Why should we consider NAVA ventilation in preterm infants?

MIĘDZYNARODOWA KONFERENCJA NAUKOWO-SZKOLENIOWA "NEONATUS 2015", 24-25 września 2015r.
Liisa Lehtonen, Professor in Pediatrics, Turku University, Finland

NAVA = Neurally Adjusted Ventilation Assist
Muscular contraction of the diaphragm is always preceded by an electrical impulse and this electrical activation is controlled by nerve stimuli, and ultimately by the respiratory center in the brain.
Edimax goal 5-15 µV

Edimin close to baseline
Why should we consider NAVA ventilation in preterm infants?
To protect the vulnerable brain of a preterm infant.
A critical period for brain development – environment matters

Early cpap at delivery room from 9/2003
More gentle treatment strategies →
CP in VLBW infants (%) decreased
Turku University Hospital

Cognitive development in infants born below 32 GA
at 5 years of age. The PIPARI Study.

<table>
<thead>
<tr>
<th>WPPSI-R</th>
<th>mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IQ</td>
<td>104 (16)</td>
</tr>
<tr>
<td>VIQ</td>
<td>104 (15)</td>
</tr>
<tr>
<td>PIQ</td>
<td>102 (17)</td>
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</tbody>
</table>
The developmental outcome of a preterm infant is impaired by

- Hypoxia or hyperoxia or fluctuation
- Hypo/hypercarbia or fluctuation
- Long ventilator treatment
- Hypotension or fluctuations of BP
- Poor nutrition/growth
- Hypoglycaemia
- Infections and inflammation
- Pain and pain medication
- Postnatal dexamethasone (and other drugs?)
- Sleep deprivation and stress
- Separation from the parents
- Parents’ stress/depression

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NAVA from 9/2009
When a newborn has breathing problems, there are physiological compensation mechanisms to ensure the brain oxygenation

\[
\begin{align*}
pCO_2 & \uparrow \\
pO_2 & \downarrow \\
\end{align*}
\]

Cerebral Blood Flow

Lehtonen L, 2014

In case of hyperventilation, the brain suffers from ischaemia

\[
\begin{align*}
pCO_2 & \uparrow \\
pO_2 & \downarrow \\
\end{align*}
\]

Cerebral Blood Flow

Lehtonen L, 2014
Potential for brain protection

1. No iatrogenic hyperventilation
   the infant is normoventilated by own regulation
   (Stein et al)

\[ \text{pCO}_2 \downarrow \quad \text{Cerebral Blood Flow} \downarrow \]

\[ \text{pO}_2 \uparrow \]

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A 30-day-old boy born at 23+6 weeks.
Switched to NAVA when 23 days old. Stable and comfortable.
\( \text{pH} \ 7.35-7.43 / \text{pCO}_2 \ 5.41-6.69 \ \text{kPa} \)
Potential for brain protection

1. No iatrogenic hyperventilation
   the infant is normoventilated by own regulation
   (Stein et al)

2. Less exposure to brain toxic medications
   less pain medication/sedatives are needed
   Kallio et al, 2014
   less dexamethasone (own data)

Lehtonen L, 2014

Less postnatal dexamethasone

The proportion of 22-27 GA infants receiving postnatal dexamethasone in Turku University Hospital

<table>
<thead>
<tr>
<th>Year</th>
<th>Proportion</th>
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<tbody>
<tr>
<td>2004-2010</td>
<td>25%</td>
</tr>
<tr>
<td>2011</td>
<td>22%</td>
</tr>
<tr>
<td>2012</td>
<td>10%</td>
</tr>
<tr>
<td>2013</td>
<td>9%</td>
</tr>
<tr>
<td>2014</td>
<td>10%</td>
</tr>
<tr>
<td>2015</td>
<td>7%</td>
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</table>
Steroids for BPD in 5 university hospitals in Finland in years 2008 to 2010

Lehtonen L, 2014

Steroids for BPD in 5 university hospitals in Finland in years 2008 to 2010 + Turku University Hospital in 2011 to 2014

Lehtonen L, 2014
Steroids for BPD in 5 university hospitals in Finland in years 2010-13

"Venla"
H 24+1, 520 g (-2.2 SD), Apgar 2/4/4
Chorioamnionitis
PPROM 13 d
Chest x-ray @dol 7

Chest x-ray @dol 13, PDA re-opened
@dol 27: SIMV + PS
fr 45/ 22/6 /FiO2 0.60
Chest x-ray

@dol 33: NAVA 2.0, PEEP +7, FiO2 0.30-0.45
1. No iatrogenic hyperventilation
   the infant is normoventilated by own regulation
   (Stein et al)

2. Less exposure to brain toxic medications
   less pain medication/sedatives are needed
   (Kallio et al, 2013)
   less dexamethasone

3. Less stress
   baby is more comfortable and sleeps better

Potential for brain protection

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Clinical experiences

The feedback comes from the both patients and parents:

Baby is more comfortable. Baby sleeps better.
Clinical experiences

The feedback comes from the clinical data

- potential brain protection
- potential lung protection

Potential for lung protection

Peak inspiratory pressure decreases

Stein H & Howards DJ Pediatrics 2012;
Lee et al, J Pediatrics 2012;
Kallio et al, 2014

→ less barotrauma
Peak inspiratory pressure is lower on NAVA
PIP 18 cmH2O $\rightarrow$ 9 to 15 cmH2O

A new tool to monitor the patient
Backup in case of apnea

Periodic breathing pattern
Sigh

A tool to adjust PEEP/CPAP
Why should be consider NAVA ventilation?

It is simple.
Why should we consider NAVA ventilation?

It is simple. It is safe. The child does better job with regulating than we do.
Evidence

- Research evidence
  - Physiological studies: less asynchrony, lower PIP
  - Research of clinical outcomes scarce
  - One RCT including neonates, no meta-analyses
- Clinical experience
  - Positive user experiences - increasingly
  - Consensus is still lacking
- Patient perspective
  - Patient-friendly care
  - Positive feedback from the parents

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Turku University Hospital, Finland

NAVA ventilation beginning from 9/2009
NIV-NAVA beginning from 1/2010

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### Ventilator days (median) in gestational age groups in Turku University Hospital

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</thead>
<tbody>
<tr>
<td>NAVA</td>
<td>9</td>
<td>20</td>
<td>28</td>
<td>37</td>
<td>36</td>
<td>44</td>
</tr>
<tr>
<td>NIV-NAVA</td>
<td>15</td>
<td>33</td>
<td>28</td>
<td>24</td>
<td>12</td>
<td></td>
</tr>
</tbody>
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**Graph:**
- **<28 weeks**
- **28-31 weeks**

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Low rate of BPD compared to Vermont Oxford Network

CLD: Infants < 33 Weeks
GA Category

A practical guideline:
how to begin and NAVA level

- To insert Edi-catheter, slide the catheter in until you see the Edi signal
- Start from NAVA level 1.0 cmH₂O/µV and adjust according to patient’s breathing effort (reflected by Edi max level when the patient is sleeping)
  - If Edi peak high (>15), increase support (NAVA level)
  - If Edi peak low (<5), decrease support (NAVA level)
- Adjust PEEP to keep Edi min close to baseline
  - If Edi min is high, increase PEEP
A practical guideline: apnea time

- Start with apnea time of 5 seconds
- Adjust according to patient’s respiratory drive:
  - Frequent apnea in unstable infant, decrease apnea time
  - More stable infant, increase apnea time to prioritize NAVA