TC monitoring in the NICU: The value of TcpO₂

Daniele De Luca (MD, PhD)
Division of Pediatrics and Neonatal Critical Care
South Paris University Hospitals, Medical Center “A. Beclere” (Paris)

& Dept of Anesthesia and Critical Care, Catholic University of the Sacred Heart, Rome

ESPNIC Respiratory Section Deputy Chair
ESPR/ESN Scientific Content Manager and Officer for Accreditation
Are they different?

FiO₂ (%)
Air = 21%
Temperature 37.5°C

PARACETAMOL 250 mg

Temperature 39.5°C

ZERO PARACETAMOL
Air (21% Oxygen) → SatO₂ 96%

40 % Oxygen → SatO₂ 100%

PaO₂ 50

PaO₂ 90
PaO₂/FiO₂ = 150

FiO₂ = 40%
PaO₂ = ???

Arterial catheters or Transcutaneous PaO₂

Very rare arterial catheters - rare Transcutaneous PaO₂

Adults with A-RDS

Babies with RDS
Does neonatal ARDS exist???

YES!

(Why not?)
Same ???

Meconium aspiration  Sepsis  ARDS
Nguyen S, Pediatrics 2002
**MONTREUX DEFINITION:** An expert consensus for neonatal ARDS

<table>
<thead>
<tr>
<th>ALL THE 5 CRITERIA MUST BE FULFILLED</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Timeframe</strong></td>
</tr>
<tr>
<td>Acute onset from a known or suspected clinical insult (such as infection [sepsis, pneumonia, bronchiolitis..], milk or meconium aspiration, NEC etc..)</td>
</tr>
<tr>
<td><strong>2. Exclusion criteria</strong></td>
</tr>
<tr>
<td>Hyaline membrane disease or transient tachypnoea of the neonate as primary current acute respiratory condition, as defined by the appendix</td>
</tr>
<tr>
<td><strong>3. Lung imaging</strong></td>
</tr>
<tr>
<td>Bilateral, irregular opacities/infiltrates or complete opacification of the lungs (at chest x-rays), not fully explained by local effusions or atelectasis or congenital malformations or hyaline membrane disease or TTN</td>
</tr>
<tr>
<td><strong>4. Origin of oedema</strong></td>
</tr>
<tr>
<td>Absence of congenital heart disease explaining the oedema (this includes PDA without acute pulmonary haemorrhage). Echocardiography is needed to verify this criterion.</td>
</tr>
<tr>
<td><strong>5. Oxygenation deficit expressed as oxygenation index</strong></td>
</tr>
<tr>
<td>(it may be calculated using transcutaneous blood gas values)</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

*OI cut-offs according to the PALICC definition of Pediatric ARDS*
How to evaluate oxygenation?
Many scores – combinations of FiO$_2$ & PaO$_2$

• PaO$_2$/FiO$_2$ ratio
• a/A ratio
• A-a gradient
• Oxygenation index (OI)
• Others...
Who’s the sickest?

TOMMY
30% Oxygen – CPAP 7 cmH₂O

MAXIME
45% Oxygen – CPAP 4 cmH₂O

David G. Sweeta Virginio Carniellib Gorm Greisenb Mikko Hallmanb Eren Ozekd Richard Plavkae Ola D. Saugstadf Umberto Simeoni g Christian P. Speerf Maximo Ventof Henry L. Hallidayg

4. Early initiation of CPAP with subsequent selective surfactant administration in extremely preterm infants results in lower rates of BPD/death when compared with treatment with prophylactic surfactant therapy (LOE 1).
OI = $\text{FiO}_2$ (%) x Mean airway pressure (cmH}_2\text{O)
Who’s the sickest?

TOMMY
30% Oxygen – CPAP 7 cmH₂O
PaO₂ = 48 mmHg

OI = 4.4

MAXIME
45% Oxygen – CPAP 4 cmH₂O
PaO₂ = 65 mmHg

OI = 2.8
OI = \[ \text{FiO}_2 \text{ (%) x Mean airway pressure (cmH}_2\text{O)} \]

PaO\(_2\) (mmHg)

What you obtain

What could increase oxygenation
• Not influenced by hemoglobine
(anemia, high Ht, hemoglobin anomalies...)
• Not influenced by age
• Can be used with all ventilation
• VERY KNOWN – used for many years
OXYGENATION INDEX

1 2-3 10-15 20 40

Surfactant

HFOV

iNO

ECMO
No excuses!!!!!

• **UAC** (art umb cat)
• **PAC** (periph art cat)
• TC Monitoring
• Arterialised capillary blood gas

**ESPECIALLY PRETERM BABIES NEED IT!!!!**
Care Customization (Clamart-Paris experience)

**Advanced Monitoring:** Arterial Cat,
BGA & OI measurement,
NIRS, hemodynamic

**Accurate Monitoring:** Arterial Cat,
BGA & OI measurement

**Medium Monitoring:** OI Measurement –
Transcutaneous Monitoring + Capillary BGA

**Minimum Monitoring:** OI Measurement –
Punctual Transcutaneous Monitoring + 1 Capillary BGA

*De Luca et al, J Puericulature in press*
Strategies

1. $\text{PaO}_2$ measurement is essential to take care of premature babies with severe respiratory disease ... or we don’t have visibility

2. Physiology is the same for adults and babies

3. $\text{PaO}_2$ measurement is possible with premature babies in a non-invasive way... so there is no reason not doing it
Why not?

No reason not doing it

If we can get more accurate information and do not stay at global level... why not?

Is anyone would do hemodynamic interventions without echo or other assessments ?

Would you give paracetamol without measuring temperature?
Thank You for Your attention!