Welcome to today’s webinar:

The Advantages of Transcutaneous CO₂ Over End-Tidal CO₂ for Sleep Monitoring

Presenter: Brian Schultz, RPSGT

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We will begin shortly. If you need technical assistance, please call 866 863 3904.
Today’s Presenter

Brian Schultz, RPSGT
The Children's Hospital of Philadelphia

Brian Schultz is a supervisor at The Children’s Hospital of Philadelphia with 18 years of sleep lab experience. He currently manages a staff of over 25 and 14 pediatric beds under the Sleep Center in three Philadelphia and New Jersey locations. Brian earned his RPSUT (registered polysomnographic technologist) credential in 1998 after four years of experience in adult sleep.

Brian has most recently written a book chapter entitled “Sleep Related Breathing Disorders in Children”, 2nd edition of the Fundamentals of sleep Technology book. His hobbies include fishing at the Jersey shore and spending time with his family.
The Advantages of Transcutaneous CO$_2$ Over End-Tidal CO$_2$ for Sleep Monitoring

Brian J. Schultz, RPSGT, The Children’s Hospital of Philadelphia
Disclosure

I have received a honorarium for this lecture but have not entered into any business agreements with Radiometer America inc.
Objectives

• Summarize the CO$_2$ measurement landscape and distinguish between the various methods currently in use
• Identify the advances in the technology of transcutaneous CO$_2$ monitoring
• Compare the detection accuracy and trend prediction capabilities of transcutaneous CO$_2$ vs. the end-tidal method
• Appraise the benefits of early detection of CO$_2$ trending to a cross-section of patients
CO₂ Monitoring Consists of Three Methods

Blood Gas (ABG)  End-Tidal CO₂ (ETCO₂)  Transcutaneous CO₂ (PtcCO₂)
Blood Gas (ABG)

• Advantages
  – Arterial blood gas (ABG) measurements are the gold standard
  – An ABG is fast and accurate
  – On the spot checks for PaCO$_2$

• Challenges
  – Not ideal for sleep studies
  – The procedure is invasive
End-Tidal CO$_2$ (ETCO$_2$) Sampling

- Side-stream
  - ETCO$_2$ collection
  - Unit calibration
  - Sleep system calibration
  - Dehumidification tubing
  - Filters
End-Tidal CO$_2$ (ETCO$_2$) Sampling

• Mainstream
  – Calibration
  – Connection is direct to the trach site
  – Trach breathing patients only
Advantages of ETCO$_2$ Monitoring

- Instant breath by breath analysis
- Non-invasive
- Easily connects to sleep lab computers
- The unit is portable and has battery backup power
Challenges of ETCO$_2$ Monitoring

- Single nare breathing
- Proper sized cannulas
- Mouth breathing
- Lag time
- Higher respiratory rates
- High flows from CPAP, ventilator or oxygen
- Excess moisture
Side-Stream ETCO$_2$
Transcutaneous Monitor
TCOM Probe
Advantages of Transcutaneous (PtcCO$_2$)

- Trends CO$_2$
- Noninvasive
- Reliable
- Portable
Challenges of Transcutaneous Monitoring

- Probe site
- Burns
- Staff competency
- Start time

²Martin. RJ. Transcutaneous monitoring: instrumentation and clinical applications. Respir Care 1990;35(6):577-583
Advances in TCOM Unit Technology

• Gold plated membrane
• Reminder to change the membrane
• Clip-on ear lobe probe
• Intuitive color touch screen and Windows CE software for increased user-friendliness
• High compatibility to interface with any patient monitoring system
• On-board video tutorials
• Built-in battery facilitates transport of the patient
• Simultaneous viewing of all measurements
• USB port for easy printing of reports
Patients at Risk for Hypoventilation

- Neuromuscular weakness
- Congenital Central Hypoventilation Syndrome (CCHS)
- Obesity-related hypoventilation
- Muscle weakness
Assessment of Hypoventilation

During Polysomnography

- CO₂ ≥ 50 Torr
- Low baseline saturation (≤ 90%)
- Decreased flow and effort
- EEG Arousal

PAP Titrations
Oxygen Titrations
Mechanical
Ventilation
## Review of 609 Pediatric Sleep Studies

<table>
<thead>
<tr>
<th></th>
<th>Interpretable data (total recording time)</th>
<th>Maximum CO(_2)</th>
<th>Mean CO(_2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ETCO(_2)</td>
<td>61.8% +/- 35.1%</td>
<td>0.1 +/- 5.4 mm Hg</td>
<td>0.6 +/- 3.9 mm Hg</td>
</tr>
<tr>
<td>PtcCO(_2)</td>
<td>71.5% +/- 25.2%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\(^3\)Kirk VG, Batuyong ED, Bohn SG. Transcutaneous carbon dioxide monitoring and capnography during pediatric polysomnography. Sleep 2006 Dec;29(12):1601-8
### Prospective Study of 15 Pediatric Sleep Studies

<table>
<thead>
<tr>
<th></th>
<th>Signal Integrity (of 30 second epochs)</th>
<th>Exceeded Mean CO₂ in ETCO₂</th>
<th>10 of 15 studies</th>
<th>Increased CO₂ value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ETCO₂</td>
<td>73%</td>
<td>-</td>
<td>≤ 4 mm Hg</td>
<td>70% increase in readable CO₂ values</td>
</tr>
<tr>
<td>PtcCO₂</td>
<td>78.5%</td>
<td>2.8 +/- 3.0 mm Hg</td>
<td></td>
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</tr>
</tbody>
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*Morielli A, Desjardins D, Brouillette RT. Transcutaneous and end-tidal carbon dioxide pressures should be measured during pediatric polysomnography. Am Rev Respir Dis.1993 Dec;148(6 Pt 1):1599-604*
Hypoventilation Titrations

American Academy of Sleep Medicine’s
Best Clinical Practice

“Transcutaneous or end-tidal PCO₂ may be used to adjust NIPPV settings if adequately calibrated and ideally validated with arterial blood gas testing”³

ETCO$_2$ vs TCCO$_2$
A Question for You:
Which CO$_2$ Value is More Accurate?
A Question for You: Can the two wave forms be trusted?

Mainstream ETCO$_2$ vs TCCO$_2$
CPAP Titration
Oxygen Titration
Severe OSA
Oxygen Titration

1 liter of oxygen
Summary

Transcutaneous monitoring in the sleep lab is well established and reliable. The CO$_2$ data from transcutaneous monitoring should be used to evaluate ventilation, hypoventilation, titrate PAP and titrate oxygen during polysomnograms.
Thank you for attending today’s session.

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