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*Keywords: gonarthrosis, course of the disease, patients' gender and age.*

## GENDER AND AGE-SPECIFIC FEATURES OF GONARTHROSIS COURSE

*Gonarthrosis has significant gender and age characteristics of the course, which are associated with the severity, the rate of progression of the disease and the prevalence of pathological articular process, and in men Baker's cysts are more frequently recorded, as well as trabecular edema in the femoral condyles and tibial bones, ligamentitis, periligamentit, changes in anterior cruciate ligament, and in women - subchondral sclerosis, damage to the posterior horn of the medial meniscus, osteocyst and intra-joint Hoff bodies. Age dimorphism is characterized by the frequency of formation of osteophytosis, osteocyst, epiphyseal osteoporosis, osteo-erosion, intraarticular cartilage flaps, change of anterior horn of the lateral meniscus, anterior cruciate and medial collateral ligaments.*

### INTRODUCTION

Osteoarthritis (OA) affects one in five people of the world, and the disease is the most common disease of the musculoskeletal system in all regions of the world (Wang M. et al., 2011). The urgency of the gonarthrosis (GA) is due not only to its high prevalence, but also to high-risk of limitation of knee joint function, which is accompanied by a significant decrease in the quality of life of patients and often leads to a partial disruption of disability or permanent disability of patients (Kovalenko V.M., Bortkevych O.P., 2010; Felson D.T., 2012).

The share of women with GA accounts for about 70% of the number of patients with primary OA (Nuaez M. et al., 2008; Hawker G.A. et al., 2009). J.M. Quintana et al (2008) found GA in 15% of the total population of women, while in men the same age, it occurred almost 2 times less often. However, there is evidence that the incidence of GA in men up to the age of 60 is still higher, and for women it starts to prevail only after 65 years (Lacey R.J. et al., 2008). The representatives of the male, allegedly, often have asymptomatic GA (Kang X. et al., 2009), but there are diametrically opposing evidence that latent OA of knee joints is a women's group is detected 2 times more often (Sudo A. et al., 2008).

As we know, one of the risk factors for GA is elderly age (Antonelli M.C., Starz T.W., 2012), although there is now a widespread increase in the number of young patients (even teenagers) age (Lebets I.S. et al., 2007; Shevchenko H.S. et al., 2010; Nowossadeck E., 2012). According to V. Wylde et al (2012), in 70% of healthy people aged 50 years and older, X-ray examination of the knee diagnosed GA. Issues of early diagnosis of GA in men and women of different age groups

require further intensive research (Gelber A.C., 2011; Pereira D. et al., 2011; Zhai Y. et al., 2012). These problems started to be treated as the most significant in modern arthrology (Allen K.D. et al., 2012).

The purpose and objectives of this work are the study of gender and age dimorphism of clinical course of GA, appreciation of differences of radiological, sonographic and densitometric characteristics of the pathological process in men and women, as well as of results of magnetic resonance imaging of the knee and the rate of disease progression among representatives of different genders.

## MATERIAL AND METHODS OF RESEARCH

104 patients with OA were examined (47% males and 53% females) aged 32 to 76 years ([55,3~{46,0–64,6}] years) among which GA was discovered in 96% of cases. Reactive synovitis on the results of clinical and sonographic study was diagnosed in 62% of cases, polyarthrosis - in 55%, systemic osteoporosis - in 14%, osteocyst - in 91%, and spondylopathy as degenerative disc disease and art-arthrosis – in 72%.

Patients underwent X-rays (apparatus «Multix-Compact-Siemens", Germany) and ultrasound (sonographer "Envisor-Philips", the Netherlands) examination of knee joints and the spine, dual-energy X-ray osteodensitometry of proximal femur (densitometer "QDR-4500-Delphi-Hologic" USA) and magnetic resonance imaging (MRI) of the knee joints (scanner "Signa-Excite-HD", Germany). In the course of the survey, "osteo-deficiency indexes" of Barnett - Nordin, Rokhlin, circularity and concavity, as well as the values of bone mineral density were evaluated. OA progression index (G) was evaluated using the formula:

$$G = [\,(A + B) \cdot C\,] \cdot 2$$

where $A$ - the joint account, $B$ - Ritchie index, $C$ - radiographic stage of the disease, $2$ - correction factor for patients with synovitis. *OA* severity index *(F)* was calculated by the formula:

$$F = \frac{C^2 + E}{D},$$

where $C$ - X-ray phase, $E$ - the amount X-ray and sonographic signs, $D$ - duration of clinical manifestation of the disease. Index of severity of *GA (H)* was also defined.

Statistical analysis of the results of research was carried out by computer variable-based, non-parametric, correlation, one-(ANOVA) and multivariate (ANOVA/MANOVA) dispersive analysis ("Microsoft Excel" and "Statistica-Stat-Soft", USA). Medians (M), as well as their standard deviations (SD) and errors (m), correlation coefficients, dispersion criteria (D) of Student, Wilcoxon – Rao, McNemar - Fischer ($c^2$) and the accuracy of statistical parameters (p) were evaluated. Sensitivity (X), specificity (Y) and importance parameters (Z) of signs were calculated.

## RESEARCH RESULTS

The severity of the knee joints problems in men is 1,74±0,670± 0,096 points, while among women it is 24% more (2,16±0,674± 0,094 points; p = 0,002). Indicators $F$ in men and women are equal to 0,66±0,556±0,079 o.e. and 0,91±0,940±0,127 o.e., $G$ - 0,86±0,472±0,067 o.e. and 0,86±0,449±0,061 o.e., $H$ - 0,86±0,472±0,067 o.e. и 0,89±0,449±0,063 o.e. It should be emphasized that the gender

dimorphism in relation to these figures in OA flow is absent. In the men group, correlations between *F* and *G* are unreliable, while women group stated a significant direct relationship. In the men's group *F* parameters are positively correlated with the stage of the disease, and in women - with the stage and the prevalence of the disease. Polyarthrosis frequency in men with GA is 51%, and in women - 61%.

Wilcoxon - Rao multivariate analysis of variance helps to determine the influence of gender on the integral features of radiology GA diagnostics, but not separately for x-ray and ultrasound exposure. Univariate analysis of variance indicates reliable gender dependence of subchondral sclerosis. As seen from Table. 1, McNemar – Fisher's criterion points to a certain gender dimorphism of features of GA course. For example, in women subchondral sclerosis is diagnosed by 19% more often, and 3.3 times – Hoff's bodies are identified, but Baker's cysts are detected 16% less. Amount of the significance of all the parameters studied in a group of men is 136%, and for women - 132%, radiographic signs - respectively 70 and 85%, sonographic ones - 66 and 47%.

The next stage of our work was to evaluate the impact of a gender dimorphism of influence of certain radiographic and ultrasonographic GA features on *F* parameters on the results of univariate analysis of variance. The rate of progression of OA was significantly dependent on the availability of osteocyst, epiphyseal osteoporosis, articular calcifications, osteo-erosion, Baker's cysts, cartilage flaps and Pellogri – Shtaydi bodies. In the groups of men and women there is an impact on rates of *F* osteoporosis and artrocalcinates. Meanwhile, in the women's group there is also a connection between *F* and presence of osteocyst, Baker's cysts and bodies of Pellogri - Shtaydi. According to the results of ANOVA completed, the *H* index is significantly effected - in both men and women – by osteocyst and osteoporosis availability. In addition, the women's group there is a connection between *H* parameter and development of the joint calcifications, Baker's cysts and intraarticular cartilage flaps. *H* parameter influences such signs of GA as subchondral sclerosis, osteocyst, epiphyseal osteoporosis, ligamentosis, calcifications, osteo-erosion, changes of horns of menisci, the presence of Baker cysts in joints, cartilage flaps and bodies of Pellogri - Shtaydi. Regardless of gender, there is a connection between *H* and osteocyst, osteoporosis, and osteo-erosion and bodies of Pellogri - Shtaydi. Gender characteristics relate to ligamentosis which is characteristic only for men, as well as subchondral sclerosis, calcifications, changes in horn meniscus, Baker's cysts and cartilage flaps, dispersion relation of which is characteristic only for women.

Table 1

Informativeness of individual x-ray and sonographic features of GA in men and women

| Features | Gender of patients | | | | | | Differences | |
|---|---|---|---|---|---|---|---|---|
| | men (n=49) | | | women (n=55) | | | | |
| | X, % | Y, % | Z, % | X, % | Y, % | Z, % | $c^2$ | p |
| 1 | 91,8 | 50,3 | 23,2 | 90,9 | 49,7 | 22,5 | 0,03 | 0,867 |
| 2 | 75,5 | 53,6 | 21,7 | 65,5 | 46,4 | 14,1 | 1,25 | 0,263 |
| 3 | 57,1 | 42,8 | 10,5 | 76,4 | 57,2 | 25,0 | 4,35 | 0,037 |
| 4 | 26,5 | 52,9 | 7,4 | 23,6 | 47,1 | 5,2 | 0,12 | 0,734 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 5 | 16,3 | 42,8 | 3,0 | 21,8 | 57,2 | 7,1 | 0,50 | 0,478 |
| 6 | 22,5 | 40,8 | 3,8 | 32,7 | 59,2 | 11,5 | 1,36 | 0,243 |
| 7 | 16,3 | 40,9 | 2,7 | 23,6 | 59,1 | 8,2 | 0,86 | 0,354 |
| 8 | 26,5 | 51,0 | 6,9 | 25,5 | 49,0 | 6,1 | 0,02 | 0,901 |
| 9 | 69,4 | 57,7 | 23,1 | 50,9 | 42,3 | 9,1 | 3,68 | 0,055 |
| 10 | 30,6 | 67,7 | 14,0 | 14,6 | 32,3 | 1,5 | 3,88 | 0,049 |
| 11 | 44,9 | 56,5 | 14,3 | 34,6 | 43,5 | 6,6 | 1,16 | 0,281 |
| 12 | 20,4 | 50,5 | 5,2 | 20,0 | 49,5 | 4,9 | 0,01 | 0,959 |
| 13 | 4,1 | 20,0 | 0,2 | 16,4 | 80,0 | 10,5 | 4,13 | 0,042 |

1 - narrowing of joint tissues; 2 – osteophytosis; 3 - subchondral sclerosis; 4 - osteokistoz 5 – osteocyst; 6 – ligamentosis; 7 - intraarticular calcifications; 8 – osteo-erosion; 9 - changes in meniscus horns; 10 - Baker's cysts; 11 - intraarticular cartilage flaps; 12 – bodies of Pellogri – Shtaydi; 13 – Hoff's bodies.

Patients were divided into three age groups: the 1st were 35 patients under 50 years old, the 2nd (62 patients) - in the age of 50-60 years, and the third (7 people) - in the age of 60. There is age dimorphism in severity of knee joints damage, and highly reliable differences relate to comparison of the 1st and the 2nd groups, the 2nd and the 3rd groups, but not the 1st and the 3rd ones.

The age of patients with GA has little effect on development of synovitis, which also applies to the age at the onset of manifestations of the pathological process. Age at the time of the survey and at the beginning of the disease according to the analysis of variance has a significant impact on the stage of OA, but not the prevalence of the pathological process. X-ray stage of GA correlates with the age of the patients. According to multivariate analysis of variance, in isolated GA, a significant impact of patients' age on sonographic and integrated radiographic signs of disease is registered. Univariate analysis of variance indicates the connection of the patients' age and incidence of subchondral sclerosis. Patient age also affects the formation of osteophytosis, osteocyst, epiphyseal osteoporosis, osteo-erosion and intra-articular cartilage flaps. Age of the patients has a significant impact on *H*, which is shown by ANOVA, and moreover there is a direct correlation with *H*.

According to ANOVA / MANOVA, patient age influences the integrated MRI signs of pathology of the knee joint. Univariate analysis of variance shows a significant correlation with age of such characteristics as changes in the anterior horn of the lateral meniscus, anterior cruciate and medial collateral ligaments, as well as the emergence of intra-articular cartilage flaps. Patients with changes in the anterior horn of the lateral meniscus were significantly older (8.3 years), and with formation of intra -articular cartilage flaps - 4.6 years younger, with the changes the anterior cruciate and medial collateral ligaments, respectively, younger by 9.8 and 9.3 years.

## DISCUSSION

As we know, ¾ of the number of patients with GA are women in the menopausal period (Iqbal M.N. et al., 2011; Iwamoto J. et al., 2011). Female gender and older age are sure risks of GA, but sex-age-specific criteria of radiological diagnostics remain unstudied (Guillemin F. et al., 2011;

Nguyen U.S. et al., 2011). For the diagnosis of GA radiography, sonography and MRI of the knee joint are usually used at the same time (Hayashi D. et al., 2012). Large-scale epidemiological studies showed that at isolated x-raying of knee joints in 39% of healthy men and 44% of the female population signs of GA were discovered (Laxafoss E. et al., 2010). Along with the X-ray, in the last years, one of the main methods for the diagnosis of GA in representatives of different genders, the method of arthrosonography is used (Iagnocco A. et al., 2011; Yang P.F. et al., 2011). Not only for the elderly but also for younger people in the early stages of the disease, ultrasound allows the simultaneous evaluation of degenerative changes in the cartilage and the subchondral bone (Aula A.S. et al., 2010). MRI is the most sensitive method for diagnosis of tendinitis and tendon ruptures at the GA, being not worse than arthrosonography (Bortkevich O.P., 2007). At GA, MRI method has high sensitivity and specificity (Menashe L. et al., 2012).

According to the results of ANOVA/MANOVA we performed, there is a highly significant effect of gender of patients on integral indicators of MRI of the knee joints. There is a dispersion relation between patients' gender and trabecular edema in femoral condyles and the tibial posterior, injury of medial meniscus and anterior cruciate ligament, ligamentosis, periligamentit and osteocyst. As follows from Table. 2, for men, trabecular edema in the femoral condyles happens 21% more often, by 34% - the tibia, 6.8 times - anterior cruciate ligament injury, by 37% - ligamentosis, and 5.7 times - periligamentit, but by 42 % less likely to have damages the posterior horn of the medial meniscus and by 34% - the development of osteocyst. As demonstrated by univariate analysis of variance, the rate of progression of the disease is affected by trabecular edema in the femoral condyles, changes in the posterior horn of the medial meniscus, the presence of ligamentosis, bursitis, intraarticular cartilage flaps and osteocyst. Within this there is a pronounced gender dimorphism, because the relationship of *F* with *MRI* features relates only to women, including factors such as the subchondral changes, swelling in the condyles of the femur, changes in the posterior horn of the medial meniscus, ligamentosis, bursitis, Baker's cysts and cartilage flaps.

Table 2

Informativeness of individual MRI signs of GA in men and women

| Features | Gender of patients | | | | | | Differences | |
|---|---|---|---|---|---|---|---|---|
| | male (n=49) | | | women (n=55) | | | | |
| | X, % | Y, % | Z, % | X, % | Y, % | Z, % | $c^2$ | p |
| 1 | 69,4 | 51,5 | 18,4 | 65,5 | 48,5 | 15,4 | 0,18 | 0,670 |
| 2 | 40,8 | 67,4 | 18,5 | 20,0 | 32,6 | 2,1 | 5,37 | 0,021 |
| 3 | 44,9 | 80,5 | 29,1 | 10,9 | 19,5 | 0,4 | 15,22 | <0,001 |
| 4 | 24,5 | 65,9 | 10,6 | 12,7 | 34,1 | 1,5 | 2,40 | 0,121 |
| 5 | 20,4 | 50,5 | 5,2 | 20,0 | 49,5 | 4,9 | 0,01 | 0,959 |
| 6 | 16,3 | 39,0 | 2,5 | 25,5 | 61,0 | 9,5 | 1,29 | 0,255 |
| 7 | 28,6 | 28,7 | 2,4 | 70,9 | 71,3 | 36,0 | 18,59 | <0,001 |
| 8 | 24,5 | 87,2 | 18,6 | 3,6 | 12,8 | 0,1 | 9,67 | 0,002 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 9 | 14,3 | 96,7 | 13,4 | 3,6 | 3,3 | 0,0 | 3,72 | 0,054 |
| 10 | 63,3 | 54,6 | 18,9 | 52,7 | 45,4 | 10,9 | 1,18 | 0,278 |
| 11 | 57,1 | 74,1 | 31,4 | 20,0 | 25,9 | 1,3 | 15,25 | <0,001 |
| 12 | 20,4 | 85,0 | 14,7 | 3,6 | 15,0 | 0,1 | 7,14 | 0,008 |
| 13 | 59,2 | 47,5 | 13,4 | 65,5 | 52,5 | 18,1 | 0,43 | 0,510 |
| 14 | 26,5 | 44,8 | 5,3 | 32,7 | 55,2 | 10,0 | 0,48 | 0,490 |
| 15 | 32,7 | 45,0 | 6,6 | 40,0 | 55,0 | 12,1 | 0,60 | 0,437 |
| 16 | 40,8 | 35,4 | 5,1 | 74,6 | 64,6 | 31,1 | 12,16 | 0,001 |

1 - subchondral changes; 2 - trabecular swelling of the bone in the femoral condyles; 3 - trabecular swelling of the bone in the tibial condyles; 4 - trabecular edema in the patella; 5 - change the hamstring; 6 - changes in the anterior horn of the lateral meniscus; 7 - changes in the dorsal horn of medial meniscus; 8 - change the anterior cruciate ligament; 9 - change of the medial collateral ligament; 10 - change the menisci; 11 - ligamentosis, 12 - periligamentit, 13 - bursitis, 14 - Baker's cysts, 15 - intra cartilage flaps, 16 - osteocyst.

*H* rates affect features such as subchondral sclerosis, osteocyst, osteoporosis, ligamentosis, calcifications, osteo-erosion, changes of meniscal horns, presence in the joints of Baker cysts, cartilage flaps and bodies of Pellogri - Shtaydi. Regardless of gender, there is a connection with osteocyst, osteoporosis, osteo-erosion and bodies of Pellogri - Shtaydi. Gender characteristics relate to ligamentosis (typical for men only), and subchondral sclerosis, calcifications, changes of horn meniscus, Baker's cyst and cartilage flaps (the dispersion relation is characteristic only of women). According to ANOVA, *H* is significantly influenced by the presence of periligamentit in patients. In turn, development of this feature of the disease depends on *H* values. This relationship applies only to men, while for women *H* influences development of degenerative changes in the meniscus and bursitis.

Patients' age does not have significant influence on the severity of GA, as evidenced by ANOVA. There is no correlation with the parameters of disease severity. *G* factors depend on age of patients, which are also in a direct very close correlation. In addition, the age at first manifestation of the disease affects *G*, and with the age - at the onset of the pathological process - *F* and *G* correlate directly.

## CONCLUSION

1. GA has significant gender-specific trends, which are associated with the severity, rate of progression of the disease and the prevalence of articular disease process.

2. Men more often have Baker's cysts, trabecular edema in the femoral condyles and tibial bone, ligamentosis, change the anterior cruciate ligament, periligamentit; and women - subchondral sclerosis, changes in the posterior horn of medial meniscus, osteocyst, and intra-joint Hoff's bodies.

3. GA features age dimorphism of the disease, which manifests the dispersion influence and correlation relationships of age at the moment of survey and at the onset of manifestation of the pathological process with the prevalence of joint syndrome, radiological stage and grade of disease

activity, with parameters *F* and *G,* with the frequency of formation of osteophytosis, osteocyst, epiphyseal osteoporosis, osteo-erosion, intra cartilage flaps, changes of anterior horn of the lateral meniscus, anterior cruciate and medial collateral ligaments.

4. Age and gender dimorphism of GA flow must be considered in the framework of the early detection of the disease, arranging rational case follow-up and medical technology of rehabilitation of men and women.

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## THE GENDER AHD AGE SPECIFIC FEATURES OF GONARTHROSIS

***O.V. Syniachenko, M.V. Ermolaeva, T.S. Yutovets, K.S. Golovkina***

*Summary. Gonarthrosis has significant gender and age course characteristics, which are associated with the severity, disease progression rate and the prevalence of articular disease process, and, in men considered Baker's cyst, trabecular edema in the femoral condyles and tibial bone ligamentosis, periligamentitis, changes in anterior cruciate ligament, in women — subchondral sclerosis, changes in the posterior horn of the medial meniscus, osteocystosis and intra-articular Hoff bodies. Dimorphic age characterized by the frequency of osteophytosis*

*formation, osteocystosis, epiphyseal osteoporosis osteousures, intrahondrome bodies, change the anterior horn of the lateral meniscus, anterior cruciate and medial collateral ligaments.*

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Key words: gonarthrosis, disease course, gender and age of patients.

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