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A comparison of total thyroidectomies carried out through LigaSure and Harmonic Scalpel: a retrospective study

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Aim: Both LigaSure (LS) and Harmonic Scalpel (HS) are new surgical technologies that have been used to secure hemostasis in various fields of surgery. There is little information in the literature about the use of LS and HS in thyroid surgery. The aim of this study was to report our experience with LS and HS in thyroid surgery.

Materials and methods: In this nonrandomized retrospective study 326 consecutive patients who underwent primary thyroid surgery were reviewed. HS was used in 136 patients and LS was used in 126 patients. A conventional technique was used in 64 patients. The were 42 male patients (12.9%) and 284 female patients (87.1%); their ages varied between 19 and 72 years (mean 42.8 ± 12.4). Data regarding each patient's demographics, thyroid pathology, operation time, and complications were collected throughout the study.

Results: The 3 study groups had similar demographics (age, female/male ratio) and thyroid pathology. Permanent hypocalcemia developed in 2 (1.6%) patients in the patient group operated on through LS, of which 1 was male and the other was female. In the HS group, postoperative hematoma developed in 2 (1.5%) patients.

Conclusion: The results of this retrospective clinical study showed that LS and HS thyroidectomy can be a useful and fast alternative for conventional thyroidectomy. The main advantage of these devices is that they simplify the procedure and eliminate the need for clips and suture ligations while achieving efficient hemostasis.

Key words: Thyroidectomy, complications, LigaSure, Harmonic Scalpel

1. Introduction

Thyroidectomy is one of the most frequently performed operations in general surgery (1). With the thyroid gland's rich blood supply, a proper hemostasis in thyroid surgery becomes vital. Although conventional vessel ligation techniques, using ties and ligatures, provide reliable hemostasis, they are not favorable in terms of operation time. Shorter operation times are becoming more and more important with increasing caseloads in high-volume centers. Thus, there is a trend towards time saving techniques, with less use of conventional knot-tying or suture ligation (2,3). The thyroid gland, with numerous blood vessels and plexuses, has one of the richest blood supplies in the human body, and thyroid surgery requires meticulous devascularization of the thyroid gland. This rich blood supply renders precise hemostasis of vital importance so as to excise the gland (4). Several alternative methods, such as electrocautery, HS, LS, and laser techniques have been tried to achieve hemostasis with promising results (5,6). This retrospective case-controlled study compared the use of HS, LS, and conventional techniques carried out by one surgeon in patients who underwent total thyroidectomy.

2. Materials and methods

This study was approved by the Ethics Committee of Kafkas University in Kars and performed according to the Declaration of Helsinki, between December 2006 and February 2011. Informed consent was obtained from each patient selected for the study. Indications for operation were determined by "Management Guidelines for Patients with Thyroid Nodules and Differentiated Thyroid Cancer", which were developed by the American Thyroid Association Guidelines Taskforce in 2009. A total of 326

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patients were included in the study, who underwent total thyroidectomy performed by the same surgeon using HS (n = 136), LS (n = 126), and conventional method (n = 64) for hemostasis. There were 42 male patients (12.9%) and 284 female patients (87.1%), and their ages varied between 19 and 72 years (mean 42.8 ± 12.4). All patients were evaluated by direct or indirect laryngoscopy for recurrent laryngeal nerves (RLN) palsy preoperatively and postoperatively. Hypoparathyroidism was defined with a requirement for calcium or vitamin D administration. Hypoparathyroidism and RLN palsy were defined as permanent when there was no evidence of recovery within 6 months of follow up postoperatively. Patients whose recurrent laryngeal nerve (RLN) and/or parathyroid glands could not be identified intraoperatively were not included in the study (Table 1).

2.1. Surgery

All patients had a routine preoperative work-up and were admitted on the same morning as the scheduled operation. They received similar anesthetic and hospital care regardless of the method of hemostasis performed. All patients underwent total thyroidectomy. The surgical technique included the development of subplatysmal flaps, separation of the strap muscles at the midline, and development of lateral reflection of the thyroid gland. The inferior, middle, and superior thyroid vessels were then transected with LS or HS. After medial rotation of the thyroid gland, various vessels in the ligament of Berry were divided in both groups. During this step, every effort was made to identify and protect the recurrent laryngeal nerves (Figure 1).

The same steps were repeated for the contralateral lobe. At the same time, a minimum of 2 parathyroid glands were preserved on both sides of each lobe (Figures 2 and 3).

Finally, after irrigation of the wound, the strap muscles and the platysmal layer were approximated using continuous 3-0 polyglactin sutures. Small-bore closed-suction catheters were used and removed on the first postoperative day. The skin was closed using subcutaneous 4-0 nonabsorbable suture. Operative time was calculated by a scrub nurse, beginning with skin incision and ending with skin closure.

2.2. Pain assessment

Patients were familiarized with an 11-point visual analogue scale (VAS) for pain from 0 to 10. The patients were questioned for pain levels within the first 24 h after the operation.

Table 1. Definition of terms.

Hemorrhage/hematoma	Deep hemorrhage or hematoma that required reoperation
Persistent hypoparathyroidism	Hypoparathyroidism verified by PTH determination that has not recovered by the sixth postoperative month
Transient hypoparathyroidism	Hypoparathyroidism with verification of recovery of PTH levels within 6 postoperative months
Recurrent paralysis	Persistent paralysis of the recurrent nerve that has not recovered by the sixth month
Transient hoarseness	Transient hoarseness of voice that has not persisted beyond the sixth month of surgery

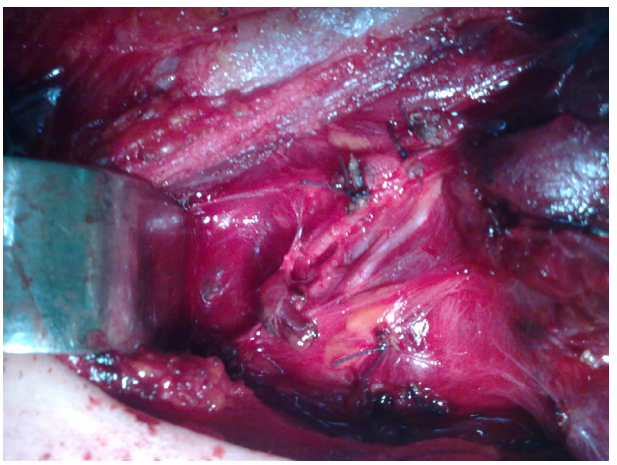

Figure 1. Identified right recurrent laryngeal nerves.

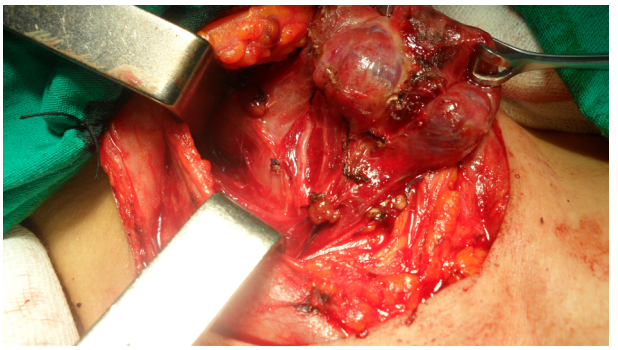

Figure 2. The superior-inferior parathyroid glands and recurrent laryngeal nerves.

Figure 3. Inferior parathyroid gland and recurrent laryngeal nerve.

2.3. Statistical analysis

The data were given as number, percentage, mean, and standard deviation. SPSS 19.0 was used for analysis of the data. Age varying with groups, the weight of the tissue excised, duration of the operation, pain in the first 24 h, the mean of VAS scores, and categorical variables were analyzed with one-way ANOVA. Transient hypocalcemia, permanent hypocalcemia, transient hoarseness, bleeding, reexploration, those operated for recurrence, those operated for illness, Graves disease, those operated in euthyroid state, and pathological results were analyzed with chi-square test (Fisher's exact test when necessary). $P < 0.05$ was considered statistically significant.

3. Results

The 3 study groups had similar demographics (age, female/male ratio) and thyroid pathology. The distributions of focal and diffuse pathologies were similar between the groups regardless of the total thyroidectomy procedure performed. Permanent hypocalcemia developed in 2 (1.6%) patients in the patient group operated on through LS. One of the patients was male and the other was female. Hoarseness developed in 1 female (0.79%) patient in the LS group and hematoma developed in 1 male (0.79%) patient in the surgical cavity. This hematoma did not require any intervention and it dissolved spontaneously. Transient hoarseness was observed in 1 female (0.79%) patient in the patient group operated on by LS. In this group of patients, the hyperthyroid situation was not ameliorated despite long-term medication in 3 patients (2.4%) before the operation. Patients with preoperative hyperthyroidism were operated on after essential measures had been taken. None of the 3 patients had any problem in the perioperative period. In 1 patient, serious tachycardia (pulse rate between 130 and 180/min) started in the 5 h after the operation had ended and lasted for about 15 h. The patient was referred to the cardiology department and 5 mg metoprolol was administered by I.V. route 4 times in this tachycardic period. However, no progress was observed in the clinical status of the patient. After 15 h of the tachycardic period, 25 mg diltiazem HCl was administered I.V. and the pulse rate decreased by 70–80/min in several minutes. In the patient group operated on by LS, 2 patients (1.6%) had Graves disease and 4 patients (3.2%) had recurrent nodular goiter. No other pathology was observed in these patients in the preoperative or postoperative period. Transient hypocalcemia was observed in 32 patients (25.4%) in the patient group operated on by LS in the postoperative period.

In the patient group operated on by HS, postoperative bleeding developed in 2 (15%) patients in the surgical cavity during the postoperative period. One of the patients was female, and the other was male. The female patient was reexplored (0.7%) and the hematoma was evacuated and the bleeding vessel was ligated. However, hematoma in the male patient spontaneously regressed. In the patient group operated on by HS, transient hoarseness was observed in 1 female (0.7%) patient. One (0.7%) patient was operated on through HS due to a recurrent nodular goiter. No pathological finding was observed in this patient in the peroperative or postoperative period. Transient hypocalcemia was observed in 6 (4.4%) patients in the patient group operated on by HS. Papillary microcarcinoma was detected in 2 (0.61%) patients operated on due to recurrent nodular goiter in the 3 patient groups. Transient hypocalcemia developed in 3 (4.7%) patients in the conventional surgery group. Postoperative results are given in Tables 2 and 3. Operation time, postoperative hypocalcemia, postoperative permanent or transient RLN palsy, postoperative bleeding, and pain scores were compared for each group.

Table 2. Operative and postoperative results.

Variable	HS group	LS group	Conventional method	P
Operation time mean ± SD	60.13 ± 12.98	60.66 ± 11.90	92.92 ± 12.12	0.000
Intraoperative complications	None	None	None	
Drainage at 24 h mean ± SD	47.45 ± 14.71	45.53 ± 10.87	48.18 ± 12.10	0.447
Transient complications				
-Hypocalcemia	6	32	3	0.000
-Laryngeal nerve palsy	1	1	-	0.781
Permanent complications				
-Laryngeal nerve palsy	-	-	-	
-Hypocalcemia	-	2	-	0.202
Postoperative bleeding	2	1	-	0.586
Reoperation	1	-	-	0.496
Pain score mean ± SD VAS at 24 h	3.5 ± 0.98	4.4 ± 0.94	2.0 ± 0.73	0.000
Thyroid volume mean ± SD	60.34 ± 72.40	67.02 ± 76.94	50.24 ± 68.91	0,050
Hospital stay, days	1.7 ± 0.65	1.8 ± 0.78	1.7 ± 0.60	0.315

VAS: Visual analogue scale

Table 3. Postoperative histopathological data in the study groups.

Pathological finding	HS group (n = 136)		LS group (n = 126)		Conventional method (n = 64)		Total	P
	Count	%	Count	%	Count	%		
Nodular hyperplasia + lymphocytic thyroiditis	42	48,3	33	37,9	12	13,8	87	0,053
Papillary carcinoma	12	35.3	9	26,5	13	38.2	34	
Multinodular goiter	74	39.2	77	40.7	38	20.1	189	
Others	8	50.0	7	43.8	1	6.2	16	
Total	136	41.7	126	38.7	64	19.6	326	

Others (follicular carcinoma, follicular adenoma, Hürthle-cell adenoma + lymphocytic thyroiditis, diffuse hyperplasia, Graves disease)

4. Discussion

The rich blood supply of the thyroid glands with its numerous blood vessels, dictates meticulous hemostasis in thyroid surgery. Hand-tied ligatures and sutures are conventional techniques used to achieve hemostasis by ligating each pole of the vessels during dissection. The last few decades have seen some other advanced methods introduced (bipolar electrocautery, lasers, clips, and staples) for hemostasis by securing vessel control. These modalities found a place in the broad practice of various surgical procedures. The exception was the thyroidectomy technique, in which, during this time, the only improvement was the utilization of monopolar electrocautery for dissection for some habitual, practical, and technical concerns. Some drawbacks exist for these alternative methods. Clips are not appropriate for large vessels and dislodgement may occur. Staplers are not versatile enough for thyroid surgery and are highly expensive. Lasers carry the risk of harm to vital structures (such as the recurrent nerves, parathyroid glands, and vascular structures) in the

surgical site, and bipolar electrocautery does not provide adequate accessibility on the margins of the thyroid gland (7–9).

The advent of ultrasonically activated shears in the early 1990s promised an alternative method for hemostasis. The conversion of ultrasonic energy to mechanical action is the physical basis for the operation of this instrument. The mechanical energy breaks down the hydrogen bonds of proteins with less heat generation, producing a glue-like substance including denaturated tissue proteoglycans and collagen fibers mixed with intracellular fluids, thus leading to less tissue damage than electrocautery (4,10).

The LS precise diathermy system is a newly introduced hemostatic system for both open and endoscopic surgical procedures that operates through permanently sealing vascular structures up to 7 mm in diameter (11–13). The HS is a newly introduced device that uses high frequency mechanical energy with the advantage of cutting and coagulating tissues simultaneously. Laparoscopic surgeons were the first to use this new technology widely. Shorter operation times and fewer complications have been shown for abdominal solid organ surgery, adrenalectomy, and thoracic surgery as well as many other procedures (14–16). We compared a total of 326 patients, 136 patients who underwent total thyroidectomy using HS, 126 patients who underwent total thyroidectomy using LS, and 64 patients who underwent thyroidectomy with the conventional method. The 3 groups had similar demographics and thyroid pathology, and had comparable rates of unilateral versus bilateral total thyroidectomy.

Ashkenazi et al. (17) reported sutureless thyroidectomy using LS, and stated that the main advantages of the LS method are reduced operation duration and the reduction of risks associated with using sutures and clips. Sandonato et al. (18) analyzed their experiences with 67 total thyroidectomies performed using LS, and noted that complications, such as transient recurrent nerve palsy and hypoparathyroidism, were significantly less frequent than they had reported in an analysis of 579 total thyroidectomy cases (19). There are possible benefits of using the HS in thyroidectomy. First, a reduction in operation time, as repetitive clip, cut, and tie routines are avoided. This also creates less need for surgical assistance. There is also a reduction in postoperative hypocalcemia, which may occur as a consequence of less injury to the parathyroids and surrounding structures through lateral dispersion of heat (20). In the present study, no significant differences were observed between HS and LS methods with regard to operation duration, total volume of intraoperative hemorrhage, duration of postoperative drain discharge, and total volume of postoperative drain discharge. On the other hand, operation times for conventional surgery were significantly longer than in the other 2 groups.

The most important difference observed between the 3 patient groups was transient and permanent hypocalcemia cases in the postoperative period, although a minimum of 2 parathyroid tissues were preserved in all patients throughout the operation. Although there were fewer patients in the patient group operated on through LS, transient hypocalcemia was observed in 32 (25.4%) patients. However, it was observed in 6 (4.4%) patients in the patient group operated on through HS. Three (4.7%) patients developed transient hypocalcemia in the conventional surgery group. This result was statistically significant. Permanent hypocalcemia was observed in 2 patients in the patient group operated on through LS, although it was not considered statistically significant. Olivier et al. detected permanent hypocalcemia in 1 patient and transient hypocalcemia in 21 patients in their series of 100 patients that were operated on through LS in their study (21). Moreover, Zarebczan et al. detected transient hypocalcemia in 12 patients in their series of 87 patients that were operated on through LS in their study (22). In contrast, Dionigi et al. reported only 1 case of permanent hypocalcemia in 92 patients who underwent HS assisted total thyroidectomy (23). In addition, according to the VAS, the level of pain was higher in the patient group operated on through LS in the first 24 h after the operation. Pain levels, which were identified by VAS, were significantly lower for the conventional surgery group than the other 2 groups. These results were associated with the fact that the LS used in the operation damaged the circulation of the surrounding tissues by spreading a much higher heat and might have caused some tissue destruction.

The results of this study revealed that newly developed surgical hemostatic devices such as LS and HS may shorten operation duration by nearly 30 min and eliminate the requirements for sutures and clips when compared with conventional total thyroidectomy. Results of the HS assisted total thyroidectomy group were parallel to those of the conventional surgery group. This proves that HS is efficient and reliable for thyroid surgery. However, the LS group had high hypocalcemia rates, which were thought to be associated with lateral thermal damage. This is a major disadvantage for LS, which is troubling for its usage in thyroid surgery. We do not recommend LS for thyroid surgery. Furthermore, both devices have disposable applicators with high costs, rendering their cost-effectiveness questionable.

Acknowledgments

This study began in Erzurum Palandöken State Hospital and continued in Erzincan University Department of General Surgery. In this process, surgeons other than the responsible authors assisted in the operations. The VAS was administered by the Department of Anesthesiology and Reanimation. The last name on the authors list contributed to the follow-up of the patients.

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