Iron stores in blood donors: A literature mini review

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Abstract

An increase in the frequency of blood donation among the donor population is liable to result in excessive iron loss and development of iron deficiency anemia. In the majority of blood banks, hemoglobin and/or hematocrit measurements are used as screening tests for the ability to donate blood even though iron stores may be depleted in donors with hemoglobin values above the arbitrarily defined limit for anemia. In the present study, we have reviewed the iron deficiency in blood donors and characteristics which predispose to this condition.

Keywords: Blood donors, Iron stores

Introduction

The occurrence of iron depletion and deficiency in first-time and repeat blood donors is well-documented in the transfusion medicine literature (1-3). With each whole blood (WB) donation, male donors lose 242 ±17 mg and female donors lose 217 ±11 mg of iron (1). Given that normal iron stores in men and women are 1000 mg and 350 mg, respectively, maintenance of iron balance is a challenge in the blood donors. Iron deficiency is a significant cause of deferral. If iron is not replaced, donors may become iron deficient. All blood donors are screened at each visit for hemoglobin (Hb) levels. Even among blood donors who have normal Hb values, iron deficiency is prevalent (4). Therefore, Hb levels alone are inadequate for distinguishing blood donors with iron deficiency without anemia (5). Moreover, some deferred blood donors do not return to donate, especially first-time donors. While there is a steady push for recruitment of more regular donors and encouragement of first time donors to give blood regularly in order to increase the safety of national blood supplies(6). Blood banks have the responsibility to prevent anemia among donors. In the present study, we have reviewed the iron deficiency in blood donors and characteristics which predispose to this condition.

Diagnostic tests of iron deficiency in blood donors: In the majority of blood banks, Hb has generally been used as a screening test for the suitability to give blood. However, it has been reported that this parameter has poor sensitivity, especially in the detection of early stages of iron deficiency. Indeed, an accurate diagnosis of iron deficiency requires several laboratory tests. Measurements of serum iron, serum ferritin concentrations, mean cell volume (MCV) and mean corpuscular hemoglobin (MCH) can be used with a high degree of accuracy and precision(7, 8). In the study by Simon et al, using ferritin ≤ 12 ng/ml to define iron depletion the overall frequency in regular blood donors was 8% in males and 23% in females(9). A systematic review found

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ferritin levels to be superior to several other tests (MCV, %Sat, zinc protoporphyrin), and ferritin < 15 ng/mL confirms the diagnosis of iron deficiency (10). Other studies suggest higher levels (22-40 µg/L) more sensitively reflect iron-deficient erythropoiesis (10-12). As in clinical studies, it is obvious that a ferritin cutoff of 12 ng/mL is a specific marker of iron depletion in blood donors, but also lacks sensitivity (13). One study found that this cutoff failed to identify iron depletion in over 1/3 of cases in blood donors (14). The investigators found a higher ferritin level, 22 ng/mL, more indicative of functional iron depletion. These investigations were not based on the "gold standard" bone marrow iron stains or a hematologic response to iron, but relied (9). In order to find out the usefulness of serum iron and ferritin for correct diagnosis of iron deficiency in hospitalized patients, Burns et al (15) compared the results of serum iron and ferritin tests with the presence of stainable iron in bone marrow aspirates from 301 patients. Iron deficiency was correctly detected by serum iron in only 41% and ferritin in 90% of patients, respectively. These investigators concluded that iron measurements, not have the adequate sensitivity and/or specificity for precise diagnosis of iron deficiency.

Iron stores in regular and first-time blood donors: In Adediran et al (16) study, the mean serum ferritin level was significantly lower in the regular donors than in the first time donors. Szymczyk-Nuzka et al (17) when determining the prevalence of iron deficiency in regular blood donors noted a lower serum ferritin in this group in contrast with first-time donors who had normal serum ferritin levels. Norashikin et al (18) also reported significantly lower serum ferritin levels in regular blood donor. Several investigators have noted a significant reduction in ferritin levels with increasing donations (18-21). However, Vilzu et al (22) reported no significant difference between ferritin levels in controls and donors donating less than 20 units. Akpotuzor et al (23) reported that there was no observable difference in biochemical iron parameters between regular donors and normal controls. In contrast, several other studies have documented lower serum iron levels in regular blood donors compared with healthy controls (19).

The effect of repeated blood donations on the iron status of male and female blood donors

The results of a study on the iron status of male Saudi blood donors showed that increased number of donations result in iron deficiency anemia, although the level of hemoglobin remained acceptable for blood donation(24). Results of a study in Iran (25) showed that 11% of male regular donors and 0.8% of first-time donors had iron store depletion. Among blood donors, premenopausal women are at high risk of iron deficiency, (26) and preventing and alleviating this problem is a major concern for blood services (27). Postmenopausal women can donate blood without becoming iron deficient if they have initially had adequate iron stores (28). However, women of childbearing age are at increased risk of iron deficiency if they donate blood more than one unit a year (29). Cable et al (30) study showed that absent iron stores (AIS), and iron deficient erythropoiesis (IDE), are highly prevalent in frequent blood donors. They defined AIS as a ferritin level below 12 ng/mL and IDE as present if the log of the ratio of soluble transferrin receptor to ferritin was greater than or equal to 2.07. In regular male donors, 16.4% had AIS and 48.7% IDE, while 27.1% and 66.1% of female regular donors have AIS and IDE, respectively. In a study by Yousefinejad et al (31) the donors with more than five instances of donation have considerably lower serum ferritin than ones with five instances of donation and less, comparing with the results of two previous studies performed in Iran (32, 33), while a study in Pakistan mentioned the relationship

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between four and more instances of donation in the past two years and iron deficiency (34). Therefore, it seems primary evaluations before blood donation is necessary for regular male donors from the fifth donation onwards with not just attention to Hb level; usage of iron supplements in this group should be evaluated and this matter had been emphasized in previous studies as well(32, 34). A study by Mirrezaie et al, (35) indicated that replacing the iron lost at donation can protect the female regular donors from iron deficiency, and assist in retaining this group of donors for future donation.

Predictors of iron levels in blood donors: Rigas et al. (36) published a paper in which they described predictors of iron levels in 14,737 Danish blood donors. Among high-frequency donors (more than nine donations in the past 3 years), they found iron deficiency (ferritin below 15 ng/ml) in 9, 39, and 22% of men, premenopausal women, and postmenopausal women, respectively. The strongest predictors of iron deficiency were gender, the number of blood donations in a 3-year period, menopausal status, and the time since previous donation. Other major factors included age, weight, and intensity of menstruation, iron tablets and vitamin pills. Cable et al, (30) found that donation frequency is the strongest predictor for iron stores. Furthermore, they report that gender, weight, iron supplements, dairy products, and age for women are significantly associated with AIS. They also reported that age in men, smoking, menstruation status, giving birth, and beef are associated with IDE. Furthermore, smoking and time since last donation are correlated with a lower risk of AIS (3). Both pica and restless legs syndrome (RLS) have been reported to occur in blood donors (37-39). Serum ferritin levels below 45–50 mcg/L have been found to exacerbate restless legs syndrome (RLS) (40, 41). In a study by Bryant et al,(42) the presence of pica and restless legs syndrome (RLS) was prospectively assessed in blood donors. Pica was reported in 11% of donors with iron depletion/deficiency, compared with 4% of iron-replete donors. Female sex, younger age, and lower MCV and transferrin saturation values were significantly associated with pica. RLS was reported in 16% of subjects with iron depletion/deficiency compared with 11% of iron-replete donors. Iron replacement generally resulted in improvement of RLS symptoms, however, at least 4–6 weeks of iron therapy was necessary. Bryant et al, (42) found an important association of pica with finger sticks Hb of less 11.5 g/dL in female and less than 12.5 g/dL in male donors.

Conclusion

Early detection of iron deficiency among donors would allow suitable readjustment of donation intervals and would guide the use of iron supplementation. Screening donors' serum ferritin levels at the time of first donation and then once every year is a very rational way to pick up an iron deficiency in a voluntary blood donor population. On the other hand, regular blood donation has several benefits, one of which is preventing enhance of body iron which can cause free radical formation in the body. Iron may also have deleterious effects on vascular function by increasing reactive oxygen species locally, decreasing the bioavailability of nitric oxide, impairing vasorelaxation, and promoting platelet adhesion and aggregation (43). In vitro studies have shown that iron acutely promotes platelet reactivity (44) and an increased risk of myocardial infarction (45).

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