

A Study on the Correlation between Cord Blood Glucose Level and the Apgar Score

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ABSTRACT

Introduction: The study of the biochemical parameters of cord blood acts as a mirror, which usually reflects the neonatal status. The widely used system for the evaluation of a neonate is the Apgar score. There is no comprehensive published data which has established the association between the cord blood glucose level and the Apgar score. Similarly, there is also no well accepted reference range of the cord blood glucose level.

Objectives: The main objectives of the present study was to ascertain any adverse effects of an abnormal cord blood glucose level on the neonatal status and to find out a standard reference level of glucose in cord blood.

Methods: The cord blood glucose estimation was done by using the glucose oxidase peroxidase method and the statistical analysis was performed by using the SPSS, version 16 software.

Results and Conclusions: In the present study, the cord blood glucose level was found to have no correlation with the Apgar scores which were calculated at both one minute and five minutes after birth. It was also found that for the foetus to be free from any obvious complication, the cord blood glucose level had to be around 87 mg/dl. The fluctuations in the maternal glucose levels are weakly associated with the glucose level in the cord blood.

Key Words: Cord blood, Glucose level, Apgar score, Neonatal status

INTRODUCTION

Each year, out of 130 million newborn infants who are born globally, about four million die in the first four weeks of life, that is the neonatal period. The developing countries report 99% of such neonatal deaths. While globally, there has been a dramatic reduction in the under-five years mortality in the past two decades, there has been relatively little change in the newborn mortality [1, 2].

The study of the biochemical parameters of cord blood act as a mirror, which usually reflects the neonatal status. The measurement of lactate in the cord blood of neonates is helpful in the assessment of foetal distress [3]. The cord blood leptin and adiponectin act as the predictors of adiposity in children. The detection of certain infections can also be done in the cord blood samples [4, 5].

The widely accepted system for the evaluation of the status of a newborn infant is the Apgar score [6-8].

A significant correlation coefficient has been reported between the foetal pH and the Apgar score and also between the umbilical artery blood glucose level and the foetal pH [9]. But even after a diligent search, no effort was noticeable in the published literature which was made in trying to establish the association between the cord blood glucose level and the Apgar score. Furthermore, as yet, there is no accepted normal reference range of the cord blood glucose level.

The present study was undertaken to find out whether any correlation existed between the cord blood glucose level and the Apgar score and to try to ascertain the standard reference range of the glucose level in cord blood.

MATERIALS AND METHODS

The present analytical, observational study was carried out on 125 randomly selected cord blood samples during a period of two months, in a tertiary-care hospital. The period of gestation was conventionally calculated from the Last Menstrual Period (LMP) with the help of Naegeles' formula and details of the maternal blood pressure, the haemoglobin concentration and the blood glucose level were collected.

Each patient was randomly selected. The clinical conditions of the selected patients were carefully monitored throughout all the stages of labour. 2 ml of fresh blood from the umbilical cord of the patients was collected in test tubes which contained adequate amounts of sodium fluoride after their deliveries at the labour room or the operation theatre [Table/Fig-1]. The cord blood glucose estimation was done by using the standard Glucose Oxidase Peroxidase (GOD-POD) method with commercially available reagents and colourimetric readings were taken at the 540 nm wave length [Table/Fig-2].

The condition of the foetuses was also monitored during and after the deliveries and the detailed data regarding the modes of delivery, the gender of the babies, foetal distress, and the birth weight of the babies, were recorded. The Apgar scores of the neonates at one minute and five minutes after their birth were assessed and recorded. Both the mother and the neonate in every case were followed up for the possible complications till their discharge from the hospital.

The statistical analysis was done with the help of the SPSS software, version 16.0. The Student's t-test, Pearson's correlation and ROC curves were used to analyze the data which was obtained.



[Table/Fig-1]: Collection of cord blood during Caesarian Section



[Table/Fig-2]: Workstation for Cord blood glucose estimation using glucose oxidase peroxidase (GOD-POD) method

RESULTS

The mean age of the study population was 22.8 years \pm 3.45(SD) (range 17 to 35 years). The mean haemoglobin concentration in the maternal blood was 10.1gm% \pm 1.75 (SD) with a minimum value of 6.1 gm% and a maximum value of 14.5 gm%. The mean systolic and diastolic blood pressures of the study population were 129 mm of Hg \pm 15.358 (SD) (range 186 to 100 mm Hg) and 83 \pm 12.092 mm Hg (range 120 to 50mm of Hg) respectively. 52% of the study population were primigravida and 48% were multigravida.

The mean blood glucose level (random) in the maternal blood was 86.17 mg/dl \pm 10.87 (SD) (range 132 to 69 mg/dl). Most of the births took place by vaginal deliveries (VDs) (65.6%). The vaginal deliveries included spontaneous vaginal deliveries, vaginal deliveries with episiotomies and VDs with tears. In 33.6% (42) cases, a Lower Uterine Caesarean Section (LUCS) was performed. In 1 case (0.8%), an assisted breech delivery was undertaken.

The mean birth weight of the neonates was 2.66 kg \pm 0.486 (SD) (range 1.49 to 4.22 kg). The mean foetal maturity, that is gestational

age, at birth, was found to be 36.35 weeks \pm 2.4 (SD) (range 42 to 28 weeks).

The cord blood glucose level had a mean value of 90.46 mg/dl \pm 20.73 (SD)(range 50 to 142mg/dl).

The mean Apgar scores after 1 minute and 5 minutes of birth were found to be 4.79 \pm 1.39 (SD) (range 7 to 1) and 6.90 \pm 1.65 (SD) (range 10 to 1) respectively. At 1 minute of birth, only 2.4% of the neonates had an Apgar score of 7, which was the cut off value for considering the infants as normal. 36.8% and 26.4% of the neonates had Apgar scores of 6 and 5 respectively. 3.2% had the lowest possible value of 1. At 5 minutes of birth, 68% of the newborns had Apgar scores of 7 or above, of which 37.6% had a score of 8. Apgar scores which were as high as 10 (0.8%) and as low as 1(3.2%) were also found [Table/Fig-3].

Among the 125 neonates which were studied, 36 (28.8%) had acute or chronic foetal distress which was identified by the meconium stained liquor and the foetal bradycardia.

Parameters	No. of cases	Minimum	Maximum	Mean	Std. Error	Std. Deviation
Age (years)	125	17	35	22.80	0.309	3.457
Hemoglobin %	125	6.1	14.5	10.11	0.157	1.759
Systolic Blood Pressure (mm of Hg)	125	100	186	129.55	1.374	15.358
Diastolic Blood Pressure (mm of Hg)	125	50	120	83.17	1.082	12.092
Blood sugar (mg/dl)	125	69	132	86.17	0.973	10.875
Birth weight (kg)	125	1.490	4.220	2.66	0.043	0.485
Fetal maturity (weeks)	125	28	42	36.35	0.215	2.400
Cord blood glucose level (mg/dl)	125	50	142	90.46	1.855	20.735
Apgar score at 1 minute	125	1	7	4.79	0.125	1.393
Apgar score at 5minutes	125	1	10	6.90	0.148	1.650

[Table/Fig-3]: Descriptive Statistics

Category of Apgar Score	No. of cases	Mean cord blood glucose	Standard deviation	t-test for Equality of Means		
				Significance (2-tailed)	Mean Difference	Standard error of difference
1 (Apgar Score \leq 6)	40	89.98	22.619	0.862	- 0.696	3.991
2 (Apgar Score \geq 7)	85	90.68	19.924	0.868	- 0.696	4.179

[Table/Fig-4]: Correlation between cord blood glucose level and Apgar score
Correlation is significant at the 0.01 level (2-tailed).

Based on the Apgar score at 5 min. the neonates were categorized into two groups, those with an Apgar score of 6 or below and those with an Apgar score of 7 or above. The independent t-test for the equality of the means, which was applied, showed almost no difference in the mean cord blood glucose level between these two groups. Similarly, the Apgar score at 1 min. of birth also showed no statistical significance. Thus, in this study, no correlation was found between these two parameters [Table/Fig-4].

The foetal maturity showed no correlation with the cord blood glucose level, as the Pearson's co-efficient was much less than zero ($r = \text{minus } 0.029$). The birth weights of the babies also had an r -value of minus 0.075, which excluded any positive correlation with the cord blood glucose levels.

Although the maternal age showed no correlation with the cord blood glucose level (r -value = minus 0.032), the maternal blood glucose level revealed a weak correlation with the cord blood glucose level (Pearson's co-efficient = 0.33).

In the standard ROC curves of the cord blood glucose level against foetal distress and the cord blood glucose level against the Apgar score at 5 minutes in the mentioned coordinates, the sensitivity and the specificity were close to each other maximally, at the point where the cord blood glucose levels were 87.20 and 86.28 mg/dl respectively.

So, from the above two curves, it was evident that the cord blood glucose level of a neonate must be around 87 mg/dl, in order to be free from any distress.

DISCUSSION

Though maternal age is an important and independent risk factor for an adverse pregnancy outcome [10], no significant change was found in the level of the cord blood glucose with an increase in the maternal age. After a thorough search on this topic, no established literature which showed the effect of the maternal age on the cord blood glucose level was found.

In this study, no correlation was also found between the cord blood glucose level and the maternal parity, blood pressure, birth weight of the baby or the mode of delivery, which mostly corroborated with the published data. However, in 2010, Marom R et al reported that the glucose concentrations in infants who were born by vaginal deliveries were higher than in the infants who were born by elective caesarean sections without labour; but no scientific explanation was provided [11].

The present study showed that whatever may be the mode of delivery, the cord blood glucose level remains unaltered. Hence, it appears that the stress of labour or surgery and the influence of anaesthetic agents do not affect the glucose level in cord blood. However, this needs further studies to arrive at a scientific conclusion and to provide a valid reason for the same.

Sogbanmu and colleagues [9] reported a correlation coefficient of 0.08 between the umbilical artery blood glucose and the foetal pH. The estimation of the pH of the blood which is taken from the foetal scalp has now been well established as a diagnostic measure in the early diagnosis of the foetal distress which is caused by hypoxia. But no direct correlation was found between the cord blood glucose level and the foetal distress which was caused by hypoxia, which corroborated with the findings of the present study.

The mean value of the maternal blood sugar level among the study population was found to be 86.17 ± 10.875 (SD) mg/dl, which was

weakly associated with the fluctuations in the cord blood.

Out of 125 newborns, 41.1 % had low birth weight (defined as the weight of the baby, which was <2.5 kg just after birth), which was more than the national average of 26%.

In the present study, the incidence of low Apgar Scores (<7) at 5 minutes was found to be 32 % in comparison to that of 97.6 % at 1 minute, which showed that after a proper medical intervention, most of the babies had improved within 5 minutes. But no statistically significant correlation was found between the cord blood glucose level and the Apgar score. The difference of the mean between the neonates who had low and high Apgar scores was just 0.7 and so the level of glucose hardly varied with low or high Apgar scores.

Although researches have been carried out to find the correlation between the Apgar score and other substances which are present in cord blood, no published literature has shown the correlation between the cord blood glucose level and the Apgar score.

36 babies (28.8 %) suffered from foetal distress among the 125 cases and the cord blood glucose level was found to be higher (around 92 mg/dl) in those babies. So, it appeared that the neonates who had comparatively high levels of glucose in their umbilical cord blood were likely to suffer from foetal distress, though the exact reason behind this could not be established. Most probably, other confounding factors were responsible for such a correlation and further studies are required for the establishment of the same.

CONCLUSION AND RECOMMENDATIONS

The present study arrived at the following conclusions:

1. The mean glucose level in the cord blood of the neonates of the study population was found to be 90.46 ± 20.735 (SD) mg/dl.
2. 97% of the newborns had Apgar scores of <7 at 1 min, which had reduced to 32% at 5 min. after proper medical interventions.
3. The glucose level in the cord blood had no correlation with the Apgar scores which were calculated at 1 minute and 5 minutes.
4. The glucose level in the cord blood of neonates must be around 87 mg/dl in order for them to be free from any obvious complications and the fluctuations in the maternal glucose level are weakly associated with the glucose level in cord blood.

The following are the recommendations of the present study:

1. Multicentric studies with more number of cases should be undertaken for the validation of the normal cord blood glucose level.
2. The correlation between the cord blood glucose level and the Apgar score, as well as, with other cord blood biochemical parameters like the foetal scalp blood pH, lactate, etc. may be searched for, in broad population based studies.
3. As was evident from the present study, whatever may be the mode of delivery (whether it was a spontaneous vaginal delivery or a lower uterine caesarean section), the cord blood glucose level does not change. So, it can be assumed that the stress of labour and surgery or the influence of anaesthetic agents do not affect the glucose level in the cord blood. Further studies are needed to establish the presence of such a homeostatic mechanism for the cord blood glucose level, which may also help in further researches which are related to diabetes.

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