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A Comparison of the LigaSure and Harmonic Scalpel in Thyroid Surgery: A Single Institution Review:

LigaSure and Harmonic Scalpel in Thyroid Surgery

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Abstract

Background—Over the last few years many surgeons have begun to utilize the LigaSure device or Harmonic scalpel to perform thyroid surgery. Several papers have demonstrated the benefits of these devices over traditional hand-tying techniques. The purpose of this study was to examine our institution's experience with the LigaSure device and Harmonic scalpel during thyroid surgery and to compare mean operative times and complications associated with each device.

Methods—A retrospective chart review was performed on all patients who underwent thyroid surgery using either the LigaSure device or Harmonic scalpel at a single institution between December 2005 and August 2009. Charts were reviewed for patient demographics, mean operative time, length of stay, and complications such as transient recurrent laryngeal nerve injury, hypocalcemia, and hematoma formation.

Results—Two hundred and thirty-one patients were included in the study, of whom 123 underwent total thyroidectomy and 108 underwent lobectomy. There was a significant decrease in the operative time for both thyroidectomies and lobectomies when the Harmonic scalpel was utilized. In regard to complications, there was no statistically significant difference in the number of transient and permanent recurrent laryngeal nerve injuries, percentage of patients developing hypocalcemia, or in the rate of hematoma development.

Conclusion—In this study, there was no difference in the rate of complications between the two devices. However, the use of the Harmonic scalpel significantly decreased operative time for both thyroidectomies and thyroid lobectomies when compared to the LigaSure device.

INTRODUCTION

One of the first accounts of thyroid surgery was published in the 12th century, but up until the 1800s morbidity and mortality were extremely high and it was not routinely performed [1]. In the 19th century with the advent of anesthesia and use of antiseptics, renowned surgeons such as Theodor Billroth were reporting mortality rates of 8% [1]. As mortality rates improved, the complications associated with thyroid surgery, such as recurrent laryngeal nerve injury and hypocalcemia became more apparent. As surgical technique and technology have advanced, complication rates are reported to be between 5-15% for transient hypocalcemia and recurrent laryngeal nerve injury [2,3]. The rate of both permanent paralysis of the recurrent laryngeal nerve and hypocalcemia is reported to be as

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low as 1% or less [4,5]. Rates of complications in thyroid surgery have improved greatly, in part to new technologies that have been invented to decrease morbidity further. Two such devices, the LigaSure and the Harmonic scalpel have been designed to allow a surgeon to attain better hemostasis and a safe dissection while performing an operation, and are both frequently utilized in thyroid surgery.

Most studies comparing the LigaSure to Harmonic scalpel have been done on patients undergoing abdominal surgeries, such as hysterectomies, laparoscopic splenectomies, and laparoscopic colectomies [6,7]. Studies have compared conventional knot tying to either the LigaSure device or Harmonic scalpel in total thyroidectomy, but few have done a comparison of both devices [8-14]. Therefore, we chose to examine our institution's experience with the LigaSure and Harmonic scalpel during total thyroidectomy and lobectomy.

METHODS

A retrospective review was done of all patients undergoing total thyroidectomy or lobectomy by one endocrine surgeon, Herbert Chen, MD, at a single institution. Patient information was collected from a prospectively maintained database. Analysis began with patients operated on in December of 2005 until August 2009. Only patients who underwent total/near total thyroidectomy or lobectomy with utilization of either the LigaSure Precise (Valleylab, Boulder, CO) or the Harmonic Scalpel Focus (Ethicon Endo-Surgery, Cincinnati, OH) were included in the study.

Patient charts were then reviewed for demographic data, mean operative time, length of stay, pathologic diagnosis, and complications of thyroid surgery such as recurrent laryngeal nerve injury, hematoma formation, and hypocalcemia. Statistical analysis was carried out utilizing unpaired t-tests and Fisher's exact test to determine significant differences with a two-sided p-value of <0.05. Analyses were performed using SPSS, version 17.

RESULTS

A total of 231 adult patients with no prior history of neck surgery or radiation, undergoing only thyroid surgery at the time of operation were included in the final study. Of the total number of patients, 123 underwent a total thyroidectomy and 108 had a thyroid lobectomy (Figure 1).

There was no difference in the gender distribution of patients undergoing thyroid lobectomy with the LigaSure when compared to the Harmonic scalpel group (Table 1). Similarly, a comparable percentage of women and men underwent total thyroidectomy with either the LigaSure device or Harmonic scalpel. Patients undergoing thyroid lobectomy with the LigaSure device were similar in age to those undergoing the procedure with the Harmonic scalpel (54 ± 15 vs. 51 ± 14 years of age, $p=0.893$). Patients who had a total thyroidectomy with the LigaSure device were older than those in which the Harmonic scalpel was utilized (49 ± 15 vs. 42 ± 14 years of age, $p=0.026$). The weight of the thyroid lobes and glands removed by the LigaSure device was similar to those removed with the Harmonic scalpel. There was also no difference in the percentage of patients who had a diagnosis of thyroid cancer on final pathology in the two groups.

When complication rates were examined there was no difference in the percentage of patients who experienced transient hoarseness or recurrent laryngeal nerve injury when operated on with the LigaSure device compared to the Harmonic scalpel (Table 2). This was true for both patients undergoing thyroid lobectomies and total thyroidectomies. On follow-up no patients undergoing thyroid lobectomy experienced permanent recurrent laryngeal

nerve injury. One patient undergoing a total thyroidectomy with the LigaSure device had permanent paralysis of the right recurrent laryngeal nerve requiring intervention by otolaryngology. The rate of transient hypocalcemia was also no different between the two devices, with 14% of patients undergoing a total thyroidectomy with utilization of the LigaSure experiencing a drop in their calcium levels compared to 8% of patients in which the Harmonic scalpel was used ($p=0.55$). Of the patients experiencing a transient drop in their calcium and parathyroid hormone levels, none developed permanent hypocalcemia. No patients undergoing thyroid lobectomy experienced a clinically relevant post-operative hematoma. In contrast, 2 (2%) patients undergoing a total thyroidectomy with the LigaSure experienced a post-operative hematoma, one necessitating re-admission with observation and the other needing re-operation. Although no patients who had a total thyroidectomy with the Harmonic scalpel developed hematomas, the difference was not statistically significant ($p=1.00$).

There was a significant difference in time in the operating room for both lobectomies and total thyroidectomies depending on the instrument utilized in the case (Table 3). On average a thyroid lobectomy with the LigaSure device took 42 ± 15 minutes compared to 35 ± 11 minutes with the Harmonic scalpel ($p=0.009$). Similarly, total thyroidectomy time was reduced by utilization of the Harmonic scalpel from 74 ± 17 minutes to 59 ± 11 minutes ($p<0.001$).

The length of stay for thyroid lobectomies was no different when the LigaSure device was used compared to the Harmonic scalpel (Table 3). In contrast, for total thyroidectomies, the length of stay was significantly increased for those patients in whom the LigaSure was used (1.1 ± 0.4 days vs. 0.9 ± 0.2 days, $p=0.039$).

DISCUSSION

The LigaSure vessel sealing device utilizes both electrical energy and pressure to liquefy and reform the collagen and elastin in vessel walls and tissue up to 7mm in diameter to provide hemostasis [15]. The device has incorporated feedback control that automatically stops further energy transmission once a seal has been achieved. In contrast, the Harmonic scalpel uses ultrasound technology to denature proteins in vessel walls and tissues up to 5mm thick leading to coagulation [16]. Unlike the LigaSure, the Harmonic scalpel is also able to cut through tissue as it coagulates.

Both the LigaSure device and Harmonic scalpel have been demonstrated to be safe in numerous papers [17-20]. One of the first published studies illustrating the safety of the LigaSure device was in 2002 in a laparoscopic splenectomy [11]. The study demonstrated the increased safety of the operation when compared to those done using conventional knot tying techniques. Similarly, multiple studies of the Harmonic scalpel have shown it to be safe and to minimize blood loss in various surgeries such as vaginal hysterectomies and laparoscopic nephrectomies [13,14].

Sandonato and colleagues were the first to describe their experience utilizing the LigaSure device in thyroidectomies in 2003 [12]. They reported a decrease in complications of transient recurrent laryngeal nerve injury and hypoparathyroidism when compared to standard knot tying techniques. A year earlier studies were published showing a similar safety profile for the Harmonic scalpel when used in thyroid surgery [8,13]. Since those first trials were published numerous studies have corroborated the safety profiles of both devices in thyroidectomy, including a retrospective review directly comparing the LigaSure and Harmonic. In this study, researchers found no difference in the rate of complications between the two devices and the most frequent complication was mild hypocalcemia

occurring in 6.7% of patients [14]. This is similar to our findings, with no difference in the rate of transient hoarseness, permanent recurrent laryngeal nerve injury, transient hypocalcemia, and hematoma formation between the two devices when used in total thyroidectomy. We also demonstrated low rates of complications with use of the LigaSure device and Harmonic scalpel in thyroid lobectomies.

Numerous studies have shown a decrease in operative time between either device and conventional knot tying [7,8,9,21]. When comparing the two devices to one another, researchers found a significant decrease in operative time when the Harmonic scalpel was used [18]. Our study concurs with these findings in patients undergoing total thyroidectomy, with an average decrease in operative time of 15 minutes. We found similar findings in operative time for patients undergoing thyroid lobectomy, with cases in which the LigaSure was used taking 7 minutes longer on average. We also illustrated a decrease in length of hospital stay for patients undergoing total thyroidectomy with the Harmonic scalpel. Our results demonstrate a statistically significant decrease in operative time and length of stay for patient's undergoing thyroid surgery with utilization of the Harmonic scalpel, but we do not know how this equates to cost analysis. A 2005 study, compared the LigaSure device and Harmonic scalpel to conventional electrosurgery in laparoscopic colectomies and found a decrease in operative time with both the LigaSure and Harmonic scalpel, but no difference in operative costs between the three groups [22]. Although there is a significant decrease in operative time seen, the cost advantage is likely negated by the cost of the devices themselves. We did not do a cost analysis as part of our project and therefore can only speculate that the decreases in operative time and length of stay with the Harmonic scalpel may confer an overall cost benefit when compared to the LigaSure by allowing a surgeon to perform more surgeries in one day and decreasing hospital costs.

This study is limited in that it is a retrospective review from a single institution, but it is the largest study of its kind with over 200 patients. It is also the only study to compare the LigaSure device and Harmonic scalpel in both total thyroidectomies and thyroid lobectomies. From this study we conclude that both the LigaSure device and Harmonic scalpel are safe to use in both thyroidectomies and lobectomies with no difference in complications between the two devices. The Harmonic scalpel does significantly decrease operative time as well as length of hospital stay when compared to the LigaSure device.

SYNOPSIS

A single institution review of the LigaSure device and Harmonic scalpel in thyroid surgery was performed. There were no differences in complication rates between the two devices, but operative time was significantly decreased with use of the Harmonic scalpel.

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Figure 1. Surgical groups

Two hundred and thirty-one patients underwent thyroid surgery by a single surgeon at an academic institution. One hundred and twenty-three patients underwent a total thyroidectomy, 87 with the LigaSure and 36 with the Harmonic scalpel. One hundred and eight patients underwent thyroid lobectomy, 81 with the LigaSure and 27 with the Harmonic scalpel. Patients were excluded from the study for various reasons including MRND or central neck dissection, prior neck surgery, a history of neck radiation, all pediatric patients, and those patients who underwent additional surgery at the time of their thyroid procedure.

Table 1

The demographic data demonstrates that there was no difference in the gender distribution of patients undergoing thyroid lobectomy and total thyroidectomy with either the LigaSure device or Harmonic scalpel. Patients undergoing total thyroidectomy with the LigaSure were slightly older than the group in which the Harmonic scalpel was used. There was no difference in the weight of the lobes and glands removed in each group. Similarly, there was no difference in the rate of cancer diagnoses on final pathology in patients undergoing thyroid surgery with the LigaSure device when compared to the Harmonic scalpel.

DEMOGRAPHIC DATA						
	Thyroid Lobectomy			Total Thyroidectomy		
	LigaSure (n=81)	Harmonic Scalpel (n=27)	p-value	LigaSure (n=87)	Harmonic Scalpel (n=36)	p-value
% Females	62 (77%)	17 (63%)	0.21	75 (86%)	32 (89%)	0.77
Average age (years)	54±15	51±14	0.893	49±15	42±14	0.026
Weight of glands (gms)	27.4±38.3	21.2±25.7	0.439	44.7±43.1	35.5±36.5	0.209
Cancer diagnosis	8 (10%)	4 (15%)	0.49	27 (31%)	13 (36%)	0.67

There was no statistically significant difference in the percentage of patients reporting complications such as transient hoarseness, permanent recurrent laryngeal nerve (RLN) injury, transient hypocalcemia, and hematoma after undergoing thyroid lobectomy or total thyroidectomy with either the LigaSure device or the Harmonic Scalpel

Table 2

	COMPLICATIONS					
	Thyroid Lobectomy			Total Thyroidectomy		
	LigaSure (n=81)	Harmonic Scalpel (n=27)	p-value	LigaSure (n=87)	Harmonic Scalpel (n=36)	p-value
Transient hoarseness	7 (9%)	1 (4%)	0.67	5 (6%)	4 (11%)	0.45
Permanent RLN injury	0 (0%)	0 (0%)	1.00	1 (1%)	0 (0%)	1.00
Transient Hypocalcemia	NA	NA		12 (14%)	3 (8%)	0.55
Hematoma	0 (0%)	0 (0%)	1.00	2 (2%)	0 (0%)	1.00

Operating room (OR) time was significantly decreased for both thyroid lobectomies and total thyroidectomies when the Harmonic scalpel was used. There was no difference in length of stay (LOS) for patients undergoing thyroid lobectomy with either device, but those patients undergoing total thyroidectomy with the Harmonic scalpel had a significantly decreased LOS compared to the LigaSure device

OPERATIVE TIME & LENGTH OF STAY				
	Thyroid Lobectomy		Total Thyroidectomy	
	LigaSure (n=81)	Harmonic Scalpel (n=27)	p-value	
	LigaSure (n=87)	Harmonic Scalpel (n=36)		p-value
OR time (min)	42±15	35±11	0.009	59±11
LOS (days)	0.3±0.5	0.3±0.7	0.664	0.9±0.2
				<0.001
				0.039