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Original Research Article

Incidence and risk factors of hypoglycemia among neonates: a hospital based prospective study

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ABSTRACT

Background: Among neonates, one of the common metabolic problem is hypoglycemia. Hence basic care of the neonate involves monitoring of blood glucose. If not diagnosed and treated early, it may lead to problems associated with physical growth and neurodevelopment. The objective was to study incidence and risk factors of hypoglycemia among neonates.
Methods: This was a prospective study carried out at a tertiary care center. 100 neonates were included. Standard glucometer was used to measure blood glucose in mothers and neonates. For mothers, it was measured at time of delivery. For neonates, it was measured at zero, three, six, twelve and twenty four hours of birth. Standard treatment protocol was followed for neonatal hypoglycemia.
Results: Incidence of hypoglycemia at birth was 17%. As maternal blood glucose increased, neonatal glucose decreased. Important risk factors found for hypoglycemia in neonates were being born by lower segment cesarean section (LSCS), low for gestational age (LGA) babies and small for gestational age (SGA) babies, pre-term and post term babies. But these risk factors were not found to be statistically significant ($p>0.05$).
Conclusions: Blood glucose varied widely in the neonates. Important risk factors found for hypoglycemia in neonates were being born by LSCS, LGA babies and SGA babies, pre-term and post term babies.

Keywords: Blood glucose levels, Neonate, Vaginal, LSCS, Preterm, Term

INTRODUCTION

For normal functioning of the brain cells, most necessary is glucose. Hypoglycemia can lead to damage to the brain. This can be taken care by appropriate and adequate treatment. Adequate neurological development in the neonates is ensured by normal blood glucose. This correlation has been shown in different studies.[1]

Proper gluconeogenesis ensures that the normal blood glucose is achieved. Risk factors for impaired gluconeogenesis are mother with diabetes, SGA, pre-term babies and LGA. Hence early diagnosis and treatment of hypoglycemia in these high risk groups are required to prevent the complications.[2-4]

It has been generally agreed that the blood glucose should be maintained in the neonates but there is confusion on what is the lowest level of the blood glucose below which it can cause the problems.[1] This dilemma is due to the fact that the neonates do not show classical clinical signs for hypoglycemia. There is also no clarity about whether the neurological damage is caused by asymptomatic hypoglycemia and therefore it is important to monitor the blood glucose levels at regular intervals.[1]

Among neonates, one of the common metabolic problem is hypoglycemia. Therefore, the regular monitoring of the blood glucose levels are part of standard protocol in many hospitals.[5] Various factors like weight at birth, co-morbidities at birth, complications that may occur during perinatal period, gestational age, behavior of the mother during feeding of the baby.[6-8]

One study has reported that the 16% was the hypoglycemia incidence among babies who were LGA.[9] The incidence varies if the cut-off point varies. For cut-off point of <1.7 mmol/l (30.6 mg/dl) it is 8.1% compared to 20.6% for cut-off point of <2.2 mmol/l (39.6 mg/dl).[10]

Generally it has been observed that low levels of the blood glucose do not cause health issues in the neonates. This is due to the fact that the neonates are adjusting to the life outside the uterus.[11,12] But if this variation is of chronic nature, then it may be associated with the complications.[5] Chronic hypoglycemia in neonates is associated with brain injury.[13]

Appropriate for gestational age (AGA) babies may not require monitoring of blood glucose. But we have no idea on how asymptomatic hypoglycemia is present in these babies and if not attended may lead to brain damage. There is also no clarity on when and how frequently the blood glucose should be monitored. This particular aspect is not much studied in the available literature. If the mother is diabetic, then the asymptomatic hypoglycemia is common in the babies born to such mothers.[14]

There is plenty of data available on hypoglycemia among neonates in the urban areas but not from semi urban areas in India.[15-19] The factors that influence the hypoglycemia in neonates may be different for babies from semi urban areas.

Hence present study was carried out to study incidence and risk factors of hypoglycemia among neonates in semi urban areas.

METHODS

This was a hospital based prospective study. The study duration was December 2009 to September 2011. The admitted cases were from a tertiary care hospital, KVG medical college and hospital, Sullia.

Sample size

Stark et al found that the incidence of hypoglycemia among newborns was 27%.[20] Based on this, using the sample size formula,

Sample size $n=\frac{DEFF\times Np\ (1-p)}{\frac{d^2}{Z21}\times-\frac{\alpha}{2}\times(N-1)+p\times(1-p)}$,

the sample size came out to be 76 with 95% confidence interval. We actually included 100 newborns.

Inclusion criteria

Babies born at the study center during the study period were included in the study.

Exclusion criteria

Patients with congenital anomalies and chromosomal anomalies were excluded from the study.

Informed consent was taken from the study subjects enrolled. Ethical committee approval was taken. Predesigned and pretested proforma was used to collect the data.

Ballards score was used to divide them into four groups of gestational age. For division using weight for gestational age, charts from Seton medical centre, Austin were used.[9]

Accu-Chek performa made by Roche diagnostics, Mannheim, Germany was used for monitoring the blood glucose levels. It was standardized as per the standard guidelines.

All aseptic precautions were taken while taking the blood sample not only from mothers but also from neonates. From mothers, the sample was collected either at the time of delivery or within 30 minutes of delivery. From neonates, the sample was collected at zero hour, three hours, six hours, twelve hours and twenty four hours of birth.

Mothers were trained in breast feeding practices before initiating the breast feeding to their babies as per the baby friendly hospital initiative policy. If the blood glucose was found out to be less than 40 mg/dl, they were examined in detail to look for the signs of hypoglycemia. In all these cases, breast feeding was continued and monitoring of the blood glucose was done.

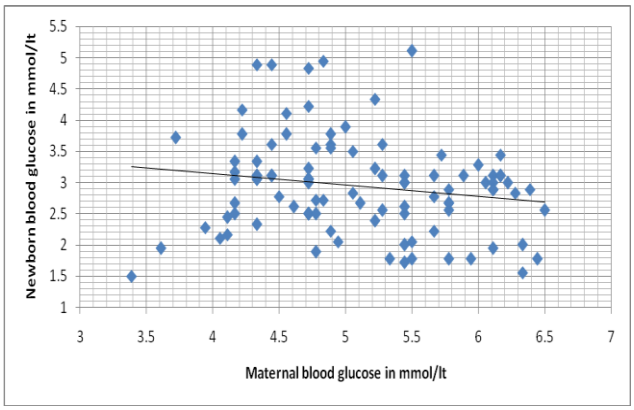
Statistical analysis

The data was entered in the Microsoft excel worksheet and analyzed using proportions and mean and standard deviation values. Students t test was used to compare the mean values in two groups or analysis of variance (ANOVA) was used if the mean was compared in more than two groups. P value less than 0.05 was taken as statistically significant.

RESULTS

Table 1 shows distribution of study subjects as per different parameters. Male babies were more than female babies (58 versus 42). 51 were delivered by LSCS. 54

were primiparous mothers. 72 babies were born at the gestational age of 38-40 weeks. 66 babies were AGA.



R=-0.176; P=0.079.

Figure 1: Scatter diagram showing correlation between maternal and newborn blood glucose levels at birth.

Table 2 shows variation in blood glucose levels in mmol/l in newborns at 5 different time points. As the time duration from birth increased, the mean blood glucose levels increased from 2.94 at birth zero hours to 3.76 at 24 hours after birth.

Figure 1 shows correlation between maternal and newborn blood glucose levels at birth. As the mother blood glucose increased the babies blood glucose decreased with r=-0.176 but this correlation was not found to be statistically significant (p>0.05).

Table 3 shows effect of gestational age on variation in blood glucose levels. The differences in the blood glucose levels at different time points at different gestational ages were not found to be statistically significant (p>0.05).

Table 4 shows effect of mode of delivery on variation in blood glucose levels. The blood glucose levels of the neonates born vaginally were more than those babies who were delivered by LSCS. But this difference was not statistically significant at any point of time (p>0.05).

Table 5 shows influence of weight for gestational age on blood glucose levels. The blood glucose levels of LGA neonates were lower at zero levels compared to SGA and AGA babies. At three hours, six hours the SGA babies had low mean blood glucose compared to other two. At 12 and 24 hours, the AGA babies had low mean blood glucose levels. But none of these differences were found to be statistically significant (p>0.05).

Table 6 shows incidence of hypoglycemia at different time intervals. The incidence was 17% at birth which reduced to 11% three hours to seven percent at six hours and one percent at 12 and 24 hours. This reduction was due to some babies who got corrected on their own and some became normal after treatment.

Table 1: Distribution of study subjects as per different parameters.

Parameters		Number	%
Sex of newborns	Male	58	58
	Female	42	42
Mode of delivery	Vaginal	49	49
	LSCS	51	51
Parity of mother	Primiparous mother	54	54
	Multiparous mother	46	46
Gestational age at which babies were born (weeks)	34-36	4	4
	36-38	20	20
	38-40	72	72
	40-42	4	4
Gestational age classification based on charts from Seton medical centre, Austin	AGA	66	66
	SGA	17	17
	LGA	17	17

Table 2: Variation in blood glucose levels in mmol/l in newborns at 5 different time points.

Newborn blood glucose levels in mmol/l	0 hour	3rd hour	6th hour	12th hour	24th hour
Mean	2.9428	3.4117	3.3328	3.6378	3.7633
Standard error of mean	0.07694	0.10121	0.11112	0.09975	0.07735
Median	3.0000	3.4444	3.1111	3.4444	3.7222
Standard deviation	0.76937	1.01209	1.11121	0.99746	0.77346
Minimum	1.50	1.78	1.94	2.11	1.67
Maximum	5.11	7.78	7.72	7.56	7.33

Table 3: Effect of gestational age on variation in blood glucose levels.

Time interval (in hours)	Gestational age (in weeks)	N	Newborn blood glucose (mmol/l) mean±SD	F value	P value
O	34-36	4	2.72±0.76	0.645	0.588
	36-38	20	2.86±0.51		
	38-40	72	2.99±0.83		
	40-42	4	2.55±0.52		
3rd	34-36	4	3.81±2.00	0.438	0.726
	36-38	20	3.27±0.52		
	38-40	72	3.44±1.06		
	40-42	4	3.15±0.72		
6th	34-36	4	4.15±2.00	0.776	0.510
	36-38	20	3.29±1.00		
	38-40	72	3.30±1.10		
	40-42	4	3.15±0.52		
12th	34-36	4	3.70±0.64	0.052	0.984
	36-38	20	3.60±0.88		
	38-40	72	3.65±1.07		
	40-42	4	4.08±0.47		
24th	34-36	4	4.08±0.47	1.339	0.266
	36-38	20	3.97±0.93		
	38-40	72	3.71±0.73		
	40-42	4	3.29±0.44		

Table 4: Effect of mode of delivery on variation in blood glucose levels.

Time interval (in hours)	Gestational age (in weeks)	N	Newborn blood glucose (mmol/l) mean±SD	t value	P value
O	Vaginal	49	3.06±0.74	1.268	0.208
	LSCS	51	2.82±0.77		
3rd	Vaginal	49	3.54±1.00	0.933	0.353
	LSCS	51	3.28±1.00		
6th	Vaginal	49	3.39±1.2	0.109	0913
	LSCS	51	3.27±1.01		
12th	Vaginal	49	3.74±1.1	0.505	0.615
	LSCS	51	3.53±0.87		
24th	Vaginal	49	3.87±0.81	0.466	0.642
	LSCS	51	3.71±0.74		

Table 5: Influence of weight for gestational age on blood glucose levels.

Time interval (in hours)	Gestational age (in weeks)	N	Newborn blood glucose (mmol/l) mean±SD	F value	P value
O	AGA	66	2.94±0.69	2.786	0.067
	SGA	17	3.23±1.00		
	LGA	17	2.62±0.70		
3rd	AGA	66	3.42±1.00	0.032	0.968
	SGA	17	3.35±0.93		
	LGA	17	3.39±1.16		
6th	AGA	66	3.26±1.09	1.161	0.317
	SGA	17	3.23±0.72		
	LGA	17	3.70±1.44		
12th	AGA	66	3.54±0.88	1.103	0.336
	SGA	17	3.68±1.05		
	LGA	17	3.94±1.31		

Continued.

Time interval (in hours)	Gestational age (in weeks)	N	Newborn blood glucose (mmol/l) mean±SD	F value	P value
24th	AGA	66	3.71±0.77	0.534	0.588
	SGA	17	3.92±0.97		
	LGA	17	3.79±0.54		

Table 6: Incidence of hypoglycemia at different time intervals.

Time intervals (in hours)	Number of babies with hypoglycemia	%
At birth	17	17
3	11	11
6	07	07
12	01	01
24	01	01

DISCUSSION

As the maternal blood glucose increased, the neonatal blood glucose decreased. Mother with high blood glucose levels at delivery had babies with low glucose levels. Singhi et al also reported the similar negative correlation between maternal blood glucose levels and neonatal blood glucose levels.[21] Curet et al also noted that the incidence of hypoglycemia in neonates was less among those neonates whose mother blood glucose was lower before and during delivery compared to those neonates whose mother blood glucose was higher before and during delivery.[22] Mendiola et al observed that the incidence of hypoglycemia was significantly associated with blood glucose levels of mother.[23]

We observed that as the period from birth increased, the average blood glucose levels also increased. Cornblath et al found that there was a small decrease in the mean blood glucose levels of the neonates in the first few hours and then the mean blood glucose levels started to increase.[24]

We found that the minimum blood glucose value was 24 mg/dl and the maximum was 140 mg/dl. Thus there was a wide variation in the blood glucose in the neonates in the present study. This variation was lower at zero hours of birth and then steadily increased till 24 hours of birth. Hawdon et al also noted from their study that the minimum blood glucose was 24 mg/dl and the maximum blood glucose level was 219.6 mg/dl.[25]

The mean blood glucose levels in the present study among babies born by LSCS were lower compared to babies delivered by vaginal route. Kayiran et al observed similar findings in their study. This may be attributed to the fact that this lower blood glucose among babies of LSCS group is due to effect of anesthesia and less stress compared to vaginal delivery. Also compared to vaginal delivery, the breast starts often late in cases of LSCS which can lead to hypoglycemia due to effect of anesthesia, shifting of mothers from operation theatre to other room, but in case of vaginal delivery, breast feeding can be initiated within half an hour of delivery.[5]

In the present study, babies with gestational age of 34-36 weeks and 40-42 weeks have shown lower blood glucose levels which increased in babies with 34-36 weeks of gestational age at three hour and lower in 40-42 weeks gestational age babies. Hawdon et al observed that the mean blood glucose levels were low in babies born pre term compared to the term babies.[25] Kayiran et al also reported more incidence of hypoglycemia in pre-term babies compared to term babies.[5] He noted that as the gestational age increased, the blood glucose also increase giving a positive correlation between gestational age and mean blood glucose levels. But this held true till term babies and later the mean blood glucose levels again shown decreasing trend as the gestational age further increased beyond the term gestation.[5]

In the present study the range for pre-term babies of the blood glucose was 27-140 mg/dl; for term babies it ranged from 32-120 mg/dl and for post term babies it ranged from 32-72 mg/dl. Thus the range was narrow for post term babies compared to term babies and pre-term babies. Hawdon et al also gave similar results based on their study that for pre-term babies of the blood glucose was 27-219.6 mg/dl; for term babies it ranged from 27-111.6 mg/dl.25

In the present study, the incidence of hypoglycemia was 17% at birth which reduced to 11% three hours to seven percent at six hours and one percent at 12 and 24 hours. This reduction was due to some babies who got corrected on their own and some became normal after treatment. The incidence of hypoglycemia was 15.15% carried out at Tehran children's hospital of Iran.[26] It was 10% in a study which was done in Philadelphia.[27] Study at Kilifi district hospital in Kenya found an incidence of 23% which is more than that we found in the present study.[28]

We observed that the signs of hypoglycemia were seen in 9% of the cases at birth which decreased to 7% at three hours of birth and further reduced to 6% at six hours and

again decreased to 1% at 12 and 24 hours of birth. Haworth et al enlisted few major signs of hypoglycemia in their study such as apnea, cyanosis, irritability, lethargy, muscular twitching, convulsions, poor sucking and disappearance of grasp and other reflexes.[29]

The limitations of the present study are that it has a small sample size hence results should be read with caution. But we tried to include maximum number given the limited time period and resources. Glucometer which was used which may be one more limitation but to overcome it, we standardized it as per the standard guidelines.

CONCLUSION

There was a wide variation of blood glucose levels in newborns. Preterm and post-term babies, babies delivered by LSCS, LGA and SGA babies were more prone for hypoglycemia requiring blood glucose monitoring.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Koh THHS, Green AA, Tarbit M, Eyre JA. Neuronal dysfunction during hypoglycaemia. Arch Dis Child. 1988;63(11):1353-58.
2. Cornblath M, Schwartz R, Green AA, Lloyd JK. Hypoglycaemia in infancy: the need for a rational definition (Ciba Foundation Discussion Meeting). Pediatr. 1990;85(5):834-7.
3. Kalhan S, Parimi P. Gluconeogenesis in the fetus and neonate. Semin Perinatol. 2000;24(2):94-106.
4. Kramer MS, Platt RW, Wen SW, Joseph KS, Allen A, Abrahamowicz M, et al. A new and improved population-based Canadian reference for birth weight for gestational age. Pediatr. 2001;108(2):35.
5. Kayiran SM, Gurakan B. Screening of blood glucose levels in healthy neonates. Singapore Med J. 2010;51(11):853.
6. Schaefer MGU, Rossi R, Buhrer CSG, Kjos SL, Dudenhausen JW, Vetter K. Rate and risk factors of hypoglycaemia in large for gestational age newborn infants of non-diabetic mothers. Am J Obstet Gynecol. 2002;187(4):913-7.
7. Cole MD, Peevy K. Hypoglycaemia in normal neonates appropriate for gestational age. J Perinatol. 1994;14(2):118-20.
8. Heck LJ, Erenberg A. Serum glucose levels in term neonates during the first 48 hours of life. J Pediatr. 1987;110(1):119-22.
9. Wilker RE. Hypoglycaemia and Hyperglycaemia. In: Cloherty JP, Eichenwald EC, Stark AR, eds. Manual of Neonatal Care. 6th ed. Philadelphia: Wolters Kluwer; 2008: 540-9.
10. Sexson WR. Incidence of neonatal hypoglycaemia: a matter of definition. J Pediatr. 1984;105(1):149-50.
11. Cornblath M. Neonatal hypoglycaemia 30 years later: does it injure the brain? Historical summary and present challenges. Acta Pediatr. 1997;39:7-11.
12. Hawdon J. Disorders of blood glucose homeostasis in the neonate. In: Rennie JM, ed. Robertson's Textbook of Neonatology. 4th ed. Edinburgh: Churchill Livingstone; 2005: 851-8.
13. Zoe T, Marian S, Philip A. Brain imaging in neonatal hypoglycaemia. Arch Dis Child Fetal Neonatal Ed. 1998;79(2):145-7.
14. Ashish J, Rajiv A, Jeevashanker M, Ramesh A, Ashok KD, Vinod KP. Hypoglycaemia in the Newborn AIIMS- NICU. Indian J Pediatr. 2008;75:63-7.
15. Dorina R, Valentin B, Doina T. Neonatal Hypoglycaemia. The incidence of the risk factors in Salvator Vuia Obstetrics Gynecology hospital, ARAD. TMJ. 2009;59:77-80.
16. Koh THHG, Eyre JA, Green AA. Neonatal hypoglycaemia: the controversy regarding definition. Arch Dis Child. 1988;63(11):1386-98.
17. Hoseth E, Joergensen A, Ebbensen F, Moeller M. Blood glucose levels in a population of healthy breast fed term infants of appropriate size for gestational age. Arch Dis Child Fetal Neonatal Ed. 2000;83(2):117-9.
18. Diwakar KK, Sasidhar MV. Plasma glucose levels in term infants who are appropriate size for gestation and exclusively breastfed. Arch Dis Fetal Neonat. 2002;87(1):46-8.
19. Lineus H, Rulina S, Taralan T. Blood glucose levels in healthy, term, appropriate for gestational age, exclusively breastfed infants. Paediatrica Indonesiana 2005;45(1):1-2.
20. Stark J, Simma B, Blassnig-Ezeh A. Incidence of hypoglycemia in newborn infants identified as at risk. J Matern Fetal Neonatal Med. 2020;33(18):3091-6.
21. Singhi S. Effect of maternal intrapartum glucose therapy on neonatal blood glucose levels and neurobehavioral status of hypoglycaemic term newborn infants. J Perinat Med. 1988;16(3):217-24.
22. Curet LB, Izquierdo LA, Gilson GJ, Schneider JM, Perelman R, Converse J. Relative effects of ante partum and intrapartum maternal blood glucose levels on incidence of neonatal hypoglycaemia. J Perinatol. 1997;17(2):113-5.
23. Mendiola J, Grylack LJ, Scanlon JW. Effects of intrapartum maternal glucose infusion on the normal fetus and newborn. Anesth Analg. 1982;61(1):32-5.
24. Cornblath M, Ichord R. Hypoglycaemia in the neonate. Semin Perinatol. 2000;24(2):136-42.
25. Dashti N, Einollahi N, Abbasi S. Neonatal hypoglycaemia prevalence and clinical manifestation in Tehran children's hospital. Pak J Med Sci. 2007;23(3):340-3.

26. Hawdon JM, Ward Platt MP, Green AA. Patterns of metabolic adaptation for preterm and term infants in the first neonatal week. Arch Dis Child. 1992;67:357-65.
27. Lubchenco LO, Bard H. Incidence of hypoglycaemia in newborn infants classified by birth weight and gestational age. Pediatr. 1971;47(5):831-8.
28. Osier J, Berkley A, Ross F, Sanderson S, Mohammed C. Abnormal blood glucose concentrations on admission to a rural Kenyan district hospital: prevalence and outcome. Arch Dis Child. 2003;88(7):621-5.
29. World Health Organization. Hypoglycaemia of the newborn. Review of the literature. Geneva: World Health Organization; 1997. Available at: https://www.who.int/maternal_child_adolescent/documents/chd_97_1/en. Accessed on: 27 August 2011.

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