Journal of Pediatric Nursing xxx (2017) xxx–xxx

Contents lists available at ScienceDirect

Journal of Pediatric Nursing

Identification of Risk Factors for Poor Feeding in Infants with Congenital Heart Disease and a Novel Approach to Improve Oral Feeding

Gitanjali Indramohan [a], Tiffany P. Pedigo [b,*], Nicole Rostoker [c], Mae Cambare [c], Tristan Grogan [d], Myke D. Federman [a]

[a] Division of Pediatric Critical Care, UCLA Mattel Children's Hospital, MDCC 12-494, 10833 LeConte, Los Angeles, CA 90095, United States
[b] Department of Pediatrics, UCLA Mattel Children's Hospital, 757 Westwood Plaza, Room 3108, Los Angeles, CA 90095, United States
[c] Department of Occupational Therapy and Rehabilitation Services, UCLA, 757 Westwood Plaza, Suite 3127, Box 957408, Los Angeles, CA 90095-7408, United States
[d] Department of Medicine Statistics Core, David Geffen School of Medicine, University of California, 911 Broxton Avenue, Room 314, Los Angeles, CA 90024, United States

ARTICLE INFO

Article history:
Received 1 November 2016
Revised 18 January 2017
Accepted 20 January 2017
Available online xxxx

Keywords:
Oral motor intervention
Oral feeding
Gastrostomy tube feeding
Nasogastric tube feeding
Complex congenital heart disease

ABSTRACT

Many infants with complex congenital heart disease (CHD) do not develop the skills to feed orally and are discharged home on gastrostomy tube or nasogastric feeds. We aimed to identify risk factors for failure to achieve full oral feeding and evaluate the efficacy of oral motor intervention for increasing the rate of discharge on full oral feeds by performing a prospective study in the neonatal and cardiac intensive care units of a tertiary children's hospital. 23 neonates born at ≥37 weeks gestation and diagnosed with single-ventricle physiology requiring a surgical shunt were prospectively enrolled and received oral motor intervention therapy. 40 historical controls were identified. Mean length of stay was 53.7 days for the control group and 40.9 days for the study group ($p = 0.668$). 13/23 patients who received oral motor intervention therapy (56.5%) and 18/40 (45.0%) controls were on full oral feeds at discharge, a difference of 11.5% (95% CI −13.9% to 37.0%, $p = 0.378$). Diagnosis of hypoplastic left heart syndrome, longer intubation and duration of withholding enteral feeds, and presence of gastroesophageal reflux disease were predictors of poor oral feeding on univariate analysis. Although we did not detect a statistically significant impact of oral motor intervention, we found clinically meaningful differences in hospital length of stay and feeding tube requirement. Further research should be undertaken to evaluate methods for improving oral feeding in these at-risk infants.

Purpose

Congenital heart disease (CHD) is the most common birth defect with a birth prevalence between 4 and 50 cases per 1000 live births in USA. The birth prevalence of severe heart disease which includes cyanotic lesions is 1.5 per 1000 live births (Van der Bom et al., 2011). Significant growth failure is well-recognized in infants undergoing congenital heart defect surgery due to multiple factors including increased metabolic demand, delayed enteral feeding secondary to prostaglandin infusion, risk of mesenteric hypoperfusion, and prolonged intubation (Golbus, Wojcik, Charpie, & Hirsch, 2011). While feeding algorithms have reduced the number of days to reach full enteral feeds (Braudis et al., 2009; Slicker et al., 2013), patients with cyanotic heart disease often continue to need nasogastric or gastrostomy tube feeds at discharge due to poor oral feeding skills (Jadcherla, Vijayapal, & Leuthner, 2009; Natarajan, Reddy Anne, & Aggarwal, 2010). Various studies have found that the proportion of neonates with CHD requiring tube feeding at discharge ranges from 29% to 45% (Einarson & Arthur, 2003; Kogon et al., 2007). The number of days to reach full oral feeds contributes significantly to prolonging ICU length of stay (Wheeler, Dent, Manning, & Nelson, 2008), and tube feeding is associated with less weight gain than exclusive oral feeding (Lambert et al., 2014; Medoff-Cooper et al., 2011). Gastrostomy tube placement bears anesthetic and infectious risks, and feeding by gastrostomy tube is associated with higher mortality prior to second stage cardiac surgery (Hebson et al., 2012) as well as neurodevelopmental delay at 6 and 12 months of age (Medoff-Cooper et al., 2015). Furthermore, it has been reported that parents have a feeling of inadequacy when their child is tube fed, and performing nasogastric or gastrostomy feeds can be a practical challenge (Craig, 2013; Rollins, 2006). Thus, there are several reasons to minimize the need for tube feeding.

The etiology of poor oral feeding in patients with cyanotic heart disease is unclear. Several previous studies have noted that patients with

* Corresponding author at: CHLA Anesthesiology/Critical Care Medicine, 4650 Sunset Blvd, MS #3, Los Angeles, CA 90027, United States.
E-mail addresses: gitamohan@gmail.com (G. Indramohan), tiffpedigo8@gmail.com (T.P. Pedigo), otfortots@gmail.com (N. Rostoker), mcambare@mednet.ucla.edu (M. Cambare), tgrogan@mednet.ucla.edu (T. Grogan), mfederman@mednet.ucla.edu (M.D. Federman).

http://dx.doi.org/10.1016/j.pedn.2017.01.009
0882-5963/

diagnosis of hypoplastic left heart syndrome (Davis et al., 2008; Golbus et al., 2011; Kelleher, Laussen, Teixeira-Pinto, & Duggan, 2006) and postoperative vocal cord paralysis (Jadcherla et al., 2009; Pham, Connelly, Wei, Sykes, & O'Brien, 2014) are more likely to require nasogastric or gastrostomy feeds at discharge. One study of 465 infants with single ventricle heart defects found that longer periods of intubation are associated with tube feeding requirement at discharge (Hill et al., 2014), though no other studies have been done to corroborate this finding. We sought to identify key variables that may predict which of these infants are at greater risk of requiring tube feeding at discharge, as recognition of risk factors for poor oral feeding may allow for early intervention in those infants who are most likely to have difficulty. Since oral feeding abilities in preterm infants have been enhanced by the application of oral motor intervention (Bingham, Ashikaga, & Abbasi, 2010; Fucile, Gisel, & Lau, 2005), we employed a similar intervention in infants born at gestational age 37 0/7 weeks and beyond who underwent complex cardiac surgery. We hypothesized that this novel approach would help improve their oral feeding skills and thereby reduce the need for nasogastric or gastrostomy feedings at discharge.

Design and Methods

Study Population

The oral motor intervention was administered to a prospective cohort of consecutive patients ≥ 37 weeks gestational age with a diagnosis of hypoplastic left heart syndrome, transposition of great arteries, or any lesion which may require a systemic-pulmonary shunt placement in the neonatal period. Bedside laryngoscopy was offered to the patients in the study group as a screening tool to detect vocal cord palsy postoperatively. Patients were recruited to the study on admission to the neonatal intensive care unit prior to surgery at a single tertiary care children's hospital for preoperative care during the study period (September 2012 to May 2015). Patients with significant central nervous system disease either clinically or by imaging (e.g. Grade III–IV intraventricular hemorrhage), orofacial anomalies interfering with feeding, and known chromosomal disorder were excluded. Infants over a month of age at the time of study entry were also excluded. The data from this group were then compared with a similar cohort of patients admitted to our neonatal intensive care unit or cardiothoracic intensive care unit from January 2010 to May 2012 who did not receive oral motor intervention therapy. Patients admitted after January 2010 were selected because a feeding algorithm (Braudis et al., 2009) was fully implemented in our cardiac and neonatal intensive care units by this time, leading to uniformity in practice. Prospective data collection for the study group was approved by a full UCLA Institutional Review Board in September 2012. Written informed consent was obtained from the parents for the administration of oral motor intervention and for postoperative bedside laryngoscopy before entry into the study. Parents were given the option to decline laryngoscopy while still participating in the study. Waiver of consent was obtained for retrospective chart review for the control group.

Intervention

Infants in the study group received oral motor intervention exercises based on the Beckman method (see Supplementary material), which has been shown to accelerate the transition to full oral feedings in preterm infants (Beckman, 2016; Fucile, Gisel, & Lau, 2002; Younesian, Yadegari, & Soleimani, 2015). The exercises are simple, brief, and do not require the use of a device for oral stimulation. The intervention was initiated preoperatively in all patients in the study group by our occupational therapists after obtaining consent. All bedside neonatal and cardiac intensive care unit nurses received instruction on administration of the oral motor intervention exercises from an occupational therapist. Parents were also taught how to administer these exercises by an occupational therapist if interested. Occupational therapists, nurses, and parents were instructed to perform oral motor intervention 4 times per day with each session lasting 15 min. A laminated chart with pictures and description of exercises was placed at the bedside to serve as an aide memoire for administration of the intervention, and occupational therapists also continued to meet with nurses and parents to reinforce the protocol.

The oral motor intervention program consisted of a series of exercises stimulating gums, cheeks and lips by stretching and stroking (Coker-Bolt, Jarrard, Woodard, & Merrill, 2013; Fucile et al., 2005). Intubated patients received a modified set of oral intervention exercises. In the intervention group, the exercises were started as soon as they were enrolled in the study and continued unless the patient was deemed unstable by the primary medical team. Oral motor intervention was withheld for the first 24 h after surgery as well as for any decompensation defined as start of a pressor or 15% increase from baseline dose, 15% decrease in pulse oximetry oxygen saturations, muscle relaxation, while receiving extracorporeal membrane oxygenation, or when the infant was deemed unstable by the primary team. Oral motor intervention was resumed once the patient was stabilized. Oral motor intervention was discontinued once the infant was taking all feeds by mouth for 24 h.

Bedside laryngoscopy was performed prior to initiation of oral feeds by either the attending or trained resident head and neck surgeon using a flexible laryngoscope. This was done in extubated infants with consent for laryngoscopy at the time of study enrollment. The procedure was brief and did not require additional sedation.

Data Collection

Data gathered for both study and control groups included date of birth, date of admission, diagnosis (including whether the diagnosis was made antenatally or postnatally), gestational age, birth weight, length and occipitofrontal circumference. Preoperative data including whether the patient was fed or intubated was collected. Feeding data collected included days to full oral feeds and presence of conditions affecting feeding such as gastroesophageal reflux disease and vocal cord palsy. Post-surgical complications including chylothorax, diaphragmatic palsy, and second surgery for any reason were noted. Method and volume of feeds and age at discharge were collected.

Statistical Methods

Patient demographics were compared between the historical controls and the oral motor intervention group using *t*-tests for continuous variables and chi-square or Fisher's Exact test for categorical variables (as appropriate). Postoperative measures were compared between groups using *t*-tests or Wilcoxon tests. To assess which pre-operative factors were associated with feeding status discharge (full oral feeds vs. not), univariate and multivariate logistic regression models were constructed. The terms of univariate models included diagnosis status, intubation time, days with oral feeds withheld, and presence of gastroesophageal reflux disease. Multivariate models were constructed with the same outcome and each of these variables and treatment + the treatment by pre-operative factor interaction. Statistical analyses were performed in SPSS V22 (IBM Corp., Armonk, NY) and p-values < 0.05 were considered statistically significant.

Results

Thirty-four neonates with hypoplastic left heart syndrome, transposition of the great arteries, or other shunt-dependent cardiac lesion were screened for the intervention. Twenty-three patients met entry criteria and were enrolled into the intervention group. Forty infants met criteria for inclusion in the control group (Fig. 1). As shown in Table 1, there were no significant differences between the two groups

Please cite this article as: Indramohan, G., et al., Identification of Risk Factors for Poor Feeding in Infants with Congenital Heart Disease and a Novel Approach to Improve Oral Feed..., *Journal of Pediatric Nursing* (2017), http://dx.doi.org/10.1016/j.pedn.2017.01.009