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КЛИНИКО-ПАТОГЕНЕТИЧЕСКИЕ АСПЕКТЫ РАЗВИТИЯ ОСТЕОПОРОЗА У ЖЕНЩИН

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АННОТАЦИЯ

Остеопороз, один из основных системных заболеваний скелета, характеризуется снижением прочности костей, что приводит к увеличению риска переломов. Прочность кости определяется суммой ее количественных и качественных свойств, таких как минеральная плотность кости (МПК), метаболизм кости и минерализация костной ткани. Из-за постепенного прогрессирования заболевания остеопороз часто диагностируется только после перелома, поэтому его называют "тихой эпидемией." Полученные данные свидетельствуют о популяционной характеристике ВМД у женщин и позволяют улучшить качество диагностики остеопоротических изменений и начать адекватное лечение остеопороза рано и своевременно.

В связи с этим целью нашего исследования было изучение особенностей развития и клинического течения остеопороза у женщин среднего возраста.

Ключевые слова: костная ткань, первичный и вторичный остеопороз, перелом, патогенез остеопороза.

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CLINICAL AND PATHOGENETIC ASPECTS OF OSTEOPOROSIS DEVELOPMENT IN WOMEN

ANNOTATION

One of the primary systemic skeletal diseases is osteoporosis, which is characterized by a decrease in bone strength that leads to an increased risk of fractures. Bone strength is determined by a combination of quantitative and qualitative characteristics, such as bone mineral density (BMD), bone turnover, and bone mineralization. Due to the gradual progression of the disease, osteoporosis is often diagnosed only after a fracture has occurred, which is why it is called a "silent epidemic." The data obtained indicate population-specific features of BMD in women and will help improve the quality of diagnostics for osteoporotic changes, allowing for the early and timely initiation of adequate OP therapy. Therefore, the purpose of our study was to investigate the features of the development and clinical course of osteoporosis in middle-aged women.

Keywords: bone tissue, osteoporosis, pathogenesis and clinical presentation of osteoporosis.

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AYOLLARDA OSTEOPOROZ RIVOJLANISHINING KLINIK-PATOGENETIK JIHLARI

ANNOTATSIYA

Skeletning asosiy tizimli kasalliklaridan biri osteoporoz bo'lib, suyak to'qimasi mustahkamligining pasayishi bilan tavsiflanadi, bu esa sinish xavfining oshishiga olib keladi. Suyak to'qimasining mineral zichligi (SMZT), suyak almashinuvi, suyak to'qimasining minerallashuvi va h.k. kabi miqdoriy va sifat xususiyatlarining yig'indisi suyakning mustahkamligini belgilaydi. Osteoporoz ko'pincha sinishdan keyin, kasallikning asta-sekin rivojlanishi tufayli aniqlanadi, shuning uchun u "yashirin epidemiyasi" deb ataladi. Olingan ma'lumotlar ayollar KMPning populyatsion xususiyatlarini ko'rsatadi va osteoporotik o'zgarishlarni tashxislash sifatini oshirish, OPni erta va o'z vaqtida adekvat davolashni boshlash imkonini beradi.

Shu munosabat bilan bizning tadqiqotimizning maqsadi o'rta yoshli ayollarda osteoporozning rivojlanish va klinik kechish xususiyatlarini o'rganish edi.

Kalit so'zlar: suyak to'qimasi, birlamchi va ikkilamchi osteoporoz, sinish, osteoporoz patogenezi.

Introduction: According to official data, osteoporosis (OP) has been detected in 200 million people and contributes to 8.9 million fractures annually [2]. In 9 out of 10 cases, osteoporotic fractures are caused by low-energy mechanical impact on bone tissue. According to research by our colleagues in the USA, osteoporosis affects 1 in every 10 to 20 patients over the age of 50 [6]. In Russia, OP is diagnosed in approximately one-third of women and one-quarter of men [8].

Bone mineral density (BMD) is a key factor in bone strength that, along with the specifics of its microarchitecture, including the characteristics of the trabecular network and organic matrix, either prevents or contributes to the development of low-energy fractures. At the same time, BMD values are a fluctuating quantity that depends on the continuous activity of two opposing processes: osteogenesis and bone resorption [2]. Osteoporosis (OP) is a disease with a polyetiological nature, which encompasses genetic predisposition and the influence of various exogenous and endogenous factors. The most significant modifiable risk factors include hormonal status (hyperparathyroidism, hypercortisolism, hyperthyroidism), level of physical activity (sedentary lifestyle), age-related changes (age over 50), dietary patterns, gender (female), tobacco smoking, and other parameters [9].

A distinction is made between primary osteoporosis, a disease caused by a genetic predisposition combined with environmental factors. This form is the most common and is subdivided into several types: postmenopausal, senile, juvenile, and idiopathic. Unlike primary osteoporosis, secondary osteoporosis has a specific cause and develops as a result of various pathologies (endocrine, gastroenterological, hematological, and others) or due to medications that negatively affect bone metabolism. In particular, 30-50% of patients on long-term glucocorticoid or proton pump inhibitor therapy have a significantly increased risk of bone fractures [10].

A characteristic feature of osteoporosis is increased bone fragility, which makes bones vulnerable to even minor mechanical impact. A fracture can occur from a fall from a standing height or even from an awkward movement [1]. The disease develops gradually: the initial stage is characterized "silent" vertebral body fractures, which progress over time to more serious injuries, such as low-energy fractures of the femoral neck or radius [11].

Osteoporosis and its related complications develop in both sexes, but at different rates and in different age periods [12]. For every man suffering from osteoporosis, there are four women; however, a number of authors emphasize in their work that men are characterized by a more severe course of the disease with frequent development of complications. Clinical observations show that after a fracture, the worst quality of life indicators and the highest mortality rates are recorded

Table 1. Clinical and anthropometric characteristics of the examined patients

Parameter	Patients with osteoporosis (n=60)
Age, years	54.7±3.35
Body weight, kg	79.5±7.17
Waist circumference, cm	90.5±6.07
BMI, kg/m ²	31.02±3.05

As shown in Table 1, the examined patients were characterized by increased body weight and abdominal obesity, as indicated by elevated BMI and waist circumference values. Obesity is known to be a significant risk factor for metabolic disorders and may influence bone

specifically in women [14]. As it turns out, sexual dimorphism plays a key role in the differences in the etiopathogenesis of the disease, which is related to the specific features of hormonal regulation of bone metabolism in the different sexes.

Thus, the data presented underscore the importance of studying gender differences in the mechanisms of osteoporosis development as a separate area within genetic and epigenetic studies of this pathology.

Therefore, **the purpose** of our study was to examine the developmental features and clinical course of osteoporosis in middle-aged women.

Methods and Materials: The study included patients who presented to the Samarkand State Medical University Clinical Hospital and Family Polyclinic No. 2 between 2024 and 2025 with complaints of persistent pain in the back, lower back, and thoracic spine, as well as changes in posture, stooping, nocturnal leg cramps, and brittle nails and hair. The main group consisted of 70 women diagnosed with osteoporosis who were examined in inpatient and outpatient settings, with a mean age of 54.7±3.35. The control group comprised 20 apparently healthy women of a comparable age. A general clinical examination was performed according to a standard protocol, which included clarifying complaints, collecting medical history, assessing the condition of organs, and measuring bone density. A comprehensive laboratory and instrumental examination included a complete blood count; determination of blood levels of Mg²⁺, P, Ca²⁺, malondialdehyde (MDA), and superoxide dismutase (SOD); X-ray densitometry; MRI and MSCT of the bones; ECG; ultrasound; and survey radiography of the joints. The One-Minute Osteoporosis Risk Test (in accordance with the 2010 recommendations of the European Society for Clinical and Economic Aspects of Osteoporosis and Osteoarthritis) was used, as well as the VAS pain scale and the SF-36 quality of life questionnaire, which are widely used in both clinical practice and research to monitor patient condition and treatment effectiveness.

Results and Discussion

The study included female patients with osteoporosis aged 43 to 63 years. The mean age was 54.7±3.35 years. All participants were women, which is consistent with epidemiological data indicating a higher prevalence of osteoporosis in the postmenopausal period.

During the clinical and anamnestic assessment, the main risk factors for osteoporosis were analyzed. The most common factors were hereditary predisposition (26.9%), history of trauma (39.6%), and obesity (42.9%), confirming the multifactorial nature of the disease. The diagnosis of osteoporosis was established in accordance with current clinical guidelines and international classification standards.

remodeling processes through hormonal and inflammatory mechanisms. Therefore, the identified anthropometric features may contribute to the progression of osteoporosis and worsening of its clinical course.

To assess functional status and quality of life, the Visual Analogue Scale (VAS), the One-Minute Osteoporosis Risk Test, and the SF-36 questionnaire were used.

Table 2. Comparative characteristics of functional status

Parameter	Control group (n=20)	Main group (n=70)	p
VAS pain, mm	57 (47–70)	49 (35.7–52.7)	<0.001
VAS general well-being, mm	51.5 (47.2–71)	46 (34.7–66)	<0.005
Physician's assessment, mm	52.5 (42–60)	42 (33–51)	<0.001
Osteoporosis risk test	5 (1–7.75)	3 (0–5.2)	<0.001

Note: statistically significant differences (Mann–Whitney test, $p < 0.05$)

The analysis demonstrates that patients with osteoporosis showed a significant deterioration across all studied parameters. The most pronounced differences were observed in pain intensity, which significantly limited daily activity. In addition, a decrease in overall well-being and a lower assessment of health status by both patients and physicians were observed.

Table 3. Quality of life indicators according to SF-36 questionnaire

Parameter	Control	Main group	p
PF (Physical Functioning)	94.4±2.6	76.4±2.6	<0.001
RP (Role Physical)	94.6±2.4	64±9.6	<0.001
BP (Bodily Pain)	96.5±1.6	67.8±7.8	<0.001
GH (General Health)	73.3±2.3	53.7±3.8	<0.001
VT (Vitality)	78.3±1.9	49.4±4	<0.001
SF (Social Functioning)	92.7±2.3	69.7±4.8	<0.001
RE (Role Emotional)	76±7	57.8±7.2	<0.001
MH (Mental Health)	86.3±2.4	66.1±4.5	<0.001

The results of quality-of-life assessment demonstrated a significant decrease across all parameters in patients with osteoporosis. The most pronounced changes were observed in physical functioning and role limitations, indicating substantial restrictions in daily activities.

Physical functioning was reduced by more than 1.2 times, reflecting decreased physical activity. Role limitations due to physical condition decreased by nearly 48%, highlighting the significant impact of the disease on daily functioning. Additionally, significant reductions were observed in vitality, general health perception, and mental health.

These findings confirm that osteoporosis has a systemic impact on quality of life, affecting both physical and psychological domains.

The study also included an assessment of oxidative stress markers. A significant positive correlation was found between malondialdehyde (MDA) levels and osteoporosis severity ($r=0.44$, $p < 0.001$), indicating increased lipid peroxidation activity in disease progression. Furthermore, a positive correlation between MDA levels and urinary deoxyypyridinoline, a marker of bone resorption, was identified ($r=0.41$, $p < 0.001$).

A negative correlation was observed between MDA levels and bone mineral density, indicating the detrimental effect of oxidative stress on

bone mass. Additionally, the activity of antioxidant enzymes, particularly superoxide dismutase, showed an inverse relationship with disease severity ($r=-0.5$, $p < 0.001$), suggesting depletion of antioxidant defense mechanisms.

Lower scores in the osteoporosis risk test indicate a higher burden of risk factors contributing to disease progression. Overall, these findings reflect a substantial impairment in functional status and highlight the need for a comprehensive therapeutic approach.

Thus, the obtained results demonstrate that oxidative stress plays a significant role in the pathogenesis of osteoporosis, contributing to increased bone resorption and decreased bone mineral density.

Conclusions: The research findings confirm the existence of differences in bone mineral density (BMD) indicators among middle-aged women. These data are of significant clinical importance, as they allow for the improvement of osteoporosis diagnostics by considering specific standards for different population groups. More

An accurate assessment of BMD is conducive to the early detection of osteoporotic changes, which is critical for preventing fractures through the timely initiation of pathogenetic therapy. Implementing these findings in clinical practice will help optimize examination algorithms, reduce the risk of fractures, and improve the prognosis for patients with osteoporosis (OP).

Implementing these findings in clinical practice will help optimize examination algorithms, reduce the risk of fractures, and improve the prognosis for patients with osteoporosis (OP).

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