Adv Ther. 2008;25(3):260–265.
DOI:10.1007/s12325-008-0024-z

Ultrasonic Harmonic Scalpel in Total Thyroidectomies

Osman Yildirim
Turan Umit
Menekse Ebru
Unal Bulent
Kocer Belma
Bozkurt Betul
Dolapci Mete
Cengiz Omer
Ankara Numune Education and Research Hospital, Ankara, Turkey

ABSTRACT

Introduction: Haemostasis is very important in thyroid surgery. In conventional surgery, electrocoagulation and suture ligation are used for haemostasis; newer techniques include vessel clips, ultrasonic instruments and lasers. The aim of this prospective study was to compare the usage of the ultrasonic harmonic scalpel (UHS) with conventional procedures, in total thyroidectomies, for operation time, blood loss, usage of drain, cost, length of hospitalisation and complications.
Methods: We examined 104 patients who underwent bilateral total thyroidectomy. They were divided randomly into two groups. Patients in Group I (n=54) underwent operations using conventional techniques (electrocautery and suture ligation) while patients in Group II (n=50) underwent operations using the UHS. Operation time, number of ligatures used, blood loss, intra-operative complications, weight of the specimen, necessity of drain, postoperative seroma, bleeding, infection, transient or permanent hypocalcaemia, permanent recurrent laryngeal nerve palsy and length of hospitalisation were recorded.
Results: The operation time was significantly longer in Group I (conventional) (105±16 minutes; mean±standard deviation) than Group II (UHS) (77.9±12.5 minutes; P<0.001). The mean blood loss was less in patients who were operated on with the UHS (25.3±10.2 g) than in patients operated on with conventional methods (59.5±33.9 g; P<0.001). The mean number

Address correspondence to: Dr Osman Yildirim,
Fatih Cad. Fatih sitesi 174/34, Kecioren, Ankara, Turkey.
Email: oyildirim99@yahoo.com

Springer Healthcare Communications

of ligatures used in the UHS group was 5.3, which was significantly fewer than the mean of 51.6 ligatures used in the conventional methods group (P<0.001). Drains were also used less in the UHS operations (12%–59%; P<0.001).

Conclusion: Use of the UHS in thyroid surgery results in decreased operation time, drain usage and amount of bleeding and does not increase postoperative complications. The UHS is an effective, reliable and less expensive technique for thyroid surgery.

Keywords: bilateral total thyroidectomy; ultrasonic harmonic scalpel

INTRODUCTION

Although nearly a century has passed after Halstead and Kocher first described thyroidectomy,[1] it has changed little until recently, and is a surgery that is performed extensively. Bilateral total thyroidectomy is performed for the majority of thyroid diseases. It has important local complications such as recurrent laryngeal nerve (RLN) palsy and hypocalcaemia.

The thyroid gland consists of many small blood vessels, each of which must be divided safely; consequently, operative procedures can take a long time to ensure these vessels are not damaged and for haemostasis to occur. In conventional surgery electrocoagulation and suture ligation have been used for haemostasis but new techniques such as vessel clips, ultrasonic instruments and lasers are now used. As haemostasis with electrocoagulation is reached at high temperatures (150°C–400°C) and its thermal effect[2,3] is at 2.5–4 mm^2, it has a risk of injuring the surrounding vital structures such as the RLN and the parathyroid.[1]

The harmonic systems consist of a generator, cord, foot pedal, hand piece and blade. Cutting and coagulation can be achieved at lower temperatures with the ultrasonic harmonic scalpel (UHS). With UHS technology, vessels are coapted and sealed at low temperatures (between 50°C and 100°C) to control bleeding by coaptive coagulation. Coagulation results from the blade vibrating at 55,500 Hz, denaturing the protein fibrinogen to form a coagulum that seals small coapted vessels. When the action is prolonged, secondary heat occurs to seal larger vessels.[1,4,5] The UHS is used in general surgery, gynaecological surgery, cardiac surgery, laparoscopic surgery, and head and neck surgery.[1,5–8]

The aim of this prospective study was to compare usage of the UHS with conventional procedures, in total thyroidectomies, for operation time, blood loss, usage of drain, cost, length of hospitalisation and postoperative complications.

MATERIALS AND METHODS

In our study we examined 104 patients operated on for bilateral total thyroidectomy in the Second General Surgery Department of Ankara Numune Education and Research Hospital between July 2006 and February 2007. Approval was obtained from the ethical committee of the hospital before initiating the study and informed consent was obtained from the patients.

Patients were evaluated with ultrasonography, fine needle aspiration cytology, thyroid function tests and with scintigraphy if necessary. After evaluation the patients diagnosed as having benign thyroid disease were included in this study and they were divided randomly into two groups. Patients in Group I (n=54) were operated on using conventional techniques (electrocautery and suture ligation) while the patients in Group II (n=50) were operated on using a UHS. All the patients' euthyroid, free triiodothyronine, free thyroxine and thyroid-stimulating hormone levels were normal.

Bilateral total thyroidectomy was performed under general anaesthesia in all cases by the same surgeon. In Group II the UHS tip used was a CS14C (Ethicon Endosurgery, Cincinnati, Ohio). This device consists of an active curved blade with a shaft 14 cm long and 5 mm wide. Each device was used for an average of 15 patients. The active blades of the device were used for tissue dissection. The branches of all vessels were coagulated and cut with this instrument. The UHS was used especially during dissection around the parathyroid glands and along the RLN. In this group, electrocoagulation was not used and as the model of UHS used cannot seal vessels with a diameter greater than 3 mm, those vessels were ligated. In Group I, suture ligation and electrocoagulation was used for haemostasis. We did not use lasers or clips in either group.

We placed a vacuum drain where large dead spaces remained after thyroidectomy or in cases where we were unsure of haemostasis. The drainage was measured and the drain was removed on postoperative day 1.

Inflammation tests (white blood cell, fibrinogen, C-reactive protein), coagulation tests, serum calcium, phosphate and total protein levels were recorded preoperatively. Vocal cord mobilities of all patients were evaluated laryngoscopically.

Operation time, number of ligatures used, blood loss, intra-operative complications, weight of the specimen and necessity of drain was noted. Blood loss was calculated from the increase in weight of the blooded gauzes.

Postoperative seroma, bleeding, infection, transient or permanent hypocalcaemia, permanent RLN palsy and length of hospitalisation were recorded. Naproxen sodium was given for analgesia and the amount of analgesic given to each patient was noted. Inflammatory response was obtained from inflammation parameters calculated on the first operative day. A cost analysis was calculated for each group.

Statistics

The statistics of this study were analysed using 10.0 SPSS (Chicago, Ill). Chi-square was used to compare the parametric data and Mann–Whitney U test was used to compare non-parametric data. A P value of less than 0.05 was accepted as statistically significant.

RESULTS

The results of our study are shown in Table 1. We did not find any difference between the two groups in pre-operative

Table 1. Results.

Parameters	Group I (conventional) (*n*=54)	Group II (UHS) (*n*=50)	*P*
Average age, years	44.89	45.16	0.924
Mean operative time (±SD), minutes	105±16	77.9±12.5	<0.001
Specimen weight, g	45.7	39.62	0.096
Mean blood loss (±SD), g	59.5±33.9	25.3±10.2	<0.001
Mean suture ligation (±SD), *n*	51.56±2.1	5.34±12.3	<0.001
White cell count, 1000 cells/mm^3	6.90	7.01	0.960
C-reactive protein, mg/l	4.32	4.22	0.889
Fibrinogen, mg/dl	285.99	300.33	0.238
Duration of hospitalisation, days	3.33	3.18	0.124
Naproxen sodium per day, mg	350	330	0.754
Drain use, *n* (%)	32 (59.3)	6 (12)	<0.001
Transient hypocalcaemia, *n* (%)	7 (13)	6 (12)	0.882
Permanent hypocalcaemia, *n* (%)	1 (1.9)	1 (2)	0.956
Permanent RLN palsy, *n* (%)	1 (1.9)	0	0.334

RLN=recurrent laryngeal nerve; SD=standard deviation; UHS=ultrasonic harmonic scalpel.

demographic and laryngoscopic data and both groups had a similar mean age (45 years). The operation time was significantly longer in Group I (105±16 minutes; mean±standard deviation) than Group II (77.9±12.5 minutes; *P*<0.001). The mean blood loss was significantly less in patients operated on with the UHS (Group II; 25.3±10.2 g) than in patients operated on with conventional methods (Group I; 59.5±33.9 g; *P*<0.001), as was the mean number of suture ligations (*P*<0.001). There was no statistically significant difference in specimen weight, pre- and postoperative phosphate, total proteins, white blood cells, C-reactive protein and fibrinogen levels (Table 1).

The two groups were similar when transient/permanent hypocalcaemia rates were compared (*P*>0.05). The mean transient hypocalcaemia rate of 13% in Group I was similar to the 12% in Group II. Permanent hypocalcaemia rate was 1.9% in Group I and 2% in Group II. Permanent RLN palsy was seen in only one patient in Group I. Drain usage was significantly less in the UHS operations (12% vs 59.3%; *P*<0.001) (Table 1).

Postoperative bleeding, seroma, infection rates, the amount of analgesics and hospitalisation time were not different between the two groups (*P*>0.05). Among all of the cases, no death was seen.

DISCUSSION

The thyroid has a rich blood supply, thus, haemostasis is very important in thyroid surgery. Electrocautery used in conventional techniques may harm the surrounding vital tissues due to high rates of lateral tissue damage. Also, the patient is subjected to electricity when electrocoagulation is used. On the other hand, UHS allows haemostasis to occur in low temperatures, lateral tissue damage is less, and electricity is not used.[1]

The main advantage of using the UHS in thyroid surgery is the reduction in operation time. In conventional methods, dissection, tying and cutting the vessels takes time. The UHS allows simultaneous dissection, cutting and coagulation so the operation time is shorter. The studies published by Siperstein et al.[9] (29 minutes), Voutilainen et al.[4] (35 minutes) and Defechereux et al.[5] (26 minutes) show that the operation time shortens with the UHS. In our study, we observed a significant reduction in operation time by 27 minutes.

Blood loss is minimal when thyroidectomy is performed by experienced surgeons. We calculated blood loss from the increase in weight of the blooded gauzes. Some authors have reported that the amount of bleeding did not differ between the two methods.[2,10,11] However, in our study the amount of bleeding was significantly less in Group II. Also Defechereux et al.[5] reported a reduction in intra-operative bleeding.

Drains were used in operations where large dead space remained after thyroidectomy or when the surgeon had concerns about haemostasis. Bleeding was less and so the space was drier in the UHS group, therefore drain usage was significantly less in the UHS group.

The major local complications of thyroidectomy are RLN palsy and hypocalcaemia. The permanent RLN paralysis range is 0%–14% in various studies. In experienced hands the rate of this complication is lower than 2%.[10] In line with previous studies, the use of a UHS did not increase the RLN palsy risk in our study.[2,8,10]

The rate of transient hypocalcaemia has been reported as 5%–15% and permanent hypocalcaemia rates have been reported as 5% in total thyroidectomies.[10] The rates of transient and permanent hypocalcaemia were 12% and 2%, respectively, in our UHS group. We believe the hypocalcaemia rates will decrease in time as our experience increases with this technique.

No difference was found when inflammation parameters and analgesic necessity was compared. Defechereux et al.[5] and Miccoli et al.[6] showed that using a UHS decreases postoperative pain. According to Defechereux, the cause of postoperative pain is hyperextension of the neck, and pain will therefore be reduced if the operation time is shorter.[5]

Operations have fixed price according to social security laws in Turkey. Operation time and hospitalisation time does not increase costs. When we calculated cost, we compared total price of all used materials used for haemostasis. Cost was US$90 in Group I for electrocoagulation +ligatures+drain and US$120 in Group II for UHS+ligatures+drain. Generator use for UHS was not added to the cost. Using every device at least 15 times reduced the cost. If the operation time and number of gauzes are included in this study, we can see the cost is similar between the two groups.

We did not evaluate length of incision and the results in thyroid surgery other than total thyroidectomy; these were limitations of our study. The cost analysis could also have been more detailed.

In conclusion, usage of the UHS in thyroid surgery decreases operation time, number of suture ligations, drain usage and amount of bleeding when it is compared to conventional methods. On the other hand there is no difference in postoperative complications or increase in cost. The UHS is an effective, reliable and less expensive technique in thyroid surgery.

REFERENCES

1. Shemen L. Thyroidectomy using the harmonic scalpel: analysis of 105 consecutive cases. *Otolaryngol Head Neck Surg.* 2002;127:284–288.

2. Karvounaris DC, Antonopoulos V, Psarras K, Sakadamis A. Efficacy and safety of ultrasonically activated shears in thyroid surgery. *Head Neck*. 2006;28:1028–1031.

3. Ata AH, Bellemore TJ, Meisel JA, Arambulo SM. Distal thermal injury from monopolar electrosurgery. *Surg Laparosc Endosc.* 1993;3:323–327.

4. Voutilainen PE, Haglund CH. Ultrasonically activated shears in thyroidectomies: a randomized trial. *Ann Surg.* 2000;231:322–328.

5. Defechereux T, Rinken F, Maweja S, Hamoir E, Meurisse M. Evaluation of the ultrasonic dissector in thyroid surgery. A prospective randomised study. *Acta Chir Belg*. 2003;103:274–277.

6. Miccoli P, Berti P, Dionigi G, D'Agostino J, Orlandini C, Donatini G. Randomized controlled trial of harmonic scalpel use during thyroidectomy. *Arch Otolaryngol Head Neck Surg.* 2006;132:1069–1073.

7. Amaral JF. Laparoscopic cholecystectomy in 200 consecutive patients using an ultrasonically activated scalpel. *Surg Laparosc Endosc.* 1995;5:255.

8. Koutsoumanis K, Koutras AS, Drimousis PG, et al. The use of a harmonic scalpel in thyroid surgery: report of a 3-year experience. *Am J Surg.* 2007;193:693–696.

9. Siperstein AE, Berber E, Morkoyun E. The use of the harmonic scalpel vs conventional knot tying for vessel ligation in thyroid surgery. *Arch Surg*. 2002;137:137–142.

10. Cordón C, Fajardo R, Ramírez J, Herrera MF. A randomized, prospective, parallel group study comparing the harmonic scalpel to electrocautery in thyroidectomy. *Surgery*. 2005;137:337–341.

11. Terris DJ, Seybt MW, Gourin CG, Chin E. Ultrasonic technology facilitates minimal access thyroid surgery. *Laryngoscope.* 2006;116:851–854.