Physical Therapy in the Neonatal Intensive Care Unit

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Objectives
After this presentation, the learner will be able to:

1) Describe the synactive theory of development as the basis for neonatal physical therapy management.
2) Identify the special needs of the neonatal patient and correctly interpret their time out and interaction signals.
3) Describe developmental care practices, including kangaroo care, and list their effects on preterm infant development.
4) Develop meaningful physical therapy goals for the NICU patient.
5) List evidence-based intervention strategies appropriate for the NICU infant, and describe important areas in parental education in the NICU.

The premature child

- <37 weeks gestation
- >500,000/yr in the U.S.
- 1% live births < 32 weeks
- Accounts for >70% neonatal deaths, 50% long-term disabilities
- Terms: AGA, LGA, SGA
- SGA categories:
  - LBW: 1501-2500 g
  - VLBW: 1000-1500 g
  - ELBW: <1000 g
### Causes?

- Social
- Genetic
- Environmental

→ Premature birth

### Organization of perinatal services

- **Level I: Basic Care**
  - Care for infants 35 to 37 wks gestation, stabilize infants under 35 wks until transfer

- **Level II: Specialty Care**
  - Care for moderately ill infants >32 wks
  - Respiratory support

- **Level III: Subspecialty Care**
  - All infants including those who need advanced resp. support, pediatric surgical specialists, etc

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### A visual tour

Overstimulation or understimulation?
• Neither is totally true
• Clinicians should:
  • Offer appropriate stimulation – touch, handling for interaction
  • Reduce inappropriate stimulation – lights, noise

Key is to MODULATE environmental stimulation
• Respond to infant signals
• Educate parents on those signals

Guidelines for tactile stimulation
• Early exposure to mother’s scent
• Minimize exposure to noxious odors
• Assess noise levels and develop noise reduction plan
  • General
  • Surrounding isolette
• Assess light levels, reduce appropriately
• Preservation of sleep
**Infant signals**

- Interaction signals
  - Awake and alert, calm and relaxed
  - Grasping blanket or finger
  - Hand clasp or hands near face

**Time-out signals**

- Squirming, finger and toe splay, airplane
- Looking away or crying
- Yawning, sneezing, having hiccups.
- Color changes

**“Listen” to the signals**

- Stable
- Disorganized
**Neonatal signs of stress**

- Monitor during treatment!

<table>
<thead>
<tr>
<th>Physiological</th>
<th>Behavioral</th>
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</thead>
<tbody>
<tr>
<td>Increased fremitus</td>
<td>Canvas creation</td>
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<tr>
<td>Decreased heart rate</td>
<td>Increased fidget</td>
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<tr>
<td>Decreased respiratory rate</td>
<td>Restlessness</td>
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<td>Increased blood pressure</td>
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<td>Ketogenesis</td>
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**Disorganization**

- Watch closely and see how many signs of stress you can identify in this clip

http://www.youtube.com/watch?v=h7pJF4TtC8Y&feature=related

**Synactive theory of development**

- Describes infant behavior and development according to 6 interacting subsystems:
  - Autonomic or physiologic
  - Motoric
  - State organization
  - Attention / interaction
  - Self-regulation
  - Disorganization in one system affects others ➔ loss of homeostasis.
  - Infant gives behavioral cues to indicate system instability/stability.
### Behavioral states
- Deep sleep
- Light sleep
- Drowsy
- Quiet awake
- Active awake
- Crying
- Smooth transition ("state organization") is indicative of more mature CNS
- Optimal state for learning/interaction?

### Quiet alert state
- Minimal movement
- Eyes open
- Attention focused on a stimulus
- This is the optimal state for learning and interacting

### Physical therapy examination
- At risk neonate = high probability of developmental delay as result of exposure to several medical factors.
- Once referral is received, PT examination to determine individual problem areas, needs.
- Based on 5 subsystems of synactive theory.
- Establishing long-term goals for D/C and short-term goals for each week.
- Need to be familiar with medical jargon of the NICU
Medical issues in the NICU – the jargon

- RSD
- BPD
- MAS
- PVL
- IVH
- NEC
- GERD
- ROP

Medical issues in the NICU – the jargon

- Respiratory distress syndrome
- Bronchopulmonary dysplasia
- Meconium aspiration syndrome
- Periventricular leukomalacia
- Intraventricular hemorrhage
- Necrotizing enterocolitis
- Gastroesophageal reflux disease
- Retinopathy of prematurity

Other issues

- Hyperbilirubinemia
- Cardiac conditions
- Fetal Alcohol Syndrome
- Neonatal Abstinence Syndrome
- Seizures
Purposes of the PT Examination

- Identify:
  - Impairments in body function and structure that contribute to activity limitations and participation restrictions (ICF terminology)
  - Developmental status
  - Responses to stress and self-regulation
  - Needs for skilled positioning and handling
  - Environmental adaptations to optimize growth and development

Areas included in physical therapy examination

- Patient profile – medical Hx, CGA (corrected gestational age), etc.
- Autonomic parameters – cardiopulmonary system, GI upsets, color (changes with handling)
- Neurological signs – tremors, twitches, etc.
- Fontanelles, sutures
- Skin integrity – edema, scars, etc.
- Oro-motor and feeding – tongue, feeding pattern

Physical therapy examination

- Musculoskeletal – range of motion of trunk & upper and lower extremities, flexibility.
- Neuromotor – tone, differentiation of trunk/LE’s/UE’s, spontaneous/elicited activity
- Reflexes - usually deferred, low energy.
- Neurobehavioral – interaction/time-out signals, self-consoling techniques, auditory and visual responsiveness.

→ Assessment, goals, and plan of care.
What about....

- Something I have not mentioned, but we should assess in all patients...
- Any ideas?

Pain

- Pain pathways active at 20-24 weeks GA
- Pain modulatory tracts not active until 36-40 wks GA
- RESULT: more sensitivity to pain than older or term infants
- Assessment?
  - Physiologic manifestations
  - Behavioral manifestations
  - Standardized measures

Alleviating pain in the preterm child

- Nonpharmacological
  - Reduce stimulation
  - Swaddle
  - NNS = non-nutritive sucking
  - Rocking
  - Containment
  - Music
  - Breast milk or sucrose solution
- Pharmacological
Standardized Tests and Measures

- NAPFNI by Dubowitz & Dubowitz
  - Detects neurological signs of deficit
  - Includes neurobehavioral and neurological items
- NIDCAP
  - Observational – good for fragile babies
  - Suggest developmental care strategies from observing baby’s response to handling and baseline state.
  - Lights, noise, facilitation of self-regulation and state transition, etc.
- TIMP
  - Spontaneous activity
  - Elicited activity
- APIB
  - Many others!

APIB

- APIB = Assessment of Preterm Infant Behavior.
- Based on synactive theory, assesses stability of subsystems.
- Systematic observation of premature infant’s behavioral response to increasing levels of environmental stimuli, examiner manipulation, and social interaction.
- Quantifying behaviors for each of the following systems: (a) physiologic, (b) motor, (c) regulatory, (d) attention–interaction, (e) sleep and wake states, and (f) amount of examiner facilitation.
- Pinpoints problem areas that should be followed up

Still awake? Let’s check....

- Name one component of the synactive theory
- Classify these signals as “organized” or “disorganized”
**NICU PT goals and plan of care**

- How can we write meaningful goals in NICU?
- How can we provide interventions that are developmentally appropriate?
- What are special considerations in caring for this patient population?

**Writing goals in the NICU**

- STG's initially aimed at resolving areas of immediate concern, esp. autonomic stability.
  - Eg: in one week, pt. will be able to complete 10 minutes of handling without desaturations to enhance ability to interact with caregiver and successfully complete feeds.
- STG's updated every week
  - Eg: in one week, pt. will demonstrate strong NNS, 2-3 bursts, with good seal, and complete a feeding of 20 cc.
- LTG's mirror what's expected of a neonate of a given CGA.
  - Eg: pt. will be able to perform visual/auditory tracking >45° with head & eyes to interact with caregiver.

**The special needs of the neonatal patient**

- It is the PATIENT who ultimately controls scheduling and directs treatment through medical stability.
- Consider need for energy reserves.
- Monitor response to handling.
- The importance of temperature.
- Avoid overstimulation.
- **FIRST THING TO DO:** schedule with Nurse, reach out to parents. Then, take temperature
Physical therapy intervention

- What do we try to accomplish?
  - Promotion of normal movement experiences
  - Reduction of active reinforcement of abnormal movement patterns and positions
  - Reduction of congenital and acquired musculoskeletal deformities/contractures
  - Fostering attachment & interaction with parents
  - Modification of sensory stimulation in the NICU to promote behavioral organization and physiological stability.

- Management of oral-motor dysfunction
- Enhancement of self-regulatory skills and smooth state transitions
- Increased tolerance to handling and minimization of undesirable autonomic responses.
- Promotion of sensory development through introduction of appropriate stimuli
- Education on developmental care strategies and infant signals for parents and other disciplines.

Developmental care plan

- After the examination, we write a personalized developmental care plan emphasizing:
  - Positioning strategies
  - Equipment needs
    - E.g: bendy bumper, gel pillow
  - Environmental modifications
  - Calming techniques
Developmental care

- **http://www.youtube.com/watch?v=Ww0h_SNUPoU**

Developmentally-appropriate care

- Reduce noise and bright lighting
- Use a variety of positions, esp. prone and side-lying while in NICU
- Handle carefully!
- Provide aids to self-regulation: pacifier, boundary equipment
- Promote NNS – translates to higher feeding performance.
- Encourage social interaction and appropriate audiovisual stim

Kangaroo care

- Placing baby skin-to-skin with parent, ensuring privacy
- Diaper, flexed position
- Rocking, auditory stimuli ok if tolerated
- May be done for several hours if medical status allows
- Initially developed in areas where incubators were unavailable
- Physiological and psychological warmth and bonding
- Studies have shown:
  - Improves breathing patterns
  - Increases quiet sleep time
  - Decreases motoric disorganization
  - Decreases parental stress
  - Promotes bonding
Evidence for developmental care

- Studies show that developmental intervention to adjust environment to infant’s needs:
  - DECREASES RISK OF INTRAVENTRICULAR HEMORRHAGE
  - INCREASES WEIGHT GAIN
  - DECREASES THE NUMBER OF DAYS:
    - On supplemental oxygen
    - On ventilator support
    - Before the infant is able to nipple-feed
    - Of hospitalization

Treatment strategies

- Positioning
- Musculoskeletal treatment that integrates developmental sequencing
- Sensory input
- Parent education
- Hydrotherapy
- Infant massage
- Oromotor

Positioning

- Physiological flexion < in pre-term infants.
- Without proper positioning, postural abnormalities typically develop:
  - Neck hyperextension → gel pillow! (also avoids head molding)
  - Shoulder retraction and abduction → < midline activity.
  - Trunk hyperextension.
  - Frog leg position.
  - Ankle and feet positional deformities.
Benefits of proper positioning:
- Inhibits dystonia, promotes symmetric posture
- Promotes normal development
- Facilitates midline activity and orientation
- Stimulates visual exploration of environment
- Facilitates development of head control and antigravity movements
- Enhances comfort, decreases stress.
- Variety is important — individual needs crucial.
- In preterm babies recovering from respiratory problems, prone position provides improved blood oxygenation.
The Bendy Bumper is a bendable positioning aid that stays in place until it is reshaped by the caregiver. It provides a boundary for developing neonates and promotes containment, flexion, correct positioning and musculoskeletal development.

Company: Children's Medical Ventures
Positioning

- Frederick Frog or “Froggy” – frog-shaped beanbag positioning aid. It may be placed around the head, neck or hips, or used to position an extremity. Portions can be adjusted separately for special positioning needs, used as an extra set of hands during procedures or to assist with a facilitative tuck. The polyethylene beads (beans) are encased in two layers of soft fabric for safety and can be moved to different places within the frog-shaped aid for different uses.
- Company: Children’s Medical Ventures

Positioning

- The SnuggleUp is a soft nest that helps to provide proper positioning and physiological stability for preterm and ill babies. The padded footroll and the soft, adjustable straps allow movement while gently maintaining appropriate positioning and flexion. Once comfortably nested in the SnuggleUp, the baby can be weighed, moved, examined or transported with minimal stress and disruption.
- Company: Children’s Medical Ventures

Proper positioning
Prone Plus assists in proper prone positioning and ventral support by utilizing the natural force of gravity. The hourglass shape facilitates natural rounding of the shoulders, hand-to-mouth coordination and head and trunk alignment.

- Antimicrobial viscoelastic (memory) foam
- Four different sizes to ensure appropriate positioning of premature through full-term infants
- Company: Children's Medical Ventures
**Musculoskeletal treatment**

- **Goals**
  - Help motor development
  - Range of motion is appropriate for CGA
  - Baby is exposed to normal movement patterns.
  - Babies on vents usually develop tightness.
  - Proper body alignment important.
  - Encourage physiological flexion.

- **Studies:**
  - Physical activity benefits short-term bone development and growth
  - More long-term studies needed

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**Example of therapeutic handling**

In side-lying, there is disassociation between pelvic and shoulder girdles and between extremities. Weight bearing through the foot provides proprioceptive input and reduces hypersensitivity.

Indications:
- Muscle tone abnormalities affecting posture and movement, or limitation of movement related to muscular or connective tissue factors.
- Behavioral state abnormalities – irritability, lethargy.
- Must be medically stable
- No IV / vent, good thermoregulation
- Useful to facilitate desired postures, musculoskeletal treatment, sensory stimulation and self-regulation
- Water buoyancy assists movement; also calming effect.
**Hydrotherapy**

Facilitation of flexed posture and hand-to-mouth movement with calmed behavioral response in infant previously irritable with handling.

**Infant massage**

- Some studies have shown
  - Increased weight gain
  - Reduced hospital stay
  - Fewer postnatal complications
- More studies needed

**Oromotor intervention**

- Stimulation of oral area
  - Some children may require desensitization – e.g. OG tube use
  - Non-nutritive sucking (NNS)
    - Shorter hospital stay
    - Improved sleep/alert patterns
    - Easier transition to oral feeds
A very important thing you need to know...

- FACT: we cannot be there all the time – the baby’s parents as well as the nurse and other caregivers have a crucial role in our treatment plan.
- The NICU is truly INTERDISCIPLINARY. To meet the needs of neonates, we must work closely with:
  - Nurses
  - Social workers
  - Respiratory therapists
  - And many others

Leaving the NICU

- On average, up to 38-40 wks CGA or by weight
- Medical status and feedings play large role
- Crucial to have a transition plan
  - Early intervention therapist, follow-up programs
- What to expect from these children?
  - CGA = corrected gestational age, accounts for preterm birth
  - CGA vs. chronological age
    - Born at 32 weeks GA, 2 months ago
    - CGA is 40 wks – functionally a NEWBORN, not a 2 m/o!

Follow-up

- Even if you are not a NICU PT, you are very likely to have patients who are NICU graduates if you work in peds....
After the NICU

http://www.youtube.com/watch?v=aoPzy2NbhFA

The parent perspective

- You are part of the parents’ support system
  - Offer enough info but
  - DO NOT overload!
- Honesty is crucial
- Emotional conflicting time
- Do not JUDGE

Family-centered care

- Respect
- Choice
- Information
- Collaboration
- Strengths
- Support
- Empowerment
- Flexibility
  www.familycenteredcare.org
Parents should...

• Feel welcome at all times
• Be encouraged to participate in child’s care
• Be engaged in a therapeutic relationship with health care providers
• Have access to support groups

Parent education - PARAMOUNT

• Discussion of goals, purposes and services.
• Orientation to the follow-up plan after D/C.
• Information on infant's temperament, signals, and ability to interact with the environment.
• Instructions on selected developmental activities and handling techniques.
• Community resources.
• Information on normal development.
• Other miscellaneous info.

Summary

• Synactive theory as the basis for eval & care.
• Signals – adjust to what infant is telling you
• "At-risk" infant → developmental delay
• Evaluation: 5 subsystems, readiness for handling.
• Intervention includes: positioning, musculoskeletal treatment, sensory input, hydrotherapy, education.
• APIB evaluates motor and neurobehavioral aspects and determines need for follow-up.
• The NICU as an interdisciplinary setting.
• Your “patient” is actually the entire family
Some interesting videos to watch after class

http://www.youtube.com/watch?v=cppYYPHIA8E&feature=related
http://www.youtube.com/watch?v=Yo8Nk_AbysD&feature=related
http://www.youtube.com/watch?v=y7fEPOlH8&feature=related
http://www.youtube.com/watch?v=Sb77y2HZQ&feature=related
http://www.youtube.com/watch?v=PrC8tTj-qR5&feature=related
http://www.youtube.com/watch?v=GFm8zxttHHH&feature=related

Different GA, different needs

- 22 week twins
  http://www.youtube.com/watch?v=cppYYPHIA8E&feature=related
- 27 wks
  http://www.youtube.com/watch?v=Yo8Nk_AbysD&feature=related
- 29 wks
  http://www.youtube.com/watch?v=Sb77y2HZQ&feature=related
- 30 wks
  http://www.youtube.com/watch?v=GFm8zxttHHH&feature=related
- 31wks
  http://www.youtube.com/watch?v=JLv8Z2UhpRw&feature=related

Different GA, different needs

- 32 wks
  http://www.youtube.com/watch?v=GFm8zxttHHH&feature=related
- 33 wks
  http://www.youtube.com/watch?v=JLv8Z2UhpRw&feature=related
- 34 wks
  http://www.youtube.com/watch?v=JLv8Z2UhpRw&feature=related
- 35 wks
  http://www.youtube.com/watch?v=3zDGeAzT8&feature=related

- 32 wks with IUHG
  http://www.youtube.com/watch?v=GFm8zxttHHH&feature=related
Interactive case activity

Time to think

- We are going to look at 2 case studies
- For each case, I would like for you to think about:
  - Two short-term goals and one long-term goal
  - Priority topic in parent and clinician education

Case 1

- Born 27 3/7 wk gestation
- Preterm labor with meconium aspiration
- Three weeks on respiratory support via ventilator, weaned to oxygen via nasal cannula at 30 3/7 wk gestation
- Other complications: bilateral IVH grade III, jaundice, mild VSD.
- Parents were very distressed about not being able to hold the baby while he was on the ventilator. They would like to start kangaroo care, but they are afraid to handle the baby because he still “seems so fragile”
- Currently 30 5/7 wk, in isolette, NPO due to reflux
Case 1 PT findings

- PT evaluation shows the following problem areas:
  - (1) decreased self-regulation with marked irritability upon handling.
  - (2) poor state transition with difficulty reaching quiet alert state; baby shows low energy reserves.
  - (3) fair autonomic stability with two episodes of oxygen desaturations during handling (O2 levels decreased from 92% to 70%), and one small episode of spit-up.
  - (4) poor non-nutritive suck with poor seal
  - (5) low muscle tone in upper extremities and in trunk, with normal PROM and AROM for CGA; midline activity in upper extremities is low for CGA (baby actively places UE's in midline ~ 10% of the time only).
  - (6) fair muscle tone in lower extremities (note: muscle tone in neonates is usually assessed as low, fair, within normal limits for CGA, or increased) with normal PROM and AROM for CGA. Mild LE tone asymmetry with muscle tone in right LE > left LE.
  - (7) motoric disorganization upon handling, with tremors and twitches.
  - (8) moderate bilateral trunk tightness to lateral flexion and rotation.
  - (9) shoulder girdle retraction and elevation.
  - (10) decreased attention/interaction for CGA due to state transition and self-regulation problems.

Case 2

- Born 33 wk gestation, currently 34 wk CGA
- Preterm labor, mother had good prenatal care, parents approachable and enthusiastic. This is their third child.
- Required O2 via nasal cannula for 5 hours only; weaned to room air after that.
- No other remarkable medical Hx
- Currently feeding po q3, RN reports poor feeding and weak suck
- In open crib, stable

Case 2

- PT evaluation shows:
  - Fair self-regulation with some initial fussiness upon handling
  - Fair state transition with some drowsiness
  - Muscle tone good in LE's, fair in UE's, low in trunk
  - NNS fair, 1-2 bursts, poor seal
  - Good autonomic stability
  - Decreased attention/interaction for CGA due to state transition and self-regulation problems.
  - Right foot actively placed in inversion 75% time, neutral 25%, eversion 0%. PROM WNL's.
**Case 1 – Appropriate STG’s**

- **Initially:**
  - Patient will complete a 20 minute session without desaturations to enhance stability and function.
  - Patient will show increased alertness prior to touch-time for at least 2 minutes to allow for well-modulated functional activity.
  - Improved NNS to fair, 2-3 bursts, fair seal to prepare for feedings.
  - Decrease trunk tightness from moderate to mild to allow well-modulated spontaneous activity in side-lying.

- **Later on:**
  - Patient will demonstrate placement of B UE’s in midline >50% of the time for self-regulation and interaction
  - Well-modulated spontaneous/elicited activity >60% time for interaction
  - Improved NNS to strong, 2-3 bursts, good seal and start po feeds.
  - Auditory tracking 15 degrees with eyes for interaction

**Case 1 continued**

- A reasonable long-term goal would be:
  - At discharge, baby will be able to perform aud/vis tracking at least 30 degrees with head and eyes to interact with caregiver.
- Focus of parental education would be on
  - Bonding, handling, interacting with the baby
  - Behavioral signals
- Focus of clinician education would be on
  - Positioning
  - Promoting NNS
  - Developmental adaptations to avoid disorganization (equipment, light levels, noise levels, etc)

- **Treatment progression: Focus on STABILITY**

**Case 2**

- **Examples of appropriate STG’s**
  - **Initially:**
    - Improved NNS to strong, 3-4 bursts, good seal, and complete a 30 cc feeding in 20 minutes.
    - Increased UE midline activity >60% for self-regulation and interaction
  - **Later on:**
    - Head lift in supported sitting 1-2 seconds for interaction
    - Auditory/visual tracking 45 degrees head & eyes for interaction

- **Long term goal:**
  - Bilateral head turn in prone 2/3 trials for face clearance
  - Well-modulated spontaneous/elicited activity > 90% of the time

- **Foot positioning – needs to be monitored**
  - If it does not resolve in one week, assess need for taping, and include pertinent goals.
Case 2

- Focus of parental education would be on
  - Oromotor techniques to improve feeding
  - Promoting attention/interaction
- Focus of clinician education would be on
  - Positioning
  - Promoting NNS
  - Oromotor techniques
- Treatment progression in this case would be more advanced than in case 1. Here stability is not the primary concern. We can start working on FUNCTIONALITY right away.

References


Thanks for participating!

Any questions on today’s material?