CLINICAL CAPNOGRAPHY

END-TIDAL CARBON DIOXIDE MEASUREMENT (ETCO₂)

Ron Sanderson
DrPH, MEd, RRT, RPFT, AE-C
Technology for assessing the ventilatory (CO$_2$ elimination) aspect of respiration has reached a point that it now surpasses pulse oximetry in monitoring respiratory rate and depth of breathing; therefore the combination of capnography and pulse oximetry are recommended standards of care.

Why is this a need to know topic?

Clinical Capnography
End-Tidal Carbon Dioxide Measurement (EtCO$_2$)
Clinical Capnography
(Measurement of EtCO$_2$)

Where will we be using this?

- Standard of care for procedural sedation
- New standard of care for patients with sedation IV pumps
- Useful to assess ventilation without an arterial puncture
- Standard of care for CPR intubation and cardiac compression assessment
Nasal Oxygen Cannula with CO$_2$ sampling line
CO\textsubscript{2} Sample Line for Vents and NIVs
CLINICAL CAPNOGRAPHY

Normal values:

\[ P_{E}CO_2 = 1 - 5 \text{ mmHg.} < P_{a}CO_2 \]

\[ P_{E}CO_2 = 35 - 43 \text{ mmHg.} \]

Since the exhaled CO\(_2\) is coming out of the blood via pressure gradient the \( P_{E}CO_2 \) will always be less than \( P_{a}CO_2 \) or \( P_{v}CO_2 \) at any given time.
Capnography

Normal Waveform

- Beginning of exhalation
- Alveolar plateau
- End of exhalation
- Beginning of new breath
- Clearing of anatomic dead space

THE STANDARD OF CARE
Physiologic factors affecting EtCO$_2$ levels:

**Increase in EtCO$_2$**

- Increased muscular activity (shivering)
- Malignant hyperthermia
- Increased cardiac output (during resuscitation)
- Bicarbonate infusion
- Tourniquet release
- Effective drug therapy for bronchospasm
- Decreased minute ventilation
Physiologic factors affecting EtCO$_2$ levels:

**Decrease in EtCO$_2$**

- Decreased muscular activity (muscle relaxants)
- Hypothermia
- Decreased cardiac output
- Pulmonary embolism
- Bronchospasm
- Increased minute ventilation
Steps to Success with EtCO$_2$

- Check for plateau on the waveform
- Whenever possible, correlate with a $P_aCO_2$

![Typical ETCO$_2$ Tracing](image)
Waveform often seen; not accurate numbers!

This curve shows $P_{ETCO_2} > 30$, however, we don’t know how much greater as the $P_{ETCO_2}$ has not stopped rising before the next breath. No plateau, Not accurate
| **PECO₂ Interpretation** – |  |
| --- | --- | --- |
| **Condition #1** | Waveform plateau present and \( P_{E}CO₂ \) correlates with a \( P_{a}CO₂ \) | Good for assessment of changes in minute ventilation. |
| **Condition #2** | Waveform plateau present and \( P_{E}CO₂ \) much lower than \( P_{a}CO₂ \). | Good for assessment of changes in \( V_D/V_T \) and trending changes in minute ventilation |
| **Condition #3** | Waveform does not plateau | Not accurate; marginal for trending minute ventilation; Useful for monitoring effectiveness of CPR |
1. Check for plateau on the waveform
2. Correlate with $P_aCO_2$ if possible
3. Always **THINK** about implications
EtCO\textsubscript{2} and Cardiac Arrest

The capnograph of an intubated cardiac arrest patient is a direct correlation to cardiac output.

Increase in CO\textsubscript{2} during CPR can be an early indicator of ROSC (Return of Spontaneous Circulation).
Termination of Resuscitation

EtCO2 measurements during a resuscitation give you an accurate indicator of survivability for patients under CPR.

**Non-survivors**

<10 mmHg

**Survivors**

>30 mmHg (to discharge)
ET Tube Verification

- Verification of proper tube placement

**no waveform = no tube!!!**

There is simply **NO BETTER WAY** to confirm proper tube placement than with waveform capnography.... PERIOD!!!