

Iron supplements and iron status in frequent blood donors

Abstract

Background: Iron deficiency anemia is a public health problem worldwide, which can cause by nutrition deficiency, blood loss, and regular blood donation. This study aims to evaluate the hematological parameters and serum ferritin of Thai male blood donors.

Methods: Eighty-nine male blood donors were divided into three groups according to their frequency of blood donation: a group of 30 cases for first time donors (group I), a group of 30 cases for donors who have donated 3-6 times (group II), and a group of 29 cases for donors who have donated more than six times (group III). Blood was collected for hematological parameters and for serum ferritin testing by immunological assay.

Results: The results showed that the level of serum ferritin tended to decrease with the frequency of blood donation. The level of serum ferritin in blood donors who donated more than six times but did not take a full dose of iron supplements ($43.2 \pm 25.0 \mu\text{g/L}$), statistically significant decreased when compared with the first donated group ($75.4 \pm 40.2 \mu\text{g/L}$) ($p=0.03$). However, all hematological parameters were not significantly different among these 3 groups. Prevalence of iron depletion without anemia in group II and III were 6% and 3.4%, respectively. Only one donor in group III was iron deficiency anemia.

Conclusion: This study shows that blood donation may lead to iron depletion and iron deficiency anemia, especially in more frequent donors. Iron supplements or dietary iron is required after a donation for iron level maintenance and iron deficiency prevention.

Keywords: blood donation, iron deficiency, ferritin, anemia

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Abbreviations: Hb, hemoglobin; Hct, hematocrit; MCV, mean corpuscular volume; MCH, mean corpuscular hemoglobin; MCHC, mean corpuscular hemoglobin concentration

Introduction

A blood donation is the process of safe blood being taken from a healthy blood donor for transfusion. Blood donors are a risk group of anemia because of blood loss, especially continuous and frequent donors.¹⁻⁵ Iron is the most important component of hemoglobin in red blood cells. The majority of iron for red blood cells production is from the recycling of red blood cell destruction by macrophages.⁶⁻⁸ Because of the duration of red blood cell restoration, regular blood donations can be repeated every 3 months. Each blood donation will cause a loss of about 200-250mg of iron per blood unit.^{9,10} In the case of iron depletion without anemia, hemoglobin is still in the normal range, so the hemoglobin screening will be passed and the participant will be able to donate. Normally, iron supplements are given after blood donation to restore iron. However, most of donors do not recognize the importance of iron supplements and this may lead to an iron depletion and iron deficiency anemia. This study aims to evaluate the ferritin level, which indicates the iron stored in the body of blood donors and the restoration of body iron with iron supplements after blood donation. The subjects of this study were donors who attended the Blood Bank department, Maharaj Nakhon Si Thammarat Hospital, Thailand.

Materials and methods

The subjects of this study were 89 female blood donors, who visited Department of Blood Bank, Maharaj Nakhonsithammarat Hospital, Thailand from September to November 2014. All of them passed the screening criteria for the blood donation. The donors were divided into three groups depending on the frequency of their blood donation. Group I was for donors making their first donation ($n=30$), group II was for donors who have made 2-6 donations ($n=30$) and group III was for donors who have made more than 6 continuous donations ($n=29$) in a three month interval. General data such as times of donation, age, and iron supplement intake after blood donation were collected by questionnaire. EDTA-blood samples were collected for a hematological parameters study and serum was prepared from clotted blood for ferritin measurement. The data of iron supplements taken after donation was collected in the questionnaire. This study was approved by the Board of Committee on Ethics, Walailak University, Thailand (31/2016). Hematological parameters including hemoglobin (Hb), hematocrit (Hct), mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC) were measured by using an automated blood cell analyzer, MEK-822K. (NIHON KOHDEN, Tokyo, Japan). Ferritin levels were analyzed by Enhanced Chemiluminescence Enzyme Immunologic assay method using VITROS ECi/ECiQ-Immunodiagnostic System. (Ortho Clinical Diagnostics, US). The guideline for anemia, iron deficiency and iron

deficiency anemia (IDA) were defined as follows.¹¹ Anemia had Hb <12g/dL, iron deficiency had serum ferritin <15µg/L and IDA had Hb <12g/dL with serum ferritin <15µg/L. For statistical analysis, the data were analyzed using SPSS for WINDOWS, version 17.0. A Kolmogorov-Smirnov test was used to determine the normality of the distribution. One way ANOVA was used for comparisons between the different parameters of the groups. A *p* value of less than 0.05 is considered significant.

Results

Donors were divided into three groups by frequent of blood donation. Group I was for donors making their first donation (n=30), group II was for donors who have made 2-6 donations (n=30) and group III was for donors who have made more than 6 continuous

donations (n=29). The average ages of groups I, II and III was 19.8±4 years (17-40years), 26.7±11years (17-55years) and 39.0±12years (20-61years), respectively. The hematological parameters of each group are shown in mean±SD, as shown in Table 1. The Hb of groups I, II and III was 14.2±1.2, 14.6±1.1 and 14.0±1.3g/dL, respectively. The Hct of groups I, II and III was 45±6.5, 47±3.3 and 45±3.8 %, respectively. The mean MCV of groups I, II and III was 90±5.4, 89±6.5 and 87±7.4fL, respectively. The mean MCH of groups I, II and III was 28±1.9, 28±2.7 and 27±2.9pg, respectively. The mean MCHC of groups I, II and III was 31±0.8, 31±1.2 and 31±0.9, respectively. The mean of all parameters was not significantly different between the groups. The serum ferritin was measured to evaluate the body iron. The mean of ferritin for groups I, II and III was 75±40.2, 65±53.2 and 56±38.8µg/L, respectively. However, there was no significant difference between groups.

Table 1 Hematological parameters and serum ferritin in all three groups

Group (n)	Hb (g/dL)	Hct (%)	MCV (fL)	MCH (pg)	MCHC (g/dL)	Ferritin (mg/L)
I (30)	14.2±1.2	45±6.5	90±5.4	28±1.9	31±0.8	75±40.2
II (30)	14.6±1.1	47±3.3	89±6.5	28±2.7	31±1.2	65±53.2
III (29)	14.0±1.3	45±3.8	87±7.4	27±2.9	31±0.9	56±38.8

The iron intake data in each donor were collected using questionnaires. To evaluate body iron replacement by iron supplement intake after blood donation, donors who taken the full dose of iron supplement were excluded from groups II and III. The hematological parameters and ferritin data for donor group II (n=26) and III (n=21) who did not intake the full dose of iron supplement were analyzed and compared to the first time donors, group I (n=30). The hematological parameters and ferritin level were shown in Table 2. The data showed that, MCV and ferritin decline depended on the frequency of blood donation (Figure 1). The mean of serum ferritin in groups I, II and III

was 75±40.2, 66±54.1 and 43±25.0µg/L, respectively. Serum ferritin of group III, who were donors who had not taken a full dose of iron supplements were significantly decreased from group I (*p*=0.03). Iron depletion and iron deficiency anemia (IDA) in all donors were analyzed. A ferritin level less than 15ng/ml indicated an iron depletion. Three of the donors were in iron depletion stages, two from group II and one from group III. Only one donor in group III had a mild form of IDA, with a ferritin level less than 15µg/L and with Hb less than 13.0g/dL (Table 3). The red blood cell morphology of anemia donors was hypochromic microcytic RBC.

Table 2 Hematological parameters and serum ferritin of donors who not taken the full dose of iron supplement after donation of all three groups

Group (n)	Hb (g/dL)	Hct (%)	MCV (fL)	MCH (pg)	MCHC (g/dL)	Ferritin (mg/L)
I (30)	14.2±1.2	45±6.5	90±5.4	28±1.9	31±0.8	75±40.2
II (26)	14.6±1.2	47±3.5	90±6.6	28±2.7	31±1.2	66±54.1
III (21)	14.0±1.4	45±4.1	88±6.1	27±2.2	30±0.8	43±25.0*

**p*<0.05 compared to group I, values are mean±SD.

Table 3 Hematological parameters and serum ferritin of donors in all groups who had anemia and/or low ferritin

Group	Hb (g/dL)	Hct (%)	MCV (fL)	MCH (pg)	MCHC (g/dL)	Ferritin (mg/L)	Validation
I	12.1	39.7	89.6	27.3	30.5	27.1	
I	11.8	40	69.6	20.5	29.5	80.4	Anemia without iron depletion
I	11.8	38.4	91.6	28.2	30.7	52.8	
II	12	41.2	70.1	20.4	29.1	56.9	Anemia without
II	12.6	37.6	78.8	26.4	33.5	15.7	iron depletion
II	13.7	44.3	83.3	25.8	30.9	9.61	Iron depletion without anemia
II	15.2	49.6	83.8	25.7	30.6	10.1	
III	12.4	41.7	81.8	24.3	29.7	157	
III	12.2	40.2	84.5	25.6	30.3	42.7	Anemia without iron depletion
III	12.4	40.8	83.8	25.5	30.4	64.1	
III	13.6	44.3	83.6	25.7	30.7	9.2	Iron depletion without anemia
III	10.9	37.3	70.5	20.6	29.2	4.86	Iron deficiency anemia

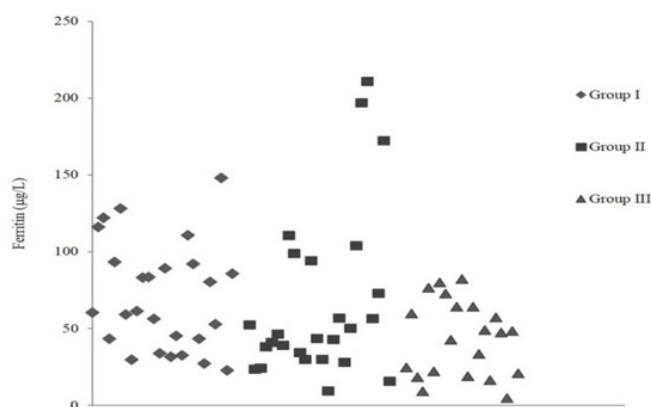


Figure 1 Distribution of serum ferritin in blood donors who not taken full dose of iron supplements, 77 cases.

Discussion

The purpose of blood donation is to collect safe blood from healthy donors to replace the depletion of blood components in patients. The screening procedure still mainly detects the hemoglobin concentration. Several abnormalities of red blood cells, with the hemoglobin concentration still in normal range, are not of concern. Normally, red blood cells circulate in blood vessels for about three months. Expired RBCs are destroyed by the reticuloendothelial system and replaced by new RBCs.^{7,8} The production of RBCs requires iron for hemoglobin synthesis, which is mainly recycled from iron stored pools in the reticuloendothelial system. For blood donors, iron is loosening with the blood. Iron supplements are used as a source of new RBCs production and to maintain body's iron level. Several reports showed the iron stored depletion in blood donors.^{1,2,4,12} This study also showed the correlation between the frequently time of repeated donations every three months and hematological parameters and also the body iron stored. Because the blood loss that occurs during menstruation by females may affect the body iron,^{13,14} only male donors were selected for studying. As only male donors were selected, the different ferritin and hematological parameters among the three groups were not dominant (normally iron depletion is mostly found in female rather than male donors).^{2,10}

Iron supplements are required for iron replacement due to blood loss from a donation.^{15–18} Thus, all donors in this study were given iron supplements after their blood donation. The difference in dose intake of each donor may be a factor that affects the ferritin level; however, ferritin itself was an acute phase reactant,^{19,20} which may increase if donors were in or recently passed the inflammatory stage and the exact dose of iron supplements in each donor was not known. The ferritin level of donors who repeated blood donation more than six times every three months and had not taken the full dose of iron supplements showed a significant reduction in ferritin compared to the first time donors. However, this study did not exclude the donors who had the low ferritin level which may resulted by the other causes. The polycythemia Vera, a red blood cell disorders did not found in donors in this study. All donors had hemoglobin level lower than 18.5g/dL, which is the one of WHO diagnostic major criteria for polycythemia Vera diagnostic.²¹ This study found iron depletion without anemia in three cases; two were in group II and one in group III. Iron depletion indicated an iron stored status and this may lead to IDA if the iron is not sufficiently replaced. IDA was also found in group III, but in a mild case. Mild Anemia without iron depletion was found

in all groups. As the high prevalence of thalassemia and abnormal hemoglobin in Thailand, one of the possible causes of anemia in these donors is thalassemia carriers.^{22–24} The complete blood count testing is necessary for donor screening to reject the mild anemia case and prevent IDA.

Conclusion

This data support the necessity of iron supplements after a blood donation to avoid iron depletion and IDA, especially in frequent donors. The suggestion of healthcare after blood donation should be considered. In addition, the screening procedure should evaluate the iron stored in frequent donors for the donor's safety and for the quality of blood components.

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Conflict of interest

The author declares no conflict of interest.

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