A Safety-Based Comparison of Pure LigaSure Use and LigaSure-Tie Technique in Total Thyroidectomy

A. Pergel¹, A. Fikret Yucel¹, I. Aydin¹, D.A. Sahin¹, S. Aras¹, H. Kulacoglu¹

¹Department of Surgery, School of Medicine, Recep Tayyip Erdogan University, Rize, Turkey
²Private Ahenk Biochemistry Laboratory, Istanbul, Turkey

Background and Aim: Sutureless total thyroidectomy by using vessel sealing devices has been shown to be safe in some recent clinical studies. However, some surgeons are still concerned about the use of these energy devices in the vicinity of the recurrent laryngeal nerve and parathyroid glands. The objective of this study was to investigate the effects of the use of pure LigaSure on postoperative complications and to discuss the pertinent literature.

Methods: A total of 456 patients having undergone a total thyroidectomy operation between June 2009 and March 2011 were included in the study. The patients were divided into two groups: Group L, consisting of 182 patients for whom pure LigaSure was used, and Group LT, consisting of 274 patients in which ligation was performed in the vicinity of the recurrent laryngeal nerve and parathyroid glands, while LigaSure was used for the rest of the operation. The groups were compared with regard to demographic characteristics, duration of operation, thyroid pathology, postoperative complications, and laboratory values.

Results: Both groups were similar in terms of demographic characteristics, duration of the operation, and thyroid pathology. No deaths were recorded. The incidence of hypocalcemia was higher in Group L (p<0.003), but there were no statistically significant differences between the two groups in terms of symptomatic hypocalcemia. No hypocalcemia or laryngeal nerve injury was observed in either group.

Conclusions: The simple LigaSure method can increase the frequency of laboratory hypocalcemia after total thyroidectomy, but not symptomatic hypocalcemia. Complications related to hemostasis were similar and occurred in a small number in both groups. The use of ligation in the areas around sensitive anatomical structures did not prolong the operating time and could represent a safer method for performing total thyroidectomy.

Cuvinte cheie: hipocalcemia, LigaSure, ligatură, leziune termică, nerv laringe recurent, tiroidectomie
may also be used at sites close to vital structures (recurrent laryngeal nerve and parathyroid glands). Some present studies also report that there is no difference between the two (5-10). The occurrence of these complications is quite rich in vascularization, as well as being adjacent to delicate anatomic structures like the recurrent laryngeal nerve and parathyroid glands. Accordingly, a good hemostasis procedure was performed using LigaSure in group L, and LigaSure+tie in group LT. The ligation procedure was performed using 4-0 absorbable suture material (polyglactine) only in areas close to the parathyroid glands and the recurrent laryngeal nerve. In almost all cases, bilateral recurrent laryngeal nerves and four parathyroid glands were revealed. Parathyroid glands were moved away by dissection from the thyroid tissue in a cautious manner. When ischemia developed or the parathyroid glands needed to be removed, auto-transplantation into the sternocleidomastoid muscle was performed. A suction drain was inserted in cases where it was considered necessary. Strap muscles and the platysma were closed with 4-0 absorbable suture, the skin was closed with subcutaneous 3-0 non-absorbable suture. Patient’s blood calcium values were checked preoperatively and at postoperative 24, 48, and 72 hours. Groups were assessed in terms of demographic properties, thyroid pathology, duration of operation, and post-operative complications.

Results: Groups were similar in respect of demographic properties, operation duration, thyroid gland pathology. No mortality rate was recorded. Laboratory hypocalcemia rate was higher in group L (P < 0.003), but no significant difference was identified between groups in terms of symptomatic hypocalcemia. No permanent hypocalcemia or recurrent laryngeal nerve injury developed in any of the patients in the two groups.

Conclusions: Pure LigaSure for total thyroidectomy may increase laboratory hypocalcemia rate, but not symptomatic hypocalcemia. Hemorrhage related complications were similar and low in the two groups. Ligations in the places close to delicate anatomic structures did not cause longer operative times and may be a safer option in total thyroidectomy.

Key words: hypocalcemia, LigaSure, ligation, thermal injury, recurrent laryngeal nerve, thyroidectomy

Introduction

Thyroidectomy is one of the most frequently performed operations in general surgery. The thyroid gland is an organ which is quite rich in vascularization, as well as being adjacent to delicate anatomic structures like the recurrent laryngeal nerve and parathyroid glands. Accordingly, a good hemostasis procedure was performed using LigaSure in group L, and LigaSure+tie in group LT. The ligation procedure was performed using 4-0 absorbable suture material (polyglactine) only in areas close to the parathyroid glands and the recurrent laryngeal nerve. In almost all cases, bilateral recurrent laryngeal nerves and four parathyroid glands were revealed. Parathyroid glands were moved away by dissection from the thyroid tissue in a cautious manner. When ischemia developed or the parathyroid glands needed to be removed, auto-transplantation into the sternocleidomastoid muscle was performed. A suction drain was inserted in cases where it was considered necessary. Strap muscles and the platysma were closed with 4-0 absorbable suture, the skin was closed with subcutaneous 3-0 non-absorbable suture. Patient’s blood calcium values were checked preoperatively and at postoperative 24, 48, and 72 hours. Patients with blood calcium values of ≤8 mg/dl (2 mmol/l) were considered as hypocalcemic. Patients developing postoperative hoarseness were evaluated with a laryngoscope. After operation, no calcium support was routinely initiated for any patient. Intravenous calcium was administered for patients whose clinical symptoms of hypocalcemia existed. Patients without complications were discharged on the 3rd postoperative day. Patients with complications were followed up until recovery. Data were recorded in terms of patient demographics, thyroid pathology, pre- and post-operative blood calcium levels,
operation duration, and postoperative complications (bleeding, recurrent laryngeal nerve injury, hypocalcemia).

Statistical analysis

For statistical assessment of data and results, Student’s t and Chi-square tests were used. The results were expressed as mean ± SD, and P<0.05 was accepted to be statistically significant.

Results

The L group consisted of a total of 182 patients, 134 females and 48 males. The mean age was 49.54±10 (range from 27-73 years). The LT group consisted of a total of 274 patients, 195 females and 79 males. The mean age was 48.95±12 (range from 22-80 years). When patients were compared in terms of age, gender, pathological results, and thyroid gland weight, there was no significant difference between the two groups. The operation duration in the group L was 71±16 minutes, 73.4±17 minutes in group LT, and no significant difference was detected between groups. Data is summarized in Table 1. Mean preoperative blood calcium values were 9.2±0.6 in the group L and 9.1±0.4 mg/dl in the group LT. In the early period after operation, 2 patients in the group L and 3 patients in the group LT were operated on again due to bleeding. Hoarseness emerged in 5 patients in group L and in 6 patients in group LT (P<0.05). At laryngoscopic examination, unilateral vocal cord paralysis was identified in these patients. No permanent recurrent laryngeal nerve injury was encountered in any patients at 6 months. Parathyroid auto-transplantation was performed in 17 patients in group L, 32 patients in group LT (P<0.05). When assessing pathology reports, an accidentally-removed parathyroid gland was detected in 9 patients in the group L, in 14 patients in group LT. Biochemically, hypocalcemia (≤ 8 mg/dl) was identified in 95 patients in group L (P<0.003), 104 patients in group LT. However, there was no significant difference between groups in terms of hypocalcemia (Table 2).

Discussion

LigaSure use in thyroidectomy provides a good hemostasis however risk of lateral thermal injury remains a concern. Therefore, there have been controversies regarding the undesirable effects of pure LigaSure use on recurrent laryngeal nerves and parathyroid glands. The extent of thermal injury has been reported as less than 1 mm (11), but some authors have stated that thermal injury might be as wide as 3 mm (12-14).

Despite similar results related to recurrent laryngeal nerve injury reported in numerous studies comparing LigaSure use and clamp-tie technique (4,7,9,15-18), varying results were reported regarding hypocalcemia (3,4,8,19) (Table 3). Highly variable hypocalcemia rates in studies may be explained by several factors such as extent of thyroidectomy (total, subtotal, lobectomy, addition of neck dissection) (7,13,16,20), whether postoperative calcium support was routinely performed or not (16), short hospitalization (24 hours) (5,9), and differences in the definition of hypocalcemia (blood calcium level, the presence of clinical symptoms, the need of calcium replacement) (5,7,9,15,16, 20,21).

In some studies comparing LigaSure and Clamp-tie

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<tr>
<th>Table 1. Clinical and demographic characteristics of the patients</th>
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<tr>
<td>Mean age (years±SD)</td>
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<td>Female/Male</td>
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<td>Thyroid gland weight (g±SD)</td>
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<td>Nodular goitre</td>
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<td>Graves’ disease</td>
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<td>Malignancy</td>
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<td>Operative time (min±SD)</td>
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<th>Table 2. Comparison of postoperative complications</th>
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<tr>
<td>Postoperative hypocalcemia</td>
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<tr>
<td>Symptomatic hypocalcemia</td>
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<tr>
<td>Parathyroid autotransplantation</td>
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<td>Accidental parathyroidectomy</td>
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<td>Temporary RLN palsy</td>
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<td>Permanent RLN palsy</td>
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<td>Hematoma</td>
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techniques in thyroidectomy it has been reported that surgeons feel safer when they perform ligation instead of LigaSure in close proximity to the recurrent laryngeal nerve and parathyroid glands (7,8,22). In these studies, no significant difference between postoperative recurrent laryngeal nerve and hypocalcemia was detected between groups (rates 1.9-2.6% and 7.5-7.6%, respectively). In their studies comparing LigaSure and conventional thyroidectomies, Musunuru et al observed 4% and 1% recurrent laryngeal nerve injury, respectively, and reported that LigaSure does not increase the risk of recurrent laryngeal nerve injury (17). However, particularly, they reported that they performed ligation in a site close to the recurrent laryngeal nerve in a group where LigaSure was used. In some other studies with similar design, the use of LigaSure in the vicinity of the recurrent laryngeal nerve and parathyroid glands was not suggested due to its thermal effect (8,16). As an opposing view, Petrakis et al reported that the use of LigaSure decreases hypocalcemia and recurrent laryngeal nerve injury (3). The rates of hypocalcemia and recurrent laryngeal nerve injury were found as 0.7%-1.1% in LigaSure group, and as 4%-4.8% in clamp-tie technique group in their study, respectively, both in favour of the LigaSure group. In their view, no additional instrument is required, because both grasping and coagulation can be achieved by LigaSure at the same time. In the present study, recurrent laryngeal nerve injury rates were similar in both groups. However, laboratory hypocalcemia was recorded in 52% of the patients in pure LigaSure group, whereas this rate was 38% in the LT group. Because both groups are similar in terms of risk factors the authors think that the higher laboratory hypocalcemia rate in the LigaSure group can be attributed to the thermal injury of the device. On the other hand, the authors have experienced that LigaSure device has revealed no contribution to meticulous dissection and manipulation of delicate tissues. In fact, many surgeons who prefer LigaSure device in thyroidectomy may also use ancillary hemostasis methods like ligation, clip, and a variety of hemostatic materials in practice, although it is not clearly indicated in relevant publications (7,8).

In the literature, symptomatic hypocalcemia has been reported in quite different rates, even reaching up to 15%, laboratory detected hypocalcemia may develop in up to 80% of the cases (23-25). Although the mechanism of hypocalcemia seen after thyroidectomy may be secondary to several reasons, the most likely cause is hypoparathyroidism (26,27). Hypoparathyroidism depending on the impairment of blood circulation, direct injury, or involuntary excision of the parathyroid gland may develop during operation (28). Patients with retrosternal large goitre and recurrent goitre, undergoing more extensive surgery (total or near total thyhroidectomy, central or lateral neck dissection) are at increased risk of hypoparathyroidism. In order to evaluate the thermal effect of LigaSure more effectively, the authors tried to minimize negative factors (demographic, histopathological ones, thyroidectomy type, surgical procedure, definition of hypocalcemia, follow-up period) affecting blood calcium values. Parathyroid auto-transplantation increases the temporary hypocalcemia risk, but permanent hypocalcemia rates become less than 1% (29-31). Parathyroid cells can gain function by revascularization in the 2nd week of auto-transplantation (32). In the literature, parathyroid auto-transplantation during thyroidectomy has been reported in a range of 13%-100%, and permanent hypocalcemia rate has been recorded as 0%-6% (33-36). In the present study, parathyroid glands were routinely checked for delicate anatomy and vitality, but auto-transplantation was required in 17 patients (9%) in the L group, and 32 patients (12%) in the LT group. Temporary hypocalcemia rates were 76% and 47%, respectively. The difference in auto-transplantation rates of the two groups was not significant. Nevertheless postoperative laboratory hypo-calcemia was significantly more frequent in the LigaSure group. Higher hypocalcemia rate in patients for which auto-transplantation was performed in the LigaSure group was suggestive of the thermal injury. In the present study, no permanent hypocalcemia was encountered in any patients for whom auto-transplantation was performed.

The maintenance of calcium hemostasis in early post-operative period after thyroidectomy is associated with the number of remaining parathyroid glands (26,37). Observing

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<th>References</th>
<th>Year</th>
<th>Type of Thyroidectomy</th>
<th>Number of Patients</th>
<th>Hypocalcemia %</th>
<th>P value</th>
<th>Recurrent Nerve Lesion %</th>
<th>P value</th>
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<tr>
<td>Saint Marc et al.</td>
<td>2007</td>
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<td>21 1</td>
<td>18 2</td>
<td>NS</td>
<td>12 1</td>
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<td></td>
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<td>53 52</td>
<td>7.5 0</td>
<td>7.7 0</td>
<td>NS</td>
<td>1.9 0</td>
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<td>204 199</td>
<td>2.5 0</td>
<td>7.0 0</td>
<td>0.02</td>
<td>1.0 0</td>
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<td></td>
<td></td>
<td></td>
<td>135 99</td>
<td>5 0</td>
<td>11 0</td>
<td>NS</td>
<td>3 0</td>
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<td>Musunuru et al.</td>
<td>2008</td>
<td>Lobektomik</td>
<td>51 99</td>
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<td>4 0</td>
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<td></td>
<td></td>
<td></td>
<td>270 247</td>
<td>1.1 0</td>
<td>4.8 0</td>
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<td>0.7 0</td>
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<td></td>
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<td>4.4 1.1</td>
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<td>1.4 0</td>
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</table>

**Table 3.** Postoperative complication rates of the clinical trials comparing L and CT
only one parathyroid gland during operation increases the risk for hypocalcemia (27,28). On the other hand, Bergamaschi et al reported that there is no relationship between the parathyroid gland number seen during operation and hypoparathyroidism with postoperative calcium levels (38). In the literature, the rate of accidental parathyroidectomy rate is reported between 6.4%-31% (39-43). In the present study, according to the histopathological results of patients, accidentally-excised parathyroid gland was detected at the rate of 4.9% in the L group, at the rate of 5.1% in the LT group, and there was statistically no significant difference.

A rapid uptake of calcium to the bones (hungry bone syndrome) emerges in patients with hyperthyroidism due to thyrotoxic osteodystrophy after operation. Therefore, the postoperative hypocalcemia risk increases (44,45). In this study, 11 and 16 Graves' patients were present in the L and LT groups, respectively. Hypocalcemia was seen in 8 patients in the L group, and 4 of them were symptomatic. In the LT group, hypocalcemia was seen in 13 patients, and 7 of them were symptomatic. Statistically, there was no significant difference between groups.

In many studies performed with LigaSure, similar results relevant to recurrent laryngeal nerve injury were reported. According to these results, nerve injury was seen at the same rate in LigaSure and in the conventional method (Table 3). Only in a few studies, LigaSure was reported to decrease the recurrent laryngeal nerve injury rate (3,46,47). In this study, recurrent laryngeal nerve injury was seen at the rate of 3% in the L group, at the rate of 2% in the LT group, and these results are compatible with many studies in the literature. The authors consider that LigaSure does not increase the recurrent laryngeal nerve injury rate.

Symptoms in clinical hypocalcemia recover quickly with the proper treatment, and the patient tolerance is quite good. However, even though the recurrent laryngeal nerve injury is temporary, especially if bilateral, clinical symptoms after operation are severe and significantly impair the patient's quality of life. This situation is also frustrating for many surgeons. So, the authors consider that the sensitivity to the recurrent laryngeal nerve injury in thyroidectomy is higher than that to dissection of the parathyroid glands. Due to the parathyroid glands' close proximity to the recurrent laryngeal nerve with the thyroid capsule and localization at the rate of 49% inside the thyroid, it causes parathyroid gland injury to occur more frequently (40). As long as the surgical experience increases, the ability to identify parathyroid glands and recurrent laryngeal nerves will improve, which in turn will reduce the number of complications (48,49).

There are certain limitations of the present study. Although data were collected prospectively, the study design is not prospective randomized. Therefore our results may provide an opinion for the safety of LigaSure thyroidectomy, but the scientific evidence is not as strong as that revealed by a randomized double blind trial. Furthermore, all the patients in the LigaSure group were operated by a single surgeon, and the results might be influenced by personal experience.

Conclusions

Pure LigaSure for total thyroidectomy may increase laboratory hypocalcemia rate, but not symptomatic hypocalcemia. Hemorrhage related complications were similar and with low rates in the two groups. Ligators in the places close to delicate anatomic structures did not cause longer operative times and may be a safer option in total thyroidectomy.

References