Noninvasive End-Tidal Carbon Dioxide Monitoring in Critically-Ill Patients

Kailee Mast, BSN, RN, Chelsea Stoner, BSN, RN, & Vicki Zahos, BSN, RN
Medical Intermediate Care Unit

Introduction
Many patients within the intermediate care unit are at a high risk of rapidly decompensating, and there is often inadequate monitoring available to detect the subtle changes in respiratory status. End-tidal carbon dioxide monitoring is an evidence-based form of detection that may be utilized with non-intubated, critically ill patients.

PICO Question
Population: Intermediate care unit patients with a high risk of respiratory failure
Intervention: Noninvasive continuous end-tidal carbon dioxide monitoring
Comparison: Arterial blood gas sampling/Patients without ETCO2 monitoring
Outcome: Rate of respiratory decompensation

Question: How does continuous end-tidal carbon dioxide monitoring compare to arterial blood gas sampling and how can it decrease the rates of respiratory decompensation in high-risk IMC patients?

Methods
A literature search was conducted using CINAHL and EBSCOhost.

Keywords: End-tidal carbon dioxide monitoring, respiratory monitoring, ETCO2 Inclusion Criteria:
Articles within 10 years, adult populations, non-intubated patients

The initial search yielded 12 articles, 4 were included for this project

Discussion
The results from this literature search provide substantial evidence that ET CO2 is effective in the early detection of patient decompensation. There is limited literature available on a larger variety of patient populations, and so continued research would be encouraged. This information will be presented to the unit and hopefully help to develop a protocol in which high risk patients are placed on continuous ET CO2.

Results

<table>
<thead>
<tr>
<th>Article</th>
<th>Methods</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bektas, F., Eken, C., Ekray, O., Gosku, E., &amp; Kartal, M. (2011).</td>
<td>Prospective Cross-sectional study carried out during a 3-month period in an Emergency Department. During the study period, 240 spontaneously ventilating patients requiring arterial blood gas analysis for any medical indication, regardless of presenting symptoms, had simultaneous ETCO2 measurement.</td>
<td>There was a statistically significant correlation between the value of ETCO2 and HCO3 levels. The mean ETCO2 level was statistically lower than patients who died and who had low bicarbonate levels. The value of ETCO2 measurement to detect low bicarbonate levels was found to be significant.</td>
</tr>
<tr>
<td>Henriquez, C., Herrin, A., Overdyk, F., Maddox, R. (2007).</td>
<td>Monitored posturgical patients in a hospital ward receiving morphine or meperidine PCA with continuous oximetry and capnography. Nurses responding to audible monitor bedside alarms documented respiratory status and interventions.</td>
<td>Total of 178 patients, 12% and 41% of whom had episodes of desaturation (Spo2 &lt;90%) and bradypnea (respiratory rate &lt;10) lasting 3 min or more. One patient required &quot;rescue&quot; with positive pressure ventilation, and none required naloxone. ETCO2 was effective in detecting these occurrences and preventing further complication.</td>
</tr>
<tr>
<td>Hunter, C., Silvestri, S., Dean, M., Falk, J., &amp; Papa, L. (2013).</td>
<td>201 adult patients that met SIRS criteria were placed on continuous ET CO2 monitoring and lactate was collected.</td>
<td>An inverse relationship was found between the end-tidal CO2 and lactate (correlation coefficient of p&lt;0.001). It demonstrated that it is effective in predicting the severity of a septic patient's condition and guiding providers' intensity of care.</td>
</tr>
<tr>
<td>Maddox, R., Ogles, H., Williams, C., Fields, M. and Danello, S. (2008).</td>
<td>Patients deemed high risk for respiratory distress: (with the inclusion factor of PCA therapy, high risk for DVT, PE, COPD, OSA, or CHF) would require continuous CO2 monitoring as well as pulse oximetry.</td>
<td>Over a 33 month span there were 16 patient instances identified with declining physiologic status due to the use of respiratory monitoring. In the case of these 16 patients unwarranted outcomes and possible ICU transfers were avoided due to early recognition and intervention.</td>
</tr>
</tbody>
</table>

Conclusions
The studies demonstrate that non-invasive end-tidal carbon dioxide monitoring accurately reflected several laboratory values that are collected invasively. Its use has helped healthcare providers to closely monitor metabolic and respiratory disturbances while preventing several cases of respiratory failure. This form of monitoring would be a vital asset to a unit in which nurses are unable to closely monitor high-risk patients.

References