

Osteoporosis in Postmenopausal Women With and Without Diabetes Mellitus Type 2

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Background: Osteoporosis is a skeletal disease, which is characterized by low bone mineral density (BMD) and alterations in bone micro-architecture, that leads to bone fragility. **Objectives:** In this study, we had an aim to establish the expression of a decrease in bone density in postmenopausal women with diabetes and osteoporosis, and compare with expression of a decrease in bone density in postmenopausal women with osteoporosis and without diabetes, in order to evaluate and compare effect of bisphosphonate therapy in these two groups. **Methods:** The study was retrospective, clinical, performed in a two-year period and processed in 2019. With method of random sampling of hospitalized patients at the Clinic for Endocrinology, Diabetes and Metabolic Diseases or examined at the Endocrinology Counseling Center of the same clinic was used to select 25 menopausal women aged 46-70 years with osteoporosis and diabetes mellitus type 2, treated with insulin therapy more than two years. For the control group, 25 menopausal women aged 46-70 years, with osteoporosis and without type 2 diabetes were selected. Patients were monitored for a period of 6 months, before and after the introduction of bisphosphonate therapy (Fosamax tablets 1x70 mg per week). **Results:** There was no statistically significant difference in age and duration of menopause between groups. In the group of patients with diabetes there was no significant difference between BMI values at the beginning and at the end of the study, while in patients without diabetes there was an increase in BMI at the beginning and the end of study. The group of subjects with diabetes had not significantly lower values of T-score compared to the group of subjects without diabetes at the beginning of the study but had lower values of T-score for lumbar spine after 6 months of treatment of osteoporosis. At the end of the study there was no significant increase in the value of the T-score in both groups. **Conclusion:** There was no significant difference in the severity of osteoporosis in postmenopausal women with diabetes mellitus and postmenopausal women without diabetes, except after 6 months of osteoporosis treatment, when bone mineral density was lower in the group of patients with diabetes. There is a higher risk of osteoporosis in women with a longer duration of menopause, that is, the duration of menopause is directly related to osteoporosis.

Keywords: osteoporosis, diabetes mellitus tip2, postmenopausal.

Research paper, Received: Jun 15, 2019, Accepted: Sep 11, 2019, doi: 10.5455/ijbh.2019.7.101-105, Int J Biomed Healthc. 2019; 7(2): 101-105

1. BACKGROUND

Osteoporosis and diabetes mellitus type 2 (DM2) are major and growing public health problems particularly among postmenopausal women (1). Osteoporosis is the most common metabolic disorder, which is accompanied by a decrease in bone mass and destruction of bone tissue (2). It is a serious health problem among postmenopausal women that leads to an increased risk of fracture, which increases with age (3). Estrogen deficiency is correlated with a rapid reduction in bone mineral density. After menopause, because there is a lack of ovarian function

and estrogen, the activity of osteoclasts and the pace of bone destruction increases, which will result in 25-30% destruction in bone mass during a 5-10 years period (4-7). In a prospective study by Schwartz et al. it has been shown that the prevalence of fractures in hip, arm and leg is higher in old aged diabetic women compared to the non-diabetic ones (8, 9). As defined by the World Health Organization, osteoporosis is diagnosed based on the bone mineral density, (10) with bone mineral densities more than -1 considered normal, densities from -1 to -2.5 considered osteopenic and amounts lower than -2.5 is defined as

osteoporotic, which can also be expressed in a T-score (11, 12). This study was conducted to assess the difference in the severity of osteoporosis in postmenopausal women with (DM2) and postmenopausal women without DM2, comparing their bone mineral density, i.e. T-score values for lumbar spine L1-L4 and neck femur.

2. OBJECTIVE

In this study, we had an aim to establish the expression of a decrease in bone density in postmenopausal women with diabetes and osteoporosis, and compare with expression of a decrease in bone density in postmenopausal women with osteoporosis and without diabetes, in order to evaluate and compare effect of bisphosphonate therapy in these two groups.

3. MATERIAL AND METHODS

The study was retrospective, clinical, comparative. The study included 50 patients aged 45-70 years. The criteria for inclusion in the study were the state of menopause with type 2 diabetes mellitus and a regular scheduled monthly visit for check-ups. The exclusion criterion from the study was irregular attendance at controls. All participants in the study were regular at the controls. No one was excluded from the study. Patients were divided into two groups with DM2 (n 25) and without DM2 (n 25). All patients were menopausal, randomly selected with a diagnosis of DM2. We monitored 50 patients who regularly visited the Endocrinology Counseling Center of the Clinic for Endocrinology, Diabetes and Metabolic Diseases performed in a two-year period and processed in 2019. Descriptive and analytical methods were used in the paper. From the anamnestic data taken from the patients, we analyzed the age and duration of menopause. Body Mass index was determined by dividing body weight expressed in kilograms by body height expressed in square meters (<18.5 kg / m²-malnutrition, 18.5-25 kg / m²-normal body weight, obesity > 25 kg / m², moderate from 25- 30 kg / m², heavy 30-40 kg / m², very heavy > 40 kg / m²). From radiological examinations, DXA densitometry (Dual energy X ray) was performed on densitometer A 06200302, version 8.26, model Hologic QDR-4000 S / N 55680. DXA of the lumbar spine was performed (L1,2,3,4), at the beginning and at the end of the examination. Femoral neck DXA was also performed at the beginning and end of the study.

During the densitometric measurement of bone mineral density (BMD), the results were expressed according to the World Health Organization from 1994, according to the assessment of the T score or T value, and depending on the T value, the results indicate different bone mass. T score in practice is shown as increased bone mass T > +1, normal bone mass T between -1 and +1. Osteopenia is present with a T between -1.0 and -2.5, while osteoporosis when T < -2.5.

Statistical data processing was done using the computer program ANOVA and SPSS 13 for Windows, a computer program for statistical analysis and descriptive statistics. The data were statistically processed so that the fol-

lowing values were determined: mean and standard deviation, minimum and maximum value. The significance of the difference for continuous variables was tested by an independent Student t-test for two independent samples for distributions that satisfy the assumption of “normality”, and t-test for two dependent samples for distributions that do not meet the presumption of “normality”, chi-square test and correlation analysis. The results were presented in the form of tables. Values of p<0.05 were considered statistically significant.

4. RESULTS

Age of patients

The mean age for postmenopausal patients with osteoporosis and diabetes (group 1) was 63.04 years ± 7.73, minimum 46, maximum 75 years. The mean age for postmenopausal patients without diabetes (group 2) was 59.08 years ± 7.27, minimum 47, maximum 70 years. There was no statistically significant difference in age between the groups. T test P = 0.068 > 0.05. Table 1. presents the age intervals of both groups of respondents.

Duration of menopause

Age group (years)	Rate of women in group1(%)	Rate of women in group2(%)
46-50	8	12
51-55	12	24
56-60	12	16
61-65	24	24
65-70	36	24
71-75	8	0

Table 1. Age of women in both groups (%)

Duration of menopause (years)	Rate of women in group1(%)	Rate of women in group2(%)
1-5	12	12
6-10	16	28
11-15	12	20
16-20	24	16
21-25	16	12
26-30	8	12
31-35	12	0

Table 2. Duration of menopause in women in both groups

T-score	Duration of menopause					
	Group 1			Group 2		
	Coefficient of correlation	P value	N	Coefficient of correlation	P value	N
Neck of femur B	-0,51	0,001	25	-0,38	0,06	25
Lumbar vertebrae L1-L4 B	-0,53	0,01	25	-0,30	0,15	25
Neck of femur E	-0,41	0,04	25	-0,15	0,48	25
Lumbar vertebrae L1-L4 E	-0,48	0,02	25	-0,01	0,95	25

Table 3. Correlation between duration of menopause and T score of DEXA in both groups. Legend: B- beginning of study, E-end of study, N- number of women in each group

	BMI of group 1 B	BMI of group 2 B	Total B	BMI of group 1 E	BMI of group 2 E	Total E
N	25	25	50	25	25	50
Mean	31,60	27,32	29,46	31,24	28,00	29,62
Standard deviation	8,29	4,74	7,025	8,11	4,37	6,65
Minimum	19	20	19	20	22	20
Maximum	46	36	46	46	35	46
Results of T-test	T empiric value=2,24 P value=0,03<0.05			T empiric value=2,06 P value=0,045<0,05		

Table 4. Values of BMI (kg/m²) in the both groups at the beginning and at the end of study. Legend: B-in the beginning of study E- at the end of study, Total-women in the both groups together, N-number of women from study

BMI (kg/m ²)	Number of women in group 1 at the beginning of the study (%)	Number of women in group 2 at the beginning of the study (%)	Number of women in group 1 at the end of the study (%)	Number of women in group 2 at the end of the study (%)
18.5-25 (healthy weight range)	28	36	36	36
25-30 (overweight)	28	36	16	32
31-40(obese)	16	20	16	32
>40 (morbidly obese)	28	8	32	0

Table 5. Body mass index subgroups of all women included in this study at the beginning and at the end of study. Legend: BMI-body mass index.

	t	df	P value
Group 1	-1,737	24	0,095
Group 2	2,083	24	0,048

Table 6. Results of t-test for dependent samples of BMI. Legend: t-value of T-test, df- degrees of freedom

The average duration of menopause of women in group 1 was 18,04 years ± 9,6 (minimally 2 years, maximally 35 years). The average duration of menopause of women in group 2 was 14,2 years ± 7,51 (minimally 3 years, maximally 28 years). T-test showed that P = 0.122 > 0.05, there was no statistically significant difference in the duration of menopause between groups. Subgroups of menopause duration in women in both groups are shown in Table 2.

There was correlation between duration of menopause and severity of osteoporosis: longer duration of menopause was associated with lower values of T-score for neck of femur or lumbar vertebrae L1-L4 (table 3).

Body mass index (BMI) values

The mean value of BMI was in the measurement range characteristic for obesity in both study groups at the beginning and at the end of the monitored period. The mean value in the group1 was significantly higher than in group 2 in the beginning and at the end of

study (Table 4).

The number of women in group 1 with BMI values in the healthy range and morbidly obese increased at the end of the study, and their number with BMI in the range of 25-30 kg/m² is reduced. The number of women in group 2 with a BMI value in the range of 25-30 kg/m² and morbidly obese decreased at the end of the study, while the number of those with a BMI in the healthy range remained unchanged. (Table 5)

The mean value of BMI in the group 1 is lower et the end of study than in the beginning of study, but not significantly. In the group 2 it is significantly higher et the end of the study (Table 6).

Bone Densitometry

The women of group 1 had lower values of T-score compared to the group 2 at the beginning of the study and after 6 months, but those differences are not significant between groups, except T-score for lumbar spine at the end of the study. (Table 7a and table 7b as a continuation of Table 7a)

The value of T score for lumbar spine at the end of study was significantly lower than it was in group 2 (Table 8).

At the end of the study there was an increase in the value of the T-score in both groups, but these differences at the beginning and end of the study were not significant in both groups (Table 9).

5. DISCUSSION

In our study there were not differences between mean value of T score of postmenopausal women with osteoporosis and diabetes mellitus type 2 and postmenopausal women with osteoporosis without DM2 at the beginning of study, but six months after of their treatment with 70

T sc	N 1	M1	Sd1	Mi1	Max1	N2	M 2	Sd 2	Mi2	Max2
hipB	25	-1,58	0,93	-3,7	-0,1	25	-1,16	1,06	-2,6	1,1
LB	25	-1,72	0,89	-3,5	-0,1	25	-1,20	1,29	-3,7	1,0
hipE	25	-1,30	1,27	-3,6	1,4	25	-0,82	1,54	-2,7	1,2
LE	25	-1,57	1,02	-3,5	1,3	25	-0,76	1,67	-3,5	1,6

Table 7a. T-score of lumbar spine and neck of femur within bone densitometry (DXA) at the beginning and end of the study for the both groups. Legend: T sc-T-score, N1-number of women in group1, M1- mean of T-score value in the group1, Sd1- standard deviation of T-score value in the group1, Mi1- minimal value of T- score in the group1, Max1- the highest value of T-score in group1, N2-number of women in group2, M2- mean of T-score value in the group2, Sd2- standard deviation of T-score value in the group2, Mi2- minimal value of T- score in the group2, Max2- the highest value of T-score in group2, hipB- neck of femur at beginning of study, hipE-neck of femur at the end of study, LB-lumbar spine L1-L4 et the beginning of study, LE- lumbar spine L1-L4 et the end of study.

Tsc	NT	MT	SdT	MiT	MaxT
hipB	50	-1,37	1,01	-3,7	1,1
LB	50	-1,46	1,13	-3,7	1
hipE	50	-1,06	1,42	-3,6	1,4
LE	50	-1,16	1,43	-3,5	1,6

Table 7b. Continued table 7a. Legend: Tsc-T-score, hipB- neck of femur at beginning of study, hipE-neck of femur at the end of study, LB-lumbar spine L1-L4 et the beginning of study, LE- lumbar spine L1-L4 et the end of study, NT- number of both group patients together, MT- mean of T-score value in the both group patients together, SdT- standard deviation of T-score value for both group patients together, MiT- minimal value of T- score of both group patients together, MaxT- the highest value of T-score of both group patients together.

T score		Empirical T	P value
At the beginning of the research	T-score of neck of femur	-1,49	0,14
	T-score of lumbar vertebrae L1-L4	-1,68	0,10
At the end of the research (after 6 months)	T-score of neck of femur	-1,21	0,23
	T-score of lumbar vertebrae L1-L4	-2,08	0,04

Table 8. Results of t test of independent samples (group1 and group 2) for T score in the beginning and et the end of study.

T score		t	P value
Group 1	T-score of neck of femur	1,91	0,07
	T-score of lumbar vertebrae L1-L4	1,29	0,21
Group 2	T-score of neck of femur	1,83	0,08
	T-score of lumbar vertebrae L1-L4	2,06	0,051

Table 9. Results of t test of dependent samples for T score of group 1 at the beginning and et the end of study and T score of group 2 at the beginning and at the end of study

mg Fosamax T per week, value of T score for lumbar spine was lower in the group 1 than in the group 2, possible due to a weaker reaction to Fosamax T due to diabetic gastropathy in women in group 1.

Dutta at al, concluded by their study that men and women with DM2 have lower bone mineral density as compared to controls (hip $0.962 \pm 0.167 \text{ g/cm}^2$ vs $1.013 \pm 0.184 \text{ g/cm}^2$, $P = 0.05$; spine $0.929 \pm 0.214 \text{ g/cm}^2$ vs $1.113 \pm 0.186 \text{ g/cm}^2$, $P < 0.00001$). Bone mineral density did not have correlation to **glycemic control**. Insulin in treatment of diabetes is associated with decrease in bone mineral density at spine and hip (13).

Balaguera and Moreno followed 58 postmenopausal women with osteoporosis in their study. They found that the 55–60-year-old age group accounted for 17.2% of this group and the 70–75-year-old age group accounted for 27.6%. The 82.8% of postmenopausal women with osteoporosis were younger than 75 years old. The 66.7% postmenopausal women with body mass index lesser than 25 kg / m2 had osteoporosis (14). In our study, in both groups of women, the highest percentage belonged to the age group of 56-60 years. Women from both groups of our study had mean value of BMI higher than 27kg /m2

The prevalence of osteoporosis was 30.4% at **lumbar spine** (LS) and 9.5% at **femoral neck** in the 148 postmenopausal diabetic women, aged 61.87 ± 7.85 years, in the study of Viégas et al. (15). After eliminating the effects of weight, height, age, BMI and duration of menopause, the results showed that the effect of the diabetes by itself was significantly meaningful on lumbar and femoral neck T-score (1).

There are controversial results surrounding the correlation of type 2 diabetes and osteoporosis in various studies (16). Although, it has been shown in some studies that type 2 diabetes has protecting effect on post-meno-

pausal osteoporosis, (17) other studies could not find any significant difference in femoral neck’s bone mass among healthy and diabetic patients (5). Based on results of Karimifar et al, they demonstrated that in post-menopausal women there is a correlation between type 2 diabetes and osteoporosis, type 2 diabetes can increase the prevalence of osteoporosis in post-menopausal women (1).

6. CONCLUSION

There were no significant differences in the severity of osteoporosis in menopausal women with DM2 and no diabetes, except at the end of the study, six months after treatment with Fosamax 70 mg once weekly, when lumbar spine T-scores were lower. found in the group of postmenopausal women with diabetes compared with the group of postmenopausal women without diabetes. The duration of menopause was directly related to the severity of osteoporosis in this study.

- *Authors contribution: All authors were involved in all steps of preparation this article. Final proofreading was made by the first author.*
- *Conflict of interest: Non declared.*
- *Financial support and sponsorship: Nil.*

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