CAPNOGRAPHY by Nick Mark MD

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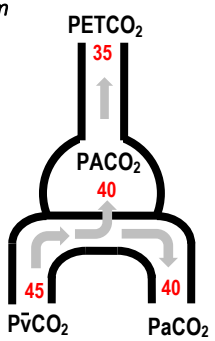
PRINCIPLE:

Measurement of exhaled carbon dioxide can be used to ***confirm ETT placement***, for ***safer procedural sedation***, to ***guide resuscitation***, and to ***monitor cardiac & pulmonary physiology***.

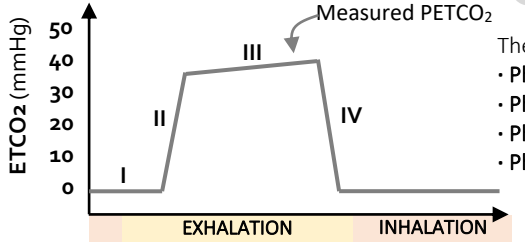
- **$PETCO_2$** – End-tidal CO_2 (what's measured by capnography)
- **$PACO_2$** – Alveolar CO_2
- **$P\bar{v}CO_2$** – Mixed venous CO_2
- **$PaCO_2$** – Arterial CO_2 (what's measured on an ABG)



$PETCO_2$ is usually less than **$PaCO_2$** because of dead space. If physiological dead space increases the difference between $PETCO_2$ and $PaCO_2$ will also rise. Examples include:

- **Low cardiac output –** reduced delivery of CO_2 to lungs
- **Blockage of Pulmonary arteries** (pulmonary embolus)
- **Poor gas exchange due to overdistension of alveoli –** high TV, excessive PEEP, COPD

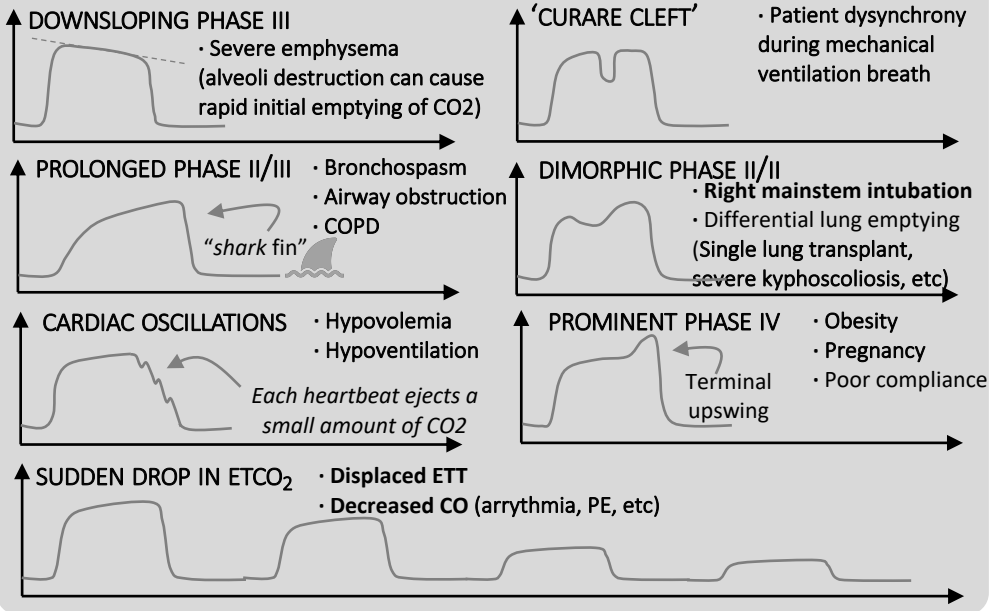
CAPNOGRAPH WAVEFORM:



The waveform is composed of 4 phases

- **Phase I** – anatomical dead space ventilation
- **Phase II** – dead space mixed with alveolar ventilation
- **Phase III** – alveolar ventilation (where $ETCO_2$ measured)
- **Phase IV** – end of exhalation

SPECIFIC CAPNOGRAPH PATTERNS:



ETT CONFIRMATION

Confirmation of exhaled CO2 can be used for ETT placement confirmation. **Colorimetric capnograph** is only appropriate in well perfusing patients; **waveform capnograph** is more accurate, particularly in low CO states.

$ETCO_2$ IN PROCEDURAL SEDATION

Waveform capnography can be used to monitor for hypoventilation in non-intubated patients during procedural sedation (using an $ETCO_2$ sensor nasal cannula). **Waveform capnography** is more sensitive than just SpO2 monitoring, and can detect hypoventilation up to 60 seconds before desaturation occurs.

$ETCO_2$ IN CARDIAC ARREST

Adequacy of CPR

- Achieving an $PETCO_2$ > 20mmHg is associated with adequate CPR. If not achieving this goal consider rotating the person performing compressions.

Detection of ROSC

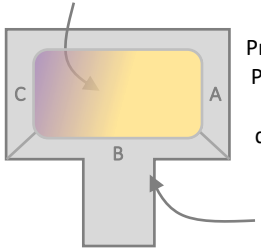
- Sudden increase in $PETCO_2$ during CPR is a marker for ROSC.

Determination of futility

- Persistent $PETCO_2$ < 10 for > 20 min is associated with futility, and even 5 min with $ETCO_2$ < 10 is associated with poor outcomes.

COLORIMETRIC CAPNOGRAPH

Litmus paper changes color based on pH; exhaled CO2 lowers the pH and causes the the paper to transiently turn from **PURPLE** to **YELLOW** ("MELLOW YELLOW"); acidic vomitus can cause a false *permanent* color change.

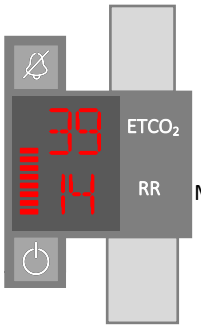


Provides an *approximate* PETCO2 reading as each area is sensitive to different $ETCO_2$ values:

A <4 MMHG
B 4-15 MMHG
C 15-38 MMHG

PORTABLE ELECTRONIC CAPNOGRAPH

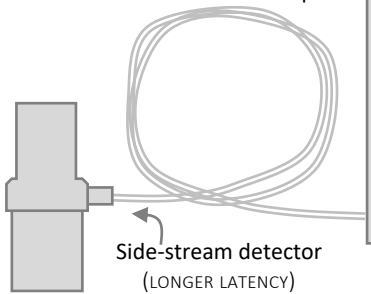
IR spectroscopy *precisely* measures exhaled CO_2 content



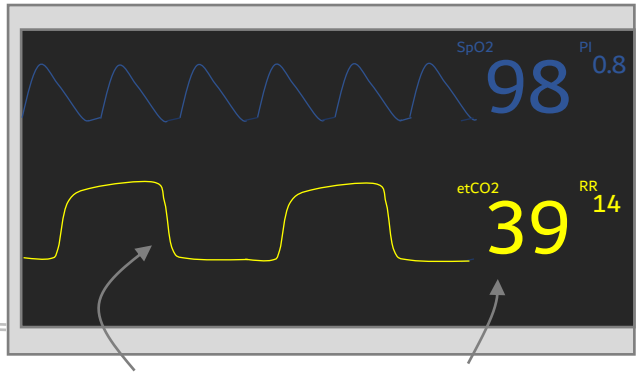
Mainstream (in-line) detector (SHORTER LATENCY)

WAVEFORM CAPNOGRAPH

IR spectroscopy measures exhaled CO2 content and displays results *graphically*; can also be used with ***special nasal cannula*** to monitor non-intubated pts.



Side-stream detector (LONGER LATENCY)



ETCO2 waveform

Peak ETCO2 value

v1.1 (2020-11-18)