Original Article

Efficacy of bipolar "button" plasma vaporization of the prostate for benign prostatic obstruction, compared to the standard technique

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Abstract

Objective: The objective of the following study is to evaluate the efficiency of transurethral plasma vaporization of the prostate in saline bipolar plasma vaporization of the prostate (BPVP) using the button electrode and comparing it to the standard transurethral resection of the prostate (TURP).

Patients and Methods: During the period of the year between 2007 and 2013, 152 patients with benign prostatic hyperplasia were rolled in our study. Fifty-two patients were underwent BPVP and 100 TURP. All patients were evaluated preoperatively, 24 h and at 3 months postoperatively. International Prostate Symptom Score (I-PSS), quality-of-life (QOL) score, Qmax and Qave and post void residual (PVR) urine. Operative time, hospital stay, catheterization time, and complications were reported. Mean serum Hb, hematocrit and serum sodium changes were reported preoperatively and within 24 h postoperatively in both groups. Statistical analysis is performed using SPSS program version 20 for windows.

Results: Mean age at surgery was 60.8 ± 8 (range 63- 92) and 66 ± 8.6 (range 50-83) for BPVP and TURP groups, respectively. Mean prostatic volume was 46 ± 11 (range 30-92) and 43 ± 8 (range 30-80) in both groups, respectively. Patients from both series had similar preoperative characteristics. The mean operative duration 53 ± 21 1 ± 2.1 (range 1-7) versus 3 ± 3.3 (range 3-8) days (*P* value 0.0001) were significantly (range 20-80) versus 62 ± 16 min (range 30-126) (*P* value 0.004), catheterization period 2 ± 0.28 (range 2-4) versus 3 ± 3.2 (range 2-7) days (*P* value 0.03).

Conclusions: BPVP has superior efficacy in short-term results and less complication rates compared with classic TURP.

Key Words: Prostate, prostatic hyperplasia, transurethral resection of prostate

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INTRODUCTION

Transurethral resection of the prostate (TURP) remains the gold standard intervention for benign prostatic obstruction (BPO). The procedure is associated with overall morbidity 18% and mortality rate less than 1%.[1-4] Operative complications of TURP such as bleeding needs transfusion, sepsis and transurethral resection (TUR) syndrome were reported.[5] The absorption of irrigating fluid during and after TURP surgery causes TUR syndrome. The ideal irrigant fluid for TURP would be translucent, iso osmolar and nonconductor to the electric current. Sterile water was used, but its absorption caused hemolysis and serious hemoglobinuria. Glycine solution (1.5%) is widely used for monopolar TURP. In recent times, normal saline is used in bipolar systems, such as Olympus® and Storz™ systems.[6-8]

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Although many endoscopic options developed for treatment of BPO, there is a continuous effort to develop minimally invasive, efficacious, safer, and cost-effective treatment options. This study aimed to evaluate the efficacy and safety of bipolar plasma vaporization of the prostate (BPVP) with "button-type" electrode compared to the standard TURP for BPO.

PATIENTS AND METHODS

During the period of the year between January 2007 and February 2013, we retrospectively analyzed the records of 152 patients who had BPO. Fifty-two patients were underwent transurethral bipolar plasma vaporization of the prostate (BPVP) (button) in saline were rolled in our study from 2010 to 2013. Hundred patients were underwent the classic TURP between 2007 and 2010. All surgeries were done by the same surgeon. Informed consent was signed from all patients.

Exclusion criteria

Patients with known neurogenic bladder, prostate cancer, previous prostatic or urethral surgery and bladder stones. Previous myocardial infarction within 6 months, previous TURP, and serum creatinine >200 mol/L also was excluded.

Preoperative evaluation

Indications of surgery were a failure of medical treatment or absolute urinary retention due to BPO. All patients are underwent history taking, physical examination, digital rectal examination, urine analysis and culture, routine preoperative laboratory investigations. All patients were undergone uroflowmetry, post void residual (PVR) urine measurement by abdominopelvic US and transrectal ultrasound for evaluation of prostatic volume. Preoperatively, I-PSS, quality-of-life (QOL) scores and maximum and average flowmetry (Qmax, Qave) were recorded in all patients.

Technique

Both techniques were performed under spinal or general anesthesia. Initial cystoscopy was done for all patients and examination under anesthesia. BPVP was performed by using the Olympus SurgMaster UES-40 bipolar generator and a 24 Fr resectoscope, at 270-300 W cutting power and 75-100 W for coagulation. Isotonic saline was used as the irrigant fluid in BPVP and to vaporize obstructing prostatic tissue with the button electrode by gentle contact. The special "mushroom" button-type vaporization electrode was used (Olympus Company, Germany) [Figure 1]. This new spherical electrode displays a plasma corona on its surface and gradually moved into direct contact with the enlarged prostatic tissue, which produces a bloodless field at 280 W [Figure 2]. Coagulation of any bleeding points, while for larger vessels, hemostasis was achieved by reducing the power of the generator.

Classic TURP was performed in 100 patients with a 24 Fr Storz monopolar resectoscope (Karl Storz, Germany). Glycine irrigation was used in the standard technique using the Storz resectoscope with monopolar diathermy. After the procedure, a three-way Foley catheter 20 Fr is inserted and slow continuous or intermittent irrigation of the bladder was used. Normal saline was used in both groups for bladder irrigation until stoppage of bleeding. An attempt of catheter removal was done after 2 days when urine was clear. All patients treated postoperatively with antibiotics and good analgesia.

Operative and postoperative care

All data belong patients such as operative time, mean serum hemoglobin and hematocrit changes and serum sodium changes were reported preoperatively and within 24 h postoperatively in both groups. Hospital stay and catheterization time also were reported. Volume and period of irrigation intraoperative and postoperative were calculated for all patients in both groups. Details of any complications were noted, including bleeding need of transfusion or capsular perforation. TUR syndrome which is

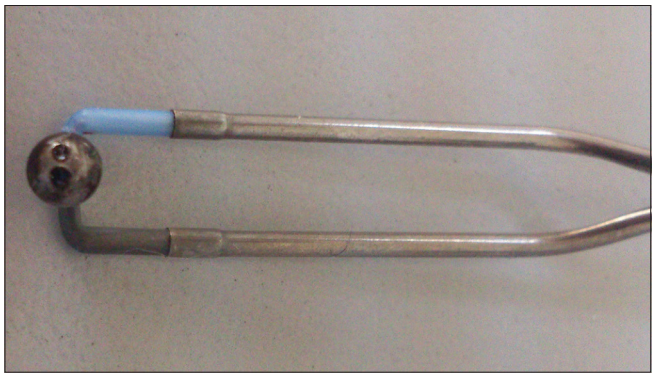

Figure 1: The special "mushroom" button-type vaporization electrode was used (Olympus Company, Germany)

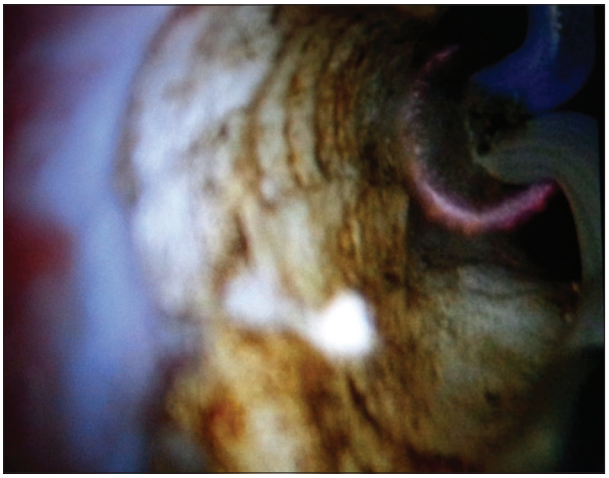

Figure 2: The new (button mushroom) electrode gradually moved into direct contact with the enlarged prostatic tissue producing a bloodless field and clear vision during the bipolar plasma vaporization of the prostate procedure

defined by sodium of ≤125 mol/L with two or more symptoms or signs of TUR syndrome such as nausea, vomiting, mental confusion and visual disturbances, hypotension, hypertension. Postoperative complications such as absolute retention, secondary hemorrhage, stricture urethra and incontinence were documented.

Short-term follow-up was performed 3 months after surgery for all patients. Follow-up with uroflowmetry (Qmax, Qave), PVR urine, I-PSS and QOL score were reported.

Statistical analysis

Data were collected and statistically analyzed using SPSS (Statistical Package for Social Science) program version 20 for windows (SPSS Inc., Chicago, IL, USA) and Epi Info program version developed by Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia, USA for all the analysis. $P < 0.05$ was considered to be statistically significant. Data are shown as mean, range or value and 95% confidence interval and frequency and percent. Fischer exact test, Student *t*-test and Mann-Whitney test were used.

RESULTS

Overall, 152 patients were indicated for TUR due to BPO. Fifty-two patients were underwent BPVP and 100 were undergone the classic TURP. Mean age at surgery was 60.8 ± 8 (63-92) and 66 ± 8.6 (50-83) for BPVP and TURP groups, respectively. Mean prostatic volume was 46 ± 11 (range: 30-92) versus 43 ± 8 (range: 30-80) in both groups, respectively.

Preoperative parameters

Preoperative I-PSS, QOL, Qmax, US measurement of PVR urine were reported in Table 1. Almost all the data were insignificant because the indications for the surgery were the same in both groups.

Perioperative data are registered in Table 2. The mean operative time was 53 ± 21 (range: 20-80) and 62 ± 16 (range: 30-126), min (*P* value 0.004), in the BPVP and TURP groups, respectively. The indwelling catheter was removed after mean 2 ± 0.28 (range: 2-4 days) in the BPVP group versus 3 ± 3.2 (range: 2-7 days) (*P* value 0.03) in the TURP group. There was statistically highly significant difference in hospital stay. BPVP patients were discharged at an average of 1 ± 2.1 (range: 1-7) versus 3 ± 3.3 days (range: 3-8) in TURP group (*P* value 0.0001). Mean irrigation volume during surgery and postoperatively was significantly lesser in volume and hours in BPVP group (*P* value 0.0001). Changes in hemoglobin, hematocrit values and serum sodium in the first 24 h after surgery were highly significant lesser in BPVP group ($P < 0.0001$) [Table 2].

Complications

In BPVP group, overall, only two patients (3.8%) were noted with early complications. Only one patient experienced capsular

Table 1: Preoperative data

Preoperative data	BPVP	TURP	*t* test	*P* value
No. of patients	52	100		
Age	60.8±8 (63-92)	66±8.6 (50-83)	3.62	0.0001** (H.S)
Prostate volume	46±11 (30-92)	43±8 (30-80)	1.92	0.056 (N.S)
I-PSS (range: 0-35)	21±3.4 (18-33)	20±4 (16-35)	1.54	0.13 (N.S)
QOL (range: 0-6)	Mean 4.2±1.3 (range: 3-6)	Mean 4.3±1.1 (range: 3-6)	0.49	0.62 (N.S)
Qmax (mL/s)	Mean 12±3.2 (range: 6-15)	Mean 11.2±2.8 (range: 7-14)	1.59	0.11 (N.S)
Qave (mL/s)	Mean 5.9±1.3 (range: 4-7)	6±1.1 (range: 3-7)	0.49	0.62 (N.S)
PVR (mL)	Mean 147±80 (range: 150-350)	Mean 182±87 (range: 155-320)	2.44#	0.02* (S)

#Mann-Whitney test, *Significant $P<0.05$, **Highly significant $P<0.01$. I-PSS: International prostate symptom score (range: 0-35), QOL: Quality of life score (range: 0-6), Qmax: Maximum flow rate (range: 0-25 mL/s), Qave: Average flow rate (0-15 mL/s), PVR: Postvoid residual (significant> 100 mL), BPVP: Bipolar plasma vaporization of the prostate, TURP: Transurethral resection of the prostate. **=(H.S): Highly significant, (N.S): Non Significant, *= (S): Significant

Table 2: Mean perioperative data

Perioperative data	BPVP	TURP	Mann-Whitney test	*P* value
Operative time (min)	53±21 (range: 20-80)	62±16 (range: 30-126)	2.95	0.004** (H.S)
Hospital stay (days)	1±2.1 (1-7)	3±3.3 (3-8)	3.97	0.0001** (H.S)
Catheterization time (days)	2±0.28 (2-4)	3±3.2 (2-7)	2.25	0.03*
Mean irrigation intraoperative (L)	11.6±2.3 (range: 4-18)	16.8±4.8 (range: 5-20)	7.38#	0.0001** (H.S)
Mean irrigation time postoperatively (h)	15±6 (range: 4-28)	26±8 (range: 8-90)	8.72	0.0001** (H.S)
Mean serum hemoglobin change (g/dl)	−0.8±0.4	−1.9±0.8	9.32	0.0001** (H.S)
Mean % hematocrit change	−1.2±0.4	−1.5±0.6	3.25	0.001** (H.S)
Serum Na change (mmol/dl)	−2±0.3	−3.6±1.7	6.72	0.0001** (H.S)
Total number (patients)	52	100		

#*t* test, **Highly significant $P<0.01$. BPVP: Bipolar plasma vaporization of the prostate, TURP: Transurethral resection of the prostate. **=(H.S): Highly significant, (N.S): Non significant, *= (S): Significant

perforation whom managed conservatively and another with absolute retention who underwent revision and vaporization of the residual tissues. No patients in the BPVP group had a significant decrease in hemoglobin or developed TUR syndrome. In TURP group, 18 patients (18%) had early complications. Capsular perforation was reported in 4 (4%) and absolute retention in 4 (4%) and TUR syndrome in 2 (2%) in the form of mental confusion and irritability with serum Na < 125. Six patients (6%) needed a blood transfusion because hemoglobin was below 9 g/dl. These patients needed second look for cauterization of the bleeding sources. Postoperatively, total incontinence was observed in only one patient (1%) who was managed conservatively with tolterodine and flavoxate Hcl oral therapy. At 3-month follow-up, five patients had urethral stricture, two patients after BPVP (3.8%) and 3 (3%) after TURP. All these patients managed by visualized internal urethrotomy [Table 3].

Short-term follow-up at 3 months showed insignificant difference in I-PSS, QOL and PVR measured by US and highly significant better results (*P* value 0.0001) in Qmax and Qave results in both groups, respectively [Table 4]. We compared the results of both groups in preoperative and at 3 months follow-up in I-PSS, QOL, Qmax, Qave, PVR for each group in [Table 5]. The results revealed highly significant improvements for patients in both groups (*P* value 0.0001) regardless of the technique used.

DISCUSSION

Recent studies show that almost three-quarters of men by the seventh decade of life will have benign prostatic hyperplasia.[9] TURP is still the most common procedure for treatment of BPO.[10,11] However, many complications were reported associated with this procedure.[12,13]

Minimally invasive techniques such as laser or transurethral microwave therapy have challenged TURP to relieve BPO symptoms. Photo-selective vaporization of the prostate uses a laser to vaporize obstructive tissue rather than thermal or electrical energy. The laser light penetrates adenomatous prostatic tissue and vaporizes it without charring and leaving behind a thin layer of coagulated tissue that helps in hemostasis.[14] Today, These alternative procedures are investigated and compared with TURP regarding efficacy, morbidity, hospital stay, and cost. Plasma kinetic system started with the use of transurethral vaporization of the prostate in saline using vaporization electrode ("button" electrode). Plasma corona generated on the surface of spherical electrode, which caused by UES-40 bipolar high-frequency electrosurgical generator is the basis of BPVP. Plasma vaporization occurs by direct gentle contact with the tissue surface associated with good hemostasis. However, because of the excellent hemostasis during surgery, there was an excellent vision throughout the procedure. Due to these advantages, postoperative outcome in our study were significantly better in BPVP cases than classic TURP, since this technique improves operative visibility, decreases capsular perforation, decrease operative time and leads to more rapid complete tissue removal as reported before in previous studies.[8,15,16]

Table 3: Postoperative complications

Postoperative complications	BPVP	TURP	*P* value
Total number of patients	52	100	
TUR syndrome	-	2	0.55 (N.S)
Transfusion	-	6	0.09 (N.S)
Capsular perforation	1	4	0.66 (N.S)
Secondary hemorrhage	-	-	-
Absolute retention	1	4	0.66 (N.S)
Total incontinence	-	2	0.55 (N.S)
Urethral stricture	2	3	1 (N.S)

BPVP: Bipolar plasma vaporization of the prostate, TURP: Transurethral resection of the prostate, TUR: Transurethral resection, (N.S): Non significant

Reich *et al*.[17] in their study have reported in multicenter study evaluation of 10,654 patients underwent classic TURP. The most significant complications reported in this study were the bleeding which needs a blood transfusion in 2.9%, TUR syndrome in 1.4%, postoperative retention in 5.8%, and mortality rate in 0.1%. However, all of these drawbacks were decreased significantly in multiple studies using the bipolar system for resection or vaporization of the prostate in saline.[7-16] Longer follow-up studies are still needed to confirm the long-term efficacy of BPVP among the minimally invasive procedures for surgical treatment of BPO.[17,18]

Hospitalization at our institution includes 1 day surgery. The urethral catheter is usually removed as soon as the urine remains clear. The patient is discharged home when he is generally stable with clear urine. Patients underwent BPVP had clear urine faster, significant shorter hospital stay and earlier catheter removal [Table 2] compared to TURP group. In similar studies, shorter catheterization and hospitalization times in the bipolar resection group. BPVP surgery is proposed to be outpatient surgery. Mean catheterization time has been 1-2 days in previously published series.[15,19]

TUR syndrome is observed in 2% of TURP patients using glycine irrigation, and none of BPVP group with saline irrigation had this risk. The volume of irrigation intraoperative and postoperative was significantly lesser in BPVP group. Fluid absorption is not measured in our study, but patients whom were undergone TURP required more time for irrigation postoperatively. Moreover, changes in serum sodium were significantly lesser in BPVP group compared with classic TURP. All of the previous criteria helped to avoid TUR syndrome in BPVP group; however, 2% of TURP suffered of

Table 4: Follow-up data at 3 months in both groups

Follow-up data at 3-month	BPVP	TURP	Mann-Whitney test	*P* value
No. of patients	52	100		
I-PSS	7.7±8	6.9±6	0.69	0.49 (N.S)
QOL score	1.7±0.8	1.5±0.6	1.73	0.09 (N.S)
Qmax (mL/s)	25±1.2	23.5±1.9	5.18#	0.0001** (H.S)
Qave (mL/s)	15±0.2	11.9±0.7	31.23#	0.0001**(H.S)
PVR (mL)	34±15 (range: 0-58 mL)	39±12 (range: 0-60 mL)	2.23	0.03* (S)

#*t* test, *Significant *P*<0.05, **Highly significant *P*<0.01. I-PSS: International prostate symptom score (range: 0-35), QOL: Quality of life score (range: 0-6), Qmax: Maximum flow rate (range: 0-25 mL/s), Qave: Average flow rate (0-15 mL/s), PVR: Postvoid residual (significant> 100 mL), BPVP: Bipolar plasma vaporization of the prostate, TURP: Transurethral resection of the prostate. **= H.S: Highly significant, N.S: Non significant, *= S: Significant

Table 5: Comparing of preoperative and postoperative outcome at 3 months of BPVP group

Patients data	BPVP (preoperative)	BPVP (postoperative)	Paired *t* test	*P* value
I-PSS (range: 0-35)	21±3.4 (18-33)	7.7±8	11.03	0.0001** (H.S)
QOL (range: 0-6)	4.2±1.3 (range: 3-6)	1.7±0.8	11.81	0.0001** (H.S)
Qmax (mL/s)	12±3.2 (range: 6-15)	25±1.2	27.42	0.0001** (H.S)
Qave (mL/s)	5.9±1.3 (range: 4-7)	15±0.2	49.89	0.0001** (H.S)
PVR (mL)	147±80 (range: 150-350)	34±15 (range: 0-58 mL)	10.01#	0.0001**(H.S)

#Wilcoxon test. BPVP: Bipolar plasma vaporization of the prostate, I-PSS: International prostate symptom score (range: 0-35), QOL: Quality-of-life score (range: 0-6), Qmax: Maximum flow rate (range: 0-25 mL/s), Qave: Average flow rate (0-15 mL/s), PVR: Postvoid residual (significant > 100 mL), **= Highly significant (H.S), H.S: Highly significant, N.S: Non significant, * = S: Significant

this syndrome. In our series, we observed bleeding necessitating blood transfusion in 6% of cases in TURP group and none of the BPVP group. Changes in serum hemoglobin and hematocrit were significantly lower in BPVP group (*P* value 0.0001 and 0.001, respectively). Six patients with TURP group had one or two units of blood transfusion. No patients with BPVP had a blood transfusion. Michielsen *et al.*[7] have reported one patient out of 120 (0.8%) underwent conventional TURP had TUR syndrome and none of the TUR of prostate in saline. Postoperative retention after endoscopic surgery of the prostate was reported. It is most probably due to edema or residual tissue because of incomplete resection. Incomplete resection of the prostate during surgery mostly due to bleeding that obscures the vision. Zhang *et al.*[6] have reported reduction in prostate volume at 6-month follow-up in BPVP group and TURP group 70.1% and 66.8%, respectively. Moreover, the authors found no difference of PSA level in 1-, 3-, and 6-month evaluation. The edema may be explained by higher electric current with lower frequency exerted to the prostatic tissue. In our report, In BPVP group, one patient (1.9%) had retention and managed conservatively by recatheterization, broad spectrum antibiotic and nonsteroidal anti-inflammatory drugs for 1 week, but unfortunately, the patient had absolute retention. Diagnostic cystoscopy showed residual tissues at the apex which vaporized by BPVP and patient voids freely later. This patient was one of the earlier cases with 85 g prostate. In TURP group, 4 patients (4%) had postoperative retention. Two improved on urethral catheterization and conservative therapy and two needs redo of the surgery. Tefekli *et al.*[8] have reported postoperative retention in three cases (6.1%) of BPVP group and 2.1% of the TURP group. Reoperation was required in 2 (4.1%) of BPVP group and 1 (2.1%) in TURP group.

In our study, during short-term follow-up of both groups at 3 months, urethral stricture formation was also noted in two patients after BPVP versus three patients after TURP group. All cases were managed by visualized internal urethrotomy. However, several risk factors, such as the larger resectoscope diameter or higher ablative energy used, longer surgical procedures as well as larger prostate volumes may also be related to increased risk of stricture formation rates. Future improvements of the size of resectoscope sheaths, with short time surgery by improving the technology may decrease the incidence of stricture formation.[15,19]

Tefekli *et al.*[8] suggested the use of BPVP in high risk patients with cardiac pacemakers or bleeding disorders because of the absence of a return current in BPVP surgery also avoid the risks of burns and cardiac pacemaker problems.

Strope *et al.*[20] compared the TURP to laser therapy for BPO. They reported that the laser is associated with shorter hospital stay (0.7 vs. 2.03 days), but laser needs longer follow-up. Our study with its short-term results revealed better outcome of BPVP than TURP. It seems that laser and BPVP have the same advantages, but the study needs longer follow-up with more number of patients. Future more specific studies may compare the laser vaporization with the bipolar plasma kinetic systems in terms of efficacy, hospital stay, morbidity, mortality, and longer follow-up with overall cost. In addition, we need to compare the learning curve between BPVP and laser, postoperative dysuria in both techniques.

BPVP represents a promising endoscopic treatment alternative for patients with BPO, showing good efficacy, reduced morbidity, fast recovery, and satisfactory follow-up at

3 months. Our results suggest that further studies with a prospective randomized design and a long-term follow-up are recommended. BPVP has the advantages of good hemostasis and clear vision during the procedure. We suggest that the improved vision during surgery offers a shorter learning curve and could be recommended at training centers or training periods for residents. Moreover, Wang[21] had reported that resection of the prostate using the bipolar system does not affect the histological pattern of tissues during examination.

CONCLUSION

Short-term results revealed that BPVP seems to be safer than TURP, highly effective, less perioperative bleeding and shorter hospital stay. We recommend BPVP as the first line of surgical treatment of BPO when indicated. Future studies for evaluation of the efficacy and cost of BPVP compared to laser vaporization. Longer follow-up is required for complete evaluation.

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