CAPNOGRAPHY:
MEASURING END-TIDAL CO₂ LEVELS
DURING CARDIAC ARREST

Presentation for MSBI Nurses
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Background/Physiology

Monitoring end-tidal CO₂ (ET-CO₂) provides instantaneous information about ventilation (how effectively CO₂ gas is being exhaled/eliminated by the respiratory system), perfusion (how effectively CO₂ is being transported through the vascular system to the lungs), and metabolism (how effectively CO₂ is being produced by cellular metabolism). To use EtCO₂ 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, ETCO₂ 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 CO₂ is returned to the lungs, increasing the level of ETCO₂
  • If perfusion decreases from poor compressions or decreasing cardiac output, less CO₂ is returned to lungs, decreasing the level of ET CO₂
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 ETCO$_2$ 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.
ETCO₂ USES DURING CPR

CONFIRM ADEQUACY OF CHEST COMPRESSIONS:

• Measurement of a low ETCO₂ 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 EtCO₂ 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 ETCO₂)

IDENTIFICATION OF THE RETURN OF CIRCULATION

• Monitor for a significant increase in the EtCO₂ to near normal (normal EtCO₂=35-45 mmHg) – represents marked increase of CO₂ delivery to lungs, suggesting ROSC
• If patient develops an organized rhythm after VF/VT/asystole – check EtCO₂ to see if ROSC has occurred

CONFIRM PLACEMENT OF ETT

• After intubation, if ETCO₂>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 CO2 to lungs (pulmonary edema)

NaHCO$_3$ 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).
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

CO$_2$ 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