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Laboratory analysis of malondialdehyde indicator in coxarthrosis of the hip joint and osteonecrosis of the femoral head in military personnel

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Abstract: In this work, the results of analysis of malondialdehyde (MDA) value of lipid peroxidation index in coxarthrosis and osteonecrosis of the femoral head are presented. The average value of the amount of malondialdehyde in the blood of healthy people was 1.2 times higher (22.9%) compared to the value found in patients treated for coxarthrosis of the hip joint. In patients treated with osteonecrosis of the femoral head, this value was found to be 1.6 times (63.9%) higher than the average value found in the control group. In erythrocytes of patients with coxarthrosis of the hip joint, this value is 1.3 times (29.7%) higher than in the control group, and in patients with osteonecrosis of the femoral head, it is 1.7 times (72.7%) higher than in the control group it happened.

Key words: malondialdehyde, coxarthrosis, osteonecrosis, peroxide oxidation, lipid, hip joint, femoral head

Introduction: Lipid peroxide oxidation (LPO) is a unique process that causes many pathological conditions. Many pathological processes occur under the influence of free radicals. An example of a free radical is MDA. It is based on the fact that free radicals cause ischemic processes and degeneration of bone tissue (coxarthrosis of the hip joint, osteonecrosis of the femoral head) [2, 10]. Tissue damage is also associated with free radicals, and therapeutic strategies are being developed [1, 11]. LPO lies in the attack of free radicals, and it consists of several stages, forming the pathogenesis of many pathological changes [4, 12, 16]. As a result of the interaction of a free lipid radical with an oxygen molecule, a peroxide radical appears. As a result of violation of oxidation and reduction reactions, free radicals are formed and peroxide oxidation state is observed. Many unsaturated aldehydes, dialdehydes and ketoaldehydes are formed in this [6, 7, 13]. Under the influence of free radicals, the oxidation process, bone tissue, cartilage tissue, endoplasmic reticulum, cytochrome-450, enzymes and other protein molecules can be damaged. As a result of the lack of antioxidants, this process deepens, and not only biochemical, but also morphological changes are observed [9, 14, 17]. The role of MDA in the development of heart diseases, neurocognitive pathologies (neurocognitive changes, dementia), cancer, and especially dystrophic-degenerative diseases of the hip joint [3, 5, 8, 15].

The purpose of the study: In coxarthrosis and osteonecrosis of the femoral head, the indicator of lipid peroxidation was the analysis of MDA value.

Materials and methods of research: Military servicemen with confirmed

degenerative and dystrophic diseases of the hip joint undergoing inpatient treatment became the research object. The Helsinki Declaration (2020) was followed and based on the human rights principles of the Geneva Convention. The study was conducted in 3 groups: healthy people, groups of patients diagnosed with coxarthrosis of the hip joint and osteonecrosis of the femoral head. People included in the study are 18-29 years old, 30-44 years old and 45 and older. Coxarthrosis and osteonecrosis of the femoral head were confirmed on X-ray. Malon-dialdehyde (MDA) in the blood - a compound with a molecular weight of 72.07 was determined based on the thio-barbituric acid (TBK) reaction. The amount of MDA was calculated based on a special formula. $p < 0.05$ was an indicator of reliable statistical difference.

Results and discussion. Malondialdehyde is an endogenous aldehyde, formed as a metabolite of arachidonic and other semi-unsaturated lipid acids. Under the influence of biochemical reactions in the body, malondialdehyde turns into carbon dioxide and has a destructive effect on phospholipids, nucleic acids, amino acids and other cell structures. Malondialdehyde reacts with thiobarbituric acid to form a red fluorescent chemical compound. Today, this fluorescent compound can be detected spectrophotometrically. Therefore, the study of MDA, a secondary product of the fat peroxidation process, in patients treated with dystrophic and degenerative diseases of the hip joint (coxarthrosis, osteonecrosis) was the next stage of our research. In this case, the average value of the MDA indicator determined in patients with coxarthrosis and osteonecrosis diseases differed from the average value of this indicator determined in healthy people. The average level of malondialdehyde metabolite in the control group was found to be 1.2 times (22.9%) higher than that of the patients treated with coxarthrosis of the hip joint.

In patients with osteonecrosis of the femoral head, the average value of this indicator was 1.6 times (63.9%) higher than that of the control group (pI >0.05, pII <0.05) (Table 1):

Table 1

Analysis of the MDA index in patients undergoing treatment for coxarthrosis and osteonecrosis and healthy people included in the control group (up to 2.0 μmol/l)

Inspection material	Control group (healthy subjects), n=35	Patients diagnosed with coxarthrosis, n=26	Patients diagnosed with osteonecrosis, n=31
Blood serum	1,22±0,103	1,50±0,138 pI >0,05	2,00±0,287 pII <0,05 pIII <0,05
Erythrocytes	6,37±0,520	8,26±0,433 pIV <0,05	11,0±2,100 pV <0,05 pVI <0,05

Note: pI and pIV - statistical difference between the values in the control group and patients diagnosed with coxarthrosis (pI - blood serum, pIV - erythrocytes); pII and pV - statistical difference between the values in the control group and patients diagnosed with osteonecrosis (pII - blood serum, pV - erythrocytes); pIII and pVI -

statistical difference between values in patients diagnosed with coxarthrosis and osteonecrosis (pIII - blood serum, pVI - erythrocytes).

Patients with coxarthrosis and osteonecrosis of the hip joint showed a statistical difference between these groups in terms of MDA levels determined in the blood serum. This indicator found in patients treated with osteonecrosis was 1.3 times higher compared to this indicator found in patients treated with coxarthrosis.

The amount of this metabolite recorded in erythrocytes in the research groups was similar to the parameters determined in blood serum, and it was observed that this indicator was recorded at a higher level in coxarthrosis and osteonecrosis diseases compared to the control group.

In the erythrocytes of patients with coxarthrosis, this indicator was 1.3 times (29.7%) higher than the value found in the control group, while in patients treated with osteonecrosis it was 1.7 times (72.7%) higher than in the control group (respectively, 8, 26±0.433 and 6.37±0.520 μmol/l, pIV <0.05; 11.0±2.100 and 6.37±0.520 μmol/l, pV <0.05).

The average value of MDA in the erythrocytes of patients with osteonecrosis in patients with dystrophic-degenerative diseases of the hip joint was 1.3 times (33.2%) higher than the average value in patients with coxarthrosis (pVI <0.05).

Thus, it was noted that the concentration of MDA in the blood serum and erythrocytes of patients with coxarthrosis and osteonecrosis increased compared to the indicator found in the control group, and this, in turn, indicates the acceleration of the processes of free radical reactions of lipids in these dystrophic and degenerative diseases.

The average value of MDA determined in patients treated with coxarthrosis and osteonecrosis and healthy people in the control group, laboratory parameters in blood serum and erythrocytes in men in the research groups are presented in the table below (Table 2):

Table 2

MDA levels (normal up to 2.0 μmol/L) in men with coxarthrosis and osteonecrosis and control men

Inspection material	Control group (healthy subjects), n=20	Patients with coxarthrosis, n=12	Patients with osteonecrosis, n=28
Blood serum	1,12±0,116	1,30±0,200 pI >0,05	1,95±0,301 pII <0,05 pIII <0,05
Erythrocytes	6,04±0,510	8,06±0,442 pIV <0,05	11,0±1,236 PV <0,05 pVI <0,05

Note: pI and pIV – the difference between the values determined in the control group and patients diagnosed with coxarthrosis (pI – blood serum, pIV – erythrocytes); pII and pV - the difference between the values in the control group and

patients diagnosed with osteonecrosis (pII - blood serum, pV - erythrocytes); pIII and pVI - the difference between values in patients diagnosed with coxarthrosis and osteonecrosis (pIII - blood serum, pVI - erythrocytes).

Table 2 shows that the average value of MDA recorded in the blood serum of men treated with coxarthrosis of the hip joint was not statistically different from the value of this indicator found in men of the control group (rI >0.05). However, this indicator was 1.7 times (74.1%) higher in men diagnosed with osteonecrosis of the femoral head compared to the average value found in men in the control group (rII <0.05). The following was noted in the blood serum of patients treated with coxarthrosis and osteonecrosis: MDA in osteonecrosis was 1.5 times (50.0%) higher than the value in coxarthrosis (pIII <0.05).

There was also a difference when MDA was detected in erythrocytes of patients with coxarthrosis and osteonecrosis. The amount detected in patients diagnosed with coxarthrosis was 1.3 times (33.4%) higher than the amount recorded in erythrocytes of men in the control group (pIV <0.05). In men with osteonecrosis, this indicator was 1.8 times higher (82.1%) than in men in the control group (pV <0.05). A comparative assessment of the malondialdehyde metabolite index detected in erythrocytes of patients diagnosed with coxarthrosis and osteonecrosis shows that MDA in osteonecrosis was 1.4 times (36.4%) higher than in coxarthrosis (pVI <0.05).

Thus, the average value of free radical index - MDA concentration accumulated in the blood serum and erythrocytes of men diagnosed with osteonecrosis of the femoral head is approximately 1.45 times higher than the average value of this indicator accumulated in the blood serum and erythrocytes of men diagnosed with coxarthrosis, which is statistically significant.

MDA indicators determined in blood serum and erythrocytes of healthy women, women with coxarthrosis and osteonecrosis were also recorded, similar to the results of the above-mentioned laboratory analysis (Table 3).

Table 3

MDA levels in women with coxarthrosis and osteonecrosis and women in the control group (normal up to 2.0 μmol/l)

Inspection material	Control group (healthy people), n=15	Patients with coxarthrosis, n=14	Patients with osteonecrosis, n=3
Blood serum	1,39±0,502	1,54±0,198 pI >0,05	3,10±0,405 pII <0,05 pIII >0,05
Erythrocytes	6,53±1,180	10,5±1,330 pIV <0,05	21,1±3,806 pV <0,05 pVI <0,05

Note: pI and pIV - the difference between the control group and patients diagnosed with coxarthrosis (pI - blood serum, pIV - erythrocytes); pII and pV – the

difference between the control group and patients diagnosed with osteonecrosis (pII – blood serum, pV – erythrocytes); pIII and pVI - difference in patients diagnosed with coxarthrosis and osteonecrosis (pIII - blood serum, pVI - erythrocytes).

Although there was an increase of MDA in the blood serum of women diagnosed with coxarthrosis compared to this value in the control group, it was not statistically significant (pI >0.05). In osteonecrosis, it was observed that the value of MDA was higher than that of the control group, and this difference was statistically significant (3.10±0.405 μmol/l and 1.39±0.502 μmol/l, respectively, pII <0.05 happened). When the average value of MDA was studied in the blood of patients with dystrophic-degenerative diseases of the hip joint, the average value of this indicator determined in the blood serum of patients with osteonecrosis was found to be almost 2 times higher than the MDA indicator recorded in patients treated with coxarthrosis (respectively 3.10±0.405 μmol/l and 1.54±0.198 μmol/l, pIII < 0.05). The MDA indicator in erythrocytes of women diagnosed with coxarthrosis and osteonecrosis was 2 times higher in women with osteonecrosis than in women with coxarthrosis (21.1±3.806 μmol/l and 10.5±1.330 μmol/l, respectively, pVI < 0.05).

The results of a comparative assessment of free radicalization of lipids in the body by the average value of MDA metabolite concentration in blood serum and erythrocytes of healthy people, patients diagnosed with coxarthrosis of the hip joint and osteonecrosis of the femoral head by gender are presented in the following table (Table 4):

Table 4

Comparative analysis of MDA level in blood serum and erythrocytes of men and women with coxarthrosis and osteonecrosis and control women (up to 2.0 μmol/l).

Groups	Research material	Control group (healthy subjects)	Patients with coxarthrosis	Patients with osteonecrosis
Men	Blood serum	1,12±0,116 (n=20)	1,30±0,200 (n=12)	1,95±0,301 (n=28)
Women	Blood serum	1,39±0,502 (n=15) pI >0,05	1,54±0,198 (n=14) pII >0,05	3,10±0,405 (n=3) pIII >0,05
Men	Erythrocytes	6,04±0,510 (n=20)	8,06±0,442 (n=12)	11,0±1,236 (n=28)
Women	Erythrocytes	6,53±1,180 (n=15) pIV >0,05	10,5±1,330 (n=14) pV >0,05	21,1±3,806 (n=3) pVI >0,05

Note: number of examinees in parentheses; pI is the difference in values between men and women in the control group; pII – difference in values in men and women with coxarthrosis; pIII – difference in values in men and women with osteonecrosis; pIV - the difference in values in erythrocytes of men and women in the

control group; pV – difference in erythrocytes of men and women with coxarthrosis; pVI - difference in erythrocytes of men and women with osteonecrosis.

The results of the study show that there was no statistical difference between the control group, men and women with coxarthrosis and osteonecrosis on MDA in blood serum and erythrocytes (pI, pII, pIII >0.05). It is important to note that, although it is not statistically significant, this indicator found in women in the studied biological fluids was found at a higher value compared to this indicator recorded in men.

Conclusion: Thus, MDA in blood serum and erythrocytes of patients with dystrophic-degenerative diseases of the hip joint increases compared to the value in the control group, which indicates the acceleration of lipid peroxidation as one of the pathogenetic links in the development of these diseases. Although there was no statistical difference in this indicator between men and women, the process of free radicalization of lipids was strongly manifested in the disease of osteonecrosis.

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