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ORIGINAL ARTICLE

Evaluation of Osteoporosis After Total Thyroidectomy in Euthyroid Post-Menopausal Women

Örgün Güneş[1], Yusuf Murat Bağ[2]

[1]Department of Gastrointestinal Surgery, Muğla Sıtkı Koçman University Training and Research Hospital, Muğla, Türkiye
[2]Department of Gastrointestinal Surgery, Health Sciences University Van Training and Research Hospital, Van, Türkiye

Abstract

Introduction: Exogenous thyroid hormone usage for thyroid-stimulating hormone (TSH) suppression was found to be risky of bone loss for post-menopausal women (PW) after total thyroidectomy (TT). However, osteoporosis in euthyroid PW was not examined. We aimed to evaluate the frequency and severity of osteoporosis after TT in euthyroid PW.

Methods: One hundred PW were included and were divided into two groups as the TT group (n=50) and the control group (n=50). The patients were in the post-menopausal period for at least 5 years, were euthyroid, and did not receive any drugs effective on bone metabolism. Age, length of post-menopausal period, and laboratory findings including TSH, triiodothyronine, thyroxine, serum calcium, serum phosphorus, serum magnesium, serum intact parathormone, serum alkaline phosphatase, 24-h urine calcium, and bone mineral density (BMD) of vertebra, femoral neck, trochanteric region, and Ward's triangle were analyzed and compared between two groups. BMD was expressed as T-score.

Results: No significant difference was found between the two groups in terms of age, length of postmenopausal period, laboratory findings, and T-scores of L1, L2, and L4 vertebra. The T-scores of the L3 vertebra, femoral neck, trochanteric region, and Ward's triangle significantly differed between the groups (p=0.029, p=0.001, p=0.005, and p=0.000, respectively). Osteoporosis was observed in 50% of patients in the TT group, but this rate was only 16% in the control group and this difference was significant (p=0.001).

Discussion and Conclusion: After TT, BMD decreases and the rate of osteoporosis increases in PW, even under replacement dose of exogenous thyroid hormone.

Keywords: Bone fracture; bone mineral density; hypoparathyroidism; osteopenia.

Thyroidectomy is a common surgical procedure performed to treat benign or malignant thyroid diseases, which involves the partial and total removal of thyroid tissue. Nowadays, total thyroidectomy (TT) is increasingly being performed for benign thyroid pathologies[1] due to its advantages, such as the reduced risk of recurrence, immediate symptom relief, and providing a definite histopathological examination of whole thyroid tissue[2].

Osteoporosis is the most common metabolic bone disease, which is a combination of reduced bone mass and deterioration of bone micro-architecture. It can lead to increased bone fracture risk, especially in post-menopausal women (PW). Osteoporosis-related fractures, especially hip and spine fractures, are associated with increased morbidity, mortality, and decreased quality of life[3].

After thyroidectomy, patients may require exogenous thy-

Correspondence (İletişim): Yusuf Murat Bağ, M.D. Department of Gastrointestinal Surgery, Health Sciences University Van Training and Research Hospital, Van, Türkiye
Phone (Telefon): +90 432 222 00 10 **E-mail (E-posta):** yusufmuratbag@hotmail.com
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roid hormone for supplementation, replacement, or thyroid-stimulating hormone (TSH) suppression. Some previous studies showed that exogenous thyroid hormone usage for TSH suppression had a risk of bone loss for PW[4]. However, osteoporosis after TT in euthyroid PW was not examined. In this study, we aimed to evaluate the frequency and severity of osteoporosis after TT in euthyroid PW.

Materials and Methods

This is a retrospective study. One hundred PW who applied to Haydarpaşa Numune Training and Research Hospital General Surgery Department between January 2002 and January 2005 were included in the study. The patients were divided into two groups as the TT group (n=50) and the control group (n=50). The inclusion criteria for the TT group were to have undergone TT for benign non-toxic multinodular goiter at least 5 years ago, to have been in the postmenopausal period during the surgery, to have received exogenous thyroid hormone for replacement not for suppression after surgery, and not to have received any drugs effective on bone metabolism. The inclusion criteria for the control group were to have been in the post-menopausal period for at least 5 years, not to have undergone any thyroid or parathyroid surgery, to have been euthyroid, and not to have received any drugs effective on bone metabolism.

Age, length of postmenopausal period serum TSH, serum free triiodothyronine (fT3), serum free thyroxine (fT4), total serum calcium (Ca) values, total serum phosphorus (P) values, total serum magnesium (Mg) values, serum intact parathormone (PTH) values, serum alkaline phosphatase (ALP) values, 24-h urine calcium values, bone mineral density (BMD) of L1, L2, L3, and L4 vertebra, femoral neck, trochanteric region, and Ward's triangle were analyzed and compared between two groups. BMD was expressed as T-score and was measured using dual-energy X-ray absorptiometry. Osteoporosis was defined as the World Health Organization (WHO) definition (a value of BMD ≥2.5 standard deviations below the young adult mean [T-score ≤−2.5])[5].

Statistical Analysis

SPSS for Windows 10.0 program was used for statistical analysis. The distribution of normality was assessed using the Shapiro–Wilk test. Continuous variables were expressed as mean±standard deviation and categorical variables were expressed as frequency (percentage). The Student's t-test was used for statistical analyses of continuous variables and the Chi-square test was used for categorical variables. $p<0.05$ was considered statistically significant.

Results

Table 1 shows the age, post-menopausal period, and laboratory findings of the two groups. The mean TSH, fT3, fT4, Ca, P, Mg, PTH, ALP, and 24-h urine calcium were all within the normal range in both groups. No significant difference was found between the two groups in terms of age, length of post-menopausal period, and laboratory findings.

T-scores of L1-L4 vertebra, femoral neck, trochanteric region, and Ward's triangle are given in Table 2. The mean T-scores were lower in the TT group in all regions. There were no significant differences in the T-scores of L1, L2, and L4 vertebra between the two groups. However, the T-scores of the L3 vertebra, femoral neck, trochanteric region, and Ward's triangle significantly differed between the groups (p=0.029, p=0.001, p=0.005, and p=0.000, respectively).

Table 1. Age, postmenopausal period, and laboratory findings

	TT group	Control group	p
Age (year)	57.36±7.23	59.34±7	0.167
Postmenopausal period (year)	7.08±6.89	6.96±5.75	0.925
TSH (μiu/Ml)	3.06±0.67	2.88±0.8	0.227
fT3 (pmol/L)	4.29±0.69	4.39±0.77	0.506
fT4 (pmol/L)	17.3±2.42	16.6±2.18	0.182
Ca (mg/dl)	9.48±0.53	9.45±0.49	0.756
P (mg/dl)	3.45±0.6	3.47±0.68	0.865
Mg (mg/dl)	2.01±0.34	1.92±0.42	0.249
PTH (pg/ml)	62.9±42.69	64.83±18.15	0.769
ALP (U/L)	74.8±21.05	72.76±18.53	0.809
24-hour urine calcium (mg/day)	153.72±98.73	142.67±62.77	0.506

TT: Total thyroidectomy, TSH: Thyroid-stimulating hormone, fT3: Serum free triiodothyronine, fT4: Serum free thyroxine, Ca: Total serum calcium, p: Total serum phosphorus, Mg: Total serum magnesium, PTH: Serum intact parathormone, ALP: Serum alkaline phosphatase.

Table 2. T-scores of L1-L4 vertebra, femoral neck, trochanteric region, and Ward's triangle

	TT group	Control group	p
L1 vertebra	-0.50±1.61	0.09±1.43	0.053
L2 vertebra	-0.69±1.5	-0.17±1.33	0.073
L3 vertebra	-0.72±1.39	-0.14±1.24	0.029
L4 vertebra	-0.57±1.21	-0.45±1.05	0.595
Femoral neck	-1.16±1.66	-0.16±1.36	0.001
Trochanteric region	-1.07±1.55	-0.28±1.20	0.005
Ward's triangle	-1.91±1.43	-0.61±1.21	0.000

TT: Total thyroidectomy.

Table 3. Osteoporosis frequency

	TT group	Control group	p
T-score > -2.5	25 (50%)	42 (84%)	0.001
T-score ≤ -2.5	25 (50%)	8 (16%)	

TT: Total thyroidectomy.

The frequencies and comparison of osteoporosis are shown in Table 3. Osteoporosis was observed in 50% of patients in the TT group, but this rate was only 16% in the control group and this difference was significant (p=0.001).

Discussion

In this study, we found a negative effect of TT on BMD. We observed significantly lower T-scores in the L3 vertebra, femoral neck, trochanteric region, and Ward's triangle in euthyroid PW with TT compared to the control group. In addition, the osteoporosis rate was significantly higher in these patients.

Benign multinodular goiter is a common thyroid gland disorder and total, near-total or sub TT is the options for surgical treatment. Some surgeons advocate TT due to the recurrence risk after sub TT, the risk of incidental cancer in the remnant gland, and the high complication rates of completion thyroidectomy[6]. However, TT has some disadvantages such as the increased risk of recurrent laryngeal nerve paralysis, hypocalcemia,[7] and lifelong thyroid hormone replacement.

Loss of BMD may be considered as another possible complication of TT. Hung et al.[8] reported that the patients with thyroidectomy had 1.43 times higher risk of osteoporosis compared to the control group. Calcitonin deficiency and the exogenous thyroid hormone treatment were considered causing bone loss after TT[9,10]. It was previously shown that suppressive thyroid hormone treatment had a negative effect on BMD in PW[11]. The patients in the TT group had received exogenous thyroid hormone for replacement not for suppression in the entire period after surgery, so we were able to exclude the effect of suppression therapy on BMD and analyzed the effect of TT alone on BMD. Thus, we think that bone loss may occur after TT in PW, even under a replacement dose of thyroid hormone therapy. We could not assess the calcitonin levels of the study group, but we think that the lack of calcitonin after TT may lead to this situation.

Hypoparathyroidism and hypocalcemia may be thought to be the causes for post-operative osteoporosis after TT. In the literature, it was reported that hypocalcemia had been developed at the rate of 22.8% after TT, and persistent hypocalcemia had been around 7%[12]. Another study revealed a post-operative hypoparathyroidism rate of 6%, and the permanent hypoparathyroidism rate around 2%[13]. As the PTH, Ca, and p values were similar between groups in the study, we did not think that the cause of osteoporosis after TT was hypoparathyroidism or hypocalcemia. However, it is known that PTH has paradoxical effects on BMD. While intermittent exposure to PTH results in an anabolic effect on bone, continuous exposure results in a catabolic response[14]. Although we could not evaluate in this study, the disruption of intermittent PTH release after TT (due to the ligation of thyroidal arteries and veins or injury of parathyroid glands) may be the cause of osteoporosis.

The study had some limitations. First, it was a retrospective study, Second, we could not analyze the calcitonin levels and intermittent PTH release due to lack of data. Third, the study group was relatively small.

After TT, BMD decreases and the rate of osteoporosis increases in PW, even under replacement dose of exogenous thyroid hormone. This may due to the disruption of intermittent PTH release or calcitonin deficiency. It is clear that the future studies are needed to reveal the true mechanism.

Ethics Committee Approval: Due to the retrospective design of the study, there is no need for ethics committee approval.

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