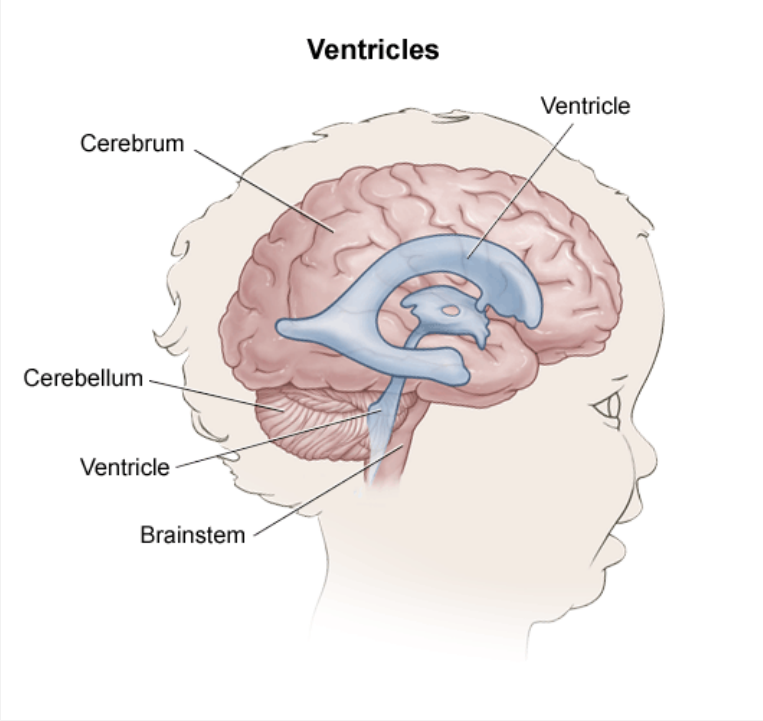
Neonatology and the Premature Infant Today

What are the factors we need to consider as we try to improve our patients' short and long term outcomes?



In-Utero Environment of a Fetus

A viable fetus's in-utero environment experiences:

- All 5 senses
- Boundaries
- Anti-gravity
- Midline flexed positioning
- Log roll fluid movement
- No noxious stimuli
- Maternal sounds
- No light

NICU Environment of a Fetus

Potentially life-threatening period for the patient – all systems are immature and require support

Currently neonatal staff monitor and support the patient's heart, respiratory system, vascular system, nutrition, immune system, and thermoregulation, etc.

HOWEVER…the fetus also experiences a high frequency of noxious environmental stimuli during the first few months of life. These stimuli include light, sound, transport noise and movements (inter and intra-hospital), temperature fluctuations, handling, etc.

SO THE QUESTION IS…How do we support an immature brain through its maturation during a NICU stay so the patient can develop into a normal human with a normal future?

The Answer is, I believe…

We must provide a more in-utero environment for the CNS (central nervous system) - this needs to cover all aspects of daily care from delivery to discharge.

Neonatology Today

Great news - We have become extremely successful at keeping extremely small babies alive and sending them home

Outcomes - while they may look normal, development for many NICU graduates is not the same as normal children born close to or at term

NICU Graduate Development - significant incidence of cerebral palsy, mental retardation, plus softer findings that still impact their lives - perceptual problems, dyslexia, ADHD, psychosocial behavioral problems, etc.

Impact - For those affected, there is a significantly negative impact on the patient as well as family dynamics, medical and school resources.

Why is this happening?

Premature babies are at risk for multiple problems, and IVH is one of the most tragic with severe life-long impact

Current incidence – High, approx. 30% for babies born under 1,500 grams, and it is largely untreatable

Current research – better understanding is providing guidance for improved practices which are being incorporated into many IVH protocols around the country, and many NICUs are working to reduce IVH incidence and severity

What do we know today about IVH of the premature infant:

Gestational age: The lower the gestational age, the higher the risk of the bleed

Site of initiation: The weakest part of the system is the germinal matrix, and can extend into the ventricles and sometimes into the parenchyma

Grades: We still use a 4 grade system – and newer research is showing us that even grade 1 bleeds impact the patient's long-term neuro-developmental outcome

Timing: Most bleeds (95%) occur in the first three days of life, and nearly half occur in the first 24 hours of life.

What do we know today about IVH of the premature infant (Continued)

Highest risk is right after birth, during "the golden hour." Therefore many may occur before the patient arrives at the NICU.

Transport: Intra or inter hospital transport can increase risks significantly.

We do not fully understand exactly when during the transport process the initial injuries to the brain's vascular walls occurs. It might occur in the out born nursery, while the patient is in a transport incubator, etc.

Where and what circumstances the extension of the bleed is precipitated?

How many babies are diagnosed with IVH each year in the US?

Current incidence

- < 1,500 grams - all grades is just under 30% according to VON
- Increases exponentially as weight and gestation decrease

Actual numbers:

- About 58,000 babies born every year are being resuscitated
- Currently in USA approximately 18,000 babies a year will sustain an IVH of some grade, and most of these will go home.

Impact of IVH on patient, their family and our communities:

THE PROBLEM IS REAL.

Affects : Involves all aspects of life, financially, physically and mentally:

Results:

- Children in wheel chairs for their whole life
- Many children requiring special education classes
- Children unable to integrate socially into school- no friends
- Children visiting child psychiatrists for treatment
- Severe impact on family resulting in frequent broken marriages and siblings in distress

Extent of the problem:

- Very significant and still impacting the lives of many NICU graduates
- Outcomes are not improving despite our successes in saving their lives

How much does IVH cost our health care system each year? Each baby?

They are the most expensive patients on the planet!!!
Micro-preemies frequently run up a hospital bill in excess of $500,000 by the time they are discharged

The current cost of a hospital stay for one baby with an intraventricular hemorrhage is $1.0 – $1.5 Million, and is usually associated with a 30% increased length of stay. (Average stay for micro-preemie is about 69 days, with an IVH around 98 days.)

Compilation of published US data suggests that the healthcare dollars spent to take care of these 18,000 infants with a diagnosis of IVH easily exceeds 18 Billion dollars annually!!!

In addition, some researchers have estimated that the ongoing, aggregate cost generated by these infants exceeds 3.6 billion annually - these kids have more frequent use of medical services for years beyond their NICU stay

Positioning Solutions

Practices used for many years:

- NICU staff has been using a variety of positioning rolls and soft pillows or mattress type devices to try to help with positioning,
- Problem - there is a lot of opportunity for inconsistency and variation in effectiveness

BUT

Newer positioning solutions that augment ongoing medial care for these patients are proving to be successful in reducing the incidence and severity of IVH in our micro-preemie population.

Positioning Solutions, cont.

<u>Lets review some newer thoughts and practice opportunities supported by research:</u>
<u>Immature cerebral blood flow</u>

- Highly dependent on neutral head position relative to the body (consistent with intrauterine life)
- Cerebral vascular drainage can be obstructed if infant head position is not supported in line with their body immediately after birth, i.e. venous congestion resulting from vascular obstruction can cause hemorrhage within the germinal matrix of the premature brain.

<u>Immature auto-regulation:</u>
This results in an inability for the patient to protect their cerebral circulation from sudden changes in flow or intracranial pressure. A situation which can easily occur due to volume pushes, Trendelenberg position during a transport transfer, resuscitation etc., resulting in ischemia, reperfusion syndrome, and intraventricular hemorrhage.

Positioning Solutions, cont.

Minimal stimulation and avoidance of patient startle is essential to stop interrupting the process of neural pathway connections in the CNS of these patients.

The immature brain of these premature infants is making neurons and glia, and constantly laying down neural pathways. Techniques using fMRI/BOLD are now allowing us to visualize these pathways around 27 weeks. They appear to be complete closer to term.

In Summary:

Neuro- protection of our patients requires us to protect baby from all these ongoing factors. This requires us to change many of our current practices in order to do our best to not only keep babies alive but also give them a future.

These practices include:

1. **Proper Positioning**
   - Consistently holding baby's head in line with their body (neutral) position as quickly as possible after birth, and even during life saving resuscitation
   - Maintain neutral position simply and consistently for the period of risk (72-96 hours)
   - Maintain HOB up 15-30 degrees to reduce pressure fluctuations experienced in the brain

Summary, cont.:

2. **Reduce toxic environmental stimulation to the absolute minimum**
   - We need to reduce all excesses of noise, vibration, shock, light, and handling etc. while caring for the child from birth, during transport and throughout their NICU stay (Often 3-4 months).

Preemies have all their senses by the time they are viable!

3. Preemies need to experience "normal fetal movements" while cared for in the NICU in order to develop their CNS (central nervous system) correctly, so handling and moving baby must simulate the experience in fetal life. Kangaroo care is clearly important in giving baby the exposure to normal maternal sounds, like moms heartbeat, her voice etc.

In Summary:

These practices are all difficult using the current positioning and transport systems, which have been used for many years, thus the need for change.

The Tortle system, including the Midliners and Transportle with accessory kits, were designed by a Neonatologist using this new research and knowledge while also using her experience and understanding these immature patients needs in the current changing and "high tech" environment of the modern NICU. The devices are specifically designed to integrate with the complex and fast moving practices needed in the NICU, while addressing the importance of a more "in utero" experience essential to the premature brain, even while needing life saving respiratory support, feeding, repositioning, lab work, etc.