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Commentary

"Pressure" to feed the preterm newborn: associated with "positive" outcomes?

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Premature infants commonly suffer from aerodigestive and pulmonary morbidities that prolong hospitalization. Whether nasal continuous positive airway pressure (NCPAP) support is an absolute contraindication for oral feeding in a physiologically mature infant is up for debate. The fear of laryngeal penetration, airway aspiration, and persistence of pulmonary pathologies among those with bronchopulmonary dysplasia (BPD) further takes the provider away from any aggressive oromotor interventions for providing nutritive feeding therapies. On one hand, delays in establishing oral feeding are going to hamper a timely discharge home; on the other hand, there is a risk in further compromising the respiratory status if the presence of the positive pressure support makes it more likely for the infant to aspirate the feed. Most clinicians would consider waiting until an infant is at least 33–34 weeks of postmenstrual age to allow for physiological maturity of coordination of the sucking and swallowing reflexes before initiating breast/bottle feeding.

These skills may be influenced by premature birth and confounding comorbidities including BPD and early neurological delays. Oral feeding during this critical window is controversial because of the potential of aspiration in an already compromised airway. Infants with BPD have already delayed aerodigestive milestones, potentially due to a combination of immaturity and limited feeding opportunities due to prolonged respiratory support and orogastric tube interfaces. These missed opportunities occur during a critical stage of skill development, often resulting in underdeveloped oral feeding skills and/or gastrostomy and/or fundoplication to ensure adequate nutrition.

The provocative study (1) published in *Pediatric Research* conducted in preterm lambs suggests that NCPAP at 6 cm H_2O improved bottle-feeding efficiency and oxygenation, without any deleterious cardiorespiratory events, albeit cough events were observed. Furthermore, preterm lambs provided NCPAP improved their "bottle-feeding performance as well as the stability of their swallowing–breathing rhythm after 24 h." Samson *et al.* (1) must be congratulated for conducting this elegant study in preterm lambs wherein the authors measured sucking–swallowing–breathing–electrocardiogram–oxygenation while orally feeding these lambs on NCPAP. Previously, these researchers characterized the physiological effects of nutritive swallowing in preterm lambs on NCPAP (2).

It is important to highlight certain limitations/differences between preterm lambs and human infants. Although the gestational age of the preterm lambs was ~34 weeks equivalent to humans, the lambs were kept prone with the neck extended, in contrast to the usual position of the infant being held partially supine/upright when being breast/bottle-fed.

Pathophysiological markers for cardiorespiratory and aerodigestive symptoms are needed to conduct such high-risk, albeit potentially high-yield, clinical trials that may have a bearing on feeding efficiency in human infants with pulmonary disease. Several factors need to be considered when feeding infants with BPD on NCPAP, which is likely the target population for such interventions. Although the controversy of air-flow delivery rates persists, recent research provides the basis for supporting clinical trials in infants with BPD on NCPAP.

Aerodigestive symptoms are frequently thought to be due to laryngeal penetration or aspiration (except silent aspiration); however, adaptive reflex mechanisms exist to divert the stimulus away from the aerodigestive tract and enable pharyngo–esophageal peristalsis to facilitate clearance of bolus transit. Such proof-of-concept studies have been piloted in premature human infants with BPD on NCPAP (3). Pharyngo–esophageal manometry and respiratory inductance plethysmography methods utilized to test the effects of controlled pharyngeal provocation-induced aerodigestive reflexes concluded that the upper esophageal sphincter and lower esophageal sphincter contractile and relaxation reflexes, as well as esophageal propagation, were well developed under such conditions. These reflexes are important for safe pharyngeal bolus transit. Thus, infants on non-invasive respiratory support are capable of adequate aerodigestive protection and may benefit from targeted and individualized oromotor feeding therapies to accelerate feeding milestones.

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Received 19 July 2017; accepted 1 August 2017; advance online publication 13 September 2017. doi:10.1038/pr.2017.198

Mechanisms of airway protection include apnea, prolonged exhalation, cough events, autonomic and respiratory rhythm regulation, swallowing and pharyngo–esophageal peristalsis (4). In infants on NCPAP, upper esophageal sphincter contractile reflex was the most frequent initial mechanism associated with cough (odds ratio = 9.13, 95% confidence interval = 1.88–44.24). The most frequent post-tussive clearance mechanism was primary peristalsis (92%) (5). Thus, the presence of such protective mechanisms that restore respiratory normalcy coupled with cardiorespiratory homeostasis, maintenance of respiratory rhythms, and oxygen saturation can be reassuring to provide carefully structured oral-feeding therapies. In a pilot study involving select BPD infants to attest the proof-of-principle, researchers studied the effects of cautious oral feeding in BPD infants on NCPAP (6). Infants on NCPAP who exhibited oral-feeding readiness cues (7) were oral-fed <30 min per session, once a day, three to five times a week until the infant was weaned off of pressure support. Feeding sessions were discontinued if infants exhibited distress. The NCPAP infants in the oral-fed group (vs. gavage tube feeding only) exhibited earlier attainment of full oral-feeding milestones by 17 days.

Limited human data from retrospective studies would suggest that selective initiation of oral feeds in infants with lung disease (BPD) while on NCPAP appeared to be safe (6). In striking contrast, initiation of oral feeds while on high-flow nasal cannula (HFNC) to provide positive pressure support appears to be detrimental. In a study comparing NCPAP of 5–6 cm H_2O to HFNC (flow adjusted to equivalent pharyngeal pressures), NCPAP was more effective in providing respiratory support (8). Although one retrospective study found no difference in terms of feeding tolerance, a larger sample size from the same group found that HFNC use was associated with delayed oral feeding (9). In a recent publication, in infants using the RAM cannula (Neotech, Neotech Products, LLC, Valencia, CA) to provide positive pressure support, there was a significant increase in tracheal aspiration events based on videofluoroscopic analysis while receiving oral feeds (10).

While macro- or micro-aspiration were not directly assessed using videofluoroscopy, lambs on NCPAP had more coughs (attributed to the high flow of milk) at the termination of the feed (1). However, as shown in human infants, post-tussive swallowing mechanisms are evoked in such circumstances and clear the material away from the aerodigestive tract (5). The authors in the current study (1) were careful to conclude that tracheal aspiration could still be a concern, before extrapolating these results to clinical practice.

Thus, in human infants, based on the evidence available, it would seem prudent to avoid routine initiation of oral feeding while on HFNC (11). Selective patients with pulmonary disease (BPD) may be appropriate for attempting oral feeds while on NCPAP, upon achieving physiological maturity/coordination of the sucking–swallowing reflexes. Physiological studies assessing swallowing–breathing interactions or aerodigestive reflexes may be necessary to assess the readiness of such infants for oral feeds (12).

STATEMENT OF FINANCIAL SUPPORT
This study was supported by R01 DK 068158 (S.R.J.).

Disclosure: The authors declare no conflict of interest.

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