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Comparative Study Between Harmonic Scalpel, Bipolar Forceps Diathermy and Classic Suture Ligation in Total Thyroidectomy

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Abstract

Background: One of the procedures in general surgery that is most regularly carried out is a thyroidectomy. For many thyroid conditions, total thyroidectomy is the preferred course of action.

Aim and objectives: The purpose of this study was to contrast the usage of Harmonic Scalpel, Bipolar forceps Diathermy and conventional clamp and tie technique in total thyroidectomy for treatment of non-toxic nodular goitre, as regards blood loss, hemostasis, time saving, nerve injury, parathyroid injury, and postoperative hospital stay.

Patients and methods: This study was conducted on 45 patients with non-toxic nodular goiter subjected to total thyroidectomy presented to Al-Azhar University Hospitals. The study was a prospective, randomized and double blind study comparing the use of Harmonic scalpel, bipolar forceps diathermy, and clamp and tie techniques in patients undergoing total thyroidectomy for nontoxic nodular goiter.

Results: Highly statistical significant (P value < 0.001) decreased blood loss in group III (30 ± 8.2 ml) and group II (44.7 ± 10.3 ml) when compared with group I (76 ± 15.1 ml).

Conclusion: In total thyroidectomy for treatment of nontoxic nodular goiter, Bipolar diathermy and harmonic focus are trustworthy and secure methods. In comparison to traditional hemostatic suture ligation, their use is more successful. At contrast to the harmonic scalpel, which is expensive and only available in higher centres, the bipolar cautery is more affordable and accessible in our government hospital.

Keywords: Bipolar forceps, Classic suture ligation, Diathermy, Harmonic scalpel, Thyroidectomy

1. Introduction

One of the procedures in general surgery that is most regularly carried out is a thyroidectomy. The preferred course of treatment for many thyroid conditions is total thyroidectomy. Despite the fact that one of the first records of thyroid surgery date to the 12th century, due to the procedure's high rates of morbidity and death, it was not routinely performed until the 1800s.¹ (see Table 5)

During the 19th century, prominent surgeons like Theoder Billroth documented death rates of 8% thanks to the development of anaesthesia and the use of antiseptics. The hazards of thyroid surgery,

such as hypocalcemia and recurrent laryngeal nerve damage, became increasingly obvious as mortality rates rose.²

One of the largest blood supply of any organ is found in the thyroid gland, which has multiple blood arteries and plexuses accessing its parenchyma. The thyroid gland is meticulously devascularized during thyroid surgery. Hemostasis in thyroid surgery has historically been achieved mostly by the successful but time-consuming techniques of tying and/or clipping blood vessels.³

The harmonic scalpel was originally introduced to the surgeon's toolkit almost twenty years ago. The use of this device has some benefits over conventional electrocautery, such as decreased

neuromuscular activation, less lateral thermal tissue damage, and a reduction in electrical harm transmission to or through the patient. Using mechanical vibrations at a frequency of 55.5 kHz, this gadget simultaneously cuts and coagulates tissue.⁴

The majority of these investigations, which have examined the Harmonic scalpel's usefulness for thyroid surgery during the previous 10 years, were conducted at European medical facilities. Similar outcomes for shorter operating times have been reported by the researchers, However, results for various surgical procedures, including temporary hypocalcemia and recurrent laryngeal nerve damage, have been equivocal. Only a few instances of these issues have been documented in specialised investigations, and they are not extremely common. In order to treat nontoxic nodular goitre, this study compared the use of harmonic scalpels, bipolar forceps diathermy, and the traditional clamp and tie procedure., as regards intra operative blood loss, hemostasis, time saving, nerve injury, parathyroid injury, and hospital stay.

2. Patients and methods

This study was conducted on 45 patients with nontoxic nodular goiter subjected to total thyroidectomy presented to Al-Azhar University Hospitals. The study was a prospective, randomized and double blind study comparing the use of Harmonic scalpel, bipolar forceps diathermy and clamp and tie techniques in patients undergoing total thyroidectomy for nontoxic nodular goiter.

All patients received a preoperative explanation of the study and the operation, and their informed permission was obtained.

2.1. Inclusion criteria

Patients with non-toxic nodular goiter.

2.2. Exclusion criteria

Patients with toxic goiter and patients with hemorrhagic blood diseases.

All patients were subjected to: Routine full clinical assessment including history and physical examination, routine preoperative lab investigations, including serum calcium, thyroid profile (free T3, free T4, TSH) and coagulation profile, thyroid ultrasound, vocal cord examination, thyroid ⁹⁹Tc scan and fine needle aspiration cytology when needed and other tests, according to the case.

The patients were randomly categorized into three groups as follows: Group 1: 15 patients in Group 1

received a total thyroidectomy using the clamp-and-tie technique, while 15 patients in Group 2 underwent a total thyroidectomy using bipolar forceps diathermy. Group 3: 15 patients who underwent total thyroidectomy using Harmonic scalpel.

2.3. Preparation

All patients were admitted the day before the surgery. They all were fasting before surgery for not less than 8 h. General anesthesia for all patients and IV. Prophylactic broad spectrum antibiotic were given with the skin incision.

Operative time was calculated beginning with the skin incision until closure of the skin.

2.4. Operative technique

All patients underwent standard complete thyroidectomy procedures. In groups 1 and 2, the middle thyroid vein's branches were first sealed using the clamp-and-tie method and bipolar forceps diathermy, respectively. and harmonic scalpel in group 3 as seen in Fig. 1.

Following this, the vessels of the superior pole were located and tied off in group 1 using the clamp-and-tie method. or with the bipolar forceps diathermy in group 2 or with harmonic in group 3 as shown in Fig. 2.

Then, the lateral section of this lobe was dissected, and the clamp-and-tie procedure was used to ligate the minute fibrous vascular attachments as they reached the thyroid capsule, the bipolar technique, or the harmonic technique (Fig. 3).

2.5. Postoperative assessment

For every patient, life long hormone replacement was prescribed after discharge. Following hospital discharge, patients were all checked on at an outpatient clinic after 1 week, 1 month, and 3 months. All patients underwent thorough evaluations, paying particular attention to:

2.6. Operative time

The length of the procedure was measured from the skin incision to the skin's closure.

2.7. Blood loss

Surgery blood loss is quantified by counting the gauze piece that has been stained with blood.

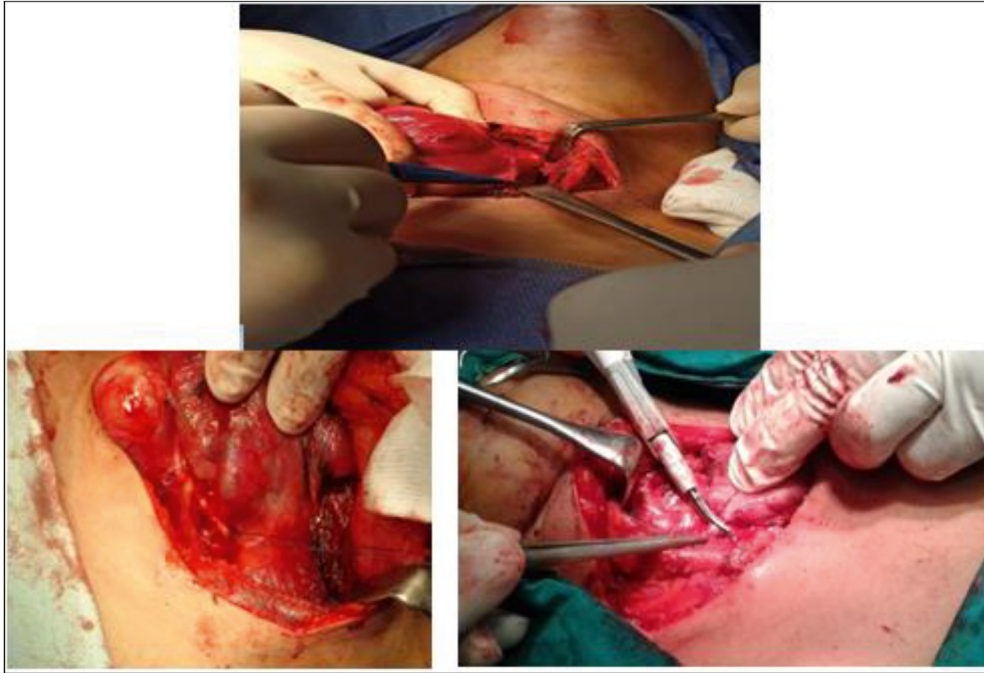


Fig. 1. Sealing of middle thyroid vein in all groups.

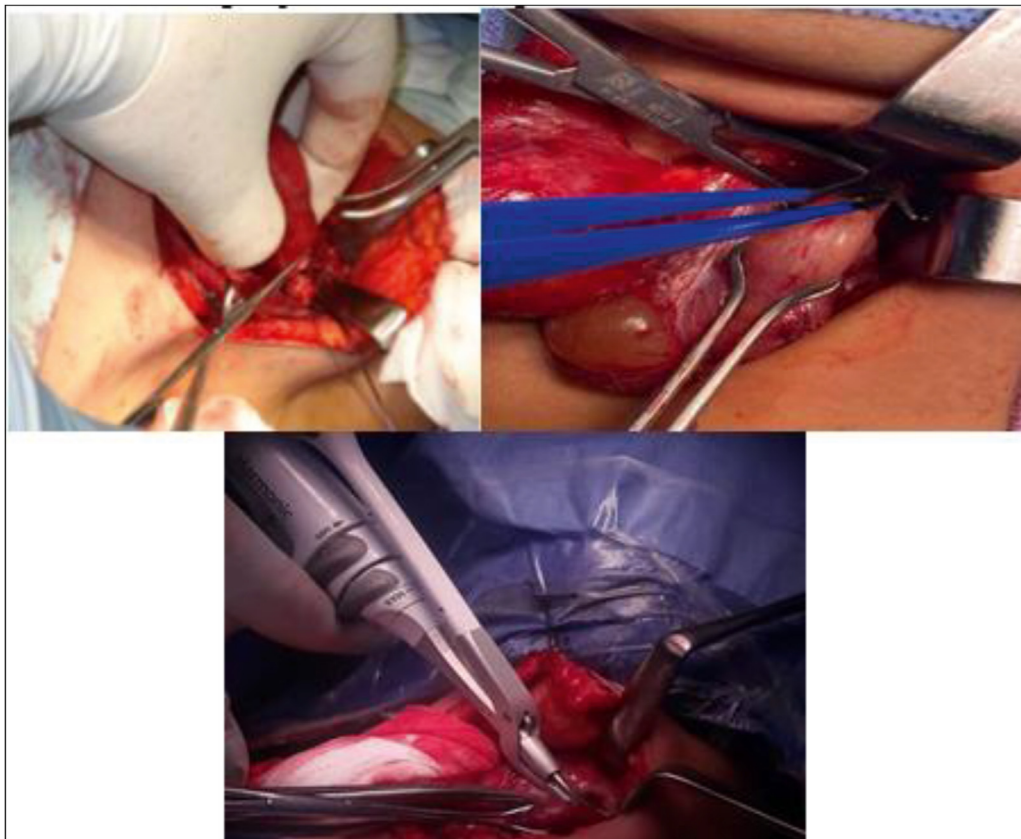


Fig. 2. Dissection of upper thyroid pole in the 3 groups.

2.8. Postoperative hypocalcaemia

Numbness, parasthesia, and a positive Chvostek sign are clinical symptoms that need replacement therapy with calcium and vitamin D. A serum calcium and phosphorus assay is used to confirm the diagnosis.

2.9. Postoperative recurrent laryngeal nerve injury

This was checked by: routine inspection of vocal folds during recovery from anaesthesia for all patients.

2.9.1. Postoperative drain outcome

Post operative hospital stay: calculated from date of surgery to discharge.

2.10. Statistical analysis

Version 24 of the Statistical Program for Social Science (SPSS) was used to analyse the data. When

comparing more than two means, use a one-way analysis of variance (ANOVA) (for normally distributed data). To compare non-parametric data, the chi-square test was used. *P* value, where *P* value 0.05 was considered significant. A *P* value of 0.001 was considered highly significant. *P* values above 0.05 were considered to be insignificant.

3. Results

This study was conducted on 45 patients with non-toxic nodular goiter subjected to total thyroidectomy presented to Al-Azhar University Hospitals. The study was a prospective, randomized and double blind study comparing the use of Harmonic scalpel, bipolar forceps diathermy and clamp and tie techniques in patients undergoing total thyroidectomy for non-toxic nodular goiter.

The patients were randomly categorized into three groups as follows: Group 1: clamp and tie technique was used on 15 patients who had entire

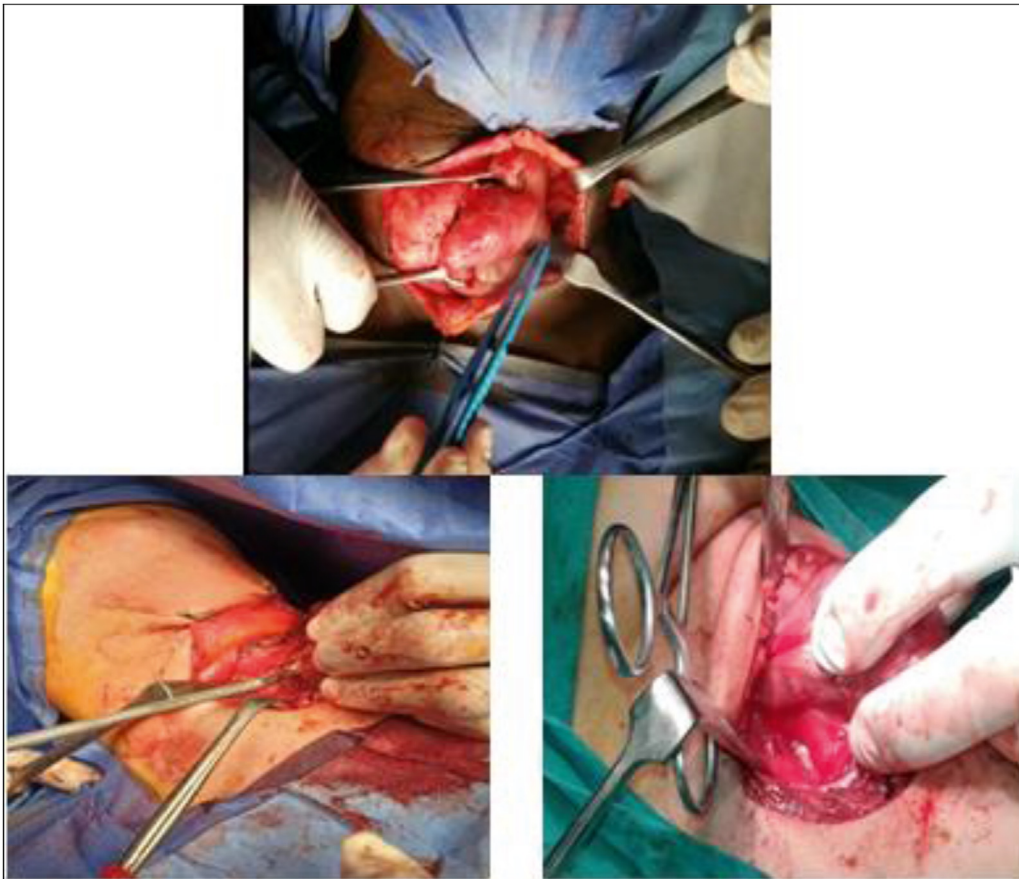


Fig. 3. The thyroid lobe's lateral portion is dissected. In group 1, the inferior pole vessels were tied off using the clamp-and-tie method. With the bipolar forceps diathermy in group 2 and harmonic in group 3, while they were within the thyroid capsule The other side of the thyroid gland was examined after this lobe of the thyroid had been removed free up to the isthmus. The thyroid lobe on the opposite side of the body was removed using the same procedure. The isthmus and pyramidal lobe were mobilised to finish the dissection. A closed suction drainage tube was placed in the surgical field, irrigated, and removed after 48 h.

Table 1. Comparisons between studied groups as regard age.

	Groups			Stat. test	P value
	Group I (n = 15)	Group II (n = 15)	Group III (n = 15)		
Age (years)					
Mean \pm SD	38.1 \pm 6.8	39.9 \pm 12.2	40.1 \pm 8.2	F = 0.19	0.821 NS
Range	25–50	23–65	25–55		

F, F value of ANOVA test; NS, P-value >0.05 is considered non-significant.

thyroidectomies; bipolar forceps diathermy was used on 15 patients in Group 2; and Harmonic scalpel was used on 15 patients who had total thyroidectomies. Table 1 (see Table 2)

This table shows no statistical significant difference (P value = 0.821) between studied groups as regard age. The mean age in group I was 38.1 \pm 6.8 with age range of 25–50 years, the mean age in group II was 39.9 \pm 12.2 with age range of 23–65 years, while the mean age in group III was 40.1 \pm 8.2 with age range of 25–55 years.

As regards the operative time, it is noticed that there was a significant reduction in operative time in group (3) and group (2) vs. group (1). The mean operative time in group (1) was 120.6 \pm 17.7 min vs. 73.3 \pm 14.4 min in group (3) and 94.7 \pm 14.8 min in group (2) (P < 0.001) highly significant. Table 3

Among the first group only 2 patients (13.3%) suffered from transient hypocalcaemia at the 1st postoperative day which was resolved after one month postoperatively, In group 2 only 1 patient (6.7%) suffered from hypocalcaemia at the 1st postoperative day which was resolved also after one month, in group 3 only 2 patient (13.3%) suffered from hypocalcaemia at the 1st postoperative day which was resolved after one week after the operation. Postoperative hypocalcaemia was diagnosed clinically by numbness and tingling in perioral area and confirmed by serum calcium. So in this study it is evident that there was no significant difference as regard post-operative hypocalcaemia in the 3 groups (P value = 0.798).

There was no significant difference between the 3 groups (P value = 0.342) as regards iatrogenic recurrent laryngeal nerve injury. Fig. 4.

High statistical significant (P value < 0.001) decreased blood loss in group III (30 \pm 8.2 ml) and group II (44.7 \pm 10.3 ml) when compared with group I (76 \pm 15.1 ml). Fig. 5.

There was high significant difference between group 1 vs. Group 2 and 3 as regard post-operative drain outcome. The P value is < 0.001. Fig. 6.

4. Discussion

This study included 45 patients, 42 females and 3 males. The range of age was 23–65 years, 40 patients suffered from simple nodular goiter and 5 patients suffered from thyroid carcinoma.

This study reveals that the Harmonic Scalpel and bipolar diathermy takes less operative time than the conventional haemostasis, where the operative time for the Harmonic Focus group ranged from 50 to 90 min (Mean \pm SD 73.3 \pm 14.4), and bipolar diathermy group ranged from 70 to 120 min (Mean \pm SD 94.7 \pm 14.8) but for the Conventional group ranged from 100 to 160 min (Mean \pm SD 120.6 \pm 17.7). Given the p value of 0.001, this difference was statistically very significant. In comparison to bipolar and conventional groups, the operative time in the harmonic group was somewhat shorter than that in the latter.

Di Rienzo et al.,⁵ to contrast the outcomes of complete thyroidectomy performed using the standard procedure, the Harmonic Focus harmonic curved shears, and an electrothermal bipolar vessel sealing device (Ligasure Precise). When compared to the other procedures, utilising Harmonic FOCUS curved shears had only one benefit: a considerable decrease in operating time. Additionally, a study

Table 2. Comparisons of the diagnoses between the groups under study No statistically significant difference between the studied groups in terms of diagnosis can be shown in this table (P-value = 0.798). In group I & group II, 2 patients (13.3%) were diagnosed as thyroid carcinoma and 13 patients (86.7%) were diagnosed as simple nodular goiter while in group III, 1 patient (6.7%) was diagnosed as thyroid carcinoma and 14 patients (93.3%) were diagnosed as simple nodular goiter.

	Groups						Stat. test	P value
	Group I (n = 15)		Group II (n = 15)		Group III (n = 15)			
Diagnosis								
Thyroid carcinoma	2	13.3%	2	13.3%	1	6.7%	X ² = 0.45	0.798 NS
Simple nodular goiter	13	86.7%	13	86.7%	14	93.3%		

NS, P value > 0.05 is considered nonsignificant; X², Chi-square test.

Table 3. Comparisons between studied groups as regard operative time.

	Groups			Stat. test	P value
	Group I (n = 15)	Group II (n = 15)	Group III (n = 15)		
Op. time (min)					
Mean ± SD	120.6 ± 17.7	94.7 ± 14.8	73.3 ± 14.4	F = 34.2	<0.001 HS
range	100–160	70–120	50–90		

F, F value of ANOVA test; HS, P value < 0.001 is considered highly significant.

Table 4. Comparisons between studied groups as regard post operative hypocalcaemia.

	Groups						Stat. test	P value
	Group I (n = 15)	Group II (n = 15)	Group III (n = 15)	Group I (n = 15)	Group II (n = 15)	Group III (n = 15)		
Hypocalcaemia								
No	13	86.7%	14	93.3%	13	86.7%	X ² = 0.45 NS	0.798
Yes	2	13.3%	1	6.7%	2	13.3%		

NS, P value > 0.05 is considered non-significant; X², Chi-square test.

was conducted by Bove et al. on patients (n = 240) who underwent a complete thyroidectomy utilising three different techniques: LigaSure Precise® (Group L, n = 80), harmonic focus™ (Group F, n = 80), and the standard suture ligation technique (Group C, n = 80). The surgical procedure took 15% less time thanks to Harmonic Focus®. Operations with F took 62.714.1 min, while operations with C took 72.713.6 min, according to a statistical comparison with (P = 0.019). Hegab,⁶ to contrast the outcomes of complete thyroidectomy utilising bipolar diathermy and knot-tying technique. He conducted the study on 60 patients who had total thyroidectomies utilising the bipolar diathermy technique (Group B, n = 30), and the traditional suture ligation technique (Group A, n = 30). Bipolar diathermy resulted in a shorter surgical duration. A statistical comparison between surgeries using a bipolar (103.97.8 min) and the traditional approach of suture ligation (124.75.2 min) showed a statistically significant difference (p 0.001).

In our study, postoperative assessment of drainage volume showed that, in conventional

group it was from (50–150) cc, the mean was (104.3 ± 27.9) cc, in bipolar group drainage volume ranged from (20–100) cc, the mean was (60.7 ± 24.9) cc, while in harmonic group it was from (20–70) cc, the mean was (46 ± 16.4)cc.

There was high significant difference between group 1 vs. Group 2& 3 as regard post-operative drainage volume. The P. value is < 0.001 HS. So in this study, the use of harmonic focus and bipolar diathermy reduced the drain outcome.

Similarly, Ferri et al.,⁷ revealed that the Harmonic Focus & Ligasue reduce the post-operative drainage volume, It had a mean of 37.4 and 2.4 for the Harmonic Focus group, a mean of 38.1 and 2.6 for the Ligasue group, and a mean and standard deviation of 56.1 and 4.2 for the Conventional Hemostatic group, respectively. In our study, intra-operative blood loss assessment showed that, the blood loss in conventional group ranged from (50–100) cc, the mean was (76 ± 15.1)cc, in bipolar diathermy group blood loss ranged from (30–60) cc, the mean was (44.7 ± 10.3)cc, while in harmonic Focus group blood loss ranged from (15–40) cc, the mean was (30 ± 8.2).

Regarding blood loss, there was a highly significant difference between groups 1 and 2 and 3. 0.001 HS is the p-value. Therefore, in this study, bipolar diathermy and harmonic focus were used to minimise blood loss during surgery. Bipolar cautery, as opposed to conventional knot tying, reduces blood loss in the surgical field, clears the surgical field, and enhances the performance of the operating surgeon, according to Sandomato et al. Also Vasuki et al.,⁸ revealed that Bipolar cautery reduces the blood loss than tie and knot technique. Both studies are coincident with our finding.

Table 5. Analysis of differences in post-operative hospital stays between the groups under study It is clear that there were substantial differences between the three groups; group 3 had the shortest hospital stay, followed by group 2, and group 1 had the longest stay (P value 0.001).

	Groups			Stat. test	P value
	Group I (n = 15)	Group II (n = 15)	Group III (n = 15)		
Hospital stay (days)					
Mean ± SD	3.2 ± 0.8	2.1 ± 0.7	1.8 ± 0.7	F = 13.1	<0.001 HS
range	2–4	1–3	1–3		

F, F value of ANOVA test; HS, P value < 0.001 is considered highly significant.

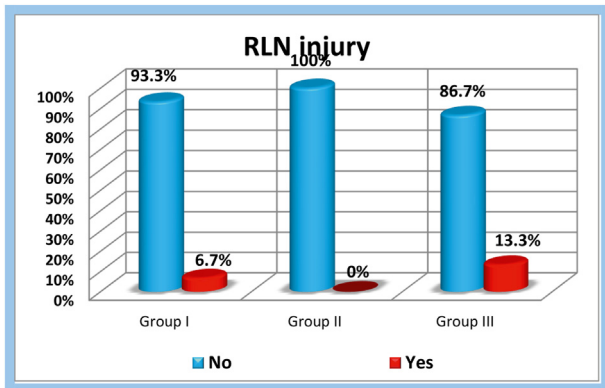


Fig. 4. Comparisons between studied groups as regard RLN injury.

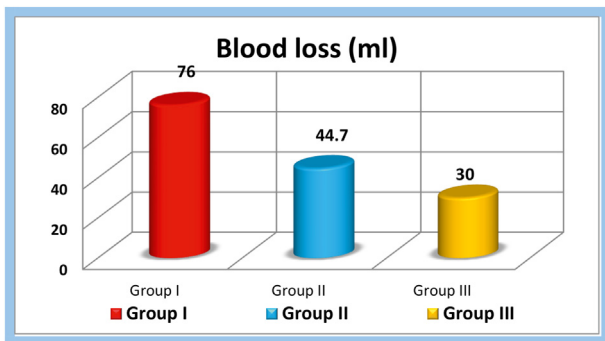


Fig. 5. Comparisons between studied groups as regard intra-operative blood loss.

The current study showed that using of Harmonic Focus and bipolar diathermy led to reduction in the post-operative hospital stay in comparison to the Conventional Hemostatic, As an example, In the Harmonic Focus group, the mean and standard deviation were 1.8 and 0.7 days, in the bipolar group, they were 2.1 and 0.7 days, and in the traditional group, they were 3.2 and 0.8 days, respectively. Similarly, Hallgrimsson et al.,⁹ revealed that using of the Harmonic Focus has led to significant

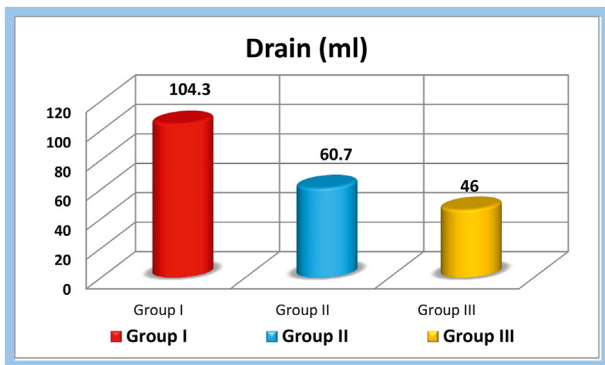


Fig. 6. Comparisons between studied groups as regard drain.

reduction of post-operative hospital stay than using Conventional Hemostasis.

Alherabi et al.,¹⁰ reported that bipolar electrocoagulation thyroidectomy was associated with less need for drain, less hospital stay and early patient discharge. In a study done by Bove,¹¹ The findings showed no statistically significant variations in the frequency of problems across the three groups. Only three patients (two with the conventional approach and one with the focus) who underwent complete thyroidectomy experienced hypocalcemia at six weeks.

4.1. Conclusion

In total thyroidectomy for treatment of non-toxic nodular goiter, Harmonic focus and bipolar diathermy are reliable and safe tools. Their use is more effective than Conventional Hemostatic suture ligation technique. At contrast to the harmonic scalpel, which is expensive and only available in higher centres, the bipolar cautery is more affordable and accessible in our government hospital.

Consent for publication

I confirm that every author has consented to submit the work.

Availability of data & material

Available.

Conflicts of interest

The authors claim that the publication of this paper is free from conflicts of interest.

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