Define neuroplasticity and neuroprotection

By 4 weeks the brain has differentiated into the forebrain, midbrain, and hindbrain.

As the brain is forming over the next few weeks, the development of the CNS is being accomplished through neuronal proliferation, neuronal and glial cell migration and myelination.

Organization and myelination continue past birth.

The neurological system is one of the earliest to develop but it is not fully developed until adulthood.

Neuroplasticity
Ability of the brain to make short and long term modifications to the strength and numbers of synaptic neural connections in response to incoming stimuli associated with activity and experience.

Neuroprotection
Refers to the relative preservation of neuronal structure and/or function.

Neurodevelopmental care then is “interventions used to support or help the brain after an injury in a way that decreases neuronal death and allows it to heal through developing new connections and pathways for functionality.”
FUNCTIONAL DEVELOPMENT OF BRAIN

- Motor function
- Maturation/coordination of neurodevelopment and muscular development
- State regulation
- Patterns of sleep/arousal cycles which begin before birth and then as they mature they become very individualized

Now, both the structural development and functional development are influenced by genetic endowment, internal, endogenous or hormonal stimulation and external experiences from the environment.

NEUROSENSORY DEVELOPMENT

- The brain is the communication center which receives messages, interprets, integrates and organizes. Then sends them back out to produce motor, language and emotional responses.
- Neurologic and sensory systems do not develop nor do they exist as two different systems they are interdependent. Each sensory experience is recorded, which leads to a behavioral response which in turn leads to another sensory experience.

SENSORY INTEGRATION

- Intrauterine environment
  - Perfect environment for positive sensory input.
  - Limited light, unrestricted access to mother, maternal voice, bowel sounds, secure boundaries, warm amniotic fluid, maternal and fetal movement, rhythmic and cyclical stimulation, all nutritional needs are met
- Extra uterine environment
  - Negative sensory inputs all around
  - Continuous interplay of stimuli in NICU
  - Can permanently change normal brain development
  - Mother is the best place to be – skin to skin

LIFE OUTSIDE THE UTERUS

HOW DO WE HELP THESE FRAGILE INFANTS?

MODELS OF CARE

- Al’s: Synactive Theory
  - Interpreted the developmental process to be based on subsystem interactions between a neonate’s internal function, the environment and caregivers
  - Portrays a patient and family centered environment within the health care universe

NEONATAL INTEGRATIVE DEVELOPMENTAL CARE MODEL
7 CORE MEASURES

- Healing environment
- Partnering with families
- Position and handling
- Safeguarding sleep
- Minimizing stress and pain
- Protecting skin
- Optimizing nutrition

MY HEALING ENVIRONMENT
GRAND TETON NATIONAL PARK

HEALING ENVIRONMENT

- Physical environment
  - Single room NICUs
  - Construction of NICUs
- Sensory environment
  - Temperature/touch/propiroception
  - Optimal environment for any infant is skin to skin with mother
  - Skin to skin care – short and long term benefits

HEALING ENVIRONMENT CONT.

Skin to skin Care: Short term benefits
1. Infant stress- decreases exposure to noxious stimuli and decrease stress response
2. Maternal- promotes attachment
3. Infant physiology, sleep and feeding- promotes longer and higher quality sleep, stable heart rate, body temperature regulation, effective gas exchange and oxygenation, and effective breastfeeding (better latch and longer feeding times)

Skin to skin Care: Long term benefits
1. May promote or protect structural brain development and synaptic effect (more studies needed)

HEALING ENVIRONMENT CONT.

- Sensory
  - Smell and Taste
  - Maternal odor influences neonatal behavior
  - Most of neonates sense of smell is stimulated primarily by unpleasant odors
  - Can respond to smells with altered respirations, apnea and increased/decreased heart rate
  - Some part of brain which processes smells also handles memories and emotions.

HEALING ENVIRONMENT CONT.

Neuroprotective actions for smell/taste
- Provide odor and taste of mother’s milk with pacifier or oral cares
- Provide a breast pad, soft cloth with maternal breast scent
- Staff should not wear scents
- Skin preps/wipes/cleaning products should all be unscented or fragrance free
- Let your hands dry well and not near baby after using alcohol foam
**HEALING ENVIRONMENT CONT.**

**Sound and noise**
- At birth the ears are capable of discerning 300,000 sounds.
- Constant barrage of sound in NICU can damage the developing cochlea, and delicate auditory structures resulting in hearing loss.
- Loud noises have been shown to have immediate physiologic effects.
- Noise levels in NICU should not exceed 55 dB.
- Interventions:
  1. Eliminate radios, pad trash can lids and cupboard doors, cover incubators with thick quilts.

**Light**
- Protecting sleep cycles especially REM sleep can help to protect visual development.
- Lighting therefore should be individualized to support/enhance each baby’s sleep/awake cycles.
- Lighting should be adjusted to each baby's level of development.

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**CORE MEASURE #2: PARTNERING WITH FAMILIES**
- This is the second most important factor impacting developmental outcomes of the premature infant.
- This must include a philosophy which acknowledges that over time the family has the greatest influence over an infant's health and well-being. They are integral to the infant’s care and without them developmental care cannot occur.

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**PARTNERING WITH PARENTS CONT.**
- 6 potential best practices are the building blocks to support both staff and parents.
  1. Family centered developmental care
  2. Peer support
  3. Mental health support
  4. Palliative and bereavement care
  5. Post-discharge support
  6. Staff education and support

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**PARTNERING WITH PARENTS: NIPU**
- Family centered developmental care
  1. Warm and culturally appropriate welcome
  2. Reconnection with baby should be first priority
  3. Provide a written description of resources
  4. Treat parents as full partners in care
  5. OT, PT, and speech therapists to mentor parents in neuroprotective care
  6. Coach parents on how to recognize and respond to stress, relaxation and feeding cues of baby
  7. Discuss benefits of skin to skin care and DO IT!
  8. Teach swaddle bathing
  9. Incrementally increase parental involvement in care as clinical status changes
PARTNERING WITH PARENTS: NIPU

Peer-to-peer and family support
1. Have a paid parent support coordinator.
2. Offer in-person peer support provided by volunteer graduate parents.
3. Provide peer support to parents beginning antepartum, through stay and through discharge home.
4. Include grandparents and siblings.
5. Forge ongoing collaboration between hospitals and veteran parents.

PARTNERING WITH PARENTS: NIPU

Mental health professionals
1. MHPs interact with parents daily.
2. Provide both formal and informal mental health support to NIPU staff.
3. Screen all parents regularly to identify those in need of higher level of care.
4. Train NIPU staff in symptom identification and counseling skills.
5. Provide debriefing sessions with NIPU staff after critical events.

PARTNERING WITH PARENTS: NIPU

- Palliative and bereavement care
  1. Provide consistent reliable care that recognizes the family as the architect of the care plan.
  2. Promote staff education and support.
  3. Create protocols for the care and disposition of an infant’s body.
  4. Respect and respond to the psychosocial needs of the staff.

PARTNERING WITH PARENTS: NIPU

- Post discharge follow-up
  1. Assign a trained point person to coordinate treatment plans and post-discharge referrals.
  2. Communicate with follow-up providers about the risk factors of parents/family, appointments, and medical records for baby.
  3. Engage and empower parents to develop parenting skills and necessary care practices for their baby.
  4. Home visits.

PARTNERING WITH PARENTS: NIPU

- Staff education and support
  1. Provide staff training and education regarding communication with parents, parental psychosocial needs, cultural care, and self-care.
  2. Supportive measures for staff may include a psychologist on staff, palliative care program, debriefing sessions, best practices for staffing, optimal physical environment, and pastoral care availability.

CORE MEASURE #3: POSITIONING AND HANDLING

- Therapeutic positioning influences......
  1. Neuromotor and musculoskeletal development.
  2. Physiologic function and stability.
  3. Skin integrity.
  4. Thermal regulation.
  5. Bone density.
  6. Sleep facilitation.
  7. Brain development.
POSITIONING AND HANDLING

- What is therapeutic positioning?
  Promotes
  - Flexion
  - Alignment
  - Containment
  - Comfort
POSITIONING AND HANDLING

- Handling
  1. Slow, modulated movements with infant flexed and contained
  2. Caregiving based on infant cues
  3. Continuous observation and response to infant during cares
  4. Skin to skin care

CORE MEASURE #4: PROTECTING SLEEP

- Avoid sleep interruptions
- Protect eyes from direct light/low ambient levels
- Provide some daily exposure to light
- Avoid high doses of sedatives and depressing drugs
- Provide developmental care appropriate to age and maturation of infant

CORE MEASURE #5: MINIMIZING STRESS AND PAIN

- Accurate monitoring of pain as “Fifth” vital sign using a pain tool
- Manage with both pharmacological and non-pharmacological interventions
- Non-pharmacological interventions
  1. Maternal presence
  2. Breastfeeding
  3. Skin-to-Skin contact
  4. Sucrose
  5. Non-nutritive sucking
  6. Facilitated tucking
  7. Swaddling
  8. Developmental positioning

CORE MEASURE #6: PROTECTING THE SKIN

- Use of emollients is controversial without any evidence for use or no use
- Infants less than 1000 grams only need to be bathed every 4 days
- Limit the use of tape and adhesives and use gentle care to remove
- Monitor sites of CPAP or nasal prongs closely and use barriers as appropriate

CORE MEASURE #7: OPTIMIZE NUTRITION

- “Nutrition is love.” Dr. Euteneuer
- Growth is brain growth
- Optimal nutrition is neuroprotective-protein, essential fatty acids
- Breastmilk is optimal
  1. Helps prevents common causes of infant morbidity
  2. Protective properties of breastmilk can’t be duplicated
- Infant-driven feeding
  1. Goals are safe, functional, nurturing, and individually and developmentally appropriate

INFANT DRIVEN FEEDING PLAN

- “Nutrition is love.” Dr. Euteneuer
- Growth is brain growth
- Optimal nutrition is neuroprotective-protein, essential fatty acids
- Breastmilk is optimal
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  2. Protective properties of breastmilk can’t be duplicated
- Infant-driven feeding
  1. Goals are safe, functional, nurturing, and individually and developmentally appropriate
WRAP UP

• Brain injury is the reality of many infants in the NICU.
• The brain is the organ that has the greatest impact on long term quality of life and function.
• We as care providers have the opportunity to improve the quality of life by following these simple steps.

REFERENCES/RESOURCES

• Synapse Care Solutions. www.synapsecare.com, Kathi Randal, RN, MSN, CNS, NNP-BC.