CAPNOGRAPHY:

MEASURING END-TIDAL CO_2 LEVELS

DURING CARDIAC ARREST

Presentation for MSBI Nurses

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Background/Physiology

Monitoring end-tidal CO_2 (ET-CO_2) provides instantaneous information about ventilation (how effectively CO_2 gas is being exhaled/eliminated by the respiratory system), perfusion (how effectively CO_2 is being transported through the vascular system to the lungs), and metabolism (how effectively CO_2 is being produced by cellular metabolism). To use EtCO_2 as a measure of blood flow:

- **Ventilation must be constant (inhalation and exhalation are stable/normal**

- **Metabolism must be constant (activity/metabolic demand are stable)**
  - **Under these conditions, ETCO_2 will reflect pulmonary blood flow and can serve as gauge for effectiveness of chest compressions**
    - **As cardiac output increases from compressions or return of spontaneous circulation (ROSC), more CO_2 is returned to the lungs, increasing the level of ETCO_2**
    - **If perfusion decreases from poor compressions or decreasing cardiac output, less CO_2 is returned to lungs, decreasing the level of ET CO_2**

Measuring $ETCO_2$

MSBI Nurses:

You may/will see a Pulmonary/CC Attending or Fellow measuring $ETCO_2$ during in a Code (and some RRT-intubation).

They will be using a hand held device (like one seen above) that will attach to the bag-valve to either a mask or to an ET or trach tube via tubing and connector (seen to right).

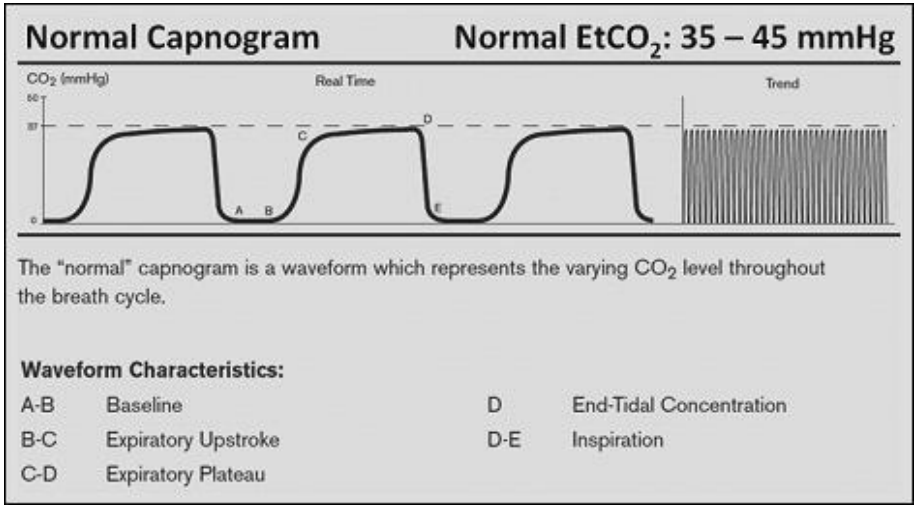
Measuring $ETCO_2$ (continued)

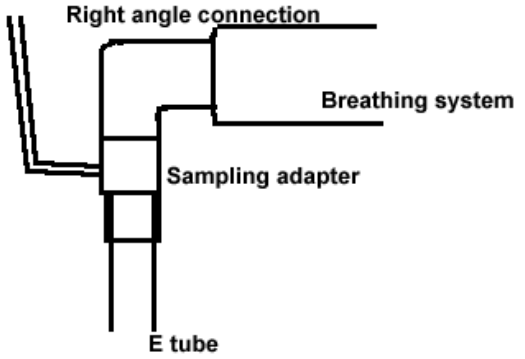
In some units/areas the ETCO2 may be measured on a bedside monitor (or portable/transport monitor defibrillator) with module and connector as seen below

End Tidal CO_2

Continuous $PETCO_2$ in line between airway and BVM or ventilator circuit.

Sensor links to monitor & displays numeric $ETCO_2$ and waveform.

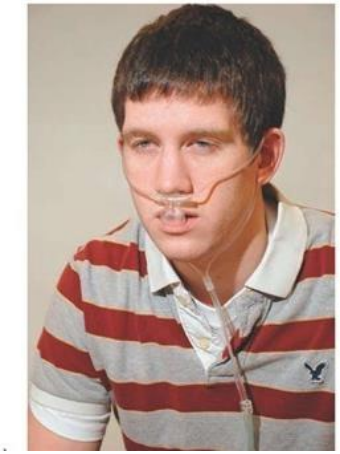




Remember CO_2 is a result of tissue metabolism and circulation. Therefore if you have circulation/perfusion---- end result will be production of CO_2. and then $ETCO_2$ can be measured.
Better the numeric = better the perfusion/circulation

End Tidal CO_2

Can also be measured and monitored in spontaneously breathing patients via nasal cannula or mask –(see pictures below)



Same connectors and monitor would be used as seen on previous slides. This monitoring is often employed in PACU and procedure/post procedure areas.

$ETCO_2$ USES DURING CPR

CONFIRM ADEQUACY OF CHEST COMPRESSIONS:

- Measurement of a low $ETCO_2$ value (< 10 mmHg) during CPR in an intubated patient suggests that the quality of chest compressions needs improvement.
  - Ensure proper rate (approximately 100/min)
  - Ensure proper depth with adequate release/recoil of thorax (1/2 thorax or minimum 2.5 inches)
- Persistently low $EtCO_2$ values (<10mmHg) despite optimal chest compressions in intubated patients suggest ROSC is unlikely (data not available for patients receiving bag-valve ventilation (given that air leak can result in a low measured $ETCO_2$)

IDENTIFICATION OF THE RETURN OF CIRCULATION

- Monitor for a significant increase in the $EtCO_2$ to near normal (normal $EtCO_2$=35-45 mmHg) – represents marked increase of CO_2 delivery to lungs, suggesting ROSC
- If patient develops an organized rhythm after VF/VT/asystole – check $EtCO_2$ to see if ROSC has occurred

CONFIRM PLACEMENT OF ETT

- After intubation, if $ETCO_2$>10mm Hg – tube in trachea
  - if undetectable, ETT may be in esophagus or cardiac output too low to detect

PITFALLS OF INTERPRETING $ETCO_2$ LEVELS

If EtCO2 level is low/undetectable, can be explained by

1) pulmonary blood flow is low (large/massive PE)
2) pulmonary exhaled air is low (status asthmaticus)
3) poor offloading of C02 to lungs (pulmonary edema)

NaHC03 will increase EtCO2 (because it splits into CO2 and H20)

So, if rises after NaHCO3, do not misinterpret as ROSC

Vasopressors will decrease ETCO2 (they cause high afterload, increasing BP and myocardial blood flow but a decrease in cardiac output)

EtCO2 may decrease after epinephrine

AHA GUIDELINE Recommendations (for INTUBATED patients):

Use $ETCO_2$ to confirm Endotracheal Tube Placement (IA)

Will not be able to detect CO_2 if ETT in esophagus

If $ETCO_2$<10mm Hg – optimize compression parameters – rate/depth (IIB)

If $ETCO_2$ abruptly increases to 35-40mm Hg, may indicate ROSC (IIb)

The value of using quantitative waveform capnography in non-intubated patients to monitor and optimize CPR quality and detect ROSC is uncertain (Class IIb, LOE C).

MOUNT SINAI BETH ISRAEL CAPNOGRAPHY DURING CARDIAC ARREST PROTOCOL

CO_2 detectors will be carried to all cardiac arrests by PCCM Team (Fellow/Attending)

Detectors to be stored and kept charged by PCCM Division

$C0_2$ detector must be immediately attached to BVM (or ETT if applicable)

- Code team members and PCCM Division must learn $ETCO_2$ monitor installation and operation during Code team training exercises
- $ETCO_2$ monitor to be placed on bed within view of compression team
- Compression team to monitor $ETCO_2$ Levels while performing compressions, must inform code leader of:
  - initial measured $ETCO_2$ level
  - any significant change in $ETCO_2$ level
    - achievement of $ETCO_2$ levels >10mmHg
    - sudden increase to near 35-40mm Hg
    - inability to achieve $ETCO_2$>10mm Hg