Gamma probe-guided surgery for revision thyroidectomy: In comparison with conventional technique

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ABSTRACT. Reoperative thyroid surgery may be required in patients who undergo any procedure less than total or near total thyroidectomy. The aim of this study was to investigate advantages of gamma-probe guided revision thyroidectomy (GGRT) over conventional revision thyroidectomy (CRT) in patients with differentiated thyroid carcinoma (DTC). GGRT was assessed according to the TSH values, complication rates and the incidence of carcinoma in residual thyroid tissue. In this randomised prospective clinical trial, 25 patients with differentiated thyroid carcinoma who had previously undergone surgery for benign multinodular goiter were included in the study. GGRT was performed in 11 (44%) patients (Group 1) and CRT in 14 (65%) (Group 2). The intraoperative mean ratio of thyroid activity to background activity (T/B) was detected as 5.1±1.4 and the mean ratio of thyroid bed activity to background activity after excision (Tbed/B) was 1.3±0.3, (p<0.01). Although the incidence of carcinoma in residual thyroid tissue was higher in group 1 (4/11) in comparison to group 2 (1/14), it was not statistically significant. The elevation of the TSH concentration at the first post-operative month was significantly higher in group 1 in comparison with group 2 (18±25 5±3 mIU/l), (p<0.02). These results indicate that intraoperative gamma probe application may be beneficial to detect and remove residual thyroid tissue in revision thyroidectomy.

INTRODUCTION

The incidence of thyroid cancer varies in different regions of the world due to environmental factors and periods of the study. These differentiated thyroid carcinomas show a wide range of biologic behavior, although it is commonly associated with low morbidity and mortality (1, 2). Although there is still a debate regarding the extent of the surgical treatment in differentiated thyroid carcinoma (DTC), recently total thyroidectomy has been increasingly accepted in the management of DTC (3). It is well documented that recurrence is more common in patients who undergo any procedure less than total or near total thyroidectomy. Fifty percent of all patients who have developed local recurrence in the thyroid bed finally die due to thyroid cancer (4, 5).

In their careers, thyroid surgeons may need to perform reoperative surgery in order to find the most suitable operation at the initial surgery. Intraoperative tumor detection and excision with gamma probe-guided surgery are currently employed for different tumor types (6, 7). Recently, intraoperative gamma probe has also been used to detect and then dissect lymph node recurrences of DTC (8). The aim of this study was to investigate the advantages of gamma probe-guided revision thyroidectomy (GGRT) over conventional revision thyroidectomy in patients with DTC.

MATERIALS AND METHODS

Patients

Twenty-five patients who had already undergone thyroid surgery for benign colloid goitre, which were diagnosed as DTC at histopathologic examination, were included in the present study between June 2002 and July 2004. Patients were selected according to the number on the random table for two different surgical techniques. GGRT was performed in 11 patients (Group 1), and conventional revision thyroidectomy (CRT) in 14 patients (Group 2). Of 25 patients, 21 were referred to our clinic from other institutions, whereas 4 underwent initial surgery in our
Department. None of the patients received L-T\textsubscript{4} replacement treatment after the initial surgical procedures. Our patients had mild hypothyroidism after the first operation because of the incomplete resection of the thyroid tissue. Although L-T\textsubscript{4} treatment after the first operation must be started to avoid potential growth of residual thyroid tissue or cancer during this period, this possibility seemed less likely when the degree of hypothyroidism and increases in TSH concentrations in our patients were taken into consideration.

**Pre-operative evaluation**

In the pre-operative period, physical examination, thyroid scintigraphy, thyroid and neck ultrasonography (US), serum concentrations of TSH, thyroglobulin (Tg), anti-Tg (anti-Tg), and indirect laryngoscopic examination were performed in all patients. Although the size of the residual thyroid tissue measured by ultrasonography is a reliable criterion for the evaluation of the extent of thyroidectomy, it could not help the surgeon to direct the exploration sites during the operation. It could be difficult to explore and differentiate residual thyroid tissue from fibrotic areas at the second operation. Therefore gamma probe demonstrates exploration sites more clearly. Serum concentrations of Tg and TSH were also measured after revision thyroid surgery before hormone replacement. Fine needle aspiration (FNA) cytology was also used in one of the patients.

**Surgical technique**

Gamma probe-guided RT was performed in group 1 patients. A hand-held commercially available gamma probe (Navigator, USSC, USA) was used. Ten min before the cervical incision, \(^{99}\text{Tc}\) (5 mCi) was injected in the patients. Both of the thyroid beds were counted in three equal parts as upper, middle, and lower with 10 sec duration by using probe. Background activity was counted on the contralateral shoulder of the radioactive material injection side. Thyroid bed count and pre-operative scintigraphy revealing remnant thyroid tissue were compared. Common sites that were detected with both techniques were dissected initially. After the removal of these tissues, other abnormal count regions were explored. At the end, the thyroid bed was controlled for abnormal count with intraoperative gamma probe. Ratios were obtained by dividing counting rates of background activity before excision (T/B). Ratios after excision were measured by dividing counting rates of thyroid bed by counting rates of background activity (Tbed/B). Completeness of excision is reflected by the low ratio of counting rates after excision.

**Post-operative follow-up**

At the first post-operative month, the thyroid scintigraphy, indirect laryngoscopy, TSH level measurement and at the second post-operative month Tg level measurement were performed in all patients. RAI ablation was performed according to the histologic criteria, which included: tumor size >1.5 cm, any size of tumor with thyroid capsule or extrathyroidal invasion or multicentricity (≥3 tumor foci). The Department of General Surgery, Endocrinology and Nuclear Medicine collaborated to maintain the treatment of patients with thyroid cancer at Istanbul Medical Faculty. RAI ablation with 100 mCi (3700 MBq) has been our policy for the past two decades. The TSH values were required to be >30 mIU/l to refer the patients to RAI ablation therapy.

Post-operative complications, residual tissue of multifocal disease, post-operative TSH and Tg values, and number of the patients needing RAI ablation were compared in gamma probe-guided RT and conventional RT performed patients.

**Statistical analysis**

Results were expressed as mean±SD. Wilcoxon, Mann Whitney U tests for unpaired subjects and chi-square test were used for statistical analysis (SPSS 10.0 for Windows) and p<0.05 was accepted as significant.

**Ethics**

The local Ethics Committee of our Institution approved the study and informed consent was obtained from all patients participating in the trial.

**RESULTS**

**Pre-operative findings**

The mean age of patients was 42 yr (range 19-61 yr) in Group 1, and 41 yr (range 18-60 yr) in Group 2. Both groups were age-matched. The male/female ratio was 1:11 and 1:14 in Groups 1 and 2, respectively. Papillary microcarcinoma is defined as a papillary thyroid carcinoma that is 1 cm or less in diameter. The mean tumor size was not significantly different between the two groups [16±13 mm (range 5-52 mm) vs 17±11 mm (range 4-40 mm)]. The laboratory and histopathologic results of both groups of patients were summarized in Table 1. The MACIS risk scores of patients in Group 1 and Group 2 were 5.4±0.5 and 5.3±0.7, respectively. TSH levels (6.8±5.1 vs 7.8±4.7 mIU/l) and Tg levels (17±8 vs 16±8 ng/ml) were not significantly different in both groups after initial surgery. Bilateral subtotal thyroidectomy had been performed in 81% of Group 1 patients and 78% of Group 2, respectively. Initial surgical procedures and histopathological examination results of both groups’ patients are revealed in Table 2.

<table>
<thead>
<tr>
<th>Table 1. Histopathologic and laboratory findings of patients.</th>
<th>No. of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tumor size &gt;1.5 cm</td>
<td>10</td>
</tr>
<tr>
<td>Multicentricity</td>
<td>7</td>
</tr>
<tr>
<td>Tumor capsule invasion</td>
<td>14</td>
</tr>
<tr>
<td>Tumor vascular invasion</td>
<td>6</td>
</tr>
<tr>
<td>Extrathyroidal invasion</td>
<td>7</td>
</tr>
<tr>
<td>TSH value &lt;30</td>
<td>25</td>
</tr>
<tr>
<td>High Tg value (15 patients &gt;10 ng/ml)</td>
<td>22</td>
</tr>
<tr>
<td>Anti-Tg</td>
<td>1</td>
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</tbody>
</table>

Tg: Thyroglobulin.