# Week 2: Neonatal Health Services Research/Quality Improvement

## Neo-Perinatal Care Delivery: Practices and Procedures

**Friday, June 19  4:30-6:00 pm EDT**

**Moderators**
Mark Hudak  
Jayasree Nair

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*Note: Schedule subject to change based on presenter availability.*
BACKGROUND: Perinatal hypoxic-ischemic encephalopathy (HIE) is a major cause of morbidity in newborns including persistent feeding difficulties. However, there is paucity of data on gastrostomy tube (GT) placement in this population.

OBJECTIVE: We aimed to determine the prevalence of, and the patient and hospital-level factors associated with GT placement in neonatal hospitalizations with perinatal HIE in the United States from 2012 to 2016.

DESIGN/METHODS: We performed a retrospective analysis using data from the National Inpatient Sample, the largest healthcare database in the US. Neonatal hospitalizations with gestational age ≥35 weeks who had an International Classification of Diseases, 9th revision (ICD-9) or 10th revision (ICD-10) code for both HIE and TH. Those with GT placement were identified using ICD-9 or 10 procedure code for GT. Transfers were excluded to avoid double counting. The exposure variable was HIE treated with TH and the outcomes of interest were GT placement. Multivariable logistic regression analysis to examine adjusted associations with patient and hospital-level factors. Statistical significance was set at P<0.05.

RESULTS: There were 2,930 HIE hospitalizations treated with TH from 2012 – 2016, of which 140 babies (4.8%) had GT placement. Among those with GT, 57.1% were male, 42.9% were White, 64.3% had Medicaid or other non-private insurance, 50% were in the South region of the US, and most were hospitalized in large (60.7%), urban teaching (92.9%) hospitals. There were no differences between those with and without GT placement in terms of sex, race, insurance status, and obstetric and perinatal complications. However, hospitalizations with GT were more likely to have complications (Table 1).

In adjusted analysis (Table 2), increased odds of GT placement was as associated with pulmonary hypertension (aOR 2.13, 95% confidence interval (CI), 1.42-3.17), seizures (aOR 1.46; 95% CI 1.01-2.1), need for mechanical ventilation for >96 hours (aOR 2.33; 95% CI 1.58-3.46), care in the Midwest and Southern regions of the US and in urban teaching hospitals (aOR= 2.88; 95% CI, 1.29-6.44).

CONCLUSION(S): Among newborns with HIE treated with TH in the US from 2012 – 2016, the prevalence of GT placement was relatively low at 4.8% and several patient and hospital-level factors including regional variation were associated with increased odds of GT placement. Future studies should elucidate region-specific factors for GT placement to improve outcomes.
Obstetric, Perinatal, and Neonatal Complications of Hospitalizations with Perinatal HIE

Multivariable Logistic Regression Analysis of Factors Associated with Gastrostomy Tube Placement in Hospitalizations with HIE

IMAGE CAPTION:
Obstetric, Perinatal, and Neonatal Complications of Hospitalizations with Perinatal HIE

Multivariable Logistic Regression Analysis of Factors Associated with Gastrostomy Tube Placement in Hospitalizations with HIE

CONTROL ID: 3369916
TITLE: Pre-intubation oxygenation level and intubation outcomes in neonates
ABSTRACT STATUS: Sessioned
PRESENTER: Ayman Abou Mehrem
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Background: Preoxygenation to achieve pulse oximetry saturation (SpO\textsubscript{2}) levels > 95% is a common practice prior to tracheal intubation (TI). High SpO\textsubscript{2} is associated with unpredictable PaO\textsubscript{2} resulting in hyperoxia and increased risk of oxidative injury. It is unknown if a pre-intubation SpO\textsubscript{2} (PreOX) target of 90-95% (PreOX-Low), compared to 96-100% (PreOX-High), affects TI outcomes.

Objective: To evaluate the impact of PreOX level on the decline in SpO\textsubscript{2} and heart rate (HR), occurrence of severe desaturation (≥ 20% decline in SpO\textsubscript{2}), TI associated events (TIAEs), and 1\textsuperscript{st} attempt success.

Design/Methods: Retrospective cohort study of NICU intubations in the National Emergency Airway Registry for Neonates (NEAR4NEOS) between Oct 2014 and Dec 2018. TIs for resuscitation or tube change, TIs with PreOX < 90%, and TIs in infants with critical congenital heart disease or airway anomalies were excluded. We compared baseline characteristics between groups and analyzed the impact of PreOX-Low compared to PreOX-High, on the outcomes of severe desaturation, TIAEs, 1\textsuperscript{st} attempt success rate, and decline in SpO\textsubscript{2} and heart rate (HR). Significant univariate variables were controlled for in multivariate logistic regression, adjusting for clustering by site. Predefined subgroup analysis based on weight was performed.

Results: Of 3169 eligible TIs from 16 NICUs, 557 (18%) had PreOX-Low and 2612 (82%) had PreOX-High. There was significant variation between centers in PreOX (Figure 1). Significant differences in patient, provider, and practice characteristics were observed (Table 1). PreOX-Low group had less severe desaturation (47.9 vs. 54%, \(p=0.009\)), but more occurrence of SpO\textsubscript{2} <80% (57.3 vs. 52.3%, \(p=0.03\)). There was no significant difference in the 1\textsuperscript{st} attempt success, TIAEs, or decline in SpO\textsubscript{2} or HR (Table 2). In multivariate logistic regression, PreOX-Low was associated with lower odds of severe desaturation; aOR 0.78, 95% CI 0.66-0.90, \(p<0.001\).

In infants with weight < 1000g, PreOX-Low group had less severe desaturation, 47.4% vs. 61.4%, \(p<0.001\), with no difference in SpO\textsubscript{2} <80%. In infants with weight ≥ 1000g, there was no significant difference in severe desaturation, but SpO\textsubscript{2} <80% occurred more in PreOX-Low, 57.5 vs. 49.8%; \(p=0.007\), (Table 3).

Conclusion(s): Pre-intubation SpO\textsubscript{2} of 90-95% was associated with lower rate of severe desaturation without concurrent increase in TIAEs, or decrease in 1\textsuperscript{st} attempt success. These results were particularly apparent in infants < 1000g. PreOX of 90-95% may be safe and the benefit of PreOX ≥ 96% requires further investigations.
Does video laryngoscopy improve tracheal intubation first attempt success in NICUs? A Report from the NEAR4NEOS.

Ahmed Moussa

Moussa, Ahmed1; Sawyer, Taylor2; Gray, Megan M.2; Brei, Brianna K.3; Krick, Jeanne4; Puia-Dumitrescu, Mihai5; Foglia, Elizabeth6; Ades, Anne7; Napolitano, Natalie8; Glass, Kristen9; Johnston, Lindsay10; Jung, Philipp11; Singh, Nectu12; Quiek, Bin Huey13; barry, james S.13; Zenge, Jeanne14; DeMeo,
Background: The use of videolaryngoscope (VL) for NICU tracheal intubation (TI) may improve 1st attempt intubation success, however, data are limited.

Objective: To evaluate VL use in TIs in diverse institutions. We hypothesized that the use of VL for TIs would be highly variable across NICUs, and would be associated with higher 1st attempt success and lower adverse events, after adjusting for patient, provider, and practice factors.

Design/Methods: Data from the National Emergency Airway Registry for Neonates (NEAR4NEOS) from 01/2015 to 12/2017 were analyzed. Primary TIs with either direct (DL) or video laryngoscope (VL) in NICUs were included. Tracheal tube change was excluded. Primary outcome was 1st attempt TI success. Secondary outcomes included: adverse TI associated event (e.g., esophageal intubation, cardiac arrest), and severe desaturation defined as a drop in $\text{SpO}_2$ of ≥ 20% from the highest pre-intubation saturation. Statistical analyses included univariate analyses to identify factors associated with VL use as covariates ($p<0.05$), followed by a multivariable logistic regression with a dependent variable: first attempt success, while adjusting for covariates. This was repeated for the secondary outcome. Sensitivity analysis by limiting the cohort to NICUs with >10 VLs was also completed.

Results: A total of 2,730 TI encounters from 13 NICUs were analyzed. 626 (23%) TIs utilized a VL. VL was used in 7 sites, and its use varied across sites (3% to 64% per site, Figure). VL was used more frequently in more mature, larger, and older neonates (Table 1). In the univariate analysis, VL use was associated with higher 1st attempt success (58% with VL vs. 47% with DL; $p<0.001$) and occurrence of adverse TI associated event was lower in TIs with VL (7% with VL vs. 23% with DL, $p<0.001$). The occurrence of severe desaturation was not different with VL (48% with VL vs. 52% with DL; $p=0.10$). After adjusting for covariates (Table 2), VL use was not associated with higher 1st attempt success (Odds...
Conclusion(s): VL use for neonatal TI is variable across sites. Use of VL is not independently associated with higher 1st TI attempt success but is associated with fewer TI associated adverse events.
ABSTRACT BODY:

Background: Measurement of birth weight, length and head circumference is part of the newborn assessment and aids in distinguishing between proportionate and disproportionate small and large for gestational age newborns. It had been shown that birth weight is related to maternal height and weight and significant differences in SGA and LGA rates for newborns of short and tall mothers exist.

Objective: This study aims to analyze birth weight, length and head circumference percentiles based on maternal stature.

Design/Methods: This observational study analyzed birth weight, length and head circumference percentiles of 2.3 million newborns based on maternal height and weight from the first obstetric assessment. Percentiles were calculated for sex and 22-43 weeks GA for all infants. For each sex, 18 subgroups based on 6 maternal height and 3 weight strata were defined and percentiles calculated from 31-42 weeks GA using GAMLSS package for R.

Results: Newborns of mothers with height <158 cm and weight <53 kg (short stature) had a rate of preterm birth of 9%, compared to 5% in the tall stature group (height >177 cm, weight >79 kg). Small stature mothers were 1.7 years younger. Birth weight percentiles based on all data showed a 22% incidence of SGA and a 2% incidence of LGA for newborns from petite mothers, compared to 4% incidence of SGA and 26% incidence of LGA newborns from tall mothers. The novel percentiles based on 18 maternal height and weight groups for both sexes showed significant differences between identical original percentiles. The differences were up to almost 800g between identical percentiles for petite and tall mothers. The largest deviation of birth length was between the 97th percentiles. At term age, male newborns’ length at the 97th percentile differed by 3.2 cm, at the 50th percentile by 2.7 cm and at the 3rd percentile by 2.5 cm.

Conclusion(s): There is a clinically significant difference in birth weight, length and head circumference percentiles when stratified by maternal height and weight. Percentile charts stratified by maternal anthropometry may provide a higher specificity and more individual prediction of perinatal risks. The new percentile data may be used to evaluate estimated fetal growth as well as birth weight, length and head circumference.

Differences in birth weight (BW), body length (BL), and head circumference (HC) between small (SGA), appropriate (AGA) and large (LGA) for gestational age infants for mothers with petite, medium and tall stature.
**BACKGROUND:**

Very low birth weight (VLBW) premature neonates undergo phlebotomy procedures at time of admission to the neonatal intensive care unit (NICU). The volume of blood required for these tests can represent up to 10% of their total blood volume, increasing the likelihood of anemia requiring packed red blood cell (PRBC) transfusion. A strategy to decrease the risk of anemia includes the use of umbilical cord blood (UCB) for admission laboratory tests. To date, there have been no randomized clinical trials to investigate its use in VLBW infants.

**OBJECTIVE:**

To compare the use of UCB vs. infant blood as a strategy to decrease the risk of anemia requiring PRBC transfusion in VLBW infants.

**DESIGN/METHODS:**

This was a multicenter, prospective, randomized control trial at United States military NICUs. Infants less than 30 weeks gestational age or birth weight less than 1200 grams admitted to one of three participating NICUs were randomized via competitive enrollment across all sites. Infants randomized to the experimental arm had all admission labs drawn from UCB whereas labs for controls were drawn from the infant. The primary outcome was hemoglobin (HgB) concentration at 12-24 hours of life. Secondary outcomes include the number of PRBC transfusions, number of blood donor exposures, vasopressor use, presence of severe intraventricular hemorrhage (IVH), and HgB concentration changes at the 7th day of life.

**RESULTS:**

81 infants were enrolled, and data from 76 are presented. Admission characteristics between groups were not significantly different. Experimental infants’ HgB concentration at 12-24 hours were higher than control infants (15.5g/dL vs. 14g/dL, p=0.02) There was no significant difference in the HgB concentration at day of life 7. While there were no differences in the number of PRBC transfusions at 24 hours of life, infants in the experimental arm had less vasopressor exposure in the first week of life (19% vs. 38%, p=0.04), less severe IVH (33% vs. 8%, p=0.01), fewer total number of transfusions (3.4 vs. 6.4, p=0.01) and donor exposures (1.1 vs. 1.9, p=0.01) over their hospital course. Lastly, the median time to first transfusion was 4 days in controls compared with 37 days in the experimental arm (p=0.04).

**CONCLUSION(S):**

Data suggest that the use of UCB for admission labs result in higher HgB concentrations in the first 24 hours of life at a period of higher risk for hemodynamic instability as well as delayed time to first transfusion.
Mode of Delivery and Outcomes among Extremely Preterm Infants

Background:
Approximately 60% of extremely preterm infants in the United States are born by cesarean delivery (CD), but the effects of mode of delivery on outcomes are not clear as randomized controlled trials have included relatively few infants.

Objective:
To test the hypothesis that the rate of death or severe neurodevelopmental impairment (NDI) is lower among extremely preterm infants born by CD compared with infants born by vaginal delivery (VD).

Design/Methods:
This study included actively treated infants without a major birth defect, birth weight 401-1000 grams, gestational age 22+0/7 to 26+6/7 weeks, and born at centers of the NICHD Neonatal Research Network from 2006 to 2016. Rates of death or severe NDI and other major outcomes were compared by mode of delivery. Severe NDI was defined as having any of the following: Bayley scales of infant development-3rd edition Cognitive Composite Score <70, cerebral palsy (with Gross Motor Function Classification Scale > 3), bilateral blindness, or bilateral hearing loss.
Analyses were performed using logistic regression adjusting for maternal and infant characteristics present at birth and known to be associated with adverse infant outcomes.

Results: 9619 infants were included [5978 (62.1%) born by CD, 3641 (37.9%) born by VD] of whom 847 were lost to follow up (91.2% follow up rate) and 58 had missing data for NDI. There was no significant difference in the risk of death or severe NDI at 18-26 month follow up between groups (42.3% CD v 50.1% VD; adjusted Odds Ratio (95% CI), 1.02 (0.89 to 1.15)). The risk of death and the risk of severe NDI in survivors did not differ significantly between groups [Table 1]. CD was associated with a higher rate of respiratory distress syndrome (RDS) treated with surfactant and a higher rate of retinopathy of prematurity (ROP) ≥ stage 3 compared with VD. There was a higher risk of delivery room (DR) intubation and a higher risk of DR chest compressions among infants born by CD compared with infants born by VD. Rates of bronchopulmonary dysplasia, severe intracranial hemorrhage or periventricular leukomalacia, necrotizing enterocolitis ≥ stage 2, and late onset culture positive sepsis did not differ significantly between groups.

Conclusion(s): Mode of delivery was not associated with death or severe NDI among extremely preterm infants. CD was associated with a higher risk of RDS treated with surfactant, ROP ≥ stage 3, DR intubation, and DR chest compressions compared with VD.
Results: A total of 1799 infants were reviewed. There were 266 infants excluded because the position was not documented in the medical record. The mean ± standard deviation GA was 31 ± 3 weeks (range 23-34). As shown in Table 1, preterm infants born in the Br had an incidence of DDH of 0.47% (2/428) and preterm infants born in the Vtx position had an incidence of DDH of 0.36% (4/1105). There was no significant difference in the incidence of DDH between infants born in the Vtx or Br (Chi square). The sensitivity of Br in detecting DDH was 33% with a specificity of 72%. The positive predictive value of Br was 0.47%. The negative predictive value was 99.6%.

We then analyzed the data for an association between clinical diagnoses of DDH (hip clicks/clunks) and Br or Vtx at birth (Table 2). There was no significant association between presentation at birth and presence or absence of hip clicks/clunks (Chi square). The sensitivity of Br in the clinical diagnosis of DDH (detection of hip clicks/clunks) was 19% with a specificity of 73%. The positive predictive value of Br was 0.8%. The negative predictive value was 98.7%.

Conclusion(s): There is no association between Br and developmental dysplasia of the hip in preterm infants. Using Br to screen for either clinical signs or hip US is not reliable with very low sensitivity, specificity and extremely low positive predictive value. The practice of obtaining hip US on preterm infants born in the Br is not recommended.
Background: Short-term outcomes after delayed cord clamping (DCC) vs umbilical cord milking (UCM) have not been studied outside the clinical trial environment.

Objective: To compare in-hospital outcomes of DCC vs UCM among infants <29 weeks (wks) gestational age (GA).

Design/Methods: Retrospective cohort study of infants $22^{0/7}$-$28^{6/7}$ wks GA born in a Eunice Kennedy Shriver NICHD Neonatal Research Network center from 1/1/16-12/31/18 exposed to DCC or UCM. Infants who had severe congenital anomalies, did not receive active treatment at delivery, or were exposed to both DCC and UCM were excluded. The primary outcome was a composite of mortality or severe intraventricular hemorrhage (IVH) by 36 wks postmenstrual age (PMA). Secondary outcomes were: 1) mortality by 36 wks PMA, 2) severe IVH by 36 wks PMA, 3) any IVH or mortality by 36 wks PMA and 4) a composite of mortality or major morbidity (severe brain injury, NEC, grade 3 BPD, late onset sepsis, and severe ROP). The risk adjusted effect on outcomes was determined using a multivariable regression, incorporating risk factors for mortality identified a priori, significant confounders, and center as random effect. A prespecified, exploratory analysis evaluated severe IVH in two GA strata, $22-24^{6/7}$ and $25-28^{6/7}$ wks.

Results: Of 1834 infants, 1402 (76.4%) were exposed to DCC and 432 (23.5%) to UCM. DCC or UCM exposure varied by center (Figure 1). Maternal/neonatal characteristics differed between groups (Table 1). After adjustment, the primary outcome did not statistically differ between groups, 28.3% in UCM vs 19.0% in DCC [aOR 1.41 (95% CI 0.91-2.2) p=0.13]. Differences in the rates of secondary outcomes did not reach statistical significance (Table 2). In the GA stratified analysis, UCM exposed infants had higher rates of severe IVH, which was significant in the $25-28^{6/7}$ wk group, 14.8% vs 7.3% [aOR 1.81 (95% CI 1.2-2.8) p =0.01]. There was a significant interaction [p=0.001] by GA between DCC or UCM and the composite mortality or major morbidity outcome (Figure 2).

Conclusion(s): Mortality or severe IVH differed by nine percent between infants exposed to DCC vs UCM; however, it was not statistically significant. Although, the two groups had similar rates of severe IVH infants in the older GA strata, $25-28^{6/7}$ wks exposed to UCM had a significantly higher odds of severe IVH. Bivariate analysis indicated UCM exposed infants may be more ill; however, the association between UCM and severe IVH is consistent with the largest DCC vs UCM trial and provide additional data favoring DCC.
Table 1: Maternal and Neonatal Characteristics

Table 2: Neonatal outcomes among infants exposed to DCC versus those exposed to UCM.

Figure 2: Raw and Adjusted Odds Ratio for Mortality or Severe Morbidity by Gestational age.

IMAGE CAPTION:
Figure 1: Number of Infants Exposed to DCC or UCM per year (2016-2018) by Center.

Table 1: Maternal and Neonatal Characteristics

Table 2: Neonatal outcomes among infants exposed to DCC versus those exposed to UCM.
Figure 2: Raw and Adjusted Odds Ratio for Mortality or Severe Morbidity by Gestational age.