Original Article

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Evaluation of Efficacy of Nucleated Red Blood Cell Count as a Predictor of Perinatal Asphyxia in Karnataka, South India

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Abstract

Background: Early diagnosis of perinatal asphyxia is very essential since it is a major cause of neurologic morbidity and mortality. The present study was undertaken to investigate the association between nucleated red blood cells count (RBCs) per 100 white blood cells (WBCs) and perinatal asphyxia with respect to its severity and prognosis.

Materials and Methods: A prospective case-control study was conducted on asphyxiated and non-asphyxiated term neonates from the neonatal intensive care unit and post-natal wards of the Adichunchanagiri Institute of Medical Sciences, B G Nagara, Karnataka. Cord blood samples from 50 asphyxiated neonates comprising the cases and 50 healthy neonates comprising the controls constituted the material for the study. Levels of nucleated RBCs per 100 WBCs were determined from both the groups and compared.

Results: No significant difference was observed between the control and the study group with respect to birth weight. The mode of delivery (normal/instrumental/cesarean) was statistically significant with a $P = 0.05$. The mean Apgar scores between the study group and the control group showed a $P = 0.001$ which was statistically significant. Nucleated RBCs (NRBCs) on 100 WBCs showed a mean value of 15.74 and standard deviation (SD) of 7.89 in the study group. The control group showed a mean value of 1.55 and SD of 0.78. The $P = 0.001$ was statistically significant and, therefore, a good predictor for birth asphyxia.

Conclusion: Early NRBC count in cord blood is an effective, simple, cost effective baseline diagnostic tool for detecting neonatal asphyxia.

Key words: Early diagnosis, Nucleated red blood cell count, Perinatal asphyxia

INTRODUCTION

Birth asphyxia-hypoxic ischemic insult has been incriminated as one of the most important causes of perinatal mortality. National neonatal - perinatal database suggests that perinatal asphyxia contributes to 20% neonatal deaths in India. Perinatal asphyxia of moderate grade is defined as slow, gasping breathing or the Apgar score of 4-6 and severe asphyxia as no breathing or the Apgar score of 0-3 at 1 min of life.[1]

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The World Health Organization defines birth asphyxia as "failure to initiate and sustain breathing at birth" with the Apgar score of <7 at 1 min of life.[2]

In developing countries, intrapartum hypoxic-ischemic injuries appear to be more common, resulting in a huge burden of disabilities.[3-5]

Approximately 8% of the total global pediatric mortalities (age <5 years) are due to birth asphyxia making it a serious problem in developing countries where the conditions are bad in terms of awareness as well as infrastructure.[6]

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Globally, hypoxia of the newborn (birth asphyxia) or the fetus ("fresh stillbirth") is estimated to account for 23% of the 4 million neonatal deaths and 26% of the 3.2 million stillbirths each year.[6] Majority of asphyxial insults occur in the antepartum or intrapartum periods as a result of placental insufficiency.[7] Detection of nucleated red blood cells (NRBCs) in cord blood allows early prediction of development and severity of birth asphyxia-hypoxic ischemic insult as this parameter is related to neurodevelopment.[8]

NRBCs are primarily produced in the fetal bone marrow in response to erythropoietin and are stored in the marrow as reticulocytes and mature erythrocytes. They are normally seen in the blood of neonates.[9] The levels of NRBCs per 100 white blood cells (WBCs) correlates with acute as well antepartum asphyxia and can be used as a reliable index of birth asphyxia and early neonatal outcome.[10]

Count of NRBCs per 100 WBCs is a simple marker for presence and assessment of severity of asphyxia as it is an early outcome and has a direct correlation with increased stress and infection.[11]

NRBC count is also a useful tool for prediction of brain damage and the expected course in hypoxic induced encephalopathy patients.

MATERIALS AND METHODS

A prospective case-control study was conducted on asphyxiated and non-asphyxiated term neonates from the neonatal intensive care unit and post-natal wards of Adichunchanagiri Institute of Medical Sciences, B.G Nagara, Karnataka.

Cases and controls included asphyxiated and non-asphyxiated neonates. Cord blood samples from 50 asphyxiated neonates comprising the cases and 50 healthy neonates comprising the controls constituted the material for the study.

Informed parental consent was obtained in all cases. Inclusion criteria for the study group included gestational age ≥37 weeks, the presence of intrapartum signs of fetal distress (on fetal monitoring and thick meconium staining of the amniotic fluid), Apgar score of <7 at 1 min of life. Inclusion criteria for the control group included the gestational age of >37 weeks, birth weight >2500 g, Apgar score >7 at 1 and 5 min, normal intrapartum fetal heart rate pattern, and clear amniotic fluid.

RESULTS

Mean birth weight in the study group was 2.87 kg with standard deviation (SD) of 0.44, whereas mean birth weight in the control group was 2.91 kg with the SD of 0.38. There was no significant difference between the control and the study group with respect to birth weight (Tables 1 and 2).

The statistical value for mode of delivery (normal/instrumental/cesarean) was significant with a $P = 0.05$ (Table 3).

All the neonates in the study group had the Apgar score of <7 at 1 min and had a $P < 0.001$.

The mean Apgar scores between the study group and the control group showed a $P = 0.001$ which was statistically significant (Table 4).

NRBCs on 100 WBCs showed a mean value of 15.74 and SD of 7.89 in the study group. The control group showed a mean value of 1.55 and SD of 0.78. The $P = 0.001$ was statistically significant and, therefore, a good predictor for birth asphyxia (Table 5).

Table 1: Birth weight distribution pattern of neonates

Birth weight (kg)	*n* (%) (*n*=50)	
	Cases	Control
2-2.5	8 (16)	3 (6)
2.5-3	27 (54)	29 (58)
3-3.5	11 (22)	16 (32)
>3.5	4 (8)	2 (4)
Total	50 (100)	50 (100)
Mean±SD	2.87±0.44	2.91±0.38

SD: Standard deviation

Table 2: Comparative mean birth weight pattern of cases versus controls

Cases (*n*=50)		Control (*n*=50)		*P* value
Mean	SD	Mean	SD	
2.87	0.44	2.91	0.38	0.591

Table 3: Mode of delivery in cases versus controls

Mode of delivery	*n* (%) (*n*=50)	
	Cases	Controls
Normal	24 (48)	34 (68)
Forceps	2 (4)	-
Vacuum	8 (16)	-
LSCS	16 (32)	16 (32)
Total	50 (100)	50 (100)

LSCS: Lower segment cesarean section

NRBCs (>6 per 100 WBCs) showed a sensitivity of 93.48%, specificity of 98.15%, positive predictive values of 97.7, and negative predictive values of 94.64 (Table 6).

The incidence of meconium-stained amniotic fluid was significantly more in the study group as compared with controls with a $P = 0.001$.

DISCUSSION

In the present study, NRBC count on 100 leucocytes and absolute NRBC in neonates with asphyxia and healthy controls was determined. They were significantly higher in neonates with birth asphyxia. Other contributory causes of increased NRBC count include prematurity, maternal diabetes, congenital infections, cyanotic heart diseases, and pre-eclampsia. The neonates with these conditions were excluded from this study. Several studies have been conducted to evaluate markers that help to diagnose and grade perinatal asphyxia. The present study focused on the efficacy of a simple and cost effective baseline investigation like estimation of NRBCs to diagnose perinatal asphyxia in a rural hospital where facilities for advanced diagnostic techniques to predict perinatal asphyxia are not available or affordable.

Table 4: Distribution pattern of Apgar score in cases versus controls

Apgar score	*n* (%) (*n*=50)	
	Cases	Control
Apgar score at 1 min		
0-3	7 (14)	
4-6	43 (86)	
≥7	-	50 (100)
Apgar score at 5 min		
0-3	-	
4-6	14 (28)	
≥7	36 (72)	50 (100)

Table 5: Mean NRBCs in cases and controls

Statistical indices	NRBC'S/100 WBCs (*n*=50)	
	Cases	Control
Mean	15.74	1.55
SD	7.89	0.78

NRBC: Nucleated red blood cells, WBC: White blood cells

Table 6: Statistical values of NRBCs for predicting HIE

NRBCs (>6/100 WBCs)				
Sensitivity	Specificity	PPV	NPV	AUROC
93.48%	98.15%	97.7	94.64	0.989

NRBC: Nucleated red blood cells, WBC: White blood cells, PPV: Positive predictive value, NPV: Negative predictive value, HIE: Hypoxic induced encephalopathy

The relation between Apgar score of 1 and 5 in the cases and controls is highly statistically significant. Lower Apgar scores were seen in the study group as observed by Boskabadi *et al*.[11]

Birth asphyxia showed a statistically significant association with meconium-stained amniotic fluid which is one the signs of fetal distress *in utero* due to asphyxia.

The relation between asphyxia and NRBCs has been studied by many study groups. In the present study, significant statistical difference was noted between the cases and controls in the terms of NRBCs in the cord blood with a $P = 0.001$.[11] These results were comparable to the study by Boskabadi *et al*.[11]

CONCLUSION

Birth asphyxia can be predicted based on NRBCs, and accordingly interventions can be started. Early NRBC count in cord blood is an effective, simple, cost effective baseline diagnostic tool for detecting neonatal asphyxia. It is a special boon in a rural care center, where advanced diagnostic modalities are unaffordable or inaccessible.

REFERENCES

1. NNPD Network. National Neonatal Perinatal Database – Report for the Year 2002-2003. New Delhi: NNF NNPD Network; 2005.
2. WHO. Basic Newborn Resuscitation: A Practical Guide. WHO Reference Number: WQ 450 98 BA. Geneva: WHO; 1997.
3. Al-Alfry A, Carol JE, Devarajan LV, Moussa MA. Term infant asphyxia in Kuwait. Ann Trop Pediatr 1900;10:355-61.
4. Boo NY. Factors associated with clinically significant perinatal asphyxia in the Malaysians neonates: A case control study. J Trop Pediatr 1991;34:284-9.
5. Airede AI. Birth asphyxia and hypoxic-ischaemic encephalopathy: Incidence and severity. Ann Trop Paediatr 1991;11:331-5.
6. Lawn JE, Causens S, Zupan J. Lancet neonatal survial steering team.4 million neonatal deaths: When? Where? Why? Lancet 2005;365:891-900.
7. NNF Teaching Aids: New Born Care. http://www.newbornwhocc.org/pdf/teaching-aids/postasphyxia.pdf. [Last Accessed 2015 Sep 15].
8. Haiju Z, Suyuan H, Xiufang F, Lu Y, Sun R. The combined detection of umbilical cord nucleated red blood cells and lactate: Early prediction of neonatal hypoxic ischemic encephalopathy. J Perinat Med 2008;36:240-7.
9. Hermansen MC. Nucleated red blood cells in the fetus and newborn. Arch Dis Child Fetal Neonatal Ed 2001;84:F211-5.
10. Ghosh B, Mittal S, Kumar S, Dadhwal V. Prediction of perinatal asphyxia with nucleated red blood cells in cord blood of newborns. Int J Gynaecol Obstet 2003;81:267-71.

11. 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.

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