Feeding on Demand and Developmental Progress Among Premature Neonates

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Purpose: Premature, compared to full-term, neonates are at risk for poorer development and other health problems, and these may persist throughout childhood. Key to neonatal development is the ability to take in nourishment. However, due to the delay in physical development, premature neonates have difficulties in controlling and coordinating breathing during the feeding process, and are at increased risk for dysphagia and apnea-related disorders. Premature neonates admitted to the Neonatal Intensive Care Unit (NICU) are traditionally fed according to rigid schedules. The first step to transition from the scheduled oral feedings to feeding on demand, is when the NICU staff, usually nurses, witness behavioral cues indicating that the premature neonates are hungry and physically able to take in oral nutrition. Several physical and clinical factors may delay the initiation of feeding on demand. However, if feeding on demand is successful, tube feedings end, and NICU release is possible. At approximately 33 week’s postmenstrual age (PMA), the suck reflex becomes more consistently coordinated with the pharyngeal swallow activity. The 34th week in premature neonate development is a turning point, since at this age oral feeding may be attempted. Prior to 34 weeks of age (PMA), accordingly, NICUs schedule oral feedings for every three hours and nurses receive orders by physicians, to gradually replace scheduled feedings with feeding on demand. Feeding on demand means oral nutrition is provided based on hunger cues from the neonate. This feeding on demand model encourages individual, consistent, safe, functional, nurturing and developmentally appropriate feeding that reduces neonate and feeder stress as well as promoting positive oral feeding experiences and development. Besides the importance of feeding on demand for the neonate’s development, Infant feeding often serves as the focal point of parent holding and touching their baby, and early parent-infant interactions. Therefore, oral feeding offers a natural means of parent involvement. Early discharge supports the formation of parent-infant attachment.

Due to the limited information on when to begin feeding on demand, this thesis will examine whether the introduction of feeding on demand at the 34th week PMA (postmenstrual age), after adjusting for confounders, benefits premature neonates. The overarching research question is: "Does transitioning premature neonates as early as possible to feeding on demand result in better developmental progress?" Current criteria used to determine neonatal growth and development include assessments on: weight, head circumference (HC), and a collection of measurements on infant activities and general movements (GM) indicating developmental progress. GM follow a pattern that can be observed in neonates as young as nine weeks post term. In neonates without neurological dysfunction, GM continue in a similar pattern until about the end of the second month post term, which then is followed by a gradually emerging new GM pattern. GM records comprise the state-of-the art parameters used to conduct neonatal developmental assessments. Methods: This mixed methods study will include: a quantitative component using an historical cohort study design of premature neonates (n=200) admitted to the NICU who had at least one developmental pediatrics visit within four to eight weeks post discharge; and a qualitative component with semi-structured interviews of a purposive sample of premature neonates’ parents (n=8). The qualitative component enables us to gain insights on the parents’ feeding experience in the NICU and at home. Contribution/Results: Results from this study will determine whether earlier feeding on demand leads to better infant developmental outcomes and identify the factors associated with successful feeding on demand in premature neonates. The goal of this study is to promote early NICU discharge and better outcomes for the premature neonate and parents.

Conclusion: the research is not yet complete, hence the conclusions are not yet available.
Title:
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Demand feeding, Development and Premature Neonates

References:
This study was helped with many sources, some of which are older than five years due to being crucial in explaining anatomical and theoretical bases for this work.


Abstract Summary:
Results from this study will determine whether earlier feeding on demand leads to better infant developmental outcomes and identify the factors associated with successful feeding on demand in premature neonates. The goal of this study is to promote early NICU discharge and better outcomes for the premature neonate and parents.
The research question is: “Does transitioning premature neonates as early as possible to ‘feeding on demand’ result in better developmental progress?”

Infant Development for Preterm Neonates.

This study is guided by an infant developmental framework. Very premature neonates fail to achieve rates of development and growth observed in normal term neonates in utero at equivalent gestational ages (Moyses, Johnson, Leaf & Cornelius, 2013). Current criteria used to determine neonatal growth and development include assessments on: weight, head circumference (HC), and a collection of measurements on infant activities and general movements (GM) indicating developmental progress (Einspieler, Bos, Libertus & Marschik, 2016; Einspieler, Marschik, Bos, Ferrari, Cioni & Prechtl, 2012). GM follow a pattern that can be observed in neonates as young as nine weeks post term. In neonates without neurological dysfunction, GM continue in a similar pattern until about the end of the second month post term, which then is followed by a gradually emerging new GM pattern (Einspieler, Prechtl, Bos, Ferrari & Cioni, 2004). GM records comprise the state-of-the art parameters used to conduct neonatal developmental assessments. This study will use two data sources, clinical records of the premature neonate from the NICU that will be merged with their GM assessment records from the first developmental clinic visit after NICU discharge.

Key to neonatal development is the ability to take in nourishment. However, due to the delay in physical development, premature neonates have difficulties in controlling and coordinating breathing during the feeding process, and are at increased risk for dysphagia and apnea-related disorders. At approximately 33 week’s postmenstrual age (PMA), the suck reflex becomes more consistently coordinated with the pharyngeal swallow activity (Gewolb et al., 2001). The 34th week in premature neonate development is a turning point, since at this age oral feeding may be attempted (Gewolb et al., 2001). Accordingly, NICUs schedule oral feedings for every three hours and receive orders to gradually replace scheduled feedings with feeding on demand (Kirk, Alder & King, 2007).

Feeding on demand means oral nutrition is provided based on hunger cues from the neonate. This feeding on demand model encourages individual, consistent, safe, functional, nurturing and developmentally appropriate feeding that reduces neonate and feeder stress as well as promoting positive oral feeding experiences and development (Ludwig & Waitman, 2007; Siddelle & Froman, 1994). Infant feeding often serves as the focal point of parent holding and touching their baby, and early parent-infant interactions. Therefore, oral feeding offers a natural means of parent involvement. Early discharge supports the formation of parent-infant attachment (Siddelle & Froman, 1994).

Today, the determination of when NICU nurses should begin feeding on demand is inconsistent. Nurses make recommendations about starting the feeding on demand based on the premature neonates’ hunger cues and development (Siddelle & Froman, 1994), and so, the attending physician orders the gradual replacement of gavage feedings until the neonate can take in enough calories by mouth to support growth (Kirk et al., 2007). There is no standard procedure for the initiation and schedule of feeding on demand, and so, it proceeds by custom rather than by evidence based protocols (Breton & Steinwender, 2008).

A mixed methods study will address this gap in literature by examining if earlier feeding on demand leads to better neonatal developmental outcomes and to identify the factors that may confound or mediate the relationship between these variables in premature neonates. The quantitative component will be comprised of data from the NICU based on selection criteria which will be merged with data from the first visit at the developmental clinic between four to eight weeks post NICU discharge. The qualitative component will be comprised of interviews from a purposive sample of premature neonates’ parents (n=8).
drawn from the NICU quantitative data to gain a better understanding of their experiences of feeding their infants in the NICU and at home.

**Growth and development**

The 34th week in premature neonatal development is a turning point when suck-swallow-breathe coordination appears (McCain, 2001). When premature neonates are unable to support oral feeding, their oxygen levels drop during initial sustained sucking periods (not seen in full-term neonates); however, as premature neonates develop and grow older, the speed of their recovery and maintenance of oxygenation levels improve (Siddelle & Froman, 1994). It is critical to understand that at this time, premature neonates are establishing their learned experiences with feeding, and therefore, every feeding experience must be as positive as possible (Price, 2014).

Due to safety considerations, premature neonates are fed by gavage until they are able to transition to oral feeding (McCain, 2002). There are two plans for feeding: feeding based on a predetermined schedule, generally ordered to be given every three hours regardless of the premature neonates' state of wakefulness or readiness (Kirk et al., 2007); or feeding on demand, when the premature neonates signal or cue that they are ready to eat.

Cues depend on the caregiver's assessment of and response to neonatal behaviors, and are used to gradually transition from scheduled feedings to feeding on demand (McCain, 2001). Feeding on demand is an infant-driven model that encourages individual, consistent, safe, functional, nurturing and developmentally appropriate feeding that reduces stress for the neonate (as well as for the caregiver), and promotes positive oral feeding experiences and feeding development (Ludwig & Waitman, 2007; Siddelle & Froman, 1994).

**Oral feeding management**

Introduction and management of oral feeding for premature neonates is a major challenge for clinicians in the NICU. Feeding practices are often inconsistent and contradictory among clinicians and NICUs; moreover, they are based on tradition rather than evidence (Breton & Steinwender, 2008). Nurses make recommendations to attending physicians about starting feeding on demand when they witness sucking behavior such as latching on to and sucking fingers, pacifier, etc. They consider neonatal development and maturation as well as the medical condition for initiating feedings (Siddelle & Froman, 1994).

The attending physician orders bottle or breast feedings to gradually replace gavage feedings based on when the neonate can take in enough calories by mouth to support growth. These scheduled feedings are generally ordered to be given every three hours, whether or not the neonate has: achieved a quiet alert state, displayed hunger cues, demanded to be fed, or demonstrated other behavior that are prerequisites for oral feeding success) Kirk et al., 2007). Determining the optimal time to introduce oral feedings and strategies for progression may lead to beneficial outcomes for neonate, the family and the NICU staff (Merritt, Pillers & Prows, 2003).

**Benefits of "Feeding on Demand"**

Premature neonates who received nutrition by feeding on demand showed more clinical improvement when compared to those neonates offered other feeding patterns (Crosson & Pickler, 2004) and earlier discharge from the hospital (the latter is especially evident in the "healthy" premature neonate population) (Breton & Steinwender, 2008). Early discharge reduces both the adverse environment of prolonged hospital stays and encourages earlier parental involvement by empowering parents to contribute to the ongoing care of their neonates (Merritt, Pillers & Prows, 2003). Neonates who received nutrition through feeding on demand exhibited more hunger cues, an improved behavioral state organization, shorter durations of hospitalization, and gained weight at the same or faster rate than neonates who were not.
Feeding on demand might prove to be a better approach for most healthy premature neonates (Crosson & Pickler, 2004).

Follow up

Neonates born very premature (VPT, gestation <33wks) have poorer social competence. These difficulties emerge early and persist throughout childhood. VPT are at increased risk of a range of neurodevelopmental impairments compared with their term-born peers including cerebral palsy (CP) and other motor impairments, cognitive deficits, language delay, and behavioral adjustment problems (Ritchie, Bora & Woodward, 2015). Developmental clinic follow up care post-NICU is necessary to detect the possible difficulties in continued growth and development, which may follow them into childhood.

Choosing demand or scheduled feeding

Premature neonate readiness to transition to oral feeding is determined primarily by week of birth (i.e., earlier than 34 GA, at or older than 34th week PMA). Number of meals on the first week of feeding on demand and the average weight gain over the three days post feeding on demand are monitored (McCain, 2001).

Many clinical indicators are taken into account including a normal hematocrit (HcT) at two days post feeding on demand and on the day prior to feeding on demand (Singh et al., 2011; Licht et al., 2008). Glucose is an important factor that is monitored on the first and second day of feeding on demand; and blood levels less than 40 mg/dl indicate hypoglycemia (Montassir et al., 2009; Stanley et al., 2015). Not being dependent on oxygen use also is necessary for successful feeding on demand (Jobe & Kallapur, 2010; Tin & Gupta, 2007; Escrig et al., 2008). Apnea due to prematurity (AOP) (Zhao, Gonzalez & Mu, 2011) and bradycardia (Zhao, Gonzalez & Mu, 2011) are monitored. Other findings that hamper feeding on demand include: intraventricular hemorrhage (IVH) (Ballabh, 2010), small head circumferences and white matter injury (Licht et al., 2008), mother's psychoactive medication during pregnancy (Laine et al., 2003; Kieviet et al., 2015), birth defects such as cleft lip and/or palate (Amstalden, Magna & Lopez, 2007; Clarren, Anderson & Wolf, 1987; Reid, 2004) and congenital heart defects (Licht et al., 2008; Strauss, 2010).

The pre-feeding on demand nutrition also must be considered: (a) gavage only or (b) combination of gavage and oral feeding. Pre-feeding on demand-type of food also is important and can be (a) breast milk, (b) formula, (c) cornflower added, or (d) combination. Once feeding on demand has started, the type of food may be: (a) breast milk, (b) formula, (c) cornflower added, or (d) combination. Certain behaviors during the last week of hospitalization and number of breast feeding occasions also may indicate developmental progress (Kirk et al., 2007). The premature neonate must be free of anomalies, severe intracranial ventricular hemorrhage, and chronic lung disease, otherwise feeding on demand is not relevant as these complicated health issues hinder oral feeding (McCain, 2002).

Other factors that may affect premature neonates ability to consume nutrients by feeding on demand, express hunger cues and achieve optimal developmental outcomes include: medications (Laine et al., 2003; Kieviet et al., 2015), having to return to gavage feedings, week of release (PMA), percent change of weight from birth to release, and total number of days in the NICU. If these criteria are not met, scheduled feeding will resume (Kirk et al., 2007).

Rationale and Contribution of the Research

Thus far the connection between feeding on demand and developmental outcomes of premature neonates has not been well-studied. The goal of this study is to determine whether earlier feeding on demand leads to better infant developmental outcomes and to identify the factors associated with successful early introduction of feeding on demand in premature neonates admitted to the NICU. These study findings may contribute to developing a feeding protocol for NICU neonates.
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