

HARMONIC SCALPEL COMPARED TO BIPOLAR COAGULATION FOR THYROIDECTOMY

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Summary

Introduction. The basic principles of high-efficient and safe thyroid surgery were established by 1920: identification and ligation of vessels, identification and preservation of laryngeal nerves, and parathyroid glands. Bleeding remains one of the major intraoperative complications of thyroid surgery.

The aim of this study is to evaluate the benefits of the Harmonic when compared with bipolar coagulation for open thyroidectomy.

Materials and methods: We enrolled 85 patients who underwent total thyroidectomy for multinodular disease from 2019 till 2022 years. Patients were randomly assigned to either the group 1 (43 patients in which the operation was performed entirely using the Harmonic scalpel (HS) and no other haemostatic tool) or the group 2 (42 patients in which the operation was performed using classic technique of resorbable ligature, bipolar coagulation). The inclusion criteria were scheduled total thyroidectomy for multinodular goiter.

Results. There were no significant differences between two groups regarding age, gender, ASA distribution, so two groups are comparable. The mean operating time in the group 1 was 62.84 ± 0.66 (M \pm m) minutes, and that in the group 2 was 75.19 ± 0.42 (M \pm m) minutes for thyroidectomy, and there was 19.65 % (i.e. 12.35 minutes) statistically significant reduction in the operating time using the Harmonic scalpel device ($p < 0.05$). The 48 hours mean total amount of drainage was 69.05 ± 0.88 (M \pm m) ml for group 1 and 81.40 ± 0.64 (M \pm m) ml for group 2, which was statistically significant ($p < 0.05$). The rate of postoperative complications was comparable among the two groups ($p \chi^2 > 0.05$).

Conclusions. The use of Harmonic scalpel in thyroid surgery is safe and effective and is associated with a significant reduction in operative time without increasing complications rate, may also permit a better view of structures to preserve nerves, vessels of parathyroid glands and parathyroid glands when operating. Other benefits include significantly lower blood loss, efficient hemostasis and sectioning in a single instrument.

Key words: harmonic scalpel, bipolar coagulation, thyroidectomy, surgery

INTRODUCTION

Theodor Kocher and Theodor Billroth first time developed an acceptable technique of thyroid surgery between 1873 and 1883. By 1920, the basic principles of high-efficient and safe thyroid surgery were established [1]. They consist: identification and ligation of vessels, identification and preservation of laryngeal nerves, and parathyroid glands. Main surgical instruments are not significantly changed; the basic innovations are new methods of vascular section and coagulation.

In the last decade, some techniques for improving effectiveness, safety and even invasiveness of thyroidectomy have been proposed, including endoscopic and video-

assisted surgery, nerve monitoring, less invasive forms of anesthesia [2, 3].

Bleeding remains one of the major intraoperative complications of thyroid surgery.

THE AIM

The aim of this study is to evaluate the benefits of the Harmonic when compared with bipolar coagulation for open thyroidectomy.

MATERIALS AND METHODS

We enrolled 85 patients who underwent total thyroidectomy for multinodular disease from 2019 till 2022

years. Patients with malignant disease who required central or lateral lymphadenectomy, toxic disease, also intrathoracic goiter were excluded from this study.

Patients were randomly assigned to either the group 1 (43 patients in which the operation was performed entirely using the Harmonic scalpel (HS) and no other haemostatic tool) or the group 2 (42 patients in which the operation was performed using classic technique of resorbable ligature, bipolar coagulation).

The inclusion criteria were scheduled total thyroidectomy for multinodular goiter.

In all cases the total thyroidectomy was performed under general anesthesia. Serum thyrotropin levels, ultrasonography to evaluate nodule size and gland volume, and fine-needle aspiration cytology were obligatory obtained for every patient; all of patients were positioned and draped in the conventional manner. The semioval incision from 4 to 6 cm (depending on the size of the thyroid) was made over the level of the thyroid isthmus. Subplatysmal flaps were developed, 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 conventional technique. The thyroid lobe was then medially rotated, then the vessels in the ligament of Berry, with the recurrent laryngeal nerve (RLN) under direct vision, were coagulated using HS in group 1 or using bipolar device in group 2. The same steps are repeated for removal of the contra lateral lobe. The wound was irrigated, drained and closed using interrupted 3-0 polyglactin sutures

to approximate the strap muscles and the platysmal layer. The skin was sutured intradermally using atraumatic suture.

Outcomes of the study included operating time (between skin incision and the end of the wound closure), post-operative blood loss (blood loss in the suction balloon (drainage volume) during the first 48 hours after surgery), and incidence of complications (rate of hypocalcemia and RLN injury).

Both preoperative and postoperative RLN statuses were determined by indirect laryngoscopy. In each patient, serum calcium levels were obtained during the first postoperative day and then once every 3 weeks. Patients with low calcium levels were given calcium 2000 mg and vitamin D-3 4000 IU every day. Patients were given paracetamol, 1000 mg every 8 hours, for the first 24 hours after surgery.

The statistical software package was used in this study. The independent 't' test was used to compare age, operating time, post-operative blood loss. Quantitative data are presented as mean and average deviation from the mean ($M \pm m$). $p < 0.05$ was considered statistically significant. Patient distribution based on gender, ASA score distribution, postoperative complications were analysed by Chi-square test (χ^2). $p\chi^2 < 0.05$ was considered statistically significant.

RESULTS

The study included 85 patients with multinodular goiter, in which there were 69 females (81.18 %) and 16 males (18.82 %), as shown in table 1. There were 43 patients in group 1 and 43 in group 2 (table 1).

Table 1

Patient demographics and patient distribution in both groups

Variables	group 1 (n=43)	group 2 (n=42)	p-value
Age, years	40.44±1.19	41.64±1.21	0.481520
Male: female	9:34	7:35	0.253
ASA score distribution I: II: III	5:30:8	6:28:8	0.929

The age was ranging from 26 years to 57 years in group 1 and from 29 to 58 years in group 2. The mean age in group 1 was 40.44 years and that in group 2 was 41.64 years. The distribution between two groups was comparable ($p > 0.05$).

The M/S ratio was 9:34 in group 1 and 7:35 in group 2. The distribution between two groups was comparable ($p\chi^2 > 0.05$).

The ASA score distribution I: II: III in group 1 was 5:30:8, in group 2-6:28:8. The distribution between two groups was comparable ($p\chi^2 > 0.05$).

No significant differences were between two groups regarding age, gender, ASA distribution, so two groups are comparable.

The mean operating time in the group 1 was 62.84±0.66 ($M \pm m$) minutes, and that in the group 2 was 75.19±0.42 ($M \pm m$) minutes for thyroidectomy, and there

was 19.65 % (i.e. 12.35 minutes) statistically significant reduction in the operating time using the Harmonic scalpel device ($p < 0.05$) (table 2).

The 48 hours mean total amount of drainage was 69.05±0.88 ($M \pm m$) ml for group 1 and 81.40±0.64 ($M \pm m$) ml for group 2, which was statistically significant ($p < 0.05$) (table 2).

The rate of postoperative complications was comparable among the two groups ($p\chi^2 > 0.05$) (table 2).

2 cases of wound hematoma (1 in group 1 and 1 in group 2) were successfully drained under sonography control and coagulated.

No patient needed to be reoperated on for bleeding or hematoma. 15 cases of transient hypocalcaemia appeared (7 in group 1 and 8 in group 2). 3 cases of transient vocal cord palsies were observed (1 in group 1 and 2 in group 2).

Results of the study

Variables	group 1 (n=43)	group 2 (n=42)	p-value
Operating time, min	62.84±0.66	75.19±0.42	0.00
Post-operative blood loss, mls	69.05±0.88	81.40±0.64	0.00
Wound hematoma, cases	1	1	0.202
Transient hypocalcemia, cases	7	8	
Transient recurrent nerve lesion, cases	1	2	

DISCUSSION

The thyroid is a highly vascularised organ, that's why the efficient and accurate hemostasis is one of the global priorities of the thyroid surgeon to prevent or minimize possible complications. It means basically to prevent and control intra- or postoperative bleeding.

New instruments such as monopolar and bipolar electric coagulation devices were introduced over the years. All of them have demonstrated the disadvantages of thermal diffusion that could damage adjacent structures and especially the inferior laryngeal nerves. Suture ligations are also time-consuming and carry the risk of knot slipping [4, 5].

Synchronous cutting and coagulation functions of the harmonic scalpel using high frequency energy make the instrument time saving, highly effective and acceptable, and because cutting and coagulation occur at lower temperatures than does electrocautery, and thermal damage is minimal [6, 7]. It seals vessels up to 5 mm in diameter. It also offering accurate and precise surgical dissection as in the thyroid surgery with a saving of operating time. Its lateral thermal damage is limited up to 2 mm beyond the tissue grasped within the forceps of the device [8]. Thermal injury induced by ultrasound is reduced 10-fold when compared with electrocoagulation [9, 10].

M.Kilic and colleagues [6] randomly assigned eighty patients into 2 groups: in group 1 (n=40) the patients underwent thyroidectomy performed with conventional knot tying and the electrocautery technique; the harmonic scalpel was used for the procedure in patients of group 2 (n=40). In group with the harmonic scalpel technique, there was a nearly 18 % significant reduction in operating time in their study, as in our study there was a reduction in operating time up to 19.65 %.

According to Foreman and colleagues study conclusions, the operations were quicker in group with the harmonic scalpel. The mean operating time of the harmonic scalpel group was 11.29 min less (12.0 % decrease; $P = 0.0036$, unpaired t -test) following total thyroidectomy than that in the group of patients where conventional hemostatic techniques were used [11]. This parallels with our study results as already described.

The reduction in post-operative hypocalcaemia may occur as a consequence of less injury to the parathyroids and surrounding structures through lateral dispersion of heat [11, 12].

We agree with authors that excellence in haemostasis may also permit a definitely better view of these structures to preserve when operating [11, 13]. It's important.

In our study, the use of Harmonic scalpel is associated with a decrease in the post operative drainage fluid (difference was 12.35 ml), and the difference was statistically significant. In a study which was conducted in 2012, the drainage fluid at 24 and 48 hours post operatively in the Harmonic scalpel group was 40ml and 25ml respectively, where as in the knot group, it was 45ml and 30ml in the first and second days respectively [14]. However, the difference was not statistically significant (p value 0.4709). A study conducted by M.Kilic and colleagues showed a statistically significant difference in the total post operative drainage fluid ($p < 0.05$) [6].

CONCLUSIONS

The use of Harmonic scalpel in thyroid surgery is safe and effective and is associated with a significant reduction in operative time without increasing complications rate, may also permit a better view of structures to preserve nerves, vessels of parathyroid glands and parathyroid glands when operating. Other benefits include significantly lower blood loss, efficient hemostasis and sectioning in a single instrument.

COMPLIANCE WITH ETHICAL REQUIREMENTS

All patients provided written consent to participate in research in accordance with the recommendations of the Ethics Committees for Biomedical Research, Ukrainian Health Legislation and the Declaration of Helsinki of 2000, European Community Directive 86/609 On Human Participation in Biomedical Research.

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*Резюме***ЗАСТОСУВАННЯ УЛЬТРАЗВУКОВОГО СКАЛЬПЕЛЯ У ПОРІВНЯННІ З БІПОЛЯРНОЮ КОАГУЛЯЦІЄЮ В ТИРЕОІДЕКТOMІЇ****Василь Р. Антонів, Олег В. Шуляренко, Тарас М. Галига, Лариса В. Шуляренко, Владислав М. Перепадя**

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Вступ. До 1920 року були встановлені принципи безпечної та ефективної хірургії щитоподібної залози. Вони складаються з трьох основних етапів: ідентифікація та перев'язка судин, ідентифікація та збереження *pervus laryngeus recurgens* і парашитоподібних залоз. Кровотеча залишається одним із основних інтраопераційних ускладнень операцій на щитоподібній залозі.

Мета дослідження – оцінка переваг ультразвукового скальпеля у порівнянні з біполярною коагуляцією при відкритій тиреоїдектomії.

Матеріали та методи: Було включено 85 пацієнтів, які перенесли тиреоїдектomію з приводу багатовузлового зобу з 2019 по 2022 роки. Пацієнти були випадковим чином розподілені до групи 1 (43 пацієнти, у яких операція була виконана повністю за допомогою ультразвукового скальпеля без будь-якого іншого гемостатичного інструменту), або до групи 2 (42 пацієнти, у яких операція була виконана за класичною технікою із застосуванням лігатур, що розсмоктуються, та біполярної коагуляції). Критеріями включення були планова тотальна тиреоїдектomія з приводу багатовузлового зоба.

Результати. Не було достовірних відмінностей між двома групами щодо віку, статі, розподілу за шкалою ASA, тому дві групи однорідні. Середня тривалість тиреоїдектomії в групі 1 становила $62,84 \pm 0,66$ (M \pm m) хвилини, а в групі 2 – $75,19 \pm 0,42$ (M \pm m) хвилин, було виявлено на 19,65 % (тобто 12,35 хвилин) статистично значуще скорочення тривалості операції в групі, де застосовано ультразвуковий скальпель ($p < 0,05$). Середня загальна кількість виділень по дренажу за 48 годин після операції становила $69,05 \pm 0,88$ (M \pm m) мл. для групи 1 та $81,40 \pm 0,64$ (M \pm m) мл. для групи 2, що було статистично значущим ($p < 0,05$). Рівень післяопераційних ускладнень був однорідним між двома групами ($p \chi^2 > 0,05$).

Висновки. Застосування ультразвукового скальпеля в хірургії щитоподібної залози є безпечним та ефективним і пов'язане з достовірним скороченням тривалості операції без збільшення частоти ускладнень, а також забезпечує кращий візуальний контроль структур із збереженням цілісності нервів, судин парашитоподібних залоз та парашитоподібних залоз під час операції. До інших переваг відносимо достовірно меншу крововтрату, ефективний гемостаз і розсічення тканин одним інструментом.