The Correlation between Thyroid Function Status and Bone Mineral Density among Postmenopausal Women

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Abstract

Background: the relationship between thyroid function and bone has been empirically known for ages. Loss of bone with aging in universal phenomenon effecting both men and women and associated with reduces bone strength and increased fracture risk. The link between bone mineral dignity, bone quality and the risk of fracture with thyroid hormones in normal postmenopausal women suggest a role for these hormones, even with the range of normal thyroid in these diseases.

Objective: To investigate the relation between thyroid function status and bone mineral density among postmenopausal women.

Study design: A cross-sectional study

Setting: Department of Obstetrics and Gynecology of Al-Yarmouk teaching hospital in cooperation with Lab of National Institute of Diabetic Center and Dexa unit.

Patients and methods: The study has included one hundred postmenopausal women with age between (45-70) years old, who attended outpatient clinic or DEXA unit. Inform consent had been taken from all participants about nature of study. Demographic information and medical history were collected using a detailed questionnaire. After the collection of data, blood samples had been taken for evaluation of thyroid function by measuring the serum level of THS, FT3 and FT4. Dual energy X ray (DEXA) was used to assess bone mineral density.

Results: The mean age of the study group was 58.8 years and the mean of BMI was (33.2 ± 5.35). The highest proportion of study patients diagnosed as Euthyroid was (63%).Proportion of osteoporosis diagnosed in spine was higher than osteoporosis diagnosed in left femur (35% versus 4%), while osteopenia was higher in left femur than spine (49% versus 45%).The highest proportion of study patients with hypothyroidism and those with Euthyroid was not osteoporotic (60% and 76.2% respectively), while those with hyperthyroidism, more than half of them were osteoporotic (55.6%) with a statistically significant association (P=0.013) between Thyroid function and bone mineral density levels.

Conclusion: There is a significant direct correlation between thyroid function and bone mineral density among postmenopausal women, but further investigations are needed to recognized all factors effecting this relationship with using wide sample size.

Keywords: *Thyroid Function , Bone Mineral Density, Postmenopausal Women*

Background

Menopause is defined by **12 months of amenorrhea after the final menstrual period** in the absence of any other pathological or physiological causes. At this point, nearly all theoocytes have undergone atresia, although a few remain and can be found on histologic examination. It is characterized by complete, or near complete, ovarian follicular depletion and absence of ovarian estrogen

secretion [1].

In the US only there are about 37.5 million women reaching or currently at menopause. The average age of menopause is 51 years; however there is a wide age distribution [2].It has been suggested that there is correlation between thyroid function status and bone mineral density among postmenopausal women. Osteoporosis is the most common bone disease and represents a major public health problem. Osteoporosis and associated fractures cause considerable disability poor quality of life, and mortality.

Osteoporosis is a common postmenopausal condition which impacts upon women's quality of life and increases the risk of fracture, which can in turn lead to heavy ongoing healthcare service load and economic burden for the family. The risk of osteoporosis-induced fracture increases with menopausal women's age, especially in those older than 65 years [3].

Thyroid hormone affects the rate of bone replacement. Data from scientific reports indicates that TSH is considered as a negative regulator of bone turnover. Its direct action on bone tissue cells leads to enhanced bone remodeling and osteoporosis.[5] The aim of this study is to investigate the correlation between thyroid function status and bone mineral density (BMD) among postmenopausal women.

Patient and Methods

This cross-sectional study was conducted in Baghdad city at Al-Yarmouk teaching hospital in cooperation with Lab of National Institute of Diabetic Center and DEXA unit, the study started from (July-December) 2017. The study protocols were approved by Scientific Council of Obstetrics and Gynecology Specialization / Iraqi Board for Medical Specialization.

Patient and Data Collection:

The study included one hundred post menopausal women with aged between (45-70) years old, who attended outpatient clinic or DEXA unit. Informed consent had been taken from all participants about nature of the study. Demographic information and medical history were taken using a detailed questionnaire. Exclusion criteria were clearly defined. After the collection of data, blood samples had been taken for thyroid function test then send them for DEXA scan. Dual- energy X-ray absorptiometry scan (DEXA), was used to assess bone mineral density, and thyroid function test was carried out. All the assay steps are performed automatically by the instrument. The reaction medium is cycled in and out of the solid phase receptacle (SPR) several times.

Statistical Analysis

Statistical analysis was performed using SPSS windows version 23 Software. Suitable tables and graphs were used to describe the data. Chi square test was used to test qualitative and frequency data and to find any relations between many risk factors and the incidence of osteoporosis. Logistic regression analysis applied, using the presence of osteoporosis as the dependent variable and the variable that were found significant in the binary analysis were included in the model as the independent variable. P value less than 0.05 was considered significant.

Results

The total number of patients in our study was 100 postmenopausal women. This study was conducted at obstetrics and gynecology department in Al-Yarmouk teaching hospital.

Thyroid hormones

Table 3.2 shows the distribution of study according to thyroid hormones levels. This study showed that the mean ± SD of T3, T4, and TSH for study patients were (5.12 ± 2.22 pmol/L, 14.51± 4.8 pmol/L, and 1.93± 3.17 umol/L respectively). Regarding levels of these hormones, the highest proportion of study patients had normal T3, T4, TSH levels (74%, 81%, and 63% respectively) which means Euthyroid. According to our Lab, the normal range of Free T3 (4-8.3) pmol/L, normal range of Free T4 (9-20) pmol/L, while the normal range of TSH (0.25-5) pmol/L.

3.3. Thyroid function condition (Diagnosis)

The distribution of study patients by thyroid function test (T3, T4 and TSH) is shown in table (3.3). The highest proportion of study patients diagnosed as Euthyroid is (63%).

3.4. DEXA scan result (bone mineral density)

The distribution of study patients by site and levels of bone mineral density (BMD) is shown in table (3.4). DEXA scan for study patients showed that the mean and

SD of T-score in left femur and spine was (-1.05 ± 0.88 and -2.04 ± 1.15 respectively).We noticed that the highest proportion of study patients was diagnosed by DEXA scan as osteopenia regardless the site used for scanning is (49%). Proportion of osteoporosis diagnosed in spine was higher than osteoporosis diagnosed in left femur (35% versus 4%), while osteopenia was higher in left femur than spine (49% versus 45%).

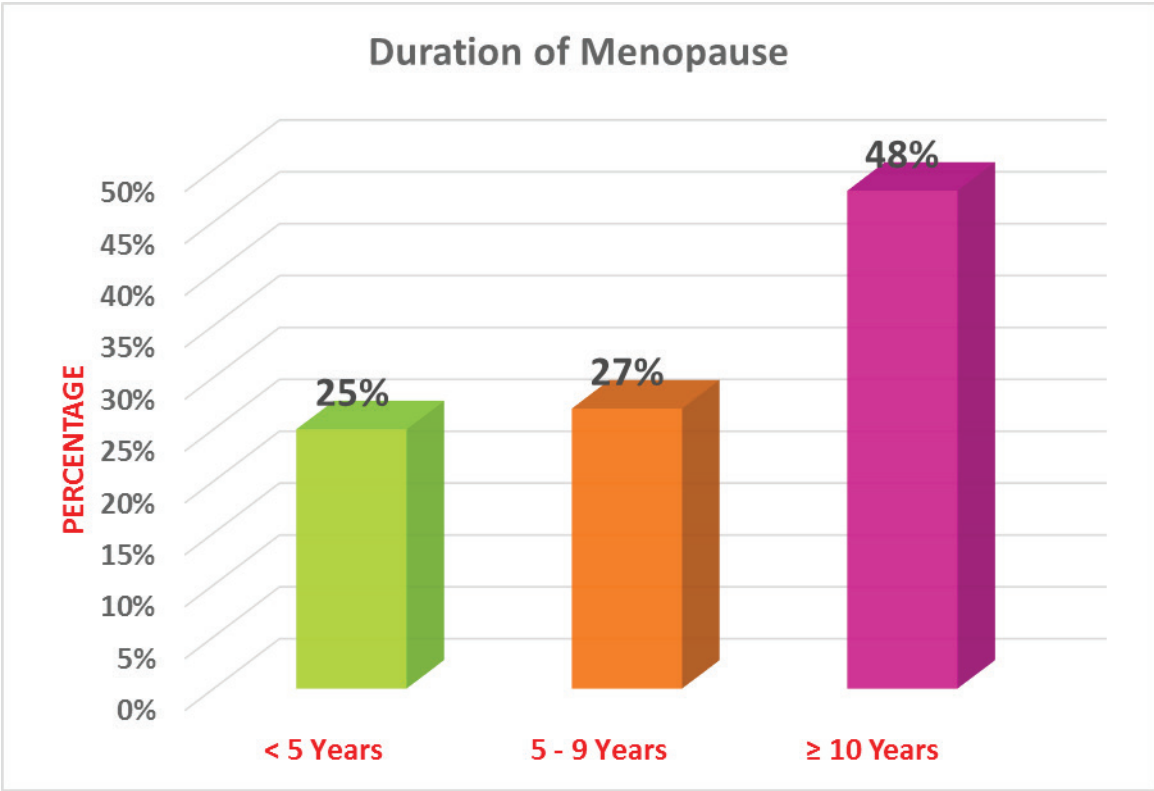

Figure 3.2: Distribution of study patients by duration of menopause

Table 3.2: Distribution of study patients by thyroid hormones levels

Thyroid hormones level	No. (n=100)	Percentage (%)
T3 level		
Low	13	13.0
Normal	74	74.0
High	13	13.0
T4 level		
Low	5	5.0
Normal	81	81.0
High	14	14.0
TSH level		
Low (Hypothyroid)	8	8.0
Normal (Euthyroid)	63	63.0
High (Hyperthyroid)	29	29.0

Table 3.3: distribution of study patients by thyroid function condition according to T3, T4 and TSH levels

Variable	No. (n=100)	Percentage (%)
Thyroid function condition		
Hypothyroidism	10	10.0
Euthyroidism	63	63.0
Hyperthyroidism	27	27.0

Table 3.4: Distribution of study patients by site and levels of bone mineral density (BMD)

Bone Mineral Density level	No. (n=100)	Percentage (%)
Regardless site (Overall)		
Normal	17	17.0
Osteopenia	49	49.0
Osteoporosis	34	34.0
In left femur		
Normal	47	47.0
Osteopenia	49	49.0
Osteoporosis	4	4.0
In lumber spine		
Normal	20	20.0
Osteopenia	45	45.0
Osteoporosis	35	35.0

3.5. Association between bone mineral density levels with demographic factors and thyroid Function

The association between bone mineral density levels and demographic factors is shown in table (3.5). The highest proportion of study patients with hypothyroidism and those with Euthyroid were not osteoporotic (60% and 76.2% respectively), while those with hyperthyroidism, more than half of them were osteoporotic (55.6%) with a statistically significant association (P=0.013) between Thyroid function and bone mineral density levels. There was no significant association (P≥0.05) between bone mineral density level and demographic factors including (age, parity, BMI, and duration of menopause).

Table 3.5: Association between TSH levels and bone mineral density levels

Variable	Bone mineral density level		Total (%) n=100	P- value
	Osteoporosis (%) n=34	NO osteoporosis (%) n= 66		
Agegroup(Years)				
< 50	2 (14.3)	12 (85.7)	14 (14.0)	0.078
50 – 59	8 (26.7)	22 (73.3)	30 (30.0)	
≥ 60	24 (42.9)	32 (57.1)	56 (56.0)	
Parity				
< 3	8 (29.6)	19 (70.4)	27 (27.0)	0.478
3 – 5	11 (29.7)	26 (70.3)	37 (37.0)	
> 5	15 (41.7)	21 (58.3)	36 (36.0)	
BMI level				
Normal	2 (33.3)	4 (66.7)	6 (6.0)	0.329
Overweight	10 (47.6)	11 (52.4)	21 (21.0)	
Obese	22 (30.1)	51 (69.9)	73 (73.0)	
Duration of menopause (Years)				
< 5	6 (24.0)	19 (76.0)	25 (25.0)	0.409
5 – 9	9 (33.3)	18 (66.7)	27 (27.0)	
≥ 10	19 (39.6)	29 (60.4)	48 (48.0)	
Thyroid gland function				
Hypothyroidism	4 (40.0)	6 (60.0)	10 (10.0)	0.013
Normal	15 (23.8)	48 (76.2)	63 (63.0)	
Hyperthyroidism	15 (55.6)	12 (44.4)	27 (27.0)	

Binary logistic regression analysis was done regarding thyroid gland function and revealed that hyperthyroidism was a significant risk factor (P=0.023) that might cause osteoporosis with Odd's ratio of (2.89) and 95% C.I (1.15 – 7.24).

Discussion

Thyroid dysfunction and osteoporosis are considered as a common disorder in menopausal women. Overt hyperthyroidism and hypothyroidism have long been known as risk factors for low bone mineral density and

osteoporotic fractures [6]. The current study shows that the mean age of menopausal patients group was 58.8 years, which is in agreement with the Iranian study done by Keramat A et al., [7] where the mean age was 58.2 Years, but it was more than (48.7 years) in Adamopoulos D et al,[56] who studied 1333 Greek postmenopausal lady. This may be due to difference in sample size collection in which the last study was with large sample size.

Hassa H et al, [9] in the study carried on menopausal Turkish women failed to find a correlation between BMD and menopausal age. In contrast, Demir B et al, [10] revealed an increased prevalence for osteoporosis in Turkish women at age under 40 years and with menopause onset. This age was not present in our study. Moreover the current study revealed that parity is not associated with abnormal bone mineral density which was in agreement with Ho Sc et al 2005, This study measure's the educational level and risk factors of osteoporosis in Chinese postmenopausal women [11].

Also our study was in agreement with Waugh EJ, et al, [12] in 2009 who did a systemic review of literature and found that there was no relation between parity and BMD in women aged 40-60 years old. Moreover in accordance with that found by Sioka C et al, in 2010 study which in title of: (Age at menarche, age at menopause and duration of fertility as risk factors for osteoporosis in Greece women) [13]. With regard to the time duration of the menopause and its association with bone mineral density, we found that there is no association between them, this was in agreement with Takada H, et al 1997 who confirmed no association between the duration of the menopause and BMD [14].

The most important finding of the present study is the significant association between the hyperthyroidism and the osteoporosis, these results were similar to that revealed in many studies: Kim DJ et al [15]2006 found the association between the low BMD in healthy postmenopausal women and low normal TSH level, while Morris MS et al 2007 [16]found associations between low-normal serum TSH and osteopenia and osteoporosis, plus a graded increase in BMD with increasing serum TSH across the normal range in healthy American women of both black and white races.

Likewise, Mazziotti G, et al [17]2010 assess the Serum level of TSH and vertebral fractures risk in euthyroid post-menopausal lady with low bone mineral density conclude that Low-normal TSH values are associated with high prevalence of vertebral fractures in women with post-menopausal osteoporosis or osteopenia, independently of thyroid hormones, age and BMD. Additionally, they were in agreement with a suggestion that TSH exerted a dose-dependent protective role on bone. In a comparative estimation of TSH levels either below or above the median level recorded among the euthyroid women enrolled in Acar B et al, study, low-normal TSH levels were associated with lowered BMD values in the L1–L4 lumbar vertebrae and femoral neck[18].

Two meta-analyses, Grimnes G, et al in 2008 studied the correlation between TSH serum level and BMD in men and postmenopausal women and Jamal SA et al, 2005 studied the Clinical utility of laboratory testing osteoporosis women, they clearly demonstrated an association between subclinical hyperthyroidism and decreased BMD values [19, 20]. Regarding to the effect of the normal range of the TSH level on bone mass density, a study carried by Kim D et al, revealed that low-normal TSH levels applied an effect on BMD values, a finding supported by Morris M et al study [15]. In addition, Mazziotti G et al, found that low-normal TSH levels were associated with vertebral fractures among postmenopausal women [17]. In our study we found that 4/10 of the patients with osteoporosis had hypothyroidisim but with no significant association due to small sample size in the current study.

The limitations of this study include: small sample size with short period duration of the study; single center study; single sample of blood were taken from the patients; and the investigation was done by two or three biochemical person.

Conclusion

There is a significant direct correlation between thyroid function and bone mineral density among postmenopausal women. For further future study, large sample size with long duration time should be adopted, and should be a multicenter study. More than one sample should be tested. The osteoporosis found to be independently related with TSH level rather than with elevated concentrations of T3 orT4. Therefore, clinicians should aim to maintain TSH levels within the upper limit of the reference range during treatment of hypothyroidism.

Ethical Clearance- Taken from Al-Mustansiriya University

Source of Funding- Self

Conflict of Interest- Nil

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