

# Comparison of the Safety of Energy Based Devices (Electrotome, Harmonic and Ligasure) in Thyroid Surgery

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## Abstract

**Background:** Thyroid surgeries are one of the most commonly performed surgeries all over the world. Energy based devices have become more popular in thyroid surgery in recent years. Conventional thyroid surgery techniques (clamp and tie) had commonly used in operations over the years. This study designed to compare the effectiveness and safety of energy based devices versus conventional techniques in thyroid surgery.

**Methods:** 120 patients who underwent thyroid surgery (bilaterally total thyroidectomy, bilaterally total thyroidectomy+ santral lymph node dissection, bilaterally total thyroidectomy+ modified radically lymph node dissection) in recent last year (2017) divided into three groups. Group 1 has been identified for patients who underwent these operations with using 'Ligasure', group 2 with 'Harmonic Scalpel', and group 3 with 'electrotome'. These 3 groups compared versus conventional clamp and tie method (group 4) according to operation time, postoperation hemostasis control, postoperation (48.hour) Ca, PTH levels and peroperative maximal T.A value. Ligasure technique is named as group A, Harmonic is named as group B, electrotome is named as group C and conventional technique is group D.

**Results:** There are differences among the 4 groups in term of parameters as hospital, stay, peroperative tension levels, posoperative Ca and PTH levels, postoperative drainage except for parameter of operation time.

**Conclusion:** In our thyroid surgeries it's clear that operation time is similar between all groups, postoperative drainage and homeostasis control is less and more comfortable in group A (ligasure) according to others and the hospital stay time is shorter in group A. Postoperative Ca, PTH levels are lower in group A according to group D.

**Keywords:** Thyroid; Surgery; Comparison; Energy based devices

## Introduction

Thyroid surgeries have been one of the most commonly performed surgical operations all over the world in recent years. Thyroidectomy was first performed in late 19th century by Kocher and Billroth as a acceptable technique in thyroid surgery [1].

Thyroid surgeries needs more attention and more precision work because of thyroid gland's extensive vascular network and close relationship with important structures as parathyroid glands and superior-recurrent laryngeal nerve [2]. To avoid these important structures damage; a well hemostasis and dry area for optimal operation (clear tissue plane) is required [3]. In conventional thyroid techniques electrotomes and clamp and tie method commonly used for years. But in electrotome using; high temperatures (150-400 °C) causes thermal damage of surrounding structures. But energy based devices like Harmonic scalpel or Ligasure emits less heat (50-100 °C) than conventional techniques [4]. It has been shown that thermal injury induced by energy based devices is reduced 10-fold comparing with electrotome. Additionally operation time is reduced with energy based devices comparing with clamp and tie method [4].

## Material and Methods

120 patients who underwent thyroid surgery (bilaterally total thyroidectomy, bilaterally total thyroidectomy+ santral lymph node dissection, bilaterally total thyroidectomy+ modified radically lymph node dissection) in recent last year (2017) divided into three groups. Group 1 has been identified for patients who underwent these operations with using 'Ligasure', group 2 with 'Harmonic Scalpel', and group 3 with 'electrotome'. These 3 groups compared versus conventional clamp and tie method (group 4)

according to operation time, postoperation hemostasis control, postoperation (48.hour) Ca, PTH levels and peroperative maximal T.A value. Ligasure technique is named as group A, Harmonic is named as group B, electrotome is named as group C and conventional technique is group D. Patients underwent informed consent. This study was approved by the Clinical Research Ethics Committee of Eskisehir Osmangazi University, Medical Faculty.

## Surgical Technique

The distribution of surgical indications and histopathological examination results were papillary carcinoma, papillary microcarcinoma, thyroiditis, hashimoto thyroiditis, medullary carcinoma, hurthle cell carcinoma, follicular variant papillary carcinoma, toxic multinodular goiter, substernal goitre, hyperthyroidism and suspicious of malignancy.

All procedures were performed under endotracheal general anesthesia. Patients were placed in supine position with closed both arms. Necks and shoulders were supported by soft pads transversely allowing neck's extension. After drawing operation area, mean 4 cm collar incision was made with cautery. Platysmal flaps were raised with blunt and sharp dissections. Superior flap sutured to the chin for large exploration. Anterior thyroid veins retracted laterally with the help of retractors. Cautery was used to dissect avascular area till trachea or isthmus. Strap muscles retracted deeper after thyroid tissues exploration. Firstly superior poles ligated or clamped with energy based devices or clamp and tie method according to the study protocol. The same process exposed for inferior poles. Parathyroid.

glands were identified and protected kindly. In all of operations recurrent laryngeal nerves were identified with the help of nerve monitorisation bilaterally. And so in all operations Zuckerkandl tubercle and Berry ligament were dissected with bipolar cautery. Other small ligaments were dissected with the help of method according to the working methods. After thyroidectomy 2 minivac drains were inserted into the surgical areas and skin sutured subcuticularly.

## Statistics Analysis

Normality of continuous variables was assessed using the ShapiroWilk test. Non-normal distributions of variables were analyzed for comparison between groups with the Kruskal-Wallis test. Data are expressed as medians (25%-75%). P-values<0.05 were considered to indicate statistical significance. The statistical analyses were performed using SPSS version 21.0 (SPSS Inc., Chicago, IL, USA).

There are differences among the 4 groups in term of hospital stay (P=0.045). This difference is among ligasure-cautery groups. There are differences between the 4 groups in terms of drainage. (P<0.001). This difference is among ligasure-harmonic and ligasure-cautery groups. There are differences between the 4 groups in terms of maximum tension arterial(P<0.001). This difference is among ligasure-harmonic, ligasure-cautery, ligasure-clamp and tie and harmonic-clamp and tie groups. There are differences between the 4 groups in terms of maximum diastolic tension (P<0.001). This difference is between ligasure-cautery, ligasure-clamp and tie, harmonic cautery and harmonic-clamp and tie groups. There are differences between 4 groups according to postoperative 48. hour Ca levels. (P<0.001). This difference is between ligasure-cautery groups. There are differences between 4 groups according to postoperative 48. hour Pth levels. (P<0.001). This difference is between ligasure and clamp-tie methods (Table 1).

	Ligasure (1) median (%25-%75)	Harmonic(2) median (%25-%75)	Cautery(3) median (%25-%75)	Clamp and tie(4) median (%25-%75)	p values	Posthoc Test
Hospitalization	2.0 (1.5-3.0)	3.0 (2.0-4.0)	3.0 (2.0-4.0)	3.0 (2.0-4.0)	0.045	1-3
cc(postoperative drainage)	21.0 (14.0-2.0)	41.0 (22.3-52.3)	51.5 (24.8-53.3)	35.0 (16.8-42.0)	<0.001	1-2, 1-3
T.artériel (peroperative)	156.5 (142.8-172.5)	174.0 (155.5-85.0)	162.0 (145.8-175.3)	124.0 (112.5-146.0)	<0.001	1-2, 1-3, 1-4, 3-4, 2-4
Diastolic (peroperative)	76.5 (66.5-86.3)	84.0 (74.0-95.0)	98.5 (83.3-116.3)	98.0 (77.8-114.0)	<0.001	1-3, 1-4, 2-3, 2-4
Ca (48.h)	8.7 (7.9-9.2)	8.3 (7.7-8.7)	7.7 (7.4-9.1)	8.7 (7.7-9.4)	0.019	1-3
Pth (48.h)	7.5 (3.3-17.0)	9.0 (4.4-19.0)	15.5 (3.8-24.5)	20.5 (16.0-34.0)	0.007	1-4

**Table1:** shows the difference between the 4 groups of variables

## Discussion

Thyroidectomy surgeries have been one of the most performed elective surgeries in recent years all over the world [1]. These operations needs more attention because of thyroid gland's strategical location. As known, thyroid glands have close

neighbourhood with trachea, major vascular veins, esophagus and more importantly with parathyroid glands and recurrent laryngeal nerve [2]. To avoid these important structures injury during the thyroid operations, a good exposure of operation area is absolutely necessary. Kindly dissection and bloodless area is needed for an excellent operation. In the current study we aimed to compare the effects of using energy based devices (Harmonic Scalpel, Ligasure, Electrotome) and conventional method (clamp and tie). Energy based devices were developed in recent years for the control of bleeding in thyroid surgeries [3]. Harmonic (Ultracision; Ethicon Endosurgery, Cincinnati, OH) was developed in the early 1990s. This method works simultaneously cutting and coagulating blood vessels using mechanical vibration at a frequency of 55.5kHz. It provides less thermal damage (50-100°C) to close structures. [4] Opposite of this instrument, electrocoagulation works only for coagulating blood vessels and ligaments with a thermal damage of (150-400 °C) [5]. Ligasure Precise LF 1212 (Covidien, Boulder, CO, USA) is a bipolar thermal instrument which uses a feedback sensor system signaling the completion of coagulation [6]. All these methods and instruments have been developing and using by surgeons according to the surgeons routine practice in all thyroid surgeries all over the world.

Thyroid surgery is the most common endocrine surgery procedure. Several studies have been reported in recent years for comparing energy based devices versus conventional methods in terms of hospitalisation time and cost, blood loss, operation time, incision length and complication rates [7]. Several studies have shown that energy based devices has clear benefits in open or minimal invasive surgery [8,9]. In the current study we aimed to show our clinical performance according to comparing these methods for operation time, postoperative blood loss, peroperative T.A value and postoperative Ca, PTH values. The basis for selecting these observation indicators was to identify energy based devices if they have harmful effects on important tissues like parathyroid glands, recurrent nerve, vessels or carotid body. Although the mechanism of using energy based devices are clear in recent years we wanted to determine primarily if these devices causes injury especially for parathyroid glands due to thermal damage. The diagnosis of postoperative hypoparathyroidism can be made with both clinical and laboratory findings. In general, a slight decrease in serum calcium level may be detected in the first 24 hours after surgery. Mostly this decline does not show parathyroid dysfunction, but returns to normal after 24 hours. After thyroidectomy for thyrotoxicosis, tetanic acid due to reduced ionized calcium may occur in the first 24 hours due to symptomatic hypocalcemia caused by passing through the adjacent calcium and phosphorus bones, or due to postoperative hyperventilation and alkalosis resulting from anxiety [10]. In contrast, clinical signs and hypocalcemia due to parathyroid dysfunction occur after 48-72 hours postoperatively.

In this retrospective study we aimed to present our clinics results after thyroid surgeries. According to the statistical analysis we observed that using Ligasure device for thyroid surgeries can provide advantages for less bleeding, clean operation area and less hospitalisation time. But opposite of this we should pay attention during using energy based devices especially Ligasure and cautery for parathyroid gland injury. In our results we observed lower calcium and parathormon levels 48 hour after surgery. This low levels can suggest us these energy based device's heat injury. Peroperative blood pressure levels were higher in group B (Harmonic scalpel) according to other groups. Operation time were similar between groups in statistical analysis.

## Conclusion

In summary we found statistically significant differences in terms of parameters. Using energy based devices can offer advantages to surgeon and patient in terms of length of hospital stay, blood loss but it should not be forgotten that these devices may damage the parathyroid glands by heat effect. According to our clinics results more attention and studies should be performed for hypertensive patients in using Harmonic scalpel.

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