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# Third Prize

# Bipolar versus Monopolar Transurethral Resection of Prostate: Randomized Controlled Study

HARBANS SINGH, M.Ch., MAHESH R. DESAI, FRCS, FRCS, PRAJAY SHRIVASTAV, M.CH., DNB, and KISHOR VANI, DNB

## ABSTRACT

*Background and Purpose:* **Transurethral resection of prostate (TURP) using bipolar electrocautery and physiologic saline is a new technical advancement in the field of surgical management of benign prostatic hyperplasia. The purpose of this study was to assess the efficacy and safety of this new technique and to compare the results with those of conventional monopolar TURP.**

*Patients and Methods:* **This study included 60 patients who were randomized 1:1 to bipolar (group 1) or monopolar (group 2) TURP. Bipolar TURP was performed with the Vista CTR resectoscope and generator (ACMI Corp.). Preoperatively, patients were assessed by symptom score, uroflow, and transrectal sonography, and the two groups were comparable with regard to these measures and age. The preoperative and postoperative parameters studied included resection time, amount of tissue resected, irrigant amount, blood loss, fluid absorption, and change in serum sodium and hemoglobin. Postoperatively, patients were assessed for symptoms, symptom score, and uroflow rate at 1 and 3 months.**

*Results:* **There was no difference in resected tissue amount, irrigant amount, fluid absorption, duration and amount of postoperative irrigation, or fall in hemoglobin. The mean resection rate was 0.61 g/min in group 1 and 0.74 g/min in group 2. Serum Na dropped by 4.6 Eq/L in group 2, whereas it fell only 1.2 mEq/L in group 1 ($P < 0.001$). Improvement in symptom and QoL scores and $Q_{max}$ were similar in the two groups. Postoperative dysuria was less common with bipolar resection.**

*Conclusion:* **Bipolar resection of the prostate is as effective as monopolar TURP. Moreover, it does not lead to any change in serum Na and causes less postoperative dysuria.**

## INTRODUCTION

BENIGN PROSTATIC HYPERPLASIA is a universal problem of aging men. Despite the availability of medical treatment, a significant proportion of patients require surgical intervention, for which the available options range from minimally invasive techniques to open procedures. Transurethral resection of prostate (TURP) has been the most common procedure and remains the gold standard, as most of the alternative less-invasive treatments, explored in an attempt to reduce the complications and hospital stay, have failed to equal TURP. Moreover, these techniques require costly instruments, steep learning curve, and long-term follow-up to establish their efficacy and safety. Thus, a technique based on the basic principles of TURP with less morbidity will be logically more acceptable to the patient as well as to the urologist.

The advantages of TURP are extensive tissue removal in a short time and the ability to keep the resection within well-defined landmarks. Despite many technical advances, the morbidity of this procedure has remained constant, in the range of 15% to 18%.[1,2] Fluid absorption with dilutional hyponatremia and TUR syndrome, glycine toxicity, perforation, and blood loss are of concern. In conventional TURP, most of the morbidities are related to the use of nonelectrolyte irrigation fluid and monopolar current, as well as poor vision and mechanical factors. Moreover, fear of TUR syndrome limits the time of re-

Department of Urology, Muljibhai Patel Urological Hospital, Gujarat, India.

Table 1. Clinical Parameters (Means ± SD)

| | *Group 1 (Bipolar)* | *Group 2 (Monopolar)* |
|---|---|---|
| Mean age (years) | 68.9 (7.6) | 67.9 (9.8) |
| IPSS | 20.5 (4.8) | 21.6 (6.3) |
| QoL | 4.6 (0.9) | 4.4 (1.0) |
| $Q_{max}$ (mL/sec) | 5.8 (3.0) | 5.1 (2.0) |
| Postvoid residual urine (mL) | 124 (58) | 136 (52) |
| Patients with retention | 10 | 11 |
| TRUS transition zone volume (cc) | 24.1 (12.7) | 27.9 (11.9) |
| Mean PCAR | 0.82 (0.5) | 0.80 (0.6) |
| Associated morbidities (no. of patients) | 12 | 15 |
| Diabetes | 6 | 8 |
| Hypertension | 7 | 8 |
| Coronary artery disease | 4 | 5 |
| Chronic obstructive pulmonary disease | 3 | 2 |
| ASA grade (no of patients) | | |
| 1 | 16 | 12 |
| 2 | 8 | 9 |
| 3 | 4 | 6 |
| 4 | 2 | 3 |
| Preop hemoglobin (g/dL) | 12.8 (2.5) | 13.2 (1.8) |
| Preop Na (mEq/L) | 139.3 (4.0) | 139.2 (3.2) |
| PSA (ng/mL) | 2.75 | 3.2 |

section, thus requiring selection of cases according to the surgeon's experience.

In order to overcome some of these complications, the bipolar resection technique was introduced. With this newer technological advancement, it seems that the morbidity of TURP can be decreased, and the procedure can be made safer. The advantages of bipolar current includes less thermal damage and charring and better visibility. However, the most important advantage of bipolar electrocautery in transurethral surgery is the ability to use physiologic saline for irrigation, thus precluding TUR syndrome. Less preoperative morbidity will not only make the procedure safe but also will hasten the training and confidence of young urologists. We performed a randomized controlled study to compare the efficacy and morbidity of this newer bipolar technique with the established conventional monopolar TURP.

## PATIENTS AND METHODS

This prospective study was performed between September 2003 and May 2004. The study included 60 men older than 50 years with symptomatic benign prostatic hyperplasia (BPH) requiring surgical intervention. Patients with an International Prostate Symptom Score (IPSS) of $<7$, $Q_{max}$ $>12$ mL/sec, PCAR of $<0.75$ on transrectal ultrasonography,[3] neurologic illness, renal insufficiency, bladder stone, urethral stricture, or taking finasteride were excluded. Patients with chronic retention underwent urodynamic evaluation, and those with Schäfer obstruction grade 2 were included. Patients were randomized 1:1 using envelopes into two groups: bipolar TURP (group 1) and monopolar TURP (group 2). The two groups were similar (Table 1).

Table 2. Parameters Studied

| *Preoperative* | *Peroperative* | *Postoperative* | *Follow-up at 1 and 3 months* |
|---|---|---|---|
| Detailed history | Anesthesia | Serum electrolytes | IPSS |
| IPSS/QoL | Operative time | Hemoglobin | QoL |
| DRE | Resection time | Irrigation | Uroflowmetry |
| Urinalysis/culture | Coagulation time | Amount | PVR |
| Hemoglobin | Weighted of resected | Duration | Urine culture |
| Serum electrolytes | tissue | Duration of catheter | Symptoms |
| Serum creatinine | Irrigant amount | Analgesic requirement | |
| Serum PSA | Fluid absorption | Hospital stay | |
| Uroflowmetry | Blood loss | Symptoms after | |
| Postvoid residual | Complications | catheter removal | |
| urine (PVR) | | | |
| Ultrasonography | | | |
| Transabdominal | | | |
| Transrectal | | | |
| Voiding cystometry | | | |

Factors assessed are shown in Table 2. Serum electrolytes were measured immediately before and after TURP. Hemoglobin was done 24 hours before and 48 hours after the procedure. Intraoperative blood loss was estimated by the indicator dilution method of Freedman and colleagues.[4] The volume of irrigant absorbed during surgery was estimated by the ethanol breath test. Ethanol (30 mL) was added to 3 L of irrigation fluid, and the patient's expired breath was analyzed using an Alco Sensor III intoximeter every 10 minutes during surgery and 30 minutes after the procedure.

A single experienced surgeon performed all resections. All patients received 1 g of cefotaxime 1 hour preoperatively. Bipolar TURP was performed with the 25.6F ACMI Elite system continuous-flow resectoscope with Vista CTR™ (controlled tissue resection) dual-loop electrode and generator (Fig. 1). Cautery settings were 6 to 8 for cutting and 7 for coagulation. Physiologic saline irrigation with 1% ethanol was used. Conventional monopolar TURP was performed with a Wolf 25.5F resectoscope and a Force Fx (Valley Laboratory) electrosurgical generator. At the end of the procedure, a 20F three-way Foley catheter was placed. The surgeon's opinion regarding cutting, hemostasis, vision, and charring was also noted. Saline irrigation was continued as required. The catheter was removed once urine had been completely clear for 24 hours and the patient had passed stool. In patients with large prostates (>40 g of resected tissue), the catheter was removed at 72 hours per protocol. Postoperatively, analgesics were given on patient demand.

Patients were given a questionnaire developed at our center to be filled out preoperatively and weekly after surgery up to 4 weeks or until symptoms subsided. Questions of concern were hematuria, dysuria, urgency, incontinence, and pain in the abdominoperineal region. The nursing staff and registrar responsible for the postoperative care were unaware of the surgical modality. Statistical analysis was carried out using Student's *t*-test, the Mann-Whitney U test, ANOVA, and chi-square test.

## RESULTS

Table 3 shows the perioperative findings. The mean total operative time was 39.3 minutes (range 20–97 minutes) in group 1 and 36.9 minutes (range 13–65 minutes) in group 2. We divided the operative time into resection and coagulation times. Although no difference was noticed in resection time, coagulation time was higher ($p = 0.019$) in group 1 (5.6 *v* 4.6 minutes). With bipolar resection, 24 g (range 10–80 g) and with monopolar 27.6 g (range 5–50 g) of tissue was resected. More than 40 g of tissue was resected in 11 and 10 cases in group 1 and group 2, respectively. Blood loss was 166.0 mL (range 60–450 mL) and 196.0 (range 70–270 mL) for group 1 and group 2, respectively. Hemoglobin decreased by 1.2 g/dL at 48 hours in both groups. We did not find symptoms of TUR syndrome in any patient, but there was a significant fall in serum sodium in group 2, the mean change being −1.2 mEq/L (range −5.0–6.0 mEq/L) and −4.6 mEq/l (0 to −12.0 mEq/L) in group 1 and group 2, respectively ($P < 0.001$). Serum Na <125 mEq/L was noticed in two patients of group 2 and none of group 1. One patient of group 1 and three patients of group 2 had an Na concentration of 125 to 130 mEq/L.

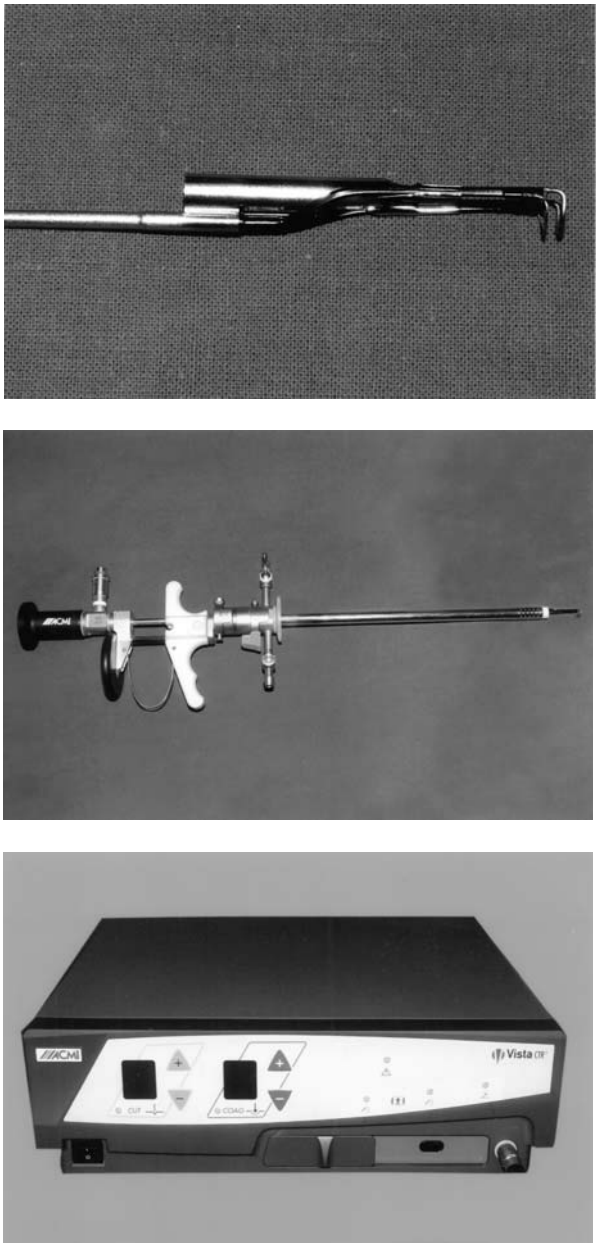


**FIG. 1.** Equipment used for bipolar resection. (ACMI). (**A**) Dual-loop electrode. (**B**) Elite system resectoscope with dual-loop electrode. (**C**) Vista CTR generator.

The mean catheter duration was 2.52 days in the bipolar resection group and 3.4 days in the monopolar group ($P = 0.022$). The hospital stay was shorter (3.02 *v* 3.88 days) in group 1 ($P = 0.019$). Overall, the operating surgeon found bipolar resection sharper, effortless, and without charring.

Efficacy measures and complications are shown in Table 4. The IPSS and QoL score improvements were equal in the two groups. The $Q_{max}$ improved by 227% and 249% in the bipolar and monopolar group, respectively, by 3 months.

There was no difference in the severity and duration of hematuria, urgency, urge incontinence, or abdominoperineal pain in

Table 3. Perioperative Data (Mean [SD])

| | *Group 1 (Bipolar)* | *Group 2 (Monopolar)* | P *value* |
|---|---|---|---|
| Anesthesia | | | |
| Regional | 27 | 28 | |
| General | 3 | 2 | |
| Patients on pre or peroperative SPC | 10 | 12 | 0.395 |
| Weight of resected tissue (g) | 24.0 (18.2) | 27.6 (13.4) | 0.287 |
| Mean operative time (min) | | | |
| Total | 39.3 (17.8) | 36.9 (14.6) | 0.961 |
| Resection | 33.7 (17.2) | 32.3 (13.9) | 0.935 |
| Coagulation | 5.6 (1.0) | 4.6 (1.1) | **0.019**[a] |
| Rate of resection (g/min) | 0.61 (0.18) | 0.74 (0.20) | 0.053 |
| Intraoperative irrigant used (L) | 19.6 (9.2) | 17.3 (6.5) | 0.660 |
| Intraoperative blood loss (mL) | 166.0 (97.8) | 196.0 (57.8) | 0.708 |
| Blood loss (mL/g) | 6.91 | 7.10 | 0.195 |
| Patients with measurable breath ethanol | 9 (30%) | 13 (43.3%) | 0.211 |
| Fluid absorption (total volume) | 133.3 (153.5) | 191.1 (190.0) | 0.303 |
| Fluid absorption (mL/min) | 3.39 | 5.17 | 0.219 |
| Preop Na–postop Na (mEq/L) | 139.3–138.1 | 139.2–134.6 | |
| Change in serum Na (mEq/L) | −1.2 (2.7) | −4.6 (3.0) | **<0.001**[a] |
| Postoperative irrigant used (L) | 9.9 (6.2) | 9.8 (3.4) | 0.405 |
| Duration of irrigation (hours) | 24 (18–30) | 28 (14–36) | 0.18 |
| Analgesic requirement (mg) | 50.0 (91.5) | 77.8 (89.5) | 0.232 |
| Preop–postop Hb (g/dL) | 12.8–11.6 | 13.2–12.0 | |
| Fall in Hb (g/dL) | 1.2 (1.0) | 1.2 (0.7) | 0.909 |
| Duration of catheter (days) | 2.52 (0.5) | 3.41 (0.53) | **0.022**[a] |
| Hospital stay (days) | 3.02 (0.55) | 3.88 (0.58) | **0.019**[a] |

[a]Statistically significant.

the two groups (Table 5). There was less dysuria in the bipolar resection group in the initial 2 weeks. Six patients in group 1 had dysuria for a mean of 2.1 weeks (range 1–4 weeks). However, in group 2, 14 patients had dysuria for a mean of 2.5 weeks (range 2–8 weeks) (Fig. 2).

## DISCUSSION

Twenty percent of patients with symptomatic BPH require surgical intervention.[5] A TURP is the most common procedure for these patients. In the last decade, however, we have wit-

Table 4. Effectiveness Measures and Complications

| | *Group 1 (Bipolar)* | *Group 2 (Monopolar)* |
|---|---|---|
| Symptom score (IPSS) | | |
| Preoperative | 20.5 | 21.6 |
| 1 month (% change)[a] | 60 (−70.7) | 7.0 (−67.6) |
| 3 months (% change) | 5.3 (−74.1) | 6.2 (−71.3) |
| QoL | | |
| Preoperative | 4.6 | 4.4 |
| 1 month | 1.4 | 1.5 |
| 3 months | 1.1 | 1.0 |
| $Q_{max}$ (mL/sec) | | |
| Preoperative | 5.8 | 5.1 |
| 1 month (% change) | 19.8 (241) | 18.6 (264) |
| 3 months (% change) | 19.0 (227) | 17.8 (249) |
| Complications | | |
| Bladder neck stenosis | 0 | 1 |
| UTI | 3 | 4 |
| Secondary hemorrhage | 0 | 1 |
| Stricture | 1 | 0 |

[a]Postop − preop/preop × 100.

TABLE 5. NUMBER OF PATIENTS WITH UROLOGIC SYMPTOMS

| | *Preop* | *1st week* | *2nd week* | *3rd week* | *4th week* | *>4 weeks* |
|---|---|---|---|---|---|---|
| Bipolar | | | | | | |
| Hematuria | 1 | 9 | 6 | 4 | 1 | 1 |
| Dysuria | 4 | 6 | 4 | 2 | 1 | 0 |
| Urgency | 4 | 10 | 6 | 3 | 0 | 0 |
| Incontinence | 1 | 4 | 2 | 1 | 0 | 0 |
| Pain | 0 | 1 | 1 | 0 | 0 | 0 |
| Monopolar | | | | | | |
| Hematuria | 2 | 10 | 7 | 4 | 2 | 1 |
| Dysuria | 4 | 14 | 11 | 6 | 2 | 1 |
| Urgency | 3 | 9 | 7 | 3 | 1 | 0 |
| Incontinence | 2 | 3 | 2 | 1 | 0 | 0 |
| Pain | 0 | 2 | 1 | 1 | 0 | 0 |

nessed an explosion of interest in alternatives. There is a constant quest for a successful surgical modality that can be used with minimal risk of complications, short hospital stay, and efficacy equivalent to that of TURP. Newer techniques not only require different equipment but also have a steep learning curve, as they are remarkably different from TURP. Thus, one of this newer technological advancement, bipolar TURP, has a definite edge over other alternative techniques as the learned skills can be transferred easily to this newer technology.

In traditional monopolar electrosurgery, radiofrequency (RF) energy is directed into the tissue. The tissue's electrical resistance creates temperatures as high as 400°C, which leads to tissue desiccation along with significant collateral and penetrative tissue damage. In contrast, with bipolar electrosurgery, RF energy converts a conductive medium (saline irrigant) into a plasma field of highly ionized particles that disrupt the organic molecular bonds between the tissues. This molecular dissociation reduces into elementary molecules. By directing the RF current from an active electrode to an adjacent return electrode, tissue damage in this technique is minimized, as tissue temperature range from 40 to 70°C. Bipolar current has been used for open surgery for a long time, but until now, equipment was not available for its use in transurethral operations. Now, with the availability of a bipolar generator and resectoscope for transurethral surgery, the advantages of this technique can be incorporated into TURP. The biggest advantage of bipolar current in TURP is the use of saline for irrigation. This may reduce the morbidity associated with absorption of fluid.

The results of our study suggest that bipolar TURP is equivalent to conventional TURP in relieving men of lower urinary-tract symptoms and improving peak urinary flow rates at 3 months of follow-up. In bipolar resection, the excursion of the loop should be slow for better hemostasis. Although the bipolar technique required more time for hemostasis at the end of the procedure, it did not make the procedure slower than monopolar resection (0.61 g/min *v* 0.74 g/min). Blood loss, fluid absorption, amount of resected tissue, and intraoperative and volume of postoperative irrigation fluid were same in both groups. The change in serum sodium concentration was significantly greater in the monopolar resection group. In bipolar TURP, the change in serum sodium was −1.2 mEq/L, which was not significantly different from the preoperative serum Na concentration, whereas in the monopolar group, the mean decrease was 4.6 mEq/L ($P <$ 0.001), and in three patients, serum Na was <125 mEq/L. Although these patients did not develop symptoms, they were at risk of TUR syndrome. Data on the frequency of TUR syndrome vary considerably in the literature, ranging from 0.18% to 10.9%.[6,7] Mebust and colleagues, in their study of 3885 patients, reported an incidence of 2%.[8] This syndrome not only increases morbidity and discomfort of the patient but also necessitates close perioperative monitoring, frequent laboratory investigations, and significant nursing time. Thus, bipolar TURP will lessen the stress on the patient and hospital as well as the surgeon.

Bipolar TURP allows more rapid catheter removal (2.52 days *v* 3.4 days) and a shorter hospital stay (3.02 *v* 3.88 days). Maislos and colleagues reported that 13 of their 14 patients voided 24 hours after surgery.[9] Botto and associates,[10] using the Gyrus instrument, reported a mean hospital stay of only 2.2 days, and all patients were discharged without a catheter.

We also found that postoperative dysuria is less with bipolar TURP than with monopolar TURP. This difference could be attributable to more thermal damage and granulation tissue with monopolar current. Studies in an animal model utilizing a different electrode configuration have also demonstrated less collateral tissue damage and less granulation tissue formation with this electrodissection technology compared with traditional monopolar techniques.[11] We encountered six complications in

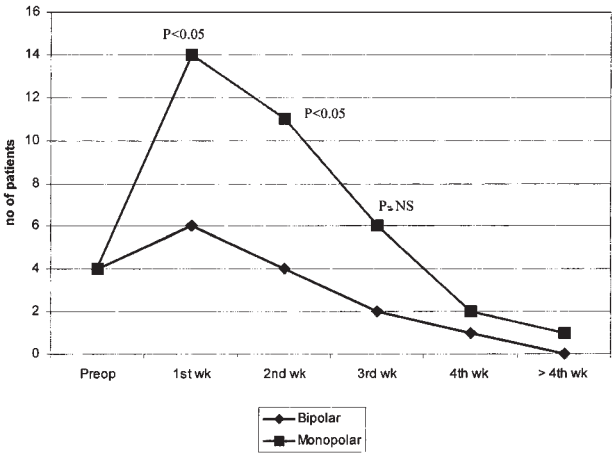


**FIG. 2.** Number of patients having postoperative dysuria.

the monopolar and four in the bipolar resection group. The majority of these were infections. Only one patient in the monopolar group required transfusion for secondary hemorrhage. The reported transfusion rate in TURP ranges from 2.5% to 4.2%.[8]

In a multicenter experience, the urologists favored bipolar TURP for cleanness of cutting (64%), better precision at the apex (61%), and less charring (93%).[12] We also feel that cutting is sharp, effortless, and without charring. Although we did not find any case of capsular perforation in either group, theoretically, the absence of charring will provide better visibility of the prostatic capsule and reduce the risk of perforation. The risk of urethral stricture associated with current leak should also be less. We followed the patients up to 3 months postoperatively. It appears that as the basic principle is same in both techniques, the long-term results will be comparable.

## CONCLUSIONS

This newer bipolar resection is as effective as the gold standard conventional monopolar TURP with the additional advantage of absence of electrolyte imbalance, early catheter removal, short hospital stay, and less postoperative morbidity. The procedure can be performed for large adenomas without the fear of TUR syndrome. Thus, bipolar TURP is a promising new technique that may prove to be a good alternative to conventional TURP in the future.

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Address reprint requests to:
*Harbans Singh, M.Ch.*
*Muljibhai Patel Urological Hospital*
*Nadiad, Gujarat, India 387 001*

*E-mail:* harbanspruthi@hotmail.com