ORIGINAL ARTICLE

Harmonic Scalpel Compared to Conventional Hemostasis in Thyroid Surgery

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Abstract The aim of this study was to determine whether conventional hemostasis (CH) or the harmonic scalpel (HS) results in shorter operative times for thyroidectomy and to evaluate the incidence of postoperative complications with each approach. In this study, 85 consecutive patients undergone open thyroidectomy were randomized into two groups: group CH (conventional hemostasis with classic technique of tying and knots, resorbable ligature, bipolar diathermy) and group HS (harmonic scalpel). Demographics, pathological characteristics, thyroid size, operative time, blood loss, and complications using the Student's t-test and χ^2 -test. The two groups were similar regarding age and sex. There were no intraoperative complications. There was no difference between the two techniques regarding the amount of blood loss for different procedures. No significant differences were found between the two groups concerning mean thyroid weight and mean hospital stay (2.2 days in HS vs. 3.7 in CH; P > 0.05). The mean operative time was significantly shorter in the HS group (47.2 min vs. 79.2 min; P<0.001). Two (4.7 %) transient recurrent laryngeal nerve palsies were observed in the CH group and no one (0 %) in the HS group. No patient developed permanent palsy. Postoperative transient hypocalcemia occurred more frequently in the CH group (21/43, 48 % vs. 7/42, 16 %). In patients undergoing thyroidectomy, HS is a reliable and safe tool. Comparing with CH techniques, its use reduces operative times, postoperative pain, drainage volume, and transient hypocalcemia.

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Introduction

There have been a few developments in the technical aspects of thyroid surgery since the surgical approach described by Kocher greater than a century ago [1]. Given the significant vascularity of the thyroid gland and the relatively small operative field, meticulous hemostasis has and will always be an important prerequisite for a successful outcome in thyroid surgery [2]. The mainstay for achieving hemostasis in thyroid surgery has been tying and/or clipping of blood vessels, both effective but time-consuming techniques. In the current climate of healthcare constraints and long surgical waiting lists, any methodology that can reduce operative times while maintaining acceptable complication rates warrants investigation.

The harmonic scalpel (Ethicon Endosurgery, Cincinnati, OH) was introduced into the surgeon's armamentarium almost two decades ago. Using mechanical vibrations at 55.5 kHz, this device is able to cut and coagulate tissue simultaneously. The proposed advantages of using this device over traditional electrocautery include less lateral thermal tissue injury, a lack of neuromuscular stimulation, and the avoidance of electrical energy transmission either to or through the patient [3]. Since the adoption of the harmonic scalpel (HS) into modern surgical practice, its utility for a wide variety of operations has been well documented. For example, a randomized prospective clinical trial demonstrated its ability to diminish blood loss as well as operative time for laparoscopic Nissen fundoplication [4].

Over the past decade, many reports have evaluated the utility of the HS for thyroid surgery and the majority of these studies have been carried out at European centers. The investigators have shown similar results regarding reduced operative times with its utilization, but conflicting results regarding other postoperative outcomes such as transient postoperative hypocalcemia and recurrent laryngeal nerve dysfunction (RLND). These complications are relatively uncommon and the number of cases reported in individual studies is limited. Consolidating the data may allow for elucidation of significant associations between HS utilization and postoperative complications.

The purpose of this study was to determine whether conventional hemostasis (CH) or the HS results in shorter operative times for thyroidectomy and to evaluate the incidence of postoperative complications with each approach.

Patients and Methods

Patients

Between January 2011 and December 2011, 85 patients underwent various thyroid surgical procedures performed using either the conventional knot tying (n=43) or the harmonic scalpel (n=42) for vessel control. Those patients undergoing either lobectomy or total thyroidectomy form the subject of this study for practical considerations. There were 42 patients operated on with the conventional technique (lobectomy, n=16; total thyroidectomy, n=26) and 43 with the harmonic scalpel (lobectomy, n=21; total thyroidectomy, n=22). The Ultracision CS (Ethicon EndoSurgery) was used in this study (Fig. 1).

Procedure

All patients had routine preoperative workup for their disease and the same anesthetic and hospital care regardless of the surgical technique employed. Total or near-total thyroidectomy was performed under general anesthesia and with endotracheal intubation in all cases for benign thyroid



Fig. 1 Harmonic main device



Fig. 2 Thyroid harmonic scalpel device

disease. A complete preoperative assessment (serum thyrotropin levels, ultrasonography to evaluate nodule size and gland volume, and fine-needle aspiration cytology) was obtained for all patients. A 3–7 cm skin incision (depending on the size of the thyroid) was made. Subplatysmal flaps were developed, and the strap muscles were separated in the midline and laterally reflected. The inferior, middle, and superior thyroid vessels were then divided either with the HS or with the conventional technique (Figs. 2 and 3). The same steps were repeated for removal of the contra lateral lobe. Finally, the wound was irrigated and closed using interrupted 3-0 polyglactin sutures (Vycril, Ethicon) to approximate the strap muscles and the platysmal layer. The skin was closed subcutaneously.

Outcomes of the study included operative time, fluid content in the suction balloon (drainage volume) during the first 24 h after surgery, postoperative pain, hospital stay, and incidence of complications (rate of hypocalcemia and RLN injury). Suction drainage was used to evaluate the overall amount of blood loss after the procedure and to assess the actual difference between the groups. The drains were removed 24–36 h after surgery.

In all patients, serum calcium levels were obtained during the first postoperative day and then once every 4 weeks. Patients with low calcium levels on the first postoperative



Fig. 3 Preoperative imaging



Table 1 Demographic characteristics and preoperative diagnosis in HS (Harmonic Scalpel) and CH (Conventional Hemostasis) groups

	HS group (n=42)	CH group (n=43)
Age (years)	43,6	37,4
Sex (M/F)	6/36	7/36
Preoperative diagnosis		
Simple multinodular goiter	37	36
Toxic multinodular goiter	5	7

day were asked to return the next day to have the level rechecked. Patients were given diclofenac, 1,000 mg every 8 h, for the first 24 h after surgery.

Analysis

The results were analyzed using the Student's *t*-test and χ^2 -test. A value of P < 0.05 was considered statistically significant.

Results

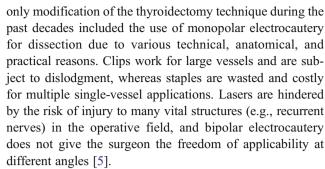
The demographic characteristics of the patients and the preoperative diagnosis are showed in Table 1. No significant difference was found between the two groups concerning mean thyroid weight and mean hospital stay (Tables 1 and 2).

The average operative time was significantly shorter in the HS group (44.9 ± 8.3 min) compared with the CH group (69.5 ± 10.7 min; P<0.001). The total drainage fluid volume was lower in the HS group than in the CH group.

Complication rate was observed in both groups. Two (4.7 %) transient RLN palsies were observed in the CH group and no one (0 %) in the HS group. Postoperative transient hypocalcemia occurred more frequently in the CH group than in the HS group. This difference was statistically significant (21/43, 48 %) in the CH group; 7/42, 16 % in the HS group) (P<0.01). All patients recovered completely and no definitive hypoparathyroidism was registered.

Discussion

Hemostasis is of utmost importance in thyroid surgery to control and divide the numerous vessels before excision of the gland. Traditional surgery involves hand-tied ligatures to control the two ends of a vessel before division. Although many sophisticated means of achieving vessel control (e.g., bipolar electrocautery, lasers, clips, and staples) found widespread applications in many other types of procedures, the



The development of ultrasonically activated coagulating shears in the early 1990s has provided an alternative to other methods of controlling blood vessels. The device divides tissue by using high-frequency (55,000 Hz) ultrasonic energy transmitted between the instrument blades. The active blade of the instrument vibrates longitudinally against an inactive blade over an excursion of 50-100 µm [6]. This mechanical action disrupts protein hydrogen bonds within the tissue. This takes place at a relatively low temperature (80 °C), causing a lesser tissue injury (<1.5 mm) compared with both electrocautery and laser. Because the water in the tissue does not boil due to this mild increase in temperature, the proteoglycans and collagen fibers in the tissue become denatured and mix with intracellular and interstitial fluids to form a gluelike substance. The primary application for the HS in the otolaryngological literature is its use for tonsillectomy and thyroidectomy. The use of the HS has also been described in excising cancer of the tongue and soft palate [7], submandibular sialoadenectomy [8], parotidectomy, treating allergic rhinitis by means of inferior turbinate alteration, and surgical treatment of rhinophyma [9]. Unlike the variable results described with the use of the HS in tonsillectomy, literature is consistent concerning the usefulness of the harmonic scalpel in thyroid surgery. Operative times are consistently lower, bleeding is insignificant, and the resulting cost containment is evident. In addition to the shorter operating time, Shemen reports the advantage of a smaller incision (4.5 cm vs. 5.5 cm) [10].

We showed that the use of the harmonic scalpel for the control of thyroid vessels during thyroid surgery is safe, and that it shortens the operative time by almost 30 min

Table 2 Operative and postoperative data in HS (Harmonic Scalpel) and CH (Conventional Hemostasis) groups

	HS group (<i>n</i> =42)	CH group (<i>n</i> =43)	p value
Operative time (mean ± SD)	44.9±8.3	69.5±10.7	P<.001
Postoperative drainage at 24 h (mean ± SD) (range), mL	37.4±2.4	56.1±4.2	<i>P</i> <.001
Hospital stay (mean ± SD), days	2.1 ± 0.9	3.2±1.3	<i>p</i> >.05, ns



compared with the conventional technique for both unilateral lobectomy and total thyroidectomy procedures despite the larger size of the thyroid removed with the harmonic scalpel.

There are possible benefits of using the harmonic in thyroidectomy—first, a reduction in operative time, as repetitive "clip, cut, and tie" routines are avoided. This also permits less need for surgical assistants. The reduction in postoperative hypocalcaemia may occur as a consequence of less injury to the parathyroids and surrounding structures through lateral dispersion of heat. Excellence in hemostasis may also permit a better view of these and other important structures to preserve when operating. However, potential increased cost and the skill required in overcoming the learning curve are possible disadvantages.

Voutilainen and Haglund [11] observed a mean advantage of 54 min with the use of the harmonic scalpel versus the use of the conventional technique in an initial matchedpair study for thyroidectomy (n=6 pairs) and lobectomy (n=1 pair). They subsequently randomized 36 patients undergoing thyroidectomy or lobectomy into ultrasonically activated shears (n=19) and conventional surgery (n=17)groups. The Voutilainen and Haglund study reported that average operating room time saving with the harmonic scalpel was 35.8 min, with no difference in complications between harmonic scalpel and traditional groups. In a French study, Meurisse et al [12] randomized 34 patients with euthyroid multinodular goiter undergoing total thyroidectomy to either ultracision or conventional hemostasis and demonstrated an average 26-minutes reduction in operating time as well as reductions in blood loss, postoperative analgesic consumption, and the incidence of transient hypothyroidism. They also reported that the use of the harmonic scalpel was no more expensive than conventional hemostasis as long as a minimum of 15 patients shared the initial unit cost of the device.

The security of vessel control obtained with ultrasonically activated shears has been demonstrated in many animal and human studies. The ultrasonically activated device has been shown to provide a mean bursting pressure of 1,204 mm Hg at 70 %, and 1,193 mm Hg at 100 % power level in small- to medium-sized intraperitoneal arteries of anesthetized living pigs—much greater than the normal intravascular pressure. In humans, the security of coapting vessels up to 6 mm with a tissue-welding technique has been demonstrated during laparoscopic splenectomy, colonic resections, and Nissen fundoplication procedures, during which bleeding is seldom seen even with division of major arteries and veins. [4]. The harmonic scalpel has also been

shown to decrease bleeding and operative time compared with the multifire clip applier for the division of the short gastric vessels during laparoscopic Nissen fundoplication in a randomized study [4].

Conclusions

In total thyroidectomy, HS is a reliable and safe tool. Its use is more effective than CH technique. The surgical operative time is shorter and the total drainage fluid volume is reduced; furthermore, the postoperative pain is less and the rate of transient hypocalcemia is lower. Both techniques are equivalent concerning RLN injuries and hospital stay.

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