Role of nucleated red blood cell count in cases of birth asphyxia

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ABSTRACT

Objective: In spite of the improvement in the care of neonates in developing countries, birth asphyxia still remains a common problem. Asphyxia can occur antepartum, intrapartum or postpartum. Elevated nucleated red blood cell counts have been associated with in utero asphyxia in previous studies. Also nucleated red blood cell counts have been related to the timing of the asphyxia. This study was undertaken to look at the role of nucleated red blood cell count in asphyxiated neonates in relation to the outcome.

Methods: In a retrospectively designed study all newborns with the diagnosis of asphyxia who were admitted to the neonatal intensive care unit at Sultan Qaboos University Hospital between November 1, 1995 to October 30, 1997 were reviewed. The medical charts were reviewed with respect to the parameters such as Apgar score, birth weight, sex, place of birth, value of nucleated red blood cell count at birth, duration of stay in hospital and mortality. A total of 27 term asphyxiated neonates were reviewed. Patients were divided into 2 groups depending upon their values of nucleated red blood cell count at birth. All patients with normal nucleated red blood cell counts (0.5-1.0 x 10^9/L or 3-10 per 100 WBC) were placed in group I and all with elevated nucleated red cell counts (> 1 x10^9/L or >10 per 100 WBC) in group II.

Results: Out of 27 neonates, 16 completed the study. Out of 16 neonates, 9 were placed in group I and the remaining 7 in group II. No significant difference was noted between the 2 groups with respect to the birth weight and severity of asphyxia. The neonates in group II, with elevated nucleated red blood cell counts, were noted to have increased mortality (28.5%) as compared to group I (11%). The neonates in group II also had prolonged hospital stay as compared to the neonates in group I, 8.7 ± 5.8 and 7.2 ± 4.3 days.

Conclusion: We concluded from the study that elevated nucleated red blood cell counts at birth in asphyxiated neonates, in addition to being used as a marker of fetal asphyxia and timing of asphyxia, may also be used as a prognostic marker in predicting the mortality and morbidity. However further prospective studies with larger population will be needed to confirm our findings.

Keywords: Nucleated red blood cell, birth asphyxia, term neonates, mortality, morbidity.

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Asphyxia remains a common problem in developing countries. Efforts have been taken to reduce its incidence. Good care during pregnancy and at the time of delivery are the known factors in decreasing its incidence. Asphyxia can occur in utero or at birth. Studies have shown elevated nucleated red blood cell (NRBC) count at birth in neonates as a marker for fetal asphyxia.\textsuperscript{1,2} Nucleated red blood cell count at birth has been suggested in previous studies as a marker of the timing of fetal neurological injury in asphyxiated neonates, and it was shown that the closer the birth was to the asphyxial event the lower was the number of NRBC count at birth.\textsuperscript{1} Elevated NRBC count has also been associated with intrauterine and fetal asphyxia in previous studies.\textsuperscript{1,3} Elevated NRBC count at birth

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beyond the normal limits and its persistence beyond 72 hours has been shown to be an abnormal finding. In this study we looked at the relation of NRBC count at birth with the neonatal outcome. The outcome variables were the mortality and duration of hospital stay.

**Methods.** All newborns with the diagnosis of birth asphyxia (with one minute Apgar score of 5 or less; Cord pH or Scalp pH were not available, as they are not carried out routinely in our institution) who were admitted to the neonatal intensive care unit at Sultan Qaboos University Hospital between November 1, 1995 to October 30, 1997 were included in the study. The medical charts were pulled out from the medical records and were reviewed with respect to the parameters like Apgar score, birth weight, sex, place of birth, value of NRBC count at birth (carried out routinely in the hospital from November 1, 1995), duration of stay in hospital and mortality. Many factors can effect the NRBC count at birth including prematurity, very low birth weight, intraventricular hemorrhage and hemolytic disease of the newborn. To control these variables we excluded all such patients from our study. Only term neonates were studied and all neonates with a gestational age of less than 37 weeks and birth weight of less than 1500 grams were excluded from the study. A total of 27 neonates were admitted with the diagnosis of birth asphyxia during the study period. As the NRBC count was not carried out routinely in the hospital before November 1, 1995, patients with the diagnosis of asphyxia admitted before November 95 were not included in the study. As gestational age has a bearing on the NRBC count, only term neonates were studied. Eleven neonates were excluded from the study for reasons such as prematurity, small for gestational age and inadequate information. A total of 16 neonates completed the study. They were divided into 2 groups, Group I and Group II, depending upon the values of NRBC count at birth. All neonates with normal counts (0.5-1.0 x 10^9/L or 3-10 per 100 WBC) were placed in group I and all with elevated counts (>1 x10^9/L or >10 per 100 WBC) in group II. Out of 16 neonates, 9 had normal NRBC counts at birth (group I) and 7 had elevated counts (group II). Data was collected in a pre-designed data collection sheet and then analyzed for different variables among both the groups. SPSS package (version 6.0, Chicago) was used for statistical analysis.

**Results.** Most of the patients (62%) were born in the University Hospital. Out of 16 neonates, 6 neonates (32%) were referred from outside hospitals. Male to female ratio was noted to be 1:1. No significant difference was noted between the 2 groups with respect to the birth weight and severity of asphyxia (see Table 1). The neonates with elevated NRBC count had prolonged hospital stay as compared to the neonates with normal NRBC count, 8.7 ± 5.8 and 7.2 ± 4.3 days. Neonates with elevated NRBC count at birth were noted to have increased mortality rate of 28.5% as compared to 11% for neonates with normal NRBC count (see Table 1).

**Discussion.** In our study we looked at the short-term outcome of asphyxiated neonates and we noted that neonates with elevated NRBC count at birth had prolonged stay in the hospital and had higher mortality than the neonates with normal NRBC count at birth. The possible explanation for the increased mortality and prolonged stay in neonates with elevated NRBC counts can be elicited from the fact that higher NRBC count at birth reflected earlier onset of asphyxia (in utero), leading to more pathophy-physiological changes or damage and delivery of a sicker neonate. The asphyxia occurring earlier in fetal life creates a state of fetal hypoxia, which stimulates fetal erythropoiesis resulting in the expulsion of increased NRBC in peripheral blood. This type of fetal response to chronic hypoxia by increasing erythropoiesis has already been documented in previous reports. None of the patients in the study cohort had severe hemolytic disease of the newborn to account for elevated NRBC counts at birth. The limitation of our study was its retrospective design with element of bias and the non-availability of NRBC counts before November 95, resulting in restriction of our sample size. Also cord pH or scalp pH were not available to make the confirmatory diagnosis of intra uterine
asphyxia. Although we noted a trend of prolonged hospital stay and increased mortality in asphyxiated neonates with elevated NRBC count, but because of the small sample size, statistical significance was not achieved. In addition to the short term outcome variables, we did try to look at the long term outcome variables like neuro-developmental status of all infants who survived, but most of the patients were lost to follow-up. Further work is needed to look at the long-term consequences of elevated NRBC in asphyxiated neonates. The significance of this study was that by looking at the NRBC count at birth, in cases of birth asphyxia, the pediatrician can assess the degree and severity of asphyxia in addition to other findings like onset of seizures, HIE (hypoxic ischemic encephalopathy) and may predict the outcome. By knowing all these variables they can modify their management. Also the pediatrician can use NRBC count at birth as a prognostic factor in counselling the parents. And with further larger prospective studies it can be used as a predictor of outcome.

In summary, we may conclude that elevated NRBC count at birth in asphyxiated neonates, in addition to being used as a marker of fetal asphyxia and timing of asphyxia, can be used as a prognostic marker in predicting the mortality and morbidity, however further prospective studies with a larger population will be needed to confirm our findings.

References