

## Nucleated RBC Count as Predictor of Neurological Outcome in Perinatal Asphyxia

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The immediate and short term outcomes of term newborns with perinatal asphyxia were studied in relation to the nucleated red blood cell count at admission. The mean (SD) NRBC/100WBC (white blood cells) was significantly higher in sequelae group than normal [9.8 (98.9) vs. 2.9 (43);  $P = 0.001$ ].

**Keywords:** Birth asphyxia, Neurologic disability, Outcome.

There is a need for a reliable marker to predict the course of hospital stay and short term prognosis in term newborns with perinatal asphyxia. Chronic or acute hypoxia is one of the most important causes of increased nucleated RBC count (NRBC count) in a neonate [1]. We studied the role of NRBC count in prediction of neurological outcome in perinatal asphyxia. Term newborns with perinatal asphyxia (Apgar Score <7 at 1 min) were enrolled within 6 hours of birth. The study was approved by the Institutional Ethical Committee.

Absolute NRBC count and NRBC count per 100 white blood cells (WBC) were done at admission using a venous sample. The smear was stained using Leishman stain. The NRBCs and leucocytes were counted manually till 500 white blood cells (WBCs) and then reported as NRBC/100 WBCs. All the counts were done by a 3rd year post graduate student of pathology and cross checked by the consultant. The consultant who finally reported remained same for all the samples. Neonates with convulsions were managed as per standard protocols. The immediate outcome was categorized into: neurologically normal (those who had normal tone and posture, were free from seizures, had good cry and activity and normal neonatal reflexes) and neurologically abnormal (those with an abnormal tone and posture or poor cry and activity or any abnormal neonatal reflexes at discharge or death). Children were followed up till 6 months for any sequelae such as hypertonia, epilepsy, spasticity and delayed milestones.

A total of 177 neonates were enrolled but 12 of the discharged neonates did not report for follow-up at six months; final analysis of 165 was done. Out of these, 97 were born vaginally and 68 were born by lower segment

caesarean section (LSCS). Fifteen neonates died during hospital stay. At discharge, 127 neonates were neurologically normal and 23 neonates were neurologically abnormal. At six months follow-up, 68.7% neonates were neurologically normal and 31.3%

**TABLE I** NUCLEATED RBC COUNTS RELATED TO BIRTH ASPHYXIA

<i>Characteristics</i>	<i>NRBC/100WBC mean (SD)</i>	<i>P value</i>
Hypoxemic Ischaemic Encephalopathy		
Stage II	4.4 (4.5)	0.005
Stage III	8.1 (5.2)	
Need for 2 <sup>nd</sup> loading with phenobarbitone		
Yes	7.2 (4.8)	0.048
No	4.6 (5.2)	
Need for 2 <sup>nd</sup> anticonvulsant		
Yes	7.1 (4.8)	0.387
No	5.4 (5.1)	
Age at first convulsion		
<12h	7.7 (5.6)	0.007
≥12 h	4.3 (4.2)	
Age at start of feeds		
<48h	5.1 (7.1)	0.987
≥48h	5.1 (6.7)	
Outcome		
Discharged	5.0 (6.7)	0.322
Expired	7.0 (5.2)	
Neurological status at discharge		
Normal	4.4 (6.6)	0.007
Abnormal	7.9 (6.0)	
Neurological status at 6 mo		
Sequelae present	9.8 (8.9)	0.001
No sequelae	2.9 (4.3)	

developed sequelae. The NRBC/100WBC was significantly higher in sequelae group than normal ( $P < 0.001$ ) (**Table I**). By drawing receiver operating characteristics (ROC) curves, NRBC  $> 450/\text{mm}^3$  and NRBC/100WBC  $> 3.25$  prediction had a sensitivity of 90% and specificity of 74.3% for predicting development of neurological sequelae at 6 months of age. Many studies have estimated the NRBC count in the cord blood [2-5].

The NRBC count and NRBC/100WBCs were significantly higher in newborns who had a convulsion within 12 h of birth, those who developed hypoxic ischemic encephalopathy (HIE) stage III, those who required a second loading with phenobarbitone, and those requiring a second anticonvulsant. In our study, NRBC count at birth was significantly higher among newborns with sequelae and those who expired, which was also observed in other studies [6-8]. The limitations of the study are short duration of follow-up and absence of other parameters like magnetic resonance imaging, cord blood pH and electro-encephalography.

We conclude that nucleated RBC count can be used as an early marker of severity of birth asphyxia during hospital stay, and may be useful to predict the neurological outcome in asphyxiated neonates.

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#### REFERENCES

1. Hermansen MC. Nucleated red blood cells in the fetus and newborn. *Arch Dis Child Fetal Neonatal Ed.* 2001;84:211-5.
2. Oski FA, Naiman JL. Normal Blood Values in the Newborn Period. *In: Hematologic Problems in The Newborn.* 3<sup>rd</sup> ed. Philadelphia: WB Saunders, 1982: 1-30.
3. Boskabadi H, Maamouri G, Sadeghian MH, Ghayour-Mobarhan M, Heidarzade M, Shakeri MT, *et al.* Early diagnosis of perinatal asphyxia by nucleated red blood cell count: a case-control study. *Arch Iran Med.* 2010;13:275-81.
4. Hanlon-Lundberg KM, Kirby RS. Nucleated red blood cells as a marker of acidemia in term neonates. *Am J Obstet Gynecol.* 1999;181:196-201.
5. Ghosh B, Mittal S, Kumar S, Dadhwal V. Prediction of perinatal asphyxia with nucleated red blood cells in cord blood of newborns. *Int J Obstet Gynecol.* 2003;81:267-71.
6. Fotopoulos S, Pavlou K, Skouteli H, Papassotiriou I, Lipsou N, Xanthou M. Early markers of brain damage in premature low-birth-weight neonates who suffered from perinatal asphyxia and/or infection. *Biol Neonate.* 2001;79:213-8.
7. Naeye RL, Localio AR. Determining the time before birth when ischemia and hypoxemia initiated cerebral palsy. *Obstet Gynecol.* 1995;86:713-9.
8. Ferns SJ, Bhat BV, Basu D. Value of nucleated red blood cells in predicting severity and outcome of perinatal asphyxia. *Indian J Pathol Microbiol.* 2004;47:503-5.