



Hematological Parameters Reference Range in Sudanese Neonatal Cord Blood in Normal and Caesarian Delivery

Abdel Rahim Mahmoud Muddathir¹, Ream Elzain Abdelgadir², Abubakr Yousif Awdoon², Elharam Ibrahim Abd Allah³, Hisham Ali Waggiallah^{4*}

¹Department of Medical Laboratory Technology, Faculty of Applied Medical Sciences, Taibah University, Medina, Kingdom of Saudi Arabia.

²Department of Hematology and Blood Transfusion, Faculty of Medical Laboratory Science, Kordofan University, Sudan.

³Department of Hematology and Blood Transfusion, Faculty of Medical Laboratory Science, Alzaeim Alazhari University, Khartoum, Sudan.

⁴Department of Medical Laboratory Sciences, College of Applied Medical Science, Prince Sattam Bin Abdulaziz University, Alkharj, Saudi Arabia.

ABSTRACT

Reference values are essential for clinical practice. Laboratory reference values should be established according to an individual's locality because of the differences in nutritional, environmental, and genetic factors. There is a lack of data about a reference value of hematological parameters in the neonates in Sudan. This study aimed to determine the local reference value of most hematological parameters in neonatal cord blood. The study was a cross-sectional descriptive study, including 500 neonatal cord blood samples from June 2016 to June 2017. The study was conducted in Elobied delivery hospitals, Kordofan state- Sudan. Three milliliters of umbilical cord blood were collected into EDTA containers immediately after the delivery. Blood counts and other hematological parameters were determined using an auto hematology analyzer (Mindary BC-3000 plus). Healthy 500 full-term newborns (49% males, 51% of females) were enrolled in this study. 61.8% (309/500) were delivered by spontaneous vaginal delivery and 38.2% (191/500) by elective caesarian section. The average weight of the newborn was 2.5– 4.0 kg. The male neonates had significantly higher Red blood cell (RBCs) count and higher RDW-CV% (P.value = 0.01) than females but lower mean cell Hb concentration (MCHC) (P.value= 0.00). While hemoglobin (Hb) concentration, hematocrit (PCV), mean cell volume (MCV), mean cell hemoglobin (MCH), platelet count, and WBC count, illustrated no significant statistical differences between both genders. According to obtained results, the reference value of hematological parameters has also established the way of delivery may affect the parameters.

Keywords: CBC, Reference values, Hematological parameters, Neonates, Umbilical cord.

HOW TO CITE THIS ARTICLE: Muddathir ARM, Abdelgadir RE, Awdoon AY, Allah EIA, Waggiallah HA. Hematological Parameters Reference Range in Sudanese Neonatal Cord Blood in Normal and Caesarian Delivery. Entomol Appl Sci Lett. 2021;8(4):59-63. <https://doi.org/10.51847/s9NYGrb3zH>

Corresponding author: Hisham Ali Waggiallah

E-mail ✉ hishamwagg30@hotmail.com

Received: 12/09/2021

Accepted: 19/12/2021

INTRODUCTION

The reference value is the value obtained by measuring individual parameters according to the reference healthy population group [1]. The clinical studies have great values when the results in disease compared to results in health state [2]. Because of variances in nutritional,

environmental, and genetic factors across different groups, laboratory reference values fluctuate from place to place; hence defining a local reference value is critical [3-5].

A neonate is defined as a child under 28 days of age. Neonate is at high risk of death during their life, accounting for 45% (4 million deaths) [6, 7]. Hematological parameters are essential in

follow-up neonatal illness and understanding their differences [8]. Complete blood count (CBC) is referred to several investigations done together. Understanding CBC strengths and limitations provide more useful information about health status. CBC can be a more useful diagnostic tool combined with the peripheral blood smear and several other tests [9]. Detecting abnormal CBC elements can influence neonatal patients' clinical management and treatment [10]. Hemoglobin (Hb) and hematocrit (Hct) measurements are routinely utilized to evaluate and follow up on newborn anemia. Other hematological markers, including white blood cell count and platelet count, can also assess the severity of neonatal sepsis and the infant's hemostatic state [11].

Race, maternity care, dietary condition, and prenatal problems such as anemia, growth retardation, and fetal infections influence newborn hematological results [12]. The umbilical cord blood is essential for determining hematological parameters in newborns at birth; because blood is not frequently drawn on healthy, normal neonates to define normal ranges, the data source for neonates' blood parameters is generally unavailable [13]. Thus, establishing reference ranges during this period is crucial to improving the chances of survival and laying the foundations for a healthy life as Newborn hematological parameters differ from infants and adults [14]. This research aimed to determine the CBC reference values of neonatal cord blood in ElObeid, Sudan.

MATERIALS AND METHODS

The study was a descriptive cross-sectional study that included 500 healthy full-term newborns (49% males, 51% females). The study was carried out in Elobied delivery hospitals, Kordofan state (Sudan), from June 2016 to January 2017.

Immediately after birth, the umbilical cord was clamped with a Kelly clamp, and 3 ml of blood was drawn from the umbilical vein and put into an (EDTA) anticoagulant tube. The samples were taken to the laboratory as soon as feasible for analysis. Pre-term neonates and mothers with chronic diseases such as heart disease, kidney illness, or diabetes mellitus were precluded from participation.

Complete blood count was performed using an auto hematology analyzer (Mindary BC-3000 plus). The following parameters were included: (Hb) levels, hematocrit (Hct) concentration, (RBCs) count, (MCV), (MCH), (MCHC), (RDW), (WBC) count, and platelet count.

The data were analyzed using the SPSS software program version 25. The mean and S.D. were obtained, and the difference between means of variables regarding gender and delivery type was performed using the Independent t-test. Analyzed parameters were compared with previous studies using multi comparison test. The statistical significance was considered when the p-value <0.05.

RESULTS AND DISCUSSION

A total of 500 healthy full-term newborns, 245(49%) males and 255(51%) females, were enrolled in this study. Of them, 309(61.8%) were delivered by spontaneous vaginal delivery and 191(38.2%) by elective caesarian section. The average weight of the newborn was 2.5– 4.0 kg. The mean and standard division of neonatal cord blood complete hemogram was illustrated in **(Table 1)**. Independent T-test showed significant statistical differences between male and female for RBCs count, MCHC and RDW (P.value = 0.01, 0.00, and 0.01 respectively) **Table 1**. The delivery type showed significantly higher CBC parameters in vaginal delivery than cesarean section delivery except for MCHC, as displayed in **Table 2**.

Table 1. CBC parameters values in neonatal cord blood among different genders

Parameters	Mean± SD	Male	Female	P.value
RBCs	4.14 ± 0.96	4.14±1.02	4.13 ± .9	0.01*
Hb	14.45 ± 3.6	14.46 ± 3.8	14.44 ± 3.42	0.17
PCV	44.89 ± 12.42	45.02 ± 12.84	44.76 ± 12.02	0.12
MCV	109.81 ±15.58	109.83 ± 5.46	109.80 ±15.72	0.88
MCH	34.87 ± 5.8	34.89 ± 5.5	34.86 ± 6.1	0.30

MCHC	31.79 ± 4.74	31.73 ± 5.22	31.85 ± 4.2	0.00**
RDW-CV%	17.32 ± 3.58	17.36 ± 3.26	17.29 ± 3.86	0.01*
WBC count	11.74±7.74	11.65 ± 7.58	11.83 ± 7.92	0.22
Platelet count	257.15 ± 128	250 ± 126	263 ± 128	0.78

*P≥ 0.05 is highly significant, **P≥ 0.001 is highly significant

Table 2. CBC parameters values in neonatal cord blood in vaginal and caesarean section delivery

CBC parameter	Hb (g/dl)	PCV (%)	RBCs (×10 ⁹ /L)	MCV (fL)	MCH (%)	MCHC (g/dl)	RDW-CV (%)	WBC Count (×10 ⁹ /L)	Platelet count (×10 ⁹ /L)
Vaginal delivery Mean ± SD (n=309)	14.58 ± 3.86	45.40 ± 14.02	4.20 ± 1.08	110.14 ± 16.74	36.77 ± 5.8	31.62 ± 4.46	17.50 ± 3.7	12.54 ± 8.28	264 ± 134
Section delivery Mean ± SD (n=191)	14.23 ± 3.1	44.06 ± 9.02	4.03 ± 0.72	109.51 ± 13.5	35.04 ± 5.82	32.07 ± 5.1	17.03 ± 3.28	10.44 ± 6	246 ± 107
P. Value	0.00**	0.00**	0.00**	0.00**	0.00**	0.01*	0.01*	0.00**	0.00**

*P≥ 0.05 is highly significant, **P≥ 0.001 is highly significant

Cord blood is used widely for measuring hematological parameters in newborns at birth. CBC significantly impacts different disorders such as anemia [15], neonatal sepsis, and the infant's hemostatic status [16]. The CBC of neonates is affected by various factors, including ethnicity, maternal health, and nutritional condition [17]. It is essential to focus on the local reference value. This study was conducted in EIObeid, Sudan, to define reference parameters for CBC in neonatal cord blood.

The current investigation found no significant difference between male and female Hb, PCV, MCV, MCH, WBCs, and platelets, consistent with the previously reported study by Al-Marzoki (2012) [18]. In contrast, it showed significant differences between males and females in RBCs, MCHC, and RDW-CV, which disagreed with the same study [18], which might be due to varying sample size of the newborns in this study, varying time intervals between birth and clamping of the cord and ethnic differences.

According to the type of delivery, the study revealed that RBCs count, Hb, and the PCV were higher in neonates delivered vaginally than those delivered by cesarean section. These results agreed with Hematyar *et al.* [19]. Qaiser *et al.* [20] Basnet, *et al.* agrees MCV, MCH, RDW-CV, and WBC count values were also higher in vaginal delivery than cesarean delivery, [21] They attribute elevated WBC counts to physical stress and intermittent hypoxia, which are more frequent and longer with vaginal birth compared to cesarean section delivery. The study also discovered a substantial variation in platelet

count between infants delivered vaginally and those delivered via cesarean surgery. These findings are similarly consistent with Redko *et al.* [22] and Chang *et al.* [23]. They suggested that higher platelet counts may be due to higher thrombopoietin and cortisol levels observed in vaginally delivered neonates.

In Comparison of our study to other similar studies in other countries, the study showed significantly lower RBCs value than those from Malawi and Mashhad (Iran). A significantly lower Hb concentration was observed than in Pakistan [20], Malawian [24], Iran [25], and Western Kenya [26], while it should have a significantly higher Hb concentration than the Iraqi study [19]. PCV showed a lower percentage than Malawian, Iran and higher than Abidjan. At the same time, the WBC count showed significantly higher results than Iraq and lower than Pakistan and Abidjan. Our result also showed a significantly lower platelet count than Iraq and Western Kenya. This difference may be related to ethnic differences, physiological conditions, environmental factors, and geographic variation, making it essential to establish a local reference range to Sudanese newborn infants' cord blood. These values may be used in Sudan to interpret the CBC results in neonates.

CONCLUSION

The study concludes that the delivery routes were an important factor that influenced the cord blood CBC values. Also, normal CBC reference values were established.

ACKNOWLEDGMENTS: The Deanship of Scientific Research at Prince Sattam bin Abdulaziz University supported this Publication. I want to thank the staff of delivery hospitals in El-Obied, Kordofan state- Sudan. Our thanks extend to the staff at the faculty of Medical Laboratory Sciences, Kordofan University at Elobied-Sudan.

CONFLICT OF INTEREST: None

FINANCIAL SUPPORT: None

ETHICS STATEMENT: The research was authorized by the ministry of health's ethics commission in Elobied City, Sudan. After a thorough description of the study's objectives, parents provided informed consent.

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