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Anaemia and iron status among blood donors in a blood transfusion unit in Malaysia

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Abstract

Iron deficiency is a major complication of regular blood donation as a result of regular iron loss from each donated blood unit. Ninety-two regular blood donors and 95 first time blood donors attending a hospital-based blood transfusion centre were assessed as to their haematological and iron status by blood counts and serum ferritin levels as an indicator of iron stores. All donors had passed the haemoglobin-screening test using a copper sulphate method prior to blood donation. Ferritin levels were found to be significantly lower among regular blood donors (47.8 mmol/L) as compared to first time blood donors (94.2 mmol/L). Iron deficiency as observed by low ferritin levels was seen in 7.4% of all first time donors as compared to 17.4% in regular donors. Male first time donors showed a low prevalence of iron deficiency but the prevalence significantly increased with regular blood donation. Female first time and regular blood donors however did not show any significant differences in prevalence of iron deficiency, with both groups exhibiting prevalence rates similar to male regular donors. The association between haemoglobin levels and iron deficiency was poor and the copper sulphate-screening test was found insensitive to anaemia with many donors passing the test and donating blood despite being anaemic. It is concluded that a high prevalence of iron deficiency is present among regular male blood donors and all female donors. Besides, the use of the copper sulphate screening test as a sole criterion for anaemia screening should be reviewed. Ferritin measurements should be included in the routine assessment of blood donors especially among regular blood donors.

Key words: blood donation, iron deficiency, ferritin, anaemia

INTRODUCTION

Blood donation is recognised as the most common iatrogenic cause for iron deficiency among healthy adults.[1] A donation of a 450ml unit of blood results in a loss of 236mg of iron.[2] Replenishment of this lost iron will take approximately 50 days based on daily iron absorption rates of 2.8 – 6.0mg/day.[3] To increase the quantity and safety of national blood supplies, there has been a steady push for recruitment of more regular blood donors and encouragement to first time donors to become repeat donors. An increase in the frequency of blood donations among our donor population is liable to result in excessive iron loss and development of iron deficiency anaemia. In Malaysia, donors are allowed to donate up to 4 times a year. Donors must weigh at least 50kg and all are screened for anaemia at the donation session, usually using a copper sulphate screening method on a fingerprick blood sample. A cut off level of 125 g/L is used, below which potential donors are excluded from donating. Although haemoglobin has generally been used for donor screening, studies have shown that haemoglobin levels may not correlate with iron status.[4,5] This study was designed to assess the development of anaemia and prevalence of iron deficiency using serum ferritin as an indicator of body iron stores among regular and first time blood donors within the local population.

SUBJECTS AND METHODS

One hundred and eighty-seven (187) unselected consecutive whole blood donors (92 regular donors and 95 first-time donors) donating blood at the University Malaya Medical Centre were recruited into the study after obtaining informed consent. Regular donors were defined as those donors who had made at least 2 previous donations within the past year while first time donors were donors who had never made a donation before. All donors were screened for anaemia at a cut off level of 125 g/L using the

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copper sulphate method. Only donors who passed the copper sulphate test were eligible for the study. Each donor donated 300mls or 450mls of whole blood depending on body weight.

Three ml each of venous blood was taken into EDTA and plain tubes at the end of donation from each donor. Full blood counts were performed within 4 hours of collection using an automated haematology analyzer (ABX Vega Retic). Serum ferritin assays were performed on the Ciba Coming ACS using chemiluminescence methodology.

Statistical analysis was conducted using SPSS. Comparisons between populations were made using the student's t-test for parametric data and the Mann-Whitney test for non-parametric data while qualitative data was analysed by χ^2 analysis. An alpha value of <0.05% denoted significant difference.

RESULTS

Donor characteristics in the two groups of regular and first-time donors are as shown in Table 1. Regular donors were significantly older as compared to first time donors. No significant demographic differences were otherwise observed between the two groups. Overall comparisons of the two groups did not show any significant differences in haematology indices. Serum ferritin levels were however significantly lower among regular blood donors.

Iron deficiency as defined by a serum ferritin level <10 mmol/l in females and <15 mmol/l in males was noted in 7.4% of all first time donors as compared to 17.4% of regular donors. Only 1.6% of male first time donors were found to be iron deficient as compared to 18.2% of female first time donors (Table 2). Among repeat donors, 15.7% of the males were found to be iron deficient as compared to 22.7% of the female donors. A significant difference in the development of iron deficiency was demonstrated by χ^2 test (p=0.005) only among male donors while there was no significant difference demonstrated in the proportion of females developing iron deficiency following repeated blood donations as compared to first time donation (Figure 1). It was alarming to note that 10 out of the 23 iron deficient individuals who had been screened to have haemoglobin levels above 125g/L by the copper sulphate method actually had haemoglobin levels below 125 g/L at donation when tested by an

TABLE 1: Demographics and laboratory data among first time and regular blood donors

		First time donors Mean	Regular donors Mean	t-test p-value
Age (years)		27.2 ± 8.4	33.8 ± 9.7	0.04
Sex (%)	Male	65.3	76.1	0.10
	Female	34.3	23.9	
Race (%)	Malay	37.9	22.8	0.09
	Chinese	43.2	57.6	
	Indian	15.8	18.5	
	Others	3.2	1.1	
Hgb (g/L)		138.0 ± 15.6	139.2 ± 14.2	0.14
Hct (L/L)		0.43 ± 0.05	0.44 ± 0.04	0.10
MCH (pg)		27.2 ± 2.5	27 ± 2.3	0.82
MCHC (g/L)		315.5 ± 11.8	314.5 ± 30.5	0.32
MCV (fL)		86.2 ± 6.7	85.2 ± 6.2	0.54
RDW		15.1 ± 1.4	15.5 ± 1.8	0.06
RBC (x 10^12/L)		5.1 ± 0.6	5.2 ± 0.6	0.75
Ferritin (mmol/L)		94.2 ± 89.9	47.8 ± 44.3	≤0.001

TABLE 2: Iron status among first time and regular blood donors among male and female donors

	First time		Regular		
	Iron deficient	Iron replete	Iron deficient	Iron replete	Total
Male	1	61	11	59	132 (p=0.005)
Female	6	27	5	17	55 (p = 0.680)
Total	7	88	16	76	187 (p = 0.037)

automated haematology analyzer using a venous blood sample. The median haemoglobin level among this group was 115 g/L.

Forty of all donors, comprising 21.3% of the donors studied, had haemoglobin levels below 125g/L although they had passed the copper sulphate screening test. The median haemoglobin level among this group was 120 g/L. Microcytosis was observed in 13 (7.0%) of the total donors, of which only 1 was iron deficient and anaemic. The remaining individuals were iron replete, with 5 (2.7%) being anaemic and 7 (3.7%) having haemoglobin levels above 125 g/L. These 12 individuals were diagnosed as having thalassaemia or HbE trait, giving an overall haemoglobinopathy prevalence rate of 6.4% among our blood donors.

DISCUSSION

This study confirms the findings of previous studies, in that the prevalence of iron deficiency increases with frequent blood donations. 15.7% of male regular donors and 22.7% of female regular donors in this study exhibited iron deficiency. Simon *et.al.*[6] showed that 8% of men and 38% of women have reduced iron stores after 5 donations as assessed by serum ferritin status. In a large Danish study, the prevalence of depleted iron stores was found to be higher in donors as compared to non-blood donors.' Similarly, in a more recent study, 26% of regular blood donors had low ferritin levels and 12% were found anaemic.[2] A high prevalence of iron deficiency however, was also noted

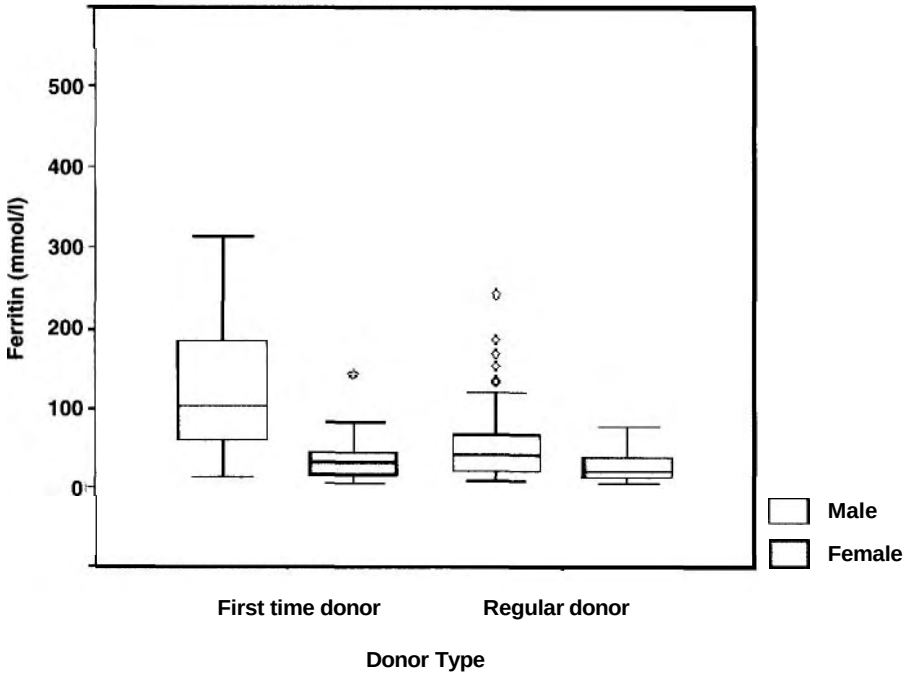

FIG. 1: Serum ferritin levels among first time and regular blood donor classified by sex of the donors

among first time donors in our study population, especially among female donors. The rate of development of iron deficiency appears to be significantly higher in male blood donors as compared to female blood donors. The prevalence of iron deficiency among first time and regular female blood donors however was not significantly different. The rapid rate at which male regular blood donors develop iron deficiency may be attributable to the larger volumes of blood that males donate in our transfusion unit as compared to females. Males generally donate 450mls of blood as compared to females who donate 250-300mls of blood unless their body weight exceeds 55kg. The higher prevalence of iron deficiency in females with borderline or absent anaemia may also mean that a larger number of preexisting iron deficient female donors who are not anaemic are recruited for donation, resulting in high numbers of iron deficient first time and regular female donors. Differences in the prevalence and development of iron deficiency among male and female blood donors would mean that different strategies may need to be employed for prevention of iron deficiency among blood donors. Among males, it is important that regular supervision of ferritin levels be made for regular donors with adequate iron supplementation, in order that iron deficiency does not develop among this vulnerable population while among females, it is important that pre-existing iron deficient individuals are recognized and treated before they donate blood and further aggravate their iron status.

Haemoglobin cutoff levels do not appear to be predictive of iron deficiency as shown by a significant proportion of individuals with low ferritin levels showing haemoglobin levels above 125g/L. The sole use of the copper sulphate test at a cutoff level of 125g/L would result in the recruitment of already iron deficient donors who are above the cutoff level. In addition, the poor sensitivity of the copper sulphate test and its low negative predictive value would result in recruitment of already iron deficient and anaemic donors, as shown by the 10 iron deficient donors who had false negative results on the copper sulphate test and were allowed to donate. The median haemoglobin level for this group was 115g/L. Although the copper sulphate test is a time honoured pre-donation screening test, its sensitivity and specificity has always been in question. Measurements are very much dependant on the technical skill of the person performing the procedure and previous studies have shown that the haematocrit value of a predonation fingerstick capillary sample was considerably higher than the immediate postdonation venous haematocrit levels.' Accurate portable haemoglobin measurement devices are currently available in the market but their cost precludes routine use for blood donor screening in most developing countries.

In conclusion, the sole use of the copper sulphate test, as a criterion for deferral of iron deficient and anaemic individuals may not be adequate in the prevention of iron deficiency developing among blood donors. Serum ferritin would need to be included in assessment of blood donors, particularly among regular male donors and all female donors so that a better picture of iron status may be obtained and donors managed and counseled appropriately. Better and more cost effective methods for assessing haemoglobin levels as compared to the current copper sulphate method should be explored for donor screening.

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REFERENCES

1. Milman N. Serum femtin in Danes: studies of iron status from infancy to old age, during blood donation and pregnancy. Int Hematol 1996; 63(2):103-35.
2. Alvarez-Ossorio L, Kirchner H, Kluter H, Schlenke P. Low ferritin levels indicate the need for iron supplementation:strategy to minimize iron-depletion in regular blood donors. Transfus Med 2000; 10(2):107-12.
3. Norrby A. Iron absorption studies in iron deficiency. Scand Haematol - Supplement 1974; 20:1-125.
4. Pedersen NS, Morling N. Iron stores in blood donors evaluated by serum ferritin. Scand Haematol. 1978; 20(1):70-6.
5. Ali AM, McAvoy AT, Ali MA, Goldsmith CH, Blajchman MA. An approach to determine objectively minimum hemoglobin standards for blood donors. Transfusion: 1985; 25(3):286-8.
6. Simon TL, Garry PJ, Hooper EM. Iron stores in blood donors. JAMA 1981; 245(20):2038-43.
7. Pi DW, Krikler SH, Sparling TG, Carter CJ, Wadsworth LD. Reappraisal of optimal hemoglobin standards for female blood donors in Canada. Transfusion 1994; 34(1):7-10.