Apneas, Bradycardias, & Desaturations During Oral Feedings in Growing Preemies: Nature vs Nurture

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Goals & Objectives:
1. To learn the significance of laryngeal chemo-receptors and their elicited response,
2. To learn the physiology of As, Bs, Ds, during swallowing,
3. To demonstrate fluoroscopic evidence of nasopharyngeal reflux, penetration, aspiration, etc.
4. To understand various strategies to prevent As, Bs, Ds during oral feedings.
5. To manage infants in private practices for follow-up care.

The American Academy of Pediatrics recommends that preterm infants demonstrate competent oral feeding skills before hospital discharge. (AAP, 1998)

The attainment:
• of exclusive oral feedings
• coordination of suck, swallow and breathe

Nature vs Nurture

- Neural Immaturity:
  - Primarily reflexive responses
  - Poor physiologic and state regulation
  - Incoordination of suck-swallow-breathe

- Feeding practices:
  - Protocols for feeding readiness
  - Nipple flow rates
  - Feeding position
  - "encouragement" during feedings

Goldfield & Smith, 2011
Laryngeal Chemo-Reflexes

- In children/adults: cough, swallow and arousal
- In newborns and preterm infants: exaggerated vagal and sympathetic components
  - Vagal responses: apnea, bradycardia, laryngospasm
  - Sympathetic responses: systemic hypertension, blood flow redistribution

Laryngopharyngeal Reflux (LPR)

(a.k.a. Gastro-oesophageal reflux, Oesophago-pharyngeal reflux, Gastro-esophageal-laryngeal reflex, Supra-esophageal reflux, Pharyngeal-esophageal reflex, Extra-esophageal reflux)

Both Acidic and Non-Acidic gastric content has been identified in the triggering of the LCR.
- Infrequently = “un-expectedness” of reflux
- Frequently = possible defective or immature swallowing mechanism.

- Presence of acute or chronic laryngeal inflammation may heighten laryngeal reactivity

Laryngeal Chemo Receptors

The most dense area of sensory receptors are within the laryngeal vestibule

Fetal Protective Reflexes
**Naso-Pharyngeal Reflux**

**Now What?**

**When to Study**

Only after:
- trying positional changes,
- trying pacing techniques,
- trying different nipple/bottle systems,
- allowing for continued maturation of the infant’s feeding development,

*VanBuren, et al, 2009, SCAN*

with no improvements 
or
with continued suspicion of aspiration

**Nipple Flow Rate = Bolus Size**

- High-flow nipples increased incidence of feeding-related apneas and bradycardia in preterm infants. *(Matthew, 1991)*
- Deglutition apnea duration increased from 0.5s to 5s, with increases in bolus volume *(Hiss et al., 2001)*
- Large volume swallows were more inclined to produce an inspiratory post-swallow breath, instead of an expiratory post-swallow breath, which increased the risk of aspiration. *(Martin et al., 1994)*

**We Intervene:**

1) **Bedside Feeding Evaluation:** to assess for “subjective” success with various feeding modifications.
- nipple flow rate – bolus size
- position – semi upright, upright, side lying, etc.
- Cue-based feeding

2) **Objective Feeding Evaluation:** to objectively evaluate the extent of swallowing physiology as well as to establish appropriate intervention techniques.
- Modified Barium Swallow Study (MBS)
- Fiberoptic Endoscopic Evaluation of Swallowing with Sensory Testing (FEEST)

**Slow**

- Respiration, feeding ability, and swallowing safety are all affected by flow rate.

**Regular**

**Medium-Fast**

Higher flow rate makes the coordination of sucking, swallowing and breathing more challenging.
Ultra Preemie Nipple
- 38% slower than their original "premature" nipple.
- According to a recent study done by Kelli Jackman (2013).
- Similar Slow Flow: 7.3ml/min.
- Dr. Brown's Premature: 7.3ml/min.
- Endaural Slow Flow: 8.8ml/min.

Although not tested in this study, the New Ultra-Preemie Nipple would flow around 5.2ml/min.

Side-Lying Position
- Better oxygen saturations, decreases work of breathing and less HR variability with use of sidelying with preemies (Clark, et al., 2007).
- Better state regulation, better-swallowing and better physiologic stability with sidelying (Thyore, in press).
  - affords more ease of anterior-posterior rib cage movement.
  - increases lung compliance and decreases airway resistance.
  - Makes it easier to maintain head and trunk alignment.
  - Reduces potential for bolus misdirection.
  - Reduced bolus flow rate due to lower hydrostatic pressure.

Similar to the cross-cradle position for breastfeeding, which is our benchmark for optimal oral feeding experiences.

Cue-Based Feeding
Volume-Driven vs Infant-Driven

Always keep in mind...

Thickening is NOT our first intervention. Our preferred intervention is identifying feeding modifications to improve swallowing in preemies with dysphagia.

<table>
<thead>
<tr>
<th>Consistency</th>
<th>Rice Cereal : Formula</th>
<th>Dr. Brown's Nipple</th>
<th>Flow Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Half Nectar</td>
<td>1 Tbsp : 3oz 1tbsp : 30ml</td>
<td>Level 2 regular</td>
<td></td>
</tr>
<tr>
<td>Nectar</td>
<td>1 Tbsp : 2oz 1tbsp : 20ml</td>
<td>Level 2 regular</td>
<td></td>
</tr>
<tr>
<td>Honey</td>
<td>1 Tbsp : 1oz 1tbsp : 10ml</td>
<td>Level 3 slow</td>
<td></td>
</tr>
</tbody>
</table>

Never use the "V" cut, the bolus is too large.
Never cut a standard nipple; the bolus is too unpredictable.
Thickening Liquids

- National Dysphagia Diet (2003) proposed terms for liquids and correlating viscosity ranges:
  - Thin: 1-50 centipoise (cP)
  - Nectar: 50-500 cP
  - Honey: 300-1,790 cP

- The thickening of liquids may:
  - Improve the effectiveness and safety of the swallow, thereby reducing the risk of aspiration.
  - Improve the child's oral control of the liquid and the coordination of SSE.

After Discharge

- All thickening recommendations should be continued until the repeat swallow study objectively assesses that child's safety on thin liquids
  (Merr, 2007, Pediatric Radiology)
- Talk to the parents and make your own record of their interpretation of the frequency of As, Bs, Ds in the NICU
- Ask specific clinical questions to help guide them through any bottle/breast feeding difficulties:
  - Coughing, choking, nasal congestion, wet vocal quality, throat clear
  - How long does it take to finish a bottle?
  - Do they fall asleep while bottle feeding?
- If feeding difficulties continue, refer out for a feeding evaluation to establish individualized modifications.

Take Away Points

- As, Bs, Ds are linked to Laryngeal Chemo Reflexes.
- They are stimulated by swallowing difficulties and/or GER, reflux as well as by improper feeding practices (nature & nurture).
- Feeding modifications can reduce / eliminate their occurrence.
- These modifications are easy to teach to nursing staff and to parents.
- When modifications don’t work, a swallow study is recommended.
- The Pediatric Doreen Team makes the swallow studies most reliable and valid.
- Any recommendations regarding thickening should be continued until a repeat swallow study is performed.

Thank you!

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