Paediatrica Indonesiana

VOLUME 48 July • 2008 NUMBER 4

Original Article

Comparison of blood glucose level between breast-fed and formula-fed term babies

Omar Sazali Aldy, Bugis M Lubis, Pertin Sianturi, Emil Azlin, Guslihan D. Tjipta

Abstract

Background Hypoglycemia is common in newborns in the first few hours after birth. This may also occur in term babies. Data of hypoglycemia in breastfed and formula-fed infants have been limited.

Objective To compare blood glucose levels between breast-fed and formula-fed healthy term babies at 1, 24 and 48 hours of life.

Methods A cross sectional study was performed on 32 neonates between January and March 2007 in the Dr. Pirngadi Hospital. The subjects was classified into two groups, the breastfed and formula-fed groups. Blood glucose level was examined at 1, 24, and 48 hours after birth and level of less than 2.6 mmol/l defined the presence of hypoglycemia.

Results There was statistically significant difference in mean blood glucose level at 1 hour of life between breastfed [59.25 (SD 3.38) mg/dl] and formula-fed infants [55.96 (SD 8.60) mg/dl], (P=0.049), while no significant difference was found after 24 hours of life, i.e., 62.59 (SD 3.57) mg/dl vs. 61.21 (SD 6.87) mg/dl, P=0.319 and also after 48 hours of life, i.e., 67.34 (SD 5.18) mg/dl vs. 66.75 (SD 7.76) mg/dl, P=0.720.

Conclusion The blood glucose level at one hour after birth was significantly different in breastfed compared to formula-fed infants, while no statistically significant difference was found at 24 hours and 48 hours after birth. The mean blood glucose at 24 hours of life was lower than that of 48 hours after birth **[Paediatr Indones 2008;48:209-13]**.

Keywords*: hypoglycemia, blood glucose concentration, breastfed, formula-fed, infants.*

Glucose is an important metabolic fuel for human body mainly the brain. Hypoglycemia is common in newborns, especially in the first day of life, which isusually asymptomatic and consequently difficult to recognize.[1,2] Breastmilk is naturally designed for feeding of the newborns up to the age of 6 months. In the first few hours and days of life, the breasts start to produce and release milk in response to changes in the hormonal milieu and stimulus of the infant's suckling.[3]

Physiologically the glucose levels are lowest in the first two to three hours after birth. Full-term infants can have blood glucose concentrations as low as 55–60 mg/dl in the two to four hours of life, and then rise to 70–80 mg/dl after 72 hours.[4,5] Low blood glucose concentration can occur in day two to three after birth in breastfed full-term infants.[6] Costello *et al*[7] report that blood glucose and ketones rise along with age in 0–48 hours of life.

Heck and Erenberg[8] report low blood glucose concentration in formula-fed babies than that of the breastfed ones. Hawdon *et al*[9] state that in the first

From the Department of Child Health, Medical School, North Sumatera University, Haji Adam Malik Hospital, Medan, Indonesia.

Reprint request to: Omar Sazali Aldy, MD, Department of Child Health, Medical School, North Sumatera University, H.Adam Malik, Medan. Bunga Lau No.17, Medan, Indonesia. Tel.62-61-8361721/8365663. Fax. 62-61-8361721.

week of life, breastfed infants have low blood glocose concentrations compared with that of formula-fed, but the they had higher ketone level at day two and three. We aimed to evaluate blood glucose concentration of healthy full term breastfed infants compared to that of formula-fed ones at 1, 24, and 48 hours of life.

Methods

This cross sectional study was done in January until March 2007 in Pirngadi Hospital, Medan. Parental informed consent from all subjects and ethical approval from Research Ethics Committee, Medical Faculty of North Sumatera were obtained. All infants born at Dr. Pirngadi Hospital during the study period were examined for blood glucose concentrations at 1, 24 and 48 hours after birth. According to feeding practice applied by the mothers, subjects were classified into two groups, breastfed and formula-fed. Capillary blood samples were examined for blood glucose level using a glucometer (Glucotrend 2®) by experienced medical personnel.

We included healthy, full-term (gestational age of 37–42 weeks) newborns with birth weight of 2550–4600 grams, had Apgar score at first and five minute of more than 7and 8, respectively, and without history of maternal diabetes mellitus. A full-term infant was defined as an infant delivered at gestational age of 37 to 42 weeks. Blood glucose concentration was measured from capillary blood taken by heel prick method. Hypoglycemia was defined as blood glucose concentration below 2.6 mmol/l for term babies.

The minimum sample size were 32 infants for each group. Data and statistical analysis were performed using SPSS 15.0 for Windows. We used chi square and t-independent tests to analyze association between variables. A P of <0.05 was considered as statistically significant.

Results

During this study, there were 64 infants classified into 2 groups, the breastfed and formula-fed groups (**data not shown**). All infants completed the study and analyzed.

Baseline characteristics of study subjects are shown on **Table 1**. Both groups had comparable characteristics.

Table 2 shows mean blood glucose concentration at 1, 24, and 48 hours after birth in both groups. There was statistically significant difference between breastfed infants compared with formula-fed ones in blood glucose level at one hour after birth, but no significant differences in blood glucose levels at 24 and 48 hours of life between both groups.

Distribution of blood glucose level at one hour after birth in breastfed and formula groups is shown in the box plot below (**Figure 1**). There was a statistically significant difference between groups at one hour after birth ($P = 0.005$)

Distribution of blood glucose level at 24 and 48 hours after birth in both groups shown at **Figures 2** and **3**. There were no significant differences in blood glucose levels at 24 and 48 hours of life between both groups ($P = 0.319$ and 0.72, respectively).

Discussion

Exclusively breastfed healthy term infants rarely have asymptomatic hypoglycemia. This fact was supported by World of Health Organization reporting

Table 1. Baseline characteristics of study subjects

Characteristics	Group	
	Breastfed (n= 32)	Formula- fed (n= 32)
Sex		
Boy	13	14
Girl	19	18
Birth weight (Grams)		
Mean (SD)	3259 (408.6)	3178 (294.2)
Mother's age (year)		
Mean (SD)	30 (6.5)	31 (6.1)
APGAR score		
9	9	16
10	23	16

Table 2. Mean blood glucose level atin both groups

Age (hours)	Breastfed Mean (SD) mg/dl	Formula-fed Mean (SD) mg/dl	P
1 hour	59.3 (3.38)	55.9 (8.60)	0.049
24 hours	62.6 (3.57)	61.2 (6.87)	0.319
48 hours	67.3 (5.18)	66.7 (7.76)	0.720

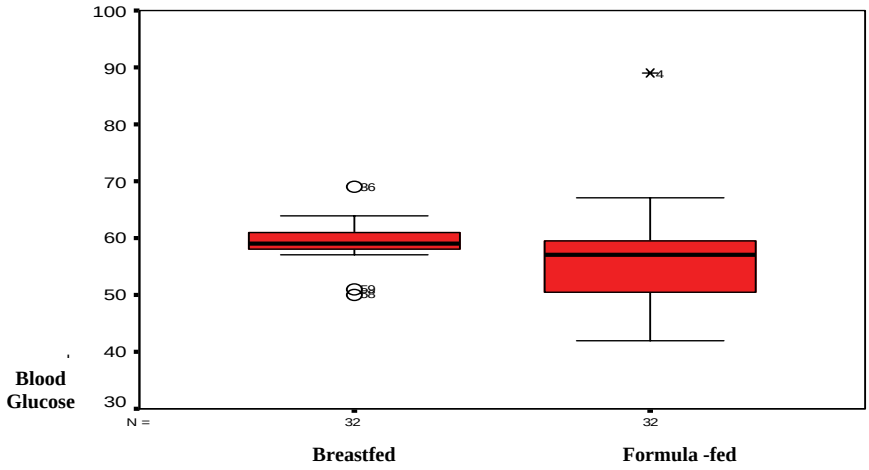

Figure 1. Box plot of blood glucose level at one hour of life in breastfed and formula-fed infants

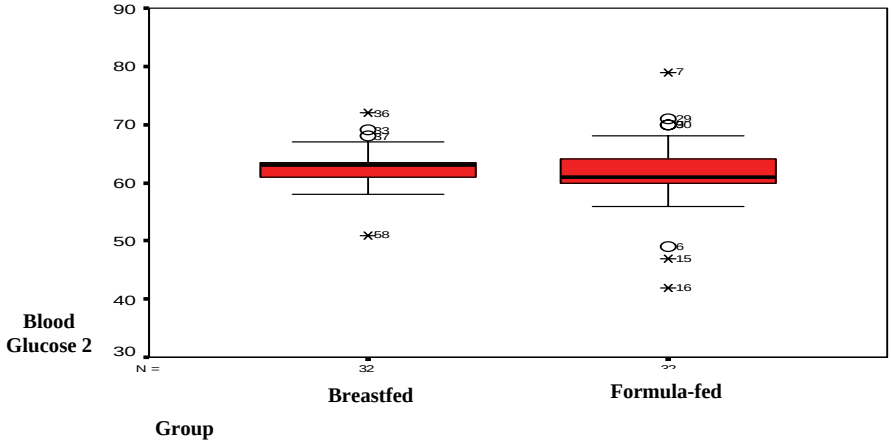

Figure 2. Box plot of blood glucose levels at 24 hours after birth

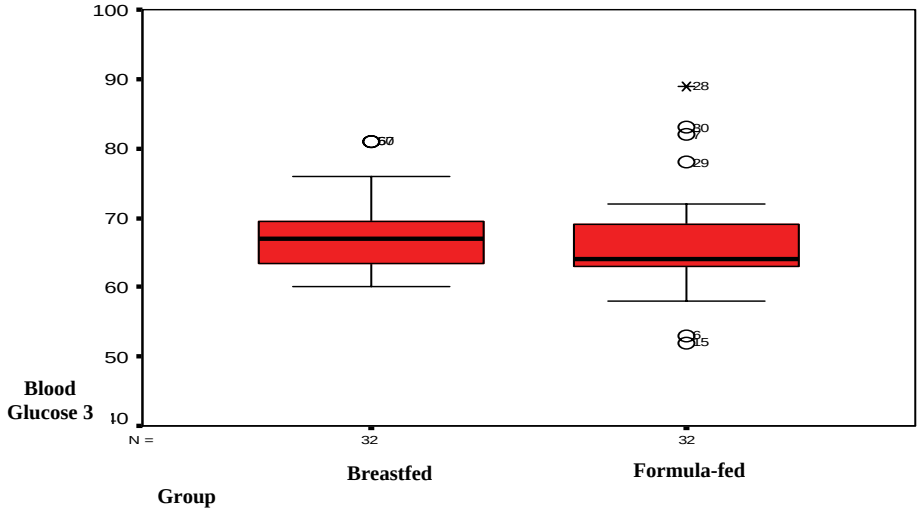

Figure 3. Box plot of blood glucose levels at 48 hours after birth in both groups

that exclusively breastfed term infant would not have symptomatic hypoglycemia.[10] In this study, no breastfed term infants showed signs of symptomatic hypoglycemia. In this study, the meanblood glucose level at one hour after birth in breastfed group was higher than that of the formula group. Heck and Erenberg study[8], who longitudinally evaluated blood glucose levels on 64 breastfed and 50 formula-fed term infants during the first 48 hours of life, found that breastfed infants had higher blood glucose level compared with that of formula-fed infants at five to six hours of life. They suggested that this phenomenon probably resulted from slight "rebound" hypoglycemic effect due to greater intake of milk in formula feeding.[8]

Hoset *et al*[1] found that blood glucose concentration within the first 24 hours of life were significantly lower than those after 24 hours. In this study, blood glucose concentration at the first 24 hours of life were lower than that of 48 hours of life in both breastfed and formula-fed infants, which was different from those reported by Hawdon et al6 and Diwakar *et al*[11]. A study done in Nepal showed that 38% neonates had capillary blood glucose concentrations lower than 2.6 mmol/L during the first three days after birth Low blood glucose concentration were often found during the first three days of life in appropriate-for-gestational age term infants, especially in exclusively breastfed ones.[12]

Hawdon *et al*[6] found that blood glucose concentration at first week of life in breastfed group ranged between 1.5–5.3 mmol/l (27–5 mg/dl) with mean 3.6 mmol/l (65 mg/dl), meanwhile in formula-fed infants it ranged between 2.5–6.2 mmol/l (45–112 mg/dl) with mean 4 mmol/l (72 mg/dl). In healthy, normal term infants, although early enteral feeding is withheld, transient hypoglycemia is self-limited, as glucose levelspontaneously rise within two to three hours. Breastfed infants tend to have slightly lower glucose and higher ketone bodies than artificially fed infants.[13] This study found that mean blood glucose level at 48 hours after birth is 67.34 mg/dl in breastfed babies and 66.75 mg/dl in those given formula milk and the lowest mean blood glucose level was at one hour after birth.

Healthy full-term infants with normal obstetric history who do not shows clinical signs of hypoglycemia do not require monitoring of glucose concentration. Low blood glucose concentration in healthy neonates merely reflect normal processes of metabolic adaptation to extrauterine life.[14] A healthy term infant can maintain the blood glucose concentration through glycogenolysis and gluconeogenesis activated by counterregulatory hormones such as glucagon, cathecolamin, cortisol and growth hormone. If blood glucose concentration decrease, the adaptive response occurs by increasing blood flow to the brain and increasing alternative metabolite such as ketone bodies, fatty acid dan lactic acid as energy resources. Breastfed infantsresponds to low blood glucose concentration by increasing production of gluconeogenic substrates such as ketone bodies, lactate, pyruvate, and alanin. In second and third day of life, the breastfed infants had higher ketone bodies concentration than infants given formula milk.[9]

In conclusion, mean blood glucose level at one hour after birth in breastfed infants is significantly higher compared to that of formula-fed infants, but there are no significant differences at 24 and 48 hours after birth between both groups. The mean blood glucose concentration at 24 hours is lower than that of 48 hours after birth.

References

1. Hoseth E, Ebbesen F. Blood glucose levels in a population of healthy, breast fed, term infants of appropriate size for gestational age. Arch Dis Child Fetal Neonatal 2000;83:E117-9.
2. Ho HT, Yeung WKY, Young BWY. Evaluation of "point of care" devices in the measurement of low blood glucose in neonatal practice. Arch Dis Child Fetal Neonatal 2004;89: 356-9.
3. Lawrence RA, Lawrence RM. Physiology of lactation. In: Lawrence RA, Lawrence RM, editors. Breastfeeding: a guide for the medical profession. 6th ed. Philadelphia: Elsevier Mosby; 2005. p. 65-103.
4. Madiyono B. Hipoglikemia. In: Markum AH, Ismael S, Alatas H, editors. Buku ajar ilmu kesehatan anak. 1st ed. Jakarta: Balai Penerbit FKUI; 1991. p. 349-50.
5. Rooy L, Hawdon J. Nutritional factors that affect the postnatal metabolic adaptation of full–term small- and large–for–gestational–age infants. Pediatrics 2002;109:1-8.
6. Hawdon JM, Green AA. Disorders of blood glucose homoestasis in the neonate. In: Rennie MJ, Roberton CRN,

editors. Textbook neonatology. 3rd ed. Toronto: Churchill Livingstoneo; 1999. p. 939-56.
7. Costello AM, Manandhar DS. Neonatal hypoglicaemia in Nepal 2. Availability of alternative fuels. Arch Dis Child Fetal Neonatal 2000;82:F52-8.
8. Heck L.J, Erenberg A. Serum glucose levels in term neonates during the first 48 hours of life. J Pediatr 1987;110:119-22.
9. Hawdon JM, Platt MPW, Aynsley-green. A patterns of metabolic adaptation for preterm and term infants in the first neonatal week. Arch Dis Child 1992;67:357-65.
10. World Health Organization. Hypoglycemia of the newborn: review of the literature. Geneva: WHO; 1997.
11. Diwakar KK, Sasidhar MV. Plasma glucose level in term infants who are appropriate size for gestation and exclusively breast fed. Arch Dis Child Fetal Neonatal 2002;87:46-8.
12. Pal DK, Manandhar DS. Neonatal hypoglicaemia in Nepal 1. Prevalence and risk factors. Arch Dis Child Fetal Neonatal 2000;82:46-51.
13. Wight N, Marinelli KA. Guidelines for glucose monitoring and treatment of hypoglycemia in breastfed neonates. Breastfeeding medicine 2006;1 Suppl 1:178-84.
14. Cornblath M, Hawdon JM. Controversies regarding definition of neonatal hypoglycemia: suggested operational threshold. Pediatrics 2000;105:1141-5.