Evaluation of the effect of mode of delivery on hematological parameters of healthy full-term newborns

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Abstract

Background: Hematological values at birth encompass broader ranges of normal than at any other time in life, and despite advances in perinatology over the past years, the exact influence of perinatal factors on hematological values in cord blood in normal pregnancy is still unclear. Moreover there was a wide variation and overlap in values between normal and abnormal infants with early symptoms and signs of neonatal sepsis.

Objectives:

1. To obtain the values of hematological parameters including complete blood picture, red cell indices, nucleated red blood cells and reticulocyte count in healthy full-term neonate and compare these values in neonates delivered by normal vaginal delivery and those delivered by cesarean section whether as elective or emergendy cesarean section.

2. To evaluate the effect of the gestational age, duration of rupture of membrane, duration of labor, Apgar score and birth weight on some hematological parameters.

Subjects, Materials & Methods: A total number of 300 healthy full term newborn were included in this prospective study. They were delivered in Al-Khadymia Teaching Hospital / labor room from October 2007 to January 2008. Those newborns were categorized into three groups, including those delivered by normal vaginal delivery (n = 200), by elective cesarean section (n = 80) and by emergency cesarean section (n = 20).

From each newborn 5 ml of venous cord blood was aspirated, and the estimation of hematological parameters was performed by Sysmex (automated hematology analyzer). Calibration of the analyzer was performed manually. Additionally the blood film was stained with Leishman's stain and differential count was done for each slide and reticulocyte count was done by standard method using brilliant cresyl blue stain.

Statistical analysis were done by students ***t*** test and correlation test taking ***P*** value < 0.05 as the lowest limit of significance.

Results: This study revealed that the total white blood cells and absolute neutrophil count were significantly lower in those delivered by elective cesarean section compared to those delivered by normal vaginal delivery (NVD) and emergency cesarean section (CS/L)

Moreover the reticulocyte count and nucleated red blood cells of neonates delivered by ECS and NVD were significantly lower than those delivered by CS/L, while the red distribution width (RDW) was significantly lower in those delivered by NVD than those delivered by ECS and CS/L.

Whereas the duration of rupture of membrane before delivery, duration of labor, gestational age, birth weight and Apgar score had no influence on cord blood hematological parameters and there was no statistical difference between the three groups.

Conclusion:

• This study revealed the total WBC count and absolute neutrophil count in those delivered by ECS were significantly lower than those delivered by NVD and CS/L.

• The mode of delivery had an influence on RDW in that neonates delivered by NVD had significantly lower RDW than those delivered by ECS and CS/L ($p < 0.05$).

• The mode of delivery had an influence on nucleated red blood cell (NRBC) and reticulocyte count in that neonates delivered by ECS and NVD had significantly lower NRBC and reticulocyte count than those delivered by CS/L ($p < 0.05$).

• The mode of delivery had no statistically significant effect on: lymphocyte, eosinophil, monocyte, RBC, Hb, PCV, MCV, MCH, MCHC, platelet, PDW and MPV.

• Duration of labor, duration of rupture of membranes before delivery, gestational age, Apgar scores and birth weight had no influence on cord blood hematological parameters.

Key words: Haematolgical parameters; mode of delivery; newborn.

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Introduction

The hematology of the fetus and newborn is a relatively recent area of study whose development depends upon the evolution of the science of hematology and, especially, upon methods to study the blood and its elements [(1)].

Despite advances in perinatology over the past years, the exact influence of perinatal factors on hematological values in cord blood is still unclear. Many studies describe changes in umbilical hematological parameters in cord blood in complicated pregnancy and in abnormal labor. However, inadequate data are available regarding the influence of perinatal factors on values in cord blood in normal pregnancies [(2)].

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 disorder.

Subjects and methods

Subjects:

This study was done on 300 healthy full-term newborns delivered in Al-Khadymia Teaching Hospital / labor room from October 2007 to January 2008 by draining a blood from umbilical cord.

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Criteria of inclusion of the subjects:-

(1) The newborn should be full-term baby whose gestational age ranges between 38-41 completed weeks, this was dated by last menstrual period of the mother and was confirmed by obstetrical examination and ultrasound done to the mother and the birth weight should be more than 2.5 kg.

(2) The neonates were excluded from study if the mother had any one of the following features: -

Infants born to woman with pre-eclampsia, diabetes mellitus, gestational hypertension, chorionamnionitis (maternal temperature > 38 ^{o}C, uterine tenderness, malodorous vaginal discharge, maternal tachycardia > 100 bpm and fetal tachycardia > 160 bpm), maternal chronic condition (disease of heart, kidney, blood or lung), smoking mothers and twins.

(3) The neonates were excluded if they had perinatal infection, asphyxia at birth (defined as an Apgar score at 1 minutes < 7), with abnormal fetal heart rate monitoring (bradycardia, tachycardia, non reassuring patterns, late or variable decelerations), with a Rhesus or ABO blood group incompatibility, being small for gestational age (below 10th percentile for sex and gestational age), and those delivered from labors complicated by muconium (i.e.) stained amniotic fluid.

The neonates were divided into three groups according to the route of delivery:

(1) First group includes 200 neonates [100 males (50%) and 100 females (50%)] delivered by normal vaginal delivery.

(2) Second group includes 80 neonates [30 males (37%) and 50 females (63%)] delivered by elective cesarean section (breech presentation, cephalo-

pelvic disproportion and repeated cesarean section).

(3) Third group includes 20 neonates [18 males (90%) and 2 femal (10%)] delivered by cesarean section during labour(emergency cesarean section) in which labour was arrested at the first or second stage .

Sample collection

After clamping of the babys' umbilical cord in the labor room, 2 – 3 ml of blood sample was aspirated from venous umbilical cord blood and transferred into an Ethylenediamine-tetra-acetic acid (EDTA) tube. Also a sample of 2 ml of maternal venous blood was collected in EDTA tube.

The following hematological tests were done on the samples from the baby's bilical cord blood:

(1) Complete blood count was done by Sysmex KX-21N (automated hematology analyzer) which was calibrated according to the operator's manual of the analyzer . The parameters obtained from the analyzer were WBC, RBC, Hb, PCV, MCV, MCH, MCHC, PLT, RDW, PDW, MCVand differential WBC.

(2) Blood film was done by using Leishman's stain [3] to assis the RBC, WBC and platelets morphology, to obtain differential WBC count and to calculate the number of NRBC in 200 WBC. [4] Reticulocyte count was done by using brilliant cresyl blue stain and according to standard manual method.

(3) Blood group and Rh was done for the baby and the mother by standard manual method to exclude Rh incompatibility.

Agar score was evaluated immediately after birth in the delivery room and was assist twice, once at 1 minute and again at 5 minutes after birth.

Statistical analysis

The statistical analysis was based on obtaining percentage, ranges, means ± standard deviation (SD) and standard error of mean (SEM), as well as the correlation coefficient and student ***t*** tests. The ***p*** value was determined. ***P*** values of less than 0.05 were considered significant.

Results

This study included 300 healthy full-term newborns with variable mode of delivery.They were collected from October /2007 to January /2008. The newborns were divided into three groups according to the route of delivery, 200 (66.6 %) newborns were delivered by normal vaginal delivery (NVD), 80 (26.6 %) newborns were delivered by elective cesarean section (ECS), and 20 (6.8 %) newborns were delivered by emergency cesarean section (CS/L).

The demographic data and hematological values of the neonates included in this study were summarized in table 1 and 2.

This study revealed that there was no statistically significant difference ($P > 0.05$) between the three group's regardig maternal age, newborn birth weight and Apgar score of the neonates. Only the gestational age of the neonates delivered by ECS was significantly lower compared to the other two groups ($P < 0.05$) as shown in table 3.

Moreover there were no statistically significant differences between the three groups regarding the RBC_S count, Hb, PCV, MCV, MCH and MCHC ($P > 0.05$). While the reticulocyte count and nucleated red blood cells of CS/L neonates were significantly higher than that of NVD and ECS neonates ($P < 0.05$). On the other hand the red cell distribution width of both ECS and CS/L neonates were significantly higher than

that of NVD neonates (P < 0.05). (Tables 4 and 5).

Also there were no statistically significant differences between the three groups regarding the lymphocyte, eosinophil and monocyte (P > 0.05). Whereas the NVD and CS/L neonates showed significantly higher total WBC and absolute neutrophil than their ECS counterpart (P < 0.05) (Table 6).

On the other hand there was no statistically significant difference between the three groups in regard to platelet count, MPV and PDW (P > 0.05) (Table 7).

When using correlation coefficient ,there was no significance influence of duration of labor, duration of rupture of membranes before delivery, gestational age, Apgar scores, and neonate birth weight on cord blood hematological parameters, ***P*** values range from (0.54 – 0.86).

Table 1: Demographic data of 300 neonates included in this study.

Parameter	**Mean ± SD**	**Range**
Maternal age (years)	26.14 ± 6.24	17 – 40
Gestational age (weeks)	39.18 ± 0.77	38 – 41
Birth weight (Kilograms)	3.454 ± 0.29	3.0 – 4.0
Apgar score		
1 minute	8.76 ± 0.45	8 – 9
5 minutes	9.36 ± 0.48	9 – 10
Multiple pregnancies		
Singleton	300 %	
Twin	0	
Gender		
Male	147 (49 %)	
Female	153 (51 %)	

Table 2: Hematologic values of 300 neonates included in this study.

Investigation	**Mean ± SD**	**Range**
Hemoglobin g/L	153.2 ± 8.08	136 – 169
Hematocrit L/L	0.455 ± 0.032	0.40– 0.59
RBC count × 10^{12}/L	4.35 ± 0.47	3.34– 5.24
Reticulocyte count %	3.66 ± 0.63	3 – 6.3
Nucleated RBC × 10^9/L	0.294 ± 0.07	0.1 – 0.48
Mean cell volume fl	104.5 ± 2.91	100 – 109
MCH pg	35.39 ± 1.67	33 – 39.7
MCHC g/L	337.4 ± 9.66	300 – 350
RDW fl	66.86 ± 4.14	60.7– 74.9
Total WBC count × 10^9/L	15.1 ± 3.17	9.2 – 20.7
Absolute neutrophil count × 10^9/L	9.3 ± 2.5	5.1 – 14.5
Absolute lymphocyte count × 10^9/L	4.67 ± 0.9	3.1 – 6.9
Absolute eosinophil count × 10^9/L	0.239 ± 0.185	0 – 0.9
Absolute monocyte count × 10^9/L	0.341± 0.212	0 – 0.9
Platelet count × 10^9 /L	221.8 ± 27.26	150 – 284
PDW fl	12.21 ± 1.34	9.3 – 15.9
MPV fl	10.11 ± 0.62	9 – 11.3

Table 3: Demographic data in relation to mode of delivery

Parameter	NVD(n=200)	ECS(n=80)	CS/L(n=20)	P - value
Maternal age (year)				NVD:ECS> 0.05˚
Mean ± SD	26.8 ± 7.27	25 ± 3.18	23.7 ± 3.03	NVD:CS/L 0.06˚
Range	17 – 40	19 – 30	20 – 32	ECS:CS/L 0.11˚
Gestational age (week)				NVD:ECS 0.00¨
Mean ± SD	39.4 ± 0.76	38.5 ± 0.37	39.2 ± 0.44	NVD:CS/L 0.28˚
Range	39 – 41	38 – 39	38.5 – 40	ECS:CS/L 0.00¨
Birth weight (kg)				NVD:ECS 0.17˚
Mean ± SD	3.43 ± 0.24	3.49 ± 0.34	3.45 ± 0.29	NVD:CS/L 0.76˚
Range	3 – 4	3 – 4	3 – 4	ECS:CS/L 0.68˚
Apgar score (1 minute)				NVD:ECS 0.66˚
Mean ± SD	8.74 ± 0.48	8.8 ± 0.40	8.8 ± 0.41	NVD:CS/L 0.59˚
Range	8 – 10	8 – 9	8 – 9	ECS:CS/L 0.43˚
Apgar score (5 minute)				NVD:ECS 0.61˚
Mean ± SD	9.37 ± 0.48	9.33 ± 0.47	9.35 ± 0.48	NVD:CS/L 0.86˚
Range	9 – 10	9 – 10	9 – 10	ECS:CS/L 0.91˚

¨ Significant ˚ Not Significant

Table4: Red blood cell parameters in relation to mode of delivery in 300 neonates.

Parameter	NVD(n=200)	ECS(n=80)	CS/L(n=20)	P - value
RBC count × 10^{12}/L				NVD:ECS 0.17˚
Mean ± SD	4.37 ± 0.4	4.28 ± 0.5	4.44 ± 0.2	NVD:CS/L 0.44˚
Range	3.36 – 5.1	3.34 – 5.2	4.1 – 4.9	ECS:CS/L 0.23˚
Hemoglobin g/L				NVD:ECS 0.52˚
Mean ± SD	154.2 ± 7.8	152.3 ± 9.3	155.7 ± 5.0	NVD:CS/L 0.15˚
Range	136 – 169	139 – 168	146 – 167	ECS:CS/L 0.15˚
Packed cell volume L/L				NVD:ECS 0.11˚
Mean ± SD	0.45 ± 0.03	0.44 ± 0.03	0.46 ± 0.02	NVD:CS/L 0.17˚
Range	0.40 – 0.59	0.40 – 0.56	0.42 – 0.49	ECS:CS/L 0.05˚
Reticulocyte count %				NVD:ECS 0.59˚
Mean ± SD	3.5 ± 0.59	3.6 ± 0.48	4.8 ± 0.75	NVD:CS/L 0.00¨
Range	3.0 – 4.9	3.0 – 5.0	3.9 – 6.3	ECS:CS/L 0.00¨
Nucleated RBC × 10^{9}/L				NVD:ECS 0.52˚
Mean ± SD	0.28 ± 0.07	0.29 ± 0.07	0.33 ± 0.06	NVD:CS/L 0.01¨
Range	0.10 – 0.4	0.11 –0.39	0.23 –0.48	ECS:CS/L 0.02¨

¨ Significant ˚ Not Significant

Table 5: Red cell indices in relation to mode of delivery in 300 neonates.

Parameter	NVD(n=200)	ECS(n=80)	CS/L(n=20)	P - value
Mean cell volume fl				NVD:ECS 0.63˚
Mean ± SD	104.4 ± 2.9	104.6 ± 2.9	104.4 ± 2.8	NVD:CS/L 0.95˚
Range	100 – 109	101 – 108	100 – 109	ECS:CS/L 0.75˚
Mean cell hemoglobin pg				NVD:ECS 0.09˚
Mean ± SD	35.2 ± 1.67	35.6 ± 1.45	35.6 ± 1.89	NVD:CS/L 0.39˚
Range	33 – 39.4	33 – 39.7	33.9 – 39.5	ECS:CS/L 0.95˚
Mean cell Hb concentration g/l				NVD:ECS 0.91˚
Mean ± SD	337 ± 8.17	337 ± 13.1	337 ± 20.3	NVD:CS/L 0.82˚
Range	300 – 350	300 – 350	320 – 350	ECS:CS/L 0.85 ˚
Red cell distribution width fl				NVD:ECS 0.00¨
Mean ± SD	64.4 ± 2.62	71.8 ± 1.88	71.0 ± 1.0	NVD:CS/L 0.00¨
Range	60.7 – 73.4	68.9 – 74.9	69.7 – 72.6	ECS:CS/L 0.08˚

¨ Significant ˚ Not significant

Table 6: White blood cell and related parameter in relation to mode of delivery in 300 neonates.

Parameter	NVD(n=200)	ECS(n=80)	CS/L(n=20)	P - value
Total WBC × 10^9/L				NVD:ECS 0.00¨
Mean ± SD	15.9 ± 3.4	13.2 ± 1.1	14.3 ± 1.7	NVD:CS/L 0.05˚
Range	9.2 – 20.7	10.6 –16.4	12.4 –17.2	ECS:CS/L 0.00¨
Neutrophil count × 10^9/L				NVD:ECS 0.00¨
Mean ± SD	9.66 ± 2.9	8.37 ± 1.2	9.33 ± 1.9	NVD:CS/L 0.61˚
Range	5.1 – 14.5	5.9 – 10.9	6.3 – 11.8	ECS:CS/L 0.00¨
Lymphocyte count × 10^9/L				NVD:ECS 0.45˚
Mean ± SD	4.63 ± 0.9	4.72 ± 0.8	4.71 ± 0.8	NVD:CS/L 0.17˚
Range	3.1 – 6.9	4 – 6.7	4 – 6.6	ECS:CS/L 0.23˚
Eosinophil count × 10^9/L				NVD:ECS 0.84˚
Mean ± SD	0.24 ± 0.2	0.24 ± 0.1	0.19 ± 0.1	NVD:CS/L 0.17˚
Range	0.0 – 0.9	0.1 – 0.5	0.1 – 0.3	ECS:CS/L 0.08˚
Monocyte count × 10^9/L				NVD:ECS 0.86˚
Mean ± SD	0.33 ± 0.2	0.34 ± 0.1	0.34 ± 0.1	NVD:CS/L 0.84˚
Range	0.0 – 0.9	0.1 – 0.6	0.1 – 0.5	ECS:CS/L 0.84˚

¨ Significant ˚ Not significant

Table 7: Platelet parameters in relation to mode of delivery in 300 neonates.

Parameter	NVD(n=200)	ECS(n=80)	CS/L(n=20)	P - value
Platelet count × 10^9/L				NVD:ECS 0.059˚
Mean ± SD	224.0 ± 29.7	217.3±13.1	218.2± 10.3	NVD:CS/L 0.38˚
Range	284 – 150	161 – 252	201 – 234	ECS:CS/L 0.82˚
Platelet distribution width fl				NVD:ECS 0.07˚
Mean ± SD	12.0 ± 1.34	12.3 ± 1.09	12.7 ± 2.0	NVD:CS/L 0.06˚
Range	9.3 – 14.6	10.7 – 14.4	10.6 – 15.9	ECS:CS/L 0.32˚
Mean platelet volume fl				NVD:ECS 0.38˚
Mean ± SD	10.09 ± 0.59	10.16 ± 0.6	10.11 ± 0.9	NVD:CS/L 0.91˚
Range	9.0 – 11.0	9.0 – 11.3	9.1 – 11.3	ECS:CS/L 0.75 ˚

¨ Significant ˚ Not significant

Discussion

Hematological values of all the neonates included in this study:

Hemoglobin value and Hematocrit value:

This study had revealed that mean Hb level and PCV of all the newborn (n = 300) as shown in table 2, were inagreement with the results of Al-Mossawy study, (n=500) which was done in Baghdad,in 2004 , despite the Hb and PCV estimation were done by cyanmethemoglobin method and microcapillary device respectively and not by automated hematology analyzer used in this study. The mean Hb level and PCV count in this study were similar to an African study done in 1985 by Scott –Emuakpor AB, et al [(6)](n= 402) . However the mean Hb level and PCV in this study were lower than that reported by Walka MM, et al (1998) in Germany, and to African study done by Broadhead R, et al (1995) [(7)] .

This discrepancy in the results may due to the environmental and physiological conditions under which the specimens were obtained, including mode of delivery, the treatment of umbilical vessels (early or late clamping), and the state of physical activity of the baby[(8,9)],also on the ethnic and racial background effect [(8)] .

Reticulocyte count & Nucleated RBC count:

The reticulocyte count and NRBC of all the neonates included in this study (Table 2) were comparable with that of Redźko S, et al (2005) done in Poland [(2)].But they were lower than those reported by Al- Zoubaidi study,(n= 120)which was done in 1998 on neonates' capillary blood, in Baghdad [(10)] and by Walka MM, et al study (n=123) which was done in Germany on umbilical cord blood,in 2004.[(11)] These differences might be attributed to different in mean gestational age since there was a significant inverse relationship between numbers of reticulocytes and NRBC and gestational age,[(12)]or might be due to the number of samples.

Red blood cell count & RBC indices:

As shown in table 2 the mean RBC count and RBC indices (MCH, MCV & MCHC) in all the newborns (n=300) were in agreement with the results reported by an African study done by Scott –Emuakpor AB, et al (1985), which was done on 402 neonates [(6)] and a study done by Walka MM, et al in 2004, which was done in Germany on umbilical cord blood of 123 neonates [(11)].

Total WBC & differential count:

This study showed that the mean total and WBC count and the absolute neutrophil count of all the neonates included in this study were in agreement with Al- Mossawy study (n=500), which was done in Baghdad,in 2004 [(62)]and similar to Walka MM, et al study[(11)] which was done in Germany , in 2004.On the other hand it was lower than Al- Zoubaidi study (n = 120), which was done in Baghdad[(10)],in 1998

These differences might be attributed to the difference in the time of collecting blood sample, since there is a marked and rapid increase in the neutrophil count during the first 24 hours after birth [(13)]. Also might be affected by the site of blood sampling, since the samples obtained in Al- Zoubaidi study were capillary blood samples while the samples in this study were cord blood samples and it had been postulated that the total WBC count, absolute neutrophil and lymphocyte count were higher in capillary blood than those obtained from cord blood [(10)].

Platelet count, Mean platelet volume & Platelet distribution width:

As shown in table 2 the mean platelet count, MPV and PDW in all the

neonates (n=300) were comparable with that obtained by Al-Mossawy(2004) (n=500) [14] ,but it was higher than that obtained by Al-Zoubaidi (1998)(n = 120), both studies were done in Baghdad .This may due to the technique used ,since in Al-Zoubaidi study the samples were collected from the heel in a capillary tube and this might cause adhesion of platelet to the site of skin puncture also the platelets were counted manually[10],unlike this study where the samples were collected from cord blood and the platelets were counted by automated haematological analyzer. On other hand the results in this study were lower than that obtained by an African study done in 1995 by Broadhead R, et al (n = 366) [7] and a German study done in 2004 by Walka MM, et al (n = 123), [11] and since all the neonates were healthy and full-term, so low platelet counts in those neonates could be due to racial difference.

***Hemtological values in relation to mode of delivery*:**

Hemoglobin & hematocrit values:

This study revealed that there were no statistically significant difference in the hemoglobin and PCV values between normal vaginal delivery (NVD), elective cesarean section (ECS) and cesarean section after labor (CS/L) neonates (Table 2). These results were similar to that observed by Al-Zoubaidi (1998) in Baghdad [10], Lubetzky R, et al (2000) in Israel [15], Nikischin W, et al (1997) in Germany [16] and Redźko S, et al (2005) in Poland[2] .

Reticulocyte count & Nucleated RBC count (NRBC):

The reticulocyte count and NRBC in ECS and NVD were significantely lower than those in CS/l, however there was no significance difference betweenNVD and ECS. This is because featus born by CS/L are more vulnerable to hypoxia than those delivered by NVD or by ECS and hypoxia is a known causes for increase in NRBC count both in fetal and infant blood through increasing the concentration of erythropoietin, which induces erythropoiesis[18].

Red blood cell count & RBC indices:

In this study there were no statistically significant difference in RBC count, MCV, MCH and MCHC between NVD, ECS and CS/L neonates (Tables 2 and 3), these result were similar to that of Redźko S, et al (2005) in Poland [2]and Nikischin W et al (1997) in Germany[16].

On the other hand RDW in both ECS and CS/L neonates was higher than that found in NVD neonates. This was similar to Redźko S, et al (2005)[2]and it may be explain by increased in the total body fluid in fetuses delivered by CS which may indirectly affect the RDW in cord blood[2].

Total WBC & differential count:

In the current study the total WBC and absolute neutrophil count of neonates who delivered by NVD and CS/L were significantl higher than those delivered by ECS (Table 4). These results were in agreement with that of Al- Zoubaidi (1998) in Baghdad [10], Nikischin W, et al (1997) in Germany [16], Redźko S, et al (2005) in Poland [2] and Chirico G, et al (1999) in Italy [19].

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 featus. This stress causes an increase in circulating catecholamine and cortisol both in mother and infant and since there is a significant correlation between cortisol and leukocytes which is responsible for the

increased WBC and absolute neutrophil count [19, 20]. On the other hand there was no statistically significant difference in absolute lymphocyte, monocyte and eosinophil counts in NVD, ECS and CS/L neonates; similar observation was found by Redźko S, et al (2005) in Poland[2] and Al-Zoubaidi (1998) in Baghdad[10].

Platelet count, Mean platelet volume & Platelet distribution width:

In this study there was no statistically significant difference in platelet count, MPV and PDW between NVD, ECS and CS/L neonates (Table 5), these result were similar to observation of Al-Zoubaidi(1998).[10]in Baghdad, Redźko S, et al(2005) in Poland[2]and Nikischin W, et al (1997) in Germany.[18]

However platelet count in the NVD group was higher than that found in ECS and CS/L but this increase was not statistically significant. This high platelet in NVD may be explained by higher thrombopoietin and cortisol levels observed in vaginally delivered neonates [2].

Hemtological values in relation to demographic data:

In this study there was no influence of duration of labor, duration of rupture of membranes before delivery, gestational age, Apgar score, or neonate birth weight on cord blood hematological parameters, these results were similar to the results of Redźko S, et al (2005) in Poland [2] .

From this study we may conclude that the total WBC count and absolute neutrophil count in those delivered by ECS were significantly lower than those delivered by NVD and CS/L, and the RDW in neonates delivered by NVD was significantly lower than those delivered by ECS and CS/L. Also the NRBC and reticulocytes count in neonates delivered by ECS and NVD had significantly lower NRBC and reticulocytes than those delivered by CS/L. Furthermore the mode of delivery had no statistically significant effect on lymphocyte,eosinophil, monocyte, RBC, Hb, PCV, MCV, MCH, MCHC, platelet, PDW and MPV. Also the Duration of labor, duration of rupture of membranes before delivery, gestational age, Apgar score and birth weight had no influence on cord blood hematological parameters.

Recommendations

1. The hematological reference values for Iraqi newborns need to be confirmed by larger number of blood sampling, collecting the samples in different areas of Iraq and at different ages of neonatal life.

2. Future study to determine the hematological parameters values from the umbilical cord blood in many inherited hematological diseases which presented during the neonatal period.

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