



THE ROLE OF METABOLIC SYNDROME IN THE DEVELOPMENT OF OSTEOPENIC DISORDERS IN MENOPAUSAL WOMEN

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ARTICLE INFO

Received:
27 Mar 2023
Accepted:
10 Jul 2023

Keywords: Osteoporosis, Menopause, Metabolic syndrome, Obesity

ABSTRACT

Metabolic syndrome is a set of diseases consisting of obesity, hyperglycemia, hypertension, and dyslipidemia, each of which can affect bone tissue. Data from various studies demonstrate the presence of common main pathways, including regulation of calcium homeostasis, ligand-receptor activator, and osteoprotegerin. The high prevalence of metabolic syndrome and osteoporosis in menopausal women, and contradictory data on the relationship between both conditions indicate the importance of further study and discussion of this topic. We suggest that metabolic syndrome may play a potential role in the development of osteoporosis in menopausal women. Two hundred and ten patients took part in this scientific research. Bone metabolism in menopausal women with metabolic syndrome was evaluated using various methods of examination. Menopause is an independent predictor of the development of metabolic syndrome. Metabolic syndrome and its components are also risk factors for a decrease in bone mineral density. As a treatment and prevention of menopausal metabolic syndrome, therapeutic measures should be aimed at achieving metabolic control, normalization of total body weight, and increased physical activity.

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To Cite This Article: Baysurkaeva DA, Dzhumataeva NT, Dzhabrailova NM, Buschanova AS, Matsuga DG, Imangulova RN. The Role of Metabolic Syndrome in the Development of Osteopenic Disorders in Menopausal Women. *Pharmacophore*. 2023; 14(S1): e-723-7262

Introduction

According to the World Health Organization, osteoporosis is defined as a disease characterized by a decrease in bone mass and a violation of the microarchitectonics of bone tissue. It is the most important cause determining mortality in older age groups [1]. In the Russian Federation, about 14 million people are susceptible to osteoporosis, which is 10% of the country's population, every third woman after the age of 50 faces osteoporotic fractures [2]. The occurrence of osteoporosis in menopause is associated with changes in bone metabolism, in the process of which lies the predominance of bone resorption over the processes of its formation as a result of estrogen deficiency [3]. The protective role of estrogens in relation to bone resorption is carried out through ligand-receptor mechanisms that increase the functional activity of osteocytes and osteoblasts, and increase osteoclast apoptosis [4]. The determination of tissue mineral density is used to diagnose osteoporosis and assess the risk of fractures. The risk of fractures increases with a decrease in height by 4 cm, kyphosis, and prolonged therapy with glucocorticoids. Densitometry is used to determine the level of standard deviation, denoted as the T-index. A T-index from -1.0 to -2.5 indicates osteopenia, whereas, an indicator from +2.5 to -1.0 indicates a normal state of bone mass.

Abdominal obesity, dyslipidemia, hyperglycemia, and hypertension also belong to the factors of osteoporosis, which are components of the metabolic syndrome [5]. The prevalence of metabolic syndrome ranges from 10 to 84%, depending on gender, age, race, and ethnicity [6], and prevails in menopausal women. Obesity contributes to an increase in the rate of androgen metabolism and an increase in the rate of their production, and with abdominal obesity, the rate of testosterone

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production is significantly higher than with the gynoid type of subcutaneous fat distribution. As a result of estrogen deficiency, lipid metabolism disorders occur in menopausal women, which has a significant impact on fatty acid metabolism and various aspects of energy metabolism, such as the basal metabolic rate and obesity. In addition, menopause is also associated with changes in the levels of various lipids circulating in the blood, such as lipoproteins, apolipoproteins, low-density lipoproteins, high-density lipoproteins, and triacylglycerin. Changes in lipid metabolism and excess adipose tissue play a key role in the synthesis of excess fatty acids, adipocytokines, pro-inflammatory cytokines, and reactive oxygen species, which cause lipid peroxidation and lead to the development of insulin resistance, abdominal obesity, and dyslipidemia. The risk of developing various diseases associated with metabolic syndrome in women is determined by the peculiarities of the distribution of adipose tissue in the body. The data from many studies demonstrate contradictory results about the relationship between metabolic syndrome and osteoporosis. In this connection, the question of the effect of metabolic syndrome on bone density is still considered the most discussed [7, 8].

The study aimed to assess the state of bone metabolism in menopausal women with metabolic syndrome.

Materials and Methods

The study involved 210 patients of urban polyclinics of Vladikavkaz (Republic of North Ossetia-Alania, Russia), aged from 54 to 76 years. All patients were divided into two groups. Group 1 included 103 patients with metabolic syndrome, group 2 - 107 patients without metabolic syndrome. All patients underwent a comprehensive examination of the body, the results of which allowed us to identify cardinal differences in the main indicators that explain the causes of the appearance and development of metabolic syndrome. The research methods included anthropometric, enzyme immunoassay, biochemical, cytological, X-ray, and densitometry.

Results and Discussion

Out of 103 patients in group 1, 92 patients were found to have obesity of I, II, and III severity. When assessing the adipose tissue mass index by densitometry, excess adipose tissue was detected in group 1 in 100% of cases and group 2 in 30% of cases (Table 1).

Table 1. Types of obesity by groups of the studied patients

Type of obesity	Group 1	Group 2
gynoid	4 %	90 %
abdominal	96 %	10 %

In group 1, a statistically significant increase in atherogenic fractions was revealed: low-density lipoproteins, very low-density lipoproteins (VLDL), triglycerides (TG), and a tendency to decrease high-density lipoproteins.

In group 2, the indicators of calcium metabolism were significantly higher than in group 1. The activity of bone-alkaline phosphatase and the level of parathyroid hormone also differed statistically in the two groups. According to the results of densitometry, the T-criterion in group 1 corresponded to osteopenia (Table 2).

Table 2. Prevalence of violations of multiplex test indicators

	Group 1	Group 2
Normal multiplex test scores	30 %	35 %
Osteopenia	56 %	42 %
Osteoporosis	14 %	23 %

In group 1, 60% of patients showed a decrease in vitamin D, compared to group II - 26%. In patients with osteopenia, a direct relationship of the T-criterion with vitamin D and the reverse relationship of vitamin D with the body mass index in overweight patients was revealed.

The main reason for the development of menopausal osteoporosis is the deficiency of estrogens, which are the main hormonal regulators of bone metabolism [9, 10]. Women with obesity have an increased risk of developing vitamin D deficiency, which was revealed as a result of this study. Atherosclerotic lesion of the arteries leads to impaired intraosseous microcirculation, and impaired bone metabolism, contributing to the development of osteoporosis, and leptin, vitamin D, and atherogenic lipid fractions can be regarded as independent triggers of osteoporosis in women with metabolic syndrome [11].

To prevent osteoporotic fractures, it is recommended to include macro and microelements in the diet. The most important substances are calcium, vitamin D, and proteins. Inadequate calcium intake can lead to decreased calcium absorption and secondary hyperparathyroidism, which can cause increased bone resorption. Due to the high risk of osteoporosis with a decrease in estrogen production, estrogen replacement therapy should be considered first. Menopausal hormone therapy reduces the incidence of hip fractures by 28%, vertebral fractures by 35%, and other fractures by 27% [12]. The presence of

bone fractures in menopausal women should be considered as an indication for specific treatment. It is recommended to prescribe medication therapy with bisphosphonates (zoledronic acid, ibandronate, alendronate, risedronate), denosumab, and parathyroid hormone preparations. Since the risk of osteoporotic fractures is higher in older women than in older men, all menopausal women also need to be screened for signs of osteoporosis [13].

Conclusion

Menopause is an independent predictor of the development of metabolic syndrome. According to previous studies, excessive accumulation of adipose tissue can contribute to the development of osteoporosis and, subsequently, bone fractures. Metabolic syndrome and its components are also risk factors for a decrease in bone mineral density. As a treatment and prevention of menopausal metabolic syndrome, therapeutic measures should be aimed at achieving metabolic control, normalization of total body weight, and increased physical activity. A separate group of patients can also be prescribed menopausal hormone therapy when a BMI of less than 40 kg / m² is reached. The fight against overweight can reduce overall mortality by up to 50%, and reduce the risk of developing malignant tumors, cardiovascular diseases, type 2 diabetes mellitus, osteopenic disorders, and other conditions against the background of deficiency estrogens.

Acknowledgments: None

Conflict of interest: None

Financial support: None

Ethics statement: The experiment was carried out with patients who signed an agreement for volunteer participation in the experiment. All raw data are available upon request from the corresponding author

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