Does the Resected Prostatic Weight Ratio Affect the Clinical Outcomes in Men Who Underwent Bipolar Transurethral Resection of the Prostate?

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Purpose: Bipolar transurethral resection of the prostate (TURP) is an effective and safe alternative to monopolar TURP. The aim of this study was to investigate the influence of resected prostate weight on the clinical outcome improvement after bipolar TURP for benign prostatic hyperplasia (BPH) patients.

Materials and Methods: A total of 233 men with BPH who underwent bipolar TURP were included in this prospective study. International Prostate Symptom Score (I-PSS), quality of life (QoL), maximum flow rate (Qmax) and post-void residual urine volume (PVR) were assessed preoperatively and 3 months postoperatively. The relationship between the resected prostatic weight ratio (RPWR, %) and clinical improvement was investigated.

Results: Significant improvements in Qmax, PVR, I-PSS and QoL were found 3 months after operation, and Qmax was correlated with RPWR ($r = 0.1521$, $P = .020$). The RPWR was significantly higher in patients with postoperative Qmax > 20 mL/s ($P = .049$). Moreover, Qmax at 3-month follow-up was higher in patients with RPWR over 50% than patients with RPWR between 0–25% ($P < .05$). In addition, patients with larger prostate volume tended to gain better Qmax and I-PSS postoperatively ($P < .05$).

Conclusion: The RPWR exerts an influence on postoperative Qmax, rather than I-PSS and QoL score, and patients with larger prostate volume tend to gain better clinical outcomes from bipolar TURP than those who with smaller prostates.

Keywords: benign prostatic hyperplasia; bipolar; clinical outcome; organ weight; transurethral resection of prostate

INTRODUCTION

Benign prostatic hyperplasia (BPH) is one of the most common diseases in the aging male with prevalence increasing with age. Lower urinary tract symptoms (LUTS) caused by benign prostatic obstruction (BPO) secondary to BPH continue to pose a major problem for the contemporary medical care system. Although LUTS/BPH is not often life-threatening, the impact of LUTS/BPH on patients' quality of life (QoL) can be significant and should not be underestimated.(1) Transurethral resection of the prostate (TURP) is the gold standard for the surgical management of BPH, removing the adenomatous tissue by physically cutting away areas of excess prostatic cell growth in order to improve urinary function in men.(2) The therapeutic efficacy of TURP in improving patients' urinary flow and relieving LUTS, as assessed by International Prostate Symptom Score (I-PSS), has a success rate of 85-90%.(3) However, this monopolar electrocautery technique has some disadvantages, including the absorption of irrigation fluid resulting in transurethral resection (TUR) syndrome, bleeding, incontinence, and so on.(4,5) Therefore, prostate volume is a critical attribute for surgical technique selection. According to the European Association of Urology guidelines, TURP is the current surgical standard procedure for men with prostate sizes of 30 - 80 mL.

The most significant recent technical modification of TURP is the incorporation of bipolar technology. Bipolar TURP addresses a major limitation of monopolar TURP by allowing performance using normal saline. Thus, the risk of dilutional hyponatremia or TUR syndrome has been expected to be eliminated allowing for longer and safer resection.(6) Therefore, bipolar TURP can be applied safely in patients with prostate gland larger than 80 mL, even over 100 mL.(7,8) However, it is not entirely clear as to how much clinical outcome improvement after bipolar TURP is related to the extent of tissue resection which is achieved. In this prospective trial, we investigated the relationship between extent of prostatic tissue resection and symptom improvement after bipolar TURP in men with LUTS/BPH.

MATERIALS AND METHODS

Patients and Study Design

This prospective study was performed at the Depart-

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Table 1. The evaluated parameters (means ± SD) before and 3 months after bipolar TURP

	Qmax (mL/s)	PVR (mL)	I-PSS (0-35)	QoL (0-6)
Preoperative	7.15 ± 3.36	96.66 ± 121.80	24.10 ± 5.72	4.85 ± 0.87
Postoperative	17.13 ± 5.66	11.02 ± 18.42	7.09 ± 4.60	1.86 ± 1.33
P-value	< .000	< .000	< .000	< .000

Paired samples t test or non-parametric test.
Abbreviations: Qmax, maximum flow rate; PVR, post-void residual urine volume; I-PSS, International Prostate Symptom Score; QoL, quality of life.

ment of Urology, Zhongnan Hospital of Wuhan University, between February 2017 and August 2018. The study was approved by the Medical Ethics Committee of Zhongnan Hospital of Wuhan University (approval date is 30.9.2016 and decision number is 2016028), and written informed consents were obtained from patients recruited into the study.

The inclusion criteria were age 50 years or greater, medication failure, and bothersome moderate-to-severe LUTS secondary to BPH. Exclusion criteria included: documented or suspected prostate cancer, neurogenic bladder, bladder calculus or tumor, previous prostate surgery, urethral stricture, unable to be placed in lithotomy position, and bleeding disorders.

Preoperatively, all patients had undergone basic evaluation including a digital rectal examination as well as assessment of I-PSS, QoL, PVR and prostate volume (estimated by transrectal ultrasound). Patients who had been scheduled for surgery underwent urinary flow rate measurements (Laborie Uroflowmetry, Mississauga, Canada) to determine the maximum flow rate (Qmax).

Surgical Procedures and Follow-up

Bipolar TURP was carried out in normal saline, and the irrigation fluid was a 0.9% sodium chloride solution. Bipolar TURP was conducted according to the principles of endoscopic electrosurgery described previously.[9] The resected tissues were weighted in the operating room immediately after the completion of bipolar TURP. At the end of the procedure, a 22-Fr 3-way Foley catheter was placed for continuous bladder irrigation until the urine was clear. Catheter was removed routinely on the 3-rd day following bipolar TURP, and patients were usually discharged 1 day after catheter removal.

Follow-up of the study patients was done with examinations 3 months after bipolar TURP, and treatment efficacy was evaluated by Qmax, PVR, I-PSS and QoL.

Statistical Analysis

Descriptive statistics were used, including the number and percentage, and the average and SD. Statistical analysis was done by comparison of means with the *t*-test for paired or independent samples, as appropriate. One-way ANOVA was used for a significance test of more than two samples mean differences. Non-parametric test was used when the data did not follow a normal distribution. Pearson correlation analysis was applied to evaluate relationship between continuous variables. Data were analyzed with GraphPad Prism 5.0 with 2-sided $P < .05$ considered statistically significant.

RESULTS

A total of 233 men (mean age 71.2 years, range 55-90) who underwent bipolar TURP for LUTS/BPH were enrolled in this study. The mean body mass index (BMI) was 23.69 (SD 3.40, range 17-36), the mean preoperative prostate volume was 64.44 mL (SD 35.51, range 11-216) and the weight of resected tissue (WRT) was 28.38 g (SD 17.71, range 4-100). The resected prostatic weight ratio (RPWR, %) was calculated as WRT/prostate volume, giving the percentage of the resected tissue during the procedure. The mean RPWR was 46.25% (SD 19.59, range 12-97). Age (**Figure 1a**), BMI (**Figure 1b**) and WRT (**Figure 1c**) were correlated with preoperative prostate volume (r = 0.1407, $P = .032$; r = 0.2261, $P = .001$; r = 0.7296, $P < .000$).

The evaluated parameters before and 3 months after bipolar TURP are given in **Table 1**. Qmax, PVR, I-PSS and QoL at 3-month follow-up compared to preoperative values were marked and statistically significant.

Table 2. The evaluated parameters (means ± SD) before (pre) and 3 months after (post) bipolar TURP in subgroups of patients with different size (small to large) of prostate volumes

Prostate volume (mL)	Patients (n)	Age (years)	BMI	WRT (g)	RPWR (%)
≤ 30	30	69.33 ± 6.75	22.13 ± 3.35	11.10 ± 4.09	54.21 ± 21.42
30 - 60	98	70.37 ± 7.37	23.78 ± 3.46	21.26 ± 9.96 *	47.67 ± 20.66
60 - 90	55	72.09 ± 7.69	23.41 ± 3.08	33.45 ± 13.65 *	44.45 ± 17.62
> 90	50	72.84 ± 7.00	24.75 ± 3.32 *	47.12 ± 20.02 *	40.68 ± 16.72 *
P-value	.095	.016	< .000	.021	

Continued

Prostate volume (mL)	Qmax (mL/s) pre	Qmax (mL/s) post	PVR (mL) pre	PVR (mL) post	I-PSS (0-35) pre	I-PSS (0-35) post	QoL (0-6) pre	QoL (0-6) post
≤ 30	7.72 ± 3.65	12.72 ± 5.39	110.50 ± 116.30	20.00 ± 28.80	24.43 ± 5.80	9.53 ± 5.33	4.80 ± 0.89	2.20 ± 1.38
30 - 60	7.00 ± 3.25	17.12 ± 5.38 *	90.54 ± 111.30	9.72 ± 15.66	24.70 ± 5.37	7.05 ± 5.02 *	4.89 ± 0.85	1.97 ± 1.35
60 - 90	6.65 ± 3.53	18.33 ± 5.82 *	103.40 ± 152.30	8.51 ± 14.70	24.15 ± 5.29	6.44 ± 3.75 *	4.95 ± 1.01	1.51 ± 1.15
> 90	7.66 ± 3.21	18.49 ± 4.97 *	92.92 ± 108.90	10.92 ± 18.23	22.66 ± 6.63	6.42 ± 3.63 *	4.72 ± 0.73	1.84 ± 1.38
P-value	.302	< .000	.852	.101	.404	< .05	.214	.088

One-way ANOVA test.* P, compared to the smallest prostate volume (≤ 30 mL)
Abbreviations: BMI, body mass index; WRT, weight of resected tissue; RPWR, resected prostatic weight ratio; Qmax, maximum flow rate; PVR, post-void residual urine volume; I-PSS, International Prostate Symptom Score; QoL, quality of life

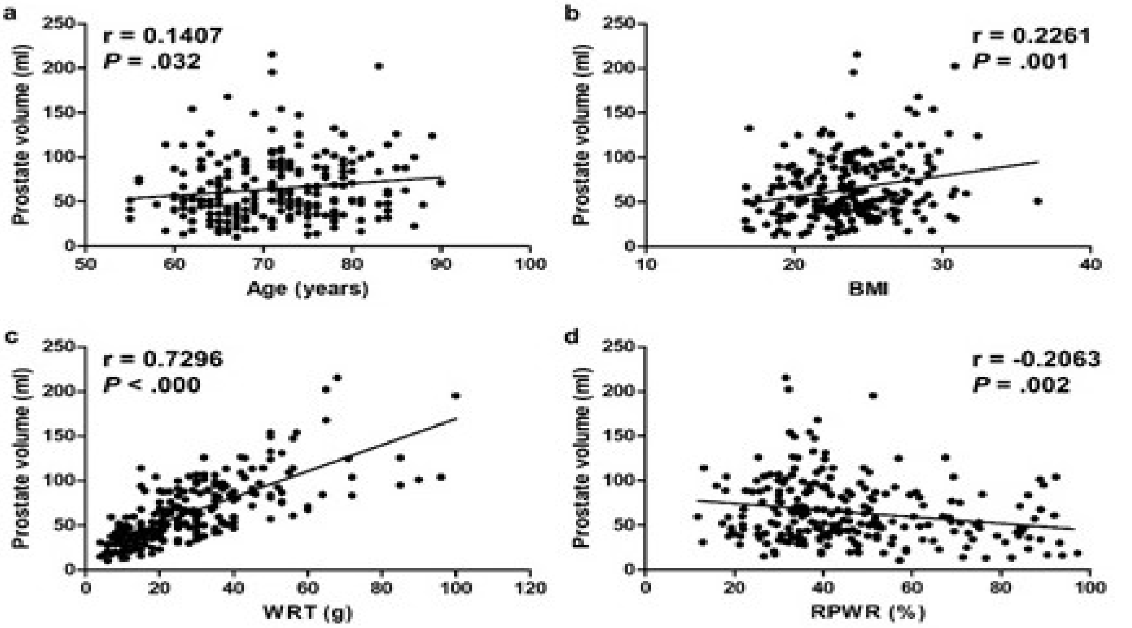

Figure 1. Correlation between age (a), BMI (b), WRT (c), RPWR (d) and preoperative prostate volume, respectively.

Bipolar TURP provides subjective (I-PSS, QoL) and objective (Qmax, PVR) symptom improvement after the operation.

At 3-month follow-up, Qmax (**Figure 2a**) showed a significant correlation with RPWR (r = 0.1521, *P* = .020), however, there was no significant correlation between RPWR and PVR (Figure 2b), I-PSS (**Figure 2c**) or QoL (**Figure 2d**) 3 months postoperatively (*P* = .945, *P* = .243, *P* = .154). Furthermore, RPWR was significantly higher in patients with Qmax > 20 mL/s postoperatively than that in patients with Qmax ≤ 20 mL/s postoperatively (50.11 ± 19.81 % vs. 44.82 ± 19.37 %, *P* = .049) (**Figure 3a**). However, there was no significant difference of RPWR between patients with I-PSS ≤ 7 and > 7 at 3-month follow-up (**Figure 3b**).

In order to determine the influence of RPWR on the objective (Qmax) and subjective (I-PSS) indicators in patients after bipolar TURP, RPWR was divided into four levels with equal distance, i.e. 0-25%, 25%-50%, 50%-75% and 75%-100%. There were no differences of the preoperative Qmax and I-PSS among patients with different levels of RPWR (**Figure 3c and 3e**). The Qmax at 3-month follow-up was higher in patients with RPWR between 50%-75% or 75%-100% than that in

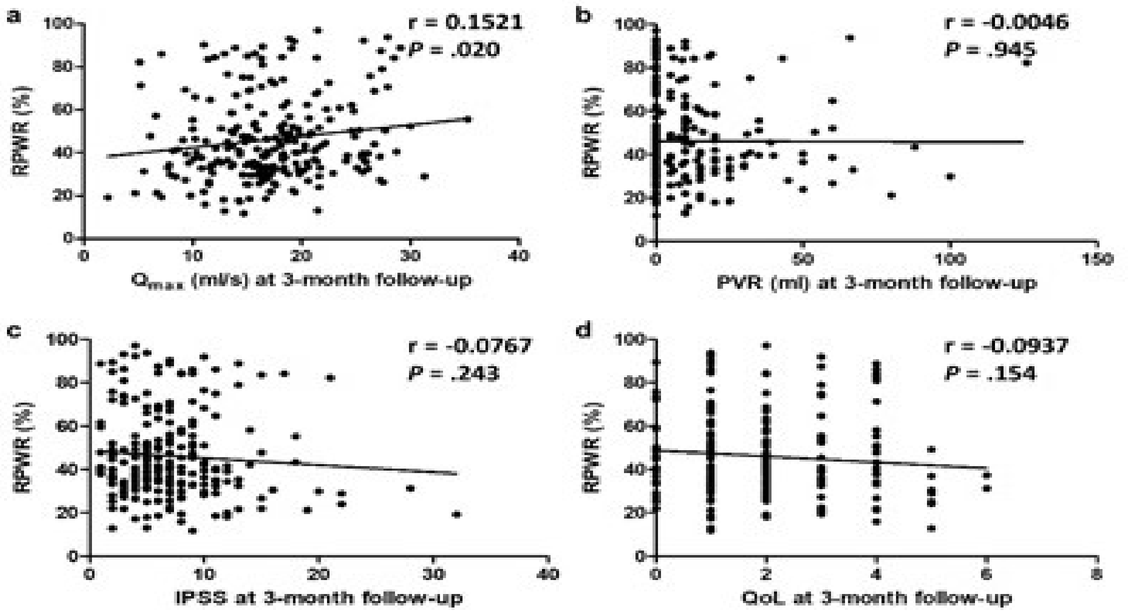

Figure 2. Correlation between Qmax (a), PVR (b), I-PSS (c), QoL (d) and RPWR at 3-month follow-up, respectively.

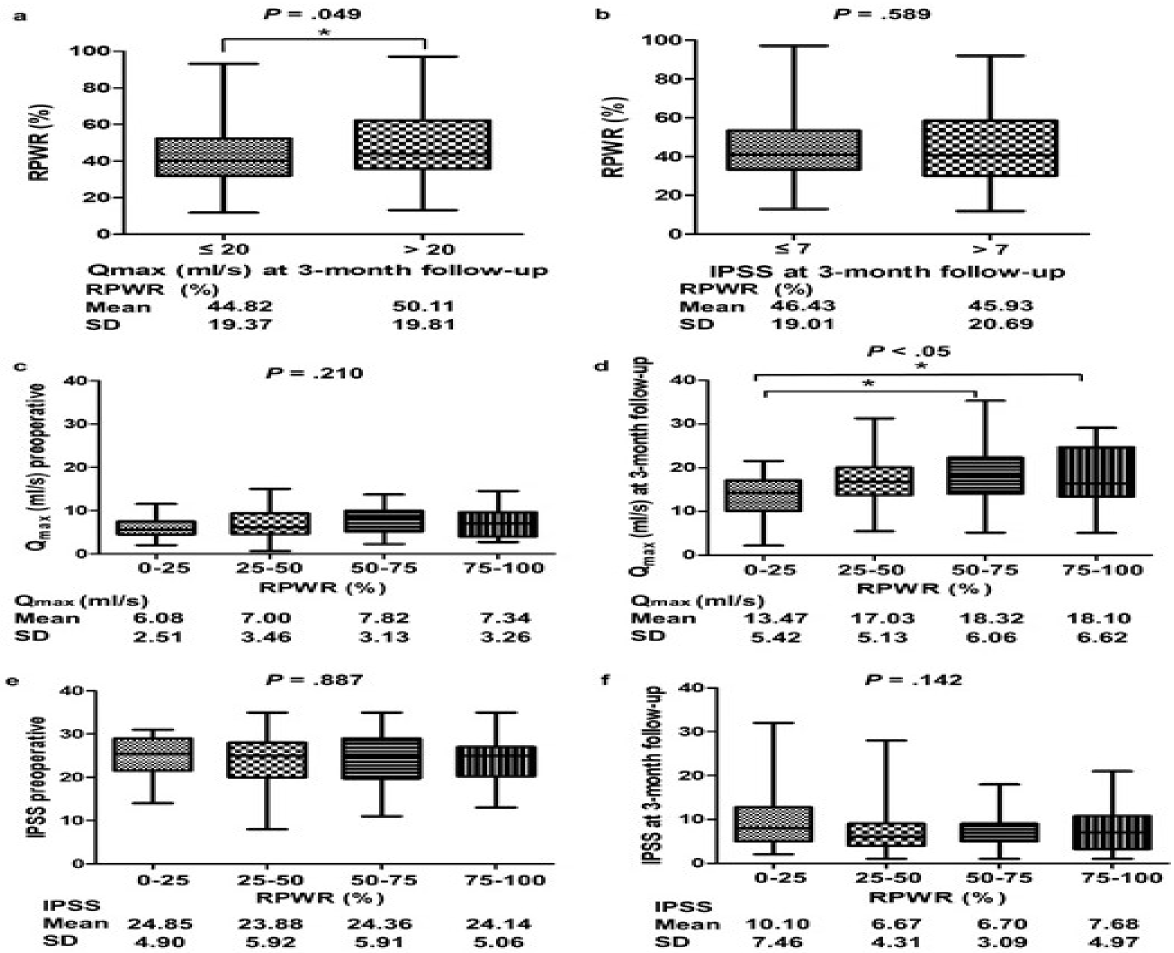

Figure 3. Differences of RPWR between patients with Qmax > 20 mL/s and ≤ 20 mL/s **(a)**, and patients with I-PSS ≤ 7 and > 7 **(b)** at 3-month follow-up, respectively. Differences of Qmax **(c, d)** and I-PSS **(e, f)** before and 3 months after bipolar TURP among patients with different levels of RPWR.

patients with RPWR between 0–25% (18.32 ± 6.06 or 18.10 ± 6.62 vs. 13.47 ± 5.42, $P < .05$) (**Figure 3d**). However, there was no significant difference of I-PSS at 3-month follow-up among patients with different levels of RPWR (**Figure 3f**).

The evaluated parameters before and 3 months after bipolar TURP in subgroups of patients with different size (≤ 30 mL, 30-60 mL, 60-90 mL, and > 90 mL) of prostate volumes are shown in **Table 2**. There were significant differences in the mean WRTs between these groups ($P < .000$). Among these four groups with increasing prostate volumes, patients with larger prostate volume tended to gain better Qmax ($P < .000$) and I-PSS ($P < .05$) postoperatively.

DISCUSSION

The perioperative morbidity of monopolar TURP in terms of blood loss and fluid absorption is related to the size of the prostate. The complications increase with increasing resection time and resected tissue volume following monopolar TURP.[1] Indeed, complete resection of the adenomatous tissue is not absolutely necessary in order to reduce the complications of TURP in clinical practice, as long as the relief from BPO is achieved.[10] Nevertheless, the association between the amount of resected prostate tissues and clinical outcome improvement in men with LUTS/BPH remains to be uncovered. For the patients with LUTS/BPH, the most important outcome parameters are the subjective and objective symptom improvements as assessed by symptom scores and uroflowmetry.[11] In a prospective study, Hakenberg et al. found early symptom improvement after TURP depended on the amount of tissue removed while the relationship was weak, and the symptomatic improvement after TURP was not primarily dependent on the relative completeness of the resection.[10]

The most significant recent technical modification of TURP is the incorporation of bipolar technology allowing performance in normal saline. More and more studies have shown that bipolar TURP is an effective/safe conventional TURP alternative with the potentiality in decreasing perioperative/similar short-term complication rates.[12-15] Bipolar TURP has a reduced risk of hyponatremia and TUR syndrome, which allows for longer resection times and surgery on larger glands.[1,7,8,13] So far there is few studies on clinical outcome improvements after bipolar TURP regarding to the extent of resected tissues.

Previous studies and analyses have confirmed that baseline prostate volume is related to progression of BPH as well as to negative outcomes related to BPH, and can also predict response to therapy.[16] However, prostate size is obviously different among men with BPH, and solely using the absolute amount of resected tissue may not accurately reflect the therapeutic efficacy of transurethral prostatectomy. Therefore, a relative RPWR, calculated as WRT/prostate volume, was adopted in our study to predict the efficacy of bipolar TURP.

In the present study, we found that age, BMI and WRT were correlated with preoperative prostate volume, while a negative correlation was revealed between RPWR and the prostate volume (**Figure 1**). As men age, symptoms worsen and obstruction and prostate volume increase.[16] In addition, with prostate volume increasing, WRT during bipolar TURP increases accordingly, which is consistent with the previous study of conventional TURP.[10] However, for patients with larger prostate glands, even if enough adenomatous tissues were removed, RPWR will still be low since the preoperative prostate volume was too large.

The RPWR was significantly correlated with Qmax at 3-month follow-up in our study, and higher in patients with Qmax > 20 mL/s than that in patients with Qmax ≤ 20 mL/s postoperatively ($P = .049$). In addition, patients with RPWR over 50% will have higher postoperative Qmax than patients with RPWR between 0–25% ($P < .05$). These findings suggest that RPWR can be used to predict the efficacy of bipolar TURP, that is more than half amount of the prostate volume should be removed in order to gain better Qmax improvement after bipolar TURP.

On the contrary, there was no significant correlation between RPWR and I-PSS or QoL 3 months after bipolar TURP. Symptom scores including I-PSS and QoL are obtained through questionnaires with subjective features, and many other factors (prolonged tissue healing, scar formation, shrinkage of the prostatic fossa, adaption of the bladder to the altered outflow conditions) will influence the degree of LUTS over the first 6 postoperative months.[10] Individual symptom resolution after TURP may be prolonged in up to 15% of cases and can take up to 12 months.[17] Therefore, RPWR cannot be used to predict I-PSS and QoL improvement at the early stage after bipolar TURP.

In the present study significant improvements in Qmax, PVR, I-PSS and QoL were found 3 months after bipolar TURP. Recently Stucki et al[18] reported in their prospective randomized trial that the preoperative to postoperative improvements in I-PSS, Qmax and PVR were highly significant in bipolar TURP group at 3-month follow-up, which is consistent with our results. Furthermore, patients with larger prostate volume tended to gain better Qmax and I-PSS improvements after bipolar TURP, which has also been proved in conventional TURP.[10]

There are some limitations in this study. First of all, the follow-up periods were too short, just 3 months after bipolar TURP. Therefore, more studies with longer follow-up periods are needed in the future. Secondly, the prostate tissue weight reduction due to vaporization process occurring during bipolar TURP was ignored. The weight of the adenoma lost due to vaporization during TURP accounted for 30.10 ± 7.71% of total prostate weight reduction.[19] However, tissue lost due to vaporization may be less in bipolar TURP than that of conventional TURP because bipolar TURP leads to less heat in the prostatic tissue surrounding the electrode.[20]

CONCLUSIONS

In the present study, RPWR is associated with Qmax improvement after bipolar TURP, while there was no correlation between RPWR and postoperative I-PSS/QoL improvements. In addition, patients with larger prostate volume tend to gain better clinical outcomes from bipolar TURP than those with smaller prostates. Prostate volume is a critical attribute for surgical technique selection. Further researches with long-term follow-up among patients undergoing bipolar TURP are worthy to be carried out.

CONFLICT OF INTEREST

None declared.

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