

Level of Nucleated Red Blood Cells as a Laboratory Parameter for Determining Severity of Perinatal Asphyxia - A Prospective Study

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Abstract:

Introduction: Perinatal asphyxia is a condition resulting from lack of oxygen that occurs either before, during, or after newborn birth. It is the leading cause of morbidity and mortality among neonates. Nucleated red blood cells (NRBC) are released as a compensatory response to hypoxia in newborns. Clinical parameters for perinatal asphyxia are well-established however laboratory criteria for perinatal asphyxia based on NRBC and the correlation are rarely studied.

Objectives: This study was conducted with the aim of correlating level of NRBC with severity of Perinatal asphyxia and thereby establish NRBC as a laboratory criterion for determining severity of asphyxia.

Methods: This was a prospective case-control study. A total of 160 neonates were included in the study, in which 80 newborns with perinatal asphyxia were in the control group and 80 normal newborns were in the experimental group. Levels of NRBC/100 white blood cells (WBC) in the cord blood of the newborns from both groups were recorded and statistically analyzed.

Results: Mean of NRBCs/100WBCS in control group was 27.97, while NRBCs/100WBCS in experimental group was 7.86. Mean of NRBS among HIE I,II,III were 22.35,27.96,55 respectively with significant p value < 0.05.

Conclusions: This study showed that NRBCs can be used as useful laboratory parameter in defining perinatal asphyxia and its severity.

Key Words: Asphyxia, hypoxic ischemic encephalopathy, nucleated red blood cells

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Introduction

Perinatal asphyxia is a condition resulting from lack of oxygen that occurs either before, during, or after newborn birth. Perinatal asphyxia is one of the leading

causes of mortality and morbidity in neonates. [1] Approximately 4 million babies die before the age of one month due to perinatal asphyxia globally and in

India, 350,000 babies die due to perinatal asphyxia mostly within first 3 days of life . [2]

Nucleated red blood cells (NRBC) are released as a compensatory response to hypoxia in newborns. In newborns. Various situations may contribute to elevated level of NRBC such as prematurity, maternal diabetes mellitus, fetal anemia, growth retardation and Rh sensitization. [3]

Perinatal asphyxia is an insult to the fetus or newborn due to lack of oxygen (hypoxia) and/or lack of perfusion to various organs. Sarnet classification is used for grading of severity of perinatal insult. This classification classify neonates into hypoxic ischemic encephalopathy (HIE), HIE I, HIE II, I HIE III. Chances of mortality and morbidity is high with a high grade of HIE. [4]. For diagnosing HIE, it requires an abnormal neurological examination on the 1st day of birth. Also, in the perinatal period there should be evidence of an asphyxiating event Acidosis, abnormal electroencephalogram, altered blood flow, hypoxia and hypercarbia etc. were observed in asphyxiated neonates. [5]

Studies correlating with level of NRBC and severity of perinatal asphyxia are still few. This study attempted to correlate level of NRBC with severity of asphyxia.

Aim and Objectives

To determine level of NRBCs in asphyxiated babies and correlate the increasing level of NRBCs with increase severity of perinatal asphyxia.

Methodology

This was a prospective case-control study. A total of 160 neonates were included in the study, in which 80 newborns with perinatal asphyxia were in the control group and 80 normal newborns were in the experimental group. This study was conducted after obtaining approval from Institutional Ethical Committee of Rewa.

Consent from the parents of the newborns were obtained for the study. The study data were collected from April 2021 to March 2022.

The cases included in the control group are those who required resuscitation at birth and within 1 min Apgar score < 7. In 80 consecutive asphyxiated neonates, mixed cord blood samples were taken from the placental side of the cut cord by milking method into an ethylenediaminetetraacetic acid containing tube along with a drop of blood put on a glass slide and smear made. The smear was immediately fixed with methylalcohol and sent to hospital lab for microscopy.

After the resuscitation was complete and baby stabilized, the baby was shifted to neonatal intensive care unit (NICU) for further management. The staging of HIE was done at NICU according to Sarnet classification.[4]

Inclusion criteria:

1. Term of neonates >37 weeks
2. Neonates with APGAR SCORE <7 at 1 min.

Exclusion criteria:

Features suggestive of chromosomal abnormalities.

Statistical analysis: Data were analyzed using SSPS. Quantitative data were conveyed as mean \pm SD and qualitative data were conveyed as frequency and percentage. An Independent sample t-test of significance was used when comparing the two means. The chi square test of significance was used to analyse proportions in between 2 qualitative parameters. P-value < 0.05 was considered as significant.

Results

Out of 80 asphyxiated babies, 52 babies (65%) were male while in non-asphyxiated group of 80 babies, 44 babies (55%) were male. As per weight distribution among control group, (i) less than 1 kg, (ii) 1-2 kg, (iii) 2-3 kg, 3-4 kg and (iv) more than

4 kg the percentage were 1.25%, 8.75%, 58%, 14%, 0% respectively. Mean of NRBCs/100WBCS in control group is 27.97, while it is 7.86 in experimental group. P value is significant. Mean of NRBCs among HIE I, II, III were 22.35, 27.96, 55 with significant p value < 0.05.

From the study result it is clear that NRBCS is statistically high in control group babies as compared to experimental group. The study finding further showed that higher the grade of asphyxia, more the NRBCs statistical significance.

Table 1: NRBCs/100 WBCs in asphyxiated and non-asphyxiated neonates

		Asphyxiated Group	Mean	P Value	NonAsphyxiated Group	Mean	P Value
1	0-10	1	27.97±	0.0056	57	7.86±	0.0287
2	11-20	28	12.52		23	4.66	
3	21-30	20			00		
4	31-40	18			00		
5	41-50	10			00		
6	51-60	02			00		
7	>60	01			00		

Table 2: NRBC in different stage of HIE

S. No.	HIE Stage	Range	Frequency	Mean	P-Value
1	I	1-80	17	22.35±9.09	<0.0001
2	II	1-80	59	27.96±11.60	
3	III	1-80	04	52±11.60	

Discussion

Perinatal asphyxia is one of the leading cause of Mortality in neonates and morbidity in later childhood [6] Grading of asphyxia is important so that outcome can be predicted and early intervention can be taken to mitigate its effect [7]. Clinical criteria to define HIE grading is well established but there are very few laboratory criteria. This study showed that the level of NRBCS can be the one such criteria. It is also shown that higher the grade of HIE, significant increase in the level of NRBCs [8]. Similar results was shown in Ghosh B et al, as per the study result 16.5 /100 WBCs in asphyxiated group and 8.6/100 WBCs in non-asphyxiated group [9]. The result of the study is in line with this current study. A study conducted by Boskabadi H et al also showed NRBC in newborns of nonasphyxiated group were 3.87 +/- 5.06 whereas that in asphyxiated cases were 18.63 +/-16.63. [10]. This study result is in

conformity with the present study. Bala D et al also showed similar results. [11]

In study conducted by Goel M et al the number of NRBC/100 WBC in the blood of 50 newborns each in the asphyxiated and in the control group were mean 29.5 ± 26.0, range 7-144 NRBCs/100 WBC and mean ± standard deviation 5.9 ± 2.6, range 3-14 NRBCs/100 WBC respectively (P < 0.01). Using quartile deviation, staging of hypoxic ischemic encephalopathy (HIE) was done on basis of NRBC count and there was 80% agreement between clinical and NRBC staging of HIE. There was a significant (P < 0.01) correlation of the number of NRBC\100 WBC with Apgar scoring, HIE staging and mortality [12,13].

The present study result showed that NRBCs /100 WBCS could be a useful laboratory parameter to determine grade of perinatal asphyxia.

Conclusion

Perinatal asphyxia is a serious neonatal problem and contributes to neonatal

morbidity and mortality. Clinical parameters for perinatal asphyxia are well-established however laboratory criteria for perinatal asphyxia based on NRBC and its creation are rarely studied. As per the study result it is clear that NRBC is statistically high in control group babies as compared to experimental group. The study finding further showed that higher the grade of asphyxia, more the NRBCs statistical significance. Therefore, this study demonstrated umbilical NRBCs/100 WBCs can be very useful supporting laboratory criteria for determining the severity of asphyxia.

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