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Hematological Features Of Patients With Osteochondrosis Of The Spine.

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ABSTRACT

Progression of osteochondrosis is connected with negative changing of metabolism in tissues. In this respect it seemed to be important to clear up the state of erythrocytes' rheological properties which mostly determined the state of microcirculation and the level of metabolism. The aim: to clear up erythrocytes' morpho-functional peculiarities in patients of the second mature age with osteochondrosis of the 2nd degree. There were examined 37 healthy persons of the second mature age and 43 persons of the same age with osteochondrosis of the 2nd degree. There were applied biochemical, hematological and statistical methods of investigation in this research. At osteochondrosis plasma levels of acylhydroperoxides and thiobarbituric acid-products rose by 38.4% and 37.4%, respectively. It was accompanied in patients by the increase of thromboxane B_2 by 30.6% , level lowering of 6-keto-prostaglandin $F_{1\alpha}$ by 15.9% and metabolites of nitric oxide – by 23.6%. The erythrocytes of persons with osteochondrosis were detected to have the increase of cholesterol quantity by 11.6% and content decrease of common phospholipids by 11.1%. The content of acylhydroperoxides in their erythrocytes turned out to be increased by 30.0%, the level of malondialdehyde rose by 36.7%. At the same time, the patients with osteochondrosis were found to have quantity decrease of erythrocytes-discocytes by 12.7% and the increase of erythrocytes' reversibly and irreversibly modified forms by 35.7% and in 2.5 times, respectively. Erythrocytes' aggregative readiness at osteochondrosis was strengthened: erythrocytes' summary involvement into aggregates was increased by 32.9%, the number of these aggregates turned out to have risen by 33.3% and the quantity of free erythrocytes was decreased by 20.9%. So, the patients of the second mature age with osteochondrosis of the 2nd degree are characterized by worsening of erythrocytes' rheological indices.

Keywords: aggregation, the membrane's surface properties, erythrocytes, the second mature age, osteochondrosis.

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INTRODUCTION

Osteochondrosis is a very widespread disease in mammals and people [1]. Great genetic predisposition [2] can be traced in mechanisms of its development. It provides high frequency of this pathology occurrence in people [3,4] and in many species of animals [5]. Signs of osteochondrosis begin to declare themselves in people against the background of active labor activity in mature age. Episodes of osteochondrosis exacerbation can lead to cases of temporal disability and sometimes – to invalidism [6]. Wide prevalence of osteochondrosis, its predisposition to progression and frequent resistance to treatment demand further detailed studying of changes in a body which are caused by this disease [7]. Long-term course of osteochondrosis often leads to worsening of a man's common state [8]. Evidently, it is caused by osteochondrosis negative impact on functioning of most internals [9].

It is known that even scoliosis presence is already accompanied by the development of erythrocytes' microrheological dysfunctions what forms the risk of hypoxia development in tissues [10]. Increasing in these conditions chronic lack of oxygen negatively influences anabolic processes and weakens the common vitality of a body [11,12]. It is a serious cause of dystrophic changes' development in many internals [13,14] and persistent spasm of vessels [15,16]. In the result of it stable rise of arterial pressure is often formed against the background of osteochondrosis leading to the development of arterial hypertension [17]. Besides, osteochondrosis can strongly aggravate already existing cardio-vascular diseases and cause resistance to hypotensive therapy [18]. High frequency of osteochondrosis and its ruinous impact on a body generate a need in further studying of erythrocytes' rheological indices at the given pathology. Estimation of evidence of erythrocyte microrheological properties' disturbances at osteochondrosis can help in search of effective approaches to inhibition of its progression and removal of exacerbation episodes. In our research we put the following aim: to clear up erythrocytes' morpho-functional peculiarities in patients of the second mature age with osteochondrosis of the 2nd degree.

MATERIALS AND METHODS

This research is approved by the local Ethics Committee of the Russian State Social University on May, 14th, 2015 (Record №5). All the examined persons gave written informed consent on participation in the conducted research. The research was conducted on persons living in Central Russia (Moscow City and Moscow region). There were examined 37 healthy people (18 men and 19 women) of the second mature age (mean age – 43.5±2.5 years) who composed the control group. The research also involved 43 people (21 men and 22 women) of similar age (mean age – 44.7±1.9 years) who had the diagnosis of osteochondrosis of the 2nd degree. They composed the group of observation. The group of observation and the control group were once observed and examined.

In our research we determined the activity of the processes of lipids' peroxidation (LPO) in blood plasma which was registered according to the content of thiobarbituricacid (TBA)-active products in it with the help of a set produced by the firm "Agat-Med" (Russia) and to the level of acylhydroperoxides (AHP) [19]. We also registered antioxidant activity of blood [20].

In blood plasma of those examined we determined the content of thromboxane A_2 metabolite – thromboxane B2 and prostacyclin metabolite – 6-keto-prostaglandin F1α by enzymoimmunoassay with the help of sets produced by the firm "Enzo Life science" (USA). We also determined the summary content of nitric oxide metabolites [21] in plasma.

Erythrocytes were washed and resuspended. Then we estimated quantitatively the levels of cholesterol in them by enzymatic colorimetric method with the help of a set produced by the firm "Vital Diagnostikum" (Russia), and common phospholipids (CPL) – according to the quantity of phosphorus in them [22].

The evidence of the processes of intra erythrocyte LPO was found in washed and resuspended erythrocytes according to the concentration of malondialdehyde (MDA) in the reduction reaction of thiobarbituric acid and to the quantity of AHP [19].

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We judged the state of erythrocytes' microrheological features by their cyto-architecture and aggregation. We determined the quantity of erythrocytes' that is considered normal and changed forms in blood with the help of light phase-contrast microscopy [23].

The ability of erythrocytes to spontaneous aggregation was determined with the help of light microscopy by calculating the quantity of erythrocytes' aggregates, the number of aggregated and non-aggregated erythrocytes [23] in Goryaev's box. Received results were processed by Student's tcriterion.

RESULTS OF INVESTIGATION

All the taken under observation persons with osteochondrosis were noted to have activation of LPO processes (Table 1). Concentrations of AHP and TBA-active compounds in their blood surpassed the control level by 38.4% and 37.4%, respectively. It developed against the background of depression of plasma antioxidant protection in patients by 36.9% (the control value – 32.6±0.49%).

Table 1: Hematologic characteristics of the examined persons second adulthood with osteochondrosis

Indicators	Persons with osteochondrosis, n=43, M±m	Control, n=37, M±m
Acylhydroperoxides of plasma, D_{233}/l ml	2.45±0.48	1.77±0.23 p<0.01
Thiobarbituric acid-products of plasma, mkmol/l	4.48±0.52	3.26±0.29 p<0.01
Antioxidant activity of plasma, %	23.8±0.41	32.6±0.49 p<0.01
cholesterol of erythrocytes, mkmol/10^{12} erythrocytes	1.06±0.008	0.95±0.012 p<0.05
common phospholipids of erythrocytes, mkmol/10^{12} erythrocytes	0.63±0.007	0.70±0.009 p<0.05
acylhydroperoxides of erythrocytes, D_{233}/10^{12} erythrocytes	4.16±0.09	3.20±0.15 p<0.01
malonicdialdehyde of erythrocytes, nmol/10^{12} erythrocytes	1.94±0.08	1.42±0.12 p<0.01
thromboxan A_2, pg / ml	220.3±0.67	168.7±0.75 p<0.01
6-keto-prostaglandin $F_{1\alpha}$, pg / ml	82.8±0.32	96.0±0.42 p<0.05
nitric oxide's metabolites, umol/l	29.2±0.24	36.1±0.29 p<0.05
erythrocytes-discocytes, %	75.6±0.24	85.2±0.17 p<0.01
reversibly modified erythrocytes,%	15.2±0.12	11.2±0.09 p<0.01
irreversibly modified erythrocytes,%	9.2±0.08	3.6±0.06 p<0.01
sum of all the erythrocytes in an aggregate	43.6±0.11	32.8±0.12 p<0.01
quantity of aggregates	8.4±0.07	6.3±0.11 p<0.01
quantity of free erythrocytes	238.6±0.32	288.5±0.34 p<0.01

Conventions: p – the significance of differences in the parameters of those surveyedwho have osteochondrosis and control groups.

The blood of patients with osteochondrosis was detected to have evident misbalance of arachidonic acid metabolites: the concentration of thromboxane B_2 in their blood was more than the control level by 30.6% and plasma concentration of 6-keto-prostaglandin $F_{1\alpha}$ turned out to decrease by 15.9% (Table 1). At the same time, the content of nitric oxide summary metabolites in patients' blood was lower than the control level by 23.6%.

The composition of erythrocyte membranes of patients with osteochondrosis of the 2nd degree was found to have surplus CS quantity (1.06±0.008 mkmol/10^{12} erythrocytes) and lowered quantity of CPL (0.63±0.007 MKMOL/10^{12} erythrocytes). At the same time, the patients were noted to have LPO strengthening in erythrocytes (AHP – till 4.16±0.09 D_{233}/10^{12} erythrocytes, MDA – till 1.94±0.08 nmol/10^{12} erythrocytes) in comparison with the control values (AHP – 3.20±0.15 D_{233}/10^{12} erythrocytes, MDA – 1.42±0.12 nmol/10^{12} erythrocytes).

The blood of persons with osteochondrosis diagnosis was found to have the decrease of erythrocytes-discocytes' quantity by 12.7% in comparison with the control level (Table 1). The levels of reversibly and irreversibly modified erythrocytes in the group of observation rose by 35.7% and in 2.5 times, respectively. The persons with osteochondrosis were detected to have activation of spontaneous erythrocytes' aggregation. It was pointed by the increase of erythrocytes' summary involvement into aggregates by 32.9% and the quantity of these aggregates – by 33.3%, and also fall of non-aggregated erythrocytes – by 20.9% in comparison with the control level.

DISCUSSION

Further advancing development of variants of lasting preservation of physiological optimum in a body is possible only on behalf of continuation of active studying of all the man's biology aspects [24,25]. It is also very important for the search of correction means of (very often developing with aging) dystrophic changes in intervertebral disks causing osteochondrosis. Steadily progressing they cause more and more evident negative clinical manifestations negatively influencing life quality [26]. Notwithstanding the serious efforts of science osteochondrosis remains one of very widespread diseases. It continues to cripple seriously to economics because of high frequency of temporal disability against its background [1]. Modern researchers note that osteochondrosis is accompanied by not only disturbances in musculoskeletal system but also weakening of metabolism and circulation processes. It negatively influences functioning of the internals additionally aggravating common state [27]. Given circumstances demand continuation of detailed studying of osteochondrosis progression mechanisms.

It can be supposed that great role in aggravating of osteochondrosis manifestations is played by changing of rheological parameters of regular blood elements [28] and, especially, erythrocytes [29]. Evidently, great significance for their development belongs to the depression of plasma antioxidant protection leading to LPO strengthening in it. Surplus of free radicals in plasma and erythrocytes damages the membranes of these cells on the outside and inside and disturbs their characteristics. It is aggravated by developing at osteochondrosis lipid imbalance in erythrocytes' membranes which seriously worsens many processes of their functioning [30]. Selective permeability of erythrocyte membranes is disturbed in these conditions and the state of membrane-bound proteins is worsened. Given situation negatively influences the membranes' structural-functional state of many erythrocytes. The blood of patients with osteochondrosis of the 2nd degree is known to have content increase of reversibly and irreversibly modified erythrocytes and quantity decrease of their discoid forms.

The detected strengthening of erythrocytes' spontaneous aggregation in patients with osteochondrosis should be considered the consequence of the impact of its pathogenesis' all components. The increase of reversibly modified erythrocytes and their irreversibly modified varieties in blood of this category of patients provides quantity growth of erythrocyte aggregates and the rise of the involvement level of erythrocytes in them. Strengthening of erythrocytes' aggregation in persons with osteochondrosis can also be explained by the impact of catecholamines' surplus on them. Their level in blood rises at any pathology [31]. The growth of catecholamines' concentration in blood of patients is considered as an important compensatory mechanism of metabolism activation in tissues which can cause some negative consequences [32]. It is accompanied by number increase of α_2-receptors on cells of the whole body, including erythrocytes. It leads to

inhibition of adenylatecyclase, quantity lowering of cyclic adenosine monophosphate in them and content increase of Ca^{2+} in them [33] thus strengthening erythrocyte aggregation.

The vessels of patients with osteochondrosis are found to have weakening synthesis of disaggregants inhibiting erythrocytes' spontaneous aggregation. It is aggravated by strengthening by thromboxane synthesis in them and weakening of prostacyclin production what forms functional imbalance of arachidonic acid metabolites. Given disturbances are aggravated in patients with osteochondrosis by coming weakening of NO synthesis in vessels in the result of NO-synthase depression and excessive LPO processes [34]. Developing erythrocytes' rheological disturbances worsen microcirculation and additionally worsen trophism of vessels' walls and disaggregants' synthesis in them.

Detected changes of erythrocyte indices in conditions of osteochondrosis give foundation to consider this state an important risk factor which worsens erythrocytes' rheological indices and gives way to angiopathy development. These states aggravate each other, disturb perfusion of tissues and promote progression of the pathological process in spinal column. Basing on the conducted research it can be considered that it's possible to inhibit osteochondrosis by conducting planned correction of erythrocytes' microrheological properties. With this aim it is possible to apply not only medicaments but also non-pharmacological impacts. Great prospect of this approach is pointed by data about correction possibilities in children with scoliosis with the help of non-pharmacological means. They turned out to be able to improve the state of structure and functions of various regular blood elements in them [36]. Taking all this into account the authors plan to conduct efficiency estimation of designed by them medicinal-prophylactic clothes [37,38] in respect of its impact on erythrocytes' microrheological properties at osteochondrosis.

CONCLUSION

Worsening of rheological characteristics of regular blood elements often develops at the appearance of spinal column osteochondrosis signs. It is established that in the second mature age at presence of osteochondrosis of the 2nd degree the activity of lipids' peroxidation rises in plasma and erythrocytes. At the same time, the quantity of modified erythrocytes increases in blood of these patients and erythrocytes' spontaneous aggregation is strengthened. These disturbances can strongly worsen perfusion of capillaries. It disturbs the trophism of tissues and can cause further progression of osteochondrosis. In this respect it seems perspective to work out variants of osteochondrosis correction with the account of their impact on aggregation evidence and alteration of erythrocytes' forms. If the given direction of researching is successful, it's possible to work out an efficient way of inhibition of osteochondrosis progression.

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