5 Ways to Offer Neuro-Protective Care in the NICU

Neotech Webinar Series

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Kathi Salley Randall,
RN, MSN, CNS, NNP-BC

Objectives

- Outline a brief history of Neuro-Science
- Describe the five domains of neuro-protection
- List at least two medical and/or nursing care interventions that could be considered neuro-protective

History of Modern Neuro-Science

1000 B.C. – Pharaohs could enter the “afterlife” without a brain, but not without a heart

History of Modern Neuro-Science

Aristotle (384 B.C.)
Believed that the heart (not the brain) was the seat of cognition and perception

History of Modern Neuro-Science

Leonardo Da Vinci (1452-1519)
Believed that perception, memory, and other cognitive functions resided within the ventricles
Thomas Willis (1621-1675)
The “father” of Neurology
Physician and Anatomist

Established that perception, movement, cognition, memory were all functions of the brain itself.

Developed the theory that complex mental functions were associated with particular areas of the brain.

### History of Modern Neuro-Science

#### Thomas Willis

- ANATOME: *Anatomiae pars posthuma* by Willis, THOMAS WILLIS, M.D., F.R.S.

#### Phrenology

P. Joseph Hall (1758-1828)

### History of Modern Neuro-Science

#### Phrenology

- P. Joseph Hall (1758-1828)

### Critical periods of brain development

- Primary neurulation
- Proencephalic development
- Myelination
- Neuronal proliferation
- Neuronal migration

### Theories of Brain Development

- Neural Plasticity
  - Experience Dependent
  - What fires together, will wire together

- Neural Pruning
  - Experience Expectant
  - Use it, or lose it

### Myelination in First 5 years

- Pathways:
  - Sensorimotor
  - Temporal language
  - Frontal language

The incidence of neurological disabilities related to perinatal brain injury has not decreased in decades:
- CP, Cognitive impairment, Epilepsy
- Term and preterm infants are affected

Leading cause of death and disability in children

Perinatal brain injury is multi-factorial and is occurring at a micro level that we do not yet even understand fully:
- In the past - Cardiovascular and hypoxia-ischemia were the sole culprit

IQ scores at 26 years (n=359)

Psychiatric diagnosis: Childhood/Adolescence

VON: Mortality and major morbidity among survivors, 2000 vs. 2009

Frequency distribution of Autism Spectrum Disorder

What is Neuro-Protection??
• Initially used to characterize substances or strategies capable of preventing cell death
• Now, encompasses all interventions that promote normal development and prevent disabilities
• And are used in a diverse range of populations

What is Neuro-Protection??
• In Peds and NICU, neuro-protective interventions are becoming common and even “standard of care”
  • From Cooling babies with HIE to Near Drowning and a number of other diseases
• Overall these interventions fall into 1 of 5 primary domains of Neuro-Protection

Let’s dive in a bit deeper

PREVENTION OF INJURY
- Maternal Health and Wellness
- Minimize Potentially Harmful Exposures
- Vigilant OB Care
- Maternal Magnesium Sulfate
- NICU Regionalization
- Maternal Transport
- NRP Trained Staff
### Prenatal Exposures

- **Maternal Infections and Illness**
  - Rubella
  - Hypothyroidism

- **Nutrition**
  - Poor Maternal Protein levels → low myelination
  - Folic Acid → NTD

- **Environmental Hazards**
  - Pesticides
  - Methyl-Mercury
  - Lead = decreased IQ scores
  - Noise = attention

- **Addictive Substances**
  - Fetal Alcohol Syndrome → microcephaly, mental retardation
  - Cocaine
  - Tobacco

- **Hormone Disruptors**
  - BPA
  - Phthalates
  - PCBs

### Body Burden in the Fetus

- An average of 287 chemicals were found in newborn cord blood
  - 180 linked to cancer
  - 217 neurotoxins
  - 208 birth defects

*Environmental Working Group 2004*

### Prevent Brain Injury in VLBWI through PBP

1. Antenatal betamethasone
2. Optimize peripartum management and delivery at a center with a NICU
3. Direct management by Neonatologists/NNPs
4. Minimize pain and stress
   1. Avoid early LP
   2. Developmental Care
5. Optimal Positioning (Mid-line)
6. Treat hypotension (Keep MAP > 30 not GA)
7. Limit postnatal indomethacin use
8. Optimize respiratory support
9. Limit sodium bicarbonate use
10. Use post-natal dexamethasone judiciously (> 42 days & too early)


### Use Midline Head Position x 3-7 days

### Drawing blood from UAC's


*PubMed PMID: 16373299*
CO2 Management

Pain and Stress in the NICU

CONTAINMENT OF INJURY

What is Neuro-Protection??

Interventions That Aim To:
- Reduce Injury Progression (containment)

Cooling for HIE

- Body or head
- Both shown to reduce death and disability
- It doesn’t help everyone
  - NNT = 7
- Additional therapies are being considered

Identification and Treatment of Sz

Animal models have indicated that seizures can accelerate cell death in H-I injuries.
- Up to a two-fold increase in the rate of cell death
- Recurrent seizures can adversely affect neurogenesis (rats)
INCREASE CELLULAR TOLERANCE

What is Neuro-Protection??

Interventions That Aim To:
- Protect Neurons from Additional Injury after Insult (increase their tolerance)
  - Hypothermia +
    - Anticonvulsants
    - Anti-Excitatory
    - Anti-Inflammatory
    - Anti-oxidants
  - Growth Factors
    - EPO – antioxidant, anti-inflammatory
    - Xenon – NMDA-receptor antagonist
    - IGF-1

Noise in the NICU

Linked to attention disorders
Linked to increased ototoxicity of some meds
Chronic Stress Exposure
Can causes physiologic instability

SALVAGE INJURED CELLS

What is Neuro-Protection??

Interventions That Aim To:
- Enhance the Repair of Injured Neurons (salvage cells)
  - Melatonin did not prevent PWMD, but promoted subsequent repair
  - An area ripe for research and new discovery

GROW & NUTURE NEW CELLS
What is Neuro-Protection??

- Interventions That Aim To:
  - Grow New Neurons (neurogenesis)
    - EPO
    - Stem Cell
    - IGF-1
    - Massage
    - Kangaroo Care

What is Neuro-Protection??

- Interventions That Aim To:
  - Nurture the Neurons we have
    - Sleeping
    - Loving
    - Bonding
    - Life-Long Learning

Minimize Pain & Promote Positive Touch

- Protect Sleep

<table>
<thead>
<tr>
<th>TABLE 2: Protecting Sleep in the Neonatal Intensive Care Unit</th>
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</thead>
<tbody>
<tr>
<td>Recommendations to Protect Sleep</td>
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<tr>
<td>Consistent and support with hand</td>
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<tr>
<td>Supportive blanket rolls</td>
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<tr>
<td>Positioning aids</td>
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<tr>
<td>Parental touch</td>
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<tr>
<td>Skin-to-skin contact</td>
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<tr>
<td>Music</td>
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<tr>
<td>Massage</td>
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<td>Allow infant to transition to an awake state before</td>
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<tr>
<td>providing nonurgent care</td>
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<tr>
<td>Set care schedule based on infant cues</td>
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<td>Based on information from Vanderberg and Coughlin et al.</td>
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</tbody>
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Parental Provided Massage

REM Sleep Deprivation

- Results in:
  - Disordered sensory system development in infants
  - Disordered or disrupted learning and memory creation
  - Loss of cortical plasticity into adulthood
  - Smaller adult brain size
Who Recommends Kangaroo Care?

- MOD (2001)
- AAP (2005)
- ABM (2007)
- NANN (2008)
- CDC (2010)
- NRP (2011)

KC Promotes brain maturation

- Higher Bayley Mental and Motor scores
- Higher IQ's
- Better brain complexity (more synapses)
- 2-4 weeks more maturity than non KC preterm infants
  - Scher MS et al. (2009)

Early & Uninterrupted Skin to Skin

Create Bonds that will last a life-time

What is Neuro-Protection??

- Interventions that:
  - Capitalize on multiple pathways and synergistic effects
    - Inflammation, hypoxia, nutrition, stress, pharmaceuticals, etc
    - Cooling + XYZ
  - Not just about the white/grey matter
    - Consideration towards oligodendrocytes, astrocytes, sub-plate neurons, and other non-neuronal cells
  - Given at a time that maximize their effect
    - I.e. begin cooling before 6 hours
  - Not just about preventing cell death
    - Also about enhancing cell growth

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Create a family

THE END

CONTACT - Kathi Salley-Randall

If you would like to contact me about this lecture and other speaking opportunities please don’t hesitate!

Email is best – nursekathi71@gmail.com