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 is usually asymptomatic and consequently difficult to recognize. 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.

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. Low blood glucose concentration can occur in day two to three after birth in breastfed full-term infants. Costello et al report that blood glucose and ketones rise along with age in 0–48 hours of life.

Heck and Erenberg report low blood glucose concentration in formula-fed babies than that of the breastfed ones. Hawdon et al state that in the first
week of life, breastfed infants have low blood glucose 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 7 and 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

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Table 1. Baseline characteristics of study subjects

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Breastfed (n= 32)</th>
<th>Formula-fed (n= 32)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boy</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>Girl</td>
<td>19</td>
<td>18</td>
</tr>
<tr>
<td>Birth weight (Grams) Mean (SD)</td>
<td>3259 (408.6)</td>
<td>3178 (294.2)</td>
</tr>
<tr>
<td>Mother’s age (year) Mean (SD)</td>
<td>30 (6.5)</td>
<td>31 (6.1)</td>
</tr>
<tr>
<td>APGAR score</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>9</td>
<td>16</td>
</tr>
<tr>
<td>10</td>
<td>23</td>
<td>16</td>
</tr>
</tbody>
</table>

Table 2. Mean blood glucose level atin both groups

<table>
<thead>
<tr>
<th>Age (hours)</th>
<th>Breastfed Mean (SD) mg/dl</th>
<th>Formula-fed Mean (SD) mg/dl</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 hour</td>
<td>59.3 (3.38)</td>
<td>55.9 (8.60)</td>
<td>0.049</td>
</tr>
<tr>
<td>24 hours</td>
<td>62.6 (3.57)</td>
<td>61.2 (6.87)</td>
<td>0.319</td>
</tr>
<tr>
<td>48 hours</td>
<td>67.3 (5.18)</td>
<td>66.7 (7.76)</td>
<td>0.720</td>
</tr>
</tbody>
</table>
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. In this study, no breastfed term infants showed signs of symptomatic hypoglycemia. In this study, the mean blood glucose level at one hour after birth in breastfed group was higher than that of the formula group. Heck and Erenberg study, 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.

Hose et al. 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 al and Diwakar et al. 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.

Hawdon et al. 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 levels spontaneously rise within two to three hours. Breastfed infants tend to have slightly lower glucose and higher ketone bodies than artificially fed infants. 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. A healthy term infant can maintain the blood glucose concentration through glycogenolysis and gluconeogenesis activated by counterregulatory hormones such as glucagon, catecholamin, 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 infants respond 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.

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

6. Hawdon JM, Green AA. Disorders of blood glucose homeostasis in the neonate. In: Rennie MJ, Robertson CRN,