO_2$ correctly identified the 1 esophageal intubation (true negative). The EDD correctly identified 98 of 99 tracheal intubations, for a true-positive rate (sensitivity) of 99%. The 1 false negative by EDD resulted from a plugged endotracheal tube in the correct location. The $ETCO_2$ detector correctly identified 86 of 99 tracheal intubations, for a sensitivity of 87%. $ETCO_2$ was incorrect (false negative) in 13 cases. Differences were most marked in the cardiac arrest group, where EDD correctly identified all 37 ETT placements and the $ETCO_2$ detector correctly identified 26 of 37 tube placements (sensitivity, 100% vs. 70%).

The sensitivities reported are meaningful; however, specificity — the ability to identify esophageal intubation — cannot be estimated because only one esophageal intubation occurred. Without a specificity estimation it is impossible to calculate likelihood ratios.

Positive predictive value (PPV) for both devices was 100%. Negative predictive value (NPV) was 50% for the EDD and 7% for $ETCO_2$; however NPV and PPV estimates are of limited usefulness, because only 1 tube was misplaced.

Comments

In contrast to waveform $ETCO_2$ detectors, the EDD is inexpensive, portable and easy to master. In patients with spontaneous circulation, the EDD is at least as sensitive as $ETCO_2$ for identifying correct ETT placement. In the setting of cardiac arrest, the EDD appears to be a more sensitive indicator

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of correct tube placement (100% vs. 70%). The inability of the $ETCO_2$ detector to correctly identify 11 of 37 anatomically correct ETT intubations among arrested patients suggests that, in this patient population, $ETCO_2$ assessment is not a reliable indicator of ETT placement. Macleod and colleagues[1] reported similar limitations in a 1991 study.

A negative test with either device will lead emergency physicians to re-examine the patient and verify ETT placement. With only one true negative in this series, and the false-negative test reflecting a blocked tube that may have been appropriate to replace anyway, a 50% NPV for the EDD is statistically meaningless.

One remaining caveat is that, in studies to date, there have been inadequate numbers of incorrectly placed endotracheal tubes to ascertain whether the EDD will correctly identify these incidents. It should be noted that there are only 4 reported false positives in the world literature describing the use of EDD.[2]

Recommendations

The EDD is a quick, portable, easy to learn and accurate device for initial assessment of correct endotracheal tube placement. It seems to be an appropriate adjunct for both ED and prehospital providers, to quickly assure tube placement. Emergency departments should consider equipping their airway carts with this simple device. Conversely, the $ETCO_2$ detector appears to be more appropriate for continuous monitoring of tube position, ventilation and circulation.

Readers are referred to the original EDD articles by Wee.[3,4]

References

1. Macleod BA, Heller MB, Gerard J, Yealy DM, Menegazzi JJ. Verification of ETT placement with colorimetric $ETCO_2$ detection. Ann Emerg Med 1991;20(3):267.

2. Ardagh M, Moodie K. The esophageal detector device can give false positives for tracheal intubation. J Emerg Med 1998;16 (5):747-9.

3. Wee M. The esophageal detector device. Anesthesia 1988;43:27-9.

4. Wee M. The esophageal detector device: an assessment with uncuffed tubes in children. Anesthesia 1991;46:869-71.

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SELECTED ARTICLES

Mannitol in head injuries

Clinical questions

In a head-injured patient with evidence of raised intracranial pressure (ICP), should mannitol be given? If so, in what dose and for what time period? How should patients receiving mannitol be monitored?

Article chosen

Schierhout G, Roberts I. Mannitol in acute traumatic brain injury [Systematic Review]. Cochrane Injuries Group. Cochrane Database of Systematic Reviews. Oxford; 1999. Issue 1.

Objectives

1. To compare the impact of dosing and duration on mannitol effectiveness.
2. To compare mannitol effectiveness to other ICP-lowering agents.
3. To quantify mannitol effectiveness at various stages following head injury.

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Background

A 1995 survey by Ghajar[1] reported that 83% of US centres used osmotic diuretics in over half of severely head-injured patients. Authors of similar surveys report that 100% of neurosurgical centres in the UK use mannitol.[2,3] The 1995 Brain Trauma Foundation Guidelines[4] recommend that mannitol be reserved for patients with signs of raised ICP