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Blood Glucose Level in Term and Preterm Newborns

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Abstract: *Glucose, amino acids and lactate are the principal energy substrates during fetal life. Hypoglycemiais one of the common metabolic hazards in neonatal medicine practice. The projected neonatal mortality rate for 2020 based on AARR from 2000-2012 is 22 per 1000 live births.[1] It is possible that neonatal hypoglycemia arising as a consequence of fetal malnutrition, birth asphyxia, post natal hypothermia or infection could be responsible for some of unexplained neonatal death.[2] There is an association between blood glucose level and neurological development. Our study involved 125 newbornsand blood glucose levels were estimatedat birth and at 72 hours by glucose oxidase method. A cross-sectional study was conducted in Department of Biochemistry in collaboration with Department of Obstetrics and Gynaecology between September 2016 to August 2017.Blood sugar levels in preterm babies were lower than term babies at birth (63.71±15.62 and 69.38±16.53 mg/dl respectively) where findings were not statistically significant. But findings at 72 hours were found to be statistically significant (52.61±10.50 and 67.10±10.11 mg/dl). Incidence of hypoglycemia was 15.2%.*

Hence forth the above study showed that hypoglycemia is a common problem in preterm babies, by taking simple low cost measures the incidence may be reduced, which may have a major impact on early infant mortality and neurodevelopmental sequel of perinatal origin.

Keywords- *hypoglycemia, preterm, term newborns*

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I. Introduction

The projected neonatal mortality rate for 2020 based on AARR from 2000-2012 is 22 per 1000 live births.[1] It is possible that neonatal hypoglycemia arising as a consequence of fetal malnutrition, birth asphyxia, post natal hypothermia or infection could be responsible for some of unexplained neonatal death.[2] During pregnancy, fetal glucose consumption increases and there is risk of maternal and possibly fetal hypoglycemia, particularly if there are long interval between meals or at night. Furthermore, premature and low birth weight babies are more susceptible to hypoglycemia since they have little adipose tissue to provide alternative fuels such as free fatty acids or ketone bodies during the transition from fetal dependency to the free living state. The enzymes of gluconeogenesis may not be functional at this time and gluconeogenesis is anyway dependent on a supply of free fatty acid for energy. Little glycerol, which would normally be released from adipose tissue, is available for gluconeogenesis.[3] The current study aims to build growing awareness of hypoglycemia in pretermbabies by comparing the blood glucose level in term and preterm babies.

II. Material And Methods

Across-sectional study was carried out in the Department of Biochemistry in collaboration with Department of Obstetrics and Gynaecology, RIMS, Imphal from September 2016 to August 2017. A total 125 newborns were included in this study.

Study Design: cross-sectional study.

Study location: This was a tertiary care teaching hospital based study done in Department of Biochemistry in collaboration with Department of Obstetrics and Gynaecology, RIMS, Imphal.

Study duration: September 2016 to August 2017.

Sample size:125 newborns.

Sample size calculation: The sample size was estimated on the basis of a single proportion design. We assumed that confidence interval was of 95%. Taking 5% of type 1 error and precision of 5 on either side and prevalence of 9% from previous study,

Sample size

$= 1.96^2 \times 0.09 \times (1-0.09)$

0.05^2

$= 125$

Subjects and selection method: The study population was drawn from consecutive 125 newborns who were delivered in Department of Obstetrics and Gynaecology, RIMS, Imphal. Samples were collected for estimation of blood glucose level at birth from umbilical cord and from cubital vein at 72 hours.

Inclusion criteria:

1. Either sex
2. Different birth weight (NBW- Normal Birth Weight, LBW- Low Birth Weight)
3. Different gestational age (Preterm or Term)
4. Different types of intrauterine growth (SGA- Small for Gestational Age, AGA- Appropriate for Gestation Age)
5. Different mode of delivery (normal vaginal or caessarian section)
6. Twins
7. Duration of labor (normal or prolonged)

Exclusion criteria:

Newborns that suffer from

1. Congenital anomalies
2. Major illness
3. Need intravenous glucose estimation
4. Die within 3 days of life
5. Neonates of mother with diabetes mellitus, gestational diabetes, preeclampsia, eclampsia, hypertension, on steroid therapy or with major illness

Procedure methodology:

Written informed consent was obtained from both mother and father of the newborn. A brief clinical history was taken from mother and all the babies were examined clinically including estimation of birth weight and gestational age. Maturity of the newborns were assessed on the basis of last menstrual period of mothers and with the help of physical and neurological criteria of the baby by Expanded New ballard Scoring system.

Blood samples for glucose level estimation were taken from cord blood just after birth and from cubital vein at 72 hours of life. Blood glucose levels were estimated by Glucose Oxidase method (GOD-PAP Method).

Statistical analysis:

Data was analysed using SPSS version 20 (SPSS Inc., Chicago, IL). Analysis was performed by using t-test. For comparison of the mean values ANOVA test was used. $P<0.05$ was considered significant.

III. Result

Table 1 shows the total number of newborns studied. Male babies were more than female babies.

Table no 1: Distribution of male and female newborns.

Number of male babies	65
Number of female babies	60
Total number of newborns	125

Table 2 shows that the blood sugar levels in low birth weight babies were lower than that of normal birth weight babies both at birth and 72 hours of age. But, no statistically significant correlation was found between values of these groups at birth ($p=0.10$) and at 72 hours of life ($p>0.10$).

Table 2: Distribution of blood sugar level in low birth weight and normal birth weight newborn babies.

Groups	Age of baby	No of cases	Blood sugar(mg/dl)		SD	SE
			Range	Mean		
Low Birth Weight	Birth	43	30-100	65.32	14.00	2.13
	72 hours	43	25-94	62.88	14.44	2.20
Normal Birth Weight	Birth	82	37-145	72.06	17.45	1.92
	72 hours	82	43-95	65.60	9.74	1.07

Table 3 shows that the blood sugar level in preterm babies were lower than that of term babies at birth but no statistically significant correlation ($p>0.10$) was found. At 72 hours of age, blood sugar levels in term babies were much higher than preterm babies and were highly significant statistically ($p<0.01$).

Table 3: Distribution of blood sugar level in preterm (babies with gestation age <37 weeks and term babies with gestation age ≥37 weeks).

Groups	Age of baby	No of cases	Blood sugar(mg/dl)		SD	SE
			Range	Mean		
Preterm babies	Birth	21	30-91	63.71	15.62	3.41
	72 hours	21	25-88	52.61	10.50	2.29
Term babies	Birth	104	37-145	69.38	16.53	1.62
	72 hours	104	43-93	67.10	10.11	0.99

Table 4 shows that the blood sugar level in AGA babies were higher than that of SGA babies at birth and values were statistically significant ($p<0.02$). But no statistical correlation was found between the values of these two groups at 72 hours ($p>0.10$).

Table 4: Distribution of blood sugar level in small for gestational age (SGA) and appropriate for gestational age (AGA) newborn babies.

Groups	Age of baby	No of cases	Blood sugar(mg/dl)		SD	SE
			Range	Mean		
SGA babies	Birth	26	30-95	61.80	13.25	2.65
	72 hours	26	36-94	63.03	14.21	2.84
AGA babies	Birth	99	33-145	69.41	16.70	1.68
	72 hours	99	25-95	64.43	11.26	1.13

Table 5 shows that at birth blood sugar level of babies delivered normally were lower than the babies delivered by caessarian section and were statistically highly significant ($p<0.01$). Blood sugar levels of normally delivered babies were increased from birth to 72 hours of age but that of caessarian babies were decreased. However, no statistically significant correlation was found between the values of these two groups at 72 hours ($p>0.10$).

Table 5: Distribution of blood sugar level in newborn delivered normally (vaginal delivery) and in babies delivered by caessarian section (C.S.).

Groups	Age of baby	No of cases	Blood sugar(mg/dl)		SD	SE
			Range	Mean		
Babies delivered normally	Birth	71	30-145	63.76	16.46	1.95
	72 hours	71	39-95	64.43	12.33	1.46
Babies delivered by C.S.	Birth	54	43-103	74.57	14.43	1.96
	72 hours	54	25-92	64.98	10.70	1.45

Table 6 shows that blood sugar levels in babies delivered following normal labor were lower than babies delivered after prolonged labor at birth but there was no statistical correlation ($p>0.10$). At 72 hours of age blood sugar levels in babies delivered following normal labor were also lower than babies delivered after prolonged labor which is also not significant statistically ($p>0.10$). But in prolonged labor, there is significant increase in blood sugar levels ($p<0.01$).

Table 6: Distribution of blood sugar level in babies in relation to normal and prolonged labor

Groups	Age of baby	No of cases	Blood sugar(mg/dl)		SD	SE
			Range	Mean		
Normal labor	Birth	104	37-145	65.43	20.73	2.03
	72 hours	104	36-149	72.45	20.61	2.21
Prolonged labor	Birth	21	25-88	69.43	19.93	4.34
	72 hours	21	35-103	76.79	24.91	5.43

Table 7 shows that blood sugar level in first baby were higher than second baby at birth but there was no statistically significant correlation ($p>0.10$). At 72 hours of age blood sugar levels in first baby were also higher than second baby of twin and also not significant statistically ($p>0.10$).

Table 7: Blood sugar level in the first baby and second baby in twin delivery

Groups	Age of baby	No of cases	Blood sugar(mg/dl)		SD	SE
			Range	Mean		
First baby	Birth	05	30-100	63.37	7.89	3.53
	72 hours	05	36-122	72.36	8.75	3.91
Second baby	Birth	05	25-94	57.11	7.39	3.30
	72 hours	05	43-95	65.60	9.74	4.35

Table 8 shows that maximum incidence of hypoglycemia occurred within 24 hours of age.

Table 8: Incidence of hypoglycemia in relation to the age of newborns

Age of newborns in hours	0-24 hrs	24-48 hrs	48-72 hrs
Number of hypoglycemic cases	12	4	3
Percentage of hypoglycemic cases	63.15	21.05	15.78

Table 9 shows that hypoglycemia appeared in 19 babies.

Table 9: Incidence of hypoglycemia

Total number of cases under study	125
Number of hypoglycemic cases	19
Percentage	15.20

Table 10 shows that 19 babies developed hypoglycemia and 9 babies were symptomatic.

Table 10: Total number of symptomatic hypoglycemic cases

Total number of cases under study	125
Number of hypoglycemic cases	19 (15.20%)
Total symptomatic hypoglycemic cases	9 (7.2%)

Table 11 shows that out of 9 symptomatic cases, 8 babies had jitteriness, 6 babies had asphyxia, 5 babies had convulsion, 3 babies had refusal of feed as well as hypotonia and 1 baby had apnea and tachypnea.

Table 11: Signs and symptoms observed in symptomatic hypoglycemic newborns

Signs and symptoms	No. of hypoglycemic cases	Percentage
Jitteriness	8	88.88
Asphyxia	6	66.66
Convulsion	5	55.55
Refusal of feed	3	33.33
Hypotonia	3	33.33
Apnea	1	11.11
Tachypnea	1	11.11

IV. Discussion

The male-female birth ratio of the population for India is 1.06.[4]
In the present study, male-female birth ratio is 1.082 in this north-east region of this country which shows slight increase.
Miranda LE and Dweck HS[5] stated that very low birth weight babies have the potential problem of hypoglycemia due to diminished hepatic glycogen stores.

In present study, blood sugar levels in low birth weight babies were lower than normal birth weight babies both at birth and 72 hours. But no statistically significant correlation was found between values of these two groups at birth and at 72 hours of life.

Preterm babies had a group mean value of 39.8 mg% as compared to 47.2 mg% in term babies, as described by Bhalla M et al.[6]

In this study also blood sugar level in preterm babies (mean 63.71 mg/dl) were lower than term babies (mean 69.38 mg/dl) at birth and at 72 hrs of age blood sugar levels in term babies (mean 67.10 mg/dl were much higher than preterm babies (mean 52.61 mg/dl).

In a study by Linda LW et al,[7] plasma glucose levels were measured during the first day of life in 24 SGA infants who began formula feedings or breast milk feeding within 2 hours of birth. In contrast to the high incidence of low blood sugar seen previously in fasted SGA infants, no infant had a plasma glucose below 30 mg/dl; after the first feeding, no values below 40 mg/dl occurred. The results indicate that hypoglycemia (plasma glucose <40 mg/dl) can be easily avoided in SGA infants simply by providing adequate calories without delay after delivery.

In present study, blood glucose levels in AGA babies were higher than SGA babies at birth and even at 72 hours. And hypoglycemia appeared in 6 cases of SGA babies and 13 cases of AGA babies. This study indicates the role of early feeding to prevent subsequent hypoglycemia which is similar with their study.

Cole MD and Peevy K[8] disclosed a 43% incidence of hypoglycemia in neonates delivered by caessarian section and a 37% incidence in neonates delivered vaginally.

In this study, distribution of blood sugar level in babies delivered normally (vaginal delivery) and in babies delivered by caessarian section showed that at birth blood sugar level of babies delivered normally (mean 63.76 mg/dl) were lower than babies delivered by caessarian section (mean 74.57 mg/dl) and were statistically significant. Blood sugar level of normally delivered babies increased from birth to 72 hrs of age but that of caessarian babies decreased. However, no statistically significant correlation was found between the values

(mean 64.43 mg/dl in normally delivered babies vs. 64.98 mg/dl in caessarian babies) of these two groups at 72 hrs. Hypoglycemia appeared in 5 cases (7.04%) of babies delivered normally and 14 cases (25.92%) of babies delivered by caessarian section.

Kim G and Chul Y[9] evaluated the blood glucose of the mother and fetus in relation to length of labor. They found that the glucose level in the blood of the mother was unchanged by the duration of labor. However, the glucose level in the blood of the fetus had a tendency to rise upto 20 hours and decreased after this time.

In this study, blood sugar level in babies delivered following normal labor (mean 65.43 mg/dl) were lower than babies delivered after prolonged labor (mean 69.43 mg/dl) at birth but there was no statistically significant correlation. At 72 hours of age, blood sugar levels in babies delivered following normal labor were lower than babies delivered after prolonged labor. But that is also not statistically significant. This study shows that in prolonged labor, blood glucose level increases significantly from birth to 72 hrs. This result contradicts with their observation and probably due to stress to the newborn during prolonged labor.

Mishra PK et al[10]observed that blood sugar levels had a definite correlation with birth weight and gestational age, significantly higher values were observed in infants weighing 2250 gm and also infants having a gestational age of over 37 weeks. The mean sugar values did not differ between the larger and smaller twin, nor were the values influenced by birth order or sex of these infants. Significant hypoglycemia (blood sugar <20 mg%) was observed in smaller member of the twin (70%) in 7 infant.

Present study shows that blood sugar level in first baby (mean 63.37 mg/dl) were higher than second baby (mean 57.22 mg/dl) (more in larger baby than smaller babies) at birth but there was no statistically significant correlation. At 72 hrs of age, blood sugar levels in first baby (mean 72.36 mg/dl) were also higher than second baby of twin (mean 65.60 mg/dl) were also higher than second baby of twin (mean 65.60 mg/dl) and also not significant statistically. The results were similar with their observations.

Prevalence of hypoglycemia ranges from 5% to 7.9% for term infants and 3.5% to 15% in preterm infants, as described by Cornblath M and Schwartz R.[11] In present study, hypoglycemia developed in 19 cases (15.20%) of study group.

In a study by Fato T et al,[12] glucose levels were measured in all 35 newborns at the 1st, 2nd, 3rd hr and 14, 24, 36 and 48 hrs before feeding. The lowest blood glucose level was seen in the first 3 hrs of life. In the first 3 hrs of life there were 12 infants with glucose levels less than 30 mg/dl but in only three of those did the hypoglycemic level continue and require treatment (9%).

In present study, maximum incidence of hypoglycemia (63.15%) occurred within 24 hrs. 21.05% between 24 to 48 hrs. Remaining 15.78% of cases between 48-72 hrs of age. This study indicates the role of early feeding to prevent subsequent hypoglycemia which is similar with the finding of Holtrop PC[13] and Fato T et al[12] but contradict the finding of Linda LW et al.[7]

Lucas A et al[14] stated that symptomatic hypoglycemia is associated with a risk of long-term neurodevelopmental sequel because of metabolic immaturity. They observed that preterm infants and infants that are small for gestational age were at greater risk of sequel. In a study by Koivisto M et al,[15] among 85 infants who had suffered symptomatic hypoglycemia, only 50% presented with convulsions and 88% of those with non-convulsive symptoms were developmentally normal.

In the present study out of 19 cases only 9 (47.36%) were symptomatic. Out of symptomatic babies, 8(88.88%) had jitteriness, 6 (66.6%) had asphyxia, 5 (55.55%) had convulsion, 3 (33.33%) had hypotonia as well as refusal of feed and 1 (11.11%) had apnea and tachypnea.

V. Conclusion

To prevent the sequels of hypoglycemia, determination of blood sugar of newborns before the development of clinical sign and symptom is recommended.

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