QUALITY IMPROVEMENT

Neonatal Hypoglycemia Management

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ABSTRACT

BACKGROUND:

Hypoglycemia is a common occurrence in newborns. This poses a risk of damage to their central nervous system and devastating neurodevelopmental outcomes. Management of hypoglycemia historically includes attempting formula or breastfeeding, IV dextrose infusions, and admissions to the NICU for closer monitoring. Our objective is to decrease NICU admissions for hypoglycemia while decreasing invasive management of hypoglycemia in neonates.

METHODS:

Newborns ≥35 weeks with no congenital malformation were included in our study. A protocol managing asymptomatic hypoglycemia with oral dextrose gel was implemented. The primary goal identified was to decrease NICU transfers for hypoglycemia management in all infants and those identified as at-risk. Secondary outcomes included reducing the length of stay and increasing breastfeeding rates in both populations.

RESULTS:

Overall, there was a statistically significant decrease in NICU admissions from 10% to 2% for at-risk neonates. Our secondary outcome also found a statistically significant reduction in the length of stay for at-risk neonates. There was no statistically significant difference in breastfeeding rates before and after protocol implementation. There was no statistically significant decrease in primary or secondary outcomes overall in those not deemed at-risk.

CONCLUSION:

Oral dextrose gel protocol decreased NICU admission rates for those at risk for hypoglycemia and secondarily reduced the length of stay for at-risk newborns.

BACKGROUND

Neonatal hypoglycemia (NH) is a relatively common complication among the newborn population, with an incidence rate of 15-30%.[1] It can have devastating implications if not promptly and adequately treated.[1,2,3] Symptomatic hypoglycemia poses several dangers to the overall well-being of a neonate. Clinical signs and symptoms of neonatal hypoglycemia include jitteriness/tremors, hypothermia, respiratory distress, apnea, central cyanosis, diaphoresis, hypotonia, lethargy, and seizures.[2,3] The major concern in hypoglycemia is seizures, which may result in permanent neurological damage to the newborn if not rapidly addressed.[3,4] Unfortunately, despite several studies on the topic, no specific plasma glucose concentration or duration of hypoglycemia has been identified as a determinant of neurodevelopmental impairment in at-risk infants.[2]

Several risk factors for neonatal hypoglycemia have been identified, and these are used to stratify concerns for possible hypoglycemic episodes. These risk factors include small for gestational age (SGA), defined as ≤10th percentile per growth chart; large for gestational age (LGA), defined as ≥90th percentile per growth chart; infants born to diabetic mothers, late preterm infants (LPT) defined as 34 0/7-36 6/7 weeks, and infants born to mothers on beta blockers or terbutaline.[2,3,5] As there is no evidence-based consensus on a standard blood glucose level with the lowest risk of morbidity and mortality[2,4], the customary standard has been to maintain glucose levels above 40-50 mg/dL.[2] Several preventative measures instituted to minimize risk include identifying at-risk infants early on, prompt feeding within 1 hour of birth, and provision of breastfeeding support.[4] Historically, management strategies of NH include formula or breastfeeding, IV dextrose, and NICU admission for resistant cases.[4]

NH resulting in NICU admission may allow the infant to receive specialized care to assess for pathologic causes, but there are also reported disadvantages with taking this step. NICU admissions, often for self-limiting situations, expose the neonate to numerous opportunities for iatrogenic harm, such as venipuncture, sepsis evaluations, and the initiation of protocol-driven antimicrobial therapy.[6] NICU admission also disrupts mother-infant bonding, increases costs, and can be physically and emotionally stressful to the mother and infant.[4] Newer studies are evaluating alternative methods to decrease NICU admissions, including prolonging skin-to-skin with mother and infant, delayed measurement of first blood glucose, encouragement of breastfeeding within the first hour of life, and administration of buccal dextrose gel for asymptomatic hypoglycemia.[1,2,7,8] These studies have shown that prophylactic measures taken in the early newborn period can reduce the risk of developing neonatal hypoglycemia and decrease the likelihood of unnecessary admission to the NICU.[1,7,9]

In this quality improvement project, we aim to evaluate the implementation of a guideline-supported hypoglycemia protocol, specifically its usage of a dextrose gel intervention to reduce NICU admission rates for hypoglycemia. Dextrose gel is a safe, non-invasive, and inexpensive treatment option for improving blood glucose levels in infants without interrupting mother-infant bonding. We hope this protocol will lead to a decrease in NICU admissions, a reduction in overall length of stay, and an increase in breastfeeding rates.

METHODS

SETTING:

Our community hospital has a 39-bed level III NICU and a 28-bed level II NICU that provides tertiary care for a sizeable semi-rural area—approximately 1,000 NICU admissions per year, 80% for premature infants. The average stay for a NICU infant is 18 days. The facility has over 4,000 deliveries annually and is the regional referral center for complex obstetrics patients and critically ill neonates. Our facility is also a baby-friendly center that promotes the mother-infant dyad.

INTERVENTION:

An updated protocol was launched in December 2021 to decrease NICU admissions for hypoglycemia. The previous hypoglycemic protocol required a point-of-care glucose of 25-40 mg/dL to be treated with an attempt at feeding and a recheck 30 minutes after feeding. If glucose dropped below 25mg/dL, a rapid response was called, and IV dextrose was given with an admission to the NICU. Our new protocol is a nurse-driven protocol that was inspired by the 2011 American Academy for Pediatrics (AAP) recommendations (Figure 1).[10] Inclusion criteria included asymptomatic neonates who met any of these criteria: those born to diabetic mothers, those >42 weeks GA, those <37 weeks GA, those LGA or SGA, and mothers taking Beta-Blockers or Terbutaline. The intervention begins by identifying these neonates and initiating the first feed within 60 minutes of birth. Thirty minutes later, obtain 1st POC glucose test. Based on the results, the nurse-driven protocol, as seen in Figure 1, states to either administer an oral glucose gel for those under 25 and those 25-40 or continue to feed and monitor q3hrs for those >40. This protocol differs from the AAP protocol, as we emphasize the utilization of oral glucose gel rather than initiating IV glucose early on. Data was collected before and after the new protocol was implemented for two months in infants with a point-of-care glucose less than 70 mg/dL. Demographic characteristics can be found in Table 1. Risk factors for hypoglycemia are listed in Figure 1. Exclusion criteria can be seen in Figure 2. Those excluded from the study included those under 35 weeks gestational age, those born at hospitals other than our facility, those who were readmitted, and those with congenital malformations. Thirty-five weeks was implemented as a cut-off due to automatic NICU admissions per hospital policy.

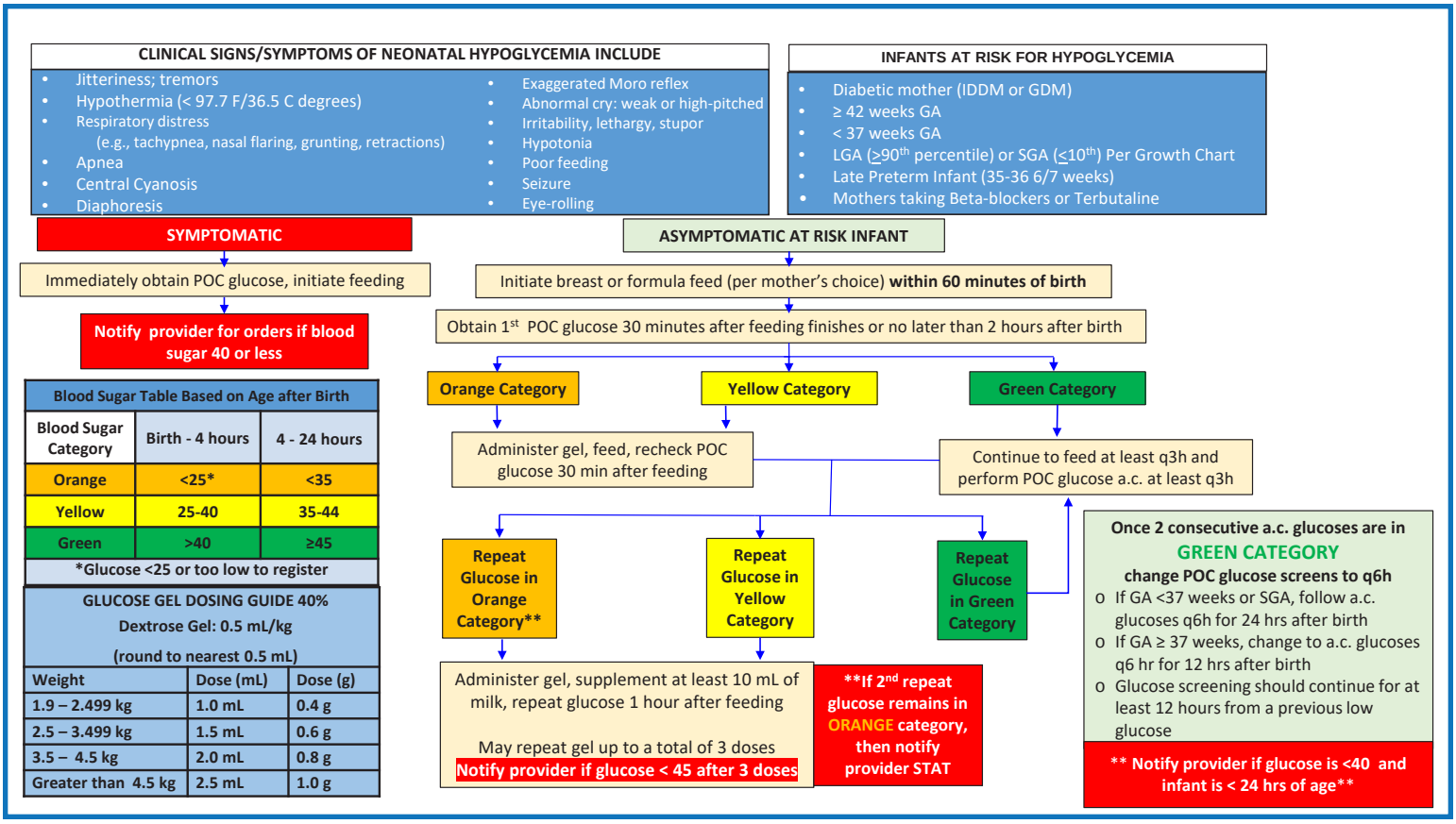

Figure 1: Hypoglycemia protocol

Nurse-driven protocol for neonates both asymptomatic and symptomatic with hypoglycemia.

Abbreviations: ac, ante cibum meaning before meals; GA, gestational age; GDM, gestational diabetes mellitus; IDDM, insulin-dependent diabetes mellitus; POC, point of care; q3h, every 3 hours.

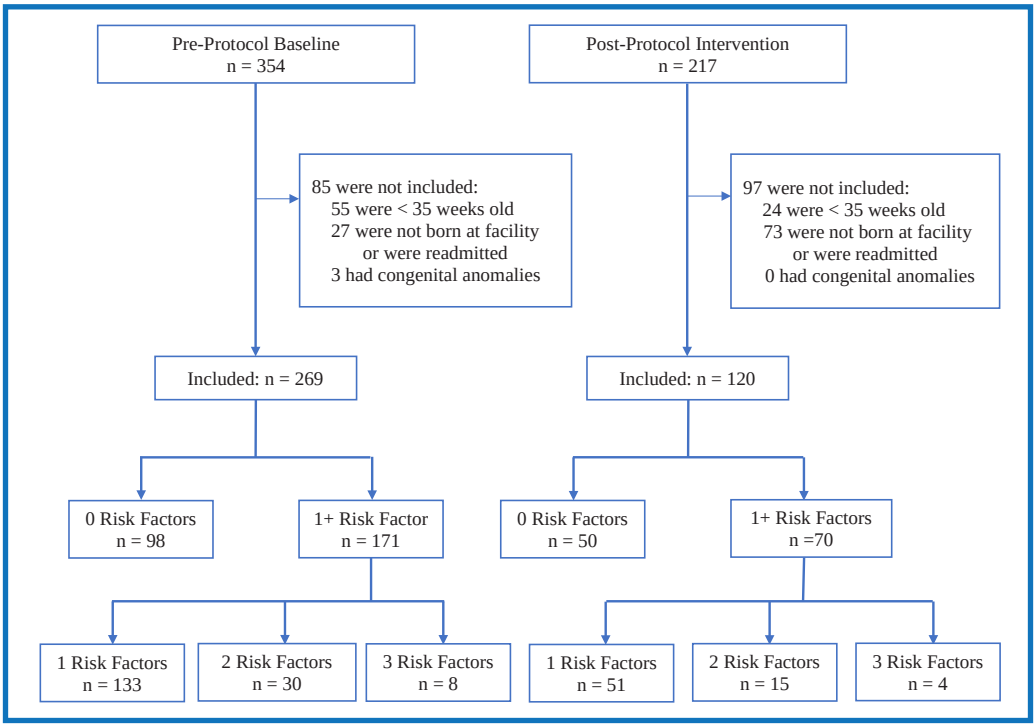

Figure 2: Exclusion Criteria

Exclusion criteria and sub-divisions of those included in the intervention.

	PRE-PROTOCOL	POST-PROTOCOL
	n=269	n=120
Feature:		
Gestational Age	37 wk 5 d (±1wk 5 d)	37 wk 6d (±1 wk 4 d)
Birth Weight	3.14 kg ± 0.67 kg	3.24 kg ± 0.64 kg
Vaginal Deliveries (%)	167 (62)	70 (58)
Cesarean Deliveries (%)	102 (38)	50 (41)
Maternal Age (Range)	29.9 (16-44)	29.6 (18-42)
Length of Stay (Range)	3.18 (1-72)	2.84 (1-54)
Breast Feeding (%)	106 (40.5)	38 (31.9)
Bottle Feeding (%)	94 (35.9)	40 (33.6)
Both (%)	62 (23.6)	41 (34.4)
Risk Factor for NH:		
Diabetic Mother (%)	49 (18)	24 (20)
LGA (%)	39 (15)	17 (14)
SGA (%)	44 (16)	10 (8)
LPT (35w - 36w+6) (%)	63 (23)	32 (26)
Maternal use of beta-blocker or terbutaline (%)	21 (8)	12 (10)
Average # of Risk Factors	0.81	0.78

Table 1: Demographic Characteristics
Demographic characteristics of mothers and infants were included in data collection.

	PRE-PROTOCOL n = 269	POST-PROTOCOL n = 120
NICU Admissions	46	17
% of Sample Population	17	14
p=.468		

Table 2: Total NICU Admissions
Percent of neonates transferred to the NICU and the p-value results of chi-squared analysis comparing the pre- and post- protocol groups.

	PRE-PROTOCOL n = 212	PRE-PROTOCOL n = 212
NICU Admissions	22	22
% of Sample Population	10%	10%
p=.015		

Table 3: At-Risk NICU Admissions
Percent of neonates with one or more risk factors for hypoglycemia who were transferred to the NICU and the p-value results of chi-squared analysis comparing the pre- and post-protocol groups.

MEASUREMENT:

The primary outcome of this study was to decrease NICU admissions. Secondary outcome goals include reducing length of stay and increasing breastfeeding rates. Five hundred seventy-one charts were individually reviewed, and data was manually extracted on those that met inclusion criteria.

ANALYSIS:

Univariate analysis was performed. Simple t-tests were used for quantitative data sets. The Chi-squared test was used for binary categorical data analysis. Baseline and post-protocol NICU admissions and lengths of stay were then compared to obtain a p-value to determine statistical significance.

RESULTS

Of the 571 original study participants (354 baseline, 217 post-intervention), 182 were excluded. A total of 389 participants (269 BL, 120 PI) were included in the study (Table 1 and Figure 2). A p-value of $< .05$ was used to determine statistical significance.

There was a non-statistically significant decrease in the percentage of total NICU admissions from 17% at baseline to 14% post-intervention (Table 2). Likewise, a non-statistically significant (p-value = .534) decrease in the average length of stay occurred when comparing both groups (baseline 3.2 ± 4.9 days, intervention 2.8 ± 4.9 days). No statistically significant difference was found (p=.668) in the percentage of breastfeeding infants at discharge (baseline 64%, intervention 66%).

At-risk neonates were defined as having one or more risk factors for neonatal hypoglycemia (Table 1). Of the 241 at-risk patients included in the study, 171 were in the baseline group, and 70 were in the intervention group. There was a statistically significant (p-value= 0.015) decrease in the percentage of all-cause NICU admissions in those at risk from 10% pre-intervention to 2% post-intervention (Table 3). Likewise, a statistically significant (p-value = 0.028) decrease in the average length of hospital stay occurred when comparing at-risk patients at baseline (2.7± 1.8 days) to at-risk patients post-intervention (2.3 ± 1.1 days). There was no statistically significant difference (p=0.860) in the percentage of at-risk breastfeeding patients at discharge (baseline 65%, intervention 64%).

DISCUSSION

This intervention successfully reduced the percentage of NICU transfers among neonates at risk for hypoglycemia in our institution from 10% to 2%. This intervention was intended to reduce the waste of resources and human resources while promoting the mother-infant dyad. The new protocol provides an easy-to-follow process that eliminates the need for urgent NICU evaluation and provides an effective method of correcting hypoglycemia that doesn't involve disrupting the mother-infant dyad or invasive procedures such as starting IVs. We also found the average length of stay for at-risk newborns decreased. This secondarily allows for more hospital beds and NICU beds to be available for other patients who may need closer monitoring and interventions that are more advanced.

While breastfeeding rates showed no change between the groups, this fact may be accounted for by the opportunity for mothers to feed their newborns with expressed breast milk if admitted to the NICU. Additionally, some mothers opted to formula feed their babies despite having the opportunity to breastfeed, which confounds the assessment of the protocol's effect on this measure. Documentation of feeding preference was inconsistent across providers, which was an additional limitation to evaluating breastfeeding rates.

This study was a single-center study at an institution with only NICU (level III); this may narrow the generalizability to other institutions. There was limited intervention time following the implementation of the new protocol, and the data extraction tool only pooled patients with glucose events under 70mg/dL, which may have impacted sample size as asymptomatic neonates above this value were omitted. Our data extraction tool also made it challenging to identify NICU admission specifically for hypoglycemia, which required us to generalize our findings to total all-cause NICU admissions instead. Lastly, other health policies were instituted at our institution during the same time frame, including implementing early feedings within two hours of birth and checking blood glucose one hour after the first feeding, which may have created confounding in this study.

Due to the limitations of this study, further research utilizing more data as it becomes available may be useful to compare annual data from 2021 to 2022 since our protocol was implemented at the end of 2021. With more data, this study may increase its power. Future studies may include looking at cost outcomes and breastfeeding rates further in depth.

Overall, implementing the new hypoglycemia protocol and adding glucose gel to the neonatologist's toolbelt was an easy and cost-effective way to reduce NICU admissions among infants at risk for hypoglycemia.

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