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ORIGINAL ARTICLE

Incidental Parathyroidectomy During Total Thyroidectomy: Do Anatomic Factors Increase the Risk?

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Abstract

One of the most common complications of thyroidectomy is incidental parathyroidectomy, which leads to disruption of calcium metabolism. The aim of this study was to examine the incidence of incidental parathyroidectomy and its effect on calcium metabolism and anatomical risk factors that have been less emphasized in the literature. This retrospective study included 333 patients who underwent total thyroidectomy. Incidental parathyroidectomy incidence, postoperative serum calcium, and parathormone values were recorded. Demographic characteristics and clinical and anatomical risk factors were investigated. Incidental parathyroidectomy was detected in 45 (13.5%) of 333 patients who underwent thyroidectomy. The incidence of hypocalcemia (30% vs. 16%) and hypoparathyroidism (41.4% vs. 18.5%) was higher in the incidental parathyroidectomy group ($p = 0.032$, $p = 0.005$). The presence of hyperthyroidism, microcalcification in thyroid nodules, malignancy status, lymph node involvement, and presence of thyroiditis did not make a significant difference in terms of incidental parathyroidectomy. In patients who underwent central lymph node dissection, the rate of incidental parathyroidectomy was higher but not statistically significant ($p = 0.306$). When the anatomical features of the thyroid gland were examined, short vertical length and the presence of small nodules caused an increase in the incidence of incidental parathyroidectomy ($p = 0.036$, $p = 0.047$). Incidental parathyroidectomy causes postoperative hypoparathyroidism and hypocalcemia, so in addition to the risk factors frequently mentioned in the literature, such as the presence of malignancy, central lymph node dissection, total thyroidectomy, and reoperation, during thyroidectomy, the surgeon should also be alert to anatomical risk factors such as the presence of small nodules and a small thyroid gland.

Keywords Incidental parathyroidectomy · Hypocalcemia · Thyroidectomy · Hypoparathyroidism · Thyroid surgery

Introduction

Thyroidectomy is a common surgical procedure for thyroid malignancies or metabolic diseases such as Graves' disease and toxic nodules, which has been practised for more than a century, and is a well-established, relatively safe procedure with low morbidity [1, 2]. The most common complications of thyroidectomy are recurrent laryngeal nerve damage and hypocalcemia [3]. Postoperative hypocalcemia is a serious complication that prolongs hospital stay or may cause emergency department admissions and intravenous calcium infusions. The main reasons for the development of postoperative hypocalcemia are gland devascularization, unintentional excision, or thermal/mechanical trauma. Incidental parathyroidectomy has been reported at the rate of 3.7–24.9% in the literature, despite familiarity with neck anatomy and meticulous dissection [4].

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The effect of incidental parathyroidectomy on hypocalcemia is still controversial and open to research [5, 6]. Among the risk factors of incidental parathyroidectomy performed during thyroidectomy, the presence of malignancy, presence of nodal metastases, type of operation, and benign diseases of the thyroid gland (thyroiditis, hyperthyroidism, etc.) have been investigated. However, reasons such as thyroid gland size, nodule features on preoperative ultrasound, and nodule size have not been examined.

The aim of this study was to determine the incidence of incidental parathyroidectomy during thyroidectomy and the effect of this on postoperative hypocalcemia. In addition to the previously investigated risk factors of incidental parathyroidectomy, evaluations were made of parameters that need to be investigated such as preoperative benign thyroid diseases, thyroid gland size, and thyroid nodule characteristics.

Methods

A retrospective review was made of patients who underwent total thyroidectomy in the Department of General Surgery of Eskişehir Osmangazi University Medical Faculty Hospital, between 01.07.2017 and 01.12.2020. Approval for the study was granted by Eskişehir Osmangazi University Ethics Committee (decision no: 30.12.2020/20).

All the procedures were performed by surgeons experienced in thyroid surgery working in the general surgery clinic. During the operation, it was attempted to identify the parathyroid gland, and meticulous dissection was performed to preserve it. Patients were excluded from the study if parathyroid adenoma was detected in the preoperative evaluation or histopathological report, if subtotal thyroidectomy or lobectomy was performed, or if they had a history of neck surgery.

Patient information was recorded, including demographic features, hyperthyroidism status, type of hyperthyroidism, type of operation (total thyroidectomy alone or with lymphadenectomy), the presence of microcalcification on ultrasound, and Bethesda classification of fine needle biopsy reports. Patients with hyperthyroidism underwent surgery, and those in euthyroid state received medical treatment. İncidental parathyroidectomy status and number, largest nodule size, total nodule dimensions, thyroid gland size, presence of malignancy, type of malignancy, presence and type of thyroiditis, and the presence of lymph node metastasis were recorded from the histopathology report. Serum calcium and parathormone values were recorded on the first postoperative day. A value < 8 mg/dl was accepted as hypocalcemia and < 10 pg/ml as low parathormone.

Data obtained in the study were analyzed statistically using SPSS v. 20.0 software (SPSS Inc., Chicago, IL, USA). Distributions of numerical variables were analyzed using visual (histogram and probability graphs) and analytical methods (Kolmogorov-Smirnov/Shapiro-Wilk tests). Descriptive statistics were expressed as mean ± standard deviation or median, minimum-maximum values. Parametric methods were used in the analysis of normally distributed data, and non-parametric methods were used in the analysis of non-normally distributed data and categorical data. A value of $p < 0.05$ was considered statistically significant.

Results

Evaluation was made of a total of 333 patients, comprising 255 (76.6%) females and 78 (23.4%) males with a mean age of 53.14 ± 13.39 years (females: 52.18 ± 13.42 years, and males: 56.30 ± 12.91 years). No significant difference was determined between the genders in respect of mean age ($p = 0.554$). Incidental parathyroidectomy was determined to have been performed in 45 (13.5%) of 333 patients. No patient had more than 2 parathyroid excisions. Two glands were excised in 6 (13.3%) of 45 patients who underwent parathyroidectomy, and single gland excision was observed in 39 (86.7%) patients.

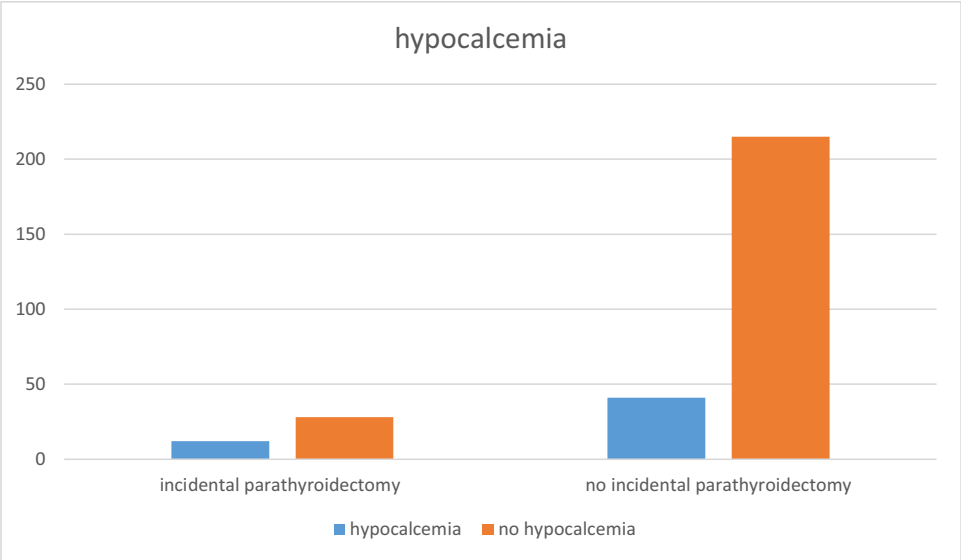
In 296 of the patients included in the study, the serum calcium level was studied on the postoperative first day, and in 53 (17.9%), hypocalcemia was present. Hypocalcemia developed in 12 (30%) of 40 patients with incidental parathyroidectomy and 41 (16%) of 256 patients without incidental parathyroidectomy (Table 1) (Graphic 1). The rate of hypocalcemia was higher in the incidental parathyroidectomy group and was statistically significant ($p = 0.032$). Parathormone levels were studied on postoperative day 1 in 218 patients. Parathormone was < 10 pg/ml in 12 (41.4%) of 29 patients with incidental parathyroidectomy and < 10 pg/ml in 35 (18.5%) of 189 patients without incidental parathyroidectomy (Table 1). Incidental parathyroidectomy was

Table 1 The effect of incidental parathyroidectomy on calcium metabolism

	Incidental parathyroidectomy (*n*, 40)	No ıncidental parathyroidectomy (*n*, 256)	*p* value
Hypocalcemia			**0.032**
Present	12 (30%)	41 (16%)	
Not present	28 (70%)	215 (84%)	
	Incidental parathyroidectomy (*n*, 29)	No incidental parathyroidectomy (*n*, 189)	*p* value
Parathormone (pg/ml)			**0.005**
< 10 pg/ml	12 (41.4%)	35 (18.5%)	
> 10 pg/ml	17 (58.6%)	154 (81.5%)	

Statistically significant *p* values were indicated in bold

Graphic 1 Hypocalcemia rates



determined to cause parathormone insufficiency ($p = 0.005$). The number of parathyroid glands removed had no effect on hypocalcemia ($p = 0.57$).

The presence of hyperthyroidism was not seen to make a significant difference in terms of incidental parathyroidectomy (11.6% vs. 13.8% $p = 0.698$) (Table 2). In the evaluation of patients with hyperthyroidism, there was no difference between toxic nodular goiter and Graves disease in terms of incidental parathyroidectomy ($p = 0.606$). The microcalcification status of thyroid nodules on neck ultrasound ($p = 0.664$), malignancy status in the histopathological report ($p = 0.173$), lymph node involvement ($p = 0.083$), and the presence of thyroiditis ($p = 0.259$) were not seen to make a statistically significant difference in terms of incidental parathyroidectomy (Table 2). The rate of incidental parathyroidectomy was higher in patients who underwent

Table 2 Categorical factors affecting incidental parathyroidectomy

	Incidental parathyroidectomy (*n*, 45)	No incidental parathyroidectomy (*n*, 288)	*p* value
Hyperthyroidism			0.698
Present	5 (11.6%)	38 (88.4%)	
Not present	40 (13.8%)	250 (86.2%)	
Microcalcification on USG			0.664
Present	10 (15.2%)	56 (84.8%)	
Not present	35 (13.1%)	232 (86.9%)	
Malignancy on histopathology			0.173
Present	19 (11.0%)	153 (89.0%)	
Not present	26 (16.1%)	135 (83.9%)	
Thyroiditis			0.259
Present	15 (17.0%)	73 (83.0%)	
Not present	30 (12.2%)	215 (87.8%)	
Involvement of lymph nodes			0.083
Present	4 (30.8%)	9 (69.2%)	
Not present	41 (12.8%)	279 (87.2%)	
Extent of SURGERY			0.306
Bilateral total thyroidectomy	41 (12.9%)	277 (87.1%)	
Bilateral total thyroidectomy + central lymph node dissection	2 (28.6%)	5 (71.4%)	
Bilateral total thyroidectomy + central lymph node dissection + lateral lymph node dissection	2 (25.0%)	6 (75.0%)	

central lymph node dissection compared to those with bilateral total thyroidectomy, but there was no statistically significant difference due to the small number of patients enrolled in the study who underwent lymph node dissection ($p = 0.306$) (Table 2). Nodules were evaluated with preoperative fine needle aspiration biopsy in 170 patients. The results according to the Bethesda classification showed no significant effect on incidental parathyroidectomy ($p = 0.257$). Of the 333 patients included in the study, 172 had thyroid malignancies, and these patients were evaluated for the type of malignancy. Incidental parathyroidectomy showed similar distribution rates according to malignancy type ($p = 0.874$). The thyroiditis types stated in the histopathology report were not seen to affect the incidence of incidental parathyroidectomy ($p = 0.391$).

The vertical and transverse lengths of the thyroid gland were evaluated based on the records in the histopathology report. The vertical length of the gland was median 5.50 cm (range, 3.50–10.00 cm) in the incidental parathyroidectomy group and median 6.00 cm (2.00–16.00 cm) in the non-incidental parathyroidectomy group. The median transverse length of the gland was 5.50 cm (2.00–10.00 cm) in the incidental parathyroidectomy group and median 5.35 cm (1.10–13.50 cm) in the non-incidental parathyroidectomy group. The vertical length of the gland was statistically significantly shorter in the incidental parathyroidectomy group ($p = 0.036$), and there was no significant difference in transverse length ($p = 0.367$). When comparing the diameters of the largest nodules, the diameter was median 1.50 cm (0.50–7.00 cm) in the incidental parathyroidectomy group and median 2.30 cm (0–14.50 cm) in the non-incidental parathyroidectomy group. More incidental parathyroidectomy was performed in patients with small thyroid nodule or nodules ($p = 0.047$). When the total of the nodule diameters was evaluated, there was no significant difference between the groups ($p = 0.320$) (Table 3).

Discussion

The incidence of incidental parathyroidectomy during thyroidectomy has been reported in the literature in a wide range of 3.7–24.9% [4, 7]. The value in this study was similar at 13.5%. That there is heterogeneity in thyroidectomy indications is an important reason for the aforementioned wide range. In addition, the types of thyroidectomy are not standardized in the studies compared, as they include total thyroidectomy, subtotal and near total thyroidectomy, and total thyroidectomy with central lymph node dissection. This heterogeneity in the type of surgical intervention may also be a reason for the wide range of incidence values.

Many risk factors have been suggested in the literature for incidental parathyroidectomy during thyroidectomy. The general opinion about thyroiditis is that there is no clear risk factor [8]. There is no significant relationship between thyroiditis types and incidental parathyroidectomy [9], and no significant difference was observed in this study. Although thyroid malignancies are considered to be an important risk factor for incidental parathyroidectomy, there are conflicting statistics in the literature [8]. Some authors have argued that the incidence of incidental parathyroidectomy increases due to more aggressive dissection in surgery for malignancy, while others have stated that the incidence of incidental parathyroidectomy is lower as more meticulous dissection is performed [10–12]. The results of the current study support the argument that thyroid malignancies are not a risk factor. Thyroid malignancy types and preoperative fine-needle aspiration biopsy evaluations were not found to have a significant effect on the incidence of incidental parathyroidectomy.

Microcalcification (punctate echogenic foci) in the thyroid nodule in preoperative thyroid ultrasound is a radiological finding that increases the suspicion of malignancy [13, 14]. The relationship between the presence of microcalcification in the nodule, which is an ultrasound finding, and incidental parathyroidectomy has not been previously investigated in the literature. Microcalcification rates of 15.2% vs. 13.1% were detected in the current study groups with no significant relationship between the presence of microcalcification and incidental parathyroidectomy. In future studies, in addition to microcalcification on ultrasound, the effect of criteria such as echogenicity (or intensity of the echoes), irregular or infiltrative margins, composition (solid or cystic), shape (greater length than width in the transverse view), and size can be evaluated on the incidence of incidental parathyroidectomy as potential risk factors.

Lymph node involvement, that is, extrathyroidal involvement, increases the incidence of incidental parathyroidectomy (30.8% vs. 12.8%, but $p = 0.083$). In the literature, it

Table 3 Numerical factors affecting incidental parathyroidectomy

	Parathyroidectomy present (n, 45) median (min-max)	No parathyroidectomy (n, 288) median (min-max)	p value
Thyroid gland vertical length (cm)	5.50 (3.50–10.00)	6.00 (2.00–16.00)	**0.036**
Thyroid gland transverse length (cm)	5.50 (2.00–10.00)	5.35 (1.10–13.50)	0.367
Largest nodule size	1.50 (0.50–7.00)	2.30 (0.00–14.50)	**0.047**
Total nodule size	3.00 (0.50–9.40)	3.80 (0.00–20.00)	0.320

Statistically significant p values were indicated in bold

has not been overlooked that especially central lymph node dissection increases the incidence of incidental parathyroidectomy [7, 12]. It is generally accepted in the literature that total thyroidectomy increases the incidence of incidental parathyroidectomy compared to subtotal or near total thyroidectomy (15). Central lymph node dissection with dissection of the tracheoesophageal groove up to the carotid artery sheath has also been reported to increase the risk of incidental parathyroidectomy [7, 11, 15]. In this study, the number of patients who underwent central lymph node dissection ($n = 7$) and lateral lymph node dissection ($n = 8$) was limited. The incidence of incidental parathyroidectomy was high in patients who underwent lymphadenectomy, but was not statistically significant ($p = 0.306$). This may have been due to the limited number of patients who underwent lymphadenectomy in this study. When the underlying benign diseases are evaluated, hyperthyroidism is an important indication for thyroidectomy. Although there are also reports to the contrary, there are studies in the literature showing causes such as Graves' disease or retrosternal or recurrent goiter as risk factors that increase the incidence of incidental parathyroidectomy, which may be a consequence of difficult dissection [16, 17]. In the current study, no significant change was observed in the incidence of incidental parathyroidectomy due to hyperthyroidism and its types, toxic multinodular goiter, or Graves' disease.

Few studies have addressed thyroid gland sizes, and most have evaluated their weight. Although there are publications showing that a small thyroid gland increases the incidence of incidental parathyroidectomy, there is also information that it does not cause a significant change [18–20]. In the current study, the low vertical (median 5.50 cm vs. 6.00 cm) size of the thyroid gland significantly increased the number of incidental parathyroidectomy ($p = 0.036$). The explanation for this is that the identification of crucial anatomical landmarks in small thyroid glands is difficult, and therefore, dissection is more complicated.

One of the most common indications for thyroidectomy is malignant/suspicious nodules, or nodules are encountered in histopathological specimen examination in many patients undergoing thyroidectomy. Few studies in the literature have examined the relationship between nodule status and incidental parathyroidectomy [4, 21]. Therefore, the size of the nodules was evaluated in this study. A higher rate of incidental parathyroidectomy was observed in patients with small nodules than in patients with large nodules ($p = 0.047$). Although the total nodule size was lower in the incidental parathyroidectomy group, it was not statistically significant. Nodules have a different histological structure from normal thyroid tissue. Small and hard nodules can change the anatomical appearance of crucial structures such as parathyroid glands, berry ligament, and the tubercle of zuckerkandl and make dissection complicated and tedious. Therefore, thyroidectomy complications, especially incidental parathyroidectomy, are expected to increase. Considering all the risk factor evaluations, it can be said that anatomical factors are more associated with the risk of incidental parathyroidectomy compared to the underlying disease or thyroidectomy indications.

The clinical effect of incidental parathyroidectomy is expected to occur as hypocalcemia. In the current literature, there is no consensus on the effect of incidental parathyroidectomy on postoperative hypocalcemia, and the debate continues [4, 5, 7, 8, 15, 22]. According to the current study results, postoperative transient hypocalcemia is increased due to incidental parathyroidectomy ($p = 0.032$). In this study, postoperative early period parathormone levels decreased due to incidental parathyroidectomy ($p = 0.005$). These two findings support the hypothesis that incidental parathyroidectomy disrupts calcium metabolism.

The main limitation of this study was the retrospective design. As some data were missing, there were fewer results for parameters such as hypocalcemia and hypoparathyroidism than the total number of patients included in the study. In addition, hypocalcemia was only investigated biochemically, and clinical data were not available. The presence of clinical data would have enabled clearer and more detailed results to be obtained for hypocalcemia. As the long-term calcium levels were not available in the study, no comment could be made on the effect of incidental parathyroidectomy on permanent hypocalcemia.

Conclusion

Incidental parathyroidectomy is a common complication of thyroidectomy, which causes postoperative hypoparathyroidism and hypocalcemia. In addition to the risk factors frequently mentioned in the literature, such as the presence of malignancy, central lymph node dissection, total thyroidectomy, and re-operation, the results of this study demonstrated that surgeons should also be alert to anatomical risk factors such as small nodules and a small thyroid gland.

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Declarations

Ethics Approval All authors declare that the study was conducted in accordance with the Declaration of Helsinki and followed the ethical standards of Turkey.

Competing Interests The authors declare no competing interests.

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