Original Article

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Effect of Birth Asphyxia on Serum Calcium and Glucose Level: A Prospective Study

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Abstract

Background: Birth asphyxia occipital sinus common cause of mortality and morbidity and associated with various metabolic changes like hypoglycemia and hypocalcemia, hyperkalemia, hyponatremia, hyperphosphatemia. We conducted this study to evaluate changes in serum glucose and serum calcium in birth asphyxia.

Objective: To study calcium and glucose levels in asphyxiated newborns of different severity in the early neonatal period and compare with controls.

Materials and Methods: Calcium, glucose were estimated in serum samples of asphyxiated newborns of different severity and control group at 24 h of age.

Results: The mean serum calcium level at 24 h of age is significantly lower (8.31 ± 0.48 mg/dl vs. 9.47 ± 0.49 mg/dl; $P < 0.001$), mean serum glucose level was significantly lower (54.4 ± 10.91 mg/dl vs. 76 ± 15.5 mg/dl; $P < 0.001$) in cases than control group. Among cases there was significant negative correlation of serum calcium level and severity of asphyxia ($P < 0.01$) while there was highly significant positive correlation of serum calcium with period of gestation (POG) and birth weight ($P < 0.01$). In the present study, there was a significant negative correlation of serum glucose level and severity of asphyxia($P < 0.01$) whereas highly significant positive correlation was there of serum glucose with POG and birth weight.

Conclusion: In the present study, it has been concluded that in birth asphyxia, there is highly significant fall in serum calcium and glucose as compared to controls and proportional to degree of asphyxia.

Key words: Apgar score, Birth asphyxia, Hypocalcemia, Hypoglycemia, Serum calcium, Serum glucose

INTRODUCTION

World Health Organization has defined birth asphyxia as "failure to initiate and sustain breathing at birth."

Perinatal asphyxia one of the most common primary cause of mortality (28.8%) and morbidity among neonates in India and is the commonest cause of stillbirths (45.1%). An Apgar score of <7 at 1 min and at 5 min respectively is seen in 8.4% and 2.45% cases in India.[1]

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The primary cause of this condition is systemic hypoxemia and/or reduced cerebral blood flow. Birth asphyxia causes 23% of all neonatal death worldwide.

Birth asphyxia is associated frequently with metabolic changes like hypoglycemia, hypocalcemia, hyponatremia, hyperphosphatemia and metabolic acidosis. Calcium is an important second messenger in our body and also helps out muscle function and acts as a co-factor for several enzymatic activities. During pregnancy, calcium is transferred actively from the maternal circulation to the fetus by a transplacental Ca pump regulated by the parathyroid hormone-related peptide. The majority of fetal Ca accretion occurs in the third trimester. This process results in higher plasma Ca concentration in fetus than in the mother and leads to fetal hypecalcemia with total and ionized Ca concentration of 10-11 mg/dl and 6 mg/dl in umbilical cord blood at term.[2]

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After birth due to the abrupt cessation of placental transfer of calcium hence, levels starts falling to 8-9 mg/dl and ionized calcium to 4.4-5.4 mg/dl at 24 h of age. Serum calcium then starts rising to reach levels comparable to older children and adults by 2 weeks of age.[3]

Glucose is an essential nutrient for the brain. Abnormally low level can cause encephalopathy and have the potential to produce long-term neurological injury. Serum glucose levels decline after birth until 1-3 h of age, when levels spontaneously increase in normal infants. In healthy term infants, serum glucose values are rarely <35 mg/dl between 1 and 3 h of life, <40 mg/dl from 3 to 24 h and <45 mg/dl after 24 h of life.[4] In birth asphyxia, hypoglycaemia is due to glycogen depletion secondary to catecholamine release and to an unexplained hyperinsulinemic state. An initial phase of hyperglycemia and hypoinsulinemia (5-10 min following an acute event due to a catecholamine surge which inhibits insulin release and stimulates glucagon release) may be followed within 2-3 h by profound hypoglycaemia.[5]

This study was undertaken to detect the incidence of hypocalcemia and hypoglycemia in asphyxiated babies as to prevent the adverse effects of these biochemical abnormalities in the newborns.

MATERIALS AND METHODS

The study was conducted on 100 newborns delivered in the obstetrics department and admitted to neonatology section of Department of Pediatrics, Government Medical College/Rajindra Hospital, and Patiala.

In a series of 135 newborns selected, 100 newborns were asphyxiated, and 35 served as control group. The study was approved by the Institutional Ethical Committee, and informed consent was obtained from the parents of each subject. In this study, 100 asphyxiated neonates (Apgar score at 1 min 7 or less) were taken as cases of study. 35 normal neonates (Apgar score at 1 min more than 7) were taken as control. Total serum calcium and serum glucose levels were determined at 24 h of life in all the newborns. Serum calcium was estimated by O-Cresolphthalein complex one end point (kit) method (Connerty and Briggs, 1966).[6] Blood glucose estimation was done by Asatoor and King Method.[7] Babies with congenital malformations, serum creatinine levels more than 1.5 mg/dl, suspected metabolic disease, treated with diuretics and those born to mothers having hypertension, diabetes mellitus, toxaemia of pregnancy were excluded from the study.

RESULTS

Of the 100 cases, 55 were male newborns and 45 were females, mean birth weight in the study group was 2405.70 ± 638.32 g. 36 newborns were delivered by normal vaginal delivery, 62 were lower segment caesarean section. The study group was comprised of 53 cases of mild birth asphyxia, 26 cases of moderate birth asphyxia and 21 cases of severe birth asphyxia.

In 35 control group, 18 were males and 17 newborns were female newborns, mean birth weight was 2624.28 ± 555.76 g respectively. 29 newborns were delivered by normal vaginal delivery, 6 were by lower segment caesarean section.

Statistical comparison of measured values between two groups were performed by the unpaired *t*-test of the means and ANOVA test of the groups. It was found that mean calcium levels in the study and control group were 8.31± 0.48 and 9.47 ± 0.49 mg/dl. The mean serum calcium level in the study group was lower as compared to control group, and statistical difference was highly significant ($P < 0.001$) as shown in Figure 1. In present study, mean calcium level of severely asphyxiated babies 7.96 ± 0.91 mg/dl was significantly lower than mean calcium level of mild and moderately asphyxiated babies 8.50 ± 0.50 mg/dl and 8.21 ± 0.38 mg/dl ($P < 0.05$), mean calcium level of moderately asphyxiated newborns were lower than mildly asphyxiated newborns ($P < 0.05$) as shown in Figure 2. This shows that calcium levels at 24 h of life is related to severity of asphyxia indicating that serum calcium has negative correlation with severity of asphyxia and highly significant positive correlation with period of gestation (POG) and birth weight as shown in Table 1.

In the present study, mean glucose levels of the study and control groups were 54.4 ± 10.91 and 76 ± 15.5 mg/dl. The mean serum glucose level in the study was lower as compared to control group, and the statistical difference was highly significant ($P < 0.001$) as shown in Figure 3. It was found that mean glucose level of severely asphyxiated babies 46.8 ± 4.58 mg/dl was significantly lower than

Table 1: Co-efficient of correlation between serum calcium and other parameters

Parameter	Coefficient of correlation	*P* value	Significance	Regression equation Y=a+bx
Serum calcium	-	-	-	-
Asphyxia	−0.45	<0.01	S	−0.39x+4.22
POG	+0.48	<0.01	HS	0.079x−5.40
Birth weight	0.47	<0.01	HS	0.0003x+7.469

POG: Period of gestation

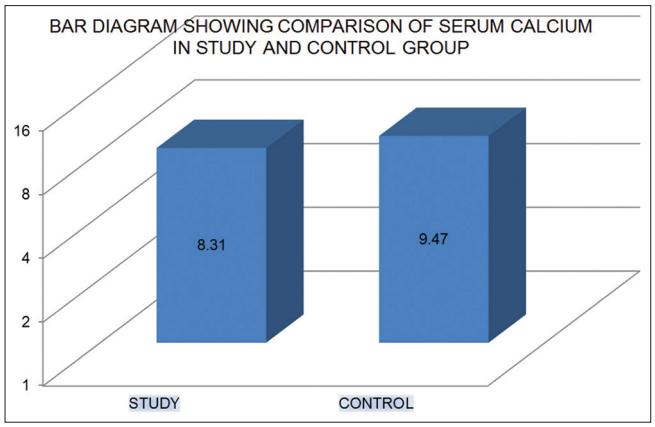

Figure 1: Serum calcium in study and control group

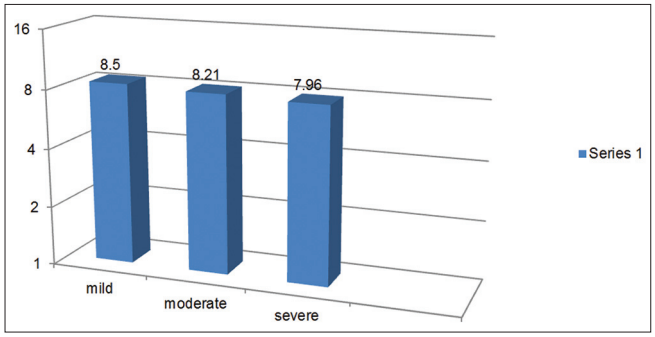

Figure 2: Serum calcium in study group according to severity of asphyxia

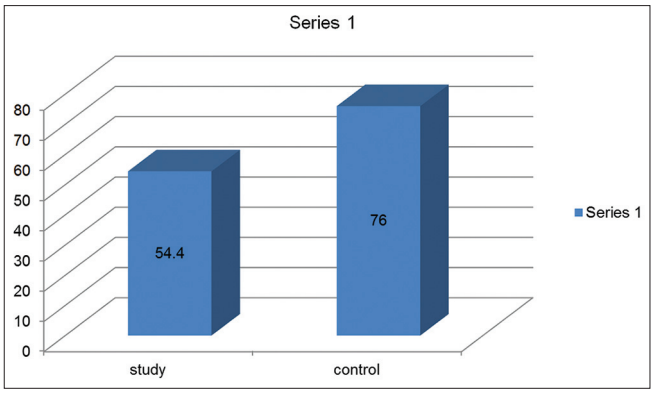

Figure 3: Glucose levels in study and control group

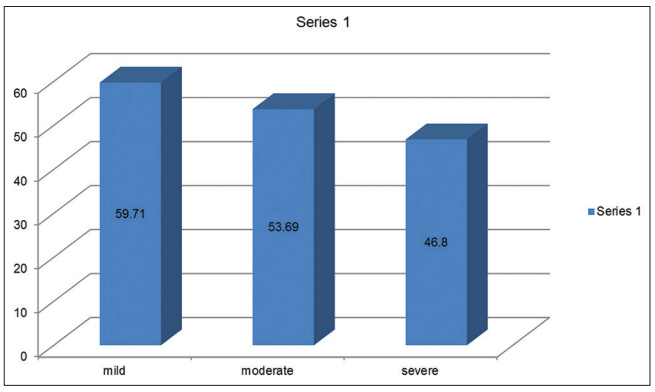

Figure 4: Glucose levels according to grades of asphyxia

mean glucose level of mild and moderately asphyxiated babies 59.71 ± 11.47 mg/dl and 53.69 ± 6.97 mg/dl ($P < 0.05$), mean glucose level of moderately asphyxiated newborns were lower than mildly asphyxiated newborns ($P < 0.05$). This shows that glucose levels at 24 h of life was inversely related to severity of asphyxia. ($P < 0.05$) as shown in Figure4. Serum glucose level had significant positive correlation with POG and birth weight ($P < 0.01$) and significant negative correlation with asphyxia as shown in Table 2.

Table 2: Co-efficient of correlation between serum glucose and other parameters

Parameters	Coefficient of correlation	*P* value	Significance	Regression equation Y=a+bx
Serum glucose	-	-	-	-
Asphyxia	−0.50	<0.01	S	−6.93x+67.58
POG	+0.40	<0.01	HS	1.56x−1.497
Birth weight	+0.35	<0.01	HS	0.006x+41.30

POG: Period of gestation

DISCUSSION

Perinatal asphyxia is a common neonatal problem and contributes significantly to neonatal mortality and morbidity. Hypoxic ischemic brain injury is the most important consequence of perinatal asphyxia.

Out of 100 cases, 44 babies had fetal asphyxia as well. Babies with Apgar score ≤7 were defined as asphyxiated and babies with Apgar score more than 7 constituted the control, group. All the neonates (both study group and control group) were subjected to determination of total serum calcium and glucose at 24 h of life. In the present study, it was found that there was a significant decrease in the extracellular calcium levels in the asphyxiated babies, and the decrease was directly proportional to the degree of asphyxia. This is similar to that reported by Manzke and Kruse who estimated total calcium and ionized calcium in asphyxiated as well as non-asphyxiated newborns and concluded that the decrease in the serum level of both the total calcium and the ionized calcium was more in asphyxiated newborns than non-asphyxiated newborns.[8] Jajoo *et al.* has also observed the high incidence of low serum calcium in asphyxiated infants.[9] According to a study conducted by Schedewie *et al.*, asphyxiated infants exhibited significantly low plasma calcium concentrations than their controls.[10] The present study shows that level of calcium at 24 h of life is related to severity of asphyxia indicating

that serum calcium has negative correlation with severity of asphyxia ($P < 0.01$) while there was highly significant positive correlation with POG and birth weight. This is in accordance with study by Mimouni *et al.* and Basu *et al.* who concluded that low serum calcium values were significantly associated with low gestational age and low Apgar score.[11,12]

In the present study, it was found that there was a significant decrease in the serum glucose in asphyxiated babies and decrease was directly proportional to the degree of asphyxia. This is similar to that observed by Xu *et al.* and Davis *et al.*, Xu *et al.* observed in their study, at day 1 of life, in asphyxiated neonates that temporary hyperinsulinism contributed to hypoglycaemia in these babies.[13] Davis *et al.* had also reported in their study that there was hypoglycaemia due to severe asphyxia.[14] Singhal *et al.* in their study concluded that out of 2/3 hypoglycemic babies, birth asphyxia contributed to 24.2% of cases.[15] The present study showed that there was significant negative correlation between serum glucose level and severity of asphyxia ($P < 0.01$) whereas highly significant positive correlation was there of serum glucose with POG and birth weight ($P < 0.01$).

CONCLUSION

It can be concluded from the present study that with perinatal asphyxia, develops hypocalcemia (when serum calcium levels <7 mg/dl) and hypoglycaemia (when serum glucose <40 mg/dl) after birth in proportion to severity of asphyxia and severely asphyxiated babies develop hypoglycaemia and hypocalcemia which may require medical intervention.

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