Original Article

Haematological Profile of Preterm Neonates:An Experience of A Specialized Tertiary Hospital in Dhaka, Bangladesh

Asmay Jahan[1], Nazmun Nahar[2], Afroza Akhter[3], Mukta Sarker[4], Fahmida Rahman[5]

Abstract

Background: 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. ***Objective:*** To observe and correlate gestational agerelated changes in the haematological profileof the preterm neonates. ***Methods:*** This cross-sectional, prospective study was conducted between July 2007 and January 2008 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. A total of 49 preterm newborns of different gestational age (28 males and 21 females) included in this study.They were divided into three groups based on their gestational age: group I (30 weeks; n=11), group II (31-33 weeks; n=17) and group III (34-36 weeks; n=21). Within 48 hours of delivery, 1 ml venous blood was collected from each neonate and was 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. ***Results:*** Significant differences were observed in total count of RBC, WBC, and platelet among those three groups. However, differential count of WBC, heamoglobin level, and haematocrit value among those three groups showed no significant differences (P>0.05). Gestational age showed a positive correlation with total count of RBC (r=0.216; P<0.05). Gestational age had also a positive correlation with neutrophil (r=0.448; P<0.001). Besides, gestational age was negatively correlated with lymphocyte (r=-0.389; P<0.001) However, gestational age did not bear any correlation with total count of WBC, monocyte, and eosinophil. Finally, gestational age was found to bear a positive correlation with heamoglobin level (r=0.412; P<0.001) and haematocrit value (r=0.382; P<0.001). ***Conclusion:*** Our data suggest that differences exist in different haematological parameters among preterm neonates of different gestational age.

Keywords: Haematological profile, complete blood count, preterm neonates, Bangladesh

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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 referenceranges for the various complete blood count (CBC) elements in the neonatalperiod are not simple to suggest, as because changes occur considerably with advancing gestational and postnatal age.[2] Hence, diagnosing a low or highblood concentration of RBC, WBC, and plateletsshould be evidence-based. This

1. Assistant Professor, Department of Paediatrics, Armed Forces Medical College, Dhaka Cantonment, Dhaka-1206, Bangladesh.
2. Professor and Head, Department of Paediatrics, Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders (BIRDEM) Hospital, Dhaka-1000, Bangladesh.
3. Classified Child Specialist, Combined Military Hospital, Chattogram Cantonment, Chattogram-4220, Bangladesh.
4. Classified Child Specialist, Combined Military Hospital,Saidpur Cantonment, Nilphamari-5310, Bangladesh.
5. Senior Medical Officer, Department of Paediatrics, Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders (BIRDEM) Hospital, Dhaka-1000, Bangladesh.

Correspondence to: Major (Dr.) Asmay Jahan, Assistant Professor, Department of Paediatrics, Armed Forces Medical College, Dhaka Cantonment, Dhaka-1206, Bangladesh. Email: asmayjahanfancy@gmail.com

cannot be accomplished using the normal ranges established in healthy adults, butcan be estimated by using reference ranges derived from large neonataldatasets.[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 infants generally do not apply to preterm infants and laboratory values for low-birth-weight.[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 tends to present specificities in case of 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.[10]Recognizing that CBC elementschanges with gestational age and abnormally high or low valuesinfluence our clinical decisions in neonates, we proposed this study to observe and compare heamatologic values in preterm neonates and evaluate the impact of gestational agein an urban tertiary specialized hospital in our country.

Methods

This cross-sectional, prospective study was conducted between July 2007 and January 2008, 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. This is tertiary level specialized hospital having NICU support. A total of 49 preterm neonates participated in this study. Gestational age was calculated from LMP (first day of a woman's last menstrual period)[11] and clinical assessment was done by using modified Ballard Maturational Score.[12]They were divided into three groups based on their gestational age: Group I (≤30 weeks; n=11), Group II (31-33 weeks; n=17) and Group III (34-36 weeks; n=21). Within 48 hours of delivery, 1ml venous blood was collectedfrom each neonate and blood sample was stored in an ethylene diamine tetra acetic acid coated plastic microcontainer following a standard operating procedure.[13]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). The mean values along with standard deviation (SD) were calculated for continuous variables. The qualitative observations were counted by frequencies and expressed in percentages. Analyses were done usingChi-square ($\chi 2$) test and one-way ANOVA for different variables. Pearson's correlation coefficient test was done to see the association between gestational age and different variables. P value <0.05 was considered as statistically significant.

Results

In group I, 5(45.45%) were male and 6(54.55%) were female, while in group II, 8(47.06%) and 9(52.94%) respectively and in group III, 8(38.10%) and 13(61.90%) respectively. However, the difference was not statistically significant (P>0.05). In group I, 4(36.36%) babies had ≤1000 gm birthweight, 6(54.55%) had 1001-1499 gm, and 1(9.09%) had 1500-2499 gm, while group II, 10(58.82%), 5(29.41%) and 2(11.77%) respectively. In group III, 2(9.52%) had 1001-1499 gm birthweight, 17(80.96%) had 1500-2499 gm and 2(9.52%) had ≥2500 gm. However, the difference was not statistically significant (P>0.05) (Table 1). Significant differences were observed in total count of RBC, total count of WBC, and platelet count among those three groups. However, differential count of WBC, heamoglobin level, and haematocrit value among those three groups showed no significant differences (P>0.05) (Table 2). Using Pearson's correlation coefficient test, gestational age was shown to have a positive correlation with total count of RBC (r =0.216; P<0.05). Gestational age had also a positive correlation with neutrophil (r =0.448; P<0.001). Besides, gestational age was negatively correlated with lymphocyte (r = -0.389; P<0.001)However, gestational age did not bear any correlation with total count of WBC, monocyte, and eosinophil. Finally, gestational age was foundto bear a positive correlation with heamoglobin level (r =0.412; P<0.001) and haematocrit value (r

=0.382; P<0.001) in preterm neonates of the study (Table 3).

Table 1. Demographic characteristicsof the preterm newborn babies (n=49)

Variables	Gestational age (in week)			P value
	Group I (n=11)	Group II (n=17)	Group III (n=21)	
Sex				
Male	5 (45.45%)	8 (47.06%)	8 (38.10%)	>0.05
Female	6 (54.55%)	9 (52.94%)	13 (61.90%)	
Birthweight (gm)				
≥2500	-	-	2 (9.52%)	
1500-2499	1 (9.09%)	10 (58.82%)	17 (80.96%)	
1001-1499	6 (54.55%)	5 (29.41%)	2 (9.52%)	>0.05
≤1000	4 (36.36%)	2 (11.77%)	-	

Table 2. Haematological variables in preterm newborn babies of different gestational age (n=49)

Haematological Profile	Gestational age (in week)			P value
	Group I (n=11)	Group II (n=17)	Group III (n=21)	
Total count of RBC ($\times 10^6$ per mm^3)	4.62 ±0.43	5.09± 0.71	5.27±0.62	<0.001
Total count of WBC (per mm^3)	17609 ±9580	13971± 10045	14486± 5567	<0.05
Differential count of WBC				
Neutrophil (%)	45±18	37±15	48±15	0.112
Lymphocyte (%)	48±20	51±21	45±16	0.615
Monocyte (%)	6±4	6±3	5±3	0.684
Eosinophil (%)	2±1	2±1	2±1	0.955
Platelet count (per mm^3)	180182 ±48245	187882± 40241	191095± 47990	<0.05
Haemoglobin (gm/dl)	15.3±1.2	16.3±2.6	16.6±2.2	0.295
Haematocrit (%)	44.4±3.9	48.3±6.8	48.5±6.9	0.202

Table 3. Correlation of gestational age with different haematological variables

Correlated variables		Correlation Coefficient(r)	P value
Gestational age	Total count of RBC	0.216	<0.05
Gestational age	Total count of WBC	0.027	0.792
Gestational age	Neutrophil	0.448	<0.001
Gestational age	Lymphocyte	-0.389	<0.001
Gestational age	Monocyte	0.051	0.616
Gestational age	Eosinophil	-0.158	0.115
Gestational age	Platelet count	0.209	<0.05
Gestational age	Haemoglobin	0.412	<0.001
Gestational age	Haematocrit	0.382	<0.001

Discussion

Preterm low-birth-weight infants remain difficult to manage despite adequate laboratory tests.[14]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).[15] However, that assumption is not always fruitful. As there are ethnic variations, as evidenced in previous studies.[16-18] Hence, we felt the importance to determine a reference value in neonates in respect of gestational age to create our own database.

Roudil et al. reported that all three blood lines increase in proportion to gestational age.[10] Several evidence suggested similar changes based on prematurity, and postnatal environment.[2-8]Those literature reportedlinear increase in RBC, WBC, and platelets as well as in haemoglobin levels and haematocrit value. For example, RBC and WBC counts increased over the firsthoursfollowing delivery, with peak values occurring between 6 and 8 hours for those ≥28 weeks gestation, but at 24hours for those delivered at <28 weeks, while thereference ranges for patients below 28 weeks gestation areabout 10 hematocrit points lower, with a mean hemoglobinconcentration 3.3 g/dl lower, than those of later preterm andterm 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.[16]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.[17]Arif et al. observed that thrombocytopenia is a problem frequently encountered in the neonatal period especially in preterm neonates.[19] Similar observations were reported by Guida et al.[20]

Numerous physiological changes lead to a rapid change in normal haematological parameters

during pregnancy, after birth and throughout the neonatal period.[21,22] Hence, it is really difficult to judge whether the changes occur due to prematurity or as a consequence oftime, mode and eventsof delivery.[16,23]Moreover, there is lack of agreement in impact of gestational age on haematologic values due to other contributing factors like maternal diabetes or hypertension.[24-27]

Conclusion

Our data suggest that differences exist in different haematological parameters among preterm neonates of different gestational age. 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 and in multi-centre settings are recommended.

Conflict of interest: The authors declare no competing financial or personal interest.

Ethical approval: 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.

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