

Comparative study of energy-based technologies in thyroidectomy: Harmonic focus, ligasure tiny jaw, and conventional techniques at a single institution

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ABSTRACT

Aim: This study aims to evaluate the exact and harmonic focus of ligature with the traditional suture ligation approach with respect to surgical problems, hospital stay, drainage volume, and time spent in the operating room during open thyroidectomy.

Materials and Methods: Between February 2018 and March 2020, 180 patients suffering from thyroid disease underwent an open total thyroidectomy at Al-Sader Medical City's general surgery department. These patients were divided into three groups at random: 60 patients were assigned to Group 1 (Ligasure precise) (LS), 60 patients to Group 2 (harmonic FOCUS) (HF), and 60 patients to Group 3 conventional (CAT).

Results: Regarding age, sex, or histological diagnosis, the three groups did not differ statistically significantly. The mean operative time for the Ligasure (LS) group was 34 minutes, while the Harmonic focus (HF) group was 38 minutes, which was less than that of the Conventional technique (CAT) group. The CAT group had a significantly larger mean drainage volume than the other 2 groups ($P < 0.001$). The three groups' postoperative hypocalcaemia levels did not differ statistically significantly. ($p = n.s.$). The HF group had a shorter mean hospital stay than the LS group, while the CAT group had the longest hospital stay ($P < 0.05$).

Conclusions: LigaSure Precise and Harmonic FOCUS are energy-based technologies that are equally safe and efficient when used for vascular dissection.

KEY WORDS: thyroidectomy, Ligasure, harmonic, conventional cautery, ligation vessels

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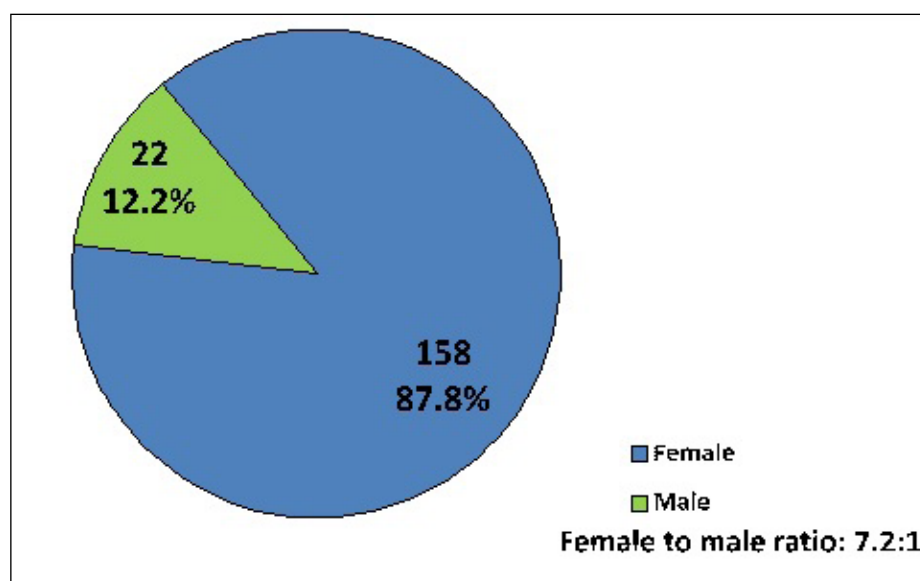
INTRODUCTION

At this time, the French Academy of Medicine prohibited thyroid surgery. Similar sentiments prevailed on the other side of the English Channel when Liston angrily said that it was "impossible to remove the thyroid gland from a living organism in a sound state without running the risk of the patient dying from bleeding." It is definitely not a procedure to be considered. [1] Even farther away, on the other side of the Atlantic, Gross criticized thyroid surgery, calling it "horrid butchery" and saying that "no honest and sensible surgeon would ever engage in it." [2] At the moment, a number of methods are used to accomplish surgical hemostasis, such as suturing and ligation (using threads, clips, and staplers), coagulation (both monopolar and bipolar electrocoagulation), ultrasonic coagulation (Ultracision, Harmonic Scalpel®; Ethicon EndoSurgery, Cincinnati, OH), and electro-migration sealing (LigaSure® Vessel Sealing System; Valleylab, Boulder, CO). Electrosurgical instruments utilise heat energy to denature proteins,

but the resulting lateral thermal dispersion can potentially damage critical structures in the surgical area. In recent years, researchers have been exploring innovative devices that minimize thermal spread to reduce operation times and decrease the likelihood of intraoperative complications. The Harmonic Scalpel FOCUS Shears System from Ethicon and the LigaSure Precise from Covidien are two prominent energy-based ligation technologies utilized in thyroid surgeries. In 2000, both the FDA in the United States and the European Medical Device Directive approved ultrasonic coagulating-dissection systems and electrothermal bipolar vascular sealing as effective methods for sealing the vasculature and tissue of the thyroid gland. [3-6] The vessel ligation technologies of these two devices are based on different principles. The Harmonic FOCUS Shears (HF) operate using mechanical vibrations, while the LigaSure Precise (LP) functions as a closed-loop bipolar device. Recent innovations in shear designs, such as the Precise® and Focus®, have been developed

Table 1. Criterion for inclusion and exclusion

Inclusion standards
Before participating in the study, the patient will complete an informed consent form.
People with multinodular goiters or thyroid cancer who are scheduled for a total thyroidectomy
Exclusion standards
Malignant aggressive cancer patients require dissection of lymph node block
individuals suffering from coagulation issues
Goiters in the cervical region prior to neck surgery
coexisting parathyroid disorders
history of neck radiation

**Fig. 1.** Gender distribution of total 180 patients of the study with female to male ratio of 7.2 to 1 ($p < 0.001$)

to enhance surgical efficiency. The safety of surgery and the impact of perioperative blood loss reduction cannot be overstated, even with a slight increase in cost [7]. This ultimately led to a lower rate of perioperative problems and a clearer understanding of the anatomy of the parathyroid gland and recurrent laryngeal nerve. [8]

AIM

This study compares LigaSure Precise and Harmonic Focus with conventional suture ligation techniques regarding operative time, hospital stay duration, drainage volume, and complications from surgery while removing the whole gland.

MATERIALS AND METHODS

Between 2019 and March 2023, open total thyroidectomies were performed on 180 consecutive patients with benign or malignant thyroid diseases at Al-Sadder Medical City's General Surgery Department and Al Furat General Hospital in Najaf. These procedures were performed by a single surgical team renowned for their

expertise in thyroid surgery. The patients were divided into three groups at random: the Ligasure (LS) group, which consisted of 60 patients who underwent the majority of the procedure using LigaSure precise; the harmonic focused (HF) group, which consisted of 60 patients who underwent the majority of the procedure using Harmonic FOCUS; and the Conventional technique group, which consisted of 60 patients who underwent the procedure using tools like the traditional clamp and tying method, absorbable ligature, bipolar diathermy, and clips (Table 1). We employed the FOCUS LigaSure precise LS (Vessel Sealing System; Valleylab, Boulder, CO, USA) and Ultracision Harmonic Scalpel (Ethicon Endo-Surgery) Level 3_5, which is the setting most frequently utilized during thyroid surgery, is selected for the generator. There are two sites on the hand-piece: a maximal site for denser tissue and a minimal site for delicate tissue. All 180 patients were blinded to the surgical procedure used and signed informed consent forms before being included in the study. Under general anesthesia and with endotracheal intubation, each patient underwent a total thyroidectomy. Every patient was positioned in a supine position with their necks

Table 2. Comparison of mean operative time among the studied groups

Statistics	Operative time (minutes)		
	Ligasure	Harmonic	Conventional
Mean	75	71	109
SD*	12	11	16
Range	50 – 90	60 – 90	90 - 150
P. values	P1: Ligasure vs. Harmonic = 0.144 (NS)		
	P1: Ligasure vs. Conventional < 0.001 (S)		
	P1: Harmonic vs. Conventional < 0.001 (S)		
	*SD: standard deviation of the mean		

Table 3. Comparison of mean Hospital stay among the studied groups

Statistics	Hospital stay (hours)		
	Ligasure	Harmonic	Conventional
Mean	29	20	35
SD*	16	4	13
Range	18 – 73	16 – 36	18 - 72
	P1: Ligasure vs. Harmonic : < 0.001 (S)		
	P1: Ligasure vs. Conventional = 0.0017(S)		
	P1: Harmonic vs. Conventional < 0.001 (S)		
	*SD: standard deviation of the mean		

outstretched, and a soft cushion was usually used to support and wrap their shoulders. A 4–6 cm incision was made across the thyroid isthmus, depending on the size of the thyroid. Due to the possibility of retraction and the difficulty in controlling hemostasis in the event of bleeding, the superior thyroid arteries were first split using LigaSure and then ligated with 0 silk suture for further safety. LigaSure was used to create subplatysmal flaps in the LS group, and the strap muscles were divided midline and laterally reflected. The duration of the procedure, the amount of fluid in the suction balloon (drainage volume) in the first 24 hours after the procedure, the length of hospital stay, and the frequency of issues (such as RLN injury and hypocalcaemia rate) were all included in the study's findings. Suction drainage was used to calculate the actual difference in loss of blood between the groups and to assess the overall amount of blood lost after the procedure; 24 hours following the treatment, the drains were withdrawn. The RLN statuses were evaluated both before and immediately following surgery using direct laryngoscopy.

RESULTS

The 180 patients' average age who were enrolled in this study was 38.3 ± 10.1 years, with a range of 20 to 70 years. In addition, there were 46 patients there were 22 patients over 50, 45 patients between 41 and

50, 67 patients between 31 and 40, and 21 patients between 21 and 30. The female-to-male ratio was 7.2 to one, and the females were significantly dominating (P value < 0.001) (Fig. 1). The average operating time for the LigaSure, harmonic, and conventional groups was 75, 71, and 109 minutes, respectively; however, the mean operating time for the conventional group was significantly longer than that of the other two groups ($P < 0.001$), but not significantly different from that of the LigaSure and harmonic groups ($P > 0.05$) (Table 2). The Ligasure group had an average drainage volume of 48 ± 13 (range: 20–70 ml), the harmonic group had an average drainage volume of 38 ± 14 (range: 10–70 ml), and the conventional group had an average drainage volume of 130 ± 39 (range: 75–200 ml). The mean drainage volume was substantially bigger in LigaSure than in the harmonic group ($P = 0.022$), but it was much smaller in the traditional group than in the other two groups ($P < 0.001$), according to the ANOVA test and repeated pairwise comparisons. As it shown in (Table 3), It was found that the harmonic group had the shortest hospital stay, with an average of 20 ± 4 hours, followed by the LigaSure group (29 ± 16) and the conventional group (35 ± 13 hours). The differences were statistically significant in all comparisons ($P < 0.05$). Regretfully, one case (1.7%) in the Harmonic group and one case (1.7%) in the LigaSure group experienced temporary RLN damage; both cases recovered after two months

DISCUSSION

The use of energy-based tools in thyroid surgery has led to the development of an experienced phrase that includes understanding the tool's mechanism of action, safety distance, activation, and lag durations as essential components for carrying out a safe procedure and avoiding damage to surrounding structures. [9]. Harmonic FOCUS treatment lowers the rate of symptomatic hypocalcemia, according to Anandaravi et al. [10], but it has no discernible effect on the incidence of recurrent laryngeal nerve palsy. Ferri et al. [11] found the same results in their similar trial, while Ciftici et al. [12] found no difference in postoperative complications between LigaSure precise, Harmonic FOCUS, and conventional technique, despite the fact that these studies noted a decrease in postoperative hypocalcaemia linked to these devices. While Cosenza et al. [13] revealed that, in comparison to the conventional group, the ligasure and harmonic groups operating times were noticeably shorter, Ciftici et al. [12] discovered that the working time was shorter in the harmonic group than the conventional group, with the ligasure group falling in between the two other groups. Our results revealed that the mean duration of surgery in the conventional group (CAT group) was significantly longer than the other two groups (LS group and HF group) ($P < 0.001$), even though the mean duration of surgery in the HF group was short-

er than the LS group ($P > 0.05$). The Harmonic Focus's lower working time is most likely a result of its special ultrasound technology, which enables simultaneous cutting and coagulation. Despite reducing the overall duration of surgery compared to traditional methods, these technologies do not demonstrate an improvement in the ratio of complications [14,15]. Numerous studies have produced contradictory findings, and prior research has not offered definitive data comparing the expenses of various novel procedures. [16,17]. The reason for this shift is that hospitals and health centers employ different target parameters to measure costs. This is particularly true in specialized centers where operating rooms are packed and longer workdays are a significant influence technologies require additional positive indicators to justify their use [18].

CONCLUSIONS

We support both the safety and effectiveness of the LigaSure Small Jaw and Harmonic Focus vessel sealing systems for routine thyroid surgery.

The real advantage of these devices in thyroid surgery is the related time savings, and less drainage volume making the application of these techniques a matter of balance between efficiency and price.

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CONFLICT OF INTEREST

The Authors declare no conflict of interest

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