NIRS utilization during first hours and days of life

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Definitions

- Pulse-oximetry
  - SpO2
  - Arterial Oxygen saturation

- Nearinfrared Spectroscopy (NIRS)
  - rStO2
  - Regional tissue oxygen saturation (mixed oxygen saturation)
  - Venous:arterial = 75:25

Oxygen saturation parameters

- Peripheral oxygen saturation
  - SpO2 (peripheral arterial oxygen saturation)
  - mStO2 (regional tissue oxygen saturation - muscle)

- Cerebral oxygen saturation
  - crStO2 (cerebral regional tissue oxygen saturation)
  - TOI (cerebral regional tissue oxygen saturation)
Are there differences between peripheral and cerebral oxygenation?

Cerebral oxygenation may show a different behavior compared to peripheral arterial oxygenation during immediate transition.
Cerebral oxygenation may show a different behavior compared to peripheral arterial oxygenation during respiratory support in NICU.

Why are there differences?

Even mild respiratory distress alters tissue oxygenation significantly in preterm infants during neonatal transition.
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Lower cerebral rSO2 levels in infants with respiratory support might not only be due to lower oxygen delivery, but there might be associations with changes in cerebral perfusion.

Transitional Changes in Cerebral Blood Volume at Birth

There is a significant decrease in CBV during neonatal transition, the amount of decrease is 25%-50% of total CBV.
We observed a less pronounced decrease of CBV in infants in need of RS, compared to infants with normal transition.

How about normal values or target ranges for cerebral oxygen saturation?
Normal values for neonates during immediate transition, and preterm infants during first 72h are established.

Are we able to aim for these target ranges? And does it matter?
Was it possible to keep crStO2 >10th perc ?

Yes !
Does it matter?

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Cerebral hypoxia during immediate transition after birth and short term neurodevelopmental outcome

Ania Baik,1,2 Bernhard Schwochberger,1,2,3,4 Anna Schwochberger,1,2,3,4
Bernhard Uhl,1,2,3,4 Alexander Klein,1,2 Georg M. Schmutzler,1,2,3,4
Bernhard Schwochberger,1,2,3,4 Bernhard Pichler

Pichler et al, J Pediatr 2016

Cerebral haemorrhage in preterm neonates: does cerebral regional oxygen saturation during the immediate transition matter?

Ania Baik,1,2 Bernhard Uhl,1,2,3,4 Bernhard Schwochberger,1,2,3,4
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Pichler et al, J Pediatr 2016

Spearmans ρ = -0.78, p = 0.02

Infants without IVH

Infants developed IVH later on
SafeBoosC: Phase II trial to test the hypothesis that the burden of hypoxia and hyperoxia could be reduced by the combination of cerebral NIRS monitoring and a dedicated treatment guideline – and to demonstrate the feasibility of such an approach.

**Safeguarding the Brain of our Smallest Children**

**Treatment Protocol**

- **rStO$_2$ < 55%**
  - Lactate
  - On vasopressors?
  - [Hb] low
  - Blood Pressure
    - Cardiovascular status
      - Consider reducing vasopressor
      - Clinical assessment
        - Consider volume expansion, vasopressor/inotropes, decrease MAP
        - Urine output
        - Echocardiography
          - rStO$_2$ > 85%
            - PDA
            - Low CO/SVC flow
              - Consider volume expansion, inotropes, decrease MAP
  - Oxygen transport
    - Respiratory status
      - SaO$_2$ low
      - PCO$_2$ low
      - Consider increase FiO$_2$
      - Consider decrease MV
      - Consider decrease FiO$_2$
      - Consider increase MV
    - SaO$_2$ high
      - PCO$_2$ high
      - Blood glucose level
        - Low
        - Consider increase glucose intake
  - Risk Stratification
  - RBC transfusion
  - Consider treatment

**rStO$_2$ > 85%**

- PDA
- Low CO/SVC flow
  - Consider volume expansion, inotropes, decrease MAP

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Results - Does it matter?

Conclusion I

- With NIRS it is possible to measure changes in cerebral oxygenation (and perfusion).
- It has been shown, that peripheral and cerebral oxygenation show differences in behaviour.
- Autonomous changes in cerebral blood flow may be associated with that different behaviour.
- Normal ranges / target ranges are established for cerebral oxygen saturation.

Conclusion II - Does it matter?

- In two recent Phase II trials it was shown, that interventions based on NIRS were feasible
  - during resuscitation
  - during first 72h in NICU
- In the intervention groups it was possible to reduce significantly the primary outcome parameter – burden of cerebral hypoxia.
- Secondary outcome parameters showed:
  - Trend to reduce mortality and cerebral injury (SafeBoosC)
  - Significant reduction in supplemental oxygen (COSGOD)
- Both trials need Phase III RCT to prove, that neonatal outcome can be improved with such interventions. COSGOD III started already!
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