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Insight into donor deferral pattern based on peripheral blood counts: An experience from South Pakistan

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Abstract:

BACKGROUND: Donor deferral owing to anemia is one of the major causative factors of temporary donor rejection, which is preventable and treatable. The basic knowledge about frequency, types, and severity of anemia among donors will help plan a strategy to promote donor recruitment and overall national health.

OBJECTIVE: The objective of this study was to provide the predonation deferral rate of the healthy blood donors based on peripheral blood counts and second to determine the types of anemia along with its severity.

MATERIALS AND METHODS: Prospective records of all the reported donors were collected from January 2014 to December 2015 at Liaquat National Hospital, Karachi, Pakistan. Donor samples were analyzed on an automated hematology analyzer.

RESULTS: Overall, 36,954 potential donors reported to the blood bank, out of which 33,853 were selected and 3101 were deferred, which makes the deferral rate of 8.39%. Majority of donors ($n = 2663$ [7.20%]) were deferred based on peripheral blood counts. Based on peripheral count, anemia (91.8%) represents the major cause of deferral, followed by raised total leukocyte count (3.7%) and polycythemia (3.3%), and thrombocytopenia (1.0%) was the least potential cause. Microcytic-hypochromic anemia was found in 58.5% of the donors followed by normocytic and macrocytic anemia in 38.9% and 2.4%, respectively. Mild anemia was seen in 78.2% followed by moderate and severe anemia in 20.5% and 1.18%, respectively.

CONCLUSION: A high prevalence of anemia among blood donors signifies deteriorating health status not only in donor population but also in general population. This situation calls for more concerted efforts as otherwise it would lead to decreased blood donor pool.

Key words:

Anemia, blood donors, donor deferrals, Pakistan

Introduction

The high prevalence of anemia is still a major public health problem in the developing countries.^[1] Worldwide, anemia affects 1.62 billion individuals, which is estimated to be ~25% of the world population.^[2] Globally, around 10% of blood donors are deferred owing to low hemoglobin on predonation assessment.^[3-5] Similarly, in the United States, approximately 10% of all

attempted blood donors are deferred due to low hematocrit.^[6] In a large majority of the donors in developing countries, anemia is correctable.

Practically, blood donors deferred due to anemia are less likely to return back due to negative sentiment even if they were regular donors beforehand.^[7] It has been observed that 30% of the donors deferred due to anemia are unlikely to come back within the

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next 5 years even if they have been regular blood donors compared with those who have been selected.^[8] Thus, the shortage of blood supply is overtly exaggerated.

As per the World Health Organization's guidelines (WHO) and American Association of Blood Banking (AABB), a specified cutoff of lower hemoglobin levels (<12.5 g/dL) for donor selection is defined, but the upper limit for hemoglobin, references ranges for white blood counts and platelet counts are not established yet.^[9,10] Each blood transfusion service is supposed to set its own reference ranges for peripheral blood count parameters.

In the present study, we aimed to assess the prevalence of donor deferral based on peripheral blood counts in otherwise healthy donor population. It would provide information about the actual health status in the healthy donors as well as in the general population. We also assessed the type and severity of anemia. Hence, donors deferred for anemia represent a considerable percentage of the donor pool. By recognizing the type of anemia, future guide for developing programs to improve the blood donors' health and to promote donor recruitment will be made to optimize blood collection.

Materials and Methods

Setting

Data collection for this prospective cross-sectional study was carried through the records maintained at the Blood Bank of Liaquat National Hospital (LNH) and Medical College, from January 2014 to December 2015. LNH is an over 700-bed tertiary care teaching institute located in the metropolitan city Karachi. Our blood bank comprises experienced faculty, well-skilled technologists, and high-tech equipment.

Study participants

Demographical data including name, age, gender, contact number, and type of donor were entered on a structured standard questionnaire. Donors were questioned about medical and prior history of donation. All donors were selected according to defined inclusion criteria taking into account, age (≥ 18 years), weight (≥ 50 kg), pulse rate (50–100/min), and normal pressure, having hemoglobin level ≥ 12.5 g/dL with hematocrit value packed cell volume of $\geq 38\%$.

Donors were excluded from the study if they had high-risk behavior, male homosexual, multiple sexual partners, history of jaundice in the past 1 year, drug abusers, tattooing, or had recent blood transfusion. Donors were deferred if hemoglobin is <12.5 g/dl or >18 g/dl, total leukocytic count (TLC) $>14 \times 10^9/l$, or platelet count $<100 \times 10^9/l$. Informed written consent was obtained from all the blood donors.

Complete blood count testing

Venous blood samples were collected in 1-mL K3-EDTA (Ethylene di-amine tetra acetic acid) anticoagulant VACUETTE tubes (Greiner Bio-one) from all donors. Complete blood counts (CBCs) were analyzed on Nihon Kohden MEK-6410K automated hematology analyzer. Appropriate controls were run simultaneously to validate the results.

Anemia was graded based on mean cell volume (MCV) values of <76 fL, 76–96 fL, and >96 fL into microcytic, normocytic, and macrocytic anemia, respectively. Severity of anemia was determined according to the WHO criteria into mild, moderate, and severe as ≥ 11 , 10.9–8.0, and <8.0 g/dl, respectively.^[11]

Statistical analysis

Data collected were recorded on Microsoft Spreadsheet, and later statistical analyses were carried out using IBM statistics SPSS version 22 (IBM Corp., Armonk, NY). Quantitative variables were reported in terms of mean and standard deviation. Frequencies and percentages were used to report categorical data.

Ethical approval

This research protocol was approved by the Institutional Review Committee of LNH and Medical College prior to the study.

Results

During the period of study, 36,954 potential donors reported to the blood bank. Out of which, 264 (0.71%) donors were excluded based on history whereas 174 (0.47%) donors were excluded due to examination findings. The remaining 36,516 donors were qualified for

Table 1: Causes of donor deferral based on peripheral blood counts

Cause of deferral	Defined criteria	Deferred donors (n=2663)	Deferred donors (%)
Low hemoglobin	<12.5 g/dl	2445	91.8
High TLC	$\geq 14 \times 10^9/l$	100	3.7
High hemoglobin	>18 g/dl	90	3.3
Low platelet count	$\leq 100 \times 10^9/l$	28	1.0

TLC = Total leukocyte count

Table 2: Types of anemia in deferred donors

Type of anemia	Deferred donors (n=2445)	Deferred donors (%)	Mean MCV	Mean MCH	Mean MCHC
Microcytic	1431	58.5	69.3 \pm 5.2	21.8 \pm 4.3	28.6 \pm 1.6
Normocytic	953	38.9	81.3 \pm 7.8	27.1 \pm 5.1	31.2 \pm 2.3
Macrocytic	61	2.4	98.4 \pm 3.2	29.9 \pm 6.4	32.9 \pm 2.8

MCV = Mean cell volume, MCH = Mean corpuscular hemoglobin, MCHC = Mean corpuscular hemoglobin concentration

CBC, of which 2663 (7.20%) donors were deferred based on deranged peripheral blood counts.

The selected blood donors comprised 33,853 participants, of which 33,717 (99.5%) were males and 136 (0.4%) were females. Overall, most (99.1%) of the donors were replacement donors ($n = 33565$) and only a small percentage (0.9%) included voluntary donors ($n = 288$).

A total of 2663 donors were deferred due to baseline outcomes of peripheral blood counts. The study participants had a mean age of 28.09 ± 8.04 (18–55) years with a median age of 28 years. Majority were males ($n = 2612$) and little were females (1.9%). Only 478 (17.9%) donors had a history of previous blood donations. As per the evaluated results, following are the main reasons for donor deferrals: Low hemoglobin levels ($n = 2445$ [91.8%]) being the most common cause followed by raised TLC and high hemoglobin in 3.7% ($n = 100$) and 3.3% ($n = 90$), respectively, and low platelet count ($n = 28$ [1.0%]) was the least common cause as shown in Table 1.

The mean hemoglobin of deferred donors was 11.4 ± 1.0 g/dl with hematocrit of 37.4 ± 3.1 . The MCV was 74.3 ± 11.2 , and mean corpuscular hemoglobin and mean corpuscular hemoglobin concentration were 22.9 ± 5.3 and 30.6 ± 1.6 , respectively. The mean TLC was $8.0 \pm 1.8 \times 10^9/l$, and the mean platelet count was $297.6 \pm 88 \times 10^9/l$.

Microcytic hypochromic anemia was found in 58.5% ($n = 1431$) of the donors followed by normocytic and macrocytic anemia in 38.9% ($n = 953$) and 2.4% ($n = 61$), respectively [Table 2]. Mild anemia was seen in 78.2% ($n = 1913$) of the donors followed by moderate anemia and severe anemia in 20.5% ($n = 503$) and 1.18% ($n = 29$), respectively.

Discussion

The present study gives an insight of existing trend of donors deferral based on peripheral blood counts in healthy blood donors. The study demonstrates the importance of performing CBC rather than reliant on copper sulfate method for semi-quantitative assessment of solely hemoglobin. Herein, in Pakistan, where blood banks mainly rely on replacement/family donations, a high prevalence of deferral rate (7.20%) based on blood counts among donor population is an alarming situation. The data reveal that iron deficiency anemia is the most common cause of deferral, thereby reflecting onto the health status of the general population.

We determined a temporary blood donor rejection rate of 7.2% which is within the established donor deferral

rate as determined previously. A previous study from Pakistan had determined an overall deferral rate of 13.5%, out of which 6.7% of donors were deferred due to anemia and thrombocytopenia.^[12] We compared this finding to regional study's findings which were analogous; Indian and Malaysian studies revealed the deferral rate as 9% and 5.6%, respectively, and anemia was the most frequent cause of donor deferral in both studies.^[13,14] One recent Spanish study reported by Prados Madrona *et al.* detected 8.7% of deferral rate, largely contributed by low hemoglobin/hematocrit.^[15] Relatively higher prevalence was seen in a USA study by Zou *et al.* as 12.8% in a cohort of 47,814,370 donors, which is mainly related to donor safety reasons.^[16]

The present study determined a high rate of temporary rejections among healthy Pakistani donors due to low hemoglobin concentration (91.8%). Similarly, results of a recent large cohort study by Custer *et al.* on 3.9 million donors estimated low hemoglobin (76%) as the most common cause of temporary deferrals in America.^[17] Rabeya *et al.* and Agnihotri from Malaysia and western India, respectively, have reported low hemoglobin concentration as 40.7% and 55.8%, respectively, with predominance in younger female donors.^[14,18]

Surprisingly, when the results of two local regional studies from Pakistan were compared, relatively very low frequency of anemia among donors (36.1% and 13.3%) was seen. This disparity is attributed to their very small sample (1833 and 3617) and it may be because of underestimation of anemia due to utilization of copper sulfate methodology.^[12,19] Moiz *et al.* from South Pakistan quoted 35.5% of donor rejection rate based on copper sulfate testing.^[20] We do not come across any Pakistani study addressing donor deferrals based on peripheral blood counts for comparison.

It is mandatory for all qualifying blood donors that they must have hemoglobin of at least 12.5 g/dl, as established by the Food and Drug Association and the AABBs, but they do not recommend a standardized method for hemoglobin estimation. Hemoglobin estimation is currently performed by several available methods, including the copper sulfate method, spun microhematocrit determination, spectrophotometric determination, or by automated hematology analyzers. The copper sulfate method is inexpensive and easy to use, but it does not give quantitative results and mostly relies on a subjective assessment. In Pakistan, most donor centers utilize the copper sulfate method to estimate hemoglobin levels and this led to acceptance of anemic donors. This study strongly highlights the need for revision of hemoglobin screening practices in our country. In view of frequent anemic borderline donors in the present study, it is strongly recommended to have a

complete blood count rather to rely on semi-quantitative methods.

Our results showed that 78.2% of the donors had mild anemia with preponderance of microcytic hypochromic anemia (58.5%) as the leading cause of deferral followed by normocytic anemia (38.9%). Analogous to this finding, Bahadur *et al.* from India have quoted that 82.9% of the donors had mild anemia.^[13] Fortunately, only 1.18% ($n = 29$) of our donors were suffering from severe anemia. One recent study by da Silva *et al.* from Brazil established the presence of iron deficiency in 37.5% in their rejected donors.^[21] We did not determine the underlying etiological factor for microcytic anemia, which is our limitation.

In view of poor socioeconomical status and inadequate dietary practices in our country, it can be hypothetical that the presence of predominant microcytic anemia indicates advanced iron deficiency among our donors. Underdeveloped countries are considered to be an area of highest prevalence of iron deficiency due to variable reasons, mainly poverty and dietary habits as compared to the Western norms.^[22] Iron deficiency anemia and other microcytic anemia, including β -thalassemia and α -thalassemia trait, are other causative factors in our setting, which needs to be validated. However, whatever will be the cause of anemia, its high prevalence indicates a poor health status in our general population. Furthermore, it strongly raises the question about the general health in Pakistani population.

Low hemoglobin level (12 g/dl) has been practiced in India and Bhutan to overcome a donors shortage.^[23,24] However, it is debatable for a long period whether to follow the international guidelines or follow the regional standards, but in the absence of local reference ranges of our population, it is reasonable to follow international guidelines.

The AABB has established a minimum limit of hemoglobin as 12.5 mg/dl for both genders, but did not set any upper acceptable limit.^[9] We determined the high hemoglobin level as a third reason (3.3%) for donor deferral. One recent Iranian study quoted that 24/1000 (2.4%) donors were rejected due to raised hemoglobin.^[25] In contrast to our findings, very low prevalence (0.1%) was seen in a Sub-Saharan African study.^[26]

Recently, the WHO revised the diagnostic criteria for polycythemia vera (2016); as diseases were possibly underdiagnosed using the high hemoglobin levels (Hb >18.5 g/dl and >16.5 g/dl in males and females, respectively) as established in 2008.^[27] At present, the threshold for diagnosis is Hb >16.5 g/dl and >16 g/dl

in males and females, respectively.^[27] Here, it needs to be clarified that what would be the approach in the potential donors with hemoglobin between 16.5 and 18.5 g/dl? Would these donors can be selected or deferred? Whether they require molecular testing or bone marrow biopsy for confirmation of occult myeloproliferative neoplasm?

The AABB also not yet determined TLC and platelet counts' acceptable limits for donors.^[9] However, it seems to be a practical decision to set appropriate ranges for TLC and platelets counts as well depending on demographics, which we did. We deferred such donors and referred them to clinical hematologist for appropriate management.

Raised TLC (3.7%) is the indirect indicator of underlying infection, which should be regularly evaluated in all donors. We did not come across any study which documented the raised TLC as a cause of donor rejection.

Finally, thrombocytopenia is the least (1.0%) encountered cause of deferral in our study. Tufail *et al.* detected the low platelet counts in 1.8% of deferred donors in their series which is in parallel to our findings.^[12] However, Pujani *et al.* determined higher prevalence (37 donors out of 343 [10.7%]) of deferred donors for low platelet counts, which is attributed to higher ($150 \times 10^9/l$) platelet count threshold for deferral.^[28] Though whatsoever the cause of thrombocytopenia, the donor screening will reflect platelet counts in general healthy population.

We would like to mention our limitation as well. The percentage of female donors is very low among deferred donors, due to which result cannot be generalized. Second, we did not have demographic details and relevant history of donors with high TLC, low platelet, and with raised hemoglobin.

To manage blood donors deferred for low hematocrit is a major challenge. A single blood donation removes 200–250 mg of iron from the donor. Iron replenishment therapy for 3 months following blood donation should be prescribed to regular donors or first-time donors depending on red cell indices. Government health policies for iron fortification can improve the general health of population. In future, more studies are definitely required assessing donors' health in relation to its etiology and prevention. Last but not the least, it is the foremost duty of blood bank staff to elucidate the cause of deferrals and guide the donors for hematological referrals for proper evaluation and treatment.

Conclusion

A considerable fraction of blood donors are deferred due to low hemoglobin, which is largely attributed to

microcytic mild variant of anemia. The study highlighted the importance of complete blood counts rather to rely on semi-quantitative methods. Future large studies from our region are needed to determine the etiology and prevalence of donor deferral. Health policies need to be revised and should target toward general health awareness among the blood donors.

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Conflicts of interest

There are no conflicts of interest.

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