

Comparison of NRBC in Term Neonatal Umbilical Cord Blood Between Neonate with Meconium-Stained Amniotic Fluid (MSAF) and Clear Amniotic Fluid

Roya Faraji DARKHANEH, Maryam ASGHARNIA, Tahereh Zareh YOUSEFI

Department Of Reproductive Health, Rasht-Guilan University of Medical Sciences, Rasht, Iran

Received 07 May 2007; received in revised form 21 November 2007; accepted 21 November 2007;
published online ???????

Abstract

Objective: The purpose of this study was to evaluate the relationship between meconium stained amniotic fluid and fetal nucleated red blood cell counts.

Materials and Methods: A prospectively case controlled study was performed on 60 women with clear amniotic fluid as control and 60 women with meconium stained amniotic fluid as study group. At delivery 2 ml of umbilical cord blood was collected and analyzed for NRBC and other hemathopoitic factors.

Results: The mean NRBC counts in meconium stained amniotic fluid was significantly higher than the control group ($p < 0.001$).

Discussion: Our results support previous studies which indicate the presence of meconium can be associated with chronic fetal hypoxia as demonstrated by elevated fetal NRBC levels.

Keywords: nucleated red blood cells, fetal hypoxia, meconium stained amniotic fluid

Özet

???????

???????

Introduction

Nucleated red blood cells (NRBCs) are commonly found in the cord blood of the newborn infants (1). Various situations may contribute to elevated level of NRBC such as prematurity, maternal diabetes mellitus, fetal anemia, growth retardation and Rh sensitization. Researchers claim that elevated NRBC

in term infants is related to intrauterine hypoxia (2). The association between chronic intrauterine hypoxia and erythropoietin levels has also been established (3,4). Recent studies suggested that nucleated red blood cell (NRBC) counts have been also elevated in neonates with meconium aspiration syndrome (5). These findings support that pregnancy with meconium staining is a high risk situation for fetal hypoxia. The aim of this study was found out the relationship between meconium stained amniotic fluid and NRBC. Since NRBC counts is less expensive than erythropoietin assay we sought to determine the correlation between fetal NRBC counts and meconium stained amniotic fluid to establish NRBC determination as an important indicator of asphyxia.

Corresponding Author: Dr. Roya Faraji Darkhaneh
Rasht-Guilan University of Medical Sciences, Rasht, Iran
Phone : +98 131 323 27 34
E-mail : tansargroup@yahoo.com

Materials and Methods

A prospective case controlled study was conducted at Alzahra Gynecology Hospital in 2006. A total number of 120 pregnant women delivered of singleton live-born infants of 37 to 42 completed weeks' gestation without any complications during pregnancy were included in the study. Those women with diabetes, hypertension, preclampsia, chorioamnionitis, smoking during pregnancy, previous low birth weight infants, or infants with cyanotic disease were excluded from the study. All women have a definite date for their last menstrual period and sonography during the first trimester. Fetal heart rate was monitored every half an hour and fetal distress subjects were also excluded. Study group (n=60) included newborns with meconium stained amniotic fluid and controls (n=60) included newborns with clear amniotic fluid.

Immediately after delivery 2 ml of umbilical cord blood was collected using a syringe into a vial containing EDTA. Hemoglobin (HB) and white blood cell count (WBC) per mm^3 were determined using automated hematologic blood cell count. A thin blood smear was made and NRBC per 100 WBC was determined manually. NRBC less than 10% was considered normal and NRBC equal or more than 10% was considered abnormal (6).

All data were statistically analyzed using Statistical Package for Social Science software (Version 11). Descriptive statistics were calculated for every continuous variable in the study. To compute the difference between the two groups Student's *t*-test, χ^2 and Fischer's exact test was applied as appropriate. A *p*-value of less than 0.05 was considered statistically significant.

Results

One hundred and twenty women participated in the study. Mean maternal age, gestational age, number of pregnancy and weight at birth of the infants (mean \pm SD) are presented in Table 1. There was no significant difference in the mean maternal age and birth at weight of study and control group (Table 1). However, gestational age of women in the control group was significantly lower than the study group (*p*=0.013).

NRBC per 100 WBC levels were estimated at birth in umbilical cord sample and results were compared between the meconium stained and control group. Mean NRBC per 100 WBC in study and control group were 8.67 ± 6.54 and 3.88 ± 3.92 , respectively. This indicates that mean NRBC difference between the study and control group was 4.79 units and the mean of NRBC in the study group was significantly higher than the control group. (*p*=0.001, Table 2)

Furthermore we classified the NRBC per 100 WBC to normal as lower than 10% of WBC and abnormal as equal or more than 10% of WBC. Control group had significantly

higher normal NRBC than the study group. The percentage of abnormal NRBC in the study group (43.3%) was significantly more than the control group (6.7%) (*p*=0.001, Table 2).

The mean hemoglobin and absolute nucleated red blood cell count of study group was significantly higher than the control group (*p*=0.001, Table 2).

The mean Apgar score of neonate in control group were 8.52 ± 0.54 with a range of 7 to 9 while the study group had significantly lower Apgar score (7.7 ± 1.08 , range: 2-9) (*p*=0.001). Table 3 demonstrates the Apgar score and outcome in the two groups. Nucleated red blood cell count had a tendency toward an inverse relationship with Apgar scores at both 1 and 5 minutes, as shown in Table 3.

Discussion

This study showed that, as hypothesized, infants with meconium stained amniotic fluid had higher absolute nucleated RBC counts than infants with clear amniotic fluid. This finding support that neonate with meconium stained amniotic fluid suffered from fetal hypoxia since NRBC is related to hypoxic situation. We have similar results like previously reported studies (2).

Gestational age of the study group was significantly higher than the control group, since nucleated red blood cell has an inverse relationship with gestational age (6) but we found higher NRBC in the study group.

Tissue hypoxia results in increased levels of erythropoietin, which in turn leads to stimulation of erythropoiesis and increased numbers of circulating NRBCs (6). Vatanserver et al. (3) found a positive correlation between erythropoietin level and NRBC. Various studies documented an increased level of erythropoietin in high risk pregnancies complicated by hypoxia such as; intrauterine growth restriction, maternal hypertension, pre-eclampsia, maternal smoking, Rh isoimmunisation, and maternal diabetes (7,8). As expected, each of these conditions has been associated with increased NRBCs in the newborn. On the other hand elevated cord erythropoietin has been reported in pregnancies complicated with meconium (9,5). Jazayeri et al. (4) found that increasing of erythropoietin with meconium is independent from advancing gestational age. Elevation of NRBC in hypoxic situation is based on the fact that any hypoxic event induces a fetal compensatory response in the form of exaggerated erythropoiesis, resulting in influx of immature red blood cells into fetal circulation, levels of which may be correlated with the presence of perinatal asphyxia (10). To conclude, estimating the number of nucleated RBC per 100 WBC in umbilical cord sample of newborns is a simple test, the sample being obtained non-invasively from an otherwise discarded specimen and analyzed by personnel on equipment readily available in most hospital laboratories. The level of nucleated

Table 1. Mean maternal age, gestational age and birth weights of the infants (mean±S.D.) and sex of the study and the control groups

	All subjects n=120	Study group n=60	Control group n=60	p value
Maternal age (year)	27.17±6.04	27.18±6.43	27.15±5.69	0.976
Gestational age (week)	39.21±1.07	39.64±1.09	38.96±0.99	0.013
Gravid	1.82±1.06	1.80±1.04	1.83±1.09	0.864
Sex of infant				0.885
Male (%)	49.2	50.0	48.3	
Female (%)	50.8	50.0	51.7	
Birth at weight (g)	3256.75±406.91	3421.00±421.91	3292.5±384.13	0.084

Table 2. Hematologic factor of the study and the control group

	All subjects n=120	Study group n=60	Control group n=60	p value
WBC/mm ³	11523.33±3492.72	12013.32±3411.82	11033.33±3532.16	0.125
Hb	14.37±1.89	14.71±2.01	14.03±1.71	0.049
NRBC/mm ³	800.13±878.73	1125.92±996.9	474.33±589.61	0.001
NRBC/100WBC	6.28±5.89	8.67±6.54	3.88±3.92	0.001
NRBC%				
Normal (<10%)	75%	56.7%	93.3%	0.001
Abnormal (≥10%)	25%	43.3%	6.7%	

Table 3. Comparison of Apgar scores and neonatal outcomes of study and control group

	All subjects n=120	Study group n=60	Control group n=60	p value
Apgar minute1 (mean±SD)	8.52±0.54	7.72±1.06	8.12±0.93	0.001
Apgar minute 5 (mean±SD)	8.98±0.22	8.73±0.63	8.86±0.49	0.005
Outcome				
Released (%)	93.3	88.1	90.8	
Bedridden (%)	6.7	11.9	9.2	0.197

RBC per WBC correlates both with acute intrapartum asphyxia as well as chronic antepartum hypoxia and can be used as a reliable index of early neonatal outcome.

Acknowledgment

We gratefully thank Dr. Hossein Shojaee and Sohrabe Ahazade in the organization of the study.

References

- Shurin SB. Hematologic problems in the fetus and neonate. In: Fanaroff AA, Martin RJ. Neonatal-perinatal medicine diseases of the fetus and infant. Chicago: Mosby-Year Book;1992. p. 941-6.
- Saracoglu F, Sahin I, Eser E, et al. Nucleated red blood cell as a marker of fetal hypoxia. International J Obstetric and Gynecology 2000;71:113-8.
- Vatansever L, Acuna B, Demg M, et al. Nucleated red blood cell counts and erythropoietin levels in high-risk neonates. Pediatrics International 2002;44:590-5.
- Jazayeri A, Politz L, John CM. Fetal erythropoietin levels in pregnancies complicated by meconium passage: Does meconium suggest fetal hypoxia? Am J Obstet Gynecol 2000;183:188-90.
- Dollberg S, Livny S, Mordecheev N, Mimouni FB. Nucleated red blood cells in meconium aspiration syndrome. Obstetrics & Gynecology 2001;97(4):Pages 593-6.
- Hermansen MC. Nucleated red blood cells in the fetus and newborn. Arch Dis Child Fetal Neonatal Ed 2001;84:F211-F215.
- Phillip GS, Tito AM. Nucleated red blood cell count in small for gestational age infants with very low birth weight. Am J Dis Child 1989;143:164-9.
- Soothil PW, Nicolaides KH, Campbell S. Prenatal asphyxia, hyperlactaemia, hypoglycemia and erithroblastosis in growth retarded fetus. BMJ 1987;294:1051-3.
- Richey SD, Ramin SM, Bawdon RE, et al. Markers of acute and chronic asphyxia in infants with meconium-stained amniotic fluid. Am J Obstet Gynecol 1995;172:1212-5.
- Ghosh B, Mittal S, Kumar S, Dadhwal V. Prediction of perinatal asphyxia with nucleated red blood cells in cord blood of newborns. International Journal of Gynecology and Obstetrics 2003;8:267-71.