Original Article

Monopolar versus bipolar transurethral resection of prostate for benign prostatic hyperplasia: Operative outcomes and surgeon preferences, a real-world scenario

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Abstract

Context: Monopolar transurethral resection of prostate (M-TURP) is considered the gold standard for the management of bladder outlet obstruction due to benign prostatic hyperplasia. Its newly introduced modification, bipolar TURP (B-TURP), promises to overcome its most prominent shortcomings, namely bleeding and dilutional hyponatremia. Literature is conflicting regarding merits of B-TURP over M-TURP.

Aims: To find a difference, if any, in perioperative outcomes between M-TURP and B-TURP in a real-wold setting.

Settings and Design: Prospective nonrandomized study.

Subjects and Methods: Operative outcomes of patients undergoing M-TURP and B-TURP from February 2014 to October 2015 were compared.

Statistical Analysis Used: Categorical data were compared by Fischer exact test and numerical data were compared by independent samples Mann–Whitney U-test. $P < 0.05$ was considered statistically significant.

Results: The mean size of prostate operated by bipolar technology was significantly greater than those operated by monopolar technology (38.12 ± 9.59 cc vs. 66.49 ± 22.95 cc; $P < 0.001$). The mean fall in postoperative serum sodium concentration was 0.99 ± 0.76 mEq/L for the B-TURP group as compared to 3.60 ± 2.89 mEq/L for the M-TURP group ($P < 0.001$). The mean drop in postoperative hemoglobin concentration ($P = 0.28$) was statistically insignificant, even though larger glands were operated by B-TURP. There were three instances of the transurethral resection (TUR) syndrome in the M-TURP group whereas no TUR syndrome occurred in the B-TURP group.

Conclusions: In spite of various contrary viewpoints in literature, surgeons prefer to operate on larger prostates using bipolar technology. B-TURP definitely reduces the incidence of bleeding and dilutional hyponatremia, making it a contender to replace M-TURP as the new gold standard.

Key Words: Benign prostatic hyperplasia, bipolar, monopolar, transurethral resection of prostate

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INTRODUCTION

The gold standard for surgical management of benign prostatic hyperplasia (BPH) is monopolar transurethral resection of prostate (M-TURP).[1,2] In spite of other technologies, M-TURP remains the most common surgical modality for treating BPH.[3-7] Bipolar TURP (B-TURP) uses isotonic saline as irrigant and hence it is believed that the dilutional hyponatremia and transurethral resection (TUR) syndrome which occur in M-TURP can be avoided in B-TURP.[8-11] However, the true merits of B-TURP over M-TURP remain unclear. We prospectively studied the patient characteristics and operative outcomes of patients undergoing M-TURP and B-TURP at our institute. No attempt was made at randomization or case selection.

SUBJECTS AND METHODS

It was a prospective nonrandomized observational study, in which all consecutive patients who underwent M-TURP or B-TURP from February 2014 to October 2015 were included. Choosing M-TURP or B-TURP was at the discretion of the surgeon. In this way, we were able to evaluate surgeon preferences and were able to find out, in which clinical scenarios the surgeon prefers one technology over the other. Our study provides a "snapshot" of the clinical practices at our center during the study period. Prior approval of the Institutional Ethics Committee was obtained. Informed consent was obtained from all subjects.

Inclusion criteria

- Age >45 years
- Symptoms of bladder outlet obstruction due to BPH
- Maximal urinary flow rate (Q_{max}) of <15 ml/s
- Prostate volume on transrectal ultrasound (USG) exceeding 20 g with no upper limit
- Failure to relieve symptoms fully by medications (alpha blockers ± 5 alpha reductase inhibitors), acute urinary retention failing at least one voiding free trial, recurrent gross hematuria due to prostatomegaly, and upper urinary tract changes due to bladder outlet obstruction due to BPH.

Subject exclusion criteria

- Neurovesical dysfunction
- Bladder calculus
- Carcinoma prostate
- Previous history of prostatic or urethral surgery
- Urethral stricture.

A detailed history was taken and a physical examination including a focused neurological examination was performed. The following diagnostic tests were performed:

- Urinalysis (urine routine, microscopic examination, and urine culture)
- USG of kidney, ureter, and bladder with prostate volume and postvoid residual urine measurement
- Uroflometry
- Serum prostate-specific antigen (PSA), (PSA level <4 ng/ml was considered normal)
- Urodynamic study if neurovesical dysfunction (e.g., diabetes) was suspected to be the cause of voiding dysfunction
- Hemoglobin, total leukocyte count, and differential leukocyte count
- Blood urea, serum creatinine, serum sodium, and potassium levels
- Coagulation profile
- Fasting and postprandial blood sugar level.

Abnormal PSA or digital rectal examination findings were triggers for a transrectal USG-guided prostate biopsy.

A 26 Fr Karl Storz (Tuttlingen, Germany) resectoscope and 1.5% glycine as the irrigation solution were used for M-TURP. A Valleylab (Medtronic, Minneapolis, USA) electrocautery generator was used with the current setting set to 120 W cutting and 80 W coagulation. B-TURP was performed using Olympus (Olympus Medical, Tokyo, Japan) 26 Fr resectoscope and 0.9% normal saline (NS) was used as an irrigant. The Olympus "TURiS system" bipolar generator (generator model ESG-400) was used with the current setting at 200 W cutting and 120 W coagulation.

Descriptive statistics such as mean, standard deviation was used to describe the study sample. Categorical data were compared by Fischer exact test and numerical data were compared by independent samples Mann–Whitney U-test. $P < 0.05$ was considered statistically significant. Statistical Package for Social Sciences version 21 (International Business Machines Corporation, New York, USA) was used for data analysis.

RESULTS

A total of 166 patients underwent TURP, of which a total of 145 patients underwent M-TURP and 21 patients underwent B-TURP at our institute from February 2014 to November 2015. Table 1 shows the baseline characteristics of the two patient groups. The mean size of prostate operated by bipolar technology was significantly greater than those operated by monopolar technology (38.12 ± 9.59 cc vs. 66.49 ± 22.95 cc; $P < 0.001$).

Table 2 shows the comparison of perioperative variables between the two groups. The mean operative time was significantly longer in the B-TURP group as compared to the

Table 1: Baseline characteristics of monopolar and bipolar transurethral resection of the prostate

	Monopolar	Bipolar	P
Mean age (years, SD)	63.08±8.28	64.38±7.52	0.54
Mean prostate size (cc, SD)	38.12±9.59	66.49±22.95	<0.001
Mean prostate-specific antigen level (ng/dl, SD)	1.93±0.91	3.31±3.16	0.03
Mean Q_{max} (ml/s, SD)	8.93±1.47	7.81±2.51	0.01

SD: Standard deviation

Table 2: Comparison between monopolar and bipolar transurethral resection of the prostate

	Monopolar	Bipolar	P
Mean operative time (min, SD)	51.75±14.28	82.14±29.60	<0.001
Mean change in hemoglobin (g/dl, SD)	−1.57±0.71	−1.75±0.77	0.28
Mean change in Na (mEq/L, SD)	−3.60±2.89	−0.99±0.76	<0.001
Transurethral resection syndrome	3	0	
Mean postoperative irrigation (h, SD)	22.87±5.09	22.57±6.26	0.318
Mean postoperative catheter (h, SD)	53.71±12.53	53.33±11.59	0.91
Clot retention (%)	11 (7.58)	4 (19.04)	0.10
Blood transfusion (%)	10 (6.89)	2 (9.52)	0.65
Mean hospital stay (days)	3.65±0.76	3.90±0.88	0.19

SD: Standard deviation

M-TURP group (82.14 ± 29.60 min vs. 51.75 ± 14.28 min; $P < 0.001$). The mean fall in postoperative serum sodium concentration was 0.99 ± 0.76 mEq/L for the B-TURP group as compared to 3.60 ± 2.89 mEq/L for the M-TURP group ($P < 0.001$). There were three instances of TUR syndrome in the M-TURP group, whereas no TUR syndrome occurred in the B-TURP group. The mean drop in postoperative hemoglobin concentration ($P = 0.28$), postoperative irrigation time ($P = 0.318$), postoperative catheter time ($P = 0.91$), and hospital stay ($P = 0.19$) were not significantly different between the two groups.

A total of eight patients failed to void after catheter removal (1 in B-TURP group and 7 in M-TURP group) and were recatheterized again.

DISCUSSION

BPH is a common disease affecting older men, often leading to troublesome symptoms, and a decrease in quality of life. Medical therapy is usually the first-line management for BPH but eventually surgery is required by 20% of men.[12] TURP is the most common performed surgery for BPH and a large amount of data has been accumulated over the years demonstrating its efficacy and safety. Even though TURP has a low mortality rate, there is some concern regarding perioperative morbidity, especially hemorrhage, dilutional hyponatremia, and TUR syndrome. Hyponatremia and TUR syndrome are caused by using the nonconducting irrigation fluid glycine (1.5%) in TURP, which is hypo-osmolar.[13-15] Mebust *et al.* reported a 2% incidence of TUR syndrome during M-TURP.[16]

B-TURP is the new modification of TURP. Due to the mechanism of current flow, B-TURP allows the surgeon to perform the resection using normal saline as irrigation, thereby decreasing the risk of dilutional hyponatremia and TUR syndrome.[17-19] This also permits a longer operative time while resecting large glands. There is a "cut-and-seal" effect during B-TURP and this is claimed to achieve better hemostasis as compared to M-TURP.

In our study, the mean prostate size of patients undergoing M-TURP was 38.12 ± 9.59 cc, and the mean prostate size of patients undergoing B-TURP was 66.49 ± 22.95 ($P < 0.001$). The difference was statistically significant. In contrast to this, at least one study shows a trend toward operating larger glands using monopolar technology as compared to bipolar technology, although the difference was not statistically significant.[20] According to other studies reported in the literature, the mean prostate size varied from 42 to 82 ml for the M-TURP group and for the B-TURP group it varied from 39 to 82 ml.[21-29] Our study shows that there are a fair number of men who present with markedly enlarged prostates. Possible reasons for this might be a lack of awareness and lack of access to health care, resulting in late presentation to a medical facility, by which time the prostate gland would have grown considerably larger. Moreover, our study shows a surgeon "preference" for operating on the larger gland using bipolar technology. A possible explanation for this might be surgeon perception that "larger glands may be safely operated using bipolar technology."[30]

In our study, patients undergoing M-TURP had a mean serum PSA level of 1.93 ± 0.91 ng/ml, while patients undergoing B-TURP had a mean serum PSA of 3.31 ± 3.16 ng/ml. This was a statistically significant difference ($P = 0.03$). Going through the literature, in one study, the mean PSA of the men undergoing B-TURP was 2.89 ± 1.34 ng/ml and the mean PSA of men undergoing M-TURP was 2.72 ± 0.91 ng/ml ($P = 0.27$).[12] Giulianelli *et al.* reported mean serum PSA in M-TURP and B-TURP groups as 2.8 ± 1.0 ng/ml and 2.2 ± 0.5 ng/ml (statistical significance not mentioned).[20] The significantly greater PSA of the B-TURP group in our study is probably due to the larger size of glands operated using bipolar technology.

In our study, patients who underwent B-TURP were more severely obstructed (Q_{max}: 7.81 ± 2.51ml/s) as compared to those who underwent M-TURP (Q_{max}: 8.93 ± 1.47ml/s), a statistically significant difference ($P = 0.01$). In a study by Kong *et al.*, the preoperative Qmax was 4.99 ml/s for B-TURP group and 4.60 ml/s for M-TURP group.[31] In contrast to this, in one study, the peak urinary flow rates were comparable between both the groups. The peak urinary flow rate was 8.7 ± 2.7 ml/s in the B-TURP group and 8.4 ± 2.0 ml/s in the M-TURP group ($P = 0.866$).[12] The peak flow reported in literature for M-TURP group varies from 4.2 to 10.9 ml/s and for the B-TURP group it varies from 4.4 to 10.9 ml/s.[30] The possible reason for our result might be that patients undergoing B-TURP had larger glands and hence were more severely obstructed.

Gland resection took a mean of 51.75 ± 14.28 min in the M-TURP group while it took a mean of 82.14 ± 29.60 min for the B-TURP group. This difference was statistically significant ($P < 0.001$). In one study, the mean operative time in the B-TURP group was 72.6 ± 31.8 min and for the M-TURP group, it was 74.2 ± 26.6 min.[12] In another study, M-TURP took 59 ± 18 min for resection while B-TURP took 58 ± 14.6 min for resection.[20] In our study, the B-TURP group took significantly larger time because of the considerably larger size of the gland resected using bipolar technology.

The mean fall in hemoglobin in the M-TURP group was 1.57 ± 0.71 g/dl whereas in the B-TURP group, it was 1.75 ± 0.77 g/dl, which was statistically insignificant ($P = 0.28$). Other studies too have noted a statistically insignificant blood loss between M-TURP and B-TURP. In one study, the mean fall in hemoglobin in the B-TURP group was 0.67 ± 0.62 g/dl, whereas for the M-TURP group, it was 0.62 ± 0.78 g/dl.[12] Although the "cut-and-seal" effect of bipolar technology is supposed to result in better hemostasis during resection,[22,27,32] an international multicenter randomized controlled trial reported statistically insignificant difference in hemoglobin drop after M-TURP and B-TURP ($P = 0.548$).[33] However, some studies have noted a lesser blood loss in B-TURP group as compared to M-TURP group (0.6 g/dl vs. 1.8 g/dl, $P = 0.01$).[31] Giulianelli *et al*. reported a drop of mean Hb from 14.52 to 10.4 mg/dl in the M-TURP group while in B-TURP group, mean Hb dropped from 14.88 to 13.6 mg/dl. However, the authors did not mention if it was statistically significant.[20] The results obtained in our study are notable in view of the fact that although glands operated using bipolar technology were significantly larger, still the blood loss between both the groups was comparable. This goes to show that bipolar technology does have a certain advantage as far as hemostasis is concerned.

Regarding the decrease in postprocedure sodium concentration, M-TURP had a mean drop of 3.60 ± 2.89 mEq/L while B-TURP TURP had a mean drop of 0.99 ± 0.76 mEq/L, which was a statistically significant difference ($P < 0.001$). Similar results were found by Kong *et al*. (1.03 mEq/L in B-TURP vs. 5.01 mEq/L in M-TURP ($P = 0.01$).[31] In our study, even though significantly larger glands were operated using B-TURP, still the postoperative sodium drop is lesser than M-TURP.

In our study, TUR syndrome occurred in three patients (2.06%) in the M-TURP group, whereas there was no TUR syndrome in the B-TURP group. This result is in concordance with literature on the subject. B-TURP leads to less decline in serum sodium levels and virtually eliminates the risk of TUR syndrome. However, the fluid absorption in B-TURP is the same as in M-TURP and hence volume overload can still occur, which may be of concern in patients with cardiac problems.[33] Of the 22 studies between 2004 and 2011 which compared M-TURP with B-TURP, not a single instance of TUR syndrome occurred in 1401 patients of the B-TURP group, whereas in same studies, 35 cases of TUR syndrome occurred out of a total of 1375 patients who underwent M-TURP.[30] However, one study has not reported any TUR syndrome in a cohort of 51 patients undergoing M-TURP, even though there was a statistically significant drop in serum sodium levels in the M-TURP group.[31] Similar to this, few other studies have also not reported TUR syndrome in patients undergoing M-TURP.[31,32,34-36]

The mean postoperative irrigation time in the M-TURP group was 22.87 ± 5.09 h while for the B-TURP group, it was 22.57 ± 6.26 h. Xie *et al*.[37] reported a mean postoperative irrigation time of 24.45 h in the M-TURP group and 15.84 h in the B-TURP group. Lee *et al*. reported mean postoperative irrigation times of 38 and 38.26 h in the M-TURP and B-TURP groups, respectively.[38] In this study, the mean gland sizes were also greater (M-TURP: 62.34 cc, B-TURP: 68.83 cc) as compared to our study, which might have led to greater hematuria and increased irrigation requirement in the postoperative period.

The mean postoperative catheter duration in the M-TURP group was 53.71 ± 12.53 h while in the B-TURP group, it was 53.33 ± 11.59 h, a statistically insignificant difference ($P = 0.91$). Similar results were obtained in a study by Lee *et al*. in which the M-TURP group had a mean catheter duration of 4.26 days and B-TURP group had a mean catheter duration of 4.05 days.[38] In contrast, a study by Kong *et al*. reported catheterization time in B-TURP group was 37.2 h, and in M-TURP was 57.7 h ($P = 0.03$).[31] In the study by Yoon *et al*., the mean duration of the catheter in the B-TURP group was 2.28 ± 1.37 days, while for the M-TURP group was 3.12 ± 0.69 days. This difference was statistically significant ($P = 0.012$).[12] Giulianelli *et al*. reported catheter times of 48 ± 48 h in the M-TURP group and 24 ± 12 h in the B-TURP group.[20] Another study by Borboroglu *et al*. reported an average catheter time of 33.6 h after B-TURP.[39]

Clot retention occurred in 11 (7.58%) patients of the M-TURP group and four (19.04%) patients of the B-TURP group. The result was statistically insignificant ($P = 0.10$). The literature remains divided on the subject. Similar to our results, Lee *et al*. reported a clot retention rate of 10.3% in the M-TURP group and 5.3% in the B-TURP group ($P = 0.389$).[38] A meta-analysis on the subject reported 24 of 883 participants undergoing B-TURP and 51 of 880 undergoing M-TURP had clot retention with a relative risk (RR) of 0.48 (95% confidence interval [CI]: 0.30–0.77; $P = 0.002$).[30]

Ten (6.89%) patients in the M-TURP group required postoperative blood transfusion, while 2 (9.52%) patients of the B-TURP group required blood transfusion. The difference was not statistically significant ($P = 0.65$). It is claimed that bipolar electrocautery is more efficient at controlling bleeding. According to *ex vivo* experiments of Wendt-Nordahl *et al*., bipolar resectoscope is more efficient at controlling bleeding than monopolar resectoscope.[19] In another study, two out of 51 patients undergoing M-TURP (3.9%) required blood transfusion, whereas no patient undergoing B-TURP required a blood transfusion. In one study, three out of eighty men undergoing M-TURP needed a blood transfusion postoperatively.[20] Borboroglu *et al*. reported a transfusion rate of 0.4% for B-TURP.[39] A meta-analysis of the subject found that 28 of 1244 participants undergoing B-TURP and 53 of 1226 participants undergoing M-TURP required a blood transfusion with an RR of 0.53 (95% CI 0.35–0.82) and the result was statistically significant ($P = 0.004$).[30]

The mean hospital stay for patients undergoing M-TURP was 3.65 ± 0.76 days while for the B-TURP group, it was 3.90 ± 0.88 days. The difference was not statistically significant ($P = 0.19$). Lee *et al*. reported a mean hospital stay of 6.6 days for M-TURP and 6 days for B-TURP.[38] In contrast, Yoon *et al*. reported lesser hospital stay for the B-TURP group.[12] In their study, the mean hospital stay in the B-TURP group was 3.52 ± 2.55 days, while for the M-TURP group, it was 4.27 ± 1.89 days ($P = 0.03$). Botto *et al*. reported a mean hospital stay of only 2.2 days for B-TURP.[17] Eaton and Francis were able to discharge 85% of patients undergoing B-TURP on the same day of surgery.[18] These patients had their catheters removed at 48 h. In another study,[40] catheter duration for B-TURP group was 1.4 days lesser than standard TURP. Kong *et al*. reported lesser hospital stay with B-TURP (1.5 days vs. 2.6 days, $P = 0.02$).[31]

Our study shows that in spite of operating on significantly larger glands using bipolar technology, the hemoglobin drop is comparable to and dilutional hyponatremia is significantly lesser than M-TURP. We found that at our center, surgeons "preferred" to operate on larger glands using bipolar technology. Other parameters such as irrigation time, catheter time, clot retention, blood transfusion, and hospital stay are comparable between M-TURP and B-TURP.

CONCLUSIONS

To conclude, B-TURP definitely holds promise in reducing the two common complications of M-TURP, i.e., bleeding and dilutional hyponatremia. The technique of B-TURP is very similar to M-TURP and there is no steep learning curve involved like in holmium laser enucleation of prostate. Given all these factors, B-TURP has the potential to become the procedure of choice for the surgical management of BPH.

Our study has some limitations. As it is a single-center nonrandomized study, the results may not be applicable to all patients. Our study shows that surgeons prefer to operate on larger glands using bipolar technology. Since fewer number of men presented with large glands (mean 66.49 ± 22.95 cc); hence, the B-TURP number is lower. A larger number of patients undergoing B-TURP would have been desirable. However, our study does provide a glimpse of the "real-world" preferences of the surgeon in treating a patient with bladder outlet obstruction due to prostatomegaly. Further randomized studies of good methodological quality with long-term follow-up need to be conducted to better define the role of B-TURP in the management of BPH.

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Conflicts of interest

There are no conflicts of interest.

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