

Cord Blood Hematological Profile of Sudanese Neonates at Birth in Khartoum State.

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Abstracts: Background and Objectives: Hematology of newborn recently represented as area of study focusing in study of umbilical cord blood and its elements in general. Identification of expected normal hematological values essentially requires as baseline data to facilitate detection of any congenital or acquired disorders present at time of birth. We aim to estimate hematological parameters and hemoglobin electrophoresis of umbilical cord blood of Sudanese neonates at birth. **Methods:** Study was conducted from July 2011 to June 2013 in Khartoum state maternity hospitals, five hundred healthy full term neonates of 36 - 42 weeks gestation, with weight of 2.5 kg and born to normal uncomplicated pregnant women were enrolled, 5 ml K2EDTA cord blood samples were collected to estimate CBC and hemoglobin electrophoresis. **Results:** the study revealed; Hb 14.35 ± 1.55 gm/dl, haematocrit $0.44.1 \text{ L/L} \pm 5.14$, MCV, MCH, and MCHC were $105.5 \text{ fl} \pm 5.14$, $33.5 \text{ pg} \pm 1.99$ and $33.1 \text{ gm/dl} \pm 1.19$ respectively. Cord blood mean Hb F was $61.9 \% \pm 8.56$, Hb A $37.18 \% \pm 0.25$, and Hb A2 $0.14 \% \pm 0.10$, respectively. RBC count $4.43 \times 10^{12}/\text{L} \pm 0.6$, nRBCs count $2.3/100 \text{ WBCs} \pm 1.46$, and absolute nRBCs count was $267.8 \times 10^{12}/\text{L} \pm 50$, white blood cells count $12.3 \times 10^9/\text{L} \pm 4.17$ and platelet count $261 \times 10^9/\text{L} \pm 83.16$. **Conclusion:** we concluded that hemoglobin red cell indices mean values of healthy Sudanese cord blood at birth with normal reference ranges, but slightly lower than reported previous studies because of ethnological and life style differences. Fetal Hemoglobin, nRBCs, leukocyte, and platelet counts as described in other population and compatible with normal cord blood reference values. [Elgari M NJIRM 2014; 5(4):22-25]

Key Words: Cord blood, Hematological profile, neonates.

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Introduction: Umbilical cord blood is the blood left over in the placenta and in the umbilical cord after the birth of the baby. The cord blood is composed of all the elements found in whole blood It contains red blood cells, white blood cells, plasma, platelets and is also rich in hematopoietic stem cells, which have immense potential to cure malignant and genetic disorders.¹ Hematology of new-born recently represented as area of study that focusing in study of umbilical cord blood and its elements in general, monitoring early blood disorders possibly occurs within newborn as consequence of complicated or due to uncomplicated pregnancy or results of congenitally anomalies.² Identification of expected normal hematological values essentially requires as baseline data to facilitate detection of any congenital or acquired disorders present at time of birth.³ Umbilical cord blood count at birth show that there is an increased in hemoglobin, hematocrit, mean corpuscular volume (MCV), leukocyte count, reticulocytes count and nucleated red blood cells with presence of occasional immature white blood cells or left-

shifted in peripheral blood of healthy infants, with variable degree of count in immature sick newborns.⁴ Erythropoietin (EPO) is glycoprotein hormone cannot cross the placenta, that fetal own erythropoietin produced by fetal kidneys or liver, hence its elevation significantly proportion to in utero-hypoxia.⁵ High white blood cell count reported at birth up to $30 \times 10^3/\mu\text{L}$, the number gradually fall to the level of $12 \times 10^3/\mu\text{L}$ by the end of the first week after birth.⁶ In full term healthy new-born about $500 \text{ nRBC}/\mu\text{L}$ counted at birth, in contrast $10 \times 10^3/\mu\text{L}$ nRBCs counted in umbilical cord blood of premature infant.⁷ hence elevation of erythropoietin level, reticulocyte count, and nucleated red blood cells give valuable inspections of neonatal healthy status.⁵ Hb F constitutes the predominant hemoglobin of the most fetal life, , before 35 weeks gestation constitutes more than 90% of the fetal blood, and then decreases.⁸ After birth percentage of Hb F decreases rapidly, small number of red cells containing less than 1% HbF persists after infancy. Therefore Hb A increases in a reciprocal of the decreasing amount of Hb A.⁹ The umbilical cord blood hematological parameters at

birth reflects the healthy status of the newborns. Such as Hemoglobin (Hb) and hematocrit (Hct) levels have been used as early indicator in the diagnosis and follow-up of the neonatal anemia. In contrast white blood cell count and platelet count are also helpful in the assessment of neonatal sepsis and hemostatic status of neonate.¹⁰ Several factors play major role in steady status of cord blood cell indices, including ethnic group, maternal health, nutritional status and antenatal complications such as anemia, growth retardation and fetal infection including asphyxia.¹¹ Delayed cord clamping results in an increase in hemoglobin (Hb) without causing any side effects in term newborn babies growing fetus is maternal blood dependent.¹² Hence fetal morbidity and mortality result from impact of complicated pregnancy. Furthermore, iron deficiency anemia is the most frequent nutritional Anemia is regarded as the most important cause of prenatal complications, such as premature delivery, intrauterine growth retardation and neonatal and prenatal death.¹

Materials and Methods: This is cross sectional, descriptive and analytical study conducted from July 2007 to June 2010 in Khartoum state maternity hospitals, five hundred healthy full term neonates of 36-42 weeks gestation, weight of 2.5 kg, and born to normal uncomplicated pregnant women were enrolled, 5 ml K2EDTA cord blood samples were collected from umbilical vein by experienced midwives using sterile syringe to estimate full blood counts using hematological analyzer²¹ and to determine fetal hemoglobin alkaline agarose gel technique using automated electrophoresis MAESTRO-Biotech-Fischer instrument. Direct Coomb's test was done immediately after collection samples show positive results were excluded. Data were statistically computerized using statistical package for the social sciences V-11. TruoScan densitometer was used to scan fetal hemoglobin and results were presented as tables and figures.

Results: Hemoglobin levels of healthy Sudanese cord blood at birth 14.35 ± 1.55 gm/dl, mean hematocrit level was $0.44.1 \text{ L/L} \pm 5.14$, MCV, MCH, and MCHC were $105.5 \text{ fl} \pm 5.14$, $33.5 \text{ pg} \pm 1.99$ and $33.1 \text{ gm/dl} \pm 1.19$ respectively. Cord blood mean Hb F was $61.9 \% \pm 8.56$, Hb A $37.18 \% \pm 0.25$, and Hb A2

$0.14 \% \pm 0.10$, respectively. Table1. the mean red cell counts of Sudanese cord blood were $4.43 \times 10^{12}/\text{L} \pm 0.6$, nRBCs count $2.3/100 \text{ WBCs} \pm 1.46$, and absolute nRBCs count were $267.8 \times 10^9/\text{L} \pm 50$, white blood cells count $12.3 \times 10^9/\text{L} \pm 4.17$ and platelet count mean of $261 \times 10^9/\text{L} \pm 83.16$ were found. Table2. Patterns of hemoglobin demonstrated by agarose gel electrophoresis using automated electrophoresis system MAESTRO 101 instrument, band one of normal adult control of hemoglobin A and small portion of hemoglobin A2, while bands 2, 3 and 4 show the FA patterns of umbilical cord blood. Figure 1. Control Hb A electrophoresis band scanned by Turbscan densitometer Shows HbA 94.4%, HbA2 2.7% Fig. Cord blood Hb electrophoresis band scanned by Turbscan densitometer software shows Hb (F 71.7%, Hb A 27.8% and Hb A2 0.5%) Fig3.

Table1: Cord Blood Hemoglobins, Hematocrit and Red Cell Indices (N=500)

Parameter	Mean \pm SD	Reference Value. ¹³
Hb g/dl	14.35 ± 1.55	13.5-19.5
HCT L/L	$0.44.1 \pm 5.14$	0.42-0.60
MCV / fl	105.5 ± 5.14	98-118
MCH/ pg	33.5 ± 1.99	33-41
MCHC g/dl	33.1 ± 1.19	30-35
HB F %	61.9 ± 8.56	60-90
HB A %	37.18 ± 0.25	10-30
HB A2 %	0.14 ± 0.10	< 1.0

Table2: Cord blood RBCs, nRBCs, and absolute nRBCs count (n=500)

Parameter	Mean \pm SD	Reference Value. ¹⁴
RBCs $\times 10^{12}/\text{L}$	$4.34 \times 10^{12}/\text{L} \pm 0.6$	4.7-5.25
nRBCs/100 WBCs	2.3 ± 1.46	<10
Absolute nRBCs $10^9/\text{L}$	$267.8 \times 10^9/\text{L} \pm 50$	<500
WBCs $\times 10^9/\text{L}$	$12.3 \times 10^9/\text{L} \pm 4.17$	9.0-30
Platelet $\times 10^9/\text{L}$	$256.00 \times 10^9/\text{L} \pm 83.16$	150-400

Figure 1: Hemoglobin electrophoresis pattern of control Hb A band 1 and patterns of cord blood FA bands (2, 3, and 4).

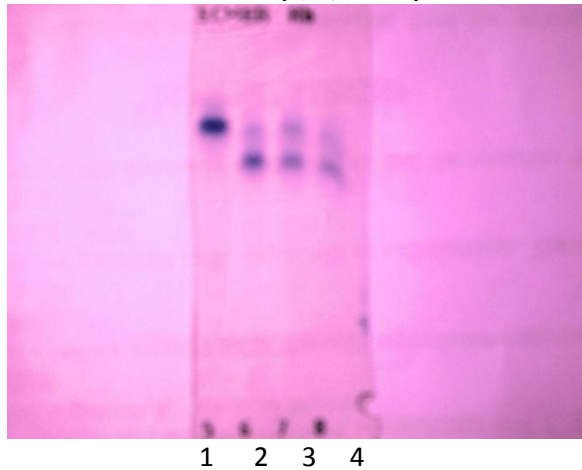


Figure 2: shows control Hb Anelectrophoresis scanned (A 94.4%, A² 2.7%)

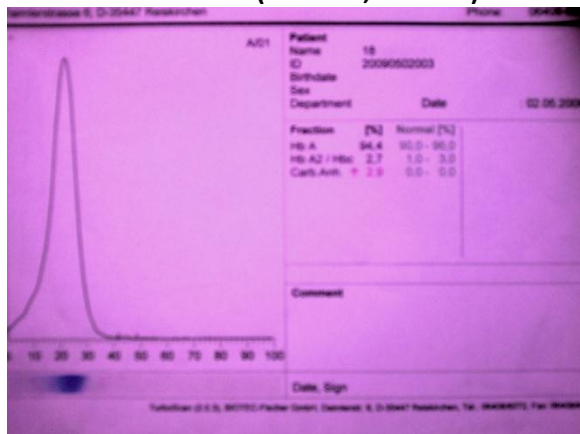
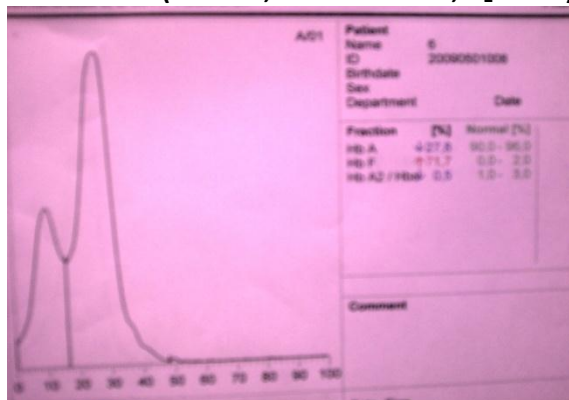


Figure 3: Shows cord blood Hb electrophoresis scanned (F 71.7%, band A 27.8%, A₂ 0.5%)



Discussion: The study revealed that hemoglobin mean value of healthy Sudanese cord blood at birth was 14.35 ± 1.55 gm/dl; the finding is slightly

lower and not consistent with study reported that the mean value of Indian cord blood hemoglobin was 16.2 ± 1.5 g/dl.¹⁶ Also mean concentration of cord, blood hemoglobin has been reported in various studies in range from 17.7 to 17.9 gm/dl, and approximately 95% of estimated values fall between 17.7 and 20.1 gm/dl. Many studies have been reported different normal ranges for Hb values of umbilical cord these reports provide an overall average Hb concentration of 16.8 g/dl.¹⁵ The role of ethnic differences is controversial, despite that, Hb and hematocrit levels in African neonates lower than Western figures. Socioeconomic status may play a crucial role in healthy status of mothers and their babies. The study explained that, a hematocrit mean value was 0.44 L/L ± 5.15 , while MCV, MCH, and MCHC mean values were 105.5 fl ± 5.14 , 33.5 pg ± 1.99 and 33.1 gm/dl ± 0.19 respectively, lower than cord blood red cell indices reported by Marwaha et al 1992.¹⁶ In Indian, and inconsistent with Tewfik H, 2005¹⁷ was demonstrated that the mean MCV of the Egyptian neonates was 110/fL. Cord blood hematocrit levels were affected by time of cord blood clamping, delay cord blood clamp leading to increases hematocrit levels, but lower or higher levels predictive for existence of neonatal anemia of < 30.0 L/L or polycythemia of Hct > 0.65 L/L, respectively.¹⁸ We found the mean value of cord blood red cells count was 4.34×10^{12} /L ± 0.6 , calculated mean values of nRBCs and absolute nRBCs were $2.3/100$ WBCs ± 1.46 and 267.8×10^9 /L ± 200 respectively. Similar count found that the mean value of nRBCs at birth in healthy term newborns in range of 500 nRBCs/mm³ to 1000 nRBCs/mm³.⁷ value above 1000 considered as elevated, elevated nRBCs counts beyond day three are predictors of adverse outcome.¹⁹ The study revealed high TWBC count 12.3×10^9 ± 4.17 similar study reported that; high total leukocyte count was observed at birth.²⁰ We demonstrated cord blood of FA pattern by hemoglobin electrophoresis, with mean values of Hb F values $61.9\% \pm 8.56$, Hb A $37.1\% \pm 2.5$, and Hb A₂ $0.14\% \pm 0.10$, The findings consistent with study reported that Hb F constitute up to 90% in fetus between 12 to 32 weeks, gradually decline at birth and constitutes about 70% of the total hemoglobin, Hb A at birth of the term neonate in averages of 30%. (Ashavaid 2005).²¹

Conclusion: The study concluded that hemoglobin red cell indices mean values of healthy Sudanese cord blood at birth with normal reference ranges, but slightly lower than reported previous studies because of ethnological and life style differences. Fetal Hemoglobin, nRBCs, leukocyte, and platelet counts as described in other population and compatible with normal cord blood reference values. Umbilical cord full blood count should be estimated immediately at birth as routine laboratory performances. Subsequently, the proposed hematological ranges could be used as a guide for further UCB analyses.

References:

1. Christopher D. Hillyer, Ronald G. Strauss & Naomi L. C. Luban. (2004). Handbook of Pediatric Transfusion Medicine. Academic Press. pp. 295, 296. ISBN 0-12-348776-5.
2. Robert D. Christensen, Eric W. Pedro De Alarc N. Neonatal Hematology: Pathogenesis, Diagnosis, and Management of Hematologic. second editon published 2013 Cambridge University press
3. Erica Purves, MSN, RN. (2000). Neonatal hematology disorders, J. pediatric Oncology nursing, Vol 22, p 168-1
4. Lewis SM. Reference ranges and normal values. In: Lewis SM, Bain BJ and Bates I, Editors. Dacie and Lewis Practical Hematology. 10th ed. Churchill Livingstone, Philadelphia: 2006. p. 11–24.
5. Marvin CY, Robert DC.: Embryonic hemopoiesis in hematological problem of neonates.:philadelphia 2000;1:20.
6. Dame C, Tuul SE.. The switch from fetal to adult erythropoiesis.(2000). Neonatal Hematology2000; 27:57-25.
7. Sheffer-Mimouni G, Mimouni FB, Lubetzky R. Labour does not affect the neonatal absolute nucleated red blood cell count. Am J Perinatol 2003;20(7):367–71.
8. El-Hazmi MAF, Warsy AS. Normal reference values for hematological parameters, red cell indices, HbA2 and HbF from early childhood through adolescence in Saudis. Ann Saudi Med. 2001;21:165–169.
9. Wintrobe MM, Lee GR. Wintrobe’s Clinical Hematology, 11th ed. Williams and Wilkins Co., Baltimore. 2006.
10. Paiva AD, Rondo PH, Pagliuisi RA, Latorre MR, Cardoso MA, Gondium SS. Relationship between the iron status of pregnant women and their newborns. Rev Saude Publica 2007; 41:321-7.
11. Jaleel R, Deeba F, Khan A. Timing of umbilical cord clampingand neonatal haematological status. JPMA 2009; 59:468-70.
12. Babay ZA, Addar MH, Warsy AS, El-Hazmi MA. The interrelationship haematological parameters between Saudi newborns and parents. Saudi Med J 2002; 23:943-6.
13. Oski & Naiman (1982). Hematologic problemsed in the newborn. 3d edition, London.
14. Schroter W, Nafz C. (1981) Diagnstic significance of hemoglobin F and Aduring infancy. Paeditr Acta; 36:519.
15. Chirstenson RD: Expected hematologic values for term and preterm neonates In: Cristensen, hematologic problems of the neonate1th(ed), Philadelphia, Saunders, 2000:118-22.
16. Marwaha N, Marwaha RK, Narang A, Thusu K, Garewal G,Bhakoo ON. Routine haematological values in term newborns.Indian Pediatr 1992; 29:1095-9.
17. Tawfik H, (2005). Mangement of allo immune fetal anemia. ASJOG: 2 March.
18. Ceriani Cernads JM, Carroli G, Pellegrini I, et al (2006) The effect of timing of cord clamping on neonatal venous hematocrit values and clinical outcome at term: a randomized , controlled trail. Pediatrics: 117:779-786. 117/4/e779.
19. Philip Lanzkowsky. (2005). Manual of Pediatric Hematology and Oncology. 4th editon.
20. Mamoury GH, Hamedy AB, Alkhlghi F. Cord hemoglobin in newborn in correlation with maternal haemoglobin in Northeastern Iran. Iran J Med Sci 2003; 28:166-8.
21. Ashavaid TF, Todur SP, Dherai AJ. Establishment of reference intervals in Indian population. Indian J Clin Biochem 2005; 20:110-8.

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