

LEVELS OF HAEMOGLOBIN AND PACKED CELL VOLUMES IN UMBILICAL CORD BLOOD IN JOS

S. O. ODEY and J. O. IBU*

Department of Human Physiology, Faculty of Medical Sciences, University of Jos, Jos
Department of Physiology, College of Medical Sciences, University of Calabar.

Summary: Haemoglobin and packed cell volume have been studied in many neonatal study populations, but in Jos, Nigeria, no real reference values exist. On the other hand, disorders of the blood are common in this environment, necessitating knowledge of the reference values of blood parameters as are applicable to neonates. Blood samples were taken from 121 umbilical cords at time of birth, and were analysed for haemoglobin concentration (Hb) and packed cell volume (PCV). The Hb concentration was determined by the indirect colorimetric method, and the PCV by the microhaematocrit centrifuge method. The mean values obtained were Hb 12.13 ± 0.11 g/dl and PCV $37.95 \pm 0.49\%$. The mean umbilical cord blood haemoglobin and packed cell volumes were compared with those of the mothers, taken also at the time of delivery. The maternal values were Hb 10.87 ± 0.012 g/dl and PCV $34.51 \pm 0.045\%$. The comparison shows statistically significant difference in Hb ($P < 0.0001$, $n = 121$) and PCV ($P < 0.0001$, $n = 121$). The study establishes a baseline data on Hb and PCV in neonates in Jos.

Key Words: Haemoglobin, packed cell volume, umbilical cord

Introduction

It is known that differences in haemoglobin and packed cell volume exist, relating to newborn and adults, resulting from the embryonic development and the extrauterine life adaptations (Elias and Frances, 1983). Previous studies suggested that variations exist between Africans and Caucasians in some haematological parameters (Harison, 1966; Ezeilo, 1972; Onwukeme and Uguru, 1990; Onwukeme *et al.*, 1993). The racial differences have been attributed to genetic factors (Ezeilo, 1972). Other workers have indicated that the factor is dietary (Ezeilo, 1974; Ogunranti, 1994). It has been shown too that infections, parasitic infestation and gravidity are contributing factors (Ezeilo 1994; Ogunranti 1994). It has been reported that the preparation of foetal haemoglobin (HbF) in umbilical cord blood for full term infants vary from 77% to due to the persistence of erythrocytes in circulation for up to four months in spite of the switch-off in polypeptide chain production (Andrews and Willet, 1965). Generally, there are few studies done on neonates (Onwukeme *et al.*, 1993). Some workers have demonstrated that human recombinant erythropoietin facilitates erythropoiesis (Bourantas, 1994). It was observed that red blood cell counts of full term newborns are very high adult values (Ezeilo, 1972). Some studies (Jelliffe and Stanfield, 1981),

gave Hb values of 16.6 g/100ml to 17.0g/100ml for umbilical cord blood. Others (Virginia *et al.*, 1982) studied PCV values in 600 healthy neonates and reported that PCV was highest at 24 hours of age. There are reports of Hb levels ranging from 11.2 to 26.6 g/100ml, with 95% of the values between 13.7 to 20.2g/100ml (Osiki and Naiman, 1972). This finding was corroborated by the work of Onwukeme *et al.* (1993).

The wide variations in report led us to examine these parameters in our locality with a view of providing a baseline data for further works.

Methods

This study was carried out on human subjects who gave their informed consent to the work. Candidates were admitted into the study by sequential registration of booked pregnant women.

One hundred and twenty-one of the women delivered in the period of this study. Blood was taken from the umbilical cord of the baby and the cubital fossae of the mothers, into potassium EDTA anticoagulant bottles.

The indirect colorimetric method of Hb estimation, and microhematocrit centrifuge method of PCV determination, as described by Ibu and Adeniyi (1989) were used. The data were analysed electronically on Macintosh

Performa 5200 CD on Statview Abacus concepts software.

Results

The results as obtained are shown below.

Table 1 compares the mean Hb level of umbilical cord blood with that of the maternal blood. The mean umbilical cord blood (\pm SEM) Hb concentration is 12.13 ± 0.11 g/dl while the maternal value is 10.87 ± 0.12 g/dl. The Hb concentrations in the umbilical cord blood is statistically higher than that of the pregnant women ($P < 0.0001$, $n=121$) at 5% significant level. The regression coefficient analysis of

mean Hb concentration between umbilical cord and maternal blood shows a positive correlation (r) of 0.195.

The mean packed cell volume of umbilical cord and maternal blood are shown in Table 2. The mean (\pm SEM) PCV of the cord blood is $37.98 \pm 0.49\%$ and that of the mother, $24.5 \pm 0.49\%$. the umbilical cord blood PCV is significantly higher than the maternal PCV ($P < 0.0001$, $n=121$) at 5% significance level. The regression coefficient analysis between the umbilical cord and maternal blood PCV is a positive correlation (r) of 0.284.

Table 1. Mean Haemoglobin concentration in umbilical cord blood and maternal blood.

	Mean	\pm SEM	Range \pm 2SD	P-value
Cord	12.13		0.11	11.90-12.36
Maternal	10.87		0.12	10.62-11.12

Table 2. Mean packed cell volume in umbilical cord blood and maternal blood.

	Mean	\pm SEM	Range \pm 2SD	P-Value
Cord	39.98	0.45	37.01-38.95	$P < 0.0001$
Maternal	34.51	0.45	33.63-35.39	

Discussion

Several studies have been carried out on hematological parameters (Onwukeme and Uguru, 1990; Olowe and Ransome-Kuti, 1980). This present study gives a mean (\pm SEM) umbilical cord haemoglobin concentration of 12.13 ± 1.26 g/dl. This figure agrees with that of an earlier work (Oski and Naiman, 1972) which reported haemoglobin concentration of 11.2g/dl. However, a group working in Benin (Scott-Emuakpor *et al*, 1985) and another in Jos (Onwukeme *et al*, 1993) reported higher values of 15.4g/dl and 170.6 ± 19.4 g/l respectively. A previous work (Jelliffe and Stanfield, 1981) also reported a cord haemoglobin level of 16.6 – 17.0g/100ml.

The earlier work in Jos (Onwukeme *et al* 1993) where this present study was carried out, used patients in a teaching hospital set up as opposed to this work in secondary health centers. The mean umbilical cord packed cell volume in this study, of $37.98 \pm 0.49\%$ is lower than of some earlier works (Oski and Naiman, 1972). It however, corroborates the values obtained at other centers, of a mean PCV of 0.46 L/L in Lagos areas, 0.45 L/L in Jos and Benin (Abudu

and Sofola, 1994; Onwukeme *et al*, 1993; Scott-Emuakpor *et al*, 1985).

These reports however were not specific for umbilical cord. A group working in Ibadan have reported a PCV of 60% among African neonates, a volume higher than obtained in this study (Effiong *et al* 1976).

The time at which the umbilical cord is clamped is an important factor in neonatal blood indices (Gairdner *et al*, 1958). This factor could not possibly be significant in this work because all the blood samples were taken almost immediately after expulsion of the baby in the second stage of labour.

The umbilical cord mean (\pm SEM) haemoglobin concentration differs significantly from the maternal value ($P < 0.001$). The maternal mean (\pm SEM) haemoglobin level found in this study agrees with the work of Ogunbode *et al* (1983), working among women attending antenatal clinic in the western part of Nigeria. This present work also corroborates other reports (Ezeilo 1972; Andrews and Willet, 1965). The PCV differs also significantly between umbilical cord blood and maternal blood ($P < 0.0001$). Lower values

than obtained in this study have also been reported (Ogunbode *et al* 1983).

A positive correlation coefficient ($r = 0.195$) as found in this work between umbilical cord and maternal cord and maternal blood haemoglobin, indicates a dependence of foetal haemoglobin level on certain maternal factors. This agrees with the report of Onwukeme and Uguru (1990). A probable maternal factor influencing cord haemoglobin is serum ferritin. The PCV level is also positively correlated between the cord and maternal blood. Work done in Lagos (Abudu and Sofola, 1994) however, reported a negative correlation between PCV and gestation ($r = -0.50$; $p < 0.02$). Plasma volume expansion may explain the relative lower haemoglobin and PCV values in the mothers than is seen in cord blood.

Acknowledgements

The authors thankfully acknowledge the contributions of Mr. D. D. Dakat, Dr. U.G. Egesie, of Physiology Department and Mr. S. Pam of the University Computer Center. This work was supported by the Faculty by the Faculty of Medial Sciences Research grant number FMS/UJ/RG/94/05.

References

- Abudu O.O. and Sofola A.O. (1994): Relationship between Red Cell Mass and packed cell volume in Nigeria Primigravidae. *Nig. J. Physiol. Sc.* 10 (1-2): 13-21.
- Andrews B.F. and Willet G.P. (1965) Foetal Haemoglobin concentration in the Newborn. *Amer. J. Obstet. Gynaec.* 91: 58-88.
- Bourantas W. K. Georgion I. And Seferiadis K. (1994) Foetal Globin Stimulation During a Short Term Trial of Erythropoietin in HB S/Beta thalassenia patients. *Acta Haematol.* 92:79-82.
- Effiong C. E. and Taiwo O. Odeniyi O.O. and Mellitis E.D. (1976) Haematological Values in Healthy full term Nigerian New-born infants. *Bio. Neonate* 28:336-46.
- Elias S, and Frances M. (1983) Haematology of the new-born. In: *Haematology* by Williams and Co 3rd ed. Mc Granw Hillbook Co.P.37.43.
- Ezeilo G. C. (1972) Haematological values in pregnant Zambian women. *Trop Geogr. Med* 24:252-258.
- Ezeilo G.C. (1974) The Aetiology of Neutropenia in Healthy Sfricans. *East. Afi. Med. J.* 51:936-941.
- Gairdner D., Marks J. Roescoe J.D and Brettel R.O. (1958). The fluid Shift from the Vascular compartments immediately after birth. *Arch Disc. Child* 33:489-498.
- Harrison K.A. (1966) Blood Volume of Nigerian Women. *West African Med. J.* 46:680-685.
- Ibu J.O. and Adeniyi K.O. (1989) *Manual of Practical Physiology*. P. 17-45.
- Jellife D.B. and Stanfield J.P. (1981) *Diseases of children in the subtropics and tropics*. 3rd ed. ELBS and Edward Arnold LTD. P. 573-599.
- Ogunbode O., Akinyele I. O. and Hussain M.A (1983) Dietary iron intake of pregnant women with anaemia. *Int. J. Gynaec. Obstet.* 17:290-293.
- Ogunranti J. O. (1994) Non-Genetic Leuko neutropenia is related to dietary cholesterol: an experimental model with the Rat. *Acta Haematol.* 92:61-65.
- Olowe S. A. and Ransome-Kuti O. (1980) The risk of jaundice in glucose, 6 phosphate Dehydrogenase deficient Babies Exposed to Menthol. *Acta Baediatr. Scand* 69:341-345.
- Onwukeme K. E. and Uguru V.E (1990) Haematological values in pregnancy in Jos. *West. Afri. J. Med.* 9 770-775.
- Onwukeme K.E., Olomu I. N. Nnana O.U. (1993) Haematological indices in Healthy Nigerian Neonates. *Nig. Med. Pract.* 23:9-12.
- Oski F. A. and Naiman J.L (1972) *Haematological problems in the newborn*. 3rd ed. W. B. Sanda Co. P. 12-13.
- Scott-Emuakpor A. B., Okolo A. A. Omene J. A. and Ukpe S. I. (1985) The limits of physiological Anemia in the African. *Acta Haemat.* 74:104-7.
- Virginia D. Black, and Lula O. Lubchanco (1982) Neonatal Polycythemia and Hyperviscosity. *Ped. Clin. Amer.* 29 :1137-48.

Received: September 16, 2003

Accepted: December 22, 2003