

ORIGINAL ARTICLE**Changing trends in patients undergoing Transurethral Resection of Prostate (TURP) and comparison of monopolar TURP with bipolar TURP: A single centre experience**

Swaroop S¹, Mohd Hamid Shafique Ahmed^{*}, Prakash Pawar¹, Ajit Sawant¹,
Amandeep Arora¹, Vishnu Pratap¹

¹Department of Urology, Lokmanya Tilak Municipal Medical College and General Hospital, Mumbai-400022 (Maharashtra) India

Abstract

Background: Transurethral Resection of the Prostate (TURP) remains the gold standard for the surgical management of Benign Enlargement of Prostate (BEP), despite advances in pharmacotherapy and newer endoscopic techniques. Monopolar TURP (M-TURP) has been challenged by bipolar TURP (B-TURP) because of its perceived safety advantages. **Aim and Objectives:** To compare the perioperative complications and outcomes of M-TURP and B-TURP, and analyze the changing trends in patient profiles and indications for TURP over time. **Material and Methods:** This retrospective study analyzed patients undergoing TURP at our center from January 2010 to December 2013 (M - TURP, n = 253) and January 2015 to December 2018 (B-TURP, n = 219). Patients with a prostate size > 100 ml, prior prostate surgery, or urethral stricture were excluded. Data on patient characteristics, intraoperative variables, and postoperative outcomes were compared using statistical tests (t-test, Mann-Whitney U, chi-square, Fisher's exact test; $p < 0.05$). **Results:** A 13% decline in TURP procedures was observed from 2010–2013 to 2015–2018. No significant differences were noted in age, symptom score, prostate size, or comorbidities between the groups. The proportion of patients refractory to medical therapy significantly decreased in the B-TURP group ($p = 0.009$). M-TURP was associated with a greater decrease in hemoglobin ($p < 0.001$), TUR syndrome (2.4%, $p = 0.03$), blood transfusions (2.7%, $p = 0.01$), and re-TURP (0.8%, $p = 0.1$) than B-TURP, which had none of these complications. Mean American Urological Association Symptom Score at 6 months was lower in the B-TURP group (5.01) than in the M-TURP group (6.06, $p < 0.001$), although the difference was not clinically significant. **Conclusion:** B-TURP is as effective as M-TURP, with reduced complications, including no TUR syndrome, lower transfusion rates, and fewer re-TURPs. The decline in TURP procedures reflects the increased efficacy of medical therapy. B-TURP should be considered the new standard for the surgical management of BEP.

Keywords: bipolar transurethral resection of the prostate, monopolar transurethral resection of the prostate, benign prostatic enlargement, transurethral resection syndrome, complications, American Urological Association Symptom Score

Introduction

Benign Enlargement of Prostate (BEP) is a common cause of Lower Urinary Tract Symptoms (LUTS) in aging men. Advances in pharmacotherapy, including alpha-blockers, 5-Alpha Reductase Inhibitors (5ARI), anticholinergics, Phosphodiesterase 5 Inhibitors (PDE5I), and beta-3 agonists, have reduced the need for surgical

intervention in patients with BEP. Apart from the absolute indications for Transurethral Resection of the Prostate (TURP), there has been a decrease in the number of patients who are refractory to medical therapy and require TURP [1-2]. TURP remains the gold standard for the surgical management of BEP [3]. Traditionally, Monopolar

TURP (M-TURP) has been used, but it has been challenged by bipolar TURP (B-TURP), which uses isotonic saline as an irritant, potentially reducing complications such as TUR syndrome [3-5]. Multiple series have reported comparable perioperative outcomes, such as bleeding, transfusion rates, stricture, incontinence, storage symptoms, re-surgery, and postoperative American Urological Association Symptom Score (AUASS), between the two modalities [6]. In this retrospective study, we compared patients who underwent M-TURP with those who underwent B-TURP at our institute during different time periods. The primary objective was to compare the perioperative complications and outcomes between the two groups and assess the superiority of one over the other, if any. We also analyzed the changing trends in patient profiles and indications for TURP.

Material and Methods

Study design and patients: This retrospective study, approved by the Institutional Ethics Committee (IEC/56/24), analyzed patients undergoing TURP from January 2010 to December 2013 (M-TURP, n = 253) and January 2015 to December 2018 (B-TURP, n = 219). Patients with prostate size > 100 ml underwent alternative procedures (HoLEP or open prostatectomy) and were excluded, as were those with prostate carcinoma, prior prostate surgery, or urethral stricture. Preoperative urodynamic studies were performed in patients with chronic urinary retention (post-void residual >300 ml), age <50 or >80 years, history of previous pelvic surgery/TURP, and in patients with suspicion of neurogenic bladder (e.g., Parkinson's disease, multiple sclerosis, or spinal cord injury). The variables compared included age, AUASS [7], comorbidities, prostate size on transabdominal

ultrasonography, indications for TURP, operative time, hemoglobin and sodium changes, complications, and 6-month AUASS.

Surgical technique

M-TURP (2010–2013) used a 26Fr Karl Storz monopolar resectoscope (double stem) with a Shalya Argon electrosurgical unit (XcelLance Medical Technologies Pvt., Ltd., Navi Mumbai, India) and distilled water irrigation as only distilled water was available at our centre amongst all irrigation agents used in M-TURP. Our institute procured a bipolar system in 2014. Hence, B-TURP results were analysed from 2015–2018. B-TURP used a 26Fr Karl Storz bipolar resectoscope with an Alan MBAVP generator (Alan Electronic Systems Pvt. Ltd., Ambarnath, India) and normal saline for irrigation. All procedures were performed using the Barnes' technique [8]. Otis meatotomy was performed for submeatal stenosis when necessary. Operative time was measured from the start of resection to the insertion of the Foley catheter.

Perioperative management

Hemoglobin and serum sodium levels were measured 24 hours preoperatively and 2 hours postoperatively, with additional sodium measurements immediately after the procedure if TUR syndrome was suspected. Antibiotics were administered based on urine culture results; ceftriaxone (1 g IV) was used for culture-negative cases. A three-way Foley catheter was inserted at the end of the procedure along with traction, and saline irrigation was used for 12 hours. Catheters were removed on day 3 to minimize the chances of recatheterization in line with traditional protocols. Paracetamol (1g IV) infusion was given for pain management. Follow-up at 1, 3, and 6 months included AUASS,

imaging, and uroflowmetry for persistent symptoms assessment.

Statistical analysis

Data normality was assessed using the Kolmogorov-Smirnov test. Quantitative data are expressed as mean ± standard deviation or median, and categorical data as frequencies and proportions. Comparisons were performed using unpaired t-tests, Mann-Whitney U tests, chi-square tests, or Fisher's exact tests, with significance set at $p < 0.05$. Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS)

software (version 20.0; IBM SPSS Statistics, IBM Corporation, Armonk, New York, USA).

Results

Preoperative characteristics (Table 1)

The mean age, AUASS, and proportion of patients with comorbidities were comparable between the groups. The most common indication in both the groups was failed Trial Without Catheter (TWOC), with 60.5 % in M-TURP group and 64.8% in B-TURP group ($p = 0.4$). The B-TURP group had a significantly lower proportion of patients who were

Table 1: Pre-operative characteristics of patients undergoing M-TURP and B-TURP

Characteristics		M-TURP (n=253)	B-TURP (n=219)	<i>p</i>
Age (Years)	Mean± SD	65.2 ± 7.1	66 ± 8.1	0.2 *
	Range	(49 - 82)	(45 - 80)	
AUASS	Mean± SD	20.2 ± 4.2	19.8 ± 4.9	0.3 *
Comorbidities	Total	78 (31%)	86 (39%)	0.07 **
	Hypertension	46 (19%)	51 (24%)	
	Diabetes mellitus	19 (7.5%)	23 (10.5%)	
	Ischemic heart disease	9 (3.5%)	7 (3%)	
	COPD	4 (1.5%)	5 (2.3%)	
Indication for TURP	Failed TWOC	153 (60.5%)	142 (64.8%)	0.3**
	Refractory to medical therapy	47 (18.5%)	22 (10%)	0.009**
	Chronic retention	33 (13%)	40 (18%)	0.1 **
	Others	20 (7.9%)	15 (6.8%)	0.6**
Prostate volume, ml (Median with IQR) Transabdominal sonography	52 (40-79)	53 (42-76)	0.8 ***	

*M-TURP = Monopolar transurethral resection of prostate; B-TURP = Bipolar transurethral resection of prostate; SD = Standard deviation; AUASS= American Urological Association Symptom Score; COPD=Chronic obstructive pulmonary disease; TWOC= Trail without catheter; IQR= Inter quartile range * Students t-test; ** Chi square test; *** Mann Whitney U test*

refractory to medical therapy than that in the M-TURP group ($P = 0.009$). However, the difference between the two groups for patients with Chronic Urinary Retention (CUR) was not significant (18% vs. 13%, $p = 0.1$). The prostate volume, assessed by transabdominal ultrasonography in both groups, was comparable ($p = 0.8$).

Perioperative parameters (Table 2)

Most cases in both groups were performed under spinal anesthesia. The median operative time was significantly shorter in the M-TURP group than in the B-TURP group (60 vs. 74 min, $p < 0.001$). A significant decrease in serum sodium level was noted in the M-TURP group compared to that in the B-TURP group (median 3.1 vs. 1, $p = 0.001$). The mean fall in haemoglobin was also significantly more in the M-TURP group as compared to the B-TURP group (1.06 vs 0.89, $p < 0.001$)

Complications

The complications are summarized in Table 3. The incidence of TUR syndrome in the M-TURP group was 1.97%, whereas it was absent in the B-TURP group. The fall in serum sodium in six patients with TUR syndrome ranged from 14 mmol/l to 21 mmol/l. Two patients in the M-TURP group underwent re-TURP. In both patients, the initial resection was halted due to capsular perforation and TUR syndrome. Both patients experienced failed TWOC and required re-TURP.

Blood transfusion was required in 2.4% of patients in the M-TURP group, whereas no transfusions were required in the B-TURP group. However, one patient in the B-TURP group presented with bladder clots and urinary retention after 14 days and underwent clot evacuation. Delayed bleeding presenting with bladder clots

Table 2: Comparison of peri-operative parameters between patients undergoing M-TURP and B-TURP

Characteristic		M-TURP (n=253)	B-TURP (n=219)	<i>p</i>
Anesthesia	Spinal	245 (97%)	214 (98%)	0.56
	General	8	5	
Operative time, minutes [†]		60 (50-65)	74 (50-90)	< 0.001*
Irrigation volume, litres [†]		30 (24-32)	30 (20-32)	0.6*
Change in serum sodium (Pre-operative minus post-operative), mmol/l [†]		3.1 (1.7-4.4)	1 (-1 – 2.7)	< 0.001*
Fall in haemoglobin, g/dL (Mean ± SD)		1.06 ± 0.21	0.89 ± 0.17	< 0.001**

[†] Median with IQR, *Mann Whitney U test, **Student's t-test, M-TURP = Monopolar transurethral resection of prostate; B-TURP = Bipolar transurethral resection of prostate; SD = Standard Deviation; IQR= Inter quartile range

Table 3: Complications and 6-month follow-up of patients undergoing M-TURP and B-TURP

Complications	M-TURP (n=253)	B-TURP (n=219)	<i>p</i>
TUR syndrome	6 (2.4%)	0	0.03*
Blood transfusion	7 (2.7%)	0	0.01*
Delayed bleeding/ bladder clot	7 (2.7%)	1 (0.5%)	0.07*
Stricture urethra	1 (0.4%)	1 (0.45%)	0.9*
UTI	8 (3.2%)	5 (2.3%)	0.5**
Stress incontinence	0	1 (0.45%)	0.2*
Urgency incontinence	7 (2.7%)	3 (1.3%)	0.2*
Re-TURP	2 (0.8%)	0	0.1*
AUASS (6months after surgery)	6.06 ± 0.57	5.01 ± 1.2	<0.001***

*M-TURP = Monopolar transurethral resection of prostate; B-TURP = Bipolar transurethral resection of prostate; UTI= Urinary tract infection; AUASS= American Urological Association Symptom Score, *Fisher's exact test, ** Chi square test, *** Student's t-test*

was observed in 2.7% of patients in the M-TURP group. Stricture rates were similar in both groups (0.4%). In both cases, short-segment strictures were observed in the proximal bulbar urethra, presenting at 5 and 6 months after M-TURP and B-TURP, respectively. Both patients were managed using visual internal urethrotomy technique. Urinary Tract Infection (UTI) was observed in eight and five cases in the M-TURP and B-TURP groups, respectively, with no significant difference between the groups ($p=0.5$).

All 13 patients were preoperatively placed on a Per-Urethral Catheter (PUC). The patients were then treated with culture-specific antibiotic therapy. One patient who underwent B-TURP presented with transient stress urinary incontinence, which was treated with pelvic floor muscle exercise. The mean AUASS after 6 months of

surgery was 5.01 and 6.06 in B-TURP group and M-TURP group respectively. One patient who underwent B-TURP presented with transient stress urinary incontinence on follow-up, which was treated with pelvic floor muscle exercise. The patient experienced complete symptomatic improvement. The mean AUASS at 6 months post-surgery was 5.01 and 6.06 in the B-TURP and M-TURP groups, respectively.

Discussion

The management protocols for BEP and the technology involved in the endourologic approach for BEP have changed significantly in the past 20 years. With the advent of LASERs, newer modalities, such as HoLEP, photovaporization of the prostate with a green light laser, and most recently, thulium laser vapo-enucleation of the prostate and UroLift, have been developed [9]. Despite the

enthusiasm for these newer modalities, TURP is still considered the gold standard [10]. Recently, M-TURP has been challenged by B-TURP because of their comparable efficacy and safety [11]. In this study, we analyzed the outcomes of changes in technology in the past decade, during which we shifted from M-TURP to B-TURP.

Trends in TURP utilization

The data was analysed over two time frames of 4 years each; M-TURP from January 2010 to December 2013 and B-TURP from January 2015 to December 2018. Only monopolar equipment was available at our institute till 2013, and from 2015-2018 only B-TURP has been performed at our centre. Thus, the two groups did not suffer from any selection bias. There was a significant 13% decrease (253 to 219) in the number of TURPs performed during 2015-2018 compared with 2010-2013. The literature also showed a gradual decrease in the number of TURPs. The number of TURPs performed in 2010 showed a decline of 50.4% from that in 2000 and 65.3% from that in 1990 [12]. The most common indication in both groups was refractory urinary retention. The proportion of patients who were refractory to medication significantly decreased from 18.5% in the M-TURP group to 10% in the B-TURP group ($p = 0.009$). This decline and decrease in the number of TURPs can be attributed to the widespread use of the alpha-blocker – 5ARI combination and the addition of therapies such as anticholinergics, beta 3 agonists, and PDE5I in patients refractory to routine combination therapy [13]. The significant reduction in patients undergoing TURP due to failed medical therapy (18.5% in M-TURP vs. 10% in B-TURP, $p = 0.009$) supports this hypothesis. However, the nonsignificant increase in CUR in

the B-TURP group (18% vs. 13%, $p = 0.1$) suggests that prolonged medical management may delay surgical intervention, potentially leading to bladder decompensation and upper tract changes [1, 2, 12]. This trend underscores the need for timely referral for surgical management in patients with progressive Lower Urinary Tract Symptoms (LUTS). The mean prostatic volume differed in previously reported studies, ranging from 41.4 to 82.6 cc in M-TURP and 39.5 to 82.4 cc in B-TURP [14]. Thus, the two groups were similar in terms of preoperative variables and comparable.

Perioperative outcomes

B-TURP required a longer median operative time (74 min vs. 60 min for M-TURP, $p < 0.001$), consistent with the findings of Huang et al. (75 min for B-TURP vs. 71 min for M-TURP) [15]. This difference may reflect more complete resections in B-TURP, facilitated by the safety of saline irrigation, which eliminates the risk of dilutional hyponatremia. However, without data on resected tissue volume or surgeon experience, this interpretation remains speculative. Future studies should explore whether longer operative times in B-TURP correlate with improved long-term outcomes or are influenced by the learning curve. The irrigation volumes were comparable between the groups (30 L, $p = 0.6$), which is consistent with the findings of Singh et al. (19.6 ± 9.2 L for B-TURP vs. 17.3 ± 6.5 L for M-TURP, $p = 0.660$), indicating that operative time differences were not driven by irrigation demands [6].

Complications and safety profile

B-TURP has a superior safety profile compared with M-TURP. No cases of TUR syndrome occurred in the B-TURP group, whereas 2.4% of

M-TURP patients (six cases) experienced TUR syndrome with postoperative serum sodium levels below 120 mmol/L ($p = 0.03$). This is consistent with meta-analyses reporting TUR syndrome in 0.8–2.5% of M-TURP cases and none in B-TURP cases [13,14,16]. The use of isotonic saline in B-TURP eliminates the risk of hyponatremia with resulting neurologic changes (confusion, nausea, vomiting, visual changes, hypertension, tachypnea, and bradycardia) caused by hypo-osmolar irrigants such as distilled water in M-TURP, making B-TURP safer for prolonged resections [17]. The median decrease in serum sodium was significantly greater in the M-TURP group (3.1 mmol/l) than in the B-TURP group (1 mmol/l) ($p < 0.001$). This is in line with previous studies, where in the M-TURP group, serum sodium declined by 2.5 mmol/l, as compared to 1.5 mmol/l in the bipolar arm [18-19].

Additionally, M-TURP patients had a greater hemoglobin drop (1.06 ± 0.21 g/dL vs. 0.89 ± 0.17 g/dL, $p < 0.001$), higher blood transfusion rates (2.7% vs. 0%, $p = 0.01$), and more delayed bleeding with bladder clots (2.7% vs. 0.5%, $p = 0.07$). These findings reflect B-TURP's enhanced hemostatic capacity, attributed to deeper coagulation depths [20] and a “cut-and-seal” effect of bipolar energy [4,11]. The reduced bleeding risk in B-TURP is clinically significant, particularly for patients with comorbidities such as ischemic heart disease, which is prevalent in 7.5–10.5% of our cohort. Urethral stricture rates were low and comparable (0.4% M-TURP vs. 0.45% B-TURP, $p = 0.9$), contrasting with literature reporting higher rates (3.4–4.1% for M-TURP, 0.5–4.7% for B-TURP) [4, 13, 14, 16]. Studies citing higher B-TURP stricture rates, such as 6.3% by Ho et al.

[21], used the TURis system, a quasi-bipolar technology with a return electrode on the resectoscope sheath, potentially increasing urethral exposure to energy [4]. Our use of a true bipolar system (Karl Storz with Alan M-BAVP generator) may explain the lower incidence of stricture. However, our 6-month follow-up limits our ability to assess the long-term risk of stricture, as this complication may manifest later. UTI rates were similar (3.2% M-TURP vs. 2.3% B-TURP, $p = 0.5$), with all cases occurring in patients with preoperative PUC, consistent with known UTI risk factors [22]. These results are consistent with the available literature, where UTI rates were 4.1–6.2% in the M-TURP group and 2.6–8.4% in the B-TURP group [13,14,19].

Functional outcomes

The mean AUASS of patients undergoing TURP in both groups was in the 'severe' range, with more than 98% of the patients in the moderate (AUASS 8-19) and severe LUTS (AUASS > 19) range. This finding is similar to those of previous studies [13]. At 6 months, B-TURP achieved a greater reduction in the AUASS (74.6% vs. 70% for M-TURP, $p < 0.001$), with mean scores of 5.01 ± 1.2 and 6.06 ± 0.57 , respectively. Although statistically significant, this difference is unlikely to be clinically meaningful. Large randomized controlled trials have reported similar AUASS reductions (71% for both modalities), supporting the comparable efficacy of M-TURP and B-TURP [13, 14, 19]. Urgency incontinence was slightly lower in the B-TURP group (1.3% vs. 2.7%, $p = 0.2$), possibly due to reduced tissue charring with lower-voltage bipolar energy [13,14,16]. These symptoms were transient and managed conservatively. Urinary storage symptoms are common after any TURP because the urethral epithelium is disrupted, and the

raw prostatic fossa takes time to re-epithelialize, leading to urgency or dysuria. The literature shows re-TURP rates of 0.2% and 0.5% for B-TURP and M-TURP, respectively [13,14,16]. In our study, re-TURP was required in 0.8% of M-TURP cases (two patients) due to incomplete initial resections aborted for TUR syndrome, with no re-TURP in B-TURP ($p = 0.1$). This highlights the advantage of B-TURP in safely completing resections and reducing the need for secondary procedures. Subsequent re-TURP procedures were uneventful, and the second surgery was not included in the study population.

Study limitations

We acknowledge the limitations of our study. First, our study design was retrospective. However, selection bias did not exist as equipment for only one type of resection was available during that period. Second, our follow-up period was short, with a maximum follow-up of 6 months. However, the main aim of the study was to evaluate perioperative outcomes and the 6 month follow-up may seem inadequate for the evaluation of complications of urethral stricture. Third, the lack of multivariate analysis limits our ability to account for confounders such as comorbidities, prostate volume, or surgeon expertise, which may impact the drop in hemoglobin level or operative time. Fourth, data on resected tissue volume or surgeon-specific outcomes were not collected, which weakens the interpretation of operative time differences. Finally, retrospective data collection may introduce missing variables and

documentation inaccuracies. Future prospective studies with longer follow-up, multivariate adjustments, and detailed surgical metrics are required to validate these findings.

Clinical implications

The shift from M-TURP to B-TURP at our center reflects broader trends in BEP management driven by improved pharmacotherapy and safer surgical technologies. B-TURP offers efficacy equivalent to that of M-TURP, with a superior safety profile, eliminating TUR syndrome, reducing bleeding, and decreasing re-TURP rates. These advantages make B-TURP particularly suitable for training environments, where longer operative times are common, and for patients with comorbidities requiring a minimized bleeding risk. The decline in TURP procedures, especially for failed medical therapy, highlights the efficacy of combination pharmacotherapy but raises concerns about delayed surgical intervention, leading to CUR [23]. Clinicians should consider early surgical referral for patients with progressive LUTS to prevent bladder dysfunction.

Conclusion

B-TURP offers equivalent efficacy to M-TURP with reduced complications, including no TUR syndrome, lower bleeding, and fewer re-TURPs than M-TURP. The decline in TURP procedures reflects the improvement in medical therapies. B-TURP should be considered the new standard for surgical management of BEP.

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***Author for Correspondence:**

Dr. Mohd Hamid Shafique Ahmed, Department of Urology, Lokmanya Tilak Municipal Medical College and General Hospital, Mumbai-400022 Maharashtra
Email ID: khanmohdhamid@gmail.com
Cell: +917387064456

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