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A study to assess the iron status of regular blood donors

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Abstract

Blood transfusions save lives and improve health. The general impact of blood donation on iron status has been studied since the late 1970's. Iron deficiency anemia is a common finding in regular blood donors. According to current guidelines hemoglobin (Hb) is used to screen donors in blood bank. Hb measurement alone may not detect donors with iron-deficiency, thus accepting many donors with depleted iron stores, but normal Hb values. In this study we have assessed the iron status of regular male blood donors. 240 male donors were included in this study and were divided into two groups depending on number of donation. Group A consisted of 110 first time donors and group B consisted of 130 regular donors, who had donated more than three times in past 2 yrs. Serum ferritin, iron, total iron binding capacity (TIBC), transferrin saturation and complete blood count (CBC) was done in all the donors. The mean serum ferritin level in group B (57.6±37.5ng/ml) was significantly lower compared to group A blood donors (75.5±50.8ng/ml). 4.5% of donors in group B and 2.3% of donors in group A had reduced serum iron. Thus Hb estimation alone will not detect iron-deficiency in regular male donors. Serum ferritin and serum iron should be done in all blood donors to ensure donor safety.

Keywords: Blood donation, Blood donors, Iron-deficiency anemia, Serum ferritin, Serum iron.

Introduction

Millions of lives are saved each year via blood transfusion[1]. A regular supply of blood is required to treat severe anemia in children under five years old, management of pregnancy related complications, and, also used for supportive care in cardiovascular and transplant surgery, massive trauma and cancer treatment.

Donations may be whole-blood (WB) or of specific components directly. Before blood donation, donors' hemoglobin is measured as a routine screening test for allowing him to donate blood[2]. Accepted baseline hemoglobin (Hb) is 12 g/dl and 13 g/dl for female and male donors' respectively and, a donation interval of 12 weeks minimum have been stipulated in some countries to ensure donor safety[3]. Measurement of Hb is an easy and inexpensive method to rule out anemia in donors. However, such routine methods do not reflect on the status of the total body iron content of an individual.

At each bleeding procedure 425 to 475 ml is collected, which results in 200 to 250 mg of iron loss, and, subsequent mobilization of iron from body stores. Recent reports have shown that body iron reserves are small and iron depletion is more common in blood donors than in non-donors[4]. An inverse relationship is seen between body iron stores and absorbed iron. As there is a decrease in body iron stores, increase in iron absorption is seen. With continued iron loss (due to frequent donation), the iron stores are depleted and the donor eventually develop iron-deficient erythropoiesis and anemia[5].

Previous studies have shown that serum ferritin levels are markedly reduced in regular blood donors corresponding to annual donation frequency[6]. Therefore, serum ferritin measurement was considered to reflect iron stores accurately. This study was conducted in Sri Ramachandra blood bank, Chennai, to evaluate the effect of frequent blood donation on iron stores of regular male blood donors using biochemical parameters.

Materials and Methods

A cross-sectional study including 240 male blood donors was conducted in Sri Ramachandra blood bank, Chennai. Blood donors were divided into two groups depending on number of donations. Group A consisted of 110 first time blood donors (taken as control). Group B consisted of 130 blood donors, who had donated blood more than three times in past 2 years. Donors in the age group 18-45yrs, with hemoglobin between 12-17 g% were included in this study. A self-administered questionnaire was employed to get information regarding blood donation history, smoking habits, dietary habits, use of vitamins, supplements, etc. Pre-donation hemoglobin estimated by photometric azide-methemoglobin method.

Random serum sample for estimation of ferritin, iron, total iron binding capacity (TIBC), & plasma for estimation of complete blood count (CBC) was collected after getting consent. Complete blood count was done in Sysmex XE 2100- fully automated analyzer. Serum ferritin was estimated by automated chemiluminescence immunoassay method. Serum iron & TIBC were estimated by RxL dimension, by photometric method. Transferrin saturation (Tf) was calculated from serum iron & TIBC values using the formula:

$$Tf = \text{Serum Iron } (\mu L/dl) / \text{TIBC } (\mu L/dl) \times 100$$

Statistical analysis was done using SPSS software

19.0. Mean and standard deviation was calculated for quantitative continuous variable. Chi-square test was used to test the significance of difference in the qualitative data. T-test was applied to test the significance in the difference between two continuous variables. Correlation between ferritin levels and different variables were tested by Pearson correlation coefficient. p <0.05 was considered as statistically significant.

In the present study, iron status is classified as (a) depleted, when serum ferritin (SF) value is < 15ng/ml; (b) reduced, when value ranges between 15-20ng/ml; (c) normal value between 20-360ng/ml. Iron deficiency anemia is considered present when SF is < 15ng/ml.

Results

240 male blood donors between 18-45 years were included in the study. Donors were divided into two groups according to the number of donations. The blood donors in group A (n= 110) were first time donors with no previous history of donation. The donors in group B (n= 130) had donated blood more than three times in past 2 years.

Characteristics of donors in the study are shown in Table 1. 46.7% belonged to the age group of 25-35years. 50% of donors had donated blood more than 6 times in their whole life time.

Table 1: Characteristics of subjects in the study group. All values shown as n (%)

Variables		All donors (n= 240)
Age:	<24 years	77 (32.0%)
	25-34 years	112 (46.7%)
	35-45 years	51 (21.3%)
Number of donations	3-5 times	55 (50%)
	6-10 times	37 (33.6%)
	≥10 times	18 (16.4%)

Comparison of hematological and biochemical parameters are shown in Table 2. No statistical significant difference was noted between two groups of donors in Hb, MCV, MCH, MCHC, and PCV. There were few outliers in both groups in the values of SF. After removing those values the difference between the groups was found to be statistically significant with p value of 0.003. The level of serum iron in group B when compared with group A show statistically significant difference (p = 0.001). No statistical difference was seen in TIBC and transferrin saturation among the two groups.

Table 2: **Comparison of hematological and biochemical parameters between the groups**

Parameters	Group A (n=110)	Group B (n=130)	p value
Hb (g/dL)	13.6±1.7	13.5±1.3	0.664
MCV (fl)	90.2±5.6	88.6±8.2	0.073
MCHC (%)	33.1±1.3	32.9±1.4	0.202
MCH (pg)	30.1±2.1	29.5±2.5	0.609
PCV (%)	40.3±4.3	40.3±3.7	0.959
S. Ferritin (ng/ml)	75.5±50.8	57.6±37.5	0.003
S. Iron (µg/dl)	104.6±55.0	84.5±41.0	0.001
TIBC (µg/dl)	373.0±91.8	356.8±73.6	0.138
Transferrin saturation (%)	27.7±11.0	23.9±11.2	0.008

(p value < 0.05 is significant)

Iron status of donors in group A and group B is shown in Table 3. Total 24 subjects, 6 from group A and 18 from group B had shown SF level below the normal range of 20–397ng/ml. None of these donors with low SF had shown Hb level below 12.0 gm%. A total of 11 subjects, 4 in group A and 7 in group B had SF level <15ng/ml and showed iron deficient anemia (IDA). 4.5% of donors in group B had serum iron <35µg/dl compared to 2.3% of donors in group A.

Table 3: **Iron status among group A and group B blood donors**

Parameter	Group A	Group B
Ferritin ≥ 20ng/ml	119(95.2%)	85(82.5%)
Ferritin 15- 20ng/ml	2(1.6%)	11(10.7%)
Ferritin <15 ng/ml	4(3.2%)	7(6.8%)
Iron <35µg/dl	3(2.3%)	5(4.5%)
TIBC>450µg/dl	22(16.9%)	8(7.3%)
Transferrin saturation<16%	14(10.9%)	19(17.8%)

Table 4 shows correlation between various parameters. Significant correlation was found between ferritin and number of donations with p = 0.012.

Table 4: Correlation between parameters

Parameter	Pearson Correlation	p-value
Ferritin – Hb	0.113	0.089
Ferritin – age	0.088	0.184
Ferritin – donation number	0.167	0.012
Hb- donation number	0.003	0.960

(p value < 0.05 is significant)

Discussion

Since 1980's blood banks have focused on safe blood collection and an adequate blood collection.[7] There is decrease in transfusion-transmitted diseases, and, also we have witnessed gain in blood supply.

However, this achievement in adequacy of blood supply has affected the regular donors. Since it is easy to collect blood from a known or existing donor than recruiting a new donor, regular donors are at risk of developing iron deficiency.

All blood banks have minimum Hb requirement for donation. In the present study, done in Sri Ramachandra Blood Bank, donors with Hb 12-17g% were included in the study. However, there are studies showing that Hb measurement alone is inadequate to detect donors with iron deficiency anemia as they maybe in the first or second stage of iron deficiency.[8,9] This results in accepting many iron depleted donors with normal Hb values.[4] Norashikin et al, in a prospective study on male blood donors found that the sensitivity of Hb concentration as an indicator of iron deficiency in repeat donors was only 40%.[10] Adediran et al, in another study found that Hb in the study and control groups were not significantly different.[11] In the present study also, no significant difference was noted between the two groups of donors for Hb, PCV, MCH, MCHC, and MCV.

Recent studies have proved that SF is a better indicator of iron stores. SF level starts decreasing in the first sage of iron deficiency,[8,9] even when Hb levels are normal. The present study showed statistically significant decrease in SF levels of regular donors (group B) when compared with first time donors (group A). 17.5% of donors in group B had iron deficiency (SF<20ng/ml) and 6.8% donors had iron-deficiency anemia (SF<15ng/ml), respectively. Our results compare well with other studies.[12,13,14] Nadarajan et al, in their study on blood donors, found Hb cut-off levels did not appear to be predictive of iron deficiency as significant proportion of individuals showed low ferritin levels.[15] Mittal et al, in their study observed low ferritin level in donors donating their blood twice a year.[16]

Iron deficiency anemia is seen in third stage of iron deficiency. It is characterized by significantly reduced hemoglobin, decreased MCV, elevated TIBC, low transferrin saturation and low serum iron level.[8,9] In the present study, 4.5% of regular donors had reduced serum iron which was statistically significant. Also a significant correlation was seen between SF and number of donations with p value 0.012 (Table 4). This shows the importance of measuring iron stores (serum ferritin) in regular donors selected for blood donation.

Conclusion

Our study found that regular blood donors had low iron stores (decreased serum ferritin seen in 17.5% donors). Using the current guidelines (Hb>12.5g/dL) for donation, donors true iron status is not reflected. Serum ferritin and serum iron reflect the true iron status more accurately. Therefore, measuring serum ferritin and serum iron in addition to Hb will protect the donors and ensure safer blood donation. Further studies are needed to confirm these preliminary findings.

References

1. Hoque, M.M., Adnan, S.D., Begum, H.A., Rahman, M., Rahman, S.M., Mamun, M.A.A. and Faruki, M.A., 2012. Haemoglobin level among the regular voluntary blood donors. Journal of Dhaka Medical College, 20(2), pp.168-173.
2. Jeremiah, Z.A. and Koate, B.B., 2010. Anaemia, iron deficiency and iron deficiency anaemia among blood donors in Port Harcourt, Nigeria. Blood Transfusion, 8(2), p.113-117.
3. Djalali, M., Neyestani, T.R., Bateni, J. and Siassi, F., 2006. The effect of repeated blood donations on the iron status of Iranian blood donors attending the Iranian blood transfusion organization. International journal for vitamin and nutrition research, 76(3), pp.132-137.
4. Cançado RD, Chiattone CS, Alonso FF, Langhi Júnior DM, Alves RD.2001. Iron deficiency in blood donors. Sao Paulo Medical Journal. Jul;119(4):132-134.
5. Harthoorn-Lasthuizen, E.J., Lindemans, J. and Langenhuijsen, M.M., 1998. Zinc protoporphyrin as screening test in female blood donors. Clinical chemistry, 44(4), pp.800-804.
6. Agba, F. and Khan, R.A. (1989). Serum Ferritin Levels in Professional Blood Donors. JAMA,39,124-126.
7. Rodolfo DC, Dante Langhi Junior, 2012. Blood donation, blood supply, iron deficiency and anemia – It is time to shift attention back to donor health. Rev Bras Hematol Hemoter. 2012;34(5):323-33.
8. Guyatt, G.H., Oxman, A.D., Ali, M., Willan, A., McIlroy, W. and Patterson, C., 1992. Laboratory diagnosis of iron-deficiency anemia. Journal of general internal medicine, 7(2), pp.145-153.
9. Kishida, T., Shinozawa, I., Tanaka, S., Hoshino, T., Tatsuguchi, A., Feng, L., Sato, J., Fujimori, S., Tachikawa, H., Yamakado, S. and Tamagawa, Y., 1997. Significance of serum iron and ferritin in patients with colorectal adenomas. Scandinavian journal of gastroenterology, 32(3), pp.233-237.
10. Norashikin J, Roshan TM, Rosline H, Zaidah AW, Suhair AA, Rapiaah M. 2006. A study of serum ferritin levels among male blood donors in Hospital Universiti sains Malaysia. Southeast Asian J Trop Med Public Health. 37:370–373.
11. Adediran, A., Uche, E. I., Adeyemo, T. A., Damulak, D. O., Akinbami, A. A., & Akanmu, A. S. 2013. Iron stores in regular blood donors in Lagos, Nigeria. Journal of Blood Medicine,4,75–80.
12. Finch, C.A., Cook, J.D., Labbe, R.F. and Culala, M., 1977. Effect of blood donation on iron stores as evaluated by serum ferritin. Blood, 50(3), pp.441-447.
13. Simon, T.L., Garry, P.J. and Hooper, E.M., 1981. Iron stores in blood donors. Jama, 245(20), pp.2038-2043.
14. Alvarez-Ossorio, L., Kirchner, H., Kluter, H. and Schlenke, P., 2000. Low ferritin levels indicate the need for iron supplementation: strategy to minimize iron-depletion in regular blood donors. Transfusion Medicine, 10(2), pp.107-112.
15. Nadarajan, V.S. and Eow, G.I., 2002. Anaemia and iron status among blood donors in a blood transfusion unit in Malaysia. The Malaysian journal of pathology, 24(2), pp.99-102.
16. Mittal, R., Marwaha, N., Basu, S., Mohan, H. and Kumar, A.R., 2006. Evaluation of iron stores in blood donors by serum ferritin. Indian J Med Res. 124:641-646.