Improving Feeding Outcomes in the NICU: Moving From Volume-Driven to Infant-Driven Feeding

Catherine S. Shaker
Florida Hospital for Children
Orlando, FL

Abstract

Current research on feeding outcomes after discharge from the neonatal intensive care unit (NICU) suggests a need to critically look at the early underpinnings of persistent feeding problems in extremely preterm infants. Concepts of dynamic systems theory and sensitive caregiving are used to describe the specialized needs of this fragile population related to the emergence of safe and successful feeding and swallowing. Focusing on the infant as a co-regulatory partner and embracing a framework of an infant-driven, versus volume-driven, feeding approach are highlighted as best supporting the preterm infant's developmental strivings and long-term well-being.

The Impact of Prematurity

Neonatal intensive care units (NICUs), along with technological advances, have contributed to the survival of tinier preterm infants. This has been particularly true for extremely low birth weight (ELBW) infants, defined as weighing less than 1000g (Hack, Friedman, & Fanaroff, 1996). In addition, over 40,000 infants born each year in the United States (approximately 1% of live births) are extremely preterm (EP) infants, defined as less than 28 weeks gestation at birth (Hamilton, Martin, & Sutton, 2004). The majority of these very small and extremely preterm infants survive. However, these improved survival rates bring an increased risk for motor, sensory, nutritional and growth problems (Hack et al., 2005; Hacket al., 1996; Msall & Tremont, 2002; O'Shea, Klinepeter, Goldstein, Jackson, & Dillard, 1997; Vohr et al., 2000). Early feeding difficulties that arise with the transition from tube feeding to oral feeding are prominent.

Extreme immaturity alone may be sufficient to alter the typical path to learning feeding skills and predispose the infant to later feeding problems as well. Even at the time of discharge, these ELBW and EP infants may be sufficient feeders (able to take in adequate volumes) but not skilled feeders. They lack consistent and stable feeding skills across the day and are unable to flexibly adapt their feeding skills to changing conditions (Thoyre, 2003). While most infants are discharged from the hospital to home taking full breast or bottle feedings, many of these infants over time show negative feeding behaviors and slow velocity in their growth (Ross, 2009). While Kirkby and colleagues (Kirkby, Greenspan, Kornhauser, & Schneidermann, 2007) found that less than one percent of preterm infants required supplemental tube feedings at the time of discharge from the NICU, Hawdon and colleagues (Hawdon, Beauregard, Slattery, & Kennedy, 2000) found that over 50% of parents report problematic feeding behaviors in former preterms at the age of 18-24 months. The incidence of feeding problems in EP infants after discharge has been reported to range from 19-80% (Cerro, Zeunert, Simmer, & Daniels, 2002; Mathisen, Worrall, O’Callahan, Wall, & Shepherd, 2000; Sweet et al., 2003; Wood et al., 2003). Given these adverse feeding outcomes, it is critical to consider how the preterm infant experiences feeding early on and the conditions and strategies that may serve to be protective from developing a feeding problem that endures (Thoyre, 2007).
Preterms are at risk for adverse developmental outcomes because they are wiring their brains outside of the womb, in an environment that often provides sensory overload: the NICU. Yet, the NICU environment is their foundation for feeding development (Ross, 2009). Preterms begin to develop feeding skills when they are also in the process of developing motor and sensory neuropathways (Thoyre, 2007). They are born with a central nervous system given less time to mature within a protected intrauterine environment. The external NICU environment, unlike the uterine environment, involves absent postural containment typically provided by the uterus and amniotic fluid, aversive and painful stimuli, irregular patterns of handling from multiple caregivers and unfiltered noise and light (Sweeney, Heriza, Blanchard, & Dusing, 2010).

Early sensory information may have an effect on the architecture of the brain. In addition, initial subsystem interactions, whether positive or negative, create not only the context in which, but also affect how, the brain is “wired” (Shore, 1997). The extrauterine environment and care giving experiences may also affect developing brain structure (Als, Duffy, McNulty, Rivkin, Vajapeyam, & Mulkern, 2004). The combination of physiologic instability and a sensory system that is undergoing rapid development in an unpredictable and often overwhelming environment may be a potential risk factor for neurobehavioral and developmental dysfunction later in life, and lay down altered sensory-motor pathways in the brain. This may also adversely affect the ability and desire to eat both in the NICU and after discharge (Ross, 2009; S. M. Thoyre, personal communication, October 23, 2009).

The Challenges of Learning to Feed

Discharge to home is commonly delayed due to challenges with learning to feed successfully and safely (Lau, Smith, & Schanler, 2003). Historically, feeding successfully implies the ability to take all prescribed volume by mouth within an allotted time and maintain a sustained pattern of weight gain. Feeding safely implies precise coordination of sucking, swallowing and breathing while maintaining physiologic stability. To accomplish safe and successful feeding, the preterm infant must be capable of sustaining attention to the task of feeding for the duration of the feeding; controlling and coordinating the postural, oral, and upper airway motor systems during the physiologic demands associated with feeding; and protecting the airway from compromise by fluid (Thoyre, 2003). This requires the dynamic integration, maturation and coordination of multiple subsystems, both internal and external.

Dynamic systems theory provides a theoretical framework for development of feeding skill in the preterm infant. Applied to infants in the NICU, it refers, first, to the presence of multiple interacting structural and physiologic systems within the infant for producing functional behaviors (such as feeding), and second, to the dynamic interactions between the infant and the environment (Sweeney, Heriza, Blanchard, & Dusing, 2010). A change or intervention affecting one system may diminish or enhance stability in another. For this reason, considering feeding from only an oral-motor perspective disregards the complexity of this task for preterm infants. Considering the whole infant (breathing pattern, work of breathing, postural, state and physiologic variables and their interaction) provides the basis for supporting positive feeding experiences for the preterm infant.

In this dynamic systems model, physiologic stability is considered as the foundation for organizing movement, behavioral state, attention/interaction and self-regulation. These systems support the infant’s posture, oral structures, upper airway, arousal and physiologic regulation, and suck-swallow-breathe patterns. For the preterm infant, these subsystems are in the process of maturing along convergent, but not always synchronous, time lines (Thoyre, 2003). The infant’s responses and behaviors are an important route for understanding the thresholds of stress or stability. Interventions contingent on the preterm infant’s behaviors focus on ways to enhance self-regulation, development and coping skills. A feeding approach based on dynamic systems theory might include (a) observing the infant continuously during feeding for signs of stress versus stability; (b) individualizing interventions contingent on the infant’s cues related to swallowing, breathing, physiologic stability, postural control; and (c) state regulation to maintain or re-gain stability (Shaker, 1999). It is the role of the caregiver to identify the infant’s behaviors or cues and use them as a guide to supporting the infant during the work of feeding.
The Impact of the Environment

The “environment of feeding” provided by the caregiver, and the interactions between the infant and caregiver, may promote or constrain the infant’s feeding skill and safety (Thoyre, 2003). Caregivers include nurses, parents, other family members and therapists. In dynamic systems theory, the caregiver system includes: how caregivers view feeding, cues they monitor during feeding, what meanings they ascribe to the infant’s cues, their beliefs about their own ability to influence feeding, their ability to take the perspective of the infant, and provide sensitive care giving. Sensitive care giving (Thoyre, 2003) involves recognizing and attending to the infant’s cues to determine when protection and support are needed, knowing when to allow the infant to regulate his own feeding behaviors, proactively structuring the feeding from moment to moment to support safety, and intervening during feeding contingent on cues from the infant signaling inability to self-regulate (Thoyre, 2003; Shaker, 1999). Is the caregiver’s goal a successful feeding or a successful feeder (Shaker, 1990)? Focusing on a successful feeding means it is all about the caregiver’s skill and often about the volume of intake, “getting it in” the infant. Focusing on a successful feeder means supporting the infant in his/her efforts to achieve adequate intake and feed safely, based on his/her continuous feedback, even if the volume is small, as the infant learns to feed safely.

Dynamic Systems Theory Applied to Feeding

Sensitive indicators of the preterm infant’s ability to cope with the stress of feeding include heart and respiratory rates, oxygen saturations, temperature, sleep-wake state, digestion, and suck-swallow-breathe synchrony. The challenge of feeding can quickly trigger changes in these indicators. The caregiver must utilize watchful vigilance to avoid potential serious consequences of subsystem instability (i.e., apnea, bradycardia, tachypnea, color changes, and loss of state arousal and/or postural control). If feeding provides too great a challenge to physiologic stability, it can have a negative effect on the control of the larynx, pharynx and esophagus. The consequence of this deterioration is the potential for penetration or aspiration. In addition, the potential for silent aspiration is heightened in this fragile population (Arvedson, Rogers, Buck, Smart, & Msall, 1994; Shaker, 1999; Thoyre, Shaker, & Pridham, 2005) Therefore, the impact of feeding on the stability of the physiologic, motor and state systems must be assessed continuously during feeding. A disruption that negatively affects the infant’s respiratory system may, for example, cause the infant to compensate through the motor system with changes in the sucking pattern (Ross & Brown, 2002), or through the state system, by moving to a lower state, which is inappropriate for successful feeding (McCain, 1997). In an attempt to keep the systems in balance, the infant may use adaptive strategies to reduce bolus size, such as limited jaw and tongue excursions, compression-only sucking or purposefully expelling excess fluid out of the oral cavity (Eishima, 1991; Ross, 2008). These adaptive strategies may be perceived by caregivers as sucking problems, if they are not viewed in the context of dynamic systems (Goldfield, 2007). Recognizing and conceptualizing disruptions in infant system synergy allows one to address the underlying issue, versus applying an arbitrary intervention that may actually over-ride the infant’s own beneficial compensatory mechanism (Ross & Brown, 2002). For example, an infant with difficulty coordinating swallowing and breathing may move to a lower sleep state, accompanied by loss of postural control, particularly in the oral area. A well-intentioned caregiver may increase the flow rate to “help” the infant, either by using a faster flow nipple, or providing cheek or jaw support, which can result in a large uncontrolled bolus moving passively toward the airway. Moreover, decreases in oxygenation compromise the infant’s physiologic stability, with a resulting loss of coordinated feeding behaviors, as the infant attempts to protect his airway (Ross & Brown). This compromise in physiologic stability may lead to an apnea and/or bradycardia event (Mathew, 1991). Accumulation of these responses to physiologic instability, in turn, may provide negative feedback leading to feeding refusal behaviors (Blackman, 1998). A good example of this is seen in infants with chronic lung disease. These infants have more feeding refusals and negatively perceived feeding behaviors, which may be a reflection of the struggle to safely coordinate when swallowing and breathing compete (Martin & Pridham, 1992). It is critical to appreciate that infants are establishing their learned experiences with feeding; therefore every feeding experience, regardless of how brief, must be as positive as possible (Ross, 2009).
The Culture of Feeding in the NICU

It is common in the NICU to hear discussions of how the infant must take his whole bottle to go home. This is the last hurdle, or task, that an infant must achieve in order to go home. Because of this task-driven model of feeding, preterm infants are often encouraged to eat even when they are indicating that they are too fatigued or not behaviorally or physiologically ready for eating (Thoyre & Brown, 2004). The pressure to get the infant to home can overshadow a more developmentally supportive focus on pleasurable feeding experience that minimizes stress (Ludwig & Waitzman, 2007). How the nurse feeds the infant has been shown to have a profound impact on mother-infant feeding interactions following discharge to home (Pridham et al., 1998). What is the nurse’s working model or paradigm about feeding? Feeding may be viewed as either supporting an infant in a learning opportunity or something one does to the infant. How does the nurse define success with feeding? It may be an empty bottle, or an infant who feeds without color change or other adverse overt behaviors. What is the relationship to the infant’s success? It may be all about the caregiver: “I am a successful nurse if I can get it all in.” Or, a focus on the infant as a co-regulatory partner: “I support the baby to feed safely based on his continuous feedback”. If parents observe a sensitive caregiver who provides an interactive fit with their infant, known as co-regulation (Thoyre, 2003), they will more likely view, and, therefore, demonstrate, feeding as relationship-based. This co-regulated approach recognizes the impact of the caregiver’s decisions on the infant’s feeding experience (S. M. Thoyre, personal communication, October 23, 2009), and views the infant as a co-regulatory partner with an individual agenda (Ross, 2008) and emerging skills. In this synergistic relationship, the caregiver modulates the approach during feeding based on the infant’s communication. The skilled and observant caregiver assists the infant in a pleasurable feeding experience that minimizes stress and maximizes intake (Ludwig & Waitzman, 2007).

An Infant-Driven vs. Volume-Driven Approach

The aim of an infant-driven approach is to help infants learn to feed, not to get them to eat or “get it all in”. Safety becomes the primary goal. That includes: avoiding aspiration with feeding, avoiding passive manipulation of the nipple, and using a flow that is controllable for the infant (Ludwig & Waitzman, 2007). Feedings are designed to be nurturing, and a relationship-based event with the caregiver. The goal is an infant who is engaged in feeding without signs of distress, even if the feeding only lasts for as long as a few sucks. The focus is not on intake. Intake will improve with time if the infant is supported to be a successful feeder. Feeding is stopped when the infant communicates being done, or the inability to continue for whatever reason, in lieu of the caregiver’s doing whatever is necessary to empty the bottle.

Having a greater emphasis on achieving adequate intake/volume and less on competence with feeding is quite problematic (Thoyre, 2003). If the focus of the feeding is solely on volume (total intake or volume per minute), the feeder may not consider the infant’s physiologic stability, and the feeding may be counterproductive (Ross, 2008). The safe consumption of nutrition, while responding to the infant’s continuous feedback, is central. The focus of feeding in the NICU should be on supporting the infant’s developmental strivings (Ross & Brown, 2002; Shaker & Woida, 2007)—with the infant enjoying the experience and interacting with caregivers, not on volume of intake (Ross, 2009).

Conclusion

This leads us to ask some critical questions:

- Are caregivers protecting the vulnerable preterm infant during feeding as well as possible?
- How do we facilitate a change of paradigm in NICUs from a predominant focus on an empty bottle to a focus on the infant as a co-regulatory partner?
- Are there practices that can help caregivers provide consistent support during feeding that will improve feeding outcomes in the NICU and after discharge?
The literature is promising and suggests the following strategies: choosing a more controllable flow rate to protect the immature preterm infant (Al-Sayed, Schrank, & Thach, 1997; Chang, Lin, Lin, & Lin, 2007; Gewolb & Vice, 2006; Goldfield, Richardson, Lee & Margetts, 2006; Lau, Sheena, Shulman, & Schanler, 1997; Lau & Schanler, 2000; Matthew, 1991; Shaker, 1999); considering a side lying position (D. Beckman, personal communication, March 21, 2002; Clark, Kennedy, Pring, & Hird, 2007; S. M. Thoyre, personal communication, October 23, 2009); providing supportive swaddling (Wolf & Glass, 1992; Shaker, 1999); providing anticipatory pacing during feeding to avoid uncoupling of swallowing and breathing (Jordan, 1998; Law-Morstatt, Judd, Snyder, Baier, & Dhanireddy, 2003; Shaker, 1999); supporting state regulation through re-arousal or calming (McCain, 1997); and avoiding prodding (Ross & Brown, 2002; Shaker, 1999). An infant-driven approach in the NICU which provides co-regulated, gentle feeding opportunities based on the infant’s continuous feedback is essential. Coupled with critical thinking and problem-solving by the caregiver, an infant-driven approach holds promise for improving feeding outcomes, the infant’s well-being, and the parent-infant relationship well beyond discharge from the hospital.

References


Ross, E. S. (2009, July). Don’t be a “babies R us” therapist: Thinking past the bottle in the NICU. *Pediatric Feeding and Dysphagia Newsletter, 9*(5), 1-4.


Three-Ounce Water Swallow Challenge as a Screening Tool for Children With Suspected Oropharyngeal Dysphagia

Debra M. Suiter
VA Medical Center
University of Memphis
Memphis, TN

Steven B. Leder
Yale University School of Medicine
New Haven, CT

Abstract

Accurate assessment of children who are risk for oropharyngeal dysphagia is vitally important because unrecognized prandial aspiration can lead to a number of serious medical complications, including failure to thrive, dehydration, oral aversion, and pneumonia (Martin et al., 1994; Langmore et al., 1998). Videofluoroscopy and endoscopy are the two most widely used instrumental tools to assess swallow function. However, videofluoroscopy exposes children to radiation, is expensive, and involves swallowing substances different from those a child might typically ingest. Endoscopy can be frightening and potentially uncomfortable for some children. Additionally, clinicians may not always have access to these instrumental evaluations.

Screening tools often are used by clinicians in an attempt to avoid unnecessary further testing, such as instrumental assessment of swallowing. In clinical practice, a screening test for oropharyngeal dysphagia has three goals:

1. To determine the likelihood that aspiration is present
2. To determine the need for formal swallow evaluation
3. To determine when it is safe to recommend resumption of oral alimentation

Accuracy of screening tests for detecting a particular disease or condition is typically expressed in four terms: sensitivity, specificity, positive predictive value, and negative predictive value. When screening for aspiration, sensitivity is the probability of a screening test being positive when aspiration is present; specificity is the probability of a test being negative when aspiration is absent. Positive predictive value is the probability of aspiration being present when a test result is positive; negative predictive value is the probability of aspiration being absent when a test result is negative.

A clinically useful screening test should provide good sensitivity for accurate identification of those individuals with a given risk factor such as aspiration, and high negative predictive value for accurate identification of those individuals who do not have a given risk factor. ASHA guidelines indicate that a screening may include

- Interview or questionnaire that addresses swallowing function.
- Observation of the signs and symptoms of oropharyngeal swallowing dysfunction.
- Observation of routine or planned feeding situation, if indicated.