Careful Examination of Thyroid Specimen Intraoperatively to Reduce Incidence of Inadvertent Parathyroidectomy During Thyroid Surgery

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Objective: To assess the incidence and clinical relevance of inadvertent parathyroidectomy during thyroidectomy, and the possibility of reducing its occurrence.

Design: Retrospective study.

Setting: University hospital.

Patients: Consecutive patients who underwent thyroidectomy from 1999 to 2005, divided into 2 groups (group 1, those with inadvertent parathyroidectomy; and group 2, those without inadvertent parathyroidectomy). Patients who underwent surgical procedures for recurrent thyroid disease, intentional parathyroidectomy, and resection of central compartment viscera were excluded.

Interventions: All pathology reports were reviewed for the presence of any parathyroid tissue in the resected specimen. Age, sex, preoperative diagnosis, thyroid hormonal status, substernal thyroid extension, number of parathyroid glands identified and spared at the time of surgery, autotransplantation of parathyroid gland, and final histologic findings were recorded.

Main Outcome Measures: Identification of parathyroid tissue in resected specimens and postoperative symptomatic hypocalcemia.

Results: A total of 307 patients were included. Surgical procedures included bilateral or unilateral thyroidectomy (95% and 5% of procedures, respectively). Central neck lymph node dissection was performed in 5% of cases. Pathologic findings showed inadvertent parathyroidectomy in 12% of cases. Of these, 32% were recognized intraoperatively. The parathyroid tissue was found in extracapsular locations in 37% of cases, intracapsular locations in 39%, and intrathyroidal locations in 24%. There was no statistical difference between the 2 groups in terms of sex, preoperative diagnosis, substernal extension, extent of surgery, pathologic diagnosis, and occurrence of postoperative hypocalcemia, except for the presence of thyroiditis.

Conclusion: Careful examination of the surgical specimen intraoperatively decreases the incidence of inadvertent parathyroidectomy during thyroidectomy.

more parathyroid glands may not necessarily have any clinical relevance, for some authors, has been a risk factor for postthyroidectomy hypocalcemia. Thus, it is important for the thyroid surgeon to be able to identify factors that could potentially increase the risk of inadvertent parathyroidectomy during thyroid surgery and therefore to take appropriate caution with those patients.

We assessed the incidence and clinical relevance of inadvertent parathyroid removal during thyroidecotomy and identified factors that might predict patients at increased risk to decrease these potential complications.

### METHODS

#### POPULATION STUDY

This study was a retrospective review of all thyroidecotomies (unilateral or bilateral) performed at the department of General Surgery in the Hotel Dieu de France Hospital, Beirut, Lebanon, from January 1999 to June 2003. Patient demographics and data regarding preoperative diagnosis and surgical procedures were collected. The local hospital medical ethics committee approved the database review. Informed consent was obtained from all the patients to review their medical files and to be included in the study. Two groups of patients were studied: those in group 1 had experienced inadvertent parathyroidectomy following thyroid surgery and those in group 2 had not. Patients undergoing concomitant central neck lymph node dissection were included in the study, whereas those who required more extensive surgical resection of central compartment viscera (eg, the larynx, trachea, or esophagus) were excluded. Patients who had undergone repeated surgical procedures for recurrent or persistent thyroid disease and patients who had undergone intenional parathyroidectomy were excluded from the study. The following parameters were recorded for all patients: age, sex, preoperative diagnosis, thyroid hormonal status, substernal thyroid extension, number of parathyroid glands inadvertently removed with the thyroid specimen, the location of the parathyroid glands within the submitted thyroid tissue (extracapsular, intracapsular, or intrathyroidal), and histological appearance of both thyroid and parathyroid tissue. Serial gross sections every 2 mm in thickness were performed on the thyroid tissue.

### SURGICAL TECHNIQUE

All surgical procedures were performed by a single surgeon (B.A.). Iodine-free solutions (chlorhexidine) were used to swab the operative field. Thyroidecotomy was performed via a transverse cervicotomy under general anesthesia. The thyroidecotomies were all performed in a similar fashion, with careful dissection along the thyroid capsule while attempting to identify and preserve the parathyroid glands with their vascular supply, as well as the recurrent laryngeal nerves. Total thyroid resection was conducted intracapsularly when necessary to preserve the vascularization of the parathyroid glands. Identification of all parathyroid glands was attempted to facilitate preservation, but excessive dissection to search for missing glands was avoided. Unequivocally devascularized parathyroid glands were removed routinely for immediate autotransplantation. All resected thyroid specimens were carefully examined intraoperatively to identify inadvertently removed parathyroid glands and to perform immediate parathyroid autotransplantation after confirmation by frozen section analysis. The glands were minced into small (0.5-mm) pieces, and the parathyroid tissue was then immediately autotransplanted into a pocket fashioned in the ipsilateral sternocleidomastoid muscle. The transplantation site was closed with permanent silk suture to prevent graft extrusion and to serve for future identification. Cervical wounds were closed without drain tubes.

### PATHOLOGIC FINDINGS

Definitive pathologic study was obtained for all resected tissues. Pathology reports were evaluated for the presence and the number of parathyroid glands inadvertently removed with the thyroid specimen, the location of the parathyroid glands within the submitted thyroid tissue (extracapsular, intracapsular, or intrathyroidal), and histological appearance of both thyroid and parathyroid tissue. Serial gross sections every 2 mm in thickness were performed on the thyroid tissue.

### POSTOPERATIVE PERIOD AND FOLLOW-UP

Postoperative complications, mainly vocal cord paralysis and temporary or permanent hypocalcemia, were noted. Data on postoperative biochemical and clinical hypocalcemia were thoroughly searched. The presence and the type of hypocalcemic signs were recorded by a surgeon or by a nurse, together with the evaluation of the Chvostek sign. Biological hypocalcemia was defined as a serum calcium concentration of less than 8 mg/dL on at least 1 postoperative measurement (to convert serum calcium to millimoles per liter, multiply by 0.25). Serum calcium levels were measured preoperatively and on the first day after surgery. In patients who received calcium replacement therapy, more measurements of serum calcium levels were performed later following discontinuation of replacement therapy to detect permanent hypoparathyroidism. Patients were classified as having transient hypocalcemia if they were normocalcemic 2 weeks after stopping all follow-up medications. Postoperative hypocalcemia requiring treatment and associated with a low parathyroid hormone level (reference range, 9-35 pg/mL; to convert parathyroid hormone to nanograms per liter, multiply by 0.1053) more than 1 year after surgery was classified as permanent.

### STATISTICAL ANALYSIS

Continuous data are expressed as mean (SD) or as mean (range). Categorical data are expressed as frequencies and percentages and were compared using the chi² statistic, corrected by Fischer exact test when appropriate. All tests were 2-sided except for incidence of inadvertent parathyroidectomy associated with parathyroid autotransplantation, which we hypothesized could not reduce incidence of inadvertent parathyroidectomy without parathyroid autotransplantation. P < .05 was considered statistically significant.

### RESULTS

A total of 307 patients (239 female and 68 male) who underwent thyroidecotomies in our department and satisfied the inclusion and exclusion criteria were retained for the study. Their mean age was 53 years (range, 16-76 years). The thyroid function was within reference range in 211 patients (69%). Hyperthyroidism was exhibited by 89 patients (29%), and 7 patients (2%) had hypothyroidism. All 89 patients with hyperthyroidism were treated with methimazole and β-blockers and had had normal thyroid function before the surgery. Substantial thyroid extension was found in 38 patients (12%). The primary thyroid lesion was benign in 244 patients (79%) and malignant in the other 63 (21%), documented preoperatively by fine-needle aspiration cytologic findings (Table 1). Surgical procedures included total lobectomy and isthmusectomy with contralateral near total lo-
and lying just beneath the capsule; and 9 (24%) were located in the intrathyroidal position, defined as being completely surrounded by thyroid parenchyma. The mean (SD) diameter of the inadvertently removed parathyroids was 4 (2) mm. In all of the 38 patients in group 1, the excised parathyroid was normal. The careful inspection of the thyroid specimen intraoperatively allowed reimplantation of inadvertently removed parathyroid glands during thyroidectomies in our series of patients, allowing a statistically significant reduction of the percentage of parathyroid glands discovered by the pathologist on the final surgical specimen (from 12% [38/307] to 8% [26/307]; P = 0.049, 1-sided t test).

### HISTOPATHOLOGIC RESULTS

Histopathologic examination of the resected thyroid revealed the presence of benign thyroid disease and thyroid malignant neoplasms in 196 patients (73%) and 73 patients (27%), respectively (Table 1). Overall, 38 of the 307 patients (12%) (Table 2) were found to have inadvertent removal of parathyroid tissue (group 1). Twenty-nine of these specimens (76%) were for thyroidectomies for benign conditions, and 9 (24%) were for thyroid malignant neoplasms. Thirty-three patients (87%) had 1 parathyroid gland removed and 5 (13%) had 2 parathyroid glands in their specimen compared with 36 of 291 patients (12%) who did not undergo central lymph node dissection. A total of 35 of 269 patients (13%) undergoing thyroidectomy without inadvertent parathyroid removal had substernal thyroid lesion, whereas 4 of the 38 patients (11%) with inadvertent parathyroid removal had a substernal extension (P = .73). Central lymph node dissection was performed in 16 patients (5%), of whom 3 (19%) had an inadvertently removed parathyroid in their specimen compared with 36 of 291 patients (12%) who did not undergo central lymph node dissection (P = .41). Table 3 summarizes the statistical analysis of various parameters as a function of inadvertent parathyroidectomy. There was no statistically significant higher percentage of women in group 1 than in group 2 (84% vs 73%; P = .31). The presumed (preoperative) and histologic diagnoses of thyroid disease (benign vs malignant) were not found to correlate with inadvertent parathyroidectomy. Similarly, the type of surgery (bilateral or unilateral thyroidectomy), central neck lymph node dissection, and the presence of substernal extension of the thyroid gland were not related to inadvertent parathyroidectomy. Conversely, the presence of thyroiditis (Hashimoto thyroiditis) did differ significantly between the 2 groups (P = .04).

Biochemical and clinical hypocalcemia was observed in 9 (24%) and 4 (11%), respectively, of the patients in

### Table 1. Inadvertent Parathyroidectomy in Thyroid Surgery

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographics</td>
<td></td>
</tr>
<tr>
<td>Female sex</td>
<td>239 (78)</td>
</tr>
<tr>
<td>Age, mean (range), y</td>
<td>53 (16-76)</td>
</tr>
<tr>
<td>Indication for surgery</td>
<td></td>
</tr>
<tr>
<td>Presumably benign thyroid disease</td>
<td>244 (79)</td>
</tr>
<tr>
<td>Multinodular goiter</td>
<td>138 (45)</td>
</tr>
<tr>
<td>Hyperthyroidism</td>
<td>89 (28)</td>
</tr>
<tr>
<td>Solitary thyroid nodule</td>
<td>17 (6)</td>
</tr>
<tr>
<td>Thyroid cancer</td>
<td>63 (21)</td>
</tr>
<tr>
<td>Type of surgical procedure</td>
<td></td>
</tr>
<tr>
<td>Total thyroidectomy</td>
<td>103 (34)</td>
</tr>
<tr>
<td>Total lobectomy with contralateral near total lobectomy</td>
<td>187 (61)</td>
</tr>
<tr>
<td>Lobectomy</td>
<td>17 (5)</td>
</tr>
<tr>
<td>Central neck lymph node dissection</td>
<td>16 (5)</td>
</tr>
<tr>
<td>Parathyroid autotransplantation</td>
<td>45 (15)</td>
</tr>
<tr>
<td>Thyroid pathologic characteristics</td>
<td></td>
</tr>
<tr>
<td>Benign tumor</td>
<td>224 (73)</td>
</tr>
<tr>
<td>Malignant neoplasm</td>
<td>83 (27)</td>
</tr>
</tbody>
</table>

**Table 2. Characteristics of Inadvertently Removed Parathyroid Glands**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inadvertent parathyroidectomy</td>
<td>38 (12)</td>
</tr>
<tr>
<td>1 Parathyroid gland removed</td>
<td>33 (87)</td>
</tr>
<tr>
<td>2 Parathyroid glands removed</td>
<td>5 (13)</td>
</tr>
<tr>
<td>Diameter of removed parathyroid glands, mean (SD), mm</td>
<td>4 (2)</td>
</tr>
<tr>
<td>Location of the removed parathyroid glands</td>
<td></td>
</tr>
<tr>
<td>Intrathyroidal</td>
<td>9 (24)</td>
</tr>
<tr>
<td>Intracapsular</td>
<td>15 (39)</td>
</tr>
<tr>
<td>Extracapsular</td>
<td>14 (37)</td>
</tr>
<tr>
<td>Removed parathyroid glands with normal histologic characteristics</td>
<td>38 (100)</td>
</tr>
</tbody>
</table>

**Note:**
- Data are given as number (percentage) unless otherwise indicated.
- Total number of patients was 307. Data are given as number (percentage) unless otherwise indicated.
group 1 and in 41 (15%) and 13 (5%), respectively, of the patients in group 2 (Table 3). There was no statistically significant difference regarding the occurrence of postoperative hypocalcemia between the 2 groups ($P=.25$). In total, 17 patients among the 307 in the present study (6%) experienced clinical hypocalcemia and received supplementation treatment with calcium and vitamin D analogue. It was transient in all patients; in all of them, the symptoms resolved within the 6- to 8-week period following thyroid surgery, and the supplementation therapy was stopped. Transient vocal cord paresis (by laryngoscopy) was observed in 3 patients in group 2 (2%) with complete recuperation 2 to 3 months after surgery.

During follow-up, no patients exhibited clinical symptoms of hypocalcemia, and the blood calcium levels were within reference range in all the patients at 12 months after surgery. The incidence of permanent hypoparathyroidism was 0% as certified from blood calcium levels measured after surgery.

**COMMENT**

The incidence rate of inadvertent parathyroidectomy during thyroid surgery was 12% in our patients, which compares favorably with rates reported in the literature (8%-19%).

The careful inspection of the thyroid specimen intraoperatively allowed reimplantation of inadvertently removed parathyroid glands during thyroidectomies in our series of patients, this retrieval being statistically significant (from 12% [38/307] to 8% [26/307], $P=.049$; 1-sided $t$ test). Lee et al described their experience reporting an incidence rate of 11% for inadvertent parathyroid removal during thyroidectomy. Sasson et al reported an incidence rate of 15% in a series of 141 thyroidectomies. In most cases, only 1 parathyroid gland was inadvertently resected with the thyroid (there was an incidence rate of 87% for removal of 1 gland in our study). By adhering to anatomical principles and strict surgical guidelines, it has been well established that the incidence rate of iatrogenic hypoparathyroidism after thyroidectomy may be minimized to 0.5% to 4%. However, little has been written about the actual incidence and clinical relevance of inadvertent parathyroid gland removal during thyroidectomy. Furthermore, despite some controversy, most authors agree that identifying parathyroid glands during thyroid surgery can result in a lower incidence of inadvertent parathyroidectomy. However, dissection in search of all parathyroid glands during thyroid surgery is unwarranted and may be hazardous.

Familiarity with the anatomy of parathyroid glands and their blood supply is necessary to prevent inadvertent injury or devascularization or resection of the parathyroid parenchyma. Although there is great variability in their number, most commonly there are 4 glands (approximately 6-8 mm in diameter) commonly located extra-capsularly on the posterior surface of the thyroid gland. They can, however, also be found within the thyroid capsule or, rarely, within the substance of the thyroid gland itself. The superior parathyroids are fairly consistently located at the superior pole of the thyroid. The inferior parathyroids are more variable in location and, at times, are intrathyroidic. The inferior parathyroid artery always arises from the inferior thyroid artery. The superior parathyroid gland also usually receives its blood supply from the inferior thyroid artery. Occasionally, it may derive its blood supply from an anastomotic loop between the superior and inferior thyroid arteries or exclusively from a branch of the superior thyroid artery. The incidence of intrathyroidal location of parathyroid glands is approximately 0.2% according to autopsy studies, but this incidence rises to 2% to 5% in patients with primary hyperparathyroidism and up to 11% in those with persistent or recurrent hyperparathyroidism. Inadvertently excised parathyroids, however, have been reported in an intrathyroidal location in 40% to 50% of cases. In our study, the inadvertently resected parathyroid was intra-thyroidal in 24% of cases. Obviously, in these cases, im-

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Group 1 (Inadvertent Parathyroidectomy)</th>
<th>Group 2 (No Inadvertent Parathyroidectomy)</th>
<th>$P$ Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female sex</td>
<td>32 (84)</td>
<td>207 (77)</td>
<td>.31</td>
</tr>
<tr>
<td>Benign preoperative diagnosis</td>
<td>29 (76)</td>
<td>215 (80)</td>
<td>.61</td>
</tr>
<tr>
<td>Type of surgical procedure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total thyroidectomy</td>
<td>13 (34)</td>
<td>90 (33)</td>
<td>.90</td>
</tr>
<tr>
<td>Total lobectomy + isthmusectomy + near total contralateral lobectomy</td>
<td>23 (61)</td>
<td>164 (61)</td>
<td>.99</td>
</tr>
<tr>
<td>Lobectomy</td>
<td>2 (5)</td>
<td>15 (6)</td>
<td>.94</td>
</tr>
<tr>
<td>Central neck lymph node dissection</td>
<td>3 (8)</td>
<td>13 (5)</td>
<td>.85</td>
</tr>
<tr>
<td>Parathyroid autotransplantation</td>
<td>12 (32)</td>
<td>33 (12)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Benign thyroid pathologic characteristics</td>
<td>28 (74)</td>
<td>196 (73)</td>
<td>.91</td>
</tr>
<tr>
<td>Presence of Hashimoto thyroiditis</td>
<td>3 (8)</td>
<td>4 (2)</td>
<td>.04</td>
</tr>
<tr>
<td>Subternal goiter</td>
<td>4 (11)</td>
<td>34 (13)</td>
<td>.71</td>
</tr>
<tr>
<td>Hypoparathyroidia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biochemical</td>
<td>9 (24)</td>
<td>41 (15)</td>
<td>.19</td>
</tr>
<tr>
<td>Clinical</td>
<td>4 (11)</td>
<td>13 (5)</td>
<td>.24</td>
</tr>
</tbody>
</table>

*Data are given as number (percentage) in each group.*
In the literature, completion thyroidectomy or re- 
tensive dissection performed during such a procedure. 
This may be related to the more ex-
section of tracheoesophageal groove lymph nodes and 
prudent. Autotransplantation should be strongly con-
comprising the oncological indication for resection, is 
suitable for autotransplantation. Careful inspec-
tions where it could be identified and preserved dur-
ing the surgery. Possibly, more careful examination of 
the thyroid capsule during and after thyroidectomy would 
decrease this incidence. Following resection of the thy-
roid gland in our series of patients, and after examining 
the surgical specimen intraoperatively, an inadvertently 
excised parathyroid was recognized and autotrans-
planted after confirmation by frozen section analysis in 
12 patients. In our series of patients, careful examina-
tion of the thyroid specimen was conducted intraopera-
tively, which resulted in identification of 32% (12/38) of 
inadvertently removed parathyroid glands. The 24% of 
parathyroid tissue that was found in an intrathyroidal lo-
cation would have been more difficult to preserve even 
with more careful dissection or inspection. 
Theoretically, the risk of inadvertent parathyroidec-
tomy may be increased in some cases, such as in pa-
ients who are undergoing extensive surgery for malig-
nant thyroid disease, in the presence of extrathyroid 
extension, or in the presence of bulky lymph node me-
tastases. Lin et al1 and Sasson et al8 reported the notable 
association of inadvertent parathyroidectomy with dis-
section of tracheoesophageal groove lymph nodes and 
modified neck dissection concomitant with thyroidec-
tomy, respectively. This may be related to the more ex-
tensive dissection performed during such a procedure. 
In the literature,1 completion thyroidectomy or re-
peated surgical procedures have been correlated with an 
increased risk for inadvertent parathyroidectomy, prob-
ably resulting from the formation of scar tissue and fi-
brosis, which may cause operative difficulty. In our study, 
however, patients who underwent repeated surgical pro-
cedure for recurrent or persisted thyroid disease were 
excluded. Some authors have described thyroiditis as a risk 
factor for inadvertent parathyroidectomy.1 In our study, 
Hashimoto thyroiditis was observed in 8% (3/38) and 2% 
(4/269) of patients with or without inadvertent parathy-
roidectomy, respectively, and the difference was statisti-
ically significant (P = .04). 
Besides recommending particular care with intraop-
erative identification and preservation of the parathy-
roids, it may also be prudent to examine the thyroidec-
tomy specimens of these patients carefully with the 
tention of identifying healthy parathyroid glands that 
may be suitable for autotransplantation. Careful inspec-
tion of the resected thyroid or neck dissection speci-
mens for the presence of normal parathyroid tissue, 
anticipating possible autotransplantation without com-
promising the oncological indication for resection, is 
prudent. Autotransplantation should be strongly con-
sidered, and its routine application during thyroid sur-

gery resulted in less than 1% incidence of permanent hypoparathyroidism.15-20 In this study, parathyroid autotransplantation was performed in 12 patients (32%) who had inadvertent parathyroid removal. 
Biochemical hypocalcemia has been reported in most 
patients (up to 83%) following thyroid surgery.11,12, clinical hypocalcemia is observed much less frequently. Al-
though there were no sequela of permanent hypocalce-
emia in any of our patients, percentages cited in the 
literature range from 0.3% to 5% for temporary and from 
0% to 0.5% for permanent hypocalcemia.8,12 The asso-
ciation between intraoperative identification of parathy-
roid glands and development of postoperative hypocal-
cemia is variable.8,12 Our policy has been to identify and 
preserve the parathyroid glands as a matter of routine for 
every patient undergoing any form of thyroidectomy for 
benign tumors or malignant disease. Despite this ap-
proach, as our analysis reports, a percentage of patients 
will have 1 or more parathyroids excised inadvertently. 
Most often, only 1 parathyroid gland is likely to be re-
moved. In our study, no correlation was found between 
inadvertent parathyroidectomy and clinical and bio-
chemical hypocalcemia. This has been the experience of 
other investigators as well. 
In conclusion, inadvertent excision of parathyroid 
glands occurred in 12% of patients undergoing thyroid-
ec tomy in our experience. Most of this parathyroid tis-
sue (76%) was found in the extracapsular and intracap-
sular locations; therefore, it is possible that these 
parathyroid glands may be identified and preserved with 
more meticulous inspection of the thyroid capsule dur-
ing and after thyroidectomy to decrease the incidence of 
inadvertent parathyroidectomy during thyroidectomy in 
the future. The careful inspection of the thyroid speci-
men intraoperatively allowed reimplantation of inadvert-
ently removed parathyroid glands during thyroidec-
tomies in our series of patients, this retrieval being statistically significant (P = .049), and allowed immedi-
ate autotransplantation of the parathyroid tissue. A no-
table percentage of inadvertently removed parathyroid 
glands are intrathyroidal, and therefore some inadvert-
ent parathyroidectomies are obviously unavoidable. Most 
patients had 1 parathyroid gland identified in their speci-
men. Although inadvertent parathyroidectomy with au-
totransplantation does not seem to correlate with post-
operative permanent hypocalcemia, every attempt should 
be made to avoid this potentially preventable complica-
tion of thyroid resection. 

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analysis. Study concept and design: Abboud, Ghorra, 
and Tabchy. Acquisition of data: Abboud, Braidy, Zeineddine, 
and Abadjian. Analysis and interpretation of data: Sleilaty.
Drafting of the manuscript: Abboud, Braidy, and Zeineddine. Critical revision of the manuscript for important intellectual content: Abboud, Sleilaty, Ghorra, Abadjian, and Tabchy. Statistical analysis: Sleilaty and Zeineddine. Study supervision: Abboud.

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