Delivery Room Management of the Micro-Premature Infants

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Dr. Michael Dunn is a Senior Neonatologist working in the Women and Babies Program at Sunnybrook Health Sciences Centre in Toronto, and an Associate Professor in the Department of Paediatrics at the University of Toronto. He is an established researcher who has spearheaded several large randomized trials examining the effect of neonatal therapies. He has been very involved in VON activities since 1992. He is, or has been, on the Steering Committees of several VON sponsored clinical trials including: Early Surfactant Replacement Trial, DR Management Trial, HeLP trial and the Extremely Low Birth Weight Follow up Project. He and the team from Sunnybrook have been active participants in three NICQ Collaboratives, including NICQ 2002 (Family Matters), NICQ 2005 (Senses and Sensibilities) and NICQ 2007 (Staffing for Quality and Safety). Dr. Dunn was also the Clinical Leader for the “Resuscitation and Stabilization” group of NICQ 2009 and has been a regular contributor to the Neonates Journal Club as an editor.

Dr. Dunn serves on several local, national, and international bodies committed to improving the quality of neonatal-perinatal care. He is a member of the Ontario Provincial Maternal-Newborn Advisory Committee, the Maternal and Perinatal Death Review Committee to the Chief Coroner for the Province of Ontario, and the Canadian Neonatal Network. He is the past President of the Neonatal-Perinatal Section of the Canadian Paediatric Society (CPS) and was a liaison member of the Fetus and Newborn Committee of the CPS. He serves as a Member of the Consensus Committee to Establish Recommended Standards for Newborn ICU Design. Dr. Dunn is committed to the provision of quality care to NICU patients and their families, and believes that we, as health care providers, need to do everything in our power to give our newest citizens the best possible start in life.

Annual Quality Congress Breakout Session, Saturday, October 3 and Sunday, October 4, 2015
Delivery Room Management of the Micro-Premature Infants
Objective: Identify 3 key opportunities to improve the delivery room management of micro-premature infants through the use of process improvement and standardization.
Delivery Room Management of Micro-Premature Infants

Giving High-risk Neonates the Best Possible Start

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Disclosure
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My content will not include any discussion or reference to any commercial products or services
I do not intend to discuss an unapproved or investigative use of commercial products or devices

Objectives
- Identify 3 key opportunities to improve the delivery room management of micro-premature infants through the use of process improvement and standardization.

Why this Topic?
Micropremature Infants
- Infants born at less than 26 weeks
- Approximately 3-5 per 1000 live births
- Small numbers but highest risk for death or morbidity
- Highest acuity, longest length of stay
- Greatest potential for improvement

Canadian Neonatal Network 2012
Vermont Oxford Network 2013

Special Micropremie Report

<table>
<thead>
<tr>
<th>Condition</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total 12271</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Died in DR (died without ventilator)</td>
<td>12263</td>
<td>13.8</td>
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<tr>
<td>Early death (died within 6 hours)</td>
<td>10614</td>
<td>9.4</td>
</tr>
<tr>
<td>Late death (died between 6 to 12 hours)</td>
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<tr>
<td>Prenatal death</td>
<td>1980</td>
<td>1.6</td>
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<tr>
<td>Any late death</td>
<td>10614</td>
<td>9.4</td>
</tr>
<tr>
<td>NEC</td>
<td>10613</td>
<td>9.6</td>
</tr>
<tr>
<td>PVL</td>
<td>9719</td>
<td>8.0</td>
</tr>
<tr>
<td>Severe IVH</td>
<td>9719</td>
<td>8.0</td>
</tr>
<tr>
<td>Pneumothorax</td>
<td>10614</td>
<td>9.4</td>
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<tr>
<td>Late infection</td>
<td>9256</td>
<td>7.6</td>
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<tr>
<td>CLD</td>
<td>9238</td>
<td>7.6</td>
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<tr>
<td>Severe ROP</td>
<td>11965</td>
<td>0.0</td>
</tr>
<tr>
<td>Survival with specific morbidity</td>
<td>11965</td>
<td>0.0</td>
</tr>
<tr>
<td>Survival without specific morbidity</td>
<td>11965</td>
<td>0.0</td>
</tr>
<tr>
<td>Survival without specified morbidity</td>
<td>11965</td>
<td>0.0</td>
</tr>
<tr>
<td>Survival without specific morbidity among infants surviving beyond 12 hours of age</td>
<td>11965</td>
<td>0.0</td>
</tr>
</tbody>
</table>

NICQ Next: Innovation in NICQ

Quality Improvement Toolkit: MICRO-PREMATURE INFANT CARE

Expert Review:
- Michael S. Dunn, MD, FRCPC
- Sharon Sylvestre, NP, PhD
- Stacey Collins, NP
- Mandy Marks, RN, MS, BC, CNS
- Monica Chow, RN, MS
- Robert Uncapher, MD

OVERALL GOAL

To increase the proportion of actively treated neonates of < 26 Q7 weeks' gestation surviving without morbidity by X% to be determined.

This home room will focus on the NICU population at highest risk for mortality and morbidity – micro-premature infants. Participating centers will form teams that will work collaboratively with the faculty and other home room teams to develop targeted treatment approaches geared towards improving the outcome of this vulnerable group of infants.

Given that a good start in life is critical to the intact survival of these fragile infants, perinatal, delivery room and neonatal care management will be a major focus of the group. Other key clinical topics to be explored include thermoregulation, skin care, fluid management, nutrition, respiratory and circulatory support, developmental care, and strategies to enhance early parental engagement in the care of their infant. Targeted interventions may be developed to prevent some of the most serious complications impacting these infants including NE, pulmonary hemorrhage, NEC, nosocomial infection and spontaneous intestinal perforation.

Transition

- The most profound period of adaptation that humans must navigate
- Everything changes
  - Circulation
  - Fluid balance
  - Lung inflation and gas exchange
  - Sensory inputs
  - Metabolic “independence”
- Amazing that it goes so smoothly so often, but many neonates require assistance
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Transition

What is this woman doing to me?

Special Considerations

Micropremature Neonates
- Poor respiratory drive
- Surfactant deficiency
- Poor thermal control
- Poor energy stores
- Immature adaptive systems
- Susceptibility to IVH and PVL
- Often born after a complication of pregnancy
  - APH, IUGR, infection, etc
- Highly stressed family

Keys to Success

- Receive infant in optimal condition
- Prepared, skilled transition team
- Respiratory support
- Circulatory support
- Thermoregulation
- Vascular access
- Developmentally supportive care

Resuscitation of High-risk Neonates

One of the most critical and risky events in neonatal-perinatal medicine

Requires a high level of individual skill AND team performance

How Many Newborn Infants “Need” Active Resuscitation?

What is this woman doing to me?
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### Need for Resuscitation
- "Approximately 10% of newborns require some assistance to begin breathing at birth; about 1% need extensive resuscitative measures to survive." (NRP)
- Decreasing GA is associated with increasing need for resuscitative interventions
- There is a move towards providing a less invasive, gentler approach to resuscitation and stabilization of high-risk neonates

### Angela Kribs
- "One must use an infant’s own natural abilities to transition"
- "...most premature infants are not born dead thus they do not require true resuscitation"
- "key ingredient is patience and having the team members on board with the concept of gentle transition"
- "the physician is not the life saver, but rather the observer and supporter to enable gentle transition"

### Micropremature Infants
- Most likely to need intensive resuscitation
- Infrequent in many centers
- Technically very challenging
- Most vulnerable to suboptimal application of resuscitative measures
  - Hypoxia/hyperoxia
  - Hyper/hypocarbia
  - Baro/volu/atelectotrauma
  - Circulatory instability
  - Hypothermia
- High potential impact of DR management on survival without morbidity

### Transient/Adaptation in the Delivery Room and Less RDS: "Don’t Just Do Something, Stand There!"
- My bias is that the delivery room beeper should initiate a focus on transition-adaptation and, with patience and after a bit of time, resuscitation if necessary.
- There is perhaps nothing more dangerous for the preterm lung than an anxious physician with an endotracheal tube and a bag.
- Although early surfactant is good for infants with RDS, there is no information to judge the benefits of surfactant for infants without RDS. A brief transition may help identify the infant in whom significant RDS will develop.

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Angela Kribs


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Questions
- What form of respiratory support should be provided immediately after birth?
  - CPAP vs elective intubation
- If support is provided with CPAP, when and how should surfactant be given?
- Are there infants in whom elective intubation and prophylactic surfactant should be the preferred approach?

Advantages of Early CPAP
The World According to Wung
- Facilitates the maintenance of an adequate FRC and promotes improved gas exchange from the first minutes of postnatal life
- Maintenance of adequate air-liquid interface in the terminal alveoli promotes release of surfactant
- Avoidance of intubation promotes less lung injury (baro/volutrauma), less secondary infection, and facilitates clearance of secretions

The CPAP vs Intubation RCTs
- CPAP or Intubation (COIN) Trial
- Surfactant, Positive Pressure, Oxygenation Randomized Trial (SUPPORT)
- VON Delivery Room Management Trial

Clinical Trials
nCPAP versus DR Intubation

<table>
<thead>
<tr>
<th>Study</th>
<th>Patients</th>
<th>N</th>
<th>Death / BPD</th>
<th>CPAP ETT</th>
<th>Other Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>COIN</td>
<td>&lt;25-28 wk +Vigorous</td>
<td>610</td>
<td>.80 (.58-1.12)</td>
<td>89 %</td>
<td>Inc. air leak Inc. mort (NS) 25-26 wk 75% of intubated babies given surf Dec. mort 24-25 wk Air leak similar</td>
</tr>
<tr>
<td>SUPPORT</td>
<td>24-27 wk</td>
<td>1316</td>
<td>.91 (.83-1.01)</td>
<td>83%</td>
<td>Dec. 24-25 wk Air leak similar</td>
</tr>
<tr>
<td>DRM</td>
<td>&lt;26-29 wk +Liveborn</td>
<td>648</td>
<td>.83 (64-1.09)</td>
<td>52%</td>
<td>Dec. mort (NS) Air leak similar</td>
</tr>
</tbody>
</table>

Conclusions
- COIN
  - In infants born at 25 to 28 weeks’ gestation, early nasal CPAP did not significantly reduce the rate of death or BPD, as compared with intubation. Even though the CPAP group had more incidences of pneumothorax, fewer infants received oxygen at 28 days, and they had fewer days of ventilation.
- SUPPORT
  - The results of this study support consideration of CPAP as an alternative to intubation and surfactant in preterm infants.
- VON DRM
  - Preterm neonates in this trial who were initially managed with either nCPAP or prophylactic surfactant with rapid extubation to nCPAP had similar clinical outcomes to those treated with prophylactic surfactant followed by a period of mechanical ventilation. An approach that utilizes early nCPAP leads to a reduction in the number of infants who are intubated and given surfactant.
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But......
Are there any circumstances in which surfactant prophylaxis is likely to be the preferred approach?

Prophylactic Surfactant or CPAP for ELBW Neonates

Resolved that:
Initial respiratory management of ELBW neonates should include intubation and prophylactic surfactant
Pro – Michael Dunn
Con – Neil Finer

Questions
What about the highest-risk babies?
If an elective nCPAP approach is taken, might some infants be disadvantaged by a delay in delivery of surfactant?
How do we decide who might benefit from intubation and prophylactic surfactant versus a trial of CPAP?

ELBW Neonates at UCSD
- 92% PPV
- 61% intubated
- 10% chest compressions
- 1.5% epinephrine

Kimball AL et al. E-PAS 2007;7832:6

Intubation for Resuscitation

Let's look at the smallest, most immature babies.....
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**Surfactant Treatment and Endotracheal Intubation by Gestation Age**

![Graph showing surfactant treatment and endotracheal intubation by gestation age.]

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**Columbia 23-25 weeks GA**

<table>
<thead>
<tr>
<th>Initial Stabilization</th>
<th>Intubation</th>
<th>CPAP</th>
<th>Failure</th>
<th>Success</th>
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</thead>
<tbody>
<tr>
<td>87</td>
<td></td>
<td></td>
<td></td>
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Ammari et al. J Pediaetr 2005

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**Outcome at 36 weeks**

![Graph showing outcome at 36 weeks.]

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**PULMONARY AIR LEAK**

![Graph showing pulmonary air leak.]

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Clinical Trials
nCPAP versus DR Intubation

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<tr>
<th>Study</th>
<th>Patients</th>
<th>N</th>
<th>Death / BPD</th>
<th>CPAP ETT</th>
<th>Other Findings with CPAP</th>
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Conclusions

- Although often successful in allowing preterm neonates to avoid intubation, initial management with nCPAP will result in a delay in the administration of surfactant to many surfactant deficient infants
- This delay can result in an increased risk of air leak and other complications of prematurity
- Intubation with surfactant prophylaxis should remain the preferred approach to the initial respiratory management of the highest-risk preterm neonates (ie. those born at less than 26 weeks’ gestation)

So, what are the arguments?

- Surfactant administration as soon after birth as is feasible and safe provides the best opportunity to evenly expand and stabilize the surfactant deficient lung
- This can be achieved by intubation and administration of prophylactic surfactant shortly after birth
- Most preterm infants born at less than 26 weeks’ require intubation at some point in their clinical course anyway
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Outcome of extremely low gestational age newborns after introduction of a revised protocol to assist preterm infants in their transition to extraterrestrial life

Key notes:
- A revised gentle delivery room management policy, which aimed at assisting preterm infants in their adaptation to extraterrestrial life without mechanical ventilation, was applied safely to 164 ELGAN infants below 26 weeks of gestation.
- With this approach, mortality, rates of bronchopulmonary dysplasia (BPD) and severe ICH were significantly lower than in a historical control cohort of ELGAN.
- 70% of infants treated following the revised protocol had no cognitive impairment.

Outcome of extremely low gestational age newborns after introduction of a revised protocol to assist preterm infants in their transition to extraterrestrial life

Respiratory management of RDS (n=155)

CPAP
CPAP + Surf
mech. Ventilation
CPAP failure as % of CPAP starters
mech. vent. due to RDS

Outcome of preterm infants ≤ 1000 g and ≤ 27 weeks

The First Golden Minutes…

"Recent research and clinical evidence suggest that interventions performed in the first minutes after birth may also have long-term consequences in addition to the short-term effects in the rate and quality of survival of ELGANs."
- Delayed cord clamping
- Use of non-invasive ventilation
- Careful oxygen titration
- Occlusive wrap to avoid hypothermia

The First Golden Minutes…

Nonintubated Surfactant Application vs Conventional Therapy in Extremely Preterm Infants: A Randomized Clinical Trial

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Nonintubated Surfactant Application vs Conventional Therapy in Extremely Preterm Infants: A Randomized Clinical Trial

Nonintubated Surfactant Application vs Conventional Therapy in Extremely Preterm Infants: A Randomized Clinical Trial

At the time of the surfactant application, the patient goes into respiratory distress with decreased oxygenation and increased work of ventilation.

- Increased intratracheal pressure (CVP) or assisted spontaneous breathing
- Inability to perform a diagnostic of intratracheal pressure with a gestational age of 23 weeks to 26 weeks 6 days.
- Inability to intubate the patient.

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So, What should we do?

- Support spontaneous respiratory efforts
  - CPAP or gentle sustained inflation
- Positive pressure ventilation **if necessary**
  - Neopuff or Bag and Mask (capable of applying PEEP)
- Intubate for resuscitation, protracted apnea, severe respiratory distress, high FiO2 requirements and/or to administer surfactant
  - Start with low pressures (16-18 / 5 cm H2O)
  - TV monitoring (target 4-6 ml/kg)
  - CO2 monitoring (target pCO2 of 45-55 mmHg)
- Administer surfactant if exhibiting signs of RDS with documented need for escalating or sustained levels of supplemental oxygen
  - INSURE
  - LISA

Exercise

- Develop an algorithm for the initial respiratory management of micro premature infants born at your center
  - Device and interface to apply first
  - ?GA for elective intubation and prophylactic surfactant vs initial stabilization on nCPAP
  - If initially supported with nCPAP, device and interface for early support
  - If initially supported with nCPAP, indications for selective surfactant and process to give it
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