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Original Research Article

Comparison Between Monopolar Cautery and Bipolar Cautery Tonsillectomy in Terms of Operative Time and Intraoperative Blood Loss

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Abstract:

Objective: To compare monopolar and bipolar cautery tonsillectomy in terms of mean operative time and mean intraoperative blood loss.

Study Design: Non-Randomized Control Trial.

Place and Duration of Study: Department of ENT, Faisalabad Medical University and Affiliated Hospitals, Faisalabad, from 01 September 2025 to 1st December 2025.

Methodology: A total of 60 patients, aged 8–15 years, were equally divided into two groups for the study: Group A (30 patients, monopolar cautery) and Group B (30 patients, bipolar cautery). Participants had to have six tonsillitis bouts per year and not have diabetes, blood problems, other ENT concerns, or peri-operative atropine. Consultant ENT surgeons conducted all procedures under general anaesthesia, noting operating time and intraoperative blood loss. Analysis was conducted using IBM SPSS Statistics, using an independent sample t-test with a significance level of p-value ≤0.05

Results: The mean operative time was significantly shorter in the monopolar cautery group compared to the bipolar cautery group (6.23 ± 0.64 min vs. 11.63 ± 0.98 min; mean difference −5.40 min; 95% CI: −5.83 to −4.97; $p<0.001$). Conversely, mean intraoperative blood loss was significantly greater in the monopolar group than in the bipolar group (17.07 ± 2.61 mL vs. 11.26 ± 1.25 mL; mean difference 5.81 mL; 95% CI: 4.75 to 6.86; $p<0.001$). These findings were consistent across all stratified subgroups based on age, gender, residence, and socioeconomic status.

Conclusion: Bipolar cautery tonsillectomy results in less intraoperative blood loss and better haemostasis than monopolar cautery, though it may prolong operative time. It is recommended for patients at higher risk of bleeding. Further large randomized controlled trials are needed to include postoperative outcomes.

Keywords: Tonsillectomy, Monopolar cautery, Bipolar cautery, Intraoperative blood loss, Operative time, Haemostasis.

INTRODUCTION

Tonsillectomy, still a commonest ENT procedure world over, accounts for 20-40% of all the ENT surgeries (1). With the advances in antimicrobial therapy and development of specific indications of tonsillectomy, the total number of tonsillectomies performed are markedly reduced (2). In recent years various surgical techniques and methods are evolved to reduce morbidity and mortality related to tonsillectomy (3, 4). Healthy tonsils provide immune protection against various pathogens whereas infected tonsils are potential source of systemic complications and reduced production of antibodies (5). Although tonsillectomy is an effective treatment

option but it involves post-operative pain and discomfort due to exposed nerve endings and involves the risk of post-operative bleeding which are its commonest complications (6, 7). Various techniques including blunt dissection, electrocautery, coblation, laser ablation, guillotine method, cryosurgery, ultrasound ablation and monopolar and bipolar diathermy are used to perform this surgery but comparison amongst any of these is still inconclusive that which of these has edge over another (8). Priority should be to opt out the one with minimum time for surgery, minimal blood loss and least post-operative morbidity and mortality and also addresses affordability of the patient (6, 9). The debate about best method is still ongoing. Tonsillectomy includes cold and hot methods. Both methods having their own pros and cons. The cold dissection methods have reportedly less post-operative pain, hemorrhage and other complications whereas hot techniques reduced the time of surgery and amount of blood lost during surgery but are more painful and delay healing of wounds. Depending on experience, training and available equipment, surgeon usually prefers one particular method over the other (10, 11). Electrocautery uses monopolar or bipolar diathermy to dissect and remove the entire tonsil. The heat of cautery can reach up to 300 to 400°C to bring about hemostasis. Monopolar cautery has two electrodes, essentially, one of which is the active electrode that is grasped by the surgeon and used to make incisions and dissections, and the other is counter electrode that is placed near the thigh of the patient (12). The handpiece enables a surgeon to make an accurate cut on the tonsillar capsule without injuring the muscle around it. The machine is set at blend mode in case of monopolar diathermy to simultaneously cut and coagulate and to avoid surrounding muscle burns. In bipolar diathermy both the electrodes are in surgeon's hand and allows for cauterization of blood vessels and hemostasis between the forceps thus avoiding the need for tonsillar fossa packing (5, 13). Bipolar cautery is a safe method of tonsillectomy. Heat dispersion in bipolar cauterization is limited to few milliliters because electrical current flows between two prongs of the forceps which minimizes risk of injuring surrounding tissues (14, 15). The designers of monopolar cautery assert that it reduces blood loss and surgical time by enabling concurrent hemostasis and tissue dissection. However, it leads to greater post-operative discomfort and delayed wound healing compared to traditional procedures. Thermal tissue damage due to high temperatures i.e., 300°C results in these complications. On the other hand, the developers of bipolar cautery claims that it reduces the tissue damage because it precisely cauterizes the area between the prongs (8). The outcomes of previous researches showed mean operating time of 6.25 ± 1.81 minutes for monopolar diathermy and 11.9 ±2.12 minutes for bipolar diathermy (16). Similarly, intraoperative blood loss of 16.70 ± 4.70 ml by monopolar cautery12 and 12 ±2.0 ml for bipolar cautery diathermy.

Previous researches showed monopolar cautery takes less operating time than bipolar cautery tonsillectomy but bipolar cautery claims to be better which will be researched in this article. My study aims to proof bipolar cautery tonsillectomy as a better option than monopolar cautery tonsillectomy both in terms of less intraoperative blood loss and reduced operative time but there are only few studies available in Pakistan in this regard.

METHODOLOGY

This non-randomized controlled trial was conducted from 01 September 2025 to 1st December 2025 at Faisalabad Medical University and its affiliated hospitals. A total of 60 patients were enrolled in the study, with 30 patients undergoing monopolar cautery tonsillectomy and 30 patients undergoing bipolar cautery tonsillectomy. The sample size was calculated using the WHO sample size calculator for comparison of two mean values, taking a test value of population mean as 12.20, anticipated population mean as 16.7, standard deviation of 3.13, power of study of 90%, and level of significance of 5%.

Non-probability consecutive sampling technique was employed. Patients aged 8–15 years, including both males and females, having a history of at least six episodes of tonsillitis within one year were included in the study. Patients with diabetes mellitus, bleeding diathesis, other ENT comorbidities such as cleft lip or cleft palate, systemic complications of tonsillitis, deviated nasal septum (DNS), nasal polyps, and patients in whom atropine was used peri-operatively were excluded from the study. After obtaining approval from the Institutional Ethical Review Committee, informed consent was obtained from the parents/guardians of all eligible patients. Patients fulfilling the inclusion criteria were admitted through the outpatient department (OPD) and prepared for surgery after routine preoperative investigations. All surgical procedures were performed by consultant ENT surgeons to maintain uniformity of results.

Under general anesthesia, after insertion of the mouth gag, operative time was recorded from the incision made parallel to the anterior pillar until removal of the mouth gag. Patients were allocated into two groups according to the surgical technique used. In one group, tonsillectomy was performed using monopolar cautery, whereas bipolar cautery was used in the other group. Intraoperative blood loss was assessed by measuring the volume collected in the suction bottle and by weighing surgical swabs before and after the procedure. One-gram increase in swab weight was considered

equivalent to one milliliters of blood loss. Total blood loss was calculated by adding the blood volume in the suction bottle to the difference in swab weights before and after surgery.

Data were collected using a structured proforma. Statistical analysis was performed using IBM SPSS Statistics. Qualitative variables such as gender and comorbid conditions were presented as frequencies and percentages. Quantitative variables including age, operative time, and intraoperative blood loss were expressed as mean ± standard deviation. Independent sample t-test was applied to compare operative time and intraoperative blood loss between the two groups. A p-value of ≤0.05 was considered statistically significant. Effect modifiers including age and gender were controlled through stratification, followed by post-stratification independent sample t-test.

RESULTS

A total of 60 patients were included in the study, with 30 patients in the monopolar cautery group and 30 patients in the bipolar cautery group. The mean age of participants in both groups was 11.83 ± 1.76 years. Most of the patients were older than 10 years of age, and males predominated in both groups. Baseline demographic and clinical characteristics including age, gender, residence, socioeconomic status, diabetes mellitus, hypertension, and bleeding diathesis were comparable between the two groups, with no statistically significant difference observed (p>0.05). Table 1 demonstrates the baseline demographic and clinical characteristics of patients undergoing monopolar and bipolar cautery tonsillectomy. The mean age was identical in both groups (11.83 ± 1.76 years; p=1.000). Most patients belonged to the age group >10 years in both monopolar and bipolar groups (73.3% each). Male patients constituted 56.7% of the monopolar group and 60.0% of the bipolar group (p=0.793). Rural residence was more common in the monopolar group (63.3%) compared to the bipolar group (50.0%), although the difference was not statistically significant (p=0.297). Regarding socioeconomic status, the majority of participants belonged to low- and middle-income groups in both study arms (p=0.687). Diabetes mellitus and hypertension were observed in a small proportion of patients, with no significant intergroup difference. No patient in either group had bleeding diathesis (Table 1).

Table 1. Baseline Demographic and Clinical Characteristics

Variable		Monopolar (n=30)	Bipolar (n=30)	p-value
Age		11.83 ± 1.76	11.83 ± 1.76	1.000
Age groups	≤10	8 (26.7%)	8 (26.7%)	0.614
	>10	22 (73.3%)	22 (73.3%)	
Gender	Male	17 (56.7%)	18 (60.0%)	0.793
	Female	13 (43.3%)	12 (40.0%)	
Residence	Rural	19 (63.3%)	15 (50.0%)	0.297
	Urban	11 (36.7%)	15 (50.0%)	
SES	Low	13 (43.3%)	10 (33.3%)	0.687
	Middle	11 (36.7%)	14 (46.7%)	
	High	6 (20.0%)	6 (20.0%)	
Diabetes mellitus	Yes	3 (10.0%)	0 (0.0%)	0.076
	No	27 (90.0%)	30 (100%)	
Hypertension	Yes	1 (3.3%)	2 (6.7%)	0.554
	No	29 (96.7%)	28 (93.3%)	
Bleeding diathesis	No	30 (100%)	30 (100%)	—

Table 2 compares operative time and intraoperative blood loss between the monopolar and bipolar cautery groups. The mean operative time was significantly shorter in the monopolar group compared to the bipolar group (6.23 ± 0.64 minutes vs. 11.63 ± 0.98 minutes), with a mean difference of -5.40 minutes (95% CI: -5.83 to -4.97; p<0.001). Conversely, intraoperative blood loss was significantly higher in the monopolar cautery group than in the bipolar cautery group (17.07 ± 2.61 mL vs. 11.26 ± 1.25 mL), showing a mean difference of 5.81 mL (95% CI: 4.75 to 6.86; p<0.001) (Table 2).

Table 2. Comparison of operative time and intraoperative blood loss between monopolar and bipolar cautery

Outcome Variable	Monopolar	Bipolar	Mean Difference	95% CI	p-value
Operative time (min)	6.23 ± 0.64	11.63 ± 0.98	-5.40	-5.83 to -4.97	<0.001
Blood loss (mL)	17.07 ± 2.61	11.26 ± 1.25	5.81	4.75 to 6.86	<0.001

Table 3 presents stratified analysis of operative time according to demographic and clinical variables. Across all age groups, genders, residence categories, and socioeconomic classes, operative time remained significantly shorter in the monopolar cautery group compared to the bipolar cautery group (p<0.001). In patients aged ≤10 years, operative time was 5.77 ± 0.58 minutes in the monopolar group versus 10.46 ± 0.27 minutes in the bipolar group. Similarly, among patients aged >10 years, operative time was significantly lower in the monopolar group (6.39 ± 0.58 minutes) than the bipolar group (12.05 ± 0.78 minutes). Male and female patients in the monopolar group also demonstrated significantly reduced operative time compared to the bipolar group. Similar statistically significant findings were observed after stratification by residence and socioeconomic status. Among hypertensive patients, operative time was also significantly shorter in the monopolar group (p=0.009). Stratified comparison could not be performed for diabetic patients due to absence of diabetic cases in the bipolar group (Table 3).

Table 3. Stratified comparison of operative time between monopolar and bipolar cautery tonsillectomy

Stratification Variable		Monopolar	Bipolar	Mean Difference	p-value
Age group	≤10 years	5.77 ± 0.58	10.46 ± 0.27	-4.69	<0.001
	>10 years	6.39 ± 0.58	12.05 ± 0.78	-5.65	<0.001
Gender	Male	6.23 ± 0.67	11.69 ± 1.03	-5.46	<0.001
	Female	6.22 ± 0.61	11.53 ± 0.95	-5.31	<0.001
Residence	Rural	6.32 ± 0.67	11.71 ± 1.12	-5.39	<0.001
	Urban	6.06 ± 0.56	11.54 ± 0.86	-5.48	<0.001
SES	Low	6.01 ± 0.51	11.02 ± 0.85	-5.02	<0.001
	Middle	6.29 ± 0.59	11.49 ± 0.72	-5.19	<0.001
	High	6.59 ± 0.86	12.96 ± 0.19	-6.37	<0.001
Diabetes mellitus	No	6.20 ± 0.64	11.63 ± 0.98	-5.42	<0.001
	Yes	6.44 ± 0.65	—	—	—
Hypertension	No	6.20 ± 0.63	11.52 ± 0.92	-5.31	<0.001
	Yes	6.95 ± 0.00	13.15 ± 0.07	-6.20	0.009*

Table 4 shows stratified analysis of intraoperative blood loss between the two study groups. In all stratified categories, monopolar cautery was associated with significantly greater blood loss compared to bipolar cautery (p<0.001). Among patients aged ≤10 years, mean blood loss was 15.11 ± 2.19 mL in the monopolar group compared to 9.66 ± 0.27 mL in the bipolar group. Similarly, in patients aged >10 years, blood loss was significantly higher in the monopolar group (17.78 ± 2.41 mL) than in the bipolar group (11.85 ± 0.90 mL). Both male and female patients undergoing monopolar cautery experienced greater intraoperative blood loss than those undergoing bipolar cautery. Similar findings were observed after stratification by residence and socioeconomic status. In hypertensive patients, monopolar cautery resulted in significantly higher blood loss compared to bipolar cautery (21.80 ± 0.00 mL vs. 13.20 ± 0.28 mL; p=0.026). Stratified analysis for diabetic patients could not be calculated because no diabetic patient was present in the bipolar group (Table 4).

Table 4. Stratified comparison of intraoperative blood loss between monopolar and bipolar cautery tonsillectomy

Stratification Variable		Monopolar	Bipolar	Mean Difference	p-value
Age group	≤10 years	15.11 ± 2.19	9.66 ± 0.27	5.44	<0.001
	>10 year	17.78 ± 2.41	11.85 ±		

	s		0.90		
Gender	Male	17.39 ± 2.45	11.28 ± 1.31	6.11	<0.001
	Female	16.65 ± 2.86	11.24 ± 1.22	5.41	<0.001
Residence	Rural	17.38 ± 2.63	11.27 ± 1.38	6.10	<0.001
	Urban	16.54 ± 2.61	11.25 ± 1.16	5.28	<0.001
SES	Low	15.78 ± 1.95	10.59 ± 1.14	5.19	<0.001
	Middle	16.90 ± 2.09	11.04 ± 0.95	5.86	<0.001
	High	20.17 ± 2.40	12.90 ± 0.40	7.27	<0.001
Diabetes mellitus	No	17.12 ± 2.53	11.26 ± 1.25	5.86	<0.001
	Yes	16.61 ± 3.89	—	—	—
Hypertension	No	16.91 ± 2.50	11.13 ± 1.18	5.78	<0.001
	Yes	21.80 ± 0.00	13.20 ± 0.28	8.60	0.026*

DISCUSSION

Tonsillectomy is one of the most common surgical procedures performed in otorhinolaryngology, which is used in a significant number of otorhinolaryngologic procedures worldwide (4, 17). The best surgical approach remains a topic of debate, even though this procedure has been performed for many years. The present non-randomized controlled trial directly compared monopolar and bipolar cautery tonsillectomy with regards to operative time and blood loss, both directly relevant to patient safety and surgical efficiency.

In the current study, the mean operative time was significantly shorter in the monopolar cautery group (6.23 ± 0.64 minutes) compared to the bipolar cautery group (11.63 ± 0.98 minutes), with a statistically significant mean difference of 5.40 minutes ($p<0.001$). These findings are consistent with those reported by Saleemi et al., who documented a mean operative time of 6.25 ± 1.81 minutes for monopolar diathermy versus 11.9 ± 2.12 minutes for bipolar diathermy (16). Similarly, Neeraj et al. reported monopolar cautery to be faster than bipolar cautery, attributing this advantage to the ability of monopolar instruments to simultaneously cut and coagulate tissue in a single step, thereby reducing the number of individual manoeuvres required during dissection (8). The blend mode setting utilised in monopolar cautery enables concurrent haemostasis and tissue division, explaining its comparatively shorter operative duration (5).

With respect to intraoperative blood loss, the bipolar cautery group demonstrated significantly superior haemostasis, with a mean blood loss of 11.26 ± 1.25 mL compared to 17.07 ± 2.61 mL in the monopolar group ($p<0.001$). This finding supports the result of Khan et al., who reported that bipolar diathermy had superior hemorrhage control during tonsillectomy, when compared to unipolar diathermy (14). This advantage relates to the physiology of the flow of electrical current in bipolar devices: current flows only between the two prongs of the forceps, which ensures that the thermal energy is not spread to the surrounding tissue; thus reducing the amount of collateral or unwanted tissue damage (15). This targeted cauterization leads to better sealing of the vessels with less unintended damage to adjacent tissues and thus to less blood loss.

Abdel-Aziz et al. summarized the various methods of tonsillectomy and found that bipolar cautery is a very effective method of achieving hemostasis, since the forceps can be used to target individual bleeding points allowing for lower temperatures (only up to 100–150°C) to cause the thermal damage, whereas monopolar cautery, although effective at dissection, brings about a higher temperature (up to 300–400°C) and may result in wider thermal injury, which in turn may lead to the delayed bleeding from eschar sloughing (5). Similarly, Kandemir et al. reported that monopolar diathermy and other electrocautery techniques had greater thermal spread than dissection and coblation, contributing to increased blood loss during the procedure in the monopolar group (1). In all subgroups, stratified according to age group (≤10 years and >10 years), gender, place of residence, and socioeconomic status, the monopolar group consistently had a shorter operative time with significantly higher intraoperative blood loss ($p<0.001$ in each subgroup). This blood loss difference was especially marked in hypertensive patients (21.80 ± 0.00 mL monopolar, vs 13.20 ± 0.28 mL bipolar, $p=0.026$), indicating potential further blood loss reduction with bipolar cautery in patients with cardiovascular comorbidities. This observation warrants further investigation in future studies with larger sample sizes.

The findings of the present study are in agreement with Soy et al., who reported that bipolar cautery tonsillectomy resulted in reduced haemorrhage

compared to monopolar methods, and also demonstrated that careful control of energy dose in bipolar instruments further optimises haemostatic outcomes and minimises postoperative pain (15). Vadivel et al. observed that hot techniques such as electrocautery reduce intraoperative bleeding compared to cold dissection, but noted that the extent of thermal injury varies with the type of diathermy used (3). The present data indicate that within electrocautery-based techniques, bipolar modality achieves superior haemostasis relative to monopolar cautery.

Postoperative haemorrhage is one of the most feared complications of tonsillectomy, with reported rates varying between 0.1% and 8.1% in the literature (18). While the present study focused exclusively on intraoperative parameters, the superior haemostatic profile of bipolar cautery observed herein suggests a potential benefit in reducing the risk of secondary haemorrhage as well. Bugten et al. showed that quality improvement programs aimed at the reduction of hemorrhages after tonsillectomy can be successful in reducing postoperative bleeding by changing the technique (18). One such technique modification, as a result of its specific energy delivery, might be bipolar cautery. But there is a need for prospective studies to confirm the inference by specifically measuring the postoperative hemorrhage rates for each cautery technique.

In practice, the small extension of the surgical time with bipolar cautery is about 5.4 minutes in this series of cases, which should be balanced against the hemostatic benefits. The decrease in blood loss during the procedure with bipolar cautery is a clinically significant benefit when compared to the operative time, which is conducted under general anesthetic, and the absolute difference in blood loss from both procedures is clinically small, especially in pediatric patients where the blood loss is a relatively large percentage of total blood volume (19). In a meta-analysis of RCTs comparing modern technology-assisted tonsillectomy to conventional tonsillectomy, Alexiou et al. found no single superiority regarding any of the parameters and that individual surgeon and patient experience should influence the choice of technique (2).

Ilyas et al. compared the coblation tonsillectomy with the conventional dissection tonsillectomy in Pakistan patients and showed that newer energy-based techniques have hemostatic benefits but cost-containment and equipment availability are significant factors in resource-limited settings (9). In this context the present study is relevant as monopolar as well as bipolar diathermy are readily available in the public sector hospitals in Pakistan and it is interesting to compare the two modalities for local clinical practice. Based on the results, bipolar cautery is a viable electrocautery method in certain environments where minimizing blood loss is important, without adding significant extra costs or equipment obstacles.

It is important to note a few limitations of the present study. First, it is a non-randomized study and so there is a potential for selection bias, even though baseline demographic and clinical information were well balanced between the two groups. Secondly, the small number of patients (30 per group) reduces the applicability of the results. Thirdly, the results of the postoperative evaluations, such as pain scores, wound healing, postoperative hemorrhage and patient satisfaction were not collected, and it is not possible to conduct a thorough evaluation of the two techniques. Fourth, the exclusion of patients with diabetes mellitus and atropine use may be representative of the need to exclude these patients for internal validity, but further limits generalizability to a wider clinical population. Larger numbers of patients should be included in these studies, with postoperative follow-up, and a more comprehensive comparison of the techniques drawn from a randomized allocation of patients is required.

CONCLUSION

The bipolar cautery tonsillectomy results in significantly better intraoperative hemostasis and less intraoperative blood loss than monopolar cautery, while the operative time is modestly longer. These results would support the use of bipolar cautery tonsillectomy, especially in patients with a high risk of hemorrhages. Further characterization of the comparative profile of these techniques is recommended through prospective randomized controlled trials which include outcome measures for Postoperative Pain, Wound Healing, Hemorrhage Rates and Patient Satisfaction.

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