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Differences in Haematological Profile of Preterm and Term Neonates: Lessons Learned from a Specialized Tertiary Hospital in Dhaka, Bangladesh

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Abstract

A complete blood count (CBC) elements that are abnormally high or low can influence our clinical decisions. However, the reference ranges for the various CBC elements in neonates change considerably in respect to gestational age. A cross-sectional, comparative study was conducted in collaboration between Department of Paediatrics and Department of Obstetrics & Gynaecology of Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders (BIRDEM) Hospital, Dhaka, Bangladesh, between July 2007 and January 2008, to compare the haematological profile of the preterm and term neonates. A total of 100 newborns (49 preterm and 51 term) of different gestational age were included in this study. Preterm babies constituted group A, while term babies constituted group B. Within 48 hours of delivery, 1 ml venous blood was collected from each neonate and sent to the Department of Clinical Pathology of the same hospital. Complete blood count (CBC) was done by using Abbott's Cell-Dyn 3200 Automated Hematology Analyzer. In group A, 28(57.1%) were male and 21(42.9%) were female, while in group B, 26(51.0%) and 25(49.0%) respectively ($p>0.05$). In group A, 6(12.3%) babies had ≤1000 gm birthweight, 13(26.5%) had 1001-1499 gm, 28(57.1%) had 1500-2499 gm, and 2(4.1%) had ≥2500 gm, while in group B, 3(5.9%) had 1001-1499 gm, 10(19.6%) had 1500-2499 gm and 30(74.5%) had ≥2500 gm birthweight respectively ($p<0.001$). No differences were observed in total count of RBC, total count of WBC and platelet count between two groups ($p>0.05$). In differential count of WBC, leucocyte and lymphocyte showed significant differences ($p<0.001$). Heamoglobin level and haematocrit value between two groups also showed significant differences ($p<0.001$). Pearson correlation coefficient showed a positive correlation of gestational age with heamoglobin level ($r=0.412$; $p<0.001$) and haematocrit value ($r=0.382$; $p<0.001$). Our data suggest that differences exist in different haematological parameters between preterm and term neonates of different gestational age.

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Introduction

Haematological examinations may contribute, especially by repeated investigations of parameters changing dynamically, to a greater safety of decisions concerning the beginning or termination of any chemotherapy in neonates with suspected infections.[1] However, unfortunately, the reference ranges for the various complete blood count (CBC) elements in the neonatal period are not simple to suggest, as because changes occur considerably with advancing gestational and postnatal age.[2] Hence, diagnosing

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a low or high blood concentration of RBC, WBC, and platelets should be evidence-based. This cannot be accomplished using the normal ranges established in healthy adults, but can be estimated by using reference ranges derived from large neonatal datasets.[3,4] Dramatic changes occur in the blood and bone marrow of the newborn infant during the first hours and days after birth and there are rapid fluctuations in the quantities of all hematologic elements.[5] Hence, haematologic values obtained from full-term babies generally are not aligned with that of preterm babies.[6-8]

In a resource-poor settings like Bangladesh, in addition to the clinical signs and symptoms, the complete blood count remains a routine examination in our healthcare service from rural hospitals to tertiary level specialized centres. Hence, determining a hematological profile of infected newborns could contribute to early management in the absence of other expensive examinations.[9] The complete blood count (CBC) is an easily achievable examination[9] and it gives clues in anaemia, neonatal infection or thrombocytopenia.[2-8] Evidence also showed that the degree of prematurity is a factor greatly influencing the values of the blood parameters at birth.[9] Recognizing that CBC elements changes with gestational age and abnormally high or low values influence our clinical decisions in neonates, we designed this study to compare heamatologic values in between preterm and term neonates in an urban tertiary specialized hospital in Bangladesh.

Methods

This cross-sectional, prospective study was conducted in collaboration between Department of Paediatrics and Department of Obstetrics & Gynaecology of Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders (BIRDEM) Hospital, Dhaka, Bangladesh, between July 2007 and January 2008. This is tertiary level specialized hospital having NICU support. A total of 100 newborns (49 preterm and 51 term) participated in this study. Gestational age was calculated from LMP (first day of a woman's last menstrual period)[10] and clinical assessment was done by using modified Ballard Maturational Score.[11] Preterm babies were in group-A, while term babies were in group-B. Within 48 hours of delivery, 1 ml venous blood was collected from each neonate and blood sample was stored in an ethylene diamine tetra acetic acid coated plastic microcontainer following a standard operating procedure.[12] The blood sample was sent to the Department of Clinical Pathology of the same hospital. Complete blood count (CBC) was done by using Cell-Dyn 3200 Automated Hematology Analyzer (Abbott Laboratories, USA).

Statistical analyses were done using the SPSS version 11.5 for Windows (SPSS Inc., Chicago, Illinois, USA). Continuous variables were expressed as mean±SD (standard deviation), while categorical variables were expressed as frequency and percentage. Chi-square test and unpaired Student’s t-test were applied for comparison. Pearson’s correlation coefficient test was done to see the association between gestational age of both preterm and term babies and their haemoglobin levels and haematocrit values. A p-value <0.05 was considered as statistically significant.

The study was approved by the Ethical Review Committee of Department of Paediatrics, Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders (BIRDEM) Hospital, Dhaka, Bangladesh. Written informed consent was taken from the mothers of the newborns.

Results

A total of 100 newborns (49 preterm babies as group A, and 51 term babies as group B) were selected for this study. In group A, 28(57.1%) were male and 21(42.9%) were female, while in group B, 26(51.0%) and 25(49.0%) respectively. However, the difference was not statistically significant (p>0.05). In group A, 6(12.3%) babies had ≤1000 gm birthweight, 13(26.5%) had 1001-1499 gm, 28(57.1%) had 1500-2499 gm, and 2(4.1%) had ≥2500 gm, while in group B, 3(5.9%) had 1001-1499 gm, 10(19.6%) had 1500-2499 gm and 30(74.5%) had ≥2500 gm birthweight respectively. The differences were statistically significant (p<0.001) (Table-I). No differences were observed in total count of RBC, total count of WBC and platelet count between two groups (p>0.05). In differential count of WBC, leucocyte and lymphocyte showed significant differences (p<0.001). Heamoglobin level and haematocrit value between two groups showed significant differences (p<0.001) (Table-II). Pearson's correlation coefficient revealed positive correlations – between gestational age and heamoglobin level (r=0.412; p<0.001) (Fig. 1) and also between gestational age and haematocrit value (r=0.382; p<0.001) (Fig. 2).

Table-I: Demographic characteristics of the preterm and term newborn babies (N=100)

Variables	Newborn Babies		p-value
	Group A (n=49)	Group B (n=51)	
Gender			
Male	28 (57.1)	26 (51.0)	>0.05^{NS}
Female	21 (42.9)	25 (49.0)	
Birthweight (gm)			
≥2500	2 (4.1)	30 (74.5)	<0.001^{S}
1500-2499	28 (57.1)	10 (19.6)	
1001-1499	13 (26.5)	3 (5.9)	
≤1000	6 (12.3)	-	

Chi-square test was applied; S=significant, NS=not significant.

Table-II: Haematological variables in preterm and term newborn babies (N=100)

Haematological Profile	Newborn Babies		p-value
	Group I (n=11)	Group II (n=17)	
Total count of RBC (×10^6 per mm^3)	5.12±0.37	5.33±0.28	>0.05^{NS}
Total count of WBC (per mm^3)	15233±8312	16496±5059	>0.05^{NS}
Differential count of WBC			
Neutrophil (%)	44±20	58±13	<0.001^{S}
Lymphocyte (%)	48±19	33±13	<0.001^{S}
Monocyte (%)	6±4	7±4	>0.05^{NS}
Eosinophil (%)	2±1	3±1	>0.05^{NS}
Platelet count (per mm^3)	188653±63605	218647±66495	>0.05^{NS}
Haemoglobin (gm/dl)	16.2±2.2	17.7±1.8	<0.001^{S}
Haematocrit (%)	47.5±6.5	51.3±4.4	<0.001^{S}

Unpaired Student's t-test was applied; S-significant, NS=not significant.

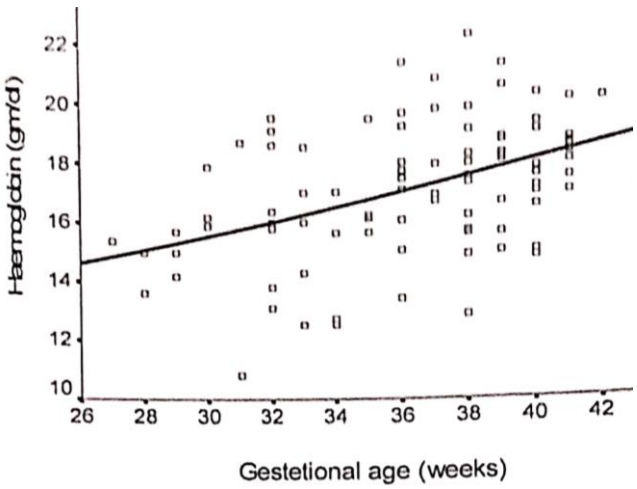

Fig. 1: Scatter diagram showing positive correlation between gestational age (both preterm and term babies) and haemoglobin level (r=0.412; p<0.001).

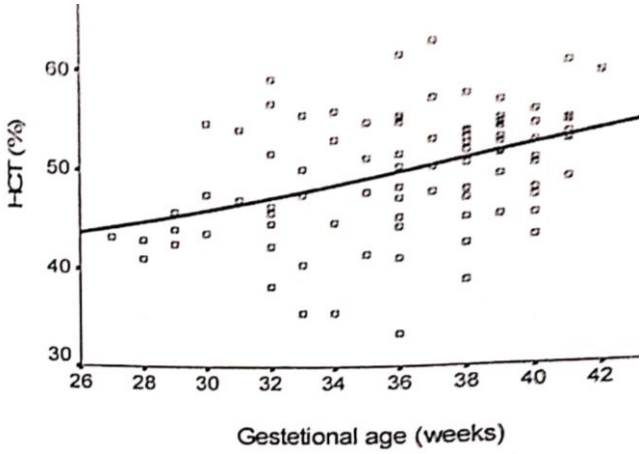

Fig. 2: Scatter diagram showing positive correlation between gestational age (both preterm and term babies) and haemotocrit value (r=0.382; p<0.001).

Discussion

Preterm low-birth-weight infants remain difficult to manage despite adequate laboratory tests.[13] In lower-middle income countries (LMICs), reference ranges remain an important guide for properly interpreting the clinical laboratory studies obtained from newborn infants.[9] However, in most LMICs, there is a paucity of appropriately designed guidelines to assist healthcare providers in their care of preterm neonates in specialties such as paediatric haematology; as a result, healthcare providers in those countries depend on guidelines developed in more affluent high income countries (HICs).[14] However, that assumption is not always fruitful. As there are ethnic variations, as evidenced in previous studies.[15-17]

Roudil *et al.* reported that all three blood lines increase in proportion to gestational age.[9] Several evidence suggested similar changes based on prematurity, and postnatal environment.[2-8] Those literature reported linear increase in RBC, WBC, and platelets as well as in haemoglobin levels and haematocrit value. For example, RBC and WBC counts increased over the first hours following delivery, with peak values occurring between 6 and 8 hours for those ≥28 weeks gestation, but at 24 hours for those delivered at <28 weeks, while the reference ranges for patients below 28 weeks gestation are about 10 hematocrit points lower, with a mean hemoglobin concentration 3.3 g/dl lower, than those of later preterm and term neonates.[2] All those findings are more or less in congruence with our results. Similarly, Wu et al. also found that there were trends of increase in red blood cell counts, haemoglobin levels and haematocrit values as gestation increased up to 34 weeks in Taiwanese preterm infants and there was an initial trend of decrease in white blood cell counts and then increased after 31 weeks gestation. However, the platelet counts were essentially unchanged.[15] In contrast, Bae *et al.* showed that RBC, haemoglobin and hematocrit values increased, whereas the white blood cell and platelets decreased as the gestational age increased.[16] Arif *et al.* and Guida *et al.* observed that thrombocytopenia is a problem frequently encountered in the neonatal period especially in preterm neonates.[18,19] Numerous physiological changes lead to a rapid change in normal haematological parameters during pregnancy and birth.[20] Similar results were showed in several previous reports from different countries.[16,21-23] However, it was beyond the scope of this study to investigate whether such changes took place due to prematurity or as a consequence of duration of labour, mode and events during delivery.

The limitations of the present study include lack of a control group, which would help better to make comparison and its cross-sectional design, which limits the possibility of understanding the mechanism or assessment of the outcomes. Moreover, our study period was short and sample size was small, due to the budget constraint. Hence, the results of the study

may not be generalized and does not necessarily reflect the overall picture of the country. Further studies with larger samples involving multiple hospitals are recommended.

Conclusion

Our data suggest that differences exist in different haematological parameters between preterm and term neonates. The results of the study may help to establish the baseline reference ranges for haematological parameters for neonates in our country. Better awareness and understanding these physiological variations may help physicians take clinical and therapeutic decisions in paediatric management in everyday practice.

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