Comparing the outcomes of total thyroidectomy using a harmonic scalpel versus the conventional ligation techniques in Iran

Aidin Yaghoobi Notash[1], Ali Momen[2], Ehsan Sadeghian[3*], Rozhina Molavi[4]

[1] *General Surgeon and Faculty Member, Tehran University of Medical Sciences, Tehran, Iran*
[2] *General Surgeon, Tehran University of Medical Sciences, Tehran, Iran*
[3] *Department of Surgery, Shariati Hospital, Tehran University of Medical Sciences, Tehran, Iran*
[4] *Central Tehran Branch, Islamic Azad University, Tehran, Iran*

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Abstract

Background: Maintaining hemostasis is considered a remarkable challenge during total thyroidectomy. The use of thermal ultrasonic electrocoagulation (harmonic scalpel) for total thyroidectomy was recently introduced to substitute the conventional ligation methods. However, controversies exist on the efficacy of this technique compared to the classic method.

Methods: The data regarding this prospective cohort study was gathered between March 2019 to March 2020. Ninety participants were enrolled in the study. Forty-five subjects received harmonic scalpel ligation and the other forty-five participants underwent conventional total thyroidectomy. Afterward, these two groups were statistically compared regarding surgical time, postoperative hypocalcemia, drainage volume, postoperative pain, hospital stay, and recurrent nerve damage.

Results: No significant difference was detected in the group undergoing harmonic ligation concerning postoperative pain, postoperative hospital stay, drainage volume, and postoperative hypocalcemia in the first 48 hours post-operation. However, using a harmonic scalpel significantly reduced the surgical time (56 ± 2 minutes in the harmonic scalpel group versus 67 ± 9 in the conventional technique group, $p < 0.001$). Also, no recurrent nerve damage was detected in the study.

Conclusions: Utilizing a harmonic scalpel has a remarkably higher time efficacy in total thyroidectomy. However, the study suggests no further advantage for this method compared to the conventional techniques in total thyroidectomy.

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Introduction

Thyroid disorders comprise a significant number of endocrine disorders, and the affected population represents the highest referrals to related surgeons. Total thyroidectomy is recognized as a common approach in numerous benign and most malignant thyroid pathologies [1].

Total thyroidectomy is considered a challenging operation due to the rich vasculature of the surgical field. This leads to a high risk of unpredicted bleedings and the presence of critical anatomical elements including the esophagus, trachea, carotid vessels, recurrent nerves, and parathyroid glands. Therefore, the development of more efficient hemostatic devices has always been a high priority [2].

In the past two decades, a vast number of technologies entering the surgical world were related to the neck field [3]. The utilization of automatic surgical devices has transformed the complications of surgery in the neck surgical field. Among these, thermal ultrasonic electrocoagulation (harmonic scalpel) has drawn significant attention for a few decades [4]. The use of a harmonic scalpel to control hemostasis was previously established to be significantly more effective than conventional methods in surgeries such as neck dissection in head and neck cancers [5]. Its utilization in thyroid surgery was first evaluated in 2010 in a study on 62 consecutive patients, indicating significantly shorter operative time, less consumption of clips and ties, and remarkably less postoperative pain and suction

*** Corresponding author**: Ehsan Sadeghian
Department of Surgery, Shariati Hospital, Tehran University of Medical Sciences, Tehran, Iran
Tel.: + 98 911 377 1046 Email: ehsan810@yahoo.com

balloon amounts [6]. In prior research, the use of ultrasonic thermal electrocoagulation has been shown to significantly reduce both operation duration and remarkable post-operation complications such as reducing the risk of developing post-operation hematomas. Moreover, no significant complications were reported [7].

Previous studies comparing the effectiveness of the harmonic scalpel with conventional total thyroidectomy have suggested operation duration, the volume of intraoperative bleeding, and the incidence of postoperative complications to be major variables among these techniques [6]. This study investigates the efficacy of the harmonic scalpel in comparison to conventional methods in total thyroidectomy regarding all the above-mentioned variables.

Method

In this prospective cohort study, we have defined the influential variables in the patient satisfaction after undergoing total thyroidectomy as gender, age, type of thyroid disorder, operation duration, accompanying hypocalcemia, drain secretion, bleeding rate, post operation pain, length of hospitalization, recurrent nerve injury and group therapy.

Prior candidates for total thyroidectomy undergoing either thermal electrocoagulation or classic technique were included in the study. Those who did not sign the informed consent or had a past medical history of any systemic disease increasing the risk of coagulating disorders were excluded from the study.

Sampling was conducted in a convenient manner. After calculating sample size based on the sample size formula while considering similar former studies and including 10% extra, 90 patients were included in the study. The data was gathered in Shariati hospital, Tehran, Iran from March 2019 to March 2020.

Patients were divided into two groups through simple randomization. One pursuing ultrasonic thermal electrocoagulation and the other underwent classic total thyroidectomy and the data were extracted through patient application forms.

The outcomes were statistically compared in two groups regarding operation duration, hypocalcemia, bleeding rate, drain secretion, post operation pain, hospitalization length, and recurrent nerve traumatization. SPSS software version 22.0 was used for conducting the statistical analysis.

Results

This study enrolled a total of 90 participants, divided into two groups: 45 candidates underwent thermal coagulation thyroidectomy, and 45 candidates underwent classic thyroidectomy. The sample population comprised seven males and 83 females. The outcomes between the two groups for given variables were statistically compared using SPSS 22.0 software.

The average operation duration and the standard deviation were calculated for each group. The independent samples t-test was used to statistically compare the results between the two groups. The application of a harmonic scalpel was shown to significantly reduce the operation duration by 11 minutes (P-value < 0.001).

Subsequently, postoperative pain was assessed based on VAS pain criteria. No significant statistical difference was detected between the two groups. The Student's t-test was applied to compare the drain secretion volume between the two groups. The results indicated a significant increase in drain secretion in the group that underwent thermal coagulation thyroidectomy (p = 0.156). These results are summarized in Table 1.

The serum calcium level in the first 24 hours post-operation was calculated twice and statistically compared using the chi-square t-test. A decrease in serum calcium levels was detected in both groups, though there was no significant variation between the

Table 1: surgical time, Post operation pain score, drain secretion volume and hospitalization duration in 2 groups

Variable	Harmonic Group	Conventional Group	P-value
Surgical time (min)	56 ± 2	67 ± 9	0.001
Post operation pain score	1.76 ± 0.98	1.69 ± 0.46	0.682
Drain Secretion Volume (cc)	10 ± 0	8.5 ± 3.4	0.006
Hospitalization duration (day)	72 ± 0	76.2 ± 20.0	0.156

Table 2: Serum Calcium level in the first 24h post operation

Serum Calcium level in the first 24h post operation	Harmonic Group	Conventional Group	P-value
First time	7.9 ± 0.19	7.8 ± 0.33	P = 0.194
Second time	7.8 ± 0.44	7.6 ± 0.76	P = 0.091

Table 3: Serum Calcium level in the second 24h post operation

Serum Calcium level in the second 24h post operation	Harmonic Group	Conventional Group	P-value
First time	8.02 ± 0.49	7.50 ± 0.48	0.001
Second time	7.68 ± 0.29	8.36 ± 0.50	0.001
Third time	7.96 ± 0.34	7.83 ± 0.55	0.178

groups (Table 2). However, in the second 24 hours post-operation, the serum calcium level was found to be significantly higher in the thermal coagulation thyroidectomy group at two out of three sampling times (Table 3).

Discussion

This study aimed to investigate the outcomes of total thyroidectomy using a harmonic scalpel compared to the conventional technique.

Operative time was previously suggested to be a significant variable between these two techniques. Earlier research indicated a significant decrease in surgical time when using a harmonic scalpel, calculating a 2.56 min/g for harmonic scalpel compared to 5.99 min/g when using the conventional method [8]. One study suggested a 20% reduction in surgical time when using an electrothermal bipolar sealing system, the harmonic scalpel [9]. A recent meta-analysis calculated a mean difference of -25.49 minutes in surgical time when using a harmonic scalpel [10]. The results of this study are congruent with previous studies regarding this variable, emphasizing the higher time-efficacy in the harmonic method (56 ± 2 minutes in the harmonic scalpel group versus 67 ± 9 in the conventional technique group, $p < 0.001$).

Moreover, drain secretion volume was significantly higher when using a harmonic scalpel. This result contradicts earlier works, which suggested a reduction in drainage volume when using a harmonic shear [11,12].

Hospitalization duration was also listed as a significant variable in related works. Some studies detected a significant reduction in the postoperative hospital stay in patients receiving harmonic scalpel ligation [13,14]. However, in this study, no significant difference was detected between the two groups concerning hospitalization duration, and all patients required an average hospital stay of three days post-operation. This variation might be related to differences in postoperative hospitalization policies in different countries [15].

Postoperative hypocalcemia is a common complication after total thyroidectomy. Considerable work has been done to determine the influential factors, though no single reason was found to be responsible for this side effect [16]. Several earlier studies showed a significant difference in the level of postoperative hypocalcemia between cases operated with a harmonic scalpel compared to those receiving classic ligation [17]. However, this study suggested no significant difference between the two groups regarding postoperative hypocalcemia, with both groups maintaining a serum calcium level of higher than 7.5 mg/dl. Future research is required to clarify these controversies.

Finally, the underlying thyroid pathology necessitating the total thyroidectomy was also investigated as a variable in several studies. Simple multinodular goiter, toxic multinodular goiter, Graves disease, and differentiated carcinoma were such instances [18]. In this study, 93% of the participants in the harmonic group had benign underlying pathology, while this number was 73% in the group undergoing conventional total thyroidectomy. Further research is required to investigate the possible effects of the primary thyroid pathology on the outcomes of each technique.

Conclusion

In conclusion, the results suggest no significant advantage in using a harmonic scalpel with respect to postoperative pain, the duration of the postoperative hospital stay, and postoperative hypocalcemia in the first 48 hours after the operation. However, this technique does present a significantly higher surgical time efficacy compared to conventional ligation techniques. Furthermore, future studies are needed to investigate these variables while matching the cases for the underlying thyroid pathology, particularly in regard to benignity or malignancy.

Conflict of interests

No conflict of interest exists in this research to be declared.

References

1. Padur AA, Kumar N, Guru A, Badagabettu SN, Shanthakumar SR, Virupakshamurthy MB, Patil J. Safety and Effectiveness of Total Thyroidectomy and

Its Comparison with Subtotal Thyroidectomy and Other Thyroid Surgeries: A Systematic Review. J Thyroid Res. 2016. https://doi.org/10.1155/2016/7594615
2. Aires FT, De Matos LL, Dedivitis RA, Cernea CR. Effectiveness of harmonic scalpel in patients submitted to total thyroidectomy: Systematic review with meta-analysis. Rev Assoc Med Bras. 2018;64:649-657. https://doi.org/10.1590/1806-9282.64.07.649
3. Monit MS. So Ly L. 2007;71-76.
4. Hodgson WJB. The ultrasonic scalpel. Bull New York Acad Med J Urban Heal. 1979;55:908-915.
5. Ren ZH, Xu JL, Fan TF, Ji T, Wu HJ, Zhang CP. The harmonic scalpel versus conventional hemostasis for neck dissection: A meta-analysis of the randomized controlled trials. PLoS One. 2015;10:1-11. https://doi.org/10.1371/journal.pone.0132476
6. Miccoli P, Materazzi G, Miccoli M, Frustaci G, Fosso A, Berti P. Evaluation of a new ultrasonic device in thyroid surgery: comparative randomized study. Am J Surg. 2010;199:736-740. https://doi.org/10.1016/j.amjsurg.2009.04.003
7. Basoglu M, Ozturk G, Atamanalp SS, Aydinli B, Yildirgan MI, Oren D. The use of harmonic scalpels in thyroidectomies: clinical experiences. Eurasian J Med. 2008;40:75-758.
8. Kang SK, Kunanandam T, Clark L. Prospective, case-control study of surgical efficiency of ultrasonic shear ('harmonic scalpel') thyroidectomy compared with conventional thyroidectomy. J Laryngol Otol. 2008;122:1194-1196. https://doi.org/10.1017/S0022215107001661
9. Manouras A, Markogiannakis H, Koutras AS, Antonakis PT, Drimousis P, Lagoudianakis EE, Kekis P, Genetzakis M, Koutsoumanis K, Bramis I. Thyroid surgery: comparison between the electrothermal bipolar vessel sealing system, harmonic scalpel, and classic suture ligation. Am J Surg. 2008;195:48-52. https://doi.org/10.1016/j.amjsurg.2007.01.037
10. Revelli L, Damiani G, Bianchi CBNA, Vanella S, Ricciardi W, Raffaelli M, Lombardi CP. Complications in thyroid surgery. Harmonic Scalpel, Harmonic Focus versus Conventional Hemostasis: A meta-analysis. Int J Surg. 2016;28:S22-S32. https://doi.org/10.1016/j.ijsu.2015.12.050
11. Kilic M, Keskek M, Ertan T, Yoldas O, Bilgin A, Koc M. A prospective randomized trial comparing the harmonic scalpel with conventional knot tying in thyroidectomy. Adv Ther. 2007;24(3):632-638. https://doi.org/10.1007/BF02848788
12. Docimo G, Ruggiero R, Gubitosi A, Casalino G, Bosco A, Gili S, Conzo G, Docimo L. Ultrasound scalpel in thyroidectomy: Prospective randomized study. Ann Ital Chir. 2012;83(6):491-496.
13. Duan YF, Xue W, Zhu F, Sun DL. FOCUS harmonic scalpel compared to conventional hemostasis in open total thyroidectomy - A prospective randomized study. J Otolaryngol - Head Neck Surg. 2013;42(1):5. https://doi.org/10.1186/1916-0216-42-62
14. Cannizzaro MA, Bianco S Lo, Borzì L, Cavallaro A, Buffone A. The use of FOCUS Harmonic scalpel compared to conventional haemostasis (knot and tie ligation) for thyroid surgery: a prospective randomized study. Springerplus. 2014;3:7. https://doi.org/10.1186/2193-1801-3-639
15. Bhattacharyya N, Fried MP. Assessment of the morbidity and complications of total thyroidectomy. Arch Otolaryngol - Head Neck Surg. 2002;128(4):389-392. https://doi.org/10.1001/archotol.128.4.389
16. Tredici P, Grosso E, Gibelli B, Massaro MA, Arrigoni C, Tradati N. Identification of patients at high risk for hypocalcemia after total thyroidectomy. Acta Otorhinolaryngol Ital. 2011;31(3):144-148.
17. Melck AL, Wiseman SM. Harmonic Scalpel Compared to Conventional Hemostasis in Thyroid Surgery: A Meta-Analysis of Randomized Clinical Trials. Int J Surg Oncol. 2010;2010:407543. https://doi.org/10.1155/2010/396079
18. Ferri E, Armato E, Spinato G, Spinato R. Focus Harmonic Scalpel Compared to Conventional Haemostasis in Open Total Thyroidectomy: A Prospective Randomized Trial. Int J Otolaryngol. 2011;2011:357195. https://doi.org/10.1155/2011/357195