#446: OPERATIONAL ASPECTS OF THE USE OF THE EARLOBE ARTERIALIZED BLOOD COLLECTOR IN CRITICALLY ILL PATIENTS


May 15th, 2013
I have the following financial relationships to disclose:

- Grant/Research support from: Crew Medical Support Office (HSF-AM), European Space Agency to Fundació Parc Taulí. Contract number: P2090973
- I am employed by Corporació Sanitària Parc Taulí.

I will discuss the following off-label use and/or investigational use in my presentation:

- EABC® (Microgravity Centre / FENG-PUCRS, Brazil)
- i-STAT® portable analyzer (Abbot, USA)
SUMMARY

• Introduction
• Hypothesis / Objectives
• Materials & Methods
• Results
• Conclusions
INTRODUCTION

• Critical medical situations can occur during spaceflight \(^1\)

• Arterial blood gas analysis could be determinant

• No method currently available on ISS

Earlobe arterialized capillary blood gas analysis:

- Substitute for arterial sampling
- Capillary arterio-venous shunt
- Discordant results on the accuracy of this technique

Heterogeneity of sampling procedures and equipment

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INTRODUCTION (cont.)

EABC®
(Earlobe Arterialized Blood Collector) + i-STAT®
INTRODUCTION (cont.)

• Good concordance of measures with arterial samples
  • Healthy volunteers during head venous congestion, hypoxia $^{1,2}$
  • Patients with chronic renal failure $^3$

• Better safety profile, training requirements and patient tolerance than arterial sampling

• Portable and easy to use - Potential benefits for aerospace and remote environment medicine

• Limited information in critically ill patients

Earlobe arterialized capillary blood obtained with the EABC® + i-STAT system is an adequate substitute of arterial blood for gas measurements in critically ill patients
OBJECTIVE

• To perform a dual analysis:
  • Analytical performance evaluation
  • **Operational evaluation**
MATERIALS & METHODS

• **Design:** prospective observational

• **Setting:** polyvalent intensive care unit – tertiary hospital

• **Patients:** 55 mechanically ventilated patients admitted for various conditions

• **Ethics:** Informed consent & evaluation by independent ethics committee

• **Interventions:** Training of two operators & Sampling of earlobe arterialized blood using the EABC® + i-STAT® analysis
MATERIALS & METHODS (cont.)

• **Measures:**
  - Demographic and clinical variables
  - Resources and Time requirements
  - Encountered difficulties
  - Auxiliary procedures
TRAINING

• Two operators
• Two separated workshops with practical rounds
• Additionally reference material available on-site
• Remote support if required
SAMPLING PROCEDURE

- Preparatory:
  - Analyzer initialization
  - Equipment preparation
  - EL selection
  - Working field setup
  - Cleaning/disinfection
  - Capillary arterialization

- Sampling

- Post sampling:
  - Haemostasis
  - Earlobe cleaning
  - Shut down of equipment
  - Storage
  - Follow up for delayed complications
SAMPLING PROCEDURE (cont.)
## RESULTS

<table>
<thead>
<tr>
<th>Patients</th>
<th>55</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>40 (72.7%)</td>
</tr>
<tr>
<td>Age</td>
<td>63 (24 - 83)</td>
</tr>
<tr>
<td>Arterial hypertension</td>
<td>23 (41.8%)</td>
</tr>
<tr>
<td>Diabetes Mellitus</td>
<td>19 (34.5%)</td>
</tr>
<tr>
<td>Chronic cardiac failure</td>
<td>4 (7.3%)</td>
</tr>
<tr>
<td>Severe vasculopathy</td>
<td>4 (7.3%)</td>
</tr>
<tr>
<td>Renal insufficiency</td>
<td>5 (9.1%)</td>
</tr>
<tr>
<td><strong>Diagnostic at ICU admission</strong></td>
<td></td>
</tr>
<tr>
<td>Severe sepsis</td>
<td>21 (38.1%)</td>
</tr>
<tr>
<td>Respiratory failure</td>
<td>7 (12.7%)</td>
</tr>
<tr>
<td>Severe Trauma</td>
<td>7 (12.7%)</td>
</tr>
<tr>
<td>Neurological</td>
<td>6 (10.8%)</td>
</tr>
<tr>
<td>Cardiogenic shock</td>
<td>5 (9.1%)</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>9 (16%)</td>
</tr>
</tbody>
</table>
RESULTS (cont.)

• **Scientific results** *(To be published in peer-review journal)*
  
  • Able to detect extreme gasometrical values
  
  • Age (> 65 years) determines sampling success
    
    • 100% success in patients < 45 years
  
  • Vasoactive drugs & hemodynamic instability may reduce sampling success

Operational evaluation
RESULTS (cont.)

- Preparatory: 15 min
- Sampling
- Post sampling: 11 min

Total: 26 min
RESULTS (cont.)

- **Sampling Success**
  - Yes: 56%
  - No: 44%

- Other Categories:
  - Alignment
  - Leak
  - Obstructed vision
  - Superficial
  - Coagulation
  - Low Blood Flow

- 10%
RESULTS (cont.)

• Earlobe Arterialization

  2.5 min (n = 20) vs. 5 min (n = 35)

  • Blood congestion equally achieved
  • No change in sampling success rate
    (OR = 0.86; p = 0.8; CI 95% = 0.28 - 2.67; )
RESULTS (cont.)

Graph showing the sampling success rate over groups of 5 patients chronologically.
RESULTS (cont.)

- Haemostasis easily achieved
- Reduced bleeding times (< 10 min 92.7%)
- Reduced delayed complications (2% infection rate)
RESULTS (cont.)

- Low power consumption
  - One battery change for 55 analysis (2 years)

- Low cartridge consumption
  - Average 1.3 cartridges per sampling attempt
    (range = 1 - 3; mode = 1)
  - Average cut attempts 1.2
    (range = 1 - 4; mode = 1)
RESULTS (cont.)

• Storage for 10 collections
  • i-STAT® portable analyzer
  • Automatic calibration system
  • 10 EABC® units
  • Miscellaneous (gloves, sterile gauzes, etc.)

• Cartridges shelf life
  • 18 - 30 °C → 2 months
  • 8 °C until expiration date
CONCLUSIONS

• EABC® + i-STAT® system concept is:
  • Safe
  • Fast
  • Easy to learn & Easy to use

• 10% of difficulties attributable to collector
  • Amendable with simple design modifications

• Small storage requirements
CONCLUSIONS (cont.)

- Reliable for extreme gasometrical values
- Sampling failures cluster in older patients
  - Mean age International Astronaut Corps = 45 years
    - 100% sampling success
- Potential for significant benefits for aerospace and remote medicine
THANK YOU

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