

Comparison of Postoperative Complications Using Harmonic Scalpel and LigaSure in Thyroid Surgery

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Abstract

Introduction: Thyroid surgery is the most common operation in endocrine surgery. This study aimed to compare the use of LigaSure vessel (LS) and Harmonic scalpel (HS) in 1599 total thyroid surgeries between January 2008 and December of 2022, regarding analysis of surgical complications, duration of hospital stays, and operative surgical time.

Material and Methods: In this retrospective study, patients have been categorized into two groups: Group A included 718 patients from January 2008 to May 2013 when the LigaSure vessel was used, and Group B included 881 patients from June 2013 to December 2022 when Harmonic scalpel was used. A summary of the total number of postoperative complications cases, surgical time, and the duration of hospital stay between the two groups is presented.

Results: There was no significant difference in the sex, age, and mean operating time between the two groups ($P > 0.05$). Either major bleeding or wound infection occurred in 4 (0.6%) or 14 (1.9%) of the patients undergoing thyroidectomy when LS was used compared to 4 (0.5%) or 15 (1.7%) of the patients undergoing thyroid surgery when HS was used ($P > 0.05$ and $P > 0.05$, respectively). In addition, either hypoparathyroidism or temporary recurrent laryngeal nerve palsy was observed in 91 (12.7%) or 39 (5.4%) of the Group A patients compared with 98 (11.1%) or 44 (5%) of the Group B patients ($P > 0.05$ and $P > 0.05$, respectively).

Conclusion: The current study demonstrates that thyroidectomy can be safely performed with both devices without increasing the risk of complications.

Keywords: complications, device, LigaSure, thyroidectomy, UltraCision

Introduction

The thyroid gland, consisting of two connected lobes, is one of the most prominent endocrine glands in the human body, weighing 20 to 30 g in adults. Thyroid lesions are often found

in the gland, with a 4% to 7% prevalence. Most of them are asymptomatic, and thyroid hormone secretion remains normal. The majority of thyroid lesions are non-cancerous. Benign lesions include simple or hemorrhagic cysts, colloid nodules, and thyroid adenomas. Thyroidectomy is the surgical procedure during which a part or the whole of the thyroid gland is removed. This procedure is performed due to numerous benign and malignant conditions. Indications for performing a thyroidectomy include thyroid nodules, hyperthyroidism – Graves' disease, obstructive or substernal goiter, differentiated (papillary or follicular) thyroid cancer, medullary and anaplastic thyroid cancer [1]. The extent of resection depends on the underlying thyroid condition. The types of thyroidectomy performed worldwide are total, near-total thyroidectomy, and the ipsilateral lobectomy with or without isthmusectomy.

Specifically, for hyperthyroidism – Graves' disease, the treatment options include antithyroid drugs, radioiodine,

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or surgery, all of which are equally effective in normalizing serum thyroid hormone levels within six weeks [2]. Surgery is the indicated option for a) patients with Graves' ophthalmopathy, b) patients with very large goiters (> 80gr) requiring multiple doses of radioiodine therapy and those causing airway obstruction or dysphagia, c) patients who have persistent hyperthyroidism despite treatment with antithyroid medication and radioiodine and d) patients who have a nonfunctional thyroid nodule with indeterminate, suspicious or positive cytology on FNA.

Graves' disease and toxic multinodular goiter require total or near-total thyroidectomy [3, 4]. For patients with toxic adenoma, ipsilateral lobectomy with or without isthmusectomy is adequate. In the case of a coexisting toxic adenoma and a nonfunctional nodule in the contralateral lobe, total thyroidectomy is the operation of choice; for patients with nontoxic, nonobstructive goiters with characteristics of continuous growth or potential obstructive symptoms, surgery is the most successful therapeutic option. Likewise, nodules within the goiter that are malignant or suspicious of malignancy on FNA require surgery.

For these cases, total or near-total thyroidectomy is preferred over subtotal thyroidectomy [5]. For patients with differentiated thyroid cancer (papillary or follicular), the primary therapy is surgery. The operations of choice are total or near total thyroidectomy [6, 7]. Although for patients with low-risk differentiated thyroid cancers confined within the gland, lobectomy with isthmusectomy is an acceptable alternative to total thyroidectomy [8]. Therapeutic lymph node dissection should be performed if there is clinical evidence (physical examination, U/S, CT scan) of central (level VI) or lateral (levels II, III, IV) node metastases due to the risk of neck recurrence [9]. Patients with medullary thyroid cancer should be treated radically with total thyroidectomy and central lymph node dissection. These patients have an increased risk of multifocal or bilateral disease [10], but there is no need for lateral dissection without evidence of lateral lymph node involvement. Anaplastic thyroid cancers are undifferentiated tumors with highly aggressive behavior. For resectable non-metastatic tumors, the treatment includes total thyroidectomy combined with chemotherapy and radiation.

Complications after thyroid surgery include wound seroma, hematoma (1,2%), hypocalcemia due to hypoparathyroidism (8,3% transient and 1,7% permanent), injury to the external branch of superior laryngeal nerve results in vocal fatigue and weakness (3,7%), recurrent laryngeal nerve injury with vocal cord paresis (3,4%)-although bilateral vocal cord paralysis from injury of both RLNs is a rare complication (0,4%)- and dysphagia (1,4%). Tracheal injury, esophageal injury, Horner syndrome, and chyle leak are also rare complications. Specifically, chyle leak occurs most often during lateral lymph node dissection for thyroid cancer because of thoracic duct injury [11]. This study aimed to compare the use of LigaSure vessel (LS) and Harmonic scalpel (HS) in 1599 thyroidectomies between January 2008 and December 2022, with the main

points of consideration being complications associated with surgical bleeding, hypoparathyroidism, infection, temporary recurrent laryngeal nerve palsy.

Material and Methods

All patient details of patients undergoing thyroid surgery in the Department of Surgery, General University Hospital of Patras, between January 2008 and December 2022, were retrieved and analyzed retrospectively. The patients have been categorized into two groups: Group A included 718 patients from January 2008 to May 2013 when LigaSure was used, and Group B included 881 patients from June 2013 to December 2022 when Harmonic Scalpel was used. The total number of postoperative bleeding, hypoparathyroidism, infection, and temporary recurrent laryngeal nerve palsy cases between the two groups was compared. A total of 1599 patients who underwent thyroidectomy between January 2008 and December 2022 were included in the study. Patients with a history of intake of anticoagulant agents and patients with impairment of coagulation tests were excluded from the study. Also, all patients who underwent near-total thyroidectomy or thyroid lobectomy were excluded from the final analysis. Student's t-test for normally distributed variables, Mann – Whitney U test for skewed variables, and Fisher's exact tests were used to compare results between groups. A $p < 0.05$ was considered statistically significant.

Results

A total of 718 thyroid operations were performed between January 2008 and May 2013. There were 214 males and 504 females with a mean age of 52 (range 14–85) years presented in Table 1. All patients underwent thyroidectomy using LigaSure small jaw open sealer, the device used in the Department of Surgery of the University Hospital of Patras. After May 2013, a total of 881 thyroidectomies were performed. There were 300 males and 581 females with a mean age of 54 (range 15–82) years.

UltraCision CD 14C Harmonic Scalpel has been used in thyroid operations since May 2013. Of these 718 patients, 664 (92.5%) from Group A had Multinodular Goiter, while Graves' disease was diagnosed in eight (1.11%) patients. Thyroid cancer was identified in 44 (6.13%) patients from Group A. There was no significant difference in the sex, age, and mean operating time between the two groups ($P > 0.05$). Either major bleeding or wound infection occurred in 4 (0.6%) or 14 (1.9%) of the patients undergoing thyroidectomy when LS was used compared to 4 (0.5%) or 15 (1.7%) of the patients undergoing thyroid surgery when HS was used ($P > 0.05$ and $P > 0.05$, respectively). In addition, either hypoparathyroidism or temporary recurrent laryngeal nerve palsy was observed in 91 (12.7%) or 39 (5.4%) of the Group A patients compared with 98 (11.1%) or 44 (5%) of the Group B patients ($P > 0.05$ and $P > 0.05$,

Variable	Major bleeding			Infection			Hypoparathyroidism			TRLN		
	Group A	Group B	p	Group A	Group B	p	Group A	Group B	p	Group A	Group B	p
No of patients	4	4	>0.05	14	15	>0.05	91	98	>0.05	39	44	NS
Males/Females (No)	0/4	0/4	>0.05	2/12	2/13	>0.05	12/79	15/83	>0.05	5/34	7/37	NS
Mean(range) age (Years)	48,7(14-84)	51,1(16-81)	>0.05	43,1(19-78)	42,4(15-82)	>0.05	52(17-75)	52(17-78)	>0.05	48,1(14-84)	48,6(14-84)	NS
Mean±SD operative time (min)	87.9±8	86.8±14.2	>0.05	98.4±15.4	99.1±12	>0.05	87.9±10	87.8±13	>0.05	76.8±14.2	75.8±14	NS
Mean±SD hospitalization (days)	2.1±3.2	2.3±3.6	>0.05	2.6±3.9	2.4±3.6	>0.05	2,5±3.1	2,6±3.5	>0.05	2.3±3	2.2±2.8	NS

Group A, Ligature Group; Group B, Ultracision Group; TRLN, temporary recurrent laryngeal nerve palsy; NS, not significant

Table 1. Patients' demographic data and postoperative complications

respectively). The total postoperative bleeding cases and the hypoparathyroidism, infection, and temporary recurrent laryngeal nerve palsy cases are presented in Table 1.

Discussion

The major drawback of thyroidectomy, like in every surgery, is the risk of complications. The most common complications are postoperative hematoma, seroma formation, injury or damage of the recurrent laryngeal nerve, hypoparathyroidism, and impending hypocalcemia. Surgeons, in their attempt to remove all the thyroid tissue during total thyroidectomy, usually come very close to the recurrent laryngeal nerves and the parathyroid glands, with impending impairments of these anatomical structures being possible. Such damages lead to vocal cord paralysis (temporary or permanent) and hypoparathyroidism – hypocalcemia, respectively. It is characteristic that according to *Padur's* article, the proportions of these complications for total thyroidectomy are much higher than in any other type of thyroidectomy [5].

The bilateral injury of RLN emerged in 0,5% to 5% and leads to airway obstruction due to the immobility of vocal cords and the closure of the glottis. Thus, securing the airway can be highly essential.

On the contrary, unilateral vocal cord paralysis is responsible for dysphonia and, on many occasions, for aspiration of food and drink into the trachea. In general, 2-12% of the patients who undergo total thyroidectomy show permanent hypoparathyroidism after surgery, while the incidence of transient hypoparathyroidism between total thyroidectomy and near-total thyroidectomy is 26% and 9,8 %, respectively.

However, it is noteworthy that *Makay* mentions in his article that if two parathyroids are identified and saved, it

is enough to avoid permanent hypoparathyroidism after thyroidectomy [2-15]. The parathyroid glands are crucial for calcium-level homeostasis; hence, their excision or devascularization is responsible for hypoparathyroidism, while imminent temporary or permanent hypocalcemia is also expected.

On the other hand, total thyroidectomy provides a definite cure for the disease and reduces the likelihood of recurrence in the future more than any other technique. The new technological aids, such as intraoperative nerve monitoring magnified glasses and visualization of the recurrent nerve during surgery, have rendered total thyroidectomy safe and reliable for a skilled and experienced thyroid/parathyroid surgeon [2-3]. Subtotal thyroidectomy was chosen in the early 20th due to the low complication rate and the reduced need for postoperative hormone replacement therapy. However, recurrence can potentially be revealed with a proportion of up to 43% after subtotal thyroidectomy, and hence, through the years, its use has not been suggested [2]. Finally, postoperative hematoma is a rare complication that occurs in 0,1% to 1% of cases. Due to the significant blood supply of the thyroid gland, the possibility of bleeding is high and can be severe and life-threatening. The most common manifestations are skin swelling, neck pain, ecchymosis, and airway obstruction, primarily if the hematoma extends under the strap muscles. We should never forget that immediate drainage is required to treat this complication [16-17].

To summarize, the safety of the thyroidectomy is a significant concern for both patients and doctors. Thus, we must be careful in the patients' preoperative, intraoperative, and postoperative course to avoid or treat each possible complication. Careful hemostasis is a priority for thyroid surgeons to avoid possible complications [7]. Hemostasis can be achieved with classic methods such as tie and clamp, electrocautery, clips or glue of fibrin, and thermal

hemostatic devices [8, 9]. The ultrasound-based Harmonic Focus scalpel (Ethicon, Cincinnati, OH) and the LigaSure Precise Vessel Sealing System (Medtronic, Minneapolis, MN) are the most commonly used hemostatic tools [10]. The Focus Harmonic scalpel uses ultrasound vibration of a blade at 55 Hz over a distance of 80 micrometers. The resulting mechanical energy is transferred to tissue proteins. Protein denaturation results in a coagulum that seals the vessels and assures hemostasis [11].

The LigaSure Precise Vessel Sealing System is a bipolar coagulation device that denatures the collagen and elastin of the vascular wall. Studies have compared conventional knot tying to either the LigaSure device or the Harmonic scalpel in total thyroidectomy, but few have compared both devices.

The significant advantage of this study is its sample size of 1599 patients, making it the largest of its kind in the current literature; however, the fact that it is a retrospective study, drawing data from a single institution, constitutes its main weak point. However, since most studies have not detected any discrepancy between the achievement of hemostasis when using the Ligature or UltraCision devices in hemostasis, further analysis is warranted. Study limitations were surgeons' experience in the University Hospital of Patras and the small number of postoperative bleeding cases.

Conclusion

In conclusion, the current study demonstrates that thyroidectomy can be safely performed with both devices without increasing the risk of complications. The postoperative morbidity was not affected. The results of the present study may be helpful for high-volume centers performing numerous thyroidectomies every day.

Conflicts of interest: There are no conflicts of interest.

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