



Comparative Analysis of Rapid Transurethral and Reverse Sequential Resection with Plasma Excision Equipment for BPH Treatment

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Abstract

Objective: To compare the rapid transurethral sequential excision and reverse sequential excision combined with plasma excision equipment for BPH treatment of benign prostatic hyperplasia (BPH) and traditional transurethral resection of prostate (TURP) in patients with BPH. **Methods:** The study conducted at the Department of Urology, the First Affiliated Hospital of Jinzhou Medical University, aimed to compare the efficacy of two surgical approaches for treating benign prostatic hyperplasia (BPH) with traditional transurethral resection of the prostate (TURP). From October 2021 to October 2023, 128 BPH patients were divided into two groups: 64 underwent rapid transurethral sequential excision and reverse sequential excision combined with plasma excision equipment, while the other 64 underwent TURP. **Results:** The excision weight was higher, and intraoperative blood loss was lower in the group using plasma excision equipment compared to TURP. Additionally, this group experienced shorter procedure times, less bladder irrigation, catheterization duration, and shorter hospital stays ($P < 0.05$). Postoperative follow-up at three months revealed significant improvements in the International Prostate Symptom Score (IPSS) and Overactive Bladder Score (OABSS) in both groups, with greater improvement in the plasma excision equipment group ($P < 0.05$). At one- and three-months post-surgery, bladder function, urodynamics, and bladder compliance were compared between the groups. The plasma excision equipment group showed better bladder compliance and urinary flow rates than the TURP group, while residual urine volume was higher in the plasma excision equipment group ($P < 0.05$). **Conclusion:** rapid transurethral sequential excision and reverse sequential excision combined with plasma excision equipment demonstrated superior perioperative indicators, treatment efficacy, preservation of erectile function, and improvement in urodynamics compared to traditional TURP for BPH treatment.

Keywords: Benign Prostatic Hyperplasia (BPH), Transurethral Resection of the Prostate (TURP), Perioperative Indicators, Plasma Excision Equipment, Urodynamics.

Introduction

The clinical manifestations of BPH are mainly lower urinary tract manifestations of obstruction and the irritation caused by it (Mallhi *et al.*, 2023). It is the most common disease in elderly urological patients and often progresses with increasing age, while the risk of surgery increases because elderly patients are mostly associated with a variety of diseases, and some patients then choose conservative treatment or even conservative surgery (cystostomy, etc.), therefore, surgical treatment is predominantly TURP, which is the gold standard for the treatment of excised BPH (Sasidharan *et al.*,

2022). It has achieved a certain therapeutic effect, and is widely used in clinical practice, but there are many bleedings, postoperative complications and other conditions (Picano *et al.*, 2024). In recent years, urological prostatectomy equipment has emerged in endlessly, and various plasma equipment and laser equipment are widely used in clinical practice (Gupta *et al.*, 2023). Therefore, the application of various different equipment to improve the surgical resection technique has also been widely carried out. For example, we created transurethral plasmakinetic enucleation of the prostate in combination with open resection of the prostate surgery and used plasmakinetic resection equipment, combined with antegrade resection and retrograde resection in transurethral resection of the prostate, based on traditional transurethral bipolar plasmakinetic resection of the prostate, and it is gradually used in excisional surgery in patients with benign prostatic hyperplasia.

Materials and Methods

Patients in this study

A total of 128 surgical patients from the Department of Urology of the First Affiliated Hospital of Jin Medical University were grouped, including 64 patients with plasma resection equipment and 64 patients in the TURP group 2021 years 10 months to 2023 10 months were collected and are reported. Data were collected from October 2021 to October 2023 on 128 patients diagnosed with benign prostatic hyperplasia and treated and operated on in the Department of Urology of the First Hospital of Jin Medical University with Inclusion criteria (1) Patients with prostate weight < 110g diagnosed by the relevant criteria in the Chinese Guidelines for the Diagnosis and Treatment of Urological Diseases (2014 Edition); (2) Patients aged < 70 years; (3) Patients who meet the surgical indications; (4) Patients with complete medical records; (5) Patients with normal state of consciousness and communication ability. The Exclusion criteria: (1) combined with severe blood system diseases, immune function diseases or cardiovascular and cerebrovascular diseases; (2) mental disorders; (3) combined with severe diabetes or hypertension; (4) combined with malignant tumors; (5) previous prostate surgery; (6) there are anesthesia contraindications. According to the difference of surgical methods, the patients were divided into plasma rapid transurethral sequential excision and reverse sequential excision and traditional electrocision group, 64 cases for each group.

Rapid transurethral sequential excision and reverse sequential excision Group, aged < 70 years, mean (64.14 ± 2.93) years; disease duration 0.3 ~ 9.2 years, mean (4.34 ± 1.02) years; lesion tissue volume 41 ~ 109 cm³, Mean (73.53 ± 11.59) cm³; degree of hyperplasia: grade I in 18 cases, grade II in 37 cases, grade III 9 cases. TURP Group, aged < 70 years, flat average (64.28 ± 3.48) years; disease duration 0.4 ~ 9.1 years, average (4.31 ± 1.10) years; lesion tissue volume 42 ~ 110 cm³, Mean (71.77 ± 10.42) cm³; duration of hyperplasia: grade I in 17 cases, grade II in 39 cases, and grade III in 8 cases. There were no significant differences in age, course and degree of hyperplasia between the two groups (P>0.05).

The ethics of this study were approved and agreed by the Ethics Committee (The First Affiliated Hospital of Jinzhou Medical University), with ref number 2023131 dated 15th September 2021 and the consent of patients and their families was solicited and the consent notice was signed. Complications: (1) bladder stones: 7 in rapid transurethral sequential excision and reverse sequential excision group and 6 in TURP group; (2) urinary retention: 10 and 11 in the two groups, respectively; (3) bladder diverticulum: 8 and 10 in the two groups, respectively; (4) secondary upper urinary tract hydrops: 4 and 5 in the two groups, respectively. There was no significant difference between the two groups (P > 0.05).

Procedures

Rapid transurethral sequential excision and reverse sequential excision group was given rapid transurethral sequential excision and reverse sequential excision combined with plasma excision equipment: the patient was placed in the lithotomy position, continuous epidural anesthesia was given, the surgical area was routinely disinfected and draped, and the British Jiale bipolar plasmakinetic resectoscope was placed into the bladder transurethrally to observe the hyperplasia of the urethra, verumontanum, bladder neck, bilateral ureteral orifices, bladder wall, and prostate lobes successively, 0.5 cm proximal to the verumontanum was located, and ring markers were made by electrocoagulation to locate the prostate from the bladder neck to 5, 7, and 1, and 11 o'clock of the anterior verumontanum marker sulcus for rapid resection and reverse resection of the prostate combined with knife until hemostasis after the surgical capsule, longitudinal marker sulcus was made, and the hyperplastic tissue was successively removed between 1, 5, 7, and 11 o'clock in the same way until hemostasis after the surgical capsule, followed by ELLIK irrigator irrigation and aspiration to

enhance the gland. TURP Group was given transurethral resection of the prostate: take the lithotomy position, after the epidural anesthesia takes effect, the resection power is adjusted to 120 ~ 150 W, and the electrocoagulation power was set to 80 W. Accurately locate the position of verumontanum under direct vision, cut at 6 o'clock position of bladder neck, perform antegrade resection, until the proximal verumontanum, remove the left and right lobes of prostate along 6 o'clock groove to the prostate capsule, and wash and suck the enhanced gland with ELLIK irrigator. In both groups, a three-lumen urinary catheter was routinely placed after surgery, and the bladder was irrigated uninterrupted with normal saline for 24 - 72 h. Antibiotics were routinely used after surgery, and prevention infection treatment was given.

Criteria for observation and evaluation

(1) Perioperative parameters. Intraoperative blood loss, tissue resection weight, operation time, postoperative bladder irrigation time, intubation (triple lumen catheter) time and hospital stay were statistically analyzed between the two groups.

(2) Therapeutic effect. Before and 3 months after operation, the changes of IPSS and OABSS were used to evaluate the therapeutic effect of the two groups. Among them, the IPSS is used to assess the degree of prostate symptoms, with a total of 7 score items, calculated as 0 - 5 points, and a total score of 0 - 35 points, and the score is positively correlated with the degree of prostate symptoms. OABSS is used to assess overactive bladder with 4 scoring items, with a total score of 0 - 15 points, 0 - 5 points for mild overactive bladder, 6 - 11 points for moderate overactive bladder, and 12 - 15 points for severe overactive bladder. (3) Erectile function. IIEF-5 index was observed before and after surgery at 3 months after surgery will be used to assess the erectile function of the two groups, including 5 score items, calculated as 0 - 5 points, with a total score of 0 - 25 points and a score of ≤ 21 points with erectile dysfunction. (4) Urodynamic parameters. Bladder compliance, urinary flow rate and residual urine volume were measured by urodynamic tester before operation and 3 months after operation.

Statistical processing

The statistical software SPSS20.0 was used to analyze the data, the t-test was used for independent sample comparison between groups, the t-test was used for intra-group comparison between pairs, the continuous data were expressed by ($\bar{x} \pm s$), (%) was used to represent the counting data to rate, and the chi-square test was used for comparison. $p < 0.05$ was considered statistically significant.

Results

Perioperative Measures

Compared with the group of rapid transurethral sequential excision and reverse sequential excision combined with plasma excision equipment, The TURP group had a large amount of bleeding and a low weight of the resected tissue, and the operation time, continuous bladder irrigation time, urinary catheter equipment time, and hospital treatment time in the TURP group were all higher than the group of rapid transurethral sequential excision and reverse sequential excision combined with plasma excision equipment ($P < 0.05$), as shown in Table 1&2.

Table 1. Preoperative general conditions of patients in the two groups

Group	N	Age (years)	Prostate Mass (g)	PSA (ng/mL)	Qmax (mL/s)	RUV (mL)	Qol score	IPSS score	OABSS score
Transurethral/Reverse Group	64	64.14 \pm 2.93 32.932.2.9 32.1964.27	78.52 \pm 15.64	3.49 \pm 0.97	9.31 \pm 0.98	152.91 \pm 24.59	4.03 \pm 0.95	21.70 \pm 5.17	7.25 \pm 1.08
TURP group	64	64.28 \pm 2.48	78.09 \pm 16.27	3.52 \pm 0.93	9.30 \pm 0.91	153.38 \pm 27.10	3.91 \pm 1.04	21.57 \pm 5.18	7.19 \pm 1.01

Table 2 Comparison of perioperative indicators between the two groups ($\bar{x} \pm s$)

Group	Intraoperative blood loss (ml)	Tissue Excision Quality (g)	Operative time (min)	Bladder irrigation time (h)	Intubation time (d)	Length of stay (d)
Combined forward and reverse group (n = 64)	30.10 ± 16.58	7 6.72 ± 15.55	5 2.62 ± 11.23	1 .74 ± 0.42	3 .72 ± 0.81	6 .27 ± 1.35
Conventional electrocision group (n = 64)	47.94 ± 17.59	6 9.44 ± 11.39	6 8.08 ± 14.56	2 .66 ± 0.48	4 .95 ± 1.02	7 .06 ± 1.17
T value	5.904	³ .025	6 .732	1 1.597	7 .596	3 .521
P value	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

Therapeutic Effects

OABSS scores were compared between the two groups ($P < 0.05$). At 3 months after surgery, the IPSS and OABSS scores of the two groups were lower than those before operation, and those in the positive and negative resection groups were lower than those before operation ($P < 0.05$), as shown in Table 3.

Table 3 Comparison of treatment effect between the two groups [points, ($\bar{x} \pm s$)]

Group	IPSS score		OABSS score	
	Before surgery	3 months after surgery	Before surgery	3 months after surgery
Forward and reverse electrocision group (n = 64)	2 1.70 ± 5.17	8 .12 ± 0.93 *	7 .25 ± 1.08	4 .17 ± 0.71 *
Conventional electrocision group (n = 64)	2 1.57 ± 5.18	1 5.75 ± 1.54 *	7 .19 ± 1.01	5 .94 ± 0.93*
T value	0 .180	3 3.878	0 .319	1 2.096
P value	0.857	< 0.001	0 .751	< 0.001

*Compared with this group before surgery, $P < 0.05$

Erectile Function

Before surgery, there was no significant difference in erectile function between the two groups ($P < 0.05$). At 3 months after operation, the IIEF-5 scores of the two groups were higher than those of the control group and rapid transurethral sequential excision and reverse sequential excision combined with plasma excision equipment group was higher than traditional resection group ($P < 0.05$), as shown in Table 4.

Table 4 Comparison of IIEF-5 scores between the two groups [points, ($\bar{x} \pm s$)]

Group	Before surgery	3 months after surgery	T value	P value
Forward and reverse electrocision group (n = 68)	1 4.41 ± 3.08	1 8.92 ± 3.59 *	7.093	< 0.001
Conventional electrocision group (n = 68)	1 4.43 ± 3.11	1 6.03 ± 2.27 *	2.941	< 0.005
T value	0 .260	5.075		
P value	0 .795	< 0.001		

Urodynamics

Before surgery, there was no significant preoperative significance in the comparison of urodynamic parameters, and the relevant indexes after 3 months of postoperative follow-up compared with preoperative were significantly improved in urodynamics, bladder compliance, and uroflow rate compared with preoperative in the forward electrocision group were higher than those in the traditional electrocision group, while the residual urine volume in the rapid transurethral sequential excision and reverse sequential excision combined with plasma excision equipment group was lower than that in the TURP group ($P < 0.05$), as shown in Table 5.

Table 5 Comparison of urodynamics between the two groups ($\bar{x} \pm s$)

Group	Bladder compliance (ml/cmH ₂ O)		Urinary flow rate (ml/h)		Residual urine (ml)	
	Before surgery	3 months after surgery	Before surgery	3 months after surgery	Before surgery	3 months after surgery
Forward and reverse electrocision group (n = 64)	1 4.54 ± 5.18	2 8.03 ± 5.23 *	7 .71 ± 1.39	1 8.19 ± 2.89*	7 8.24 ± 10.93	2 2.59 ± 3.71 *
Conventional electrocision group (n = 64)	1 4.56 ± 5.17	2 2.46 ± 4.99 *	7 .73 ± 1.51	1 5.31 ± 3.68 *	7 8.21 ± 11.23	3 2.71 ± 4.99 *
T value	0 .017	6. 169	0 .058	4 .928	0 .015	1 3.017
P value	0 .987	< 0.001	0 .954	< 0.001	0 .988	< 0.001

Discussion

Benign prostatic hyperplasia (BPH) is benign lesion in elderly men, which is associated with aging and testis with function. Under the action of hormone, mixed nodules are formed. The lesions are mainly manifested as bilateral lobe and middle lobe hyperplasia, protruding into the urethra and bladder. With the development of the lesions, lower urinary tract obstruction symptoms occur or cause urinary tract irritation symptoms, resulting in serious impact on the patient's quality of life and voiding function. Professional treatment should be performed in a timely manner. At present, TURP remains the most commonly used and effective method for surgical treatment of prostatic hyperplasia (Nunes *et al.*, 2017), but with the improvement of technology, combined with the technical improvement based on the resection technique, it also continues to withdraw, for example: Professor Liu Chunxiao at home and abroad used plasmakinetic resection equipment, combined with open surgery, to create the "transurethral plasmakinetic enucleation of the prostate (Yang *et al.*, 2022), this study is based on the combination of push resection and resection during using plasma equipment, in the transurethral resection of the prostate, the rapid resection knife method of serial incision combined with retrograde resection was used to form the transurethral transurethral rapid knife resection method of ion resection equipment, because the surgical method uses rapid forward and reverse resection combined with resection (Fukuda *et al.*, 2002), until hemostasis after the capsule, the inclusion criteria select a younger age, < 70 years, prostate volume less than 110g, of patients with relatively good general condition, intraoperative forward and reverse combined with rapid resection was adopted until hemostasis after surgical capsule. In this study, forward and reverse combination group had less intraoperative blood loss, higher tissue resection weight and shorter operation time, bladder irrigation time, intubation time and hospital stay than traditional electrocision group, traditional electrocision group ($P < 0.05$). It is suggested that in the treatment of patients with benign prostatic hyperplasia, although transurethral resection of the prostate has many advantages, transurethral bipolar plasma forward and reverse combined with rapid resection resection of the prostate has advantages in improving perioperative parameters. Transurethral bipolar plasma forward and reverse combined with rapid resection resection of prostate, under the premise of making full use of the advantages of plasma equipment, combined with the advantages of forward and reverse combined with rapid resection technique, rapid resection until the surgical capsule, bleeding and operation time are shorter, and the cutting wound is relatively flat, which can accurately identify the capsular tissue of prostate and effectively reduce the invasiveness. At the same time, the advantages of transurethral bipolar plasmakinetic resection of prostate equipment have also been fully utilized, high-energy plasma will be formed between the ring body and the loop electrode, high-energy plasma is used to cut the lesion tissue, and there is no direct contact between the cutting ring and the lesion tissue during the cutting operation, which can achieve good hemostatic effect, increase the weight of tissue resection, shorten the operation time, promote the timely recovery of patients after surgery, thereby shortening the bladder irrigation time, intubation time and hospital stay.

In this study, 3 months after surgery, the IPSS and OABSS scores in the Rapid transurethral sequential excision and reverse sequential excision group were all lower than TURP group, and the IIEF-5 score was higher than that TURP group ($P < 0.05$). These results suggest that compared with traditional transurethral resection of the prostate, rapid transurethral sequential excision and reverse sequential excision combined with plasma excision equipment can further improve the therapeutic effect and improve erectile function. In addition, the bladder compliance and urinary flow rate in the

combined compliance group were higher than TURP group, while the residual urine volume was lower than that in the TURP group ($P < 0.05$). It suggests that rapid transurethral sequential excision and reverse sequential excision combined with plasma excision equipment is also superior to traditional transurethral resection of the prostate in improving urodynamics. Our study also suggests that there will be current generation during transurethral resection of the prostate, which will have a heat penetration effect and may damage the prostate capsule, resulting in thermal damage to the neurovasculature and easily affecting erectile function. While transurethral bipolar plasmakinetic resection of prostate combined with transurethral and reverse rapid resection in the resection of benign prostatic hyperplasia tissue, rapid excision of hyperplastic prostate tissue until hemostasis after capsular removal, the possibility of thermal damage is reduced, while the plasma device makes the bipolar current produce a control loop, and produces a large number of plasma spheres, so that the disintegrating tissue and organic molecular bonds in the airway are broken, electrolytic chemical bonds, ion bonds and biological macromolecular hydrogen bonds, etc., forming a vaporization cutting effect, and adequate and complete resection of the hyperplastic lesion tissue is performed, thereby improving the clinical efficacy and relieving the degree of prostate symptoms and excessive bladder activity. Moreover, using bipolar plasmakinetic equipment, transurethral and reverse combined with fast electrocision and cold cutting mode to remove the diseased tissue can effectively reduce the local temperature, control the effect of thermal injury, prevent sexual dysfunction caused by thermal injury, promote the recovery of erectile function and relieves symptoms of obstruction and irritation caused by obstruction, thereby improving urodynamics.

However, our study also found that although the transurethral and reverse combined with rapid resection method is not difficult to master, almost urologists can use the transurethral and reverse cutting knife method, but can use the good forward and reverse combined with rapid resection, the process does not stop bleeding, until excision to surgical envelope and then haemostasis and the technical proficiency of the surgeon has a great relationship, because the larger prostate can not be quickly transurethral and reverse combined with resection to the capsule (Teo *et al.*, 2017), easy to cause unclear vision due to bleeding, causing intraoperative complications, so it is not suitable to use this method in the larger prostatectomy process. At the same time, we also found that this method has a great correlation with the technical proficiency of the surgeon. Another research found that the patients who received TURP had a lower risk of UTI, repeat UR episodes, and emergent bony fracture in the future than did those who received medication alone. (Lin *et al.*, 2018). Under the premise of unskilled technique, the use of this resection method will lead to more bleeding (Li *et al.*, 2019), while because of more bleeding, unclear vision, prolonged operation time and bleeding volume, but also unclear vision causing capsule perforation, bladder neck injury and other intraoperative side injuries, and even cause more urinary incontinence, and because early rapid resection without systemic hemostasis, resulting in macrovascular bleeding and lead to persistent thermocoagulation, causing erectile dysfunction (Podestà *et al.*, 2019), therefore, transurethral bipolar plasma transurethral and reverse combined with rapid resection of the prostate should be established under the premise of skilled technique, select a good general state, prostate weight less than 110 g, in order to benefit the patient during the operation, while the personal technical proficiency requirements are high.

Conclusion

Comparison between TURP, rapid transurethral sequential excision and reverse sequential excision combined with plasma excision equipment, it in terms of improving urodynamic data, treatment efficacy, and erectile function in patients with BPH before and after surgery with benign prostatic hyperplasia have a significant advantage. However, there are some shortcomings in this study, such as small number of cases, selective bias, few observation indicators, and no long-term follow-up observation, and large data and multicenter studies are still needed for subsequent work, so as to objectively evaluate the clinical effects of more on the rapid transurethral sequential excision and reverse sequential excision combined with plasma excision equipment in the treatment of benign prostatic hyperplasia with transurethral resection of the prostate.

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Conflict of Interest

Nil.

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