**DOI:** https://doi.org/10.54393/pjhs.v6i5.3044

PAKISTAN JOURNAL OF HEALTH SCIENCES
(LAHORE)
https://thejas.com.pk/index.php/pjhs
ISSN (E): 2790-9352, (P): 2790-9344
Volume 6, Issue 05 (May 2025)

**Original Article**

OPEN ACCESS

# Comparison of Operative Outcomes of Open Thyroidectomy with Electrothermal Bipolar Vessel Sealer versus Conventional Hemostasis for Benign Thyroid Swelling in Adults Population

**Muzammal Islam[1*], Absar Nazir[1], Muhammad Tahir Usman[1], Tayyaba Jamil[1], Ghazala Bano[1], Mehwish Raheem[1], Mohammad Amir Jan[1], Saiqa Afzal[1] and Syeda Aleena Zahra[1]**

[1]Department of Surgery, Fatima Jinnah Medical University/Sir Ganga Ram Hospital, Lahore, Pakistan

## ARTICLE INFO

***Keywords:***
Electrothermal Bipolar Vessel Sealer, Open Thyroidectomy, Benign Thyroid Swelling, Conventional Hemostasis

***How to Cite:***
Islam, M., Nazir, A., Usman, M. T., Jamil, T., Bano, G., Raheem, M., Jan, M. A., Afzal, S., & Zahra, S. A. (2025). Comparison of Operative Outcomes of Open Thyroidectomy with Electrothermal Bipolar Vessel Sealer versus Conventional Hemostasis for Benign Thyroid Swelling in Adults Population: Thyroidectomy with Electrothermal Bipolar Vessel Sealer versus Conventional Hemostasis for Benign Thyroid. Pakistan Journal of Health Sciences, 6(5), 07-12. https://doi.org/10.54393/pjhs.v6i5.3044

***Corresponding Author:**
Muzammal Islam
Department of Surgery, Fatima Jinnah Medical University/Sir Ganga Ram Hospital, Lahore, Pakistan
islammuzammal@gmail.com

Received date: 28th February, 2025
Revised date: 5th May, 2025
Acceptance date: 7th May, 2025
Published date: 31st May, 2025

## ABSTRACT

Precise dissection and effective hemostasis are crucial for safe thyroid surgery. The bipolar vessel sealer, a first-generation electrosurgical instrument, is widely used in thyroidectomies to improve hemostasis, reduce tissue trauma, shorten surgery time, and eliminate the need for sutures. **Objective:** To compare the operative outcomes of electrothermal bipolar vessel sealer in total thyroidectomy. **Methods:** At the Department of Surgery, Sir Ganga Ram Hospital, from August 2024 to January 2025, a quasi-experimental study was carried out, involving 80 patients undergoing total thyroidectomy. Exclusion criteria included patients with significant comorbidities, bleeding disorders, or renal and liver dysfunctions. The study participants were divided into two groups: Group A (bipolar vessel sealer) and Group B (clamp-and-tie technique). Primary outcomes included surgery duration, intraoperative blood loss, and hospital stay. Data were entered and analyzed by SPSS version 25.0. **Results:** The average age of patients was 35.5 ± 4.9 years. Group A had 70% female and 30% male, while Group B had 77.5% female and 22.5% male. Group A had significantly shorter hospital stays (3.8 ± 1.2 days) compared to Group B (5.2 ± 2.3 days, p=0.000). Intraoperative blood loss was significantly lower in Group A (109.7 ± 7.3 mL) compared to Group B (154.3 ± 6.7 mL, p<0.000). Surgery duration was longer in Group A (121.3 ± 13.1 minutes) than in Group B (94.3 ± 11.3 minutes, p<0.05). **Conclusions:** It was concluded that the bipolar vessel sealer in total thyroidectomy for benign thyroid swelling is effective, and results in shorter hospital stays without increasing complications or costs

## INTRODUCTION

Thyroid disorders are among the most common conditions affecting the head and neck, with surgery being the definitive treatment for many cases. Thyroidectomy, the most common neck surgery, effectively addresses various thyroid disorders [1, 2]. Although advancements have lowered mortality rates to nearly 0% and complications to less than 3%, however, risks of hemorrhage, recurrent laryngeal nerve injury, and postoperative hypocalcemia persist as concerns [3]. Hemorrhage, although a rare but serious complication of thyroid surgery, occurs in 0.3% to 4.2% of cases. It may lead to neck swelling, pain, and airway obstruction (dyspnea, stridor, hypoxia), with reoperation necessary if drainage fails to prevent obstruction [4]. Hypocalcemia, caused by postoperative hypoparathyroidism, affects 7% to 37% of total thyroidectomy patients [5], with rates varying due to differing diagnostic criteria. Most cases resolve within weeks, depending on the degree of parathyroid

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devascularization or accidental removal [6]. However, Optimal outcomes rely on precise dissection, effective hemostasis, and preservation of vital structures, using techniques like knot-tying, electrocautery, and vessel-sealing devices [7]. The use of ultrasonic and bipolar energy devices has become increasingly common in surgery. Recently, integrated devices combining both energy types have gained popularity, particularly in laparoscopic and open surgeries [8]. Advances in hemostasis techniques have led to the growing use of energy-based devices in neck surgery [9]. These devices utilize different energy forms: Liga Sure™ relies on radiofrequency [10], the Harmonic Scalpel converts electrical energy into ultrasonic vibrations [11], and Thunder beat combines harmonic and radiofrequency technologies for efficient tissue dissection and coagulation [12]. These days, coagulation devices, metallic clips, staples, and suture ligation are used to stop bleeding. Nonabsorbable elements like staples and clips can occasionally induce irritation and impede wound healing, and ligation and sutures take time [13]. Electrocautery can cause thermal damage to the recurrent laryngeal nerve and parathyroid glands [14]. As an alternative, the electrothermal bipolar vessel-sealing system uses a combination of energy and pressure to denature collagen and elastin in vessel walls and adjacent tissues. The FDA approved Liga Sure (Tyco Int. Valley lab), which effectively seals vessels >7 mm in diameter [15]. Despite the widespread application of the electrothermal bipolar vessel sealer in surgery, its precise advantage in total thyroidectomy for benign disorders, especially when pitted against standard techniques involving meticulous hemostasis, is still not well studied. With the growing sophistication of surgical technologies, consideration is needed regarding the effect of this approach on surgical time, blood volume loss, and complications.

This study aims to evaluate the effectiveness of using a bipolar vessel sealer in total thyroidectomy in terms of operative outcome and complications, and compare it to a traditional clamp-and-tie technique.

## METHODS

At the Department of Surgery, Sir Ganga Ram Hospital, from August 2024 to January 2025, a quasi-experimental study was carried out from August 2024 to January 2025. A total of 80 patients undergoing total thyroidectomy were enrolled using a convenient sampling technique, following ethical approval (179-MS-Surgery/ERC). Taking a 5% margin of error and an 80% study power with 20% expected dropout, the sample of subjects by complication rate in the Bipolar Vessel Sealing group was 60.0%, and the traditional method was 24.0%. The sample size was 80(40 in each group [16]. The study included patients aged 18-60, both genders, undergoing elective total thyroidectomy who provided informed consent. Patients with an ASA grade of 3 or higher, significant comorbidities, bleeding disorders (INR >1.5), or renal (creatinine >2 mg/dl) or liver dysfunction (bilirubin >1.5 mg/dl) were excluded. The patients were divided into two groups. Group A (Bipolar Vessel Sealing): Liga Sure TM system was used for hemostasis. Group B (Clamp-and-Tie Technique): Hemostasis was achieved using suture ligation and electrocautery. Under aseptic conditions, patients underwent total thyroidectomy using the standard approach. After dissection of the thyroid gland, bleeding from the thyroid bed was observed. In Group A, the electrothermal bipolar vessel sealer was used for hemostasis. The middle thyroid vein, superior thyroid artery, vein, and terminal branches of the inferior thyroid artery and inferior pedicle were coagulated and divided with careful dissection to preserve the superior laryngeal nerve. The recurrent laryngeal nerve and parathyroid glands were identified and protected. Terminal branches of the inferior thyroid artery were coagulated near the gland, and the thyroid was retracted medially for vessel division at the ligament of Berry. Absorbable sutures (polyglactin 2-0) were used if vessels were encountered near vital structures. Intraoperative blood loss was calculated. In Group B, the conventional clamp-and-tie technique was employed. The middle thyroid vein, superior thyroid artery, vein, and terminal branches of the inferior thyroid artery and inferior pedicle were ligated and divided using absorbable sutures (polyglactin 2/0-3/0). Intraoperative blood loss was objectively measured by calculating the increase in the weight of surgical swabs and gauze used during the procedure, with each gram of weight gain considered equivalent to one milliliter of blood loss (i.e., 1 g = 1 mL). The effectiveness of the two methods was evaluated based on the cessation of bleeding from the thyroid bed within 10 minutes, indicating successful hemostasis. After securing hemostasis, drain placement was done if required, and the wound was closed in reverse fashion, and postoperative blood loss was calculated. All data, including demographic details, were recorded in the attached proforma. The same surgical team conducted all of the procedures, and the lead surgeon had five years of thyroid surgery experience. Numerical variables (e.g., age, hospital duration, and Intraoperative & Postoperative blood loss) were presented as mean ± SD. Categorical variables (e.g., gender, history of diabetes, history of hypertension, and complications) were presented as frequencies and percentages. Data were entered and analyzed using SPSS version 25.0, with independent sample t-tests and chi-square tests used for comparisons. A p-value of <0.05 was considered statistically significant.

## RESULTS

The mean age was slightly higher in Group A (40.2 ± 5.3 years) compared to Group B (38.9 ± 4.5 years), though this difference may not be clinically significant. Group A had 70% females and 30% males, while Group B had 77.5%

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females and 22.5% males, indicating a higher proportion of females in both groups. Regarding Body Mass Index (BMI), Group A had a higher proportion of obese individuals (47.5%) compared to Group B (37.5%), while both groups had a similar percentage of non-obese individuals (60% in Group A vs. 57.5% in Group B). Diabetes Mellitus was higher in Group A (47.5%) compared to Group B (30%), suggesting that Group A had a greater proportion of individuals with diabetes. The frequency of hypertension was slightly higher in Group A (57.5%) than in Group B (50%), with both groups showing a substantial percentage of individuals without hypertension (40% in Group A vs. 52.5% in Group B). There was no significant difference in baseline investigations between the two groups (p-value>0.05) (Table 1).

**Table 1:** Baseline Investigations of Patients

| Variables | Group-A | Group-B | Total | p-value |
|---|---|---|---|---|
| Age (Years) | 40.2 + 5.3 | 38.9 + 4.5 | 35.5 + 4.9 | 0.311 |
| **Gender** | | | | |
| Male | 12 (30.04%) | 9 (22.5%) | 21 (26.2%) | 0.611 |
| Female | 28 (70.0%) | 31 (77.5%) | 59 (73.7%) | |
| **Body Mass Index (BMI)** | | | | |
| Obese | 19 (47.5%) | 15 (37.5%) | 33 (41.2%) | 0.839 |
| Non-Obese | 24 (60.0%) | 23 (57.5%) | 47 (58.7%) | |
| **Diabetes Mellitus** | | | | |
| Yes | 19 (47.5%) | 12 (30.0%) | 31 (38.7%) | 0.754 |
| No | 27 (67.5%) | 22 (55.0%) | 49 (61.3%) | |
| **Hypertension** | | | | |
| Yes | 23 (57.5%) | 20 (50.0%) | 43 (5.7%) | 0.490 |
| No | 16 (40.0%) | 21 (52.5%) | 37 (46.2%) | |
| Total | 109 | 109 | 218 | |

The results demonstrated significant differences among groups across all measured variables. The mean hospital duration was shorter in Group A (3.8 ± 1.2 days) compared to Group B (5.2 ± 2.3 days), with a p-value of 0.000, indicating statistical significance.Moreover, the duration of surgery was notably longer in Group B (121.3 ± 13.1 minutes) compared to Group A (94.3 ± 11.3 minutes), with a p-value of 0.000.The mean intraoperative blood loss was significantly less in Group A (109.7 ± 7.3 mL) compared to Group B (154.3 ± 6.7 mL), with a p-value of 0.000.Moreover, the mean postoperative blood loss was similar in Group A (32.03 ± 10.4 mL) compared to Group B (35.7 ± 10.3 mL), with a p-value of 0.11. On Day 2, the mean blood loss was 19.1 ± 5.72 mL in Group A and 19.2 ± .82 mL in Group B (p=0.893), showing no significant difference.Similarly, on Day 3, the mean blood loss was 16.8 ± 5.93 mL in Group A and 15.2 ± 6.68 mL in Group B (p=0.269), with no statistical difference among study groups (Table 2).

**Table 2:** Comparison of Intra- and Post-Operative Outcomes of Surgery Among Groups

| Variables | Group A | Group B | p-value |
|---|---|---|---|
| Hospital Duration | 3.8 ± 1.2 | 5.2 ± 2.3 | 0.000 |
| Duration of Surgery (In minutes) | 94.3 ± 11.3 | 121.3 ± 13.1 | 0.000 |
| Intraoperative blood loss (mL) | 109.7 ± 7.3 | 154.3 ± 6.7 | 0.000 |
| Postoperative blood loss (mL) by the amount of drain output at Day 1 | 32.03 ± 10.4 | 35.7 ± 10.3 | 0.11 |
| Postoperative blood loss (mL) by the amount of drain output at Day 2 | 19.1 ± 5.72 | 19.2+5.82 | 0.893 |
| Postoperative blood loss (mL) by the amount of drain output at Day 3 | 16.8 ± 5.93 | 15.2+6.68 | 0.269 |

Effectiveness was higher in Group A, with 47 participants showing positive outcomes compared to 23 in Group B. In contrast, fewer individuals in Group A reported ineffectiveness ("No"), with only 3 responses, compared to 7 responses in Group B. There was a significant association between the effectiveness of both groups(p-value<0.05)(Figure 1).

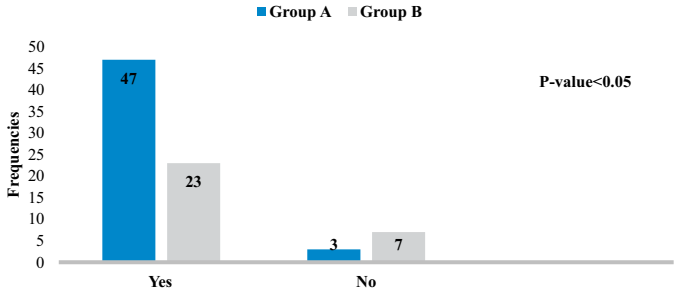


**Figure 1:** Comparison of Effectiveness among Groups

## DISCUSSION

Precise dissection and efficient hemostasis are necessary for a safe surgical procedure to preserve important tissue. Although knot tying is the conventional technique for hemostasis, vessel sealing technologies save more time but come at a higher cost.About 80 milliliters per 100 grams per minute is the rich blood supply to the thyroid gland, which increases in hyperthyroidism.Modern electrosurgical instruments reduce tissue reactivity, shorten the duration of the operation, and eliminate the need for sutures.The bipolar cautery, a common first-generation instrument for thyroidectomies, works with any standard electrosurgical unit that has a foot switch and monopolar cautery [17].In the current study, the average age of patients was (35.5 + 4.9 years), Group A had 70% female and 30% male, while Group B had 77.5% females and 22.5% males. The mean hospital duration was shorter in Group A (3.8 ± 1.2 days) compared to Group B (5.2 ± 2.3 days) (p-value<0.05). The comparison of intraoperative blood loss showed that Group A (109.7 ± 7.3mL) had less blood loss as compared to Group B (154.3 ± 6.7mL, p-value=0.000).

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However, the duration of surgery was notably longer in Group B (121.3 ± 13.1 minutes) compared to Group A (94.3 ± 11.3 minutes) (p-value<0.05). Bipolar cautery plays a crucial role in surgical procedures by significantly reducing blood loss, which improves the visibility of the surgical field. This enhanced clarity allows surgeons to work more effectively and accurately, making the procedure faster and more precise. By reducing or eliminating the need for conventional knot-tying techniques, bipolar cautery also contributes to better control of bleeding during surgery [18]. In research by Manouras *et al.*, the efficacy of the bipolar vessel sealer and harmonic scalpel was compared to traditional methods. The findings showed a notable reduction in surgical time, with the advanced tools cutting the duration by approximately 20%. Specifically, surgeries using the bipolar vessel sealer or harmonic scalpel took 74.3 ± 14.2 and 73.8 ± 13.8 minutes, respectively, compared to 93.3 ± 12.5 minutes when the classic technique was employed. This reduction not only enhances procedural efficiency but also minimizes patient and surgical team strain [19]. These findings were also comparable to another study, which demonstrated notable differences in outcomes. Patients who underwent surgery with Liga Sure BDS had a significantly shorter postoperative hospital stay (2.3 ± 1.7 days) compared to those who had the conventional technique (2.8 ± 1.3 days), with a statistically significant difference (p<0.05). The results indicated that Liga Sure vessel sealer is an alternative, reducing the overall duration of surgery and being suitable for use through a narrow surgical incision [20]. However, another retrospective study comparing thyroid surgeries with traditional electric knives and bipolar electrocoagulation demonstrated that bipolar electrocoagulation reduced 50% of operation time and 80% of intraoperative bleeding, with no significant risk of complications [21]. A study was conducted to see the effectiveness of a bipolar electrosurgical device found that the bipolar vessel sealer reduced the surgical time. It also reduces the blood loss. It was demonstrated that these devices are time-efficient alternatives in low-resource settings [22]. Additionally, the study found that bipolar vessel sealer significantly reduces both total operation time and intraoperative bleeding compared to traditional methods. These results are consistent with existing literature, confirming that bipolar electrocoagulation allows for greater precision, reduces bleeding, and lowers the likelihood of complications [21, 23]. In the current study, it was demonstrated that the blood loss during the surgery was significantly less in Group A (109.7 ± 7.3 mL) compared to Group B (154.3 ± 6.7 mL). Moreover, the mean postoperative blood loss was similar in Group A (32.03 ± 10.4 mL) compared to Group B (35.7 ± 10.3 mL), which were comparable with literature, as the Electrothermal Bipolar Vessel Sealer (EBVS) offers significant advantages in thyroid surgery by reducing intraoperative and postoperative blood loss. It ensures precise hemostasis, minimizing blood loss while protecting vital structures like the parathyroid glands and recurrent laryngeal nerve [24]. In another meta-analysis, it was found that EBVS reduced intraoperative blood loss by an average of 20.03 mL compared to conventional techniques [25]. Additionally, it shortens operative time, further enhancing surgical efficiency [15]. Postoperatively, EBVS promotes faster recovery by minimizing bleeding, enabling early drain removal, and reducing the risk of neck hematoma. This leads to shorter hospital stays, earlier discharge, and improved cost-effectiveness [19]. A meta-analysis confirmed that EBVS significantly lowers postoperative complications, reinforcing its value as a superior alternative to conventional methods [26]. Given these benefits, EBVS enhances both intraoperative safety and postoperative recovery, making it a preferred choice for thyroidectomy.

## CONCLUSIONS

It was concluded that the electrothermal bipolar vessel sealer is an effective hemostatic tool for total thyroidectomy in benign thyroid conditions. While it prolonged surgical duration, it significantly reduced intraoperative blood loss and hospital stay compared to the conventional clamp-and-tie technique. These benefits highlight its clinical value in enhancing recovery and reducing complications. The technique may be especially useful in resource-limited settings and for surgeons with varying experience, providing a sutureless, cost-effective option without increasing operative risks.

## Authors Contribution

Conceptualization: MI
Methodology: MI, AN, MTH, MR
Formal analysis: MTH, TJ, GB
Writing review and editing: MI, MAJ, SA, SAZ
All authors have read and agreed to the published version of the manuscript

## Conflicts of Interest

All the authors declare no conflict of interest.

## Source of Funding

The author received no financial support for the research, authorship and/or publication of this article.

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