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Ocurrence of Hyperglycemia and Hypoglycemia in Premature and Malnourished Premature Infants During Glucose Infusion in the First 48 Hours of Life*

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Since the infant's intake of food in the first two days is low, the necessary carbohydrates have to be supplied mainly from the stored glycogen which is usually only adequate for twelve hours.[7, 20] If the babies are premature or sick for some reason, the need for carbohydrates and calories becomes much more important. Since such babies cannot suck or cannot tolerate oral feeding they have to be fed intravenously.

The most important part of I. V. treatment is to find the proper solution which will meet the optimal fluid and calory requirement of these babies during the first two days of life.

It is known that small infants who receive glucose exceeding 6 mg/kg min develop hyperglycemia and because of this hyperosmolality they develop vascular complications and intracranial bleeding.[9, 12] Myers' study revealed that hyperglycemia may cause significant brain injury when asphyxia is superimposed.[17, 18] The immaturity of the premature infants expressed by their limited ability to tolerate parenteral glucose infusion puts them at risk of becoming hypreglycemic. To observe the occurrence of hyperglycemia and to avoid its complications a study was planned which permits comparison of the results of two different concentrations of glucose infusion in the premature infants.

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Materials and Methods

Five % and 10 % glucose solutions at 80 ml/kg/24 hrs were started intravenously within few hours after birth to 24 premature infants divided into two groups. Duration of perfusion was 48 hours. During this period the infants did not receive oral feeding.

Infants with conditions which may affect carbohydrate metabolism, like respiratory distress, anoxia etc., were not accepted to the study.

Twelve infants were premature by gestational age (range was between 30-37 weeks according to Dubowitz[13] scoring system) and the rest were malnourished prematures according to Lubchencho's[14] intrauterine growth chart. Weight range of the infants was between 1200 and 2200 g. Intravenous glucose was given by IVAC pump. Blood sugar determinations were carried out every four hours during the period of 48 hours by dextrostix method (Ames). For the definition of hypoglycemia and hyperglycemia under 20 mg/dl and over 125 mg/dl blood sugar levels were accepted respectively.

Results

In analyzing the results the 24 infants were divided into 4 groups shown in Table I.

TABLE I
FOUR INFANT GROUPS

Group 1-a	6 Premature infants	Received 5 % glucose
Group 1-b	6 Malnourished premature infants	Solution
Group 2-a	6 Premature infants	Received 10 % glucose
Group 2-b	6 Malnourished premature infants	Solution
Total	24 Cases	

Although there are many fluctuations in the blood sugar levels only one of the 6 prematures (group 1-a) had hypoglycemia during the infusion of 5 % glucose. This infant also had hyperglycemia before and after hypoglycemia; hyperglycemia was also noticed in four infants on 7 occasions during the study period in this group (Figure 1). Hypoglycemia was observed in 2 malnourished prematures (group 1-b) who also received glucose at 5 % concentration, however hyperglycemia was observed on 9 occasions in 3 infants (Figure 2.)

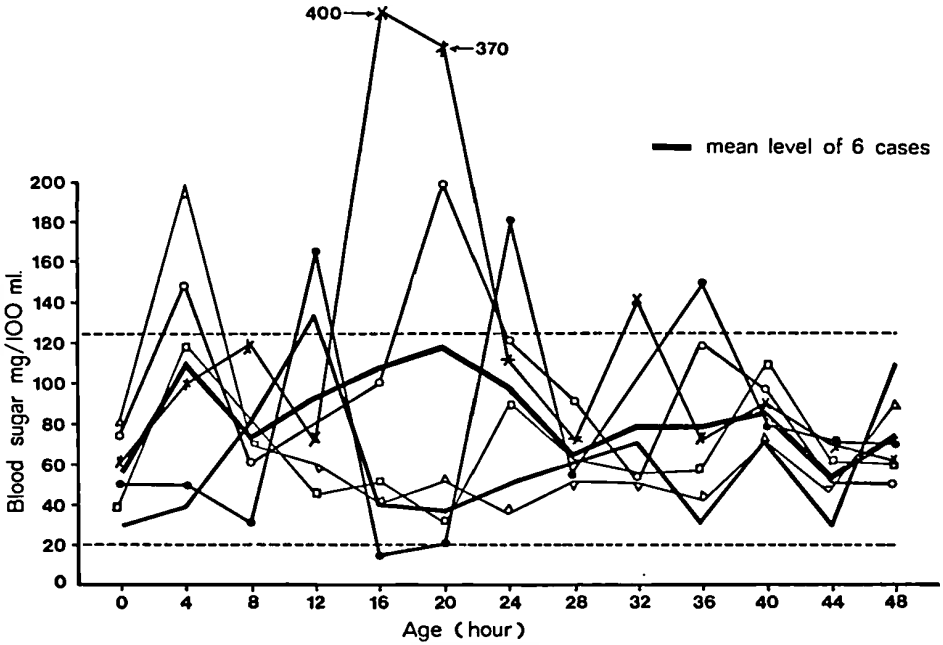

Figure 1
Blood sugar levels of premature infants who received 5 % glucose solution (group 1-a)

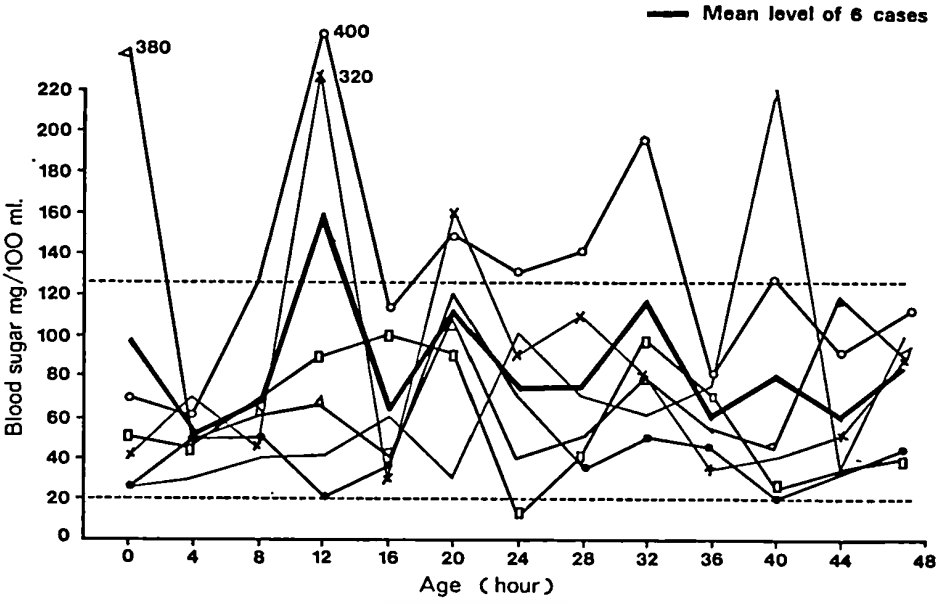

Figure 2
Blood sugar levels of malnourished premature infants who received glucose solution (group 1-b)

Therefore hypoglycemia was observed in 3 prematures on 5 occasions and hyperglycemia on 19 occasions in 8 children who were perfused with 5 % glucose.

It can be seen on Figure 3 that there were also fluctuations in the blood sugar levels of 6 prematures who received 10 % glucose perfusion. Although no hypoglycemia was detected, hyperglycemia was shown on 16 occasions in all six (group 2-a, Figure 3). Malnourished prematures who were also perfused with 10 % glucose solution showed hyperglycemia on 14 occasions in 5 babies; hypoglycemia was not observed in any of them. (Figure 4.)

In total hypoglycemia was not observed in any babies who were getting 10 % glucose, but hyperglycemia was detected in at least 11 subjects on 30 occasions.

Figure 5 shows the curves of the mean blood sugar levels of the 4 infant groups. It can be seen that the fewest fluctuations in the blood sugar levels were found in the premature infants who received 5 % glucose infusion (group 1-a). However, statistically there was no significant difference between these four groups.

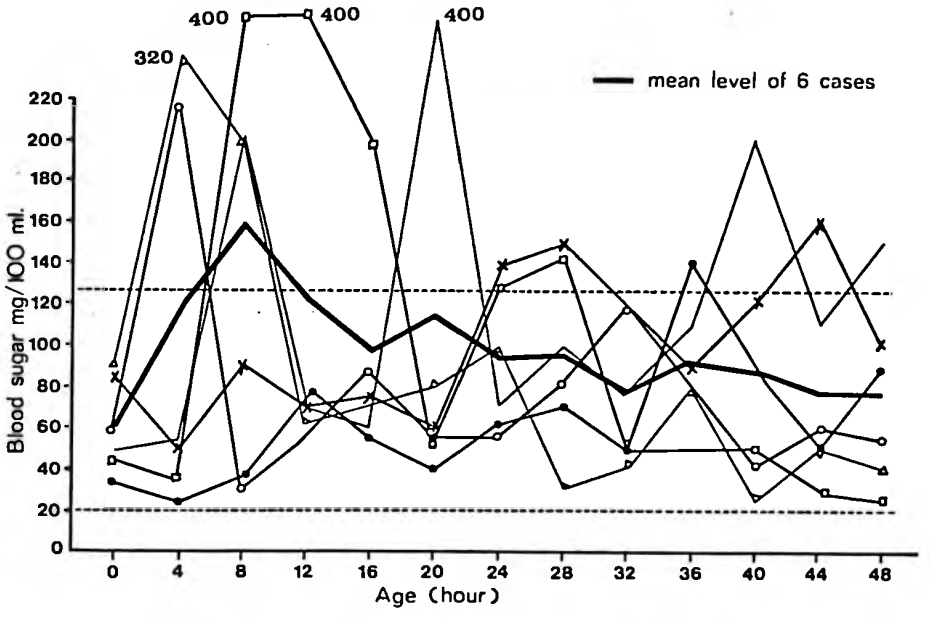

Figure 3

Blood sugar levels of premature infants who received 10 % glucose solution (Group 2-a)

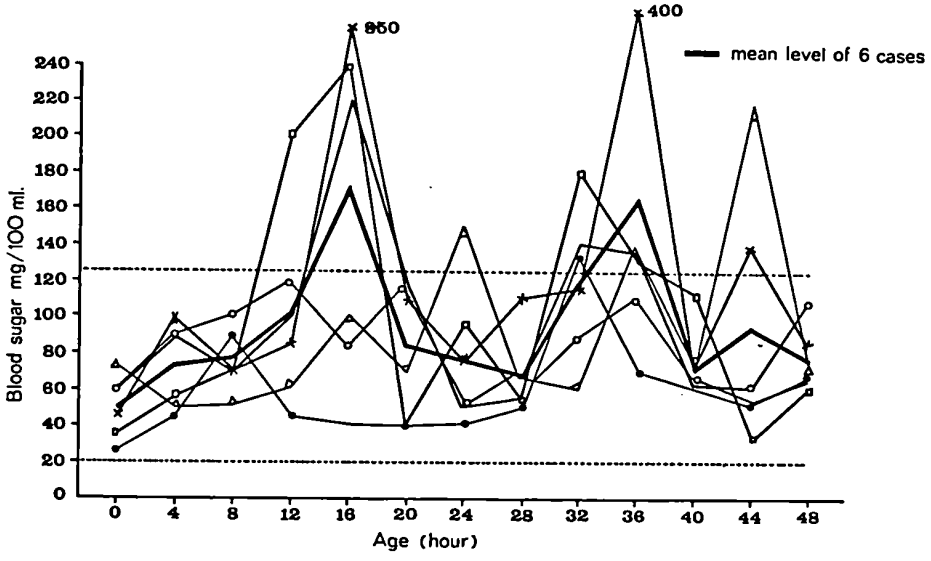

Figure 4
Blood sugar levels of malnourished premature infants who received 10 % glucose solution (Group 2-b)

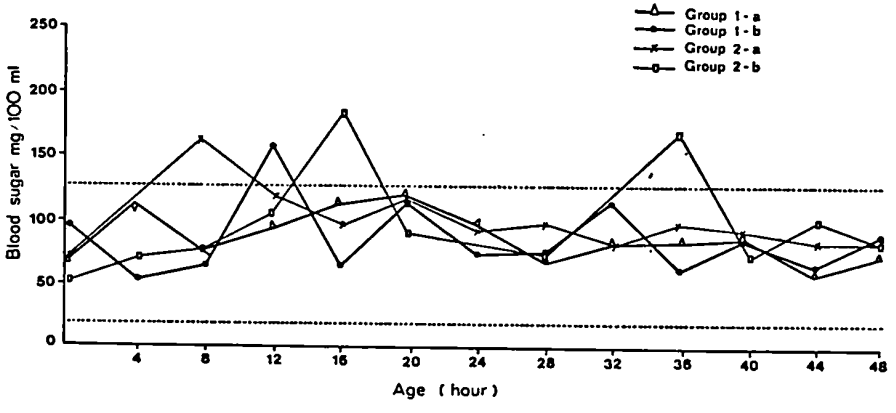

Figure 5
Mean blood sugar levels of the four infant groups

Discussion

Hyperglycemia from parenteral infusion of glucose is more likely to occur in the first 24 to 48 hours.[10, 22] Each 18 mg/dl of glucose results in an osmalal rise of 1 mOsm/liter.[12] Hyperosmolality accounts not only for osmotic diuresis which results in greater water loss, but may cause intracranial bleeding.[8, 12]

Under normal conditions basal hepatic glucose production rate is 6-8 mg/kg/min.[4]

A recent publication by Lilien[15] revealed that constant glucose infusion at the rate of 8 mg/kg/min was found to be useful for neonatal hypoglycemia.

Our infusion rate with 5 % glucose solution was approximately 3 mg/kg/min and with the 10 % glucose solution the rate was 6 mg/kg/min. In spite of that lower concentrations of glucose were used, hyperglycemia occurred during glucose infusions in both of the treated groups.

Pathogenesis of hyperglycemia in this vulnerable period is not very clear. Some studies suggest a diminished[10] or sluggish[3] insulin response in prematurely born infants, others[22] have reported significantly higher mean insulin values during hyperglycemia. An additional study[9] of six infants receiving glucose infusion at constant rate of 6 mg/kg/min during the first 48 hours after birth, were reported to have low mean insulin levels when compared with term infants and in response to higher glucose levels.[16] Insulin enhances glycogenesis by activation of glycogen synthetase[2] and depresses glycogenolysis by inhibiting phosphorylase activity.[5] Failure of this effect of insulin may be responsible for the occurrence of hyperglycemia in the preterm infants receiving parenteral glucose.[1, 16] In animal study, 5 term and 11 prematurely born rhesus monkeys were given an acute glucose load followed immediately by an 3 hour constant glucose infusion at rate of 8 mg/kg/min. While peak insulin levels were similar in all babies, 6 of the prematurely born developed hyperglycemia. The rate of endogenous hepatic glucose output was not suppressed by glucose stimulated insulin release as was found in the other 5 non hyperglycemic premature and 6 term monkeys.[19] Endogenous glucose production during glucose infusion was also shown in the newborn lamb.[6]

Decreased hepatic gluconeogenetic capacity is suggested by accumulation of gluconeogenic aminoacid precursors in hypoglycemic small for gestational age infants.[21]

From the present data the following conclusions can be drawn:

1. Although our glucose infusion rate was not higher them 6 mg/kg/min hyperglycemia occurred during glucose infusion in both of the treated groups.

2. Hypoglycemia was observed in the group receiving 5 % glucose infusion, there were no cases with hypoglycemia in the 10 % glucose infusion group.

3. Of the 4 infants' groups (Figure 5) the mean blood sugar levels in the premature infants who received 5 % glucose infusion revealed fewer fluctuations than the other three groups. Most fluctuations in the blood sugar levels were observed in the malnourished premature infants who received 10 % glucose infusion. From the above results, it seems that 5 % glucose infusion was more appropritate for premature infants during the first few days of the life.

During the first few days of the life a careful monitoring of blood sugar levels (by dextrostix screening) is necessary for not only for the occurrence of hypoglycemia but also for the occurrence of hyperglycemia during glucose infusion.

For the protection of infants from harmful effects of iatrogenic hyperosmolality by giving excess intravenous glucose infusion during the first few days of the life our early result need to be supported by repeating this study including a more quantitative method for the determination of blood sugar and corresponding insulin levels and urine and serum osmolality in small premature infants.

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