The Role of Transcutaneous Co2 Monitoring in High Risk Respiratory Patients

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Respiratory Drive

- Central Chemoreceptors
- Peripheral Chemoreceptors
Types:
- Hypoxemic without Hypercarbia (type I)
- Hypoxemic with Hypercarbia (type II)

Diagnosis:
- Clinical Manifestations
- Labs
Causes of Hypoxemic Failure

- Parenchymal disease (V/Q mismatch)
- Shunts
- Interstitial disease (pneumonia, edema)
Causes of Hypercarbic Respiratory Failure

- Fatigue
- Decreased respiratory drive
- Decreased lung area for gas exchange
If you have to develop respiratory failure which type would you choose?
Time is Everything...

- Clinical course of a hypoxemic respiratory failure
- Clinical course of a hypercarbic respiratory failure
Respiratory Monitoring

- Pulse Oximeter
- End Tidal CO2 (Capnography)
- Transcutaneous CO2
- Others
These Monitors Have Different Goals

• Pulse Oximeter
• End tidal Co2 (Capnography)
• Transcutaneous Co2
• American Society of Anesthesiologists
• Guidelines For ICU monitoring
Pulse Oximeter

- Wavelengths: Red Band and Infrared
- Accuracy
- Most accurate site
Pulse Oximeter

Response time – Dependent on site (20 vs 35 sec)

Downsides

• Low Amplitude states
• Dyshemoglobinemias
• Dyes and Pigments
Direct flow vs. Side stream sampling

• Mass Spectrometry

• Difference between Capnometry and Capnography

• Limitations: Respiratory disorders and Nonintubated patients
Causes of decreased ETCO₂

- Increased dead space ventilation
- Hyperventilation
- Decreased cardiac output
- Esophageal Intubation
- Sample contamination (disconnection, sample tube leak, mouth breathing)
Causes of Increased ETCO2

- Hypoventilation
- Increased CO2 production
- Right to left shunt
End Tidal CO2

Figure 1: A normal capnography waveform
End Tidal CO2
Feasibility

Is the end tidal CO2 feasible in the non-OR setting for awake patients?
Transcutaneous CO2 monitor
Transcutaneous CO2

History

• Severinghaus 1960

• Jonhs 1969

• First commercially available TcCo2 1980

Principle

Goals of TcCo2 monitoring
Typical characteristics of a TcCo2 sensor

Size

- Diameter: 15 mm
- Height: 8 mm
- Weight: 3g
- PCO2 range: 1-200 mm Hg
- Arterialization time: 3-10 min
Tosca Sensor
Recent Developments of TcCo2

- Combination with Spo2
- Use of lower sensor temperature
- Diminution of the size of the sensor
- Digitalization of the signal inside the sensor
Accuracy of Transcutaneous CO2

- Clinical settings
- Studies design
Transcutaneous carbon dioxide monitoring in infants and children.

“Noninvasive monitoring of PaCO(2) during one-lung ventilation and minimal access surgery in adults: End-tidal versus transcutaneous techniques.”

“Transcutaneous monitoring of partial pressure of carbon dioxide in the elderly patient: a prospective, clinical comparison with end-tidal monitoring.”

“Accuracy and precision of three different methods to determine Pco2 (Paco2 vs. Petco2 vs. Ptcco2) during interhospital ground transport of critically ill and ventilated adults.”

Hinkelbein et al. J Trauma. 2008
Respiratory monitoring and patient outcomes

What type of monitoring has been shown to improve outcomes in acutely ill patients?

Ospina - Tascón GA et al.
Intensive Care Med. 2008
“Randomized evaluation of pulse oximetry in 20,802 patients: II. Perioperative events and postoperative complications.”

Moller et al. Anesthesiology. 1993
“A comparative evaluation of capnometry versus pulse oximetry during procedural sedation and analgesia on room air.”

Sivilotti et al. CJEM. 2010
“Capnography is superior to pulse oximetry for the detection of respiratory depression during colonoscopy. “

Cacho et al. Rev Esp Enferm Dig. 2010
“Detection of hypoventilation during deep sedation in patients undergoing ambulatory gynaecological hysteroscopy: a comparison between transcutaneous and nasal end-tidal carbon dioxide measurements.”

De Oliveira et al. Br J Anaesth. 2010
Current Research

- The effect of ketamine to Prevent Hypoventilation in Deeply sedated patients undergoing breast surgery
  - In-Press
  - Accepted by the European Journal of Anesthesiology
64 year old male s/p surgery for knee replacement 1 week ago presents to the ER with SOB, chest pain that worsens with inspiration. ABG: ph 7.21 PaO2 60 mmHg and PaCo2 32 mmHg

Which monitor would you choose:

A) End tidal CO2
B) Pulse oximetry
C) Transcutaneous CO2
Patient  Male 78 years , with Hx of severe CAD with a AICD come after being promptly resuscitated by paramedics at a shopping mall . He will have a new defibrillator implanted in the morning.

Besides hemodynamic monitors, would you use:

A) End tidal CO2
B) Pulse oximetry
C) Transcutaneous CO2
35 year old Female morbidly obese with Hx of severe obstructive sleep apnea was extubated in MICU after 3 days. She is receiving supplemental oxygen through a NRM

Which monitor would you choose?

A) End tidal CO2
B) Transcutaneous CO2
C) Pulse Oximetry
Pt s/p craniectomy seems drowsy, He is extubated and placed on NC 6l/min.

What would be the best monitor:

a) Pulse Oxymetry
b) Transcutaneous CO2
c) End tidal CO2
Thank You!

Questions?