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A comparative study between bipolar cutterly and conventional suture ligation for hemostasis in total thyroidectomy for benign thyroid disease

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Abstract

Background: Over the last years many surgeons have begun to use energy based devices to perform thyroid surgery, several literatures have demonstrated the benefits of these devices over traditional techniques, they can provide a combined dissection and hemostatic effect and particularly advantageous in reduction of incision length, operative time, operative blood loss and complications.

Aim of study: Compare bipolar cautery to traditional suture ligation in hemostasis during complete thyroidectomy in nerve damage, operating time, hypocalcemia, post-operative blood loss and hematoma development, and hospital stay.

Patients and Method: In this study 61 patients who underwent total thyroidectomy, they were divided into two groups according to the type of hemostasis: bipolar cautery hemostasis group and conventional suture ligation hemostasis group, different diseases were included (multinodular goiter, solitary thyroid nodule), these groups were compared in regard to operative time, complications and length of hospital stay.

Results: The bipolar cautery hemostasis group had a shorter operation time (67.36 ± 9.77 min) and a lower post-operative blood loss (55.78 ± 14.45 ml) than the conventional suture ligation group (91.09 ± 27.37 ml). Other outcomes included post-operative hematoma formation, recurrent laryngeal nerve injury, and post-operative hypoxia.

Conclusion: Using bipolar cautery device in total thyroidectomy reduced the operative time and post-operative blood loss, without any change in the incidence of recurrent laryngeal nerve injury, post-operative hypocalcemia, hematoma formation, and the length of hospital stay.

Keywords: Bipolar cutterly, conventional suture, ligation, hemostasis, total thyroidectomy, benign thyroid

Introduction

Thyroid surgery, with roots reaching back to 952 AD when Alubcasim (Alzahrawi) first conducted the procedure, has experienced significant advancements over the centuries^[1]. The surgical techniques, originally detailed by Kocher, have since undergone myriad refinements and enhancements^[2]. Currently, total thyroidectomy is the predominant surgery within endocrine gland operations, proving essential for treating a multitude of thyroid-related disorders^[3, 4]. The thyroid gland, notable for its rich blood supply, stands as one of the most vascularized organs within the human body^[3]. The gland's proximity to the recurrent laryngeal nerve and parathyroid glands elevates the risks associated with thyroid surgeries. Historically, the conventional suture ligation technique was the primary means for ensuring hemostasis during these operations^[4]. However, the method, despite its efficacy, is time-consuming and poses risks, especially when knots potentially slip. Conversely, electrocautery, though efficient, introduces risks associated with electrical currents and heat potentially damaging surrounding tissues^[5]. The innovation of surgical electrocautery owes much to William T Bovie, who, between 1914 and 1927, pioneered the use of high-frequency alternating currents for incising and coagulating tissue^[6]. Bipolar electro surgery, a later evolution of the technique, offers better control, as it restricts the electric current to the tissue between the forceps electrode^[7]. This method significantly minimizes the risk of burns to the patient, making it a safer option for those with implanted devices^[8]. However, as with any surgical innovation, bipolar electro surgery is not without its challenges. The risk to the recurrent laryngeal nerve (RLN) during thyroidectomy remains a significant concern^[9]. Any damage to this nerve can lead to vocal cord paresis or even paralysis^[10].

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Statistics indicate varying incidence rates of RLN injuries, but it's evident that thermal injury is a dominant factor [11]. Additionally, post-operative stands out as a distressing consequence of aggressive thyroid surgeries [12]. The inadvertent injury or resection of the parathyroid glands can result in hypocalcaemia, presenting with a plethora of symptoms from numbness and tingling to tetany and seizures [13, 14]. The aim of study is to compare the use of bipolar cautery and conventional suture ligation in total thyroidectomy hemostasis in terms of nerves injury, operative time, hypocalcemia, post-operative blood loss and hematoma formation, and hospital stay.

Methods

A total of 61 patients with various thyroid diseases (including multinodular goiter, toxic goiter, and malignant disease) underwent total thyroidectomy at AL-Hilla teaching hospital and AL-Imam AL-Sadiq Hospital between October 2017 and November 2019.

Exclusion Criteria

Patients were excluded if they had

1. Pre-operative hyper/hypocalcemia.
2. Retrosternal goiter.
3. Previous thyroid surgery or neck surgery.
4. Prior neck irradiation.
5. Bleeding disorders.
6. Underwent single lobe or subtotal thyroidectomy.
7. Preoperative diagnosis of malignant thyroid disease.
8. History of recurrent laryngeal nerve palsy.

Procedure

All patients underwent pre-operative assessments such as vocal cord mobility check, thyroid function tests, serum calcium measurement, neck ultrasound, and fine needle aspiration for any suspicious nodules, besides routine investigations. Depending on the surgeons' preferences, patients were divided into two hemostatic groups:

1. Conventional Suture Ligation Hemostasis Group (42 patients or 68.8%)
2. Bipolar Cautery Hemostasis Group (19 patients or 31.2%)

For the conventional group, the thyroid gland was approached using suture ligation techniques with electrocautery used for minimal oozing. In the bipolar cautery group, bipolar cautery forceps were used for hemostasis and dissection, ensuring the safety of the recurrent laryngeal nerve and the preservation of the parathyroid glands. Post-surgery, Radi-vac drains were used to assess post-operative bleeding.

Outcomes Monitored: Intra-operative parameters, including operative duration and any complications (like RLN injury), were recorded. Post-operative monitoring included checking for hematomas, symptoms of RLN injury, symptoms of hypocalcemia, serum calcium levels on the first post-operative day, and blood collected in the drain over 24-48 hours. Follow-ups were done for six months, particularly for patients showing signs of hypocalcemia and RLN injury.

Ethical Considerations: Patients and their families were verbally briefed about the study, and their consent was obtained. Data analysis was done using SPSS software version 25. Continuous variables were represented as mean and standard deviation (SD), while categorical variables were depicted using frequency distributions. Chi-square tests were used for low expected frequencies with significance set at $p < 0.05$.

Results

The mean age of all patients in this study was 35.24 years (range 17-63 years), with standard deviation 12.32, all patient was female. The mean age in the conventional suture ligation group was 35.48 year with standard deviation 10.69, while in the bipolar cautery group was 34.26 year with standard deviation 11.36. This is shown in table (1) and figure (2).

Table 1: Mean age according to surgical technique

Operative technique	Mean age (years)	Number	Standard deviation
Suture ligation	35.48	42	10.693
Bipolar Cautery	34.26	19	11.366
Total	35.24	61	12.326

P value = 0.652

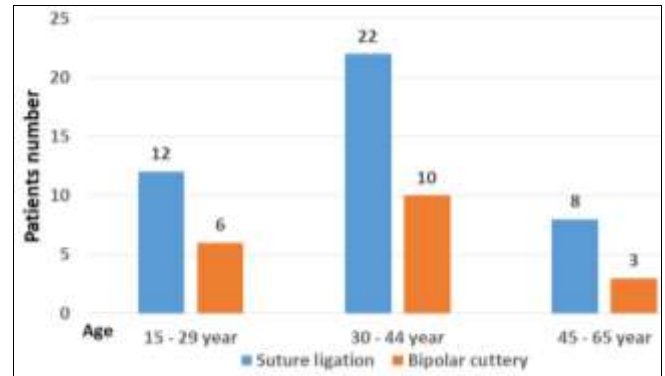


Fig 1: Age distribution according to hemostatic procedure.

The underlying diseases were: multinodular goiter (MNG) 36 (59.02%) patients, and solitary thyroid nodule 25 (40.98%) patients.

All patient underwent total thyroidectomy, (table 2 and figure 3 show the general demographic and pathological criteria of the group studied).

Table 2: General demographic criteria in the study group (N=61).

Age (yrs.), M(SD)	35.24 (12.32)
Underlying disease	
Multi nodular goiter (MNG)	36 (59.02%)
Solitary thyroid nodule	25 (40.98%)
Type of hemostasis	
Conventional hemostasis	42 (68.8)
Bipolar cautery	19 (31.2%)

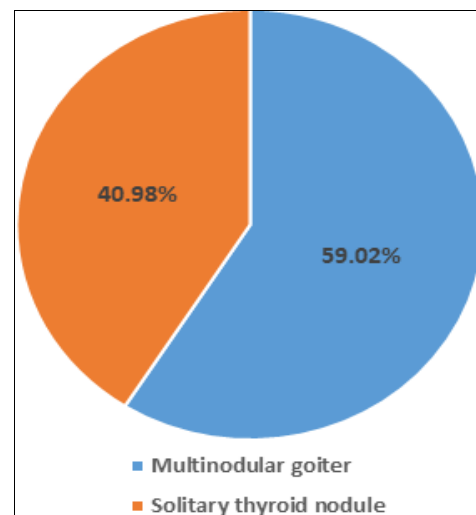


Fig 2: Distribution of thyroid disease

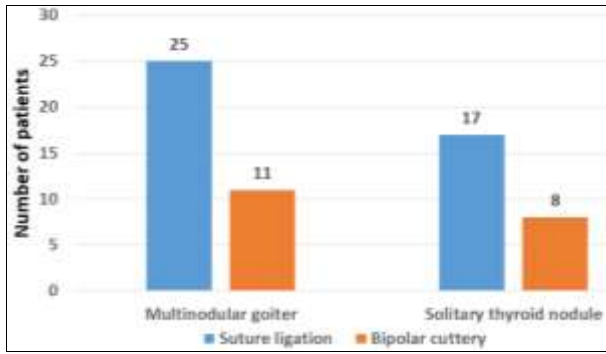


Fig 3: Distribution of hemostatic procedure according to the thyroid disease

The operative time was significantly shorter in the bipolar cautery hemostasis group than the group of conventional suture ligation group: 67.36±9.77 minutes vs. 85.09±13.64 minutes respectively with p <0.0001 (as shown in table 3).

Table 3: The operative time according to hemostatic method.

Operative technique	Time (minutes)	Standard deviation
Suture ligation	85.09	13.64
Bipolar Cautery	67.36	9.77
P Value < 0.001		

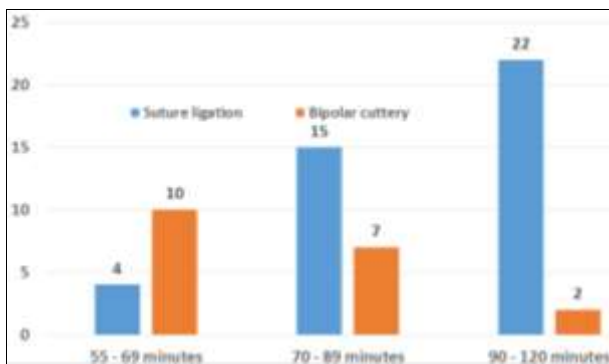


Fig 4: Operative time in relation to surgical technique.

Recurrent laryngeal nerve (RLN) injury was not significant and

Table 4: Complication of thyroid surgery in relation to surgical technique and its significance.

Outcome	Conventional haemostasis	bipolar cautery	P value
Time of operation (minutes), M (SD)	85.09 (13.64)	67.36 (9.77)	<0.0001
RLN injury	1 (2.3%)	0 (0%)	0.355
Hypocalcemia (S. Ca++ <2.0 mmol/L)	7 (16.66%)	3 (15.78%)	0.677
Hypocalcemia (Symptomatic)	2 (4.76%)	1 (5.26%)	0.653
Amount of blood loss in the drain (ml), M (SD)	91.09 (27.37)	55.78 (14.45)	<0.0001
Postoperative hematoma	1 (2.3%)	0 (0%)	0.355
Hospital stay (days), M(SD)	1.39 (0.82)	1.36 (0.87)	0.844

Discussion

The study involved 61 patients with varying thyroid diseases, undergoing total thyroidectomy using two distinct surgical techniques. Using the conventional suture ligation hemostasis method, which employs a knot-and-tie approach, can be time-consuming. Conversely, the application of electrocautery in thyroid surgery risks thermal injury to adjacent nerves and parathyroid glands [15, 16]. Thus, the necessity for quick and secure hemostasis is paramount. In this research, both groups had a mean age of 35.24±12.32 years. Specifically, the bipolar cautery hemostasis group had a mean age of 34.26±11.36, and the conventional suture ligation hemostasis group had a mean

age of 35.48±10.69. No significant age difference existed between the groups (P=0.652). The surgical procedures and underlying diseases were equally distributed across both groups, ensuring unbiased results. Notably, the use of bipolar cautery significantly reduced the surgery duration by approximately 18 minutes (P<0.0001). This finding aligns with prior research by Govindaraj M. *et al* 2014 [15], where surgery time decreased by roughly 31 minutes with bipolar cautery, and Bove A. *et al* 2012 [17], where the reduction was about 22 minutes. Regarding post-operative bleeding, two Radi-vac drains were utilized for all patients, revealing a significant difference in blood drainage between the groups (P<0.0001). The bipolar cautery group

occurred in one case (2.63%) in the conventional suture ligation group vs no nerve injury reported in the bipolar cautery hemostasis group with p = 0.355, nerve injury was temporary, unilateral, no tracheostomy required, and recover within three months, (table 4). The amount of blood loss in the drain was lower in the bipolar cautery hemostasis group than conventional suture ligation group, and was statically significant: 55.78±14.45 ml vs. 91.09±27.37 ml respectively with p<0.0001 (see table 4).

Post-operative hematoma developed in one case (2.6%) in conventional suture ligation group vs. no hematoma occurred bipolar cautery hemostasis group with p=0.355 (table 4); the hematoma from conventional hemostasis group was tension hematoma that required urgent surgical intervention for evacuation of hematoma to release the pressure on trachea and securing the hemostasis and ligation the source of bleeding. Hypocalcemia developed in three cases (15.78%) in bipolar cautery hemostasis group and seven cases (16.66%) in conventional hemostasis group and with p=0.653 (figure 4), one case in bipolar cautery hemostasis group was symptomatic and two patients in conventional suture ligation hemostasis group. All cases were treated with calcium supplement, and all cases were temporary, that recovered within 6 months, (Table 4).

Hospital stay was approximately equal in both groups (1.39 day in conventional hemostasis group vs. 1.36 day in bipolar cautery group with p =0.844) as shown in table 4 below.

Hypocalcemia developed in three cases (15.78%) in bipolar cautery hemostasis group and seven cases (16.66%) in conventional hemostasis group and with p=0.653 (figure 4), one case in bipolar cautery hemostasis group was symptomatic and two patients in conventional suture ligation hemostasis group. All cases were treated with calcium supplement, and all cases were temporary, that recovered within 6 months, (Table 4).

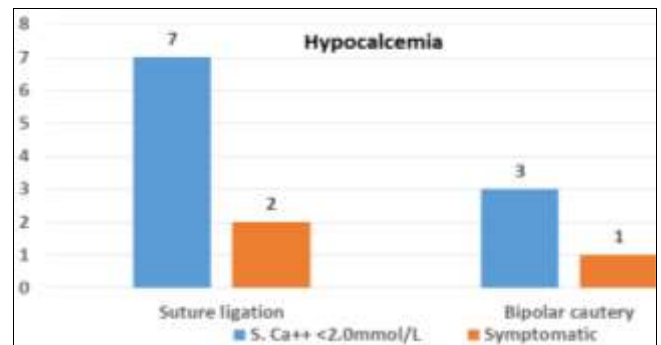


Fig 5: Distribution of hypocalcemia according to surgical technique

exhibited a decrease of about 39 ml in blood drainage, comparable to results from Govindaraj M. *et al.* 2015^[15] (a decrease of 28.6 ml) and Manouras A. *et al.* 2008^[18] (a decrease of 28 ml). Recurrent laryngeal nerve (RLN) injury, a grave complication in total thyroidectomy, was not found to differ significantly between the groups ($P=0.355$). One temporary RLN injury occurred in the conventional group, recovering within three months – consistent with the outcomes in other studies^[17, 19]. Post-operative hematoma was observed in one patient from the conventional group, necessitating urgent intervention. These findings correspond with those of Govindaraj M. *et al.*^[15], Challa S *et al.* 2012^[20], and Vidinov KN *et al.*^[21], but differ from Ecker T *et al.*^[19], which noted a reduced hematoma incidence when using electrocautery for hemostasis. Post-operatively, ten patients exhibited hypocalcemia, but treatment with calcium supplements led to recovery within six months. No significant variance in hypocalcemia was observed between the groups ($P=0.677$). Lastly, the method of hemostasis did not influence the duration of hospital stays ($P=0.844$).

Conclusion

From all of the above results, it was found that using of bipolar cautery in total thyroidectomy reduced the time of surgery and decreased post-operative blood loss without changing the incidence of nerves injury or post-operative hematoma, hypocalcemia and without a change in the length of hospital stay.

Conflict of Interest

Not available

Financial Support

Not available

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