CHARACTERISTICS OF BLOOD DONORS, ACCORDING TO THE RESULTS OF COMPLEX LABORATORY TESTS OF PERIFERAL BLOOD

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Summary

Nowadays, there is a significant storage of donated blood in the world. According to the recommendations of the WHO, adequate and reliable supply of save donated blood can only by carried out on the base of regular voluntary non-paid donations. This particular category of donations in the safest from the point of view of the prospect of having infectious diseases that can be transmitted through blood. Recrutitg and retaining the donors who make voluntary non-paid donations is a priority for the blood service on the way to achieving 100% voluntary non-paid donation of blood and its components.

Blood transfusion service and its social component – donor ship must be the priority areas of the state policy because the results of its work are of paramount importance. The main task of the blood transfusion service is supply of high quality components for blood transfusion therapy. Quality of blood components is compliance of properties and specifications of the blood component supplied to the recipient with the set standards. Strict order of conformance with the approved regulations and procedures is important at all technological states and is a cornerstone of blood transfusion service products quality. All actions, planned and implemented, starting with planning donor ship and ending with the finished product manufacturing and storage conditions, are important for ensuring the quality as the final result.

Keywords: blood donation, erythrocytes, metabolic disorders, ferritin, transferin, serum iron.

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1. Introduction

In spite of the lately increasing number of scientific research programs on donor blood storage, integrated solution of this problem remains a challenging open issue. We studied parameters indicative of iron metabolism in donors, and glycolytic processes in peripheral blood erythrocytes depending on history of donations, donors' health at the time of plasma donation via automatic plasmapheresis, issues of donorship optimization, and its medical and social aspects *(Masse, 2014, Yin, 2015, Ngoma, 2017)*.

Potential donors reserve decrease negatively affects the volumes of donor blood collected by the blood transfusion service of Ukraine. Reducing number of donors in contrast to the increasing need for blood components and products is a topical issue of present-day transfusion medicine because the number of donors is decreasing by 10-15% annually worldwide.

Pathogenic factor of iron deficiency is its negative balance caused by the discrepancy between resorption and intake, or high losses *(Magnussen, 2015, Karpenko, 2017)*. Iron deficiency leads to erythrocyte transport function impairment (oxygen and carbon dioxide transporting), shortening of their life cycle from 120 to 56 days, and reduction of resistanceto different physical and chemical factors, in particular impact on erythrocytes in donors with latent iron deficiency: freezing at ultra-cold temperatures leads to hemolysis increase to over 30% when reference rate is 2-5%. Acid resistance of erythrocytes decreases almost 2-fold (acid erythrograms demonstrate destruction of the main erythrocyte mass during the first 8 minutes instead of 15-16 minutes). In iron deficiency, erythropoiesis intensity is not accompanied by increased production of erythrocytes, but causes metabolic, functional and morphologic changes in them, which is of particular importance for blood donors because, on an average, 5% of donors stop donating for the reason of deterioration of the peripheral blood parameters. Erythrocyte destruction caused by metabolic, functional and morphologic changes in them leads to macrophage system overstraining. Besides, the above-mentioned changes in the erythrocytes of the blood donors result in donor blood quality lowering and, consequently, lower quality of blood components containing erythrocytes, which can affect the results of blood transfusion therapy and recipients' health *(Magnussen, 2015, WHO, 2020)*.

Iron metabolism evaluation method used for blood donors by the Ukrainian blood transfusion service and approved legally provisions measurement of hemoglobin parameter pathophysiology of which changes only at the stage of overt iron deficiency. Peripheral blood parameters abnormality detected by the establishments of the blood transfusion service in more than 5% of blood donors is a cause of denial of donations, while iron deficiency was found in 25-50% of the active donors.

Study of the latent abnormalities of iron metabolism and related changes of physical properties of erythrocytes, rheological abnormalities and energy processes in erythrocytes of blood donors, as well as development of correction and prevention methods is a topical issue for the state blood transfusion service. Their impact on functional capacity of peripheral blood erythrocytes in the body of active donors, the study of this problem has just started, which calls for the development of diagnostic methods for detection of the above-mentioned changes and methods of their correction.

Goal: upon the study of laboratory, morphologic, biochemical and biophysical properties of donor blood erythrocytes, determine pathogenesis of metabolic abnormalities in erythrocytes of blood donors depending on how long they have been donating blood and increase effectiveness of early diagnostics and prevention of the above changes for donors' health protection.

2. Material and methods of research

The study included 459 donors who donated in clinical centers of the chair of hematology and transfusiology of Shupyk National Healthcare University of Ukraine. All donors were examined pursuant to the Medical Examination Procedure for Donors of Blood and (or) its Components approved by Decree of the Health Ministry of Ukraine № 385 dated 01.08.2005 – «On Infectious Safety o Donor Blood and its Components» as donors whose blood is used for production of components. Before donation, blood donors filled questionnaire and were examined by qualified specialists pursuant to the requirements of the applicable Medical Examination Procedure for Donors of Blood and (or) its Components. Hemoglobin was measured for all the donors (RR: M – no less than 130 g/l, F – no less than 120 g/l). Blood donation volume was determined on the basis of hemoglobin test (max volume – 450 ml excluding blood volume

drawn for the test (up to 40 ml). For active blood donors, it is necessary to consider the interval before the donations that should not be less than 60 days from the date of the previous donation, as well as number of donations per year – no more than 5 for men and 4 for women.

After blood donation, alanine aminotransferase (ALT, RR 0,1 – 0,68 mmol/h-l) level was measured in donors' blood; it was also tested for hemotransmissive infections (HIV ½, hepatitis B, hepatitis C, syphilis).

459 blood donors (231 men and 228 women) were examined, among which 299 were active donors (148 men and 151 women) donating on regular basis, no less than 3 times a year and 160 first-time registered donors (83 men and 77 women). According to age classification *(WHO, 1991)*, first-time donors were divided into three subgroups: young donors – 48 (26 men and 22 women aged 20-34), middle-aged donors – 62 (30 men and 32 women aged 35-44) and ripe-age donors – 50 (27 men and 23 women aged 45-59). First-time registered donors made the control group of our research.

Mean age of the first-time donors from the control group was (38,90±1,31) (20-59 years old). Mean age of the male donors was (39,66±1,53) (22-59 years old). Mean age of female donors was (37,56±2,45) (20-57 years old).

All 160 first-time donors were practically healthy and eligible for donation subsequent to the result of survey, examination by specialists and hemoglobin level. Markers of hemotransmissive infections were all negative. ALT level was within the normal limits.

Since the control group was made by first-time donors, for convenience of systematization and reflection of the results of scientific research, objectivation in research data comparison, all the examined active donors were divided into three groups depending on the number of years they were donating and, consequently, increasing risk of latent metabolic abnormalities: group I – 146 donors (76 men and 70 women) donating from 2 to 5 years (number of donations in men was (10,41±0,96) (from 3 to 24), in women – (10,41±0,96) (from 3 to 18). Mean age of Group I active donors was (38,49±1,43) (20 – 58 years old). Mean age of male donors was (39,18±1,65) (20-58 years old). Mean age of female donors was (36,25±2,89) (22-58 years old). Groups of the examined donors were similar in terms of age and sex distribution.

Research was approved by the Ethics Committee of Shupyk National Healthcare University of Ukraine.

The following methods were used: general blood tests, blood chemistry, specific blood chemistry, radioimmune and enzyme-immunoassay, statistic methods.

Devices and chemical agents used for the research were registered and certified in Ukraine. Devices were subjected to metrological monitoring in the due time.

Hemoglobin measuring, erythrocyte, leukocyte, platelet count and calculation of RBC indices were performed in the laboratory on the automated analyzer PCE-210 (ERMA, Japan). Determination of serum iron was performed according to beta-phenantroline method. Total iron binding capacity (TIBC) was evaluated by transferrin (TF) saturation with three-valence iron. Unsaturated (latent) iron binding capacity (UIBC) was calculated as difference between TIBC and iron concentration. Transferrin saturation coefficient (TSC) was calculated as serum iron (SI)/TIBC ratio. Serum TF was determined by TIBC value. Serum ferritin (FN) was evaluated by radioimmunoassay technique using ИРМО-ФЕРРИТИН set (Belarus). Optical transmission of erythrocytes (OTE) was determined in accordance with Danop-Marikovaski method (1964). Physical and chemical parameters of erythrocyte membrane penetrability (PEMP) was evaluated in accordance with Kulapina et al. method (2006). Red blood cell distribution width (RDW) was determined automatically on automated hemo analyzer PCE-210 (ERMA, Japan). Effectiveness of erythropoiesis value (EEV) was evaluated in accordance with Kozinets

et al. method (1988). All data obtained in the course of research were statistically processed. Research scope sample was analyzed by Student's t-test and Mann-Whitney nonparametric U-test, correlation and dispersion analyses. For data analysis, IBM SPSS Statistics 22,0 and Excel XP were used.

3. First-time blood donors patternbased on the results of laboratory, morphologic, biophysical and biochemical peripheral blood tests

459 blood donors (231 men and 228 women) were examined. 160 of them (83 men and 77 women) were first-time donors and they made the control group (I), while 299 donors (148 men and 151 women) were regular blood donors donating for more than two years (no less than 2 times a year) – they made thestudy group (II). According to the age classification *(WHO, 1991)*, first-time donors (control group, n=160) were divided into three subgroups: young donors – 48 (26 men and 22 women) aged 20-43, middle-aged donors – 62 (30 men and 32 women) aged 35-44, ripe age donors (27 men and 23 women) aged 45-59.

Active donors (n=146) were divided into groups: I – donating from 2 to 5 years: young donors – 41 (22 men and 19 women), middle-aged – 56 (29 men and 27 women), ripe age – 49 (25 men and 24 women). In first-time donors, mean hemoglobin level was (138,88±0,95) g/l: in men – (142,72±0,81) g/l (135 g/l – 150 g/l), in women – (132,06±0,89) g/l (127 g/l – 140 g/l). Hemoglobin level was higher in male than in female donors ($p<0,001$). In first-time donors, erythrocyte count was, on an average, $(4,63±0,03)×10^{12}$/l. In the examined male donors it was, on an average, $(4,76±0,03)×10^{12}$/l ($4,5×10^{12}$/l – $5,0×10^{12}$/l), in female – $(4,40±0,03)×10^{12}$/l ($4,2×10^{12}$/l – $4,7×10^{12}$/l). Erythrocyte count was higher in men than in women ($p<0,001$). In the examined male donors, leukocyte count was in the mean $(6,86±0,21)×10^{9}$/l ($4,4×10^{9}$/l – $8,6×10^{9}$/l), in female – $(6,79±0,29)×10^{9}$/l ($8×10^{9}$/l – $9,2×10^{9}$/l). Average leukocyte count in the group of first-time donors was $(6,83±0,17)×10^{9}$/l. In first-time donors, platelet count was, on an average, $(203,40±1,97)×10^{9}$/l. In the examined male donors it was, on an average, $(204,38±2,69)×10^{9}$/l ($180×10^{9}$/l – $230×10^{9}$/l), in female – $(201,76±2,71)×10^{9}$/l ($190×10^{9}$/l – $210×10^{12}$/l). Erythrocyte count was higher in men than in women ($p<0,001$).

In the group of first-time donors, reticulocyte count was, on an average, (0,88±0,05) ‰. In the examined male donors, mean reticulocyte count was (0,87±0,05), in female – (0,88±0,04) ‰. There were no significant age- or sex-dependent differences between mean leukocyte, platelet and reticulocyte counts in the examined first-time donors ($p>0,05$).

In the first-time donors, mean cell hemoglobin (MCH) was, on an average, 30,63±0,25 pg (27-33 pg). In female donors, mean MCH was (29,40±0,42) pg (27-31 pg), in male – (31,13±0,24) pg (28-33pg). There was no significant sex-dependent difference in MCH in the examined first-time donors ($p>0,05$).

In all first-time donors, mean corpuscular volume (MCV) was, on an average, (93,41±0,91) fl (84-97 fl). In female donors, mean MCV was (94,22±1,69) fl (89-97 fl), in male – (92,29±1,01) fl (84-96 fl). There was no significant sex-dependent difference in MCV in the control group ($p>0,05$).

In all first-time donors, mean corpuscular hemoglobin concentration (MCHC) was, on an average, (34,38±0,23) % (33-35%). In female donors, mean MCHC was (34,35±0,31) % (33-35 %), in male – (34,41±0,41) % (33-35%). There was no significant age- or sex-dependent difference in MCHC in this group ($p>0,05$).

We performed cytometry of peripheral blood erythrocytes of the first-time donors. Mean corpuscular diameter was, on an average, (7,192±0,06) mcm^3, micro- and schistocytes – (4,80±0,14) fl, anisocytosis – (4,02±0,14) %, discocytes – (80,41±0,45) %, abnormal

shape – (19,59±0,55) %. There was no significant age- and sex-related difference between average mean corpuscular diameter, micro- and schistocyte count, % of anisocytosis, discocytes and abnormally shaped erythrocytes in first-time donors (p>0,05).

In first-time donors, mean serum iron (SI) was (20,04±2,03) μmol/l, and it was higher in male donors (p<0,01). In fist-time donors, TIBS was, on an average, (57,25±2,49) μmol/l. In the examined male donors, TIBS was, on an average, (56,52±2,37) μmol/l (52,05 – 61,03 μmol/l), in female – (58,55±2,20) μmol/l (54,87 – 62,05 μmol/l). TIBS was higher in females (p<0,01). In the examined male donors, UIBS was, on an average, (35,77±4,07) μmol/l (28,05 – 43,37 μmol/l), in female – (39,78±3,53) μmol/l (34,18 – 45,65 μmol/l). In general, the mean UIBC for the group of the first-time donors was (37,21±4,31) μmol/l. UIBC was higher in females (p<0,01). In first-time donors, TSC was, on an average, (35,18±4,90) %. In the examined male donors, man TSC was (36,88±4,74) % (28,60 – 46,10 %), in female – (32,17±3,63) % (26,40 – 38,30 %). TSC was higher in male donors (p<0,01). In first-term donors, serum TF was, on an average, (2,23±0,10) g/l. In the examined male donors, serum TF was (2,20±0,09) g/l (2,03 – 2,38 g/l), in female – (2,28±0,09) g/l (2,14 – 2,42 g/l). Serum TF was higher in female donors (p<0,01).

In the examined male donors, serum FN was, on an average, (24,91±2,14) mcg/l (20,64 – 30,12 mcg/l) in female – (19,19±1,41) mcg/l (17,15 – 21,82 mcg/l). In general, the mean serum FN in the group of first-time donors was (22,85±3,36) mcg/l. Serum FN was higher in male donors (p<0,001).

In young donors, serum iron was, on an average, (21,43±1,56) μmol/l (19,1 – 24,0 μmol/l), in middle-aged donors – (20,17±1,860 μmol/l (17,4 – 24,6 μmol/l), in ripe age donors – (18,03±1,14) μmol/l (16,4 – 19,8 μmol/l).

Serum iron level in young first-time donors was higher than in middle-aged (p<0,05) and ripe age (p<0,001) donors. The level of serum iron in middle-aged donors was higher than in the ripe age donors (p<0,01).

Average level of serum TF in young donors was (2,13±0,06) g/l (2,03 – 2,24 g/l) in middle-aged – (24±0,05) g/l (2,15 – 2,35 g/l), in ripe age – (2,35±0,05) g/l(2,26 – 2,42 g/l).

Average level of serum FN in young donors was (24,01±4,17) mcg/ml (17,21 – 30,12 mcg/ml), in middle-aged donors – (22,88±3,08) mcg/ml (17,49 – 26,55 mcg/ml), in ripe age donors – (21,34±2,18) mcg/ml (17,15 – 24,21 mcg/ml).

Serum FN in young donors was higher than in the ripe age (p<0,05). There was no significant difference in serum FN level between first-time young and middle-aged donors and middle-aged and ripe age donors.

In all first-time donors, RDW was 79,81±0,81 fl (79,01 – 80,71 fl). There was no significant sex-related difference in RDW in the examined first-time donors (p>0,05).

The margin of errors for mean values for erythrocyte populations varied between 0,4 – 4,1% of the reference value. In most cases, it did not exceed 1-2%. According to the criteria approved for biology and medicine, accuracy achieved in the process of research is quite high. The data obtained is reliable and can be used both in practical work and as reference points.

In first-time donors, OTE was 0,006±0,001 g/ml (0,005±0,001 – 0,007±0,001 g/ml). There was no significant sex-related difference in OTE in the examined first-time donors (p>0,05). There was no significant sex-related difference in erythrocyte aggregation, platelet aggregation index and hematocrit in first-time donors (p>0,05).

We established that in the group of first-time donors erythrocyte fragmentation was, on an average, (1,74±0,09) % (0,75 – 3 %). There was no significant sex-related difference in erythrocyte fragmentation in first-time donors (p>0,05).

We established that in the group of first-time donors EEV was $(0,070\pm0,0010)\cdot10^{12}$/l: in female donors it was, on an average, $(0,069\pm0,0021)\cdot10^{12}$/l, in male donors – $(0,071\pm0,0019)\cdot10^{12}$/l. First of all, EEV of $(0,07\pm0,001)\cdot10^{12}$/l in first-time donors demonstrates that this is the number of erythrocytes formed and is released daily into one liter of peripheral blood in this category of donors (hence in healthy people).

4. Pattern of active blood donors donating for 2-5 years based on the results of laboratory, morphologic, biochemical and biophysical tests of peripheral blood

In group I active donors hemoglobin concentration was, on an average, (138,18±8,98) g/l. There was no significant difference in hemoglobin concentration, erythrocyte and platelet count between Group I donors and control group donors ($p>0,05$), reticulocyte count was, on an average (0,88±0,05) ‰: examined male donors – (0,87±0,05) ‰, femal donors – (0,88±0,04) ‰.

There was no significant sex-related difference in the mean leuocyte, platelet and reticulocyte count in the examined group I active donors ($p>0,05$).

In group I active donors, mean MHC was (30,63±0,25) pg (27 – 33 pg). In female donors, MHC was, on an average (29,40±0,42) pg (27 – 31 pg), in male donors – (31,13±0,24) pg (28 – 33 pg). There was no significant sex-related difference in MHC in the examined group I active donors ($p>0,05$). In group I active donors, mean MCV was (93,41±0,91) fl (84–97 fl). In female donors, MCV was, on an average (94,22±1,69) fl (89-97fl), in male donors – (92,29±1,01) fl (84-96 fl). There was no significant sex-related difference in MCV in the examined group I active donors ($p>0,05$). In group I active donors, mean MCHC was (34,38±0,23) % (33-35%). In female donors, MCHC was, on an average (34,35±0,31) % (33-35%), in male donors – (34,41±0,41) % (33-35%). There was no significant sex-related difference in MCHC in the examined group I active donors ($p>0,05$).

In young active donors, the results of the peripheral blood test were within the normal limits. It was established that mean hemoglobin concentration as well as erythrocyte and platelet count was higher in male donors ($p<0,05$), while average leucocyte count was the same in both sexes ($p>0,05$). There was no significant difference in peripheral blood parameters between young active donors and control group donors ($p>0,05$).

In middle-aged active donors, the results of the peripheral blood test were within the normal limits. It was established that mean hemoglobin concentration as well as erythrocyte and platelet count was higher in male donors ($p<0,05$), while average leucocyte count was the same in both sexes ($p>0,05$). There was no significant difference in peripheral blood parameters between middle-aged active donors and control group donors ($p>0,05$) as well as between young and middle-aged active donors ($p>0,05$).

Extended peripheral blood test was performed for all ripe age active donors of study group I. Hemoglobin concentration was, on an average, (137,84±7,90) g/l, erythrocyte count – $(4,60\pm0,27)\times10^{12}$/l ($p<0,001$). There was no sex-related significant difference in reticulocyte count between group I ripe age active donors ($p>0,05$). There was no significant difference in reticulocyte count between Group I ripe age active donors and control group donors ($p>0,05$). In group I ripe age active donors, the results of the peripheral blood test were within the normal limits. It was established that mean hemoglobin concentration as well as erythrocyte and platelet count was higher in male donors ($p<0,05$), while average leucocyte count was the same in both sexes ($p>0,05$). There was no significant difference in hemoglobin concentration, erythrocyte, reticulocyte and leukocyte count between young, middle-aged and ripe ageactive donors ($p>0,05$), while man platelet count in ripe age active donors was higher than in young and middle-aged donors ($p<0,05$).

We performed cytometry of peripheral blood erythrocytes in this group of donors. Mean corpuscular diameter was, on an average, (7,192±0,06) mcm^3, micro- and schistocytes – (4,80±0,14) fl, anisocytosis – (4,02±0,14) %, discocytes – (80,41±0,45) %, abnormal shape – (19,59±0,55) %. There was no significant age- and sex-related difference between average mean corpuscular diameter, micro- and schistocyte count, % of anisocytosis, discocytes and abnormally shaped erythrocytes in group I donors (p>0,05).

In group I active donors, SI was (20,04±2,03) μmol/l. In the examined male donors, SI was (20,75±1,94) μmol/l (17,30 – 24,60 μmol/l), in women – (18,77±1,53) μmol/l (16,40 – 21,30 μmol/l). SI was higher in male donors (p<0,01). In group I active donors, TIBS was, on an average, (57,25±2,49) μmol/l. In the examined male donors, TIBS was, on an average, (56,52±2,37) μmol/l (52,05 – 61,03 μmol/l), in female – (58,55±2,20) μmol/l (54,87 – 62,05 μmol/l). TIBS was higher in females (p<0,01). In group I active blood donors, UIBS was, on an average, (37,21±4,31) μmol/l. UIBC was higher in females (p<0,01). In group I active blood donors, TSC was, on an average, (35,18±4,90) %. In the examined male donors, man TSC was (36,88±4,74) % (28,60 – 46,10 %), in female – (32,17±3,63) % (26,40 – 38,30 %). TSC was higher in male donors (p<0,01).

In group I active blood donors, serum TF was, on an average, (2,23±0,10) g/l. In the examined male donors, serum TF was (2,20±0,09) g/l (2,03 – 2,38 g/l), in female – (2,28±0,09) g/l (2,14 – 2,42 g/l). Serum TF was higher in female donors (p<0,01). In the examined male donors, serum FN was, on an average, (24,91±2,14) mcg/l (20,64 – 30,12 mcg/l), in female – (19,19±1,41) mcg/l (17,15 – 21,82 mcg/l). In general, the mean serum FN in group I active blood donors was (22,85±3,36) mcg/l. Serum FN was higher in male donors (p<0,001).

In middle-aged donors, mean SI was (20,17±1,86) μmol/l (17,4 – 24,6 μmol/l). In ripe age donors, mean SI was (18,03±1,14) μmol/l (16,4 – 19,8 μmol/l). SI in group I young donors was higher than in middle-aged (p<0,05) and ripe age (p<0,001) donors. SI in middle-aged donors was higher than in ripe age donors (p<0,01). In young donors, TIBS was, on an average, (54,60±1,54) μmol/l (52,05 – 57,44 μmol/l). TIBS in ripe age donors was higher than in middle-aged (p<0,001) and young donors (p<0,001). TIBS in middle-aged donors was higher than in young donors (p<0,001).

In middle-aged donors, UIBS was, on an average, (37,29±3,00) μmol/l (31,30 – 42,60 μmol/l). In group I ripe age active donors, UIBS was higher than in middle-aged (p<0,001) and young donors (p<0,001). UIBS in group I middle-aged active donors was higher than in young donors (p<0,001).

In young donors, TSC was, on an average (39,34±3,77) % (33,9 – 46,1%), in middle-aged donors – (35,17±3,88) % (29,0 – 44,0 %), in ripe age donors – (30,02±2,47) % (26,4 – 33,7 %). TSC of young donors was higher than in middle-aged (p<0,01) and ripe age (p<0,001) donors. TSC of middle-aged donors was higher than in ripe age donors (p<0,001).

In young donors, serum TF was, on an average, (2,13±0,06) g/l (2,03 – 2,24 g/l), in middle-aged donors – (2,24±0,05) g/l (2,15 – 2,35 g/l), in ripe age donors – (2,35±0,05) g/l (2,26 – 2,42). In group I ripe age active donors, TF was higher than in young (p<0,001) and middle-aged (p<0,001) donors. In middle-aged donors, TF was higher than in young donors (p<0,001).

In group I young active blood donors, serum FN was, on an average, (24,01±4,17) mcg/ml (17,21 – 30,12 mcg/ml). In group I young active blood donors, FN level was higher than in ripe age donors (p<0,05). There was no significant difference between FN level in group one young active blood donors and middle-aged active donors as well as between middle-aged and ripe age active donors (p>0,05).

Main parameters of iron metabolism in group I active blood donors were within normal limits except for elevated UIBS. Mean SI, TSC and FN were higher in male donors ($p<0,05$), while mean TIBS, UIBS and TF were similar ($p>0,05$). However, max levels of TIBS, UIBS and TF were elevated, while minimal levels of TSC and FN were low. Mean SI, TSC and TF in group I active donors were lower than in the control group ($p<0,05$), while mean TIBS, UIBS and TF were higher than in the control group ($p<0,05$).

Our research revealed sex-dependent peculiarities of peripheral blood parameters and iron metabolism in active blood donors.

In all group I active blood donors, RDW was (79,81±0,81) fl (79,01 – 80,71 fl). There was no significant age-related difference in RDW between the examined active blood donors of group I ($p>0,05$) as well as between them and control group ($p>0,05$).

In group I active blood donors, OTE was (0,006±0,001) g/ml (0,005±0,001 – 0,007±0,001 g/ml). There was no significant sex-related difference in OTE and coefficients calculated from it between group I active blood donors ($p>0,05$) as well as between them and control group ($p>0,05$).

There was no significant sex-related difference in erythrocyte aggregation, platelet aggregation index and hematocrit between group I active blood donors as well as between them and control group ($p>0,05$).

We established that in group I active blood donors erythrocyte fragmentation was, on an average, (1,73±0,12) % (0,76 – 2,9 %) – (1,74±0,11) % and (1,72±0,17) % in male and female donors respectively. There was no significant sex-related difference in erythrocyte fragmentation between group I active blood donors as well as in comparison with control group ($p>0,05$).

There was no significant difference in EEV between group I active blood donors and control group donors ($p>0,05$).

5. Conclusions

Study of the latent abnormalities of iron metabolism and related changes of physical properties of erythrocytes, rheological abnormalities and energy processes in erythrocytes of blood donors, as well as development of correction and prevention methods is a topical issue for the state blood transfusion service. In spite of paramount importance of the energy processes progress in erythrocytes, their impact on functional capacity of peripheral blood erythrocytes in the body of active donors, the study of this problem has just started, which calls for the development of diagnostic methods for detection of the above-mentioned changes and methods of their correction.

6. Practical recommendations

In order to preserve health of active donors and ensure quality of blood components received at the time of donation, thorough checkup of donors, including, apart from the main and biochemical peripheral venous blood parameters, morphologic, biophysical and rheological parameters of erythrocytes is highly recommended before donation.

For iron metabolism monitoring, it is recommended to measure serum ferritin, transferrin of peripheral venous blood. Timely detection of iron deficiencies and prescription of preventive treatment will result in prevention of iron deficiency anemia in active donors.

References

Karpenko, FN, Bogdan, EL, Migal' T.F, Barz, VA, Mitrakov, YY. (2017) Donorstvo krovi i ee komponentov v Respublike Belarus' [Donation of blood and ist components in the Republic of Belarus]. Hematology. Transfusiology. Estern Europe. 3(4): 619-628. [in Russian].

Magnussen, K., Ladelund, S. (2015) Handling low hemoglobin and iron deficiency in a blood donor population: 2 years' experience. Transfusion. 55; 10: 2473-2478.

Masse, B. (2014) Donor research in Australia: Challendes and promise. Transfus. Med. Hemother. 41; 4: 296-301.

Ngoma, AM. (2017) Blood donor deferral among students in Northern Japan: Challeng-es Acead. Transfus. Med. Hemother. 41;4: 251-256.

Sergienko, AV, Chebotaieva EY. (2021) Lichnostnye osobennosti donorov krovi [Personality traits of blood donors]. Hematology. Transfusiology. Estern Europe. 7; 2: 619-628. DOI 10.34883/PI.2021.7.2.009 [in Russian].

WHO, Blood safety and availability (2020). Available at: https://www.who.int/news-room/fact-sheets/detall/blood-safety-and-availability

Yin, Y-H, Li, C-Q, Liu, Z. (2015) Blood donation in China: substaining efforts and challenges in achiving safety and availability. Transfusion. 55; 10: 2523-2530.