A Pre-Operative Standardized Feeding Protocol Improves Human Milk Use in Infants with Complex Congenital Heart Disease

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BACKGROUND

Breast milk is the best source of nutrition for infants when it is safe to give and available. Its use has improved long- and short-term outcomes for preterm infants; however, there is a paucity of data for optimal feeding practices for infants with congenital heart disease (CHD) due to fear of NEC. Oral care with maternal colostrum may bridge the gap for infants who are too ill to receive feeds, such as those with CHD. A retrospective cohort study from our institution suggests an exclusive unfortified human milk diet in infants with CHD requiring surgery is associated with a significantly lower risk of NEC.

PURPOSE

To evaluate the hypothesis that implementation of a pre-operative standardized feeding protocol increases human milk use in infants with complex CHD.

METHODS

- Quasi-experimental study
- Inclusion criteria: Neonates of any gestational age with CHD requiring prostaglandins and surgery
- Exclusion criteria: Congenital anomalies precluding feeding
- Extensive education
- Implementation of pre-operative feeding protocol emphasizing human milk use in NICU and CICU
- Data collection:
  - Primary outcome: Pre-operative human milk use (defined as mother's own milk (MOM) with or without donor human milk (DHM))
  - Secondary outcome: Incidence of pre-operative NEC, days to full feeds, length of hospital stay

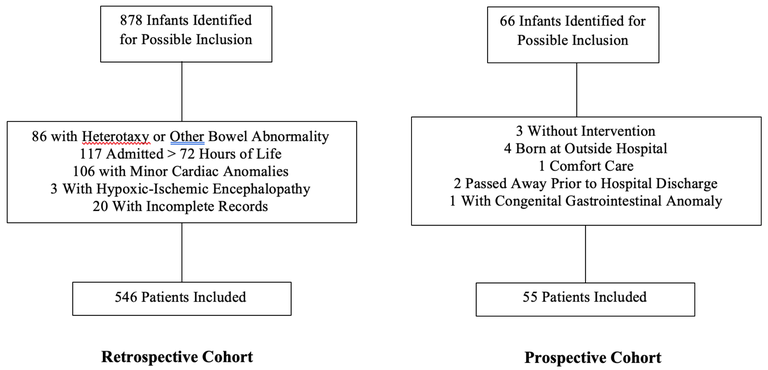

Figure 1. Flowchart of infants included in both cohorts and reasons for exclusion.

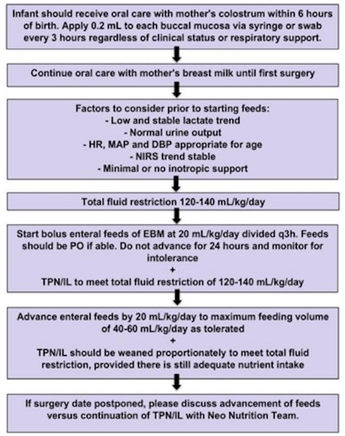

Figure 2. Pre-operative feeding protocol emphasizing human milk use.

	Pre-Protocol N=546 (%)	Post-Protocol N=55 (%)	P-value
Sex			
Male	319 (58.4)	28 (50.9)	0.32
Race			
African American	67 (12.3)	8 (14.5)	0.67
Caucasian	452 (82.8)	38 (69.1)	0.02
Asian/Pacific Islander	16 (2.9)	6 (10.9)	0.01
Native American	3 (0.5)	0 (0)	1
Unknown	8 (1.5)	3 (5.5)	0.07
Ethnicity			
Hispanic	196 (35.9)	16 (29.1)	0.30
Mean GA (days) ± SD	266.9 ± 13.7	264.4 ± 20.0	0.66
Preterm (<37 weeks' GA)	105 (19.2)	10 (18.2)	1.00
Birthweight (g)			0.08
<1000	0 (0)	2 (3.6)	
1000-15000	29 (5.3)	4 (7.3)	
1501-2000	510 (93.4)	48 (87.3)	
>2000	7 (1.3)	1 (1.8)	
Median APGAR score 1 min (IQR)	8 (7-8)	8 (7-8)	0.98
Median APGAR score 5 min (IQR)	9 (8-9)	8 (8-9)	0.34
Cardiac Lesions			
SV dd-SBF	126 (23.1)	3 (5.5)	<0.01
BiV dd-SBF	119 (21.8)	11 (20.0)	0.86
SV dd-PBF	61 (11.2)	5 (9.1)	0.82
BiV dd-PBF	85 (15.6)	21 (38.2)	<0.01
d-TGA	89 (16.3)	10 (18.2)	0.70
Other	66 (12.1)	5 (9.1)	0.66

Table 1. Patient characteristics of retrospective and prospective cohorts.

	Pre-Protocol N=546 (%)	Post-Protocol N=55 (%)	P-value
Fed Pre-Operatively	363 (66.5)	38 (69.1)	0.77
Pre-Operative Diet*			
MOM	129 (35.5)	7 (18.4)	0.03
MOM and/or DHM	83 (22.9)	31 (81.6)	<0.01
Formula	68 (18.7)	0 (0)	<0.01
Other	83 (22.9)	0 (0)	<0.01
Pre-Operative NEC	18 (3.3)	1 (1.8)	1.00
Mean Days to Full Feeds ± SD	8.5 ± 6.1	9.5 ± 8.0	0.37
Mean Hospital LOS ± SD	35.2 ± 46.6	26.3 ± 25.6	0.14
Median % MOM (IQR)		69.5 (5-97)	
>50% MOM		23 (63.9)	
Oral Care	0 (0)	48 (87.3)	<0.01
Oral Care Within 24 Hours of Birth	0 (0)	28 (50.9)	<0.01
Oral Care if Not Fed	0 (0)	9 (56.3)	<0.01
Mean Feeding Volume Reached Pre-Operatively ± SD (mL/kg/day)	54.6 ± 64.5	75.5 ± 62.4	<0.01

*Category total adds up to number of infants fed pre-operatively
MOM: Mother's own milk; DHM: Donor human milk; NEC: Necrotizing enterocolitis; LOS: Length of stay

Table 2. Comparison of Pre-Operative Exposures and Outcomes Between Two Cohorts.

RESULTS

- A total of 601 patients were identified for inclusion, 546 in retrospective cohort and 55 in prospective cohort
- Overall, patients were predominantly male, born at term, and Caucasian in both cohorts
- The majority of patients were fed in both cohorts
- Human milk use increased significantly post-protocol (58.4% versus 97.4%, p<0.001)
- There was no formula use post-protocol (18.7% versus 0%, p=0.003)
- Pre-operative NEC occurred in 18/546 (3.3%) infants pre-protocol compared to 1/55 (1.8%) post-protocol, p=0.335
- The average number of days to full feeds and LOS in both cohorts was not significantly different
- The median % MOM use was 69.5% and 69.3% of patients received > 50% of pre-operative feeds from MOM
- Compared to no oral care in the retrospective cohort, 87.3% of patients received oral care with maternal colostrum in the prospective cohort (p<0.001)

CONCLUSION

This study demonstrates successful implementation of and adherence to a pre-operative standardized feeding protocol to promote the use of human milk in infants with CHD. This is a potential first step to eliminate practice variation in the management of a vulnerable population. Though the study was insufficiently powered for the secondary outcomes, the results illustrate the safety and feasibility of using a feeding protocol without significant adverse outcomes. While a randomized controlled trial may not be feasible, a well-designed, large, multi-center prospective study is needed to further address the impact of a standardized feeding protocol on important peri-operative outcomes.

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