A STUDY OF SERUM FERRITIN LEVELS AMONG MALE BLOOD DONORS IN HOSPITAL UNIVERSITI SAINS MALAYSIA

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Abstract. Iron deficiency is the commonest cause of anemia worldwide and healthy blood donors are estimated to lose about 236 mg of iron with each donation. The objective of this study was to determine the serum ferritin levels among first time and regular male blood donors, and also to correlate the serum ferritin levels with the number of donations and hemoglobin levels. Hemoglobin levels and serum ferritin were measured in three groups of donors divided into first time donors; (n=92), donors with 2-4 donations (n=41), and regular donors (n=78). The mean hemoglobins in the first time donors, second group and regular blood donor group were 14.95±1.08, 15.12±1.44 and 15.56±1.48, respectively. The serum ferritin level were found to be significantly lower among the regular donors (62.0±39.78 ng/ml) compared to first time donors (90.7±66.63) and second group donors (114.12±66.97). The serum ferritin levels gradually decrease according to the number of donations and there was a significant correlation between frequency of donations and the serum ferritin level (r^2=0.082). Significant correlation between the number of donations and hemoglobin level r^2=0.061) was noted. However, there was no significant correlation between hemoglobin and serum ferritin levels (r^2=0.015). Eleven percent of regular donors had depleted iron stores. This was not noted in donors who donated less than 5 times within 2 years.

INTRODUCTION

The process of blood donor selection is designed to ensure that the donation does not cause harm to the donors. In Hospital University Sains Malaysia (HUSM), blood donors are generally allowed to donate blood every three months. Their age should be between 18 years to 55 years, the weight at least 45 kg and they should be generally healthy according to a history obtained from a health questionnaire and questions asked during pre-donation counselling. With all the precautions taken to ensure safety of blood donation, iron deficiency among regular blood donors is still a common problem. There are several studies confirming iron stores depletion in blood donors (Finch *et al*, 1977; Simon *et al*, 1981; Alvarez-Osorio *et al*, 2000). Previous studies have shown that the serum fer-

ritin levels were reduced markedly in regular donors corresponding to annual donation frequency (Jaime *et al*, 1988, Milman *et al*, 1999, Alvarez- Osorio *et al*, 2000). The iron loss caused by the donation of one unit of blood was calculated to be 236 mg of iron in males (Finch *et al*, 1977). Therefore iron deficiency in regular blood donors is an important donor safety issue. The main objective of this study was to evaluate iron stores by measuring serum ferritin levels among male first time donors and regular blood donors. The second objective was to compare the frequency of donation with hemoglobin concentrations and serum ferritin levels. Male blood donors were chosen because 94.4% of blood donors in our hospital are male. Serum ferritin measurement was considered to reflect iron stores accurately (Finch *et al*, 1977, Milman *et al*, 1984, Walters *et al*, 1973).

MATERIALS AND METHODS

Subjects

This prospective study was performed at

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the Transfusion Medicine Unit at Hospital Universiti Sains Malaysia from November 2004 to January 2005. Serum ferritin was measured in 211 blood donors. The eligible donors were divided into three groups depending on the number of donations. The first group was comprised of first time donors. The second group consisted of donors who had previously donated two to four times within the previous two years. The third group consisted of regular blood donors. First time donors were registered as new blood donors and the regular donors were selected from the number of previous donations: over 5 donations with a frequency of at least 2 donations per year. Data on the number and time of last donation was taken from the blood bank data base. The hemoglobin levels were screened using Haemocue hemoglobinometer (Translab) and only donors with a hemoglobin of more than 13.5 g/dl were allowed to donate.

Methods

Informed written consent was obtained from each donor who fulfilled the criteria for blood donation. After blood donation of 450 ± 50 ml of whole blood, an additional sample was taken via the bleed line into a plain tube for serum ferritin analysis. Serum ferritin was measured using microparticle enzyme immunoassay (MEIA: AxSYM System, Abbot Diagnostic).

Analysis

The diagnosis of iron deficiency was based on serum ferritin values lower than 15 ng/dl. Data were analyzed using SPSS software.

RESULTS

A total of 211 blood donors were screened for hemoglobin and serum ferritin levels. Of the blood donors, 121 (57.3%) were Malays, 40 (19.0%) were Chinese, and 50 (23.7%) were from other ethnic groups. The mean ages of the donors were 21.54±7.61, 26.56±9.74 and 37.50±8.45 years old for the first time donor group, 2-4 donations group and ≥5 donations group, respectively. The mean hemoglobins in first time donor group, second group and regular blood donor group were 14.95±1.08, 15.12±1.44 and 15.56±1.48, respectively (Table 1). The results indicated that the serum ferritin level of regular blood donors was the lowest of the groups. There was a significant difference between first time donors and regular donors (p=0.001) and between second group donors and regular donors (p=0.001). There was no significant difference between first time donors and second group donors, p=0.06. Depleted iron stores were found in 11.54 % of regular blood donors; this was not the case in first time donors and second group donors. The mean values for serum ferritin are shown in Table1. There was a significant correlation between the frequency of donations and the level of serum ferritin among donors, r^2=0.082 (Fig 1). The frequency of donations and hemoglobin concentrations also showed a significant linear correlation, r^2=0.061 (Fig 2). However, no correlation was seen between the hemoglobin concentration and the serum ferritin level, r^2=0.015 (Fig 3).

Table 1
Mean hemoglobin concentrations and serum ferritin levels among different groups of blood donors.

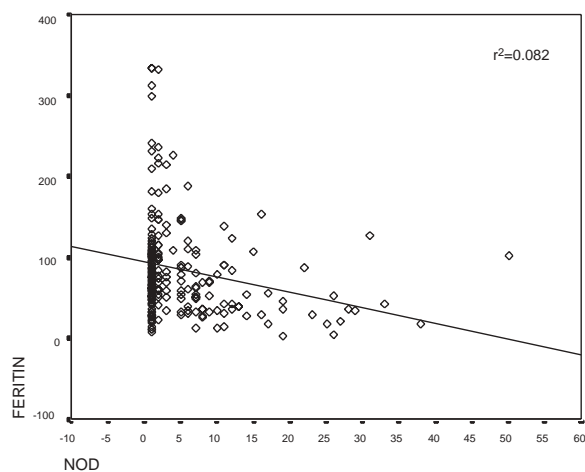|	First time donor (n=41)	2-4 donations (n=41)	≥ 5 donations (n=78)
Age (years), mean±SD	21.54±7.61	26.56±9.74	37.5±8.45
Hemoglobin (g/dl) mean±SD	14.95±1.08	15.12±1.44 p=0.305	15.5 ±1.48 p=0.002
Serum ferritin (ng/ml), mean±SD	90.7±66.63	114.12±66.97 p=0.06	62.0±39.78 p=0.001
Serum ferritin <15 ng/ml	0	0	9 (11.54%)

Fig 1–Scatter plot indicating correlation between serum ferritin level and frequency of donations.
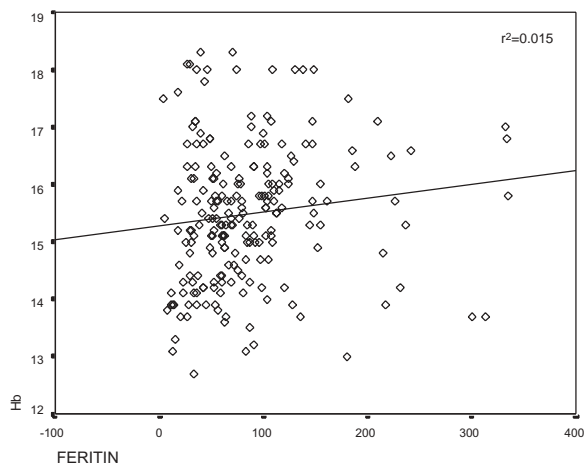

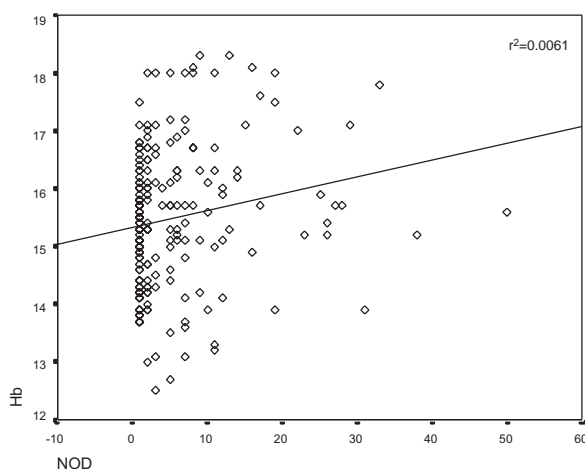Fig 3–Scatter plot indicating correlation between hemoglobin level and serum ferritin level.

Fig 2–Scatter plot indicating correlation between hemoglobin level and frequency of donations.

DISCUSSION

The aim of this study was to evaluate the iron status in first time and regular male blood donors by measuring serum ferritin levels. The study indicates the serum ferritin level of the regular blood donors was the lowest of the other two groups. This finding was consistent with the results of other studies in which serum ferritin levels were significantly lower in regular blood donors (Punnonen and Rojamaki, 1999; Alvarez-Ossorio et al, 2000; Nadarajan and Eow, 2002).

The results of this study show that 11% of regular blood donors had depleted iron stores (serum ferritin <15 ng/ml). Our study indicates that there was a significant correlation between the frequency of donations and the serum ferritin level. The mean ferritin level decreased tremendously in the regular blood donors as early as after the first 10 donations, and remained stable after 20 or more donations (Alvarez-Ossorio, 2000). Although serum ferritin is considered an accurate measure for iron stores, it should be noted that many factors may influence the results. Inflammation and hepatic tissue injury may cause inappropriate elevation of serum ferritin levels. The cut-off value for hemoglobin levels for blood donation in men was 13.5 g/dl. However, the normal hemoglobin level does not exclude iron deficiency among the blood donors. As shown by our result, there was no significant linear correlation between hemoglobin and serum ferritin. Several studies indicate that hemoglobin is not a sensitive indicator to detect iron deficiency but is useful in detecting the majority of donors with established iron deficiency (Finch et al, 1977, Simon et al, 1981). The sensitivity of hemoglobin concentration as an indicator of iron deficiency in repeat donors was only 40% (Jaime et al, 1988).

It has been reported that in men, the amount of iron lost from a 400 ml donation is made up by enhanced absorption of dietary iron

over 3 months (Finch, 1972). In HUSM, the minimal time interval for each donation is every 3 months. Each blood donor is also given 120 mg ferrous fumarate supplement daily for 3 weeks. Giving iron supplement alone is not enough to prevent iron deficiency among blood donors. Effective counselling is an important issue to encourage donor compliance. This is important to ensure the donor's health and will allow for further blood donations. We also recommend measurements of serum ferritin levels after five donations, as proposed by Alvarez-Ossorio *et al* (2000). This will help identify iron deficient individuals.

In conclusion, to minimize iron deficiency among regular blood donors, we should continue with our current practice of giving oral iron supplements and improving counselling to all blood donors.

ACKNOWLEDGEMENTS

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