DETECTING METHODS OF ENDOTRACHEAL TUBE POSITION

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Objectives

• Review of conventional methods
• Good and Gold Standards for ETT positioning
• International recommendations
• An algorithm to confirm tube position
Endotracheal intubation is a potential minefield for disaster. Errors in its performance can be associated with high morbidity and mortality for the patient and legal liability for the practitioner.
Verification methods

- Observational verification
- Measured verification
- Anatomical verification
Observational verification

- Direct visualization
- Observation of chest movement
- Five point auscultation
- Presence of exhaled tidal volume
Observational verification

- Reservoir bag compliance
- Tube condensation with exhalation
- Absence of gastric contents within the ETT
Measured verifications

- End-tidal Carbon dioxide (ETCO₂)
- Pulse Oximeter
Anatomical verification

- Esophageal Detector Device (EDD)
- Chest Radiograph
- Lighted Stylet
Anatomical verification

- Sonography (USG)
- Fiberoptic Bronchoscope / Laryngoscope
- Video Assisted Laryngoscope
Direct visualization

- Non visualization of cords
- Dislodged tube (before / after securing)
- Inadvertent esophageal tube position after direct vision intubation *

* White SJ, Slovis CM. Inadvertent esophageal intubation in the field: Reliance on a fool’s “gold standard”. Acad Emerg Med 1997; 4: 89-91
Chest Movement

- Obesity - decreased or absent chest excursion
- Lung diseases - decreased or absent chest excursion
- Esophageal intubation does produce some degree of chest movement *

Auscultation – Axilla

• Breath sounds may be heard in both axillae but may result in misdiagnosis in up to 15% of all esophageal intubations.*

Epigastric Auscultation

- Not 100% reliable
- Gastric distention is gradual due to previous bag mask ventilation
End tidal CO$_2$ detection
End tidal CO$_2$ detection

• CO$_2$ in exhaled air confirms tracheal tube position in patients with spontaneous circulation *

End tidal CO₂ detection

Cardiac arrest

• CO₂ level > 2 % - confirms tracheal tube position
• Absence of CO₂ will not rule out esophageal intubation.

ETCO$_2$ useful as an adjunct to confirm ET tube placement

<table>
<thead>
<tr>
<th>Studies</th>
<th>LOE</th>
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<tbody>
<tr>
<td>Li.J et al, J. Emerg Med. 2001</td>
<td>1</td>
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<td>Germec S et al, Intensive Care Med 2002</td>
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End tidal CO₂ detection

• **Positive predictive value** (Endotracheal placement if CO₂ is detected) **100 %**

• **Negative predictive value** (Esophageal placement if CO₂ is *not* detected) **20-100%**
End tidal CO₂ detection

- Threshold to detect - 15 mmHg for the colorimetric capnometer
- Waveform may be detected at much lower levels with capnography

End tidal CO₂ detection

- Most reliable method
- Independent of user’s experience

False negative reading
(Failure to detect CO₂ when tube is in the trachea)

- Low Blood flow and CO₂ delivery to lung (CPR)
- Pulmonary embolism – decreased pulmonary blood flow
- Contaminated detector – gastric content and acidic drugs like epinephrine when administered through trachea.
False negative reading
(Failure to detect CO₂ when tube is in the trachea)

- IV Epinephrine will reduce elimination and detection of CO₂ *
- Severe airway obstruction
- Status Asthmatics
- Pulmonary Edema

Esophageal Detector Devices (EDD)
Esophageal Detector Devices (EDD)

- The EDD consists of a bulb that is compressed and attached to ET tube or a syringe that is attached to ETT.
Collapsible Esophagus & Non collapsible Trachea
Esophageal Detector Devices (EDD)

• The suction created by the EDD will collapse lumen of the esophagus and the bulb will not re expand
## EDD sensitivity for esophageal tube position

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<tr>
<td>Takeda T et al, Resuscitation 2003</td>
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<td>Pelucio M et al, Emerg Med 1997</td>
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<td>Tanigwa K et al, Anesthesiology 2000</td>
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<tr>
<td>Sherieff GQ. et al, Acad Emerg. Med 2003</td>
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<td>Wee MY et al, Anesthesia. 1991</td>
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<tr>
<td>Williams KN et al, Anaesthesia 1989</td>
<td>7</td>
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<tr>
<td>Zalesi L et al, Anesthesiology 1993</td>
<td></td>
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### EDD – Less specific for tracheal tube position

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<td>Tanigwa K et al, Anesthesiology 2000</td>
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Esophageal Detector Devices (EDD)

- Highly sensitive for detection of esophageal intubation *
- Poor specificity for tracheal tube placement
- EDD is not accurate for continuous monitoring

Pelucio M. Out-of-hospital experience with the syringe esophageal detector device Acad Emerg Med 1997; 4: 563-68
Tanigwa K. Accuracy and reliability of the self-inflating bulb to verify tracheal intubation in out-of-hospital cardiac arrest patient Anesthesiology 2000; 93: 1432-1446
EDD will be misleading

- Morbid obesity
- Late pregnancy
- Status Asthmaticus
- Copious ET Secretions
- Tracheal collapse
Pulse Oximetry

Useful?
Pulse Oximetry

Useful

But,

Delayed !!

* Benumof J. Critical Hemoglobin desaturation will occur before return to unparalyzed state following 1mg/kg intravenous succinyl choline. Anesthesiology 87, 979, 1997
Chest Radiography

Primary purpose is to ensure its position below the cords and above the carina *

Other methods

- Sonography
- Lighted Stylet
Other methods

- Fiberoptic scope
- Video Assisted Laryngoscope
International Recommendations
“Independent confirmation of correct tube placement by the use of devices that detect end-tidal CO$_2$ is mandatory for every endotracheal intubation performed in the emergency department and as part of the assessment of all patients who arrive at the emergency department already intubated”

American College of Emergency Physicians (ACEP) October 2001

End-tidal CO₂ detection, either qualitative, quantitative, or continuous, is the most accurate and easily available method to monitor correct endotracheal tube position in patients who have adequate tissue perfusion *

* Verification of endotracheal tube placement; policy statement. American College of Emergency Physicians. www.acep.org/1,4923,0.html
National Association of EMS Physicians (NAEMPS) – Position statement 1999

In the patient with a perfusing rhythm, end-tidal CO₂ detection is the best method for verification

Expired CO₂ detectors are very reliable in patients with perfusing rhythm and are recommended to confirm tube position in these patients (Class IIa) *

Association of Anesthetists of Great Britain & Ireland and American Society for Anesthesiologists (ASA) *

- Capnography is essential to the safe conduct of anesthesia
- Continual monitoring for the presence of expired carbon dioxide shall be performed unless invalidated by the nature of the patient, procedure or equipment


• Exhaled CO₂ detection is reliable indicator of ETT placement in infants and it identifies esophageal intubation faster than clinical assessment.

• NRP recommends using exhaled CO₂ detection to confirm tracheal tube placement

“Despite the recommendations issued by various National organizations that endorse continues monitoring of ET CO₂ for confirming ET tube placement, it is *neither widely available nor consistently applied*”

Suggesting
A
Practical
Approach !!
Intubate under direct vision (as far as possible)

Hold the ET Tube & Note down tube markings at lip level

Attach ETCO2 Detector, Start Ventilation

Look for adequate chest expansion

Do five point auscultation
Observe ETCO2 color change / Wave form / Digital display

+ve
Tube position is correct

-ve / ?
Use EDD
Rule out Esophageal tube position

Not reinflated

+ve
Re intubate

-ve / ?
Fiber-optic confirmation

Reinflated

Tube position is correct

Re intubate
Algorithm to confirm Tube Position

1. Intubate under direct vision (as far as possible)
2. Hold the ET Tube & Note down tube markings at lip level
3. Attach ETCO2 Detector, Start Ventilation
4. Look for adequate chest expansion
5. Do five point auscultation
6. Observe ETCO2 color change / Wave form / Digital display
   - +ve: Tube position is correct
   - -ve / ?: Use EDD Rule out Esophageal tube position
     - Not reinflated: Re intubate
     - Reinflated: Fiber-optic confirmation
       - +ve: Tube position is correct
       - -ve / ?: Re intubate
Conclusion

• Confirmation of proper tracheal tube placement is as important as successful intubation.
• Exhaled CO$_2$ detection is reliable and should be considered the standard for confirmation of tracheal placement of an ETT and for early detection of accidental esophageal intubation.
Conclusion

The Emergency Physician should make sure the availability of ET CO$_2$ detection devices in ER and with EMS team when they are in the field. They should also ensure usage of confirmation devices by the concerned persons.
Thank You

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