

NON-INVASIVE RESPIRATORY MONITORING

This procedure includes the following:

- Waveform Capnography
- Pulse Oximetry
- Colorimetric End-Tidal CO₂ Monitoring

WAVEFORM CAPNOGRAPHY

GENERAL CONSIDERATIONS

- A. End-tidal CO₂ (EtCO₂) is a measurement of carbon dioxide in the airway at the end of each breath. Capnography provides a numeric reading of the EtCO₂ and a graphic display (waveform) of CO₂.
- B. CO₂ produced by cells is transported via the vascular system and diffused into the alveoli to be exhaled. PaCO₂, the partial pressure of CO₂ in arterial blood, is normally 2 – 5 mmHg higher than EtCO₂ in the airway.
- C. Normal EtCO₂ is 35-45 mmHg. Figure 1 shows a normal capnography waveform.
- D. According to the American Heart Association, studies of waveform capnography to verify endotracheal (ET) tube position in victims of cardiac arrest have shown 100% sensitivity and 100% specificity in identifying correct ET tube placement. Continuous waveform capnography is required (in addition to clinical assessment) for the confirmation and monitoring of the correct placement of ANY advanced airway. This includes an endotracheal tube, I-GEL, LMA, King, or cricothyrotomy.

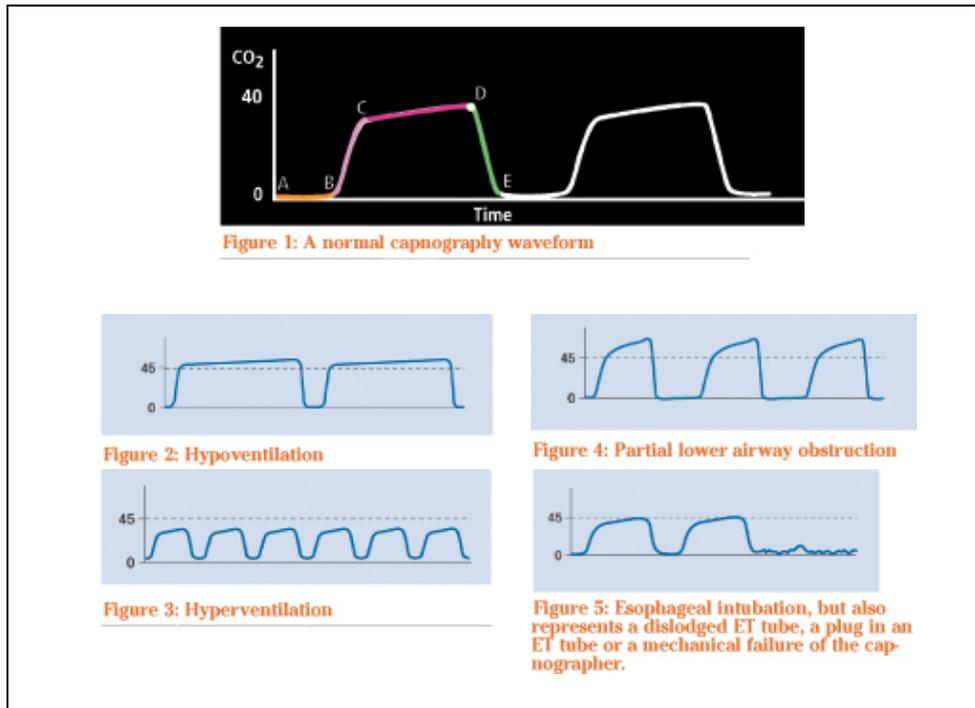
INDICATIONS

- A. Intubated patients
 1. Verification of the placement of any advanced airway
 2. Monitoring and detection of tube dislodgment (figure 5)
 3. Identify the loss of circulatory function
 4. Determination of adequate CPR compressions
 5. Confirmation of return of spontaneous circulation
 6. Monitoring of patients in the peri-arrest period
- B. Non-intubated patients
 1. Assessment of asthma and COPD (figure 4)
 2. Detection of apnea or inadequate ventilation
 3. Monitoring of hypo- and hyperventilation (figures 2 & 3)

PROCEDURE

- A. Use ET tube adapter for intubated patients

- B. A nasal-oral cannula can be used for non-intubated patients. This may also be used with CPAP.
- C. During CPR attempt to maintain EtCO₂ above 20 mmHg.



PULSE OXIMETRY

GENERAL CONSIDERATIONS

- A. Pulse oximetry is used in conjunction with other assessment processes to determine the actual available oxygen in the blood for use by body tissue. Pulse oximetry measures the oxygen saturation of red blood cells (% SpO₂).
- B. Clinical assessment and pulse oximetry may identify those patients in mild to moderate hypoxia and with proper intervention, profound hypoxia can be prevented,
- C. Hypovolemic, hypothermic, and peripheral vascular disease patients may not be suitable candidates for pulse oximetry due to peripheral shutdown.
- D. Be aware that there may be a 30-60 second delay between changes in SpO₂ conditions and pulse oximeter readings.
- E. A pulse must be detected by the oximeter in order to determine SpO₂.
- F. Pulse oximeter is not accurate with carbon monoxide exposures.

- G. COPD patients may normally have a low SpO₂ and should be treated based on clinical presentation and not solely based on pulse oximeter readings.

PROCEDURE

- A. Apply sensor to patient and obtain reading.
- B. Interpretation of reading:
- 100% to 96% Ideal Range – maintain oxygen and airway support methods being used
 - 95% to 90% Mild to Moderate Hypoxemia – Check airway; increase oxygen support and ventilatory support as needed to achieve ideal range reading.
 - 89% to 85% Severe Hypoxemia – Aggressive airway, ventilatory, and oxygen support is essential. Look for and treat cause.
 - Below 85% BE PREPARED TO INTUBATE and/or ASSIST VENTILATIONS

COLORIMETRIC END-TIDAL CO₂ MONITORING

- A. Endotracheal tube placement needs to be verified through clinical evaluation (lung sounds, chest rise, absence of sounds over the epigastric area) and by another confirmation device. Colorimetric End-Tidal CO₂ is one way to confirm ET tube placement.
- B. There are several brands of detectors available. Some are part of the bag-valve-mask and others need to be placed between the ET tube and the BVM.
1. Follow manufacturer's recommendations for storage and expiration dates.
- C. Must first verify that the initial color of the monitor strip is purple before use. See comparison strip or plastic housing for approximate colors. If the initial color is not purple, do not use this device to measure CO₂ levels.
- D. Ventilate the patients with six breaths of moderate tidal volume (may be done quickly). Interpreting results with less than six breaths can yield false results.
- E. Compare the color of the monitor strip on full-end expiration to the comparison strip or plastic housing. The monitor strip color should fluctuate with CO₂ levels for up to two hours.
- F. Interpretation of color change:
1. Purple (Color Range A) = CO₂ is 0.3% to less than 0.5% (< 4mmHg)
 - a. Causes: ET tube is in the esophagus or there is inadequate pulmonary perfusion (i.e., ineffective CPR)
 - b. "Purple means Problem"
 - c. Use laryngoscope to visualize ET tube placement. If ET tube is in the esophagus, remove tube and ventilate patient. Refer to Advanced Airway Management Procedure. If ET tube is visualized through the vocal cords into the trachea, take appropriate steps to improve CPR
 2. Tan (Color Range B) = CO₂ is 0.5% to less than 2% (4 mmHg to < 15 mmHg)
 - a. Retained CO₂ in the esophagus or low pulmonary blood flow
 - b. Deliver 6 additional breaths and re-evaluate. If color remains tan, ET tube is in the trachea with low pulmonary blood flow. Take appropriate steps to improve CPR.
 - c. "Tan means Think about it"
 3. Yellow (Color Range C) = CO₂ is 2-5% (15 -38 mmHg)

- a. ET Tube in the trachea.
- b. Continue to observe color change
- c. "Yellow means Yes or Yeah"

G. This device is not to be used for:

1. Detection of hypercarbia
2. Detection of mainstem bronchial intubation

H. Cautions:

1. Reflux of gastric contents, mucus, edema fluid, or intratracheal epinephrine into the detector can yield persistent patchy yellow or white discoloration which does not vary with respiratory cycle. Contamination of this type may also increase airway resistance and affect ventilation. Discard device if this occurs.
2. In cardiac arrest, re-establishment of cardiac output and pulmonary blood flow by adequate CPR is necessary to increase end-tidal CO₂ to levels detectable by the detector (above 0.5%).
3. The detector is not a substitute for observation of the patient. This device must not be relied upon as the sole indicator of resuscitation performance.