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Original Article

Pathology Section

Comparative Analysis of Red Cell Parameters of First-time and Repeat Blood Donors: A Descriptive Study

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ABSTRACT

Introduction: Blood transfusion services form an essential component of any healthcare system and it is imperative to provide adequate and safe blood for management of patients. Voluntary blood donors form the backbone of this service. However, regular donation by such voluntary donors may cause significant depletion of iron stores in the body. This has the potential to adversely affect the donor's health, and also to lower the quality of blood being collected subsequently. The temporary deferral of such donors also causes reluctance to return for future blood donations, leading to decrease in size of the donor pool. The prompt detection of subclinical iron deficiency in voluntary blood donors is the need of the hour.

Aim: To compare and analyse the difference in red cell parameters of first-time and repeat blood donors.

Materials and Methods: A descriptive study was conducted by the Department of Blood Bank and Pathology at Rajarshi Dashrath Autonomous State Medical College, Ayodhya, Uttar Pradesh, India, from July 2021 to December 2022. After prospective donors were assessed for suitability of blood donation, written informed consent was obtained, and 5 mL venous blood was collected into an Ethylenediaminetetraacetic Acid (EDTA)-anticoagulated vial via the antecubital fossa. Complete blood count was performed within one hour of collection using an automated haematology analyser. The parameters analysed in the study were Red Blood Cell (RBC) count, haemoglobin, Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH), Mean Corpuscular Haemoglobin Concentration (MCHC), and Red cell Distribution Width (RDW). The generated data was compiled and statistical analysis, with Kruskal-Wallis test (at a p-value of 0.05) and post-hoc Dunn test was performed to determine the significant differences, if any.

Results: The study included 455 participants, out of which 210 were repeat blood donors. The significant differences for MCV, MCH and RDW between groups defined by number of donations (p-value <0.001) were observed. The difference was most significant between the donors having five or more donations compared to donors having no previous donations. No significant differences were observed for other parameters, with p-values for RBC count, haemoglobin, and MCHC being 0.3, 0.07, and 0.09, respectively.

Conclusion: Repeat blood donors having low MCV and MCH along with high RDW, with haemoglobin values within normal range, are most susceptible to having subclinical iron deficiency, which needs to be identified and managed pre-emptively, before development of Iron Deficiency Anaemia (IDA). This is necessary in order to retain regular and repeat voluntary blood donors, and also to ensure adequate quality of collected blood.

Keywords: Anaemia, Blood bank, Blood donation, Iron deficiency

INTRODUCTION

Blood transfusion services form a very essential component of the healthcare system and play an important role in the management of patients, both surgical and medical [1]. The purpose of blood banks is to provide safe and adequate blood and blood products. The World Health Organisation (WHO) recommends voluntary non remunerated blood donations by healthy individuals for the same [2]. The selection of prospective donors for blood donation is one of the most important steps in the process. Strict guidelines are followed to assess suitable donors, to safeguard the health of both the recipient and the donor [3]. This is done in order to ensure the quality of blood and blood products. Also, their sufficient supply of blood as per local requirement has to be maintained. So certain steps need to be taken to prevent unnecessary loss of healthy donors. Individuals who are found unsuitable for blood donation are deferred, either temporarily or permanently. The most frequent cause for temporary donor deferral is low haemoglobin level, which in majority of the cases is due to IDA [4].

Repeat blood donors are particularly at risk for developing IDA, for which they will be temporarily deferred in the future. This avoidable temporary deferral leads to loss of the individual from the pool of potential donors, due to reluctance to return for blood donation. Individuals who have been temporarily deferred for this reason donate 30% less blood over the next five years, even after their haemoglobin levels return to normal range [5,6]. The frequency of blood donation has been regulated to prevent the development of anaemia in repeat donors, with an interval of three months necessary after the previous donation. Routinely, haemoglobin level is tested to determine the suitability of the prospective donor. However, this is insufficient by itself for identifying iron deficiency as lowering of haemoglobin level is the last stage in the pathogenesis of body iron depletion.

The alteration in red cell indices and RDW can be useful in the early detection of IDA. The present study aimed to study the relation of these parameters with the number of blood donations, in order to identify repeat blood donors who are at an increased risk of developing iron deficiency. This is necessary for a relatively newer blood bank, and findings of the study can be used to frame institutional and regional guidelines.

MATERIALS AND METHODS

A descriptive study was conducted at the Department of Blood Bank and the Department of Pathology at Rajarshi Dashrath Autonomous State Medical College, Ayodhya, Uttar Pradesh, India, from July 2021 to December 2022. Ethical clearance for the study was obtained as per institutional guidelines (RDASMC/IEC/2022/427). The prospective donors were assessed for suitability of blood donation and were asked specific questions as per the standard technical manual of the

Directorate General of Health Services (DGHS) [7]. Written informed consent was obtained from all participants.

Inclusion criteria: The donors were in the age range of 18 to 60 years and had haemoglobin values above 12.5 g/dL. They were healthy individuals with no clinical manifestations of any disease, and repeat donors had previously donated blood more than three months ago. The number of such previous blood donations was enquired from each donor.

Exclusion criteria: The donors who did not fulfil the inclusion criteria, provided history of chronic illnesses, or had donated blood within the previous three months were not included in the study. Also, those donors who did not provide consent for the study were excluded from the study.

The donors were grouped on the basis of number of previous blood donations into five categories, which were as follows: Group I-comprising of first-time donors; Group II-comprising those who had donated once previously; Group III-comprising those who had donated two to three times previously; Group IV-comprising those who had donated four to five times previously; and Group V-those who had donated six or more times previously [1,8].

The salient features of the study were explained to the participants and written informed consent was obtained. A 5 mL venous blood was collected into an EDTA-anticoagulated vial via the antecubital fossa, from the opposing arm intended for the actual blood donation. Complete blood count was performed within one hour of sample collection using an automated haematology analyser Medonic M-series M20M-GP.

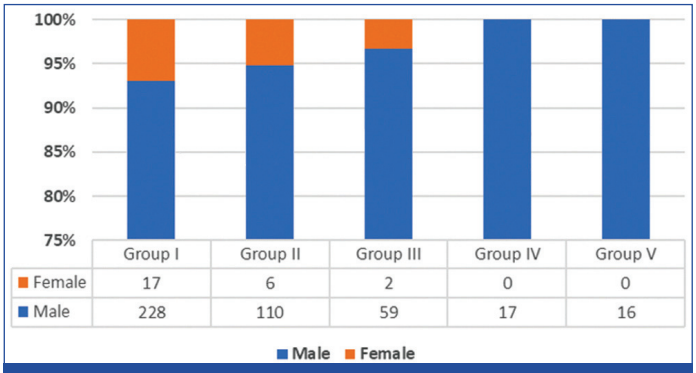
The reference ranges for the parameters evaluated in the study are as follows (for adult males, adult females) [9]: RBC count- 5.0±0.5×10^6/cumm, 4.3±0.5×10^6/cumm; haemoglobin- 15±2 g/dL, 13.5±1.5 g/dL; MCV- 92±9 fL; MCH- 29.5±2.5 pg; MCHC- 33±1.5 g/dL; RDW- 12.8%±1.2%.

STATISTICAL ANALYSIS

The parameters analysed in the study- RBC count, haemoglobin, MCV, MCH, MCHC, and RDW- were tabulated and statistically analysed using Statistical Package for the Social Sciences (SPSS) Statistics version 28.0. Kruskal-Wallis test, with statistical significance at a p-value of 0.05, and post-hoc Dunn test were performed.

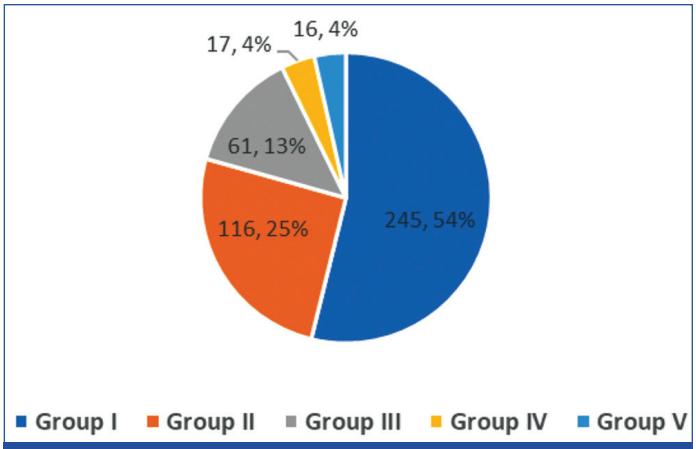
RESULTS

A total of 455 blood donors participated in the study, out of which 430 were males and 25 were females. Out of the total participants, 210 (46.15%) were repeat blood donors, which included 202 male and eight female participants. The age of participants ranged from 19 to 51 years, with more than 50% of the donors being in the range of 30 to 40 years. The distribution of participants by gender and number of blood donations is shown in [Table/Fig-1,2], respectively.



[Table/Fig-1]: Shows distribution of participants by gender.

[Table/Fig-3] shows the comparison of analysed haematological parameters among the participants, as grouped on the basis of number of blood donations. Statistical analyses showed significant differences for MCV, MCH and RDW between groups defined by number of blood donations (p-values <0.001). These differences were observed between Groups IV and V as compared to Group I for MCV and MCH, and between Group-V as compared to Group I for RDW. The mean values of MCH for Groups I, IV, and V were 30.4, 30.2, and 28.1 (in pg); of MCV for Groups I, IV, and V were 88.4, 84.1, and 82.2 (in fL); of RDW for Groups I and V were 13.8% and 15.5%. No significant differences were observed for other parameters studied across the pre-defined groups. The p-value for RBC count was 0.3, for haemoglobin it was 0.07, and for MCHC it was 0.09.



[Table/Fig-2]: Shows of participants by number of blood donations.

Variables	Pre-defined groups	Number of participants	Mean	Median	p-value
MCH (pg)	Group I	245	30.4	29.9	<0.001
	Group II	116	30.8	30.6	
	Group III	61	29.6	29.8	
	Group IV	17	30.2	30.1	
	Group V	16	28.1	27.6	
MCV (fL)	Group I	245	88.4	87.9	<0.001
	Group II	116	88.5	88.1	
	Group III	61	86.3	86.5	
	Group IV	17	84.1	84.8	
	Group V	16	82.2	82.7	
MCHC (g/dL)	Group I	245	33.8	34	0.09
	Group II	116	34.1	34.1	
	Group III	61	33.8	33.9	
	Group IV	17	33.7	33.9	
	Group V	16	33.7	33.8	
RDW (%)	Group I	245	13.8	13.6	<0.001
	Group II	116	13.9	13.7	
	Group III	61	14.1	13.6	
	Group IV	17	14.1	13.7	
	Group V	16	15.5	14.8	
RBC count (x10^6/cu mm)	Group I	245	5.3	5.1	0.3
	Group II	116	5.1	5.1	
	Group III	61	5.2	5.3	
	Group IV	17	5.1	5.2	
	Group V	16	5.2	5	
Hb (g/dL)	Group I	245	14.1	14.3	0.07
	Group II	116	14	14.1	
	Group III	61	13.8	13.9	
	Group IV	17	13.8	13.7	
	Group V	16	13.5	13.8	

[Table/Fig-3]: Shows the comparison of analysed haematological parameters among the participants, as grouped on the basis of number of blood donations.

DISCUSSION

Voluntary non remunerated blood donors form the basis of blood donation services in India. Donation-induced iron deficiency is the most common complication of repeated blood donations [10]. Nearly 250 mg iron is present in 450 mL of blood (one unit), which constitutes nearly one-thirds of the average body iron stores in males and more than two-thirds in females [11]. It is the responsibility of the blood bank to protect donors from iron deficiency and also to impart awareness regarding iron supplementation. The development of iron deficiency occurs in three steps: iron depletion, iron-deficient erythropoiesis, and IDA. This continues until the haemoglobin level decreases below the reference range for age and gender, and the anaemia becomes evident clinically. It is postulated that after donating blood, the donor requires atleast three months to replenish their body iron stores [10,12]. Most of the studies from the country have reported anaemia as the commonest cause for temporary donor deferral [13]. Less than 10% of the temporarily deferred individuals return later for voluntary blood donation after the period of deferment [4]. This leads to an unnecessary loss of donors from the prospective pool which is already deficient in number. There is shortage of almost three million units of blood and blood products in India per year. In a system that is dependent on voluntary non remunerated donors, it is imperative to maintain a pool of individuals who are willing to donate blood on humanitarian grounds. Care must be taken to safeguard their well-being, which includes the diagnosis of depletion of iron stores at the earliest possible stage, so that it can be proactively managed. This will have a positive psychological impact on the individual and ensure their availability for future blood donations.

The primary finding of this study is that repeat donors who have previously donated blood more than four times have significantly lower MCV and MCH values as compared to first time blood donors. Also, the RDW is significantly increased in donors who have donated blood six or more times previously. Various studies have highlighted the role of red cell indices and RDW in the early detection and prevention of IDA across different settings [14,15]. In a study by Jain A et al., on the role of altered red cell indices in repeat blood donors, significant differences were found for MCH, MCV, and haemoglobin in donors having six or more donations [8]. Ogar CO et al., have demonstrated significant differences in MCH, MCHC, and RDW in their study on repeat blood donors, the findings of which match with the current study [1].

Using these parameters, it is possible to prevent the development of overt IDA in repeat donors. By early and prompt detection of iron deficiency, necessary supplementation and dietary modification can be done. This will reduce the number of temporary deferrals and ensure a healthy donor pool for subsequent donations.

Limitation(s)

The limitation of the study was that the findings were not compared with serum ferritin, which is the confirmatory test for analysis of body iron stores. Also, the time duration between successive blood donations was not be included in the study. The minimum duration for repeat blood donation was strictly followed in all cases, as it the time required for replenishment of body iron stores.

CONCLUSION(S)

MCV, MCH and RDW are useful tools for detection of iron deficiency at an early stage, much before the decrease in haemoglobin level below the lower limit for age and gender. Proper use of these parameters will be helpful to prevent the development of clinically evident IDA. This will play a very important role in the assessment and management of repeat blood donors, who are at high-risk for developing iron deficiency.

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