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The role of the bipolar plasmakinetic TURP over 100 g prostate in the elderly patients

Enis Rauf Coskuner · Tayyar Alp Ozkan · Sefik Koprulu · Ozdal Dillioglugil · Ibrahim Cevik

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Abstract
Background and purpose Bipolar plasma kinetic (BP) transurethral resection of prostate (TURP) has been proved to be a safe and effective treatment for benign prostatic enlargement (BPE). However, the role of bipolar TURP on large prostates over 100 g compared with open suprapubic prostatectomy (SP) in elderly patients (>65 years) has not ever been studied before.
Patients and methods A retrospective analysis of patients' medical records between 2007 and 2012 was performed. A total of 102 patients who underwent SP ($n = 44$) or BP-TURP [Gyrus Plasma Kinetic^{TM} (Gyrus ACMI, USA)] ($n = 58$) for obstructive lower urinary tract symptoms due to BPE were included in this retrospective study. Inclusion criteria were age $\geq$65 years, prostate volume $\geq$100 g, International Prostate Symptom Score (IPSS) $\geq$18, and peak urinary flow rate (PFR) $\leq$15 ml/s. Exclusion criteria were urethral stricture, known history of neurogenic bladder due to neural disorders, previous prostate and/or urethral surgery, bladder stone, bladder cancer, and known prostate cancer. Operation time, hospitalization, and catheter removal times were noted. Patients were re-evaluated at postoperative 3rd and 12th months. Evaluated parameters were IPSS, quality of life (QoL), simplified International Index of Erectile Function-5 (IIEF-5), PFR, post-voiding residual urinary volume (PVR). Statistical significance was set at 0.05 and all tests were two-tailed.
Results Preoperative IPSS, PVR, IIEF-5, QoL, and prostate volume were not statistically significantly different between two groups except for PFR. Mean follow-up for BP-TURP and SP groups were 15.0 ± 5.8 (R: 11–38), 22.1 ± 11.2 (R: 11–59) months, respectively ($p < 0.001$). When compared with SP, mean catheter removal time ($p < 0.001$) and median hospitalization time ($p < 0.001$) were significantly shorter in BP-TURP group. However, mean operative time was significantly ($p < 0.001$) longer than SP group and also median resected material weight was significantly lower in the BP-TURP group ($p < 0.001$). IPSS, QoL, PFR, PVR, and IIEF-5 scores at postoperative 3rd and 12th month were not significantly different between the two groups ($p > 0.05$). Thirty-three patients had perioperative complications according to the modified Clavien–Dindo system. Thirteen patients (22.4 %) in BP-TURP group and 20 patients (45.4 %) in SP group had complications. In 12th month follow-up visit, four patients presented with urethral stricture, three patients (5.1 %) were in BP-TURP group, and one patient (2.3 %) in SP group ($p = 0.455$). All strictures were treated with internal urethrotomy.
Conclusions BP-TURP is a safe and highly effective treatment modality for BPE in the elderly patients with prostate glands over 100 g. Clinical efficacy and postoperative 12th month's results were similar to SP. Larger studies with longer follow-up are needed in order to confirm our findings.

Keywords Prostate · BPH · TURP · Open prostatectomy · Plasmakinetic

E. R. Coskuner · I. Cevik (✉)
Department of Urology, School of Medicine, YeniYuzyil University, Bagdat Cad. no. 448 Kat: 1, 81070, Suadiye-Istanbul, Turkey
e-mail: cevik@urotip.com.tr; cevik@renetworks.net

T. A. Ozkan · O. Dillioglugil
Department of Urology, School of Medicine, Kocaeli University, Kocaeli, Turkey

S. Koprulu
Department of Anesthesiology, School of Medicine, YeniYuzyil University, Istanbul, Turkey

Introduction

Benign prostatic enlargement (BPE) is one of the most frequent diseases causing significant problems in the aging men and results in bladder outlet obstruction. Transurethral resection of the prostate (TURP) and suprapubic prostatectomy (SP) are the gold standard surgical treatment modalities for this disease [1]. Prostate size generally dictates whichever will be performed in any patient.

Conventional suprapubic or retropubic prostatectomies still remain the reference standard for managing large BPE in many urology centers, especially in developing countries. A large gland that obscures the trigone and the ureteric orifices cannot be comfortably resected transurethrally. Also conventional monopolar TURP has some limitations associated with prolonged operation time: (1) the use of nonelectrolyte irrigation fluid and monopolar current can result in transurethral resection (TUR) syndrome, (2) increased risk of bleeding, and (3) urethral stricture. General morbidity due to monopolar TURP was reported as 18 % and overall mortality between 0.17 and 0.77 % [2–4]. Although most urologists are comfortable and the patients are safe with the removal of glands with monopolar TURP in the range of 50–75 g in general, open surgery is recommended for larger glands. Complications of BPH and comorbid medical conditions are also other indications for open prostatectomy.

Various alternative surgical treatment options have been explored in an attempt to reduce BPE-related complications. Bipolar plasmakinetic TURP (BP-TURP) with isotonic saline irrigation is a recently introduced minimal invasive surgical method in the treatment of BPE. BP-TURP has some advantages, such as elimination of TUR syndrome, less risk of capsule trauma, better tissue orientation (decreased coagulation depth), and self-cleaned loop (plasma flow). But it has also some disadvantages such as high electro-trauma risk (in case of deviation of flows), the possibility of too high fluid absorption (serum Na diagnosis is not possible), and more limited coagulation (bleeding probability). Despite all, BP-TURP proved to be a safe and effective treatment for BPE [5–8]. However, the role of BP-TURP on large prostates (>100 g) in the elderly patients (>65 years) has not been studied well.

In this study, we aimed to analyze the efficacy, safety, and postoperative outcomes of the BP-TURP on large prostates (>100 g) compared with SP in the elderly (>65 years) patients. To the best of our knowledge, the study presented here has not ever been studied before.

Patients and methods

A retrospective analysis of patients' medical records operated between 2007 and 2012 was performed. A total of 44 patients who had open prostatectomy and 58 patients who underwent BP-TURP [GyrusPlasmaKinetic™ (Gyrus ACMI, USA)] for obstructive lower urinary tract symptoms due to BPE were included in the study. Prostate-specific antigen (PSA), serum creatinine, International Prostate Symptom Score (IPSS), urinary symptoms related quality of life (QoL), International Index of Erectile Function-5 (IIEF-5), uroflowmetry measuring the peak urinary flow rate (PFR), post-voiding residual urine volume (PVR), and suprapubic or transrectal ultrasound scan (US) measurement of the prostate volume were performed for all patients under a standard preoperative evaluation protocol. As a standard follow-up, IPSS, QoL, IIEF-5, PFR, and PVR at 3rd and 12th postoperative month have been done for all patients.

Inclusion criteria were age ≥65 years (geriatric population), prostate volume ≥100 g, IPSS ≥18, and PFR ≤15 ml/s. Exclusion criteria were urethral stricture, known history of neurogenic bladder due to neural disorders, previous prostate and/or urethral surgery, bladder stone, bladder cancer, and known prostate cancer. Operation duration, hospitalization, and catheter removal times were noted. Three experienced surgeons on TURP and SP performed the operations. All patients received standard regional or general anesthesia.

In the SP group, transvesical enucleation of the hyperplastic prostate tissue was performed through an extraperitoneal incision of the lower anterior bladder wall. In the BP-TURP group, the prostate was resected transurethrally by using a standard continuous irrigating resectoscope with a 27 French outer sheath. The operation was initiated and conducted with the thick loop, and fine-tuning and coagulation was performed with the thin one toward the end of the resection. At the end of the surgery, all BP-TURP patients had tri-way 22 F Foley catheter and received continuous bladder irrigation. The catheters were removed when the urine became clear without continuous saline irrigation. SP patients had Malecot cystostomy tubes, Foley catheter, and perivesical 18 F silicone drainage tubes, which were removed depending on the clearance and the amount of draining fluids; Malecot first, Foley second and 18 F silicone last.

Patients were re-evaluated for treatment efficacy, and preoperative and postoperative outcome measures (IPSS, QOL, IIEF-5, PFR, and PVR) were compared. Both 3rd and 12th month results of IPSS, QoL, IIEF-5, PVR and PFR were used for the statistical comparisons. Postoperative complications according to the modified Clavien system, including hematuria, acute urinary retention after catheter removal, lower urinary tract infection, catheter malfunction, transient serum creatinine elevation, blood transfusion, and pulmonary embolism were recorded.

Results were expressed as mean ± standard deviation (SD) if data were normally distributed, otherwise expressed as median (Interquartile range [IQR] or range [*R*]).

Table 1 Demographics and preoperative clinical results

	TURP ($n = 58$)	Suprapubic prostatectomy ($n = 44$)	p
Age, median (IQR)	72.5 (68–77)	69.5 (65.5–74)	0.068
PSA, median (IQR)	3.69 (2.5–6.75)	4.38 (2.83–6.4)	0.359
Creatinine, median (IQR)	1.0 (0.89–1.2)	1.0 (0.93–1.2)	0.317
PreOp IPSS, median (IQR)	20 (14–22)	21 (19–23)	0.072
PreOp QoL, mean ± SD	4.9 ± 1	5.1 ± 0.9	0.509
PreOp PFR, median (IQR)	6 (4.41–8)	7.8 (6.6–9.4)	0.003
PreOp PVR, median (IQR)	141.5 (92–278)	115 (71–250)	0.237
Prostate Volume, median (IQR)	116.1 (105–128)	120 (109.5–139)	0.418
IIEF-5 score, mean ± SD	16.7 ± 5.5	17.4 ± 5.7	0.522

IQR Interquartile range, *IPSS* International Prostate Symptom Score, *PFR* Peak flow rate, *PVR* post-voiding residue, *IIEF-5* International index of erectile function-5

Table 2 Comparison of the outcome measures in study groups

	Bipolar TURP ($n = 58$)	Suprapubic prostatectomy ($n = 44$)	p
Operative time, min, mean ± SD	102.76 ± 20.92	73.5 ± 24.14	<0.001
Resected material weight, g, median (IQR)	67.5 (59–80)	80 (70–90)	0.001
Peroperative blood transfusion % (n)	8.6 (5/58)	25 (11/44)	0.024
Catheter removal, days, mean ± SD	3.19 ± 0.87	5.22 ± 1.38	<0.001
Hospitalization, days, median (IQR)	2 (2–3)	5 (5–6.5)	<0.001
IPSS 3rd mo, median (IQR)	7 (4–10)	8 (7–9)	0.155
QoL 3rd mo, mean ± SD	0.87 ± 1	0.91 ± 0.7	0.863
PFR 3rd mo, ml/s, median (IQR)	16 (14–22)	18.35 (17.5–21.1)	0.082
PVR 3rd mo, ml, median (IQR)	37.5 (20–50)	40 (10–85)	0.726
IIEF-5 3rd mo, mean ± SD	14.1 ± 4.6[a]	14.3 ± 4.6[b]	0.832
IPSS 12th mo, median (IQR)	6 (3–9)	6 (3–8)	0.918
QoL 12th mo, mean ± SD	1.29 ± 1	1.18 ± 0.7	0.526
PFR 12th mo, ml/s, median (IQR)	17.75 (15.6–21)	17.1 (15.35–18.3)	0.085
PVR 12th mo, ml, median (IQR)	30 (20–60)	47.5 (30–53.5)	0.198
IIEF-5 12th mo, mean ± SD	16.2 ± 4.5[c]	15.5 ± 4.8[d]	0.431

IQR Interquartile range, *IPSS* International Prostate Symptom Score, *PFR* peak flow rate, *PVR* post-voiding residue, *IIEF-5* International index of erectile function-5

[a] Missing in three patients, [b] missing in two patients, [c] missing in two patients, [d] missing in one patient

Repeated measures were tested with Wilcoxon signed rank for non-normally distributed, and t test was used for normally distributed data. All analysis was performed using STATA 12.0 SE statistical software package (Stata Corp, TX, USA). Statistical significance was set at 0.05, and all tests were two-tailed.

Results

Detailed comparison of demographic data and perioperative findings between BP-TURP and SP groups were summarized in Table 1. They were not statistically significantly different between two study groups except for preoperative PFR. Mean follow-up for BP-TURP and SP groups were 15.0 ± 5.8 (R: 11–38), 22.1 ± 11.2 (R: 11–59) months, respectively ($p < 0.001$). Of all, 7.8 % ($n = 8/102$) patients had incidental prostate cancer (3 in BP-TURP and 5 in SP groups).

When compared with SP, mean catheter removal time ($p < 0.001$) and median hospitalization duration ($p < 0.001$) were significantly shorter in BP-TURP group. However, mean operative time was significantly ($p < 0.001$) longer than SP group and also median resected material weight was significantly lower in the BP-TURP group ($p < 0.001$). Findings at postoperative 3rd and 12th month for IPSS, QoL, PFR, PVR, and IIEF-5 scores were not significantly different between the two groups ($p > 0.05$). Outcome measures are summarized in Table 2.

Thirty-three patients had perioperative complications according to the modified Clavien–Dindo system. Thirteen patients (22.4 %) in BP-TURP group and 20 patients (45.4 %) in SP group had complications. Detailed complication grades and management strategies are summarized in Table 3. Five patients (8.6 %) in BP-TURP group and 11 patients (25 %) in SP group required perioperative blood transfusion due to intraoperative bleeding ($p = 0.025$). No TUR syndrome was observed in any group.

Table 3 Grade of complications according to Clavien–Dindo system and management strategies

Grade	Complication	Management
Bipolar plasmakinetic transurethral resection of prostate		
Grade 1	Hematuria ($n = 2$)	Bed side irrigation
	Acute urinary retention ($n = 3$)	Re-catheterization
	Lower urinary tract infection ($n = 2$)	Antibiotics
	Catheter malfunction ($n = 1$)	Catheter change
Grade 2	Intraoperative bleeding/Hematuria ($n = 5$)	Blood transfusion
Suprapubic prostatectomy		
Grade 1	Hematuria ($n = 2$)	Bed side irrigation
	Transient serum creatinine elevation ($n = 1$)	Saline hydration
	Lower urinary tract infection ($n = 5$)	Antibiotics
Grade 2	Intraoperative bleeding/Hematuria ($n = 11$)	Blood transfusion
	Pulmonary edema ($n = 1$)	Diuretics

Overall, 3 of 58 (5.2 %) patients in BP-TURP group required clean intermittent catheterization; indication for treatment of all of these three patients was acute urinary retention due to detrusor insufficiency. All of these patients had diabetes mellitus type II in their medical history. Of these three patients, only one benefited from myocholine treatment. Other two patients are still on clean intermittent catheterization. In 12th month follow-up visit, four patients presented with urethral stricture symptoms, three patients (5.1 %) were in BP-TURP group, and one patient (2.3 %) in SP group ($p = 0.455$). All strictures were treated with internal urethrotomy.

Discussion

Although monopolar TURP is used for the treatment of BPE in large size prostates, open prostatectomy still has a role [1, 8, 9]. Monopolar TURP is being gradually replaced by BP-TURP because of the associated morbidity and mortality rates in monopolar TURP. Although a number of new techniques have been reported as alternatives to monopolar TURP [10, 11], BP-TURP with isotonic saline irrigation solutions is the most prominent minimal invasive surgical method in the treatment of BPE [7].

Giulianelli et al. evaluated efficacy and safety of BP-TURP to open prostatectomy in patients with lower urinary tract symptoms with markedly enlarged glands refractory to medical therapy. They divided the patients into two groups: open prostatectomy ($n = 70$) and bipolar TURP ($n = 70$). There was no significant difference between the two groups in terms of IPSS, IIEF, QoL, PSA, PFR, and PVR, but postoperative Hb levels and catheter removal time, hospitalization length, and 3 year overall surgical re-treatment-free rate were all significantly better in the BP-TURP group [12]. Thus, results of Giulianelli's and our study showed that BP-TURP has promising results, and it may be a good alternative to SP.

In another multicenter double-blind randomized controlled trial on the perioperative efficacy and safety of bipolar ($n = 141$) versus monopolar ($n = 138$) TURP, only serum Na^+ changes were found to be significantly different between the two groups. No significant difference was found for the other parameters: PFR, PVR, IPSS, QoL, Hb levels, operation time, capsular perforation, catheter removal time, and postoperative complications. Only one TUR syndrome occurred in monopolar TURP group; however, this was not translated to a statistical significance. Authors also reported that bipolar TURP is a safe and highly effective treatment for larger prostates (mean volume: 63 ml vs. 64 ml) with long resection time and allows for better hemostasis [5].

Gupta et al. reported transurethral vapor resection of prostate (TUVRP) using a thicker loop at higher current settings in glands larger than 100 g. At an average follow-up of 6 months, good perioperative results with minimal morbidity were reported in 39 consecutive large prostate glands (mean 121.39 g, *R*: 101–232 g) [13].

Currently, there are very few studies evaluating the efficacy of photoselective vaporization of prostate (PVP) in large size glands. Gu et al. have reported that PVP is a viable surgical option for BPH, irrespective of prostate size. Gland size >80 g was compared with <80 g, and good functional outcomes without increased morbidity were reported using 120 W system [14]. In another study, patients were randomized to 120 W PVP and holmium laser enucleation of the prostate (HoLEP) for large prostates (mean 90 g). In this study, the residual prostate weight at 6 months of surgery was twice as more for PVP than HoLEP (41.2 ± 13.3 vs. 20.7 ± 7.7 g, $p < 0.0001$) [15]. In another controlled trial, Chen et al. randomized 280 cases to BP-TURP or HoLEP. Mean prostate size was equivalent (60.3 vs. 56.7 g) in both groups. HoLEP was found more effective than BP-TURP with respect to bladder irrigation, catheter time, and hospital stay. HoLEP group also demonstrated significantly higher resected prostate weight and less hemoglobin loss [16]. In their randomized controlled study, Fayad et al. showed that HoLEP and BP-TURP were both comparable to each other. However, HoLEP is not the first choice because of its steep learning curve, longer operation time, and high cost [17]. A recent meta-analysis revealed that HoLEP results in outcomes superior to open prostatectomy, and better hospitalization and catheter removal time than monopolar TURP [18].

AUA 2011 Update on BPH management states that laser therapies including HoLEP and PVP has a role even in very large prostates over 100 g [1].

The mortality of monopolar TURP is less than 0.25 %. But monopolar TURP still has complications, such as TUR syndrome (up to 2 %) and blood loss that needs blood transfusion (up to 8 %). The bipolar electrosurgical system vaporizes tissue at the same time during resection so the surgeon controls bleeding effectively [5]. Kuntz et al. reported on a total of 120 urodynamically obstructed patients with prostates larger than 100 g. Patients were randomized to HoLEP or open prostatectomy. None of the HoLEP cases needed blood transfusion, in contrast to 8 in the open prostatectomy group [19]. Many studies have reported that HoLEP is a technique considered as being most similar to open prostatectomy enucleation but with less blood loss and early recovery [20, 21]. In our study, five patients required postoperative transfusion of two packed red blood cells rendering our blood transfusion rate 9.09 %. When compared with literature, our transfusion rate is relatively high [2], but it has not been possible for us to find a comparable series.

Recent study evaluated urethral stricture development. Although reported time intervals for the actual development of stricture differed widely (3–12 months) from each other, stricture rates did not differ significantly between bipolar and monopolar TURP [22].

Kan et al. have recently compared the efficacy and safety of bipolar endoscopic enucleation of prostate with bipolar TURP in saline for large BPE >70 g. They randomized 160 patients into bipolar enucleation and bipolar resection groups. In this study, their mean operative time was longer in bipolar resection group ($n = 86$) when compared with our BP-TURP group, although more tissue was resected in our study (45.7 vs. 67.5 g). 12 months after the procedure, our BP-TURP group had better IPSS (11.6 vs. 6) compared with their bipolar resection group [23].

BP-TURP is a technique promising good efficacy for large sized glands [24–26]. But no previous study discussed the role of BP-TURP on large prostates (>100 g) in the geriatric population. In the current study with BP-TURP, we also had significant improvements in IPSS, PFR, and PVR at the 3rd and 12th postoperative month follow-up. We think that BP-TURP is a safe alternative to SP in patients with large prostates (>100 g) in geriatric population. Our postoperative complications were similar in BP-TURP and SP groups except for high transfusion rate in SP group. All of the three urinary retentions occurred in preoperatively catheterized diabetic patients (all in BP-TURP group), who most probably had insufficient detrusor function due to diabetic neuropathy.

Recently, De Nunzio et al. tried to validate modified version of the Clavien system to assess the complications associated with transurethral resection of the prostate. In this multicenter study, they found that most of the complications were Clavien type I and II. Similar to our study, they also found that TURP (bipolar or monopolar) is a safe procedure with minimal perioperative morbidity. Our complications in this study are reasonable and consistent with the current literature [22, 27].

Early catheter removal (median 3 days), a very short hospitalization and less bleeding in our study (elderly patients with large prostate) render BP-TURP more favorable. Saline utilization in BP-TURP allows longer resection time, which in turn helps removal of as much adenoma as in open prostatectomy. So, in terms of mean resected prostate weight, IPSS and PFR improvements, hospital stay, and bleeding (no reoperation for bleeding in our study), BP-TURP is more favorable than SP.

In our study, IIEF-5 was used for the assessment of sexual function and IIEF-5 score over 22 was considered adequate in terms of erectile function. The presence of retrograde ejaculation, on the other hand, was directly asked to the patient. Erectile dysfunction occurs in 3–5 % of patients undergoing an open prostatectomy, and it is more common in older men [28]. The incidence of erectile dysfunction after plasmakinetic energy usage for the prostate was reported as 10 % [29]. In a recent study for plasmakinetic energy, none of the patients who were preoperatively potent developed erectile dysfunction and some of the patients with some degree of erectile dysfunction preoperatively reported normal after operation [30]. Bipolar systems require less energy for resection, and electric current does not affect the periprostatic tissue to stimulate or damage the surrounding nerves [31]. Also, bloodless resection helps the operator identify and avoid injury to nearby important structures [32]. As shown in our study, both groups seemed to produce the same erectile function rate in preoperative and postoperative 12th month evaluation, although slight decrease was seen in postoperative 3rd month. Another sexual dysfunction is retrograde ejaculation, and it occurs in 80–90 % of patients after SP (1). In a recently performed prospective study, the retrograde ejaculation after plasmakinetic usage was reported in 59 % of the patients [32]. In our study groups, among the patients with normal preoperative erectile function, 31 (81.5 %) in SP group and 32 (65.3 %) in BP-TURP group had retrograde ejaculation and this is consistent with the literature.

Our findings suggest that BP-TURP is a safe and highly effective treatment modality for BPE in geriatric patients (>65) with prostate glands over 100 g. Although our study is the first trial evaluating BP-TURP in oversize prostates in geriatric patients, it has some limitations. Limitations of our study are non-randomized retrospective nature and the relatively short postoperative follow-up period.

Conclusion

BP-TURP is a safe and highly effective treatment modality for BPE in the geriatric patients with prostate glands over

100 g. Larger studies with longer follow-up are needed in order to confirm our findings.

Conflict of interest No competing financial interests exist.

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