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Original Research Article

STUDY OF INCIDENCE OF HYPOGLYCEMIA IN SMALL FOR GESTATIONAL AGE (SGA) NEONATES IN FIRST 48 HOURS IN A TERTIARY CARE HOSPITAL

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Abstract

Background: Small for gestational age (SGA) neonates are at an increased risk of hypoglycemia in the immediate postnatal period due to limited glycogen reserves and immature metabolic adaptation. Early identification and management are essential to prevent neurodevelopmental consequences. **Objectives:** To estimate the incidence of hypoglycemia in SGA neonates within the first 48 hours of life and compare the occurrence between term and preterm SGA neonates. **Materials and Methods:** A hospital-based prospective observational study was conducted in the NICU of a tertiary care hospital from December 2022 to December 2023. A total of 100 SGA neonates, as per Lubchenco growth charts, were enrolled. Blood glucose levels were monitored at 1, 2, 4, 6, 12, 24, and 48 hours of life. Demographic, clinical, and delivery-related data were collected. Hypoglycemia was defined as blood glucose <45 mg/dL. Statistical analyses included Chi-square tests and logistic regression. **Result:** The incidence of hypoglycemia was 26%, with a higher prevalence in preterm SGA neonates (61.54%) compared to term SGA (38.46%) (p=0.001). Most episodes occurred at the 2nd hour of life. Symptomatic hypoglycemia was seen in 61.5% of affected neonates. Delayed enteral feeding and cesarean delivery were significantly associated with increased hypoglycemia risk. Multivariate analysis identified head circumference, chest circumference, low Apgar score, and cesarean delivery as significant predictors. **Conclusion:** Preterm SGA neonates are at greater risk of hypoglycemia. Early initiation of feeding and vigilant glucose monitoring, especially in cesarean-delivered and low Apgar score neonates, are critical for prevention.

INTRODUCTION

Neonatal hypoglycemia is one of the most common metabolic disorders encountered in the immediate postnatal period.[1] It poses a significant risk to neonatal health, especially in vulnerable populations such as small for gestational age (SGA) infants, who are defined as neonates with a birth weight below the 10th percentile for gestational age.[2] These infants have limited glycogen and fat stores, along with immature enzymatic pathways required for gluconeogenesis, making them highly susceptible to hypoglycemia during the critical transitional phase after birth.[3]

The neonatal brain relies heavily on glucose as its primary energy source. Inadequate glucose availability during early life has been associated with adverse neurological outcomes, including seizures, cerebral injury, and long-term developmental impairments.[4] Although hypoglycemia may remain asymptomatic in many neonates, it can also present with non-specific signs such as jitteriness, lethargy, poor feeding, or convulsions, necessitating routine monitoring among at-risk groups.[5]

Current clinical guidelines, including those by the American Academy of Pediatrics, recommend a blood glucose threshold of 45 mg/dL as the minimum safe limit for at-risk neonates after the first few hours of life.[6] Despite this, controversies persist regarding the frequency of screening, optimal management strategies, and the long-term neurodevelopmental impact of transient versus persistent hypoglycemia.[7] SGA neonates, both term and preterm, form a critical subgroup requiring vigilant observation. However, literature on the comparative incidence and associated risk factors of hypoglycemia in this

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subgroup, especially within the first 48 hours, is limited in the Indian context. This study aims to determine the incidence of hypoglycemia in SGA neonates and compare its occurrence in term and preterm SGA infants, while identifying contributing risk factors to aid in timely intervention.

MATERIALS AND METHODS

Study Design and Setting: This was a prospective, hospital-based observational study conducted in the Neonatal Intensive Care Unit (NICU) of Government General Hospital, Vijayawada, Andhra Pradesh, over a period of one year, from December 2022 to December 2023.

Study Population

The study included 100 neonates classified as Small for Gestational Age (SGA), defined as birth weight less than the 10th percentile for gestational age based on the Lubchenco growth charts. Both term and preterm SGA neonates less than 48 hours of age admitted to the NICU were included.

Inclusion Criteria

Neonates with birth weight <10th percentile for gestational age (SGA)

Both term and preterm SGA neonates

Age <48 hours at the time of admission

Exclusion Criteria

Appropriate for gestational age (AGA) and large for gestational age (LGA) neonates

Neonates with perinatal asphyxia

Infants of diabetic mothers

Neonates with early-onset sepsis, congenital anomalies, polycythemia, or requiring resuscitation

Neonates already receiving intravenous glucose or parenteral nutrition

Sample Size

The sample size was calculated using a 95% confidence interval and an expected hypoglycemia incidence of 24% based on prior studies. A minimum of 96 neonates was required, and 100 neonates were enrolled using purposive sampling.

Data Collection and Procedure

Demographic and clinical data, including gestational age, birth weight, mode of delivery, maternal parity, Apgar scores, and anthropometric measurements were recorded using a predesigned proforma. Blood glucose levels were measured at 1, 2, 4, 6, 12, 24, and 48 hours of life using heel prick capillary samples and a calibrated glucometer. Readings <45 mg/dL were confirmed using plasma glucose estimation in the laboratory.

Hypoglycemia was defined according to American Academy of Pediatrics (AAP) guidelines as<40 mg/dL from birth to 4 hours of life

<45 mg/dL from 4 to 48 hours of life

Symptomatic neonates were monitored for signs such as jitteriness, lethargy, apnea, poor feeding, or seizures.

Ethical Considerations

The study was approved by the Institutional Ethics Committee(IEC/2022/054/SMC dated 03/11/2022, and informed written consent was obtained from the parents or guardians of all participants.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using SPSS version 22. Descriptive statistics (means, standard deviations, percentages) were used to summarize baseline characteristics. Chi-square test and Student's t-test were used for categorical and continuous variables, respectively. Univariate and multivariate logistic regression analyses were performed to identify predictors of hypoglycemia. A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 625 neonates were admitted to the NICU during the study period, of which 100 neonates (16%) were identified as Small for Gestational Age (SGA). Among them, 66% were term SGA and 34% were preterm SGA neonates, as shown in **Table 1**.

Incidence and Timing of Hypoglycemia

The overall incidence of hypoglycemia among SGA neonates was 26% (n=26). A higher proportion of hypoglycemic episodes occurred in preterm SGA neonates (61.54%) compared to term SGA neonates (38.46%) ($p = 0.001$). The highest incidence of hypoglycemia was observed at the 2nd hour of life (21%), followed by the 1st hour (9%), 6th hour (9%), 12th hour (7%), 24th hour (3%), and 48th hour (1%) (**Table 2**).

Symptomatic vs Asymptomatic Hypoglycemia

Among the 26 hypoglycemic neonates, 61.5% presented with symptoms such as poor feeding, lethargy, jitteriness, and seizures, while 38.5% were asymptomatic. This association between hypoglycemia and clinical symptoms was found to be statistically significant ($p < 0.0001$) (**Table 3**).

Enteral Feeding and Hypoglycemia

Enteral feeding was initiated within the first hour of life in 78% of the neonates. A delayed initiation of feeding (beyond 1 hour) was significantly associated with a higher incidence of hypoglycemia. Specifically, 64.29% of those fed between 1–2 hours and 62.5% of those fed after 2 hours developed hypoglycemia compared to only 15.39% in those fed within the first hour ($p < 0.001$) (**Table 4**).

Association with Gestational Age and Birth Weight

Preterm SGA neonates consistently had lower mean blood glucose levels compared to term SGA neonates across all time intervals. The most pronounced difference was at 2 hours post-birth (38.2 ± 3.6 mg/dL vs 41.9 ± 6.7 mg/dL), although differences at other time points were not statistically significant (**Table 5**). The incidence of hypoglycemia was highest among neonates with birth weights between 1.0–1.5 kg and 1.5–2.5 kg, both categories showing an equal incidence of 38.5% (**Table 6**).

Mode of Delivery and Parity

Hypoglycemia was more prevalent in neonates delivered via cesarean section (69.2%) than in those

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delivered vaginally (30.8%). Furthermore, the incidence was slightly higher in neonates born to primigravida mothers (25.92%) compared to multigravida mothers (26.08%) (**Table 7**). Although these differences were noted, only the mode of delivery approached statistical significance.

Blood Glucose Levels by Feeding Type

Neonates who received early feeding (within the first hour) demonstrated significantly higher mean blood glucose levels (46.2 ± 7.9 mg/dL) compared to those who were fed later (42.04 ± 5.9 mg/dL) ($p = 0.004$), as presented in **Table 8**.

Risk Factors for Hypoglycemia

Univariate logistic regression analysis revealed several factors significantly associated with hypoglycemia, including low birth weight, preterm status, cesarean delivery, low Apgar score at 1 minute, and smaller head and chest circumference. Multivariate analysis confirmed that head circumference, chest circumference, low Apgar score at 1 minute, and cesarean delivery were the strongest independent predictors ($p < 0.05$) (**Table 9**).

Clinical Outcomes

Among the hypoglycemic neonates, two deaths were recorded, both associated with concomitant sepsis. Preterm hypoglycemic neonates who developed seizures had significantly lower mean blood glucose levels than term neonates with seizures (41.5 ± 1.6 mg/dL vs 48.5 ± 0.9 mg/dL, $p < 0.05$) (**Table 10**).

Table 1: Distribution of SGA Neonates by Gestational Age

SGA Type	Frequency (n)	Percentage (%)
Term	66	66%
Preterm	34	34%

Table 2: Incidence and Timing of Hypoglycemia

Time of Life (hr)	Incidence of Hypoglycemia (%)
1	9%
2	21%
6	9%
12	7%
24	3%
48	1%

Table 3: Symptomatic vs Asymptomatic Hypoglycemia

Hypoglycemia Type	Frequency (n)	Percentage (%)
Symptomatic	16	61.5%
Asymptomatic	10	38.5%

Table 4: Enteral Feeding and Hypoglycemia

Time of Feeding Initiation	Hypoglycemia Incidence (%)
< 1 hour	15.39%
1–2 hours	64.29%
> 2 hours	62.5%

Table 5: Mean Blood Glucose Levels by Time and Gestation

Time Point	Preterm SGA (mg/dL)	Term SGA (mg/dL)
2 hours	38.2 ± 3.6	41.9 ± 6.7
4 hours	51.7 ± 8.3	53.3 ± 6.5
12–24 hours	58.3 ± 4.7	56.3 ± 8.3
24–48 hours	60.5 ± 6.8	62.3 ± 10.1

Table 6: Hypoglycemia by Birth Weight Category

Birth Weight Category	Hypoglycemia Incidence (%)
1.0–1.5 kg	38.5%
1.5–2.5 kg	38.5%

Table 7: Hypoglycemia by Mode of Delivery and Parity

Category	Hypoglycemia Incidence (%)
Cesarean Section	69.2%
Vaginal Delivery	30.8%
Primigravida	25.92%
Multigravida	26.08%

Table 8: Blood Glucose Levels by Feeding Type

Feeding Type	Mean Glucose Level (mg/dL)
Early	46.2 ± 7.9
Delayed	42.04 ± 5.9

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Table 9: Significant Predictors of Hypoglycemia (Multivariate Analysis)

Predictor	Significant ($p < 0.05$)
Head circumference	Yes
Chest circumference	Yes
Apgar score (1 min)	Yes
Cesarean delivery	Yes

Table 10: Neonatal Outcomes in Hypoglycemic Neonates

Outcome	Blood Glucose Level / Count
Seizures in preterm	41.5 ± 1.6 mg/dL
Seizures in term	48.5 ± 0.9 mg/dL
Deaths (with sepsis)	2 cases

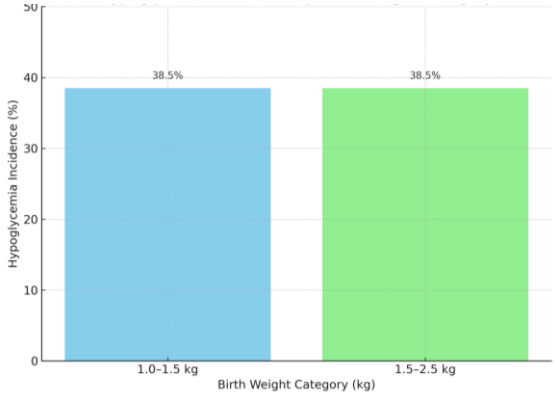

Figure 1: Hypoglycemia incidence by Birth Weight Category

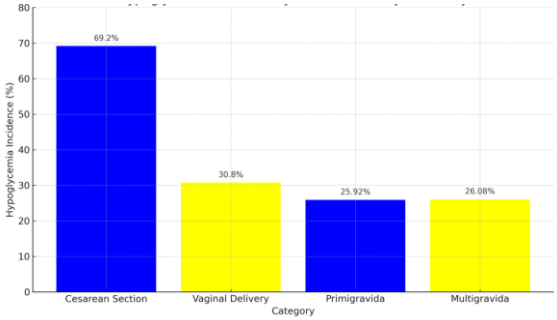

Figure 2: Hypoglycemia incidence by Mode of Delivery and Parity

DISCUSSION

This prospective observational study assessed the incidence and associated risk factors of hypoglycemia in SGA neonates during the first 48 hours of life in a tertiary care hospital. Among the 100 SGA neonates enrolled, the overall incidence of hypoglycemia was 26%, with a significantly higher prevalence in preterm SGA neonates (61.54%) compared to their term counterparts (38.46%). This aligns with prior studies by Alph Shirley et al. and Mushtaq Ahmad Bhat et al., which also reported higher susceptibility in preterm SGA neonates due to immature metabolic regulation and limited glycogen reserves.[8]

The majority of hypoglycemic episodes were observed within the first few hours of life, with the peak occurrence at the second hour (21%), emphasizing the critical window for monitoring in early neonatal life. These findings are consistent with existing literature, which describes a physiological nadir in glucose levels within the first 1–2 hours after birth, especially among high-risk groups.[9]

Symptomatic hypoglycemia was observed in 61.5% of affected neonates, with clinical presentations such as lethargy, jitteriness, poor feeding, and seizures. The statistically significant correlation between symptoms and hypoglycemia underscores the need for vigilant clinical assessment, as delayed recognition can lead to adverse neurological outcomes.[10]

The study revealed that early initiation of enteral feeding within the first hour was protective, with only 15.39% of those neonates developing hypoglycemia, compared to >60% among those fed later. This finding supports existing evidence suggesting that early feeding promotes metabolic adaptation and helps maintain glucose homeostasis in neonates.[11]

Mode of delivery also played a significant role. Hypoglycemia was more common in neonates delivered via cesarean section (69.2%), potentially due to delayed metabolic transition and late initiation of breastfeeding. Moreover, multivariate analysis identified head circumference, chest circumference, Apgar score at 1 minute, and cesarean delivery as significant independent predictors of neonatal hypoglycaemia.[12,13]

Interestingly, the incidence of hypoglycemia was slightly higher among neonates born to primigravida mothers (25.92%) than multigravida mothers (26.08%), although this difference was not statistically significant. This finding may reflect differences in maternal experience and preparedness for early initiation of neonatal care.[14]

Two neonates with sepsis and persistent hypoglycemia succumbed, further highlighting the clinical implications of hypoglycemia as a marker of neonatal vulnerability.

Strengths and Limitations

The study's strengths include its prospective design and systematic glucose monitoring across standardized time points. However, limitations include its single-center setting and relatively small sample size, which may affect generalizability. Also, long-term neurodevelopmental outcomes were not assessed.

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CONCLUSION

This study highlights that hypoglycemia is a common and significant metabolic concern among SGA neonates, particularly in preterm infants. The incidence was highest within the first few hours of life, emphasizing the need for early and routine glucose monitoring. Preterm status, cesarean delivery, low Apgar score, and smaller anthropometric measurements were identified as key predictors. Early initiation of enteral feeding within one hour of birth significantly reduced the risk of hypoglycemia. Timely detection and management are essential to prevent neurological complications. These findings support implementing targeted screening protocols for high-risk neonates to improve short-term outcomes and long-term neurodevelopmental health.

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