

## MICROELEMENTOSIS IN PATIENTS WITH GONARTHROSIS ON THE BACKGROUND OF PROSTHETIC KNEE JOINTS

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**Abstract.** The purpose of the research – to determine blood and hair levels of metals included in the composition of prosthetic knee joints in patients with gonarthrosis, to evaluate the clinical and pathogenetic significance of this microelementosis in different variants of disease course. *Materials and methods.* Were examined 87 patients with gonarthrosis (45 % men and 55 % women with an average age of 53 years). Atomic absorption spectrometer "SolAAr-Mk2-MOZe" with electrographite atomizer (UK) were used to study the existence of metals in the organism. *Results.* Microelementosis in blood of patients with gonarthrosis observed in 41 % of cases, while in the hair - 23 %, which is accompanied by increased levels of Ti and V in serum on the background of reducing the concentration of Fe, and the hair changes of metals are related to the increasing content of Al, Fe and Ti with decreasing parameters of Co, Cr and Mo. It depends on the radiographic stage of the disease, the presence of synovitis, the prevalence and severity of articular syndrome, involving in the pathogenesis of meniscus lesions, bursitis, trabecular oedema in the patella, forming osteophytes, osteocytes and intraarticular Shtydy bodies, which is correlated with osteoporosis. *Conclusions.* Gonarthrosis courses with changing levels of metals in blood and hair (Al, Co, Cr, Fe, Mo, Ti, V) contained in the prosthetic knee joints, which depends on the clinical course of the disease, determines the pathogenetic compositions of articular degenerative inflammatory lesions.

**Keywords:** gonarthrosis, coxarthrosis, metals, blood, hair, course, pathogenesis.

**Actuality.** Gonarthrosis is one of the most common rheumatologic and orthopedic profile disease [1, 2, 3], which causes a significant health and social damage either to the people with illness or to society as a whole [4, 5]. Gonarthrosis is accompanied by microelementosis proceeding with a violation of the many essential and toxic metal body levels [6, 7]. After endoprosthesis replacement of knee joints in the patients' body, the content of such metals as Co, Cr, Ti, and others [8, 9, 10] are able to determine the "durability" of the graft prosthesis and the further course of gonarthrosis [11, 12].

*The purpose and objectives of the research* – to determine levels of metals included in the composition of total knee joints (Al, Co, Cr, Fe, Mo, Ni, Ti, V) in patients with gonarthrosis, as well as compare the values with concentrations of these trace elements in hair, comparing with the indicators of Co, Cr, Mo, Ni, Ti and V in the soil of areas of patients residence, to evaluate the clinical and pathogenetic significance of endogenous and exogenous microelements in different variants of the disease.

**Materials and methods.** Were examined 87 patients with gonarthrosis (45 % men and 55 % women with an average age of 53 years). I, II and III stages of the disease respectively identified in 28 %, 41 % and 31 % of observations, polyarthrosis occurred in 53 % of cases, osteochondrosis – in 92 %, spondylarthrosis of arcuate joints in 71 %, clinically symptomatic synovitis – 67 %. Among these patients diagnosed coxarthrosis was in 36 % of cases (main group) and the remaining 64 % without any changes of the hip joints constituted the control group. I, II and III stages of the disease respectively identified in 19 %, 48 %, 32 % of cases in the control group, polyarthrosis occurred in 58 % of cases, vertebral osteochondrosis in 94 %, spondylosis of arcuate joints in 65 %, synovitis in 61 %. To study the performance of metals in the organism were used atomic absorption spectrometer SolAAr-Mk2-MOZe with electrographite atomizer (UK). As a control, these laboratory parameters were determined in 40 healthy people between the ages of 38 to 79 years.

Assessment of anthropogenic trace element contamination of soil by metals is made by sanitary stations and the regional offices of the State committees for Hydrometeorology, environmental control and environmental safety.

Statistical analysis of the results of the research was carried out using computer variational, nonparametric, correlation, regression, one – (ANOVA) and multivariate (ANOVA / MANOVA) variance analysis (Microsoft Excel and Statistica-Stat-Soft, USA). Average values (M), their standard deviations

(SD) and errors (SE), Pearson parametric correlation coefficients and nonparametric Kendall coefficients, multiple regression criteria, Brown-Forsyth dispersion and Wilcoxon-Rao variance, Student and McNamara-Fisher differences, and reliability of statistical indices were evaluated. Critical level of significance in testing statistical hypotheses in this study was assumed to be 0.05.

**Results.** Microelementosis in blood of patients with gonarthrosis observed in 41 % of cases, while in the hair - 23 %, which is accompanied by increased levels of Ti and V in the serum on the background of reducing the concentration of Fe that is accordingly observed in 40 %, 44 % and 43 % of patients, and hair changes of metals are related to the increasing content of Al, Fe and Ti with decreasing parameters of Co, Cr and Mo in 46 %, 100 %, 22 %, 12 %, 29 % and 45 % of cases.

It depends on the radiographic stage of the disease, the presence of synovitis, the prevalence and severity of articular syndrome, involving in the pathogenesis of meniscus lesions, bursitis, trabecular oedema in the patella, forming osteophytes, osteocytes and intraarticular Shtydy bodies, which is correlated with osteoporosis (Al, Co, Cr, Ni) values of Cr, Ti and V in different objects of study (blood, hair) are correlated to each other, as well as have prognostic significance.

If in the blood serum of gonocoxarthrosis is accompanied by a significant rise of blood levels of Ti to 25 % V 43 %, in hair – Al to 27 %, Fe to 6.1 % and Ti by 14 % while reducing the first object of study Fe 4 %, and in the second object – Co to 30 %, Cr to 34 % and Mo to 10 %, with the additional development of lesions of the hip joints occurs with higher blood Ti to 19 %, V to 18 %, in the hair – Ti to 9 % on the background of oppression of Cr content of 22 %, which indicators correlate among themselves, depend on the degree of severity of the disease (Ni, V), make influence on the severity of degenerative-inflammatory changes in the compositions (Fe, Ni), and the difference between gonocoxarthrosis from the isolated gonarthrosis is high frequency of microelements Cr, Mo and Ti (Table 1).

Table 1. Indicators of metals in blood and hair of healthy people, patients with gonarthrosis and gonocoxarthrosis (M±SD±SE)

Indicators		Examined groups		
		healthy (n=40)	patients	
			gonarthrosis (n=56)	gonocoxarthrosis (n=31)
Blood	Al, µg/l	2,7±1,76±0,27	3,0±1,43±0,19	2,9±1,46±0,26
	Co, µg/l	8,3±5,58±0,84	10,1±6,07±0,81	9,2±4,94±0,89
	Cr, ng/l	1,2±0,55±0,08	1,3±0,49±0,07	1,3±0,51±0,09
	Fe, mg/l	443,1±21,70±3,27	427,1±33,54±4,48	425,0±33,46±6,01
	Mo, µg/l	1,6±0,87±0,13	1,7±0,56±0,07	1,8±0,89±0,16
	Ni, µg/l	3,9±2,11±0,32	4,4±1,92±0,26	4,6±2,43±0,44
	Ti, µg/l	2,0±0,31±0,05	2,1±0,42±0,06	2,5±0,60±0,11 *
	V, µg/l	1,4±0,69±0,10	1,7±0,70±0,09	2,0±0,80±0,14 *
Hair	Al, µg/g	2,2±0,72±0,11	2,6±0,87±0,12	2,8±0,85±0,15
	Co, ng/g	18,1±14,17±2,14	14,8±8,69±1,16	12,7±6,14±1,10
	Cr, ng/g	43,1±22,60±3,41	36,5±18,63±2,49	28,4±15,69±2,82 *
	Fe, µg/g	1,7±0,20±0,03	10,3±4,00±0,53	10,3±4,59±0,83
	Mo, µg/g	1,9±0,17±0,03	1,6±0,35±0,05	1,7±0,32±0,06
	Ni, µg/g	3,9±1,77±0,27	3,6±1,85±0,25	3,7±1,76±0,32
	Ti, µg/g	2,1±0,39±0,06	2,2±0,42±0,06	2,4±0,54±0,10 *
	V, ng/g	104,7±113,34±17,0	116,1±110,81±14,8	150,5±115,17±20,6

\* differences between patients with gonarthrosis and gonocoxarthrosis are authentic.

The level of Ti in soil is directly correlated with the concentrations of Fe and Mo in serum, and the settings in hair of Al, Co, Cr, Mo, Ni, Ti and V depend on the content in the soil of Co, Cr, Ni and V, and the integral indexes of the severity of microelements in blood and hair of patients with gonarthrosis have direct dispersion-correlation connections, respectively, with the indices Cr and V in the soil, with Co, Ti and V have an impact on the formation of the epiphyseal osteoporosis, ligamentos, trabecular edema of the femur and of the patella, damage to the anterior cruciate ligament.

**Conclusions.** Gonarthrosis courses with changing levels of metals in blood and hair (Al, Co, Cr, Fe, Mo, Ti, V) contained in the prosthetic knee joints, which is closely associated with the same level of metals in the soil of the region of patients' residence. Combined lesions of the knee and hip joints accompanied by increased microelements that flows with the changes of levels in blood and hair of such metals as Cr, Ti and V which contained in the endoprosthesis of hip and knee joints, which

depends on the clinical course of the disease, determines the pathogenetic of compositions of articular degenerative inflammatory lesions and necessitates the study of microelements in the body of patients in the process of dynamic observation after joint replacement taking into account the nature of the environmental areas.

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## ULTRASTRUCTURAL ORGANIZATION OF THE AORTIC WALL IN THE WHITE RAT

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**Abstract.** *The article is devoted to the comparative study of the ultramicroscopic structure of the aortic wall in the white rat in norm. The obtained results of the study may be useful in modeling of aortic diseases, since it is necessary to take into account the peculiarities of ultrastructural organization of the aorta of the experimental animal to extrapolate the experimental data to medical practice. Using the method of electron microscopy, it was established that the aortic wall is composed of three tissue layers - the inner, represented by the endothelial cells, the sub-endothelial layer and the internal elastic membrane; medial, which consists of the external elastic membrane/lamina; and the external (outer) layer - adventitia. The latter is formed by the loose fibrous connective tissue with a small amount of collagen fibers, muscle cells and macrophages. Haemomicrocirculatory pathway vessels (HPV) start from the blood vessels located in the adventitia, penetrate the outer third of the medial layer and branch out between the outer and medial layers of the aortic wall. Despite availability of the numerous comparative studies devoted to the anatomy of the aorta of the white rats and humans observed on the electro-microscopic level in norm, the results of our study will help to systematize and supplement the existing scientific information for further investigations of both morphologists and clinicians on the microanatomy of the aorta in terms of the development of new methods in the future diagnostics, prophylaxis and treatment of vascular pathologies. The present abstract is a part of the research work of the Lviv National Medical University named after Danylo Halytsky on "Morphological peculiarities of the haemomicrocirculatory pathway of the aortic wall of the rat in norm and in experimental diabetes mellitus".*

**Keywords:** *aorta, endothelial cells, ultrastructure, haemomicrocirculatory, white rat.*

**Вступ.** Ураження судин належить до важких патологій, які зустрічаються в щоденній лікарській практиці (патологія судин при атеросклерозі, інфекційні захворювання, вроджені аномалії, травми, цукровий діабет тощо), що доволі часто призводять до безпосередньої небезпеки для життя хворого. Діагностика та лікування судинної патології потребують доскональних знань анатомії судин в нормі. Порушення кровотоку в аорті та її основних гілках супроводжується важкими та широко розповсюдженими захворюваннями: гострими порушеннями мозкового та серцевого кровообігу, артеріальною гіпертензією при ураженні ниркових артерій, наднирковою недостатністю при їх неадекватному кровопостачанні, тромбозами мезентеріальних судин і т. д. Наслідками несвоєчасної діагностики та лікування цих захворювань є втрата працездатності пацієнтів. Одним із перспективних напрямів дослідження змін ультраструктури органів є використання експериментальних моделей [1]. Тому, вивчення електронномікроскопічної будови стінки аорти білого щура в нормі є актуальним до сьогоденішнього дня.

**Матеріал і методи дослідження.** Матеріалом дослідження були статеві зрілі білі щурі-самці масою 100 – 160 г лінії “Вістар” в кількості 10 тварин. Всі тварини знаходились в умовах віварію і робота проводилась згідно “Правилам проведення робіт з використанням експериментальних тварин”.

При виконанні роботи використовувався метод електронної мікроскопії. Тварину виводили з експерименту шляхом передозування внутрішньоочеревинного наркозу з використанням тіопенталу натрію (з розрахунку 25 мг/кг). Відразу після смерті тварини здійснювався забір і стандартне проведення матеріалу для електронної мікроскопії. Матеріалом для електронномікроскопічного дослідження слугували шматочки висхідного відділу, дуги та низхідного відділів аорти. Ультратонкі зрізи готували на ультрамікротомі УЖТП-3 за допомогою скляних ножів. Для дослідження відбирали стрічки зрізів сріблястого або ніжно-цитринового кольору. Зрізи контрастували спочатку в 2 % розчині ураніл ацетату, а потім