Five-Year Follow-Up Study of Transurethral Plasmakinetic Resection of the Prostate for Benign Prostatic Hyperplasia

Yangyang Hu, MD,^{1,2*} Xuecheng Dong, MD,^{3*} Guangchun Wang, MD,¹
Jianhua Huang, MD,¹ Min Liu, MD, PhD,¹ and Bo Peng, MD, PhD^{1,2}

Abstract

Purpose: To explore the long-term clinical efficacy and safety of transurethral plasmakinetic resection of the prostate (PKRP) for benign prostatic hyperplasia (BPH).

Patients and Methods: A total of 550 patients with BPH who had undergone PKRP from October 2006 to September 2009 were enrolled in this study. All patients were evaluated at baseline and follow-up (3, 12, 24, 36, 48, 60 months postoperatively) by peak flow rate (Qmax), postvoid residual (PVR), quality of life (QoL), International Prostate Symptom Score (IPSS), and Overactive Bladder Symptom Score (OABSS). Operative details and postoperative complications regarded as safety outcomes were documented.

Results: A total of 467 patients completed the 5-year follow-up. The mean duration of surgery was 36.43 minutes, mean catheterization time was 48.81 hours, mean hospital stay was 4.21 days. At 60 months postoperatively, the mean Qmax increased from 6.94 mL/s at baseline to 19.28 mL/s, the mean PVR decreased from 126.33 mL to 10.45 mL, the mean IPSS score decreased from 15.79 to 7.51, the mean QoL score decreased from 4.36 to 1.91, and the mean OABSS score decreased from 6.39 to 3.65 ($P < 0.001$), respectively. In perioperative complications, the blood transfusion rate was 2.7%, urinary tract infection rate was 3.6%; no transurethral resection syndrome (TUR syndrome) occurred. In late complications, urethral stricture rate was 5.4%, recurrent bladder outlet obstruction rate was 2.1%, and the reoperation rate was 4.5%.

Conclusions: PKRP is based on conventional monopolar transurethral resection of the prostate (TURP) and uses a bipolar plasmakinetic system. Our results indicate that the long-term clinical efficacy and safety of PKRP for BPH are remarkable. In particular, the incidence of urethral stricture, recurrent bladder outlet obstruction, and reoperation is low. We suggest that PKRP is a reliable minimally invasive technique that may be the preferred procedure for the treatment of patients with BPH.

Introduction

BENIGN PROSTATIC HYPERPLASIA (BPH) is one of the most common conditions in elderly men. The prevalence of BPH is about 70% in men who are more than 60 years old. BPH is clinically distinguished by lower urinary tract symptoms (LUTS) that seriously reduce the quality of life (QoL).¹ Transurethral resection of the prostate (TURP) is considered the “gold standard” in the surgical therapy of BPH; it is still applicable at present because of its well-documented long-term efficacy.^{2–5} The complications associated with TURP are high, however, and include transurethral resection (TUR) syndrome, blood transfusion, urethral stricture, BPH recurrence, and reoperation.⁶

To reduce the incidence of these complications, a variety of new treatment modalities have been introduced. Transurethral plasmakinetic resection of the prostate (PKRP) represents a significant technical improvement over recent years. With a bipolar plasmakinetic system, the current does not pass through the patient's body because the active and return electrodes of the loop are placed on the resectoscope. Physiologic saline irrigation is used instead of hyponatremic glycine or mannitol for the purpose of decreasing the risk of TUR syndrome and allowing for longer resection time to reach “anatomic resection” of the prostate.^{7–9}

Several previous randomized controlled trials (RCTs) of PKRP and TURP^{10–16} have reported that PKRP has advantages of less bleeding, lower TUR syndrome incidence,

¹Department of Urology, Shanghai Tenth People's Hospital, Tongji University, Shanghai, China.

²Department of First Clinical Medical College, Nanjing Medical University, Nanjing, Jiangsu, China.

³Department of Urology, Cixi People's Hospital, Wenzhou Medical University, Cixi, Zhejiang, China

*These authors contributed equally to this work.

shorter catheterization time and hospital stay. These studies, however, were limited by a short-term follow-up or a small sample size. The aim of this study was to explore the long-term clinical efficacy and safety of PKRP for BPH based on 5 years of follow-up and a large sample size.

Patients and Methods

Patients

From October 2006 to September 2009, patients with BPH who received PKRP in Department of Urology at Tongji University Shanghai Tenth People's Hospital were invited to participate in the study. Inclusion criteria included peak flow rate (Qmax) of less than 15 mL/s, International Prostate Symptom Score (IPSS) of greater than 13, LUTS associated with BPH, progressive renal failure or dilation of the upper urinary tract from BPH, recurrent or persistent gross hematuria, or urinary tract infection because of BPH.

Exclusion criteria included prostate surgery history, neurogenic bladder, permanent anticoagulation therapy, total age-specific prostate-specific antigen (tPSA) values of greater than 2.5 ng/mL for 40 to 49 years old, 3.5 ng/mL for 50 to 59 years old, 4.5 ng/mL for 60 to 69 years old, and 6.5 ng/mL for 70 to 79 years old, and postoperative pathology findings of a diagnosis of prostate cancer. A total of 550 patients were enrolled in the study. All patients signed an informed consent. This study was approved by the hospital's ethics committee.

Baseline data were evaluated before the surgical procedure and included age, Qmax, IPSS, QoL, Overactive Bladder Symptom Score (OABSS) and postvoid residual (PVR). PVR was measured by abdominal ultrasonography. Duration of surgery, weight of resected prostate tissue, postoperative irrigation time, catheterization time, hospital stay, incidence of blood transfusion and TUR syndrome were documented.

Five-year follow-up visits were performed by independent investigators. Treatment efficacy was evaluated at each follow-up visit (3, 12, 24, 36, 48, and 60 months after operation) by Qmax, PVR, IPSS, QoL, and OABSS. All postoperative complications were recorded, included urethral stricture, permanent urinary incontinence, and recurrent bladder outlet obstruction.

Surgical procedure

All patients received epidural anesthesia. All operations were performed by one surgeon with rich clinical experience in PKRP procedures. PKRP was performed with the Olympus TURis system using Olympus UES 40 bipolar generator (Olympus, Japan), with a cutting power of 240 W and a coagulation power of 100 W. All resections were performed with a 24 resectoscope and a plasma-loop electrode (Olympus, Japan). Physiologic saline (0.9% NaCl) was used as irrigation fluid. All the resected prostate tissue was collected at the end of the procedure. A 22F three-way Foley catheter was inserted into the bladder and then saline irrigation was initiated. The saline irrigation was continued until the effluent fluid was completely clear. We removed the catheter when the patient's hematuria ceased.

Statistical analysis

The data were analyzed statistically using the SPSS 15.0 (Chicago, IL). All numerical results are presented as

mean $\pm$ standard deviation; the *t* test was used to compare preoperative and postoperative parameters. Differences were considered statistically significant at a *P* value of less than 0.05.

Results

A total of 467 patients completed the 5-year follow-up: 16 patients died of other diseases unrelated to PKRP; 67 were lost to follow-up. Baseline data and perioperative parameters are shown in Table 1. The average age was 70.42 years. The preoperative mean Qmax was 6.94 mL/s, mean PVR was 126.33 mL, mean IPSS was 15.79, mean QOL was 4.36, and mean OABSS was 6.39. The mean duration of surgery was 36.43 minutes; the mean weight of resected prostate tissue was 31.67 g. The mean postoperative irrigation time was 24.52 hours, the mean catheterization time was 48.81 hours, and the mean hospital stay was 4.21 days.

Follow-up parameters were shown in Table 2. There were significant improvements in Qmax, PVR, IPSS, QOL, and OABSS of 5-year follow-up compared with the preoperative parameters (*P* < 0.001). At 60 months postoperatively, the mean Qmax increased from 6.94 mL/s at baseline to 19.28 mL/s, the mean PVR decreased from 126.33 mL to 10.45 mL, the mean IPSS score decreased from 15.79 to 7.51, the mean QOL score decreased from 4.36 to 1.91, and the mean OABSS score decreased from 6.39 to 3.65, respectively.

The perioperative and postoperative complications of PKRP were shown in Table 3. Blood transfusion was needed in 13 (2.7%) patients. Fifteen (3.6%) patients were found to have urinary tract infection; they were all treated with sensitive antibiotics. No patient had a diagnosis of TUR syndrome. Urethral stricture occurred in 25 (5.4%) patients; all received the diagnosis more than 3 months postoperatively. There were 14 patients who were treated with urethral dilation, and 11 patients needed internal urethrotomy. Ten (2.1%) patients had recurrent bladder outlet obstruction; re-PKRP was needed for them. Reoperations occurred in 21 (4.5%) patients. No patient had permanent urinary incontinence.

Discussion

For decades, conventional monopolar TURP has been considered the "gold standard" in the surgical therapy of

TABLE 1. BASELINE DATA AND PERIOPERATIVE PARAMETERS

Parameter	Mean $\pm$ SD
Age (y)	70.42 $\pm$ 6.77
Qmax (mL/s)	6.94 $\pm$ 3.62
PVR (mL)	126.33 $\pm$ 25.41
IPSS	15.79 $\pm$ 8.37
QoL	4.36 $\pm$ 0.83
OABSS	6.39 $\pm$ 3.74
Duration of surgery (min)	36.43 $\pm$ 21.51
Resected prostate tissue (g)	31.67 $\pm$ 12.88
Postoperative irrigation time (h)	24.52 $\pm$ 7.80
Catheterization time (h)	48.81 $\pm$ 6.72
Hospital stay (d)	4.21 $\pm$ 1.20

SD=standard deviation; Qmax=peak flow rate; PVR=postvoid residual; IPSS=International Prostate Symptom Score; QoL=quality of life; OABSS=Overactive Bladder Symptom Score.

TABLE 2. FIVE-YEAR FOLLOW-UP PARAMETERS

Parameter	Follow-up (months)					
	3	12	24	36	48	60
Qmax (mL/s)	17.25 ± 3.24*	19.34 ± 4.12*	20.73 ± 4.15*	21.71 ± 4.31*	20.17 ± 4.50*	19.28 ± 6.14*
PVR (mL)	8.18 ± 5.12*	7.24 ± 4.25*	7.12 ± 3.28*	8.42 ± 3.18*	10.28 ± 4.13*	10.45 ± 4.24*
IPSS	7.21 ± 2.71*	6.32 ± 2.98*	5.74 ± 2.12*	4.71 ± 4.37*	5.34 ± 4.25*	7.51 ± 3.37*
QoL	2.50 ± 1.04*	2.25 ± 0.82*	1.98 ± 0.91*	1.78 ± 1.14*	1.84 ± 1.31*	1.91 ± 1.22*
OABSS	2.67 ± 1.55*	2.21 ± 1.51*	2.28 ± 1.50*	2.54 ± 1.79*	3.52 ± 1.86*	3.65 ± 2.12*

* $P < 0.001$, compared with the perioperative value.

BPH, yet the associated complications of monopolar TURP are high. A large-scale multicenter study reported the short-term morbidity rate for monopolar transurethral prostate resection was 11.1%, the mortality rate for monopolar transurethral prostate resection was 0.10%, the urinary tract infection rate was 3.6%, the blood transfusion rate was 2.9%, and the TUR syndrome rate was 1.4%.¹⁷ In a study of long-term complications of monopolar TURP, the urethral stricture rate was 2.2% to 9.8%, bladder neck contractures rate was 0.3% to 9.2%, the re-treatment rate was 3% to 14.5% 5 years postoperatively.⁶

To reduce the complications of monopolar TURP, many electroresection technologies have been introduced. PKRP using bipolar technology has demonstrated promising early results compared with monopolar TURP. The use of physiologic saline irrigation in PKRP reduces the possibility of TUR syndrome. The resection using a plasma system at low temperature can accomplish anatomic prostate resection with less bleeding.

In our study, 550 patients were enrolled and 467 patients completed the 5-year follow-up. Treatment efficacy was evaluated at each follow-up visit, and all complications were recorded. To our knowledge, this is the first study of PKRP based on 5-year follow-up and a large sample size.

In our study of PKRP, the mean duration of surgery was 36.43 min, the mean catheterization time was 48.81 hours, and the mean hospital stay was 4.21 days. Compared with the parameters of monopolar TURP quoted in the literature (the mean duration of surgery was 60.1 minutes, the mean catheterization time was 3.61 days, and the mean hospital stay was 5.19 days),¹⁸ the duration of surgery, catheterization time, and hospital stay were shorter in PKRP.

Treatment efficacy of PKRP for BPH was generally evaluated by Qmax, PVR, IPSS, QoL, and OABSS.¹⁹ Kallenberg and associates⁵ conducted a long-term follow-up study of

monopolar TURP recently. Mean follow-up results were IPSS, 7; QoL, 1.5; Qmax, 23 mL/s; PVR, 45 mL; these were a significant improvement from baseline of 67%, 63%, 187%, and 80%. Mattiasson and colleagues²⁰ reported that at 5 years postoperatively in a TURP group, IPSS decreased from 20.4 at baseline to 6.0, QoL score dropped from 4.2 to 1.1, Qmax increased from 7.9 to 13.6 mL/s, and PVR decreased from 94 to 51 mL.

In our study, the outcomes also showed significant improvements in terms of Qmax, PVR, IPSS, QoL, and OABSS at each follow-up visit. At 60 months postoperatively, the mean Qmax increased from 6.94 mL/s at baseline to 19.28 mL/s, the mean PVR decreased from 126.33 mL to 10.45 mL, the mean IPSS score decreased from 15.79 to 7.51, the mean QoL score decreased from 4.36 to 1.91, and the mean OABSS score decreased from 6.39 to 3.65, respectively. Patients received PKRP were satisfied with the clinical efficacy at the 5-year follow-up.

TUR syndrome is one of the most serious perioperative complications of TURP. Wang and coworkers⁷ reported in their meta-analysis of recent RCTs for PKRP and monopolar TURP that the incidences of TUR syndrome were 1% to 12% in monopolar TURP groups and 0% in PKRP groups. Similarly, the incidence of TUR syndrome in our study was 0%. The use of physiologic saline irrigation in PKRP reduces the risk of TUR syndrome, but bipolar technology does not prevent fluid absorption, which should always be kept in mind.²¹

Bleeding in conventional monopolar TURP has always been a problem; severe hemorrhages necessitate blood transfusion or lead to shock-related complications. PKRP was performed by using a bipolar plasmakinetic system. The cutting and coagulation, achieved simultaneously with a plasma-loop electrode, resulted in satisfactory hemostasis.

Fagerstrom and colleagues²² indicated PKRP reduced overall perioperative and total surgical bleeding by 34% compared with monopolar TURP, the incidence of blood transfusion was 4% in the PKRP group and as high as 11% in the monopolar TURP group, and the need for blood transfusion was significantly reduced by PKRP. Erturhan and associates²³ also reported the blood transfusion rate of monopolar TURP was 5.8% (7/120). In this study, blood transfusion was needed in 13 patients (2.7%), which showed the advantage of plasma in hemostasis.

Urinary tract infection is a common perioperative complication. According to the analyses of Ho and coworkers²⁴ and Xie and associates¹⁸ in their studies, the urinary tract infection rate was 3.9% to 7.3% in the TURP group, 4.1% to

TABLE 3. COMPLICATIONS

Type	Number (%)
Blood transfusion	13 (2.7%)
Urinary tract infection	17 (3.6%)
TUR syndrome	0 (0%)
Urethral stricture	25 (5.4%)
Permanent urinary incontinence	0 (0%)
Recurrent bladder outlet obstruction	10 (2.1%)
Reoperation	21 (4.5%)

TUR = transurethral resection.

7.3% in the PKRP group, which had no significant difference compared with our result (3.6%).

Urethral stricture is one of the major late complications of prostate surgery. Although it may occur in each part of the urinary tract, the most common places are the urethral orifice and bladder outlet. The incidence of urethral stricture in a 5-year follow-up study for monopolar TURP was as high as 14%.⁵ The development of a urethral stricture is most likely secondary to instrumentation, technique, or postoperative catheterization. Routine urethral dilation before insertion of the resection sheath may reduce the incidence of stricture. Lowering the cut current and increasing the use of lubrication are also thought to help minimize the risk of urethral stricture.

The degree to which these factors influence the stricture rate is unknown, however. In a recent study by Komura,²⁵ the urethral stricture rate of monopolar TURP was 6.6% at 3 years postoperatively with the improvements in surgical techniques and lubricants. In our study, the incidence of urethral stricture in PKRP was 5.4% (25/467). Fourteen patients were treated with urethral dilation and 11 patients needed internal urethrotomy. Bipolar technology may reduce the risk of urethral stricture, but we still need further studies to confirm it.

Ten (2.1%) patients had recurrent bladder outlet obstruction postoperatively with the clinical symptoms of LUTS, severe hematuria, or urinary tract infections in this study; they all received re-PKRP. Compared with the incidence of recurrent bladder outlet obstruction quoted in the literature (4.4%⁵), this rate is much lower. The reasons for recurrent bladder outlet obstruction include insufficient resection of the prostate gland and the natural course of the disease itself. Bipolar technology has the advantage of allowing for longer resection time than TURP to reach “anatomic resection” of the prostate.

As mentioned above, 21 (4.5%) patients need reoperation during the 5 years: 11 patients who had urethral stricture received internal urethrotomy, and 16 patients who had recurrent bladder outlet obstruction received re-PKRP. Hammadehand coworkers²⁶ and Xie and colleagues¹⁸ reported the reoperation rates of TURP were 13% (7/52) and 10% (11/110), which were higher than our result. The low incidence of late complications also confirmed the long-term safety of PKRP for BPH.

There is a limitation to our study, however. It is a retrospective study incorporating only a single surgeon's results. We can only compare the results with those published in the literature. This may influence the integrity of our study.

Conclusions

To our knowledge, this is the first long-term follow-up study of PKRP with a large sample size. PKRP is based on conventional monopolar transurethral resection of the prostate (TURP) and uses a bipolar plasmakinetic system. Our results indicate that the long-term clinical efficacy and safety of PKRP for BPH are remarkable. In particular, the incidence of urethral stricture, recurrent bladder outlet obstruction, and reoperation is low. We suggest that PKRP is a reliable minimally invasive technique that may be the preferred procedure for the operative treatment of patients with BPH.

Author Disclosure Statement

No competing financial interests exist.

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Address correspondence to:

Bo Peng, MD, PhD
No. 301, Yanchang Road
Zhabei District
Shanghai 200072
China

E-mail: Pengbo6908@163.com

Abbreviations Used

BPH = benign prostatic hyperplasia
 IPSS = international prostate symptom score
 LUTS = lower urinary tract symptoms
 OABSS = overactive bladder symptom score
 PKRP = transurethral plasmakinetic resection
 of the prostate
 PVR = postvoid residual
 Qmax = peak flow rate
 QOL = quality of life
 RCTs = randomized controlled trials
 tPSA = total prostate specific antigen
 TUR = transurethral resection
 TURP = transurethral resection of the prostate