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Harmonic Scalpel Versus Bipolar Diathermy in Trans -areolar Thyroidectomy

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Authors' contributions

This work was carried out in collaboration between all authors. Author MSA designed the study, performed the statistical analysis and wrote the protocol. Authors HAN and AZG wrote the first draft of the manuscript. Authors AMR and SSS managed the analyses of the study. Author TMEG managed the literature searches. All authors read and approved the final manuscript.

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Review Article

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ABSTRACT

Background: Years ago the LigaSure device and Harmonic scalpel were tried in thyroid surgery. It was found to be superior to hand-tying techniques. The aim was to assess bipolar diathermy against harmonic scalpel regarding operation time, cost and complications.
Videoscopic neck surgery is developing despite the fact that only potential spaces exist in the neck. These approaches are more appealing since the size of the incision of the conventional approach seems to be out of proportion compared to the small size of the tumours.
Purpose: to assess the applicability of bipolar diathermy in transareolar thyroidectomy.
Patients and Methods: The interventions were led at Beni-suef University Hospital between January 2017 and December 2017, after the patients fitted both the inclusions and exclusions criteria. This study enrolled 30 co-operative patients aged 18-60 years with unilateral thyroid lobe nodule, nodules or diffused swelling with the largest diameter less than 4 cm. A total of 30 patients went with the transareolar thyroid lobectomy, 20 went with the harmonic scalpel and 10 with the bipolar diathermy. Thyroid nodules were less than 4-cm in their largest transverse diameter. Thyroid gland volume was less than 20-ml as estimated by US. Cranio-caudal axis of the lobes must not exceed 7-cm.

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Results: Mean operating time was 90 min (57 -135) with the harmonic scalpel while it was 105 min (70-145) minutes. No significant post-operative bleeding was seen in both groups. LOS was same in both groups. Marked reduction in the cost was reported.
Conclusion: Transareolar thyroidectomy with bipolar diathermy is associated with a marked reduction in cost compared to transareolar thyroidectomy with harmonic and this worth the long operating time.

Keywords: Harmonic; bipolar; transareolar thyroidectomy.

1. INTRODUCTION

Cervical hematomas were not seen in any patients since the harmonic scalpel was used which causes denaturation of proteins causing complete hemostasis [1]. Vessels effectively coagulate without any damage to the surrounding tissue. The 5 mm scissor grip handle connected to the Harmonic Scalpel, plays an important role in reducing the operating time length [2]. In electrosurgery, energy may be delivered through either monopolar or bipolar. In monopolar circuit current run through the human body while in a bipolar system, it is transmitted along the tissue held in the forceps [3].

Monopolar electrosurgery is most commonly applied during thyroidectomy. It is a pointed tip active electrode. The current runs from it to the patient and returns electrode back to the generator. At the entrance there is high density current while at the exit it is low [4].

In bipolar electro surgery, in contrast to monopolar the two are near to each other the entrance and exit of the current, this is safer as the energy do not go outside the forceps tips. With no return electrode, much lower voltages with lesser thermal injury and is advised to delicate, highly conductive tissue [3].

The harmonic scalpel is ultrasonically activated coagulation shears, which use high- frequency ultrasound (55KHz) to interrupt vessels of up to 5mm during thyroidectomy. The active blade vibrates longitudinally against an inactive blade, combining cutting and coagulation. It operates at a relatively low temperature (80°c) so, there is potentially less thermal damage to the surrounding tissue than any electrocautery [5].

Patients: This study was carried out in Beni-suef University Hospital between January 2017 and December 2017, after the patients fitted both the inclusions and exclusions criteria. This study enrolled 30 co-operative patients aged 18-60 years with unilateral thyroid lobe nodule, nodules or diffused swelling with the largest diameter less than 4 cm. 30 patients went with the transareolar thyroid lobectomy, 20 went with the harmonic scalpel and 10 with the bipolar diathermy thyroid nodules less than 4-cm in their largest transverse diameter. Thyroid gland volume was less than 20-ml as estimated by the US. Cranio-caudal axis of the lobes must not exceed 7-cm.

1.1 Inclusion Criteria

Thyroid nodules less than 4-cm in their largest transverse diameter. Thyroid gland volume less than 20-ml as estimated by US Cranio-caudal axis of the lobes must not exceed 7-cm. Benign thyroid lesions.

1.2 Exclusion Criteria

1.2.1 Absolute

Previous neck surgery. Multi-nodular goitre. Malignant thyroid lesions evidenced by fine needle aspiration cytology preoperatively.

1.2.2 Relative

Previous neck irradiation. Hyperthyroidism (GD or toxic adenoma). Chronic thyroiditis. Lactating females.

2. METHOD: OPERATIVE STEPS

2.1 Patient Position

All patients were prepared for Transareolar endoscopic thyroidectomy under general anaesthesia. After the patient was placed in a supine position and their legs apart, a pillow was placed beneath the shoulder to extend the head and neck. The operator stands between the patient's legs, and scope assistant stood on the right side of the patient, and the monitor was placed at the head of the patient [6].

2.2 Preparation of Operative Field

To facilitate dissection and reduce bleeding, approximately 50 ml of saline solution (including 1 ml epinephrine and 20 ml bupivacaine) was

injected into the subcutaneous layer of the anterior chest and the subplatysmal space in the neck. A 10-mm incision was made on the upper edge of the areola on the right side, (direction, at 2–4 o'clock) a 5-mm incision was made on the upper edge of the areola on the right side at 11 o'clock position, and a 5-mm incision was made on the upper edge of the areola on the left side at 11 o'clock position. After the blunt dissection, ports were inserted through each incision. Then, the flaps were dissected bluntly from the suprasternal notch untill the thyroid cartilage and laterally to the medial edge of each of the sternocleidomastoid muscles. Carbon dioxide gas was injected with a pressure of 6 to 8 mmHg. A 30-degree rigid endoscope was inserted through the 10 mm trocar on the upper edge of the right areola. The other two ports were used for the Harmonic scalpel or the bipolar diathermy on one side and for grasping the specimen on the other side [6].

2.3 Surgical Steps

Separation of the inferior pedicle: After the subplatysmal space was created with blunt and sharp dissection using a shears-type Harmonic scalpel, the strap muscles were separated at the midline with the Harmonic scalpel. Once the inferior thyroid pedicle was identified, inferior thyroid veins were coagulated 1st with the Harmonic scalpel in 20 cases and with bipolar in 10 cases to divide the lower pole of the thyroid from the upper pole of the thymus. Then the inferior thyroid pedicle was lifted and the isthmus was divided and freed from the trachea with the Harmonic scalpel in 20 cases and with bipolar in 10 cases [6].

Identification of the RLN and the parathyroid glands: A gentle traction was maintained upward, keeping the trachea and RLN in view. Image magnification permits an excellent view of the parathyroid glands, nerves, and vessels. The ITA was coagulated with the Harmonic scalpel in 20 cases and with bipolar in 10 cases. In doing so, care was taken to avoid thermal injury to the RLN by keeping the hot tip of the away [6].

Controlling the middle thyroid vein: After separation of the inferior pedicle of the thyroid gland, gentle traction on the lobe was done medially to expose the middle thyroid vein and it is coagulation with the Harmonic scalpel in 20 cases and with bipolar in 10 cases [6].

Separation of the superior pedicle: The thyroid lobe was lifted up from trachea until the superior pole was reached. Then entire lobe was retracted downward and laterally, and the superior thyroid pedicle and ligament of Berry were divided with the Harmonic scalpel in 20 cases and with bipolar in 10 cases [6].

Removal of the specimen: The removed specimen was put in an endo-bag and guided out through the 10-mm port on the left side [7]. The cavity was cleaned with a saline solution before a meticulous hemostasis was performed. The separated strap muscles were approximated at the midline using 3 or 4 interrupted absorbable braided suture. A 100-ml Hemovac was placed into the neck through the 5mm port site and removed when the amount of drain was < 15-ml per day. The skin wounds were closed with non-absorbable stitches after the tight closure of subcutis using a 4-0 absorbable multifilament [6].

3. RESULTS

Regarding the calculated cost for the use of the electro surgical.

Table 1. Comparison between operative time and cost

Mean	Transareolar with harmonic	Transareolar with bipolar
Operative time	90 minutes (57- 130)	115 minutes (85 – 155)
LOS	2 days	2 days
Drain removal	48 h	48 h
Cost	1300$	100$

4. DISCUSSION

Monopolar energy relies on electrical current flowing from the generator through the patient and returns via a grounding pad. It can be used to facilitate dissection, achieve hemostasis, and ligate small vessels. Devices such as scissors, hook cautery, or graspers can be utilised, and the energy can be set as cutting or coagulation. Similar to monopolar, above the circuit outside of the designated grounding pad. Other disadvantages to the standard monopolar energy include an increased lateral thermal spread when compared to the bipolar devices. This may be critical when dissecting in confined spaces adjacent to the critical structures such as the pelvic plexus during the anterior portion of an LAR, where thermal damage to the nerves may have long-term consequences [8].

Traditional bipolar energy still relies on using electricity to perform its function. Unlike

monopolar energy, bipolar energy does not require grounding pad, as the circuit is completed between the two instrument tips adjacent to one another. This results in a higher degree of current density at the tissue between the tips of the instrument. Advanced bipolar energy systems add in the third component of vessel sealing (along with heat and time)—compression. This allows lower voltage to be used and, hence, lower heat to complete much larger tasks. Bipolar energy is used in a variety of vessel sealing devices and delivers a much smaller lateral thermal spread footprint. This energy, combined with the increased pressure delivered by the jaws of the instrument, allows for permanent sealing of up to 7 mm vessels. The size of the vessel and thermal spread is variable depending on the instrument. Many of these instruments are shaped in a blunt-tipped, versatile fashion. The advantage of bipolar devices is that these instruments can be used to grasp, dissect, and coagulate, thereby reducing the need to change instruments [9].

Devices such as harmonic scalpel, convert electrical energy at the generator into mechanical motion at the jaw blade. Unlike monopolar and bipolar instruments, no energy flows through the patient. In fact, these instruments are more in line with surgical staplers than they are with the advanced bipolar devices. Yet, these devices can still reproducibly and reliably seal vessels ≤5 mm with minimal thermal damage, and newer models are FDA approved up to 7 mm vessels [10].

They only have one active blade that can be rotated. Depending on several factors such as the power setting at the generator, (max) or (min) activation at the device and degree of tissue tension applied by the user will all determine which end of the coagulation versus cut spectrum the device will function. These devices also have the advantage of serving multiple purposes (i.e., cut, coagulate, coapt, cavitate) and thereby eliminating the need to change instruments [11].

Surgeons who receive adequate training in endoscopic surgery can perform endoscopic neck surgery as safely as open surgery [12]. The study successfully attempted these cases after a vast experience of performing them by the open method. The chief contraindications to this endoscopic method are previous neck surgery and neck irradiation.

In traditional open thyroidectomy, ties are done to control bleeding but this is not applicable in the videoscopic neck surgery as it is time-consuming and ergonomically not accepted. Monopolar diathermy is not recommended in neck surgery even the open one. It is associated with too much local heat, and not safe enough as its effect is easily transmitted to nearby structures. This is in contrast to bipolar where its effect is limited to the points applied to it [3-4]. This is the same for harmonic; moreover, it is associated with lower heat output [13].

The mean operative time for transareolar thyroidectomy using the harmonic scalpel was 90 minutes (57- 130), while it was 115 minutes (85 – 155) using the bipolar diathermy. This difference is in favour of the uses of the harmonic scalpel. Both are safe but harmonic is safer as the control is more perfect in contrast to the bipolar in which the sticking of the burnt tissue to its blade may be associated with on table rebleeding, re control and this is the cause of operative prolongation [14].

The main criticism to transareolar thyroidectomy with the harmonic scalpel is the issue of the cost [15,16,17]. The price of the harmonic electrosurgical unite exceeds too much the price of the diathermy with bipolar option. Moreover, the cost of the disposable handle of the harmonic is extremely far from that of the reusable bipolar instrument which is more fragile and expensive than that of unipolar diathermy. Approximately it was 1300$ for harmonic vs 100$ for the bipolar.

5. CONCLUSION

Transareolar thyroidectomy with bipolar diathermy is associated with the marked reduction in cost compared to the transareolar thyroidectomy with harmonic and this worth the long operating time.

DISCLAIMER REGARDING CONSENT/ ETHICAL APPROVAL

As per university standard guideline participant consent and ethical approval has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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