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 references 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 centrifugation method. The mean values obtained were Hb 12.13 ± 0.11 g/dl and PCV 37.95 ± 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 ± 0.12 g/dl and PCV 34.51 ± 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 extraterrestrial life adaptations (Elias and Frances, 1983). Previous studies suggested that variations exist between Africans and Caucasians in some haematological parameters (Harison, 1966; Ezeliu, 1972; Onwukeme and Uguru, 1990; Onwukeme et al, 1993). The racial differences have been attributed to genetic factors (Ezeliu, 1972). Other workers have indicated that the factor is dietary (Ezeliu, 1974; Ogunnati, 1994). It has been shown too that infections, parasitic infestation and gravidity are contributing factors (Ezeliu 1994; Ogunnati 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 (Bouman, 1994). It was observed that red blood cell counts of full term newborns are very high adult values (Ezeliu, 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 (Oski and Naim, 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 microhaematocrit centrifugation method of PCV determination, as described by Ibu and Adeniyi (1989) were used. The data were analysed electronically on Macintosh
Perform a 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 (± 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 (± SEM) PCV of the cord blood is 37.98 ± 0.49% and that of the mother, 24.5 ± 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.

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>±SEM</th>
<th>Range + 2.SD</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cord</td>
<td>12.13</td>
<td>0.11</td>
<td>11.90-12.36</td>
<td>P&lt;0.0001</td>
</tr>
<tr>
<td>Maternal</td>
<td>10.87</td>
<td>0.12</td>
<td>10.62-11.12</td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>±SEM</th>
<th>Range ± 2SD</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cord</td>
<td>39.98</td>
<td>0.45</td>
<td>37.01-38.95</td>
<td>P&lt;0.0001</td>
</tr>
<tr>
<td>Maternal</td>
<td>34.51</td>
<td>0.45</td>
<td>33.63-35.39</td>
<td></td>
</tr>
</tbody>
</table>

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 (±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 11.2 g/dl. However, a group working in Benin (Scott-Emuakpor et al, 1985) and another in Jos (Onwukeme et al, 1993) reported higher values of 15.4 g/dl and 170.6 ± 19.4 g/l respectively. A previous work (Jelliffe and Stanfield, 1981) also reported a cord haemoglobin level of 16.9 – 17.0 g/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 ± 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 (±SEM) haemoglobin concentration differs significantly form the maternal value (P<0.001). The maternal mean (± 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. Pum of the University Computer Center. This work was supported by the Faculty by the Faculty of Medical Sciences Research grant number FMS/UI/RG/94/05.

References


Received: September 16, 2003
Accepted: December 22, 2003