



ARAŞTIRMA / RESEARCH

Effect of delivery mode on newborns cord blood hematological parameters

Doğum şeklinin yenidoğan kordon kanı hematolojik parametrelerine etkisi

Mohammed Siddig Younis¹, Mahmoud Mohamed Elgari¹, Babiker Ahmed Mohamed², El fadil Eissa Idris³

¹College of Medical Applied Science Taibah University, Department of Medical Laboratory Technology, Almadina Almonawwarah, Saudi Arabia

²Karari University, Faculty of Medicine, Khartoum- Sudan.

³University of Gezira Faculty of Medicine, Department of Pediatrics, Wad Madani, Sudan.

Cukurova Medical Journal 2017;42(4):735-740

Abstract

Purpose: The aim of this study is to evaluate the influence of the mode of delivery on hematological parameters of newborns cord blood.

Material and Methods: This a cross-sectional comparative study carried out at Wad Madani Teaching Maternity Hospital, Gezira State, Sudan, from July 2014 to October 2015. 400 pregnant women and their respective newborns were enrolled in the study. Blood was collected before delivery from antecubital fossa of the mothers when admitted for normal vaginal delivery or in labor for elective caesarean section and cord blood was collected by well-experienced midwives.

Results: The study revealed the results of red blood cells count, white cells count count neutrophil and monocyte, were found to be higher in newborns cord blood delivered by normal vaginal delivery than those delivered by caesarean section . Mean corpuscular hemoglobin, man corpuscular volume, reticulocyte count and lymphocyte were higher in caesarean section group.

Conclusion: The study observed that some complete blood count parameters affected by the mode delivery and other parameters cannot affect.The delivery route had no statistically significant effect on hemoglobin, hematocrit, mean cell hemoglobin concentration, platelet count eosinophil and basophil.

Key words: Complete blood count, normal vaginal delivery, caesarean section, newborn.

Öz

Amaç: Bu çalışmada doğum şeklinin yenidoğan kordon kanı hematolojik parametreler üzerindeki etkisini değerlendirilmesi amaçlanmıştır.

Gereç ve Yöntem: Bu kesitsel karşılaştırmalı çalışma, Temmuz 2014'ten Ekim 2015'e kadar Sudan Gezira State'de bulunan Wad Madani Eğitim ve Araştırma Hastanesi'nde, 400 gebe ve yeni doğan bebekleri ile gerçekleştirildi. Normal vajinal doğum yapacak olan annelerin, antekübital fossasından doğumdan önce ya da elektif sezaryen yapan annelerden doğum sırasında, iyi tecrübeli ebeler tarafından kordon kanları toplandı.

Sonuç: Bu araştırma normal vajinal doğum ile doğan yenidoğanların kordon kanındaki alyuvar, akyuvar, nötrofil ve monosit sayımlarının sezaryen ile doğanlara göre daha yüksek seviyelerde olduğunu ortaya koymuştur. Ortalama eritrosit hemoglobini, ortalama eritrosit hacmi, retikülosit sayısı ve lenfosit ise sezaryen grubunda daha yüksekti.

Tartışma: Bu çalışma ile doğum şeklinden, bazı tam kan sayımı parametrelerinin etkilendiği ancak diğer parametrelerin etkilenmediği gözlemlendi. Doğum şekli, hemoglobin, hematokrit, ortalama hücre hemoglobin konsantrasyonu, trombosit sayısı eozinofil ve bazofil üzerinde istatistiksel olarak anlamlı bir etkiye sahip değildi.

Anahtar kelimeler: Tam kan sayımı, normal vajinal doğum, sezaryen, yenidoğan.

Yazışma Adresi/Address for Correspondence: Dr. Mohammed Siddig Younis, College of Medical Applied Science Taibah University, Department of Medical Laboratory Technology, Almadina Almonawwarah.Saudi Arabia

E-mail: mohglbcenter@yahoo.com

Geliş tarihi/Received: 09.02.2017 Kabul tarihi/Accepted: 25.03.2017

INTRODUCTION

Complete blood count (CBC) is one of the commonly used laboratory examinations for evaluating the clinical condition of diseased neonates. Cord blood provides an alternative choice for just-born babies if blood sampling is necessary¹. In addition, cord blood is enriched with hematopoietic stem cells and progenitors, which is a good source for stem cell transplantation and regenerative medicine^{2,3}. Umbilical cord blood has emerged as a viable source of hematopoietic stem cell transplantation (HSCT) in many other countries. With numerous advantages, umbilical cord blood transplantation (UCBT) has extended the availability of HSCT in the absence of a suitable donor and can be used in urgent situations such as graft failure⁴. Also in neonates, factors such as the gestational age, day of life, maternal factors, mode of delivery and site of blood collection can affect the results. Much information relevant to managing neonatal patients can be obtained from a complete blood count (CBC)⁵.

Hemoglobin and hematocrit have been used routinely in the diagnosis of neonatal anemia and polycythemia⁶. White blood cell and platelet counts have been proven to be helpful in the assessment of neonatal sepsis and the hemostatic status of the infant, respectively⁷.

Cord blood screening is a useful tool for identification of anemia, sepsis, thrombocytopenia or any hematological diseases that could occur or manifest during the neonatal period. In most cases, the hematological values are frequently determined in the newborn for diagnostic purposes in suspected infection (sepsis), bleeding and hemolytic disorder⁸. Furthermore, hematological values in newborns are an index of health and depend to large extent on maternal, social and geographical factors.

The delivery route was an important confounding factor with respect to the CBC and WBC differential count⁹.

Hematologic values are affected by many different factors such as sex, gender, race, environment, time and place of sampling¹⁰. Also in neonates, factors such as the gestational age, day of life, maternal factors, mode of delivery and site of blood collection can affect the results¹¹.

A number of studies have been done to relate the maternal factors (differences in mode of delivery,

maternal age, and parity etc.) with newborn hematological parameters. Studies have noted the difference in hematological values of neonates delivered by different methods. A study has shown that the cord blood hemoglobin is lower in the newborn delivered by caesarean section. Another study has shown that the number of total leukocytes, neutrophils, band forms and platelets are significantly higher in vaginally born newborns than the neonates born by caesarean section¹².

Infants born by normal vaginal delivery generally had higher red blood cell (RBC) count, hemoglobin (Hb) and hematocrit (Hct) levels compared with those delivered by caesarean section. The mode of delivery affects the white blood cell (WBC) count as well. Neonates born by vaginal delivery have higher WBC and band counts compared with neonates delivered by caesarean section¹³.

Knowledge of the normal hematologic values of newborns and young children is essential for the proper interpretation of test results and understanding of the dynamic changes occurring during that period. In the neonatal period, the CBC correlates highly with gestational age, birth weight, blood sampling site, crying, physical therapy, mode of delivery and other factors¹⁴.

MATERIALS AND METHODS.

This is a cross-sectional comparative study was conducted and carried out in Wad Madani Teaching Maternity hospital, Wad Madani, Sudan, between July 2014 to October 2015. The hospital contains about 208 beds. There are six units and eight consultants, nine registrars. Eight medical officers and twenty-five house officers and suitable numbers of paramedicals (e.g. midwives, anaesthetists, laboratory technicians, etc) the average number of deliveries per month is 370. A total number of 400 healthy full-term newborns were included in this study, 224 delivered by elective caesarean section and 176 by spontaneous vaginal delivery.

Inclusion criteria of the study were; the newborns should be full-term baby whose gestational age ranges between 37-42 completed weeks was calculated from the first day of the last menstrual period and confirmed by ultrasound, the birth weight should be more than 2.5 kg and newborns, single birth baby. Exclusion criteria were newborns that delivered from mothers with diseases complicating

pregnancy, eclampsia, diabetes, cardiac, kidney or lung disease, mothers with malaria is excluded, bleeding during delivery, those who received aspirin, those delivered by emergency caesarean section and mothers with malaria disease. Preterm newborns-newborns before 37 completed weeks of gestation, newborns with a birth weight less than 2.5kg, newborns with congenital malformations and twin delivered newborns were also excluded.

Ethical approval for the study was obtained by Ethics Committee of the ministry of health of Gezira State, Informed consent was also obtained from the general managers of WMTMH and informed verbal consent was obtained from the mothers before blood sample collection (Procedure for cord blood sampling was explained to the pregnant mothers).

Three milliliters Cord blood was collected by well-experienced midwives trained in cord blood collection immediately after delivery. 2.5 ml was drained in a K2EDTA The specimen of newborns was labeled with the corresponding number and the sample was sent early as possible (maximum 2 – 4 hours) to the laboratory of Wad Madani Renal Hospital. for analysis. Red blood cell (RBC) count, hematocrit or packed cell volume (PCV), hemoglobin (Hb), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC), white blood cell count and platelet count were measured using the Sysmex autoanalyzer model KX-21N (Sysmex Corporation, Kobe, Japan) on the same day of collection and white blood cell differential was done manually by light microscopy from smear stained with Leishman. Reticulocyte count (RC) was manually performed using new methylene blue stain, corrected reticulocyte count (CRC) were calculated.

Statistical analysis

The data were collected, organized, and analyzed using SPSS (Statistical Packages of Social Sciences) 16. To evaluate the mean differences of the variances of cord blood CBC standard deviation of hematological values, between caesarean section normal vaginal delivery and normal vaginal delivery, student's t-test was used. In all statistical analysis, only $p < 0.05$ were considered significant. and $P < 0.01$ to be highly significant.

RESULTS

A total of 400 healthy full-term newborns were enrolled in this cross-sectional with a different mode of delivery. 224 of newborns were delivered by elective caesarean section (56.0%) and 176 by spontaneous vaginal delivery (44.0%). (119 [54%] males and 101 [46%] females). The mean of gestation age of 38.6 ± 1.46 (range: 36-42) wks. The newborns are 191 males and 209 females with a mean birth weight of 3.06 ± 0.28 Kg (range: 2.5-4 kg).

Table 1 summarized the comparison of Red blood cell parameters between newborn delivered by SVD and ECS group, The result revealed that Red blood cell count, was found to be significantly higher in vaginally born infants than Caesarean section ($p < 0.01$), whereas mean cell hemoglobin, Mean corpuscular volume and reticulocyte count were higher in caesarean section cord blood newborns ($p < 0.005$). On the other hand, there were no statistically significant differences between the two groups regarding the Hb, hematocrit, and MCHC ($P > 0.05$). Table 1 compares white cell count and platelet count between newborns delivered by normal vaginal delivery and elective caesarean section. The result revealed that the white blood cell count was significantly higher in vaginally born infants than Caesarean section ($p < 0.005$), On the other hand, there were no statistically significant differences between the two groups regarding the platelet count ($P > 0.05$). Table 1 also illustrates the comparison of the mean level for leukocyte differential between SVD and elective caesarean section newborns. The results showed significantly higher values of neutrophil and monocyte in the newborn cord blood delivered by SVD compared to caesarean section ($P < 0.05$), while lymphocyte was found higher in caesarean section group babies ($p < 0.005$). On the other hand there were no statistically significant differences between the two groups regarding the eosinophil and basophil ($P > 0.05$).

DISCUSSION

Umbilical cord blood has been recently considered a useful alternative source of hematopoietic progenitor cells for clinical application^{15,16}. Many studies have described changes in umbilical haematological parameters in cord blood in

complicated pregnancy and in abnormal labour. However, inadequate data are available on the influence of perinatal factors on values in cord blood in normal pregnancies with uncomplicated labour¹⁷. In the present study the newborns were divided into two groups according to the route of delivery, 176 (44.0 %) newborns were delivered by normal vaginal delivery (NVD), and 224 (56.0 %) newborns were delivered by elective caesarean section (ECS). Several differences in hematological parameters values were observed in cord blood of newborns delivered by caesarean section and vaginal newborns.

his study showed that there were no statistically significant differences in the hemoglobin and hematocrit values between normal vaginal delivery (NVD), elective caesarean section (ECS) (Table 1). These results were similar to that observed by Al-

Mudallal and Al-Habbobi , Redzko, et al , Beşkardeş et al, Al-Zoubaidi et al, Lubetzky, et al and Nikischin, et al^{8,17,18,27,28,29}. This similar finding because their studies conducted on normal healthy full term and normal birth weight babies. In contrast, Sheffer-Mimouni et al, Lee et al , Qaiser et al., Acharya and Sitras , Eskola et al., Zhou et al., Chang, et al. and El Gendy et al , Samantaray and Pradhan^{19,20,21,22,23,13,24,25,26} .Their studies reported significantly increased levels of Hb and Hct in vaginally born infants compared with infants born by caesarean section. The differences in the results may be due to the sample size, environmental and, time of cord blood collection, site of collection of cord blood, physiological conditions of mode of delivery, the state of physical activity of the baby and their studies conducted on preterm newborns and with abnormal birth weights.

Table 1. Comparison of blood parameters of newborns cord blood delivered by spontaneous vaginal delivery (SVD) and elective caesarean section (CS)

	CS (n=224)	SVD (n=176)	p
Hb	14.6±1.6	14.7±1.56	0.504
Hct	45.2±4.9	45.8±5.0	0.258
RBC	4.3±0.51	4.5±0.49	<0.01
MCV	106.1±5.1	103.8±5.9	<0.01
MCH	34.1±2.2	33.4±2.5	0.004
MCHC	32.3±1.3	32.2±1.3	0.416
Reticulocyte	6.1±0.7	5.9±0.8	0.003
WBC x 10 ⁹ /L	12.3±3.7	13.2±3.8	0.016
Plt x 10 ⁹ /L	261.4±53.6	271.8±58.9	0.066
Neutrophil(%)	57.2±6.1	58.6±4.5	0.011
Eosinophil (%)	2.6±0.8	2.5±0.7	0.150
Basophil (%)	0.6±0.5	0.57±0.5	0.503
Lymphocyte(%)	34.8±6.0	33.2±4.5	0.003
Monocyte (%)	4.8±1.4	5.2±1.3	0.006

HB = Hemoglobin; HCT =Hematocrit; MCV = Mean corpuscular volume; MCH = Mean corpuscular hemoglobin; MCHC = Mean corpuscular hemoglobin concentration; RBC = Red blood cell; WBC: White blood cell; Plt: Platelet;

In the present study, total RBC and reticulocyte count of neonates who delivered by NVD were significantly higher than those delivered by ECS (Table 1). These results were in agreement with that of Qaiser et al, Chang, et al, Eskola et al, Zhou et al, And El Gendy et al^{21,24,23,13,25}, but disagree with study done by Al-Mudallal and Al-Habbobi , Redzko, et al , and Nikischin, et al^{8,17,29}. This discrepancy in the results may due to the environmental and physiological status during specimen collection, including site of blood collection, delay in cord clumping, mode of delivery

and on the ethnic and racial factors, also because of more controlled haemorrhage during caesarean section in the later study.

In the current study, the results of MCV and MCH of neonates who delivered by ECS were significantly higher than those delivered by NVD (Table 1). These result contradictory to the study done by Chang et al²⁴. which found that MCV and MCH was high in vaginally born infants .This variation from our findings might be attributed to their large sample size compared to ours and also the

differences in type of anticoagulant used to collect the cord blood as in study of Taiwan which used the cord blood samples from the cord blood bag that contained anticoagulant and the dilution effect of the anticoagulant on the results. In contrast, Qaiser et al²¹ found that the MCV was higher in vaginally newborns than those delivered by caesarean section.

In this study, there was no statistically significant difference in MCHC value between NVD, ECS neonates (Table 1), this result was in agreement with the studies conducted by Qaiser, et al, Al-Mudallal and Al-Habbobi and El Gendy et al^{21,8,25}.

This study found that platelet count was higher in vaginally born infants than cesarean section born infants but this increase was not statistically significant (Table 2), this result was in agreement with the result reported by Al-Mudallal and Al-Habbobi, , Qaiser, et al, Al-Zoubaidi et al and Nikischin, et al.^{8,21,27,29}.

In contrast, in the study carried out by Eskola et al and Chang et al^{23,24}, they found significantly higher values of platelet in newborns born delivered by normal vaginal delivery, the reported the high platelet in NVD may be explained by higher thrombopoietin and cortisol levels observed in vaginally delivered neonates Redzko S, et al¹⁷.

In the current study, the total WBC, neutrophil and monocyte differential count of neonates delivered by NVD were significantly higher than those delivered by ECS (Table 2) and (Table 3). These results were in agreement with that of Al-Mudallal and Al-Habbobi, Redzko S, et al, Eskola et al, Lee et al, El Gendy et al and Chirico, et al^{8,17,23,20,25,30}. This is because during labor there is a combination of severe stress and physical stimulus, to the mother and periodic physical stress resulting from intermittent episodes of hypoxia during labor, to the fetus. This stress causes an increase in circulating catecholamine in mother and infant and since there is a significant correlation between cortisol and leukocytes which is responsible for the increased WBC and neutrophil percentage Redzko S, et al and Proytcheva et al^{17,14} suggested the high neutrophil count at birth mostly arises from bone marrow mobilization of the pre-existing neutrophil pool owing to stress during labour and not as much from an increase in WBC production.

On the other hand there was no statistically significant difference in basophil, and eosinophil differential counts in NVD and ECS neonates;

similar observation was found by Al-Mudallal, and Al-Habbobi, Redzko S, et al, Sheffer-Mimouni et al. and El Gendy et al^{8,17,19,25}.

However lymphocyte percentage in the ECS group was significantly higher than that found in NVD. This result was similar to that reported by Qaiser, et al²¹. In contrast, other investigator Al-Mudallal and Al-Habbobi and Al-Zoubaidi et al^{8,29}, they observed no statistically significant difference between two groups. This is most likely due to the physical stress and periodic hypoxia, which is more frequent and prolonged with vaginal delivery as compared to delivery by caesarean section. During stress the hormone epinephrine and hydrocortisone may play a role in high counts of neutrophil and low count of lymphocyte in vaginally born infants and there is a significant correlation between cortisol and leucocytes, which is responsible for the increased WBC and absolute neutrophil count Qaiser, et al²¹. The results of this study are confirm the theory of stress-induced leucocytosis, related to epinephrine and hydrocortisone released during labour.

Mode of delivery is important factors that influenced the cord blood CBC. This study revealed that RBCs and WBCs count, neutrophil and monocyte in those delivered by ECS were significantly lower than those delivered by NVD, whereas MCH, MCV, reticulocyte count, lymphocyte were higher in caesarean section group babies and the results of Hb, Hct, MCHC, platelet, basophil and eosinophil, had no effected by the mode of delivery.

REFERENCES

1. Ramasethu J. Complications of vascular catheters in the neonatal intensive care unit. *Clin Perinatol*. 2008;35:199-222.
2. Roy V, Verfaillie CM. Expression and function of cell adhesion molecules on fetal liver, cord blood and bone marrow hematopoietic progenitors: implications for anatomical localization and developmental stage specific regulation of hematopoiesis. *Exp Hematol*. 1999;27:302-12.
3. Lanfranchi A, Porta F, Chirico G. Stem cells and the frontiers of neonatology. *Early Hum Dev*. 2009;85:15-8.
4. Adewumi A, Titilope A, Akingun A, Abidoya G, Ebele U, Sulaimon A. Cord blood full blood count parameters in Lagos, Nigeria. *Pan Africal Medical Journal*. 2014;13:192.
5. Keramati MR, Mohammadzadeh A, Farhat AS, Sadeghi R. Determination of hematological reference

- values of neonates in Mashhad-Iran. *International Journal of Hematology and Oncology*. 2011;2:101-5.
6. Mamoury GH, Hamedy AB, Alkhalghi F. Cord hemoglobin in newborn in correlation with maternal hemoglobin in Northeastern Iran. *Iran J Med Sci*. 2003;28:166-8.
 7. Al-Marzoki JM, Al-Maaroof ZW, Kadhun AH. Determination of reference ranges for full blood count parameters in neonatal cord plasma in Hilla, Babil, Iraq. *J Blood Med*. 2012;3:113-18.
 8. Al-Mudallal SS, Al-Habbobi MA. Evaluation of the effect of mode of delivery on hematological parameters of healthy full-term newborns. *Iraqi J Med Sci*. 2010;8:29-38
 9. Siddiqui MAR, Saxena H, Srivasta JR. A study of hematological values in newborns. *Indian Pediatr*. 1972;2:90-4.
 10. Solberg HE. Establishment and use of reference. In: *Tietz Textbook of Clinical Chemistry and Molecular Diagnostics*. 4th ed. (Eds CA Burtis, ER Ashwood, DE Bruns):425-49. Philadelphia, Elsevier Saunders, 2006.
 11. Lokeshwar MR, Dalal R, Manglani M, Shah N. Anemia in newborn. *Indian J Pediatr*. 1998;65:651-61.
 12. Marwaha N, Marwaha RK, Narang A, Thusu K, Garewal G, Bhakoo ON. Routine hematological values in term newborns. *Indian Pediatr*. 1992;29:1095-9.
 13. Zhou YB, Li HT, Zhu LP, Liu JM. Impact of caesarean section on placental transfusion and iron-related haematological indices in term neonates: a systematic review and meta-analysis. *Placenta*. 2013;35:1-8.
 14. Proytcheva MA. Issues in neonatal cellular analysis. *Am J Clin Pathol*. 2009;131:560-73.
 15. Rabian- Herzog C, Lesage S, Gluckman E, Characterization of lymphocyte subpopulations in cord blood. *Bone Marrow Transplant*. 1992;9:64-7.
 16. Varadi G, Elchalal U, Brautbar C, Nagler A, Human umbilical cord blood for hematopoietic progenitor cells transplantation. *J Leuk Lymphoma*. 1995;20:51-8.
 17. Redzko S, Przepieć J, Urban J, Urban J, Wysocka J. Influence of perinatal factors on hematological variables in umbilical cord blood. *J Perinat Med*. 2005;33:42-5.
 18. Beşkardeş A, Salihoğlu O, Can E, Atalay D, Akyol B, Hatipoğlu S. Oxygen saturation of healthy term neonates during the first 30 minutes of life. *Pediatr Int*. 2013;55:44-8.
 19. Sheffer-Mimouni G, Mimouni FB, Lubetzky R, Kupfermanc M, Deutsch V, Dollberg S. Labour does not affect the neonatal absolute nucleated red blood cell count. *Am J Perinatol*. 2003;20:367-71.
 20. Lee HR, Shin S, Yoon JH, Kim BJ, Hwang KR, Kim JJ, Roh EY. Complete blood count reference values of donated cord blood from Korean neonates. *Korean J Lab Med*. 2009;29:179-18.
 21. Qaiser DH, Sandila MP, Kazmi T, Ahmed ST. Influence of maternal factors on hematological parameters of newborns of Karachi. *Pak J Physiol*. 2009;5:34-7.
 22. Acharya G, Sitras V. Oxygen uptake of the human fetus at term. *Acta Obstet Gynecol Scand*. 2009;88:104-9.
 23. Eskola M, Juutistenaho S, Aranko K, Sainio S, Kekomäki R. Association of cord blood platelet count and volume with hemoglobin in healthy term infants. *J Perinatol*. 2011;31:258-62.
 24. Chang YH, Yang SH, Wang TF, Lin TY, Yang KL, Chen SH. Complete blood count reference values of cord blood in Taiwan and influence of gender and delivery route on them. *Pediatr Neonatol*. 2011;52:155-60.
 25. El Gendy FM, Allam AA, Allam MM, Allam RK. Haematological parameters of newborns delivered vaginally versus caesarean section. *Menoufia Medical Journal*. 2016;29:259-64.
 26. Samantaray R, Pradhan BB. Effect of faeto-maternal factors on haematological parameters of cord blood. *IOSR Journal of Dental and Medical Sciences*. 2015;14:92-9.
 27. Al-Zoubaidi WM, Mansoor SS, Musa RJ. Hematological parameters in healthy neonates delivered by vaginal route and cesarean section. *Iraqi J Med Sci*. 2003;2(Suppl 3):40-4.
 28. Lubetzky R, Ben-Shachar S, Mimouni FB, Dollberg S. Mode of delivery and neonatal hematocrit. *Am J Perinatol*. 2000;17:163-5.
 29. Nikischin W, Peter M, Oldigs HD. The influence of mode of delivery on hematologic values in the umbilical vein. *Gynecol Obstet Invest*. 1997;43:104-7.
 30. Chirico G, Gasparoni A, Ciardelli L, Martinotti L, Rondini G. Leukocyte counts in relation to the method of delivery during the first five days of life. *Biol Neonate*. 1999;75:294-9.