Safety and efficacy of bipolar versus monopolar transurethral resection of the prostate in benign prostatic hyperplasia: A comparative study

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ABSTRACT

Introduction: Monopolar transurethral resection of the prostate (TURP) is considered the gold standard for surgical management of benign prostatic hyperplasia (BPH). Recently, TURP using bipolar electrocautery is increasingly used with promising results over conventional TURP. The aim of this study was to compare the peri-operative outcomes between monopolar and bipolar TURP. **Methods:** In this study, patients who underwent TURP between January 2023 and June 2025 were analyzed retrospectively. The patients were divided into two groups: monopolar TURP (n=71) and bipolar TURP (n=116). The parameters including prostate volume, symptoms scores, maximum flow rate (Qmax), resection time, resected tissue weight, decrease in hemoglobin and sodium, and complications were recorded and analyzed. **Results:** The amount resected prostate tissue was significantly greater in bipolar TURP (19.4±9.4 vs 16.4±7.0 g, p=0.023), although the resection time was comparable between two groups. Bipolar TURP (bTURP) resulted early catheter removal (2.35±0.6 vs 2.77±1.4 days; p=0.007) and shorter hospital stay (4.28±0.6 vs 4.68±0.9 days; p=0.001) than monopolar TURP (mTURP). There was significant decrease in post-operative serum sodium concentrations in mTURP (3.14 ± 3.0 vs 1.5 ± 2.4 mEq/L, p<0.001). The improvement in symptoms, quality of life, Qmax, and complications encountered were similar in two groups. Transurethral resection (TUR) syndrome occurred in one patient in mTURP group whereas none occurred in bTURP group. **Conclusions:** Bipolar TURP is as effective and safe as monopolar TURP in BPH. Moreover, bipolar resection has the additional advantage of early catheter removal, shorter hospital stay, minimal electrolyte imbalance, and less post-operative morbidity.

Keywords: Benign prostatic hyperplasia, bipolar, monopolar, transurethral resection of prostate.

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INTRODUCTION

Benign prostatic hyperplasia (BPH) is one of the most common urological diseases causing lower urinary tract symptoms (LUTS) in aging men. With increasing age, the prevalence of LUTS due to BPH increases, approaching 50% by age 60 years and 90% by age 85 years.[1] Several treatment modalities are available for the treatment of BPH with LUTS which includes watchful waiting, pharmacological therapy, minimally invasive therapy, transurethral resection of prostate (TURP), enucleation, ablation and open prostatectomy. Surgical treatment is recommended for patients who do not respond to medical treatment or who develop complications related to BPH.[2] TURP is still regarded as the gold standard for the treatment of BPH. The first TURP was performed by Maximilian Stern (1843-1946) in 1926 in the USA.[3] Conventional TURP utilizes monopolar current and non-conducting solutions (like glycine, dextrose, sorbitol, distilled water) as irrigating solutions. However, TURP is associated with various complications, including bleeding, TUR syndrome, incontinence, urethral stricture, bladder neck contracture, impotence and prolonged catheterization.[4] Bleeding is the most common complication while transurethral resection

(TUR) syndrome is the most dreaded one, which occurs due to excessive absorption of hypotonic solution leading to dilutional hyponatremia.[4,5] Although the mortality was reduced (0.1%) in TURP, the morbidity rate is still high (11.1%).[6]

Various measures have been attempted to minimize these complications and increase the efficacy. Use of bipolar energy is one attempt where a high-frequency current is generated and flows between two electrodes. One important advantage of bipolar TURP (bTURP) is the elimination of TUR syndrome risk due to the use of isotonic fluid such as normal saline, instead of the hypo-osmolar irrigation fluid used in monopolar TURP (mTURP).[7,8] The other advantages of bipolar current includes less thermal damage and charring, and better visibility. Studies have shown that bTURP is safe and effective with lesser bleeding, faster resection, lower irrigation time and indwelling catheter time, and shorter hospital stay.[9]

Use of bTURP in BPH has been increasing in Nepal as the technology is gradually being available in the hospitals. However, there is a paucity of studies evaluating the safety and efficacy of bTURP and its comparison with the conventional mTURP. In this study, we aimed to compare the complications and clinical outcomes of monopolar and bipolar TURPs.

METHODS

This hospital-based, retrospective, comparative study was performed in Gandaki Medical College Teaching Hospital, Pokhara Nepal. The charts of all patients undergoing TURP between January 2023 and June 2025 were reviewed. This study was reviewed and approved by the Institutional Review committee of the institute (Ref. No. 102/081/082). The consent from the patients was not obtained due to the retrospective design of the study. Patients diagnosed as BPH with LUTS who underwent TURP were included in the study. The indications for surgical intervention were failure of medical management and patients having complications due to BPH such as urinary retention, bleeding, recurrent infections, obstructive uropathy, etc. Patients diagnosed with prostate cancer, neurogenic lower urinary tract dysfunction, urethral stricture and those with a history of previous prostate surgery were excluded from the study. Patients were divided into two groups based on surgical method: monopolar TURP (mTURP) and bipolar TURP (bTURP).

All TURP surgeries were performed under spinal anesthesia in lithotomy position by a single urologist. Monopolar TURP was performed with a Richard Wolf 26 Fr resectoscope (Knittlingen, Germany) and a Force Fx (Valley Laboratory) electrosurgical generator. In bipolar group, Richard Wolf 24 Fr resectoscope (Knittlingen, Germany) with KLS Martin (Germany) bipolar system were used. The irrigation solution for bTURP and mTURP were NaCl 0.9% and Glycine 1.5% respectively. After resection, 22 Fr 3-way Foley catheter was inserted, and normal saline irrigation was started. The bladder irrigation was continued till urine was clear, typically for 24 hours and catheter was removed usually on second post-operative day. The hemoglobin and serum sodium was measured immediately after surgery. Patients were followed up at outpatient department at one and three months, and the data were recorded. The demographic parameters, International Prostate Symptom Score (IPSS), quality of life (QoL) score, maximum urinary flow rate (Qmax), post voiding residual urine volume (PVR), serum prostate specific antigen (PSA) level, prostate volumes, pre-operative hemoglobin and serum sodium levels were obtained from the patients chart in the medical record department. Data on operation time, weight of resected prostate tissue, decrease in hemoglobin and sodium levels, immediate post-operative complications like bleeding, need for blood transfusion, urinary retention and UTI or sepsis, catheter removal time, and hospital stay were recorded. Also, the follow up findings including IPSS, QOL, Qmax, PVR; late complications such as stricture, incontinence, urinary retention, and histopathology reports were obtained.

Finally, these data were analyzed using Statistical Package for the Social Sciences (SPSS), version 25.0 (SPSS Inc., Chicago, IL, USA) and compared between two groups. Discrete variables were evaluated by chi-square test and continuous variables by unpaired student t-test. All statistical tests were based on two-tailed probability, and a p-value <0.05 was considered statistically significant.

RESULTS

In this study, medical records of 220 patients who underwent TURP were assessed. However, 33 patients were excluded as they didn't meet the inclusion criteria (previously diagnosed carcinoma prostate- 4, patients with urethral stricture- 15, history of previous prostate surgery- 6, neurogenic lower urinary tract dysfunction- 8). Thus, total of 187 patients (mTURP, n= 71 and bTURP, n= 116) were analyzed.

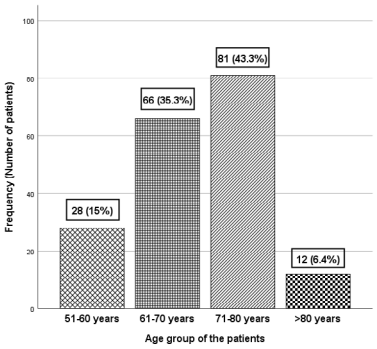

Figure 1: Age distribution of the patients (n=187)

The mean age of the patients was 69.27±7.2 years. Figure 1 shows the age distribution of the patients, and most patients were between 60 to 80 years. Table 1 shows the preoperative baseline parameters and their comparison between two groups. The mean prostate volume was 52.8±21.2 mL and serum PSA level was 3.5±3.2 ng/mL. The duration of LUTS, IPSS symptom score, QoL score and preoperative hemoglobin and sodium levels were comparable between two groups. The peak flow rate (Qmax) was 9.26±4.0 mL/sec and was similar in both groups. Around 80(42.8%) patients had pre-operative urinary retention with perurethral catheter in-situ.

Table 1: Patients' baseline characteristics (n=187)

Parameters	Total (n=187)	Monopolar (n=71)	Bipolar (n=116)	p-value
Age in years*	69.27±7.2	69.9±7.2	68.8±7.1	0.306
Symptoms duration* (months)	41.0±30.9	43.3±24.6	39.6±34.1	0.423
Prostate volume* (mL)	52.8±21.2	51.8±20.5	53.3±21.6	0.632
Serum PSA* (ng/mL)	3.5±3.2	3.2±2.2	3.7±3.5	0.266
Preoperative hemoglobin* (g/dL)	13.5±1.3	13.4±1.2	13.5±1.3	0.611
Preoperative Na* (mEq/L)	139.9±2.8	140±2.6	139.8±2.9	0.725
Qmax* (mL/sec)	9.26±4.0	9.0±4.2	9.3±4.0	0.671
IPPS score*	23.8±5.1	23.8±5.1	23.7±5.0	0.910
QoL score*	4.9±0.85	5.1±0.76	4.9±0.8	0.07†
Patients with preoperative catheter†**	80(42.8%)	26(36.6%)	54(46.5%)	0.183
Postvoid residual urine* (mL)	117.4±131.8	126.4±138.5	114.9±131.3	0.776
IPP* (mm)	15.7±6.6	15.2±7.9	15.9±6.1	0.653

Values are presented as mean ± standard deviation or number (percentage). *analysis by Student t-test; **analysis by chi-square test. IPP, intravesical protrusion of prostate; †denotes statistical significance (p<0.05)

The resected prostate tissue was significantly greater in bipolar group (19.4±9.4 vs16.4±7.0,p=0.023), although the resection time was comparable between two groups (Table 2). The length of hospital stay (4.28±0.6 vs 4.68±0.9; p=0.001), and post-operative urethral catheter duration (2.35±0.6 vs 2.77±1.4; p=0.007) were significantly lower in bipolar group as compared to monopolar group. The decrease in hemoglobin level was comparable, however, the post-operative fall in sodium level was significantly high in monopolar TURP group (3.14±3.0 vs 1.5±2.4 mEq/L, p<0.001). (Table 2)

Table 2: Peri-operative parameters between two groups (n=187)

Parameters	Monopolar (n=71)	Bipolar (n=116)	p-value*
Resection time (min)	56.4±8.7	58.9±16.1	0.222
Resected prostate tissue (g)	16.4±7.0	19.4±9.4	0.023
Length of hospital stay (days)	4.68±0.9	4.28±0.6	0.001**
Post-operative catheter duration (days)	2.77±1.4	2.35±0.6	0.007**
Decrease in Hb (g/dL)	1.7±1.1	1.6±0.9	0.528
Decrease in Na (mEq/L)	3.14±3.0	1.5±2.4	<0.001**
IPSS at follow up	8.5±3.0	8.6±3.5	0.836
QOL at follow up	1.66±0.8	1.59±0.9	0.606
Qmax at follow up (mL/sec)	17.5±5.2	18.5±3.8	0.185

Values are presented as mean ± standard deviation; *Statistical analysis by Student t-test; **denotes statistical significance (p<0.05)

The intra-operative and post-operative complications were minimal and comparable between mTURP and bTURP groups. (Table 3) Clot retention occurred in 20(10.7%) patients and out of them nine patients required cystoscopic removal of clots. After removal of urethral catheter post-operatively, urinary retention occurred in 8(4.3%) patients requiring recatheterization. Blood transfusion was required in 4(2.1%) patients, two in each group. TUR syndrome occurred in one patient in monopolar TURP group (which was treated with 3% NaCl in ICU setup), whereas none of the patients from bTURP developed TUR syndrome. There was no mortality after TURP in this study. At follow up period, 7(9.8%) patients in mTURP and 9(7.7%) patients in bTURP developed some complications.

Table 3: Post-operative complications (n=187)

Parameters	Monopolar (n=71)	Bipolar (n=116)	p-value*
Perioperative complications	16(22.5%)	16(13.8%)	0.123
Blood transfusion	2(2.8%)	2(1.7%)	0.635
Clot retention	9(12.7%)	11(9.5%)	0.493
Urinary retention	5(7.0%)	3(2.6%)	0.159
TUR syndrome	1(1.4%)	0	
Complications at follow up	7(9.8%)	9(7.7%)	0.562
Urethral stricture	2	3	
Bladder neck contracture (n)	1	1	
Urge incontinence (n)	2	3	
UTI (n)	4	4	

Values are presented as number (percentage); *Statistical analysis by chi-square test

At three months follow up, there was significant improvements in IPSS score, QoL score and Qmax, however, there was no significant difference between two groups. Histopathology showed nodular hyperplasia of prostate (BPH) as the most common finding followed by BPH with prostatitis. Prostate cancer was found in 4(2.1%) patients;

three in bipolar and one in monopolar group. (Figure 2)

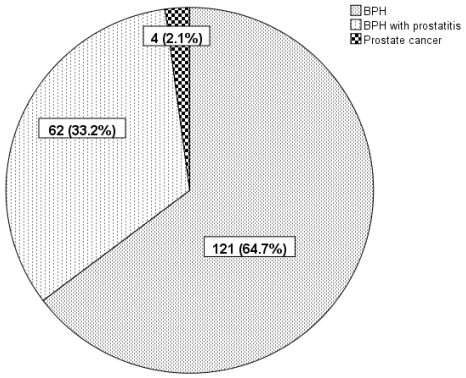

Figure 2: Histopathology reports of the resected prostate tissue (n=187)

DISCUSSION

BPH is a common disease affecting older men, often leading to troublesome symptoms, and a decrease in quality of life. Approximately 20% of symptomatic BPH patients need surgical intervention.[10] Apart from failure of medical management, development of complications like recurrent urinary retention, recurrent urinary tract infections, recurrent hematuria, renal failure, and bladder stones are the indications of surgery in BPH patients.[11] Hence, the goal of TURP is to reduce the bothersome symptoms, improve the quality of life and minimize the complications. TURP is still the most commonly performed surgery in patients with BPH. Despite having a low mortality rate, TURP is associated with some perioperative morbidities, particularly hemorrhage, clot retention and dilutional hyponatremia leading to TUR syndrome. TUR syndrome, which occurs due to dilutional hyponatremia owing to use of hypo-osmolar irrigating fluid, is the most severe complication with reported incidence of 2% after monopolar TURP.[12] The bTURP is the modification of conventional TURP, where the current flows from an active electrode to an adjacent return electrode and normal saline is used for irrigation, which is the biggest advantage of bipolar current. Hence, the tissue damage is minimum, and the risk of dilutional hyponatremia and TUR syndrome is reduced.[13,14]

In our study, most patients undergoing TURP were in seventh decade. The possible reasons could be late presentation to hospitals as well as last preference for surgical intervention by the patients. The mean age of 69.27±7.2 years in our study was comparable with the study by Singh et al. where average age of the patients was 68.9±7.6 years.[15] The mean prostate volume was higher in bipolar group as compared to monopolar, however, the difference was not statistically significant (53.3±21.6 vs 51.8±20.5, p=0.632). Some studies have shown the surgeon's preference for operating on the larger gland using bipolar technology and a possible explanation might be that longer resection without fear of TUR syndrome is possible in bTURP.[16,17] The duration of LUTS due to BPH, the IPSS symptoms score, quality of life affected by BPH and percentage of patients with indwelling urethral catheter due to urinary retention were similar in both groups, and the findings were in accordance with other studies.[7,15]

In our study, the resection time was slightly longer in bTURP group, although it was statistically insignificant (58.9±16.1 vs 56.4±8.7, p=0.222). Studies by Singh et al.,[15] Hirik et al.[7] and Ho et al.[18] have shown comparable resection time between bipolar and monopolar groups. In contrast, other studies have shown significantly longer operation time in patients who underwent bTURP.[17,19,20] Further, Erturhan et al. found shorter operation times for bipolar group as compared to the mTURP.[21] Although the bipolar technique required more time for hemostasis, Singh et al.[15] demonstrated faster resection rate with bTURP.

In this study, the weight of resected prostate tissue was significantly higher in bipolar group, and it was in accordance with the study by Kervancioglu et al. (19.65 vs 14 g; p=0.01).[19] The greater amount of resected tissue may be attributed to faster resection rate in bipolar system. However, Singh et al.[15] found no difference in amount of resected tissue between two groups.

Many reposts suggested that the "cut-and-seal" effect of bipolar technology results in better hemostasis during resection leading to decreased blood loss.[22,23] However, in present study, the fall in hemoglobin level was 1.7±1.1 in mTURP and 1.6±0.9 in bTURP group, which was statistically insignificant (p=0.528). In a study by Madduri et al., the hemoglobin fall was 1.57±0.71 g/dl in mTURP and 1.75±0.77 g/dl in bTURP group, and thus comparable (p=0.28).[17] Similar result was reported by Singh et al.[15] where decrease in hemoglobin was 1.2±1.0 g/dL in monopolar and 1.2±0.7 g/dL in bipolar group; p=0.909.

One of the greatest advantages of bTURP is the use of normal saline solution which virtually eliminates dilutional hyponatremia. The decrease in serum sodium concentration was significantly greater in monopolar than in bipolar resection group. The mean fall in sodium level was 3.14±3.0 mEq/L in mTURP and 1.5±2.4 mEq/L in bTURP patients (p<0.001), and this finding was supported by many other studies. Kong and colleagues found that the decrease in serum sodium in bTURP was 1.03 mEq/L,

which was significantly lower than the drop of 5.01 mEq/L in mTURP with p=0.01.[24] Similar results were reported by Madduri et al.[17] (drop of 3.60±2.89 vs 0.99±0.76 mEq/L; p<0.001), and Singh et al.[15] (4.6±3.0 vs1.2±2.7 mEq/L; p=0,001). In our study, TUR syndrome occurred only in one (1.2%) patient in mTURP group, and there was no TUR syndrome in bTURP patients. Madduri and colleagues reported the occurrence of TUR syndrome in three (2.06%) patients in monopolar and none in bipolar group.[17]

In a meta-analysis of 22 studies comparing monopolar and bipolar TURP, Omar and colleagues reported 35 cases of TUR syndrome that occurred out of a total of 1375 patients who underwent mTURP, whereas there was not a single instance of TUR syndrome occurred in 1401 patients of the bTURP.[16] Therefore, the risk of significant hyponatremia and TUR syndrome always exists in mTURP. Hence, bipolar resection is preferable in elderly patients with larger prostate volume because prolonged resection can be performed without the risk of hyponatremia and TUR syndrome. However, the fluid absorption in bTURP is the same as in mTURP and volume overload can still occur, which may be of concern in patients with cardiac problems.[25]

In present study, bTURP allowed early post-operative catheter removal (2.35±0.6 vs 2.77±1.4 days; p=0.007) and a shorter hospital stay (4.28±0.6 vs 4.68±0.9 days; p=0.001) in comparison to mTURP, and these differences were statistically significant. Supporting our results, Singh et al. have also found early catheter removal (2.52 vs 3.41 days; p=0.022), and significantly shorter hospital stay (3.02 vs 3.88 days; p=0.019) in bipolar group.[15] Similar results were obtained in a study by Lee et al. in which the mean catheter duration was 4.26 vs 4.05 days, p<0.001, and mean hospital stay was 6.6 vs 6 days, p<0.001 in mTURP and bTURP groups respectively.[26] Furthermore, Hirik et al.,[7] and Ahyai et al.[27] in their meta-analysis, compared catheterization time and demonstrated significantly shorter catheter duration in bipolar group. However, other studies didn't show the improvement in hospital stay and catheter duration between two groups.[9,17,19,26,28] Madduri et al.[17] showed that the catheter duration (53.71 vs 53.33 h, p=0.91) and hospital stay (3.65 vs 3.9 days, p=0.19) were comparable between two groups. In another study by Starkman et al., the catheter duration; 3.2(1–15) vs 1.8(1–5) days (p=0.12), and hospital stay; 2.1(1–7) vs 1.2(0–5) days (p=0.11) were not different between monopolar and bipolar TURP patients.[28]

The patients experienced significant decrease in bothersome symptoms, and the quality of life was greatly improved in both groups. The improvement in urine flow, measured by Qmax, was significant (9.26±4.0 to 18.14±4.4 mL/sec) after TURP and comparable between two groups. Bleeding is one of the most common complications of TURP, which is seen in about 5% of patients.[8] Although it is claimed that bipolar electrocautery is more efficient at controlling bleeding, the decrease in hemoglobin level and the blood transfusion rate were not significantly different between monopolar and bipolar resections. The blood transfusion rate in present study was 2.8% and 1.7% in mTURP and bTURP respectively. In one study, 6.89% patients in monopolar and 9.52% patients in bipolar resection required blood transfusion which was not statistically significant (p=0.65).[17] Several studies including meta-analysis also reported that there were no significant difference in transfusion rate between two groups.[27,29] However, in a meta-analysis study, 28 of 1244(2.25%) patients undergoing bTURP and 53 of 1226(4.3%) patients undergoing mTURP required blood transfusion, and the difference was significant (p=0.004).[16]

The perioperative complications were comparable between two groups in our study. The clot retention occurred in 9(12.7%) patients in mTURP and 11(9.5%) patients in bTURP, which was comparable, p=0.493. Similar to our results, Lee et al.[26] reported a clot retention rate of 10.3% in mTURP and 5.3% in bTURP group, (p=0.389); and Madduri et al.[17] found a clot retention rate of 7.58% in mTURP and 19.04% in bTURP group, (p=0.10). However, one meta-analysis reported that 51 of 880(5.6%) patients undergoing mTURP and 24 of 883(2.7%) patients in bTURP had clot retention (RR: 0.48; 95% CI: 0.30–0.77; p=0.002).[16] The complications at three months follow up were minimal, mostly minor and comparable between two groups suggesting satisfactory outcome of TURP.

Reports suggested that the urologists preferred to operate on larger glands using bipolar technology).[17] In a multicenter experience, the urologists favored bTURP for cleanness of cutting (64%), better precision at the apex (61%), and less charring (93%).[30] It is commonly accepted that in bTURP, the cutting is sharp, effortless, and without charring. Theoretically, less charring provides better visibility of the prostatic capsule, thus reducing the risk of perforation. Also, as the current passes between the electrodes in the loop, the risk of urethral stricture associated with current leak should be minimum in bipolar resections.

As the bTURP is being used more frequently, the true advantages will be obvious in the recent future. One aspect is the higher cost of the bipolar electrocautery unit to purchase at first. However, it will be compensated as the

same machine can be used in many open and laparoscopic surgeries as the vessel sealer. The basic surgical steps of monopolar and bipolar resection are the same, except different energy sources are used. Hence, there will be no difficulty in learning bTURP for those practicing mTURP. In fact, due to no relative restriction of time limit of resection, bTURP is easier for the beginner to learn.

In present study, preoperative parameters, the improvement in symptoms and urinary flow, and the complications were comparable between two groups up to three months follow up. However, the bTURP has the advantages of early catheter removal, shorter hospital stay and minimal incidence of hyponatremia.

This study has some limitations. This is a single-center retrospective study, which may have an unavoidable inherent bias. It has relatively short follow-up period which may miss the long-term outcomes. Future multi-centric, randomized studies with larger sample size will better define the role of bTURP in the management of BPH.

CONCLUSIONS

The present study has shown that the bTURP is as effective as conventional mTURP for the treatment of patients with symptomatic BPH. It has the additional advantage of early catheter removal, shorter hospital stay, minimal electrolyte imbalance, and less postoperative morbidity. Further, it can be performed for large adenomas without the fear of TUR syndrome. Hence, bTURP is a promising newer technique with better outcomes and minimal morbidities.

CONFLICTS OF INTEREST: None declared

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AUTHORS' CONTRIBUTIONS

HBKC designed the research, searched the literature, collected the data, performed statistical analysis, and prepared the first draft of the manuscript. SS and RA did the literature search, data interpretation, and manuscript editing. All the authors have read and approved the final draft.

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