Am J Clin Exp Urol 2024;12(3):134-140
www.ajceu.us /ISSN:2330-1910/AJCEU0156007

Original Article

Effect of saline perfusion before catheter removal in patients with BPH treated with GreenLight laser photoselective vaporization of the prostate

Jiaxi Han, Fei Luo, Jian Li, Di Zheng, Na Zhang, Xiaoyi Zhou, Dong Zhang

Department of Urology, Tianjin Union Medical Center of Nankai University, Tianjin, China

Received February 20, 2024; Accepted May 23, 2024; Epub June 25, 2024; Published June 30, 2024

Abstract: Objective: To investigate the effect of saline perfusion before catheter removal in patients with benign prostatic hyperplasia (BPH) treated with GreenLight laser photoselective vaporization of the prostate (PVP). Materials and Methods: Patients (n=200) with BPH treated with PVP were divided into perfusion (n=100) and control (n=100) groups. For the perfusion group, saline (200 mL or the maximum capacity tolerated) was irrigated into the bladder after standardized external urethral disinfection, and the catheter was removed. Catheter removal was routinely performed in the control group. Perioperative adverse events and clinical outcomes were compared between the groups. Results: Patients in the perfusion group had a shorter waiting time [3 (0-4) vs. 15 (8.75-26) min; *P*<0.001] and a better satisfaction grade [24 (21.75-26) vs. 23 (20-25); *P*=0.016] for first urination than those in the control group. The perfusion group exhibited lower anxiety levels regarding first urination than the control group [1 (1-2) vs. 1.5 (1-2), respectively; *P*=0.012]. Urinalysis revealed that the perfusion group had significantly lower white blood cell (WBC) count than the control group on the day [25.5 (8-37.75) vs. 43.5 (24.0-64.75); P<0.001] and 2 weeks [20.5 (11-27) vs. 31.0 (20-42); *P*<0.001] after catheter removal. No significant differences in treatment-related adverse events were observed [perfusion (n=15), control (n=20)]. Conclusion: Saline perfusion before catheter removal in patients with BPH treated with PVP could shorten the waiting time for first urination, improve patient anxiety and satisfaction and reduce postoperative urinary WBC levels.

Keywords: Benign prostatic hyperplasia, GreenLight laser, PVP, catheter removal, saline perfusion

Introduction

Benign prostatic hyperplasia (BPH) commonly occurs in older men, with an incidence of up to 90% reported in men in the ninth decade of life [1]. BPH refers to the benign enlargement of the prostate gland and may result in lower urinary tract symptoms (LUTS), including voiding, storage, and post-voiding symptoms [2]. Traditionally, transurethral resection of the prostate (TURP) has been considered the gold standard surgery. However, it has potential risks of bleeding, clot retention, transurethral resection syndrome, and other perioperative adverse events. Therefore, new techniques are required to treat patients with BPH [1].

GreenLight laser photoselective vaporization of the prostate (PVP) is a safe and effective surgery associated with reduced bleeding, reduced injury, and a low complication rate. Clinical research has demonstrated that PVP could improve clinical outcomes in patients with BPH [3, 4]. The GOLIATH Study [5] proved that 180 W XPS PVP was a safe, effective, and feasible alternative surgical option to TURP, based on 24-month follow-up data. In addition, many studies have suggested that anticoagulation therapy or high-risk factors do not increase the adverse event rates of PVP [6-10], and it is effective for high-risk patients or patients being treated with oral anticoagulants [6, 7]. However, the optimal time for catheter removal is inconclusive, and saline perfusion before catheter removal in patients with BPH treated with PVP has not yet been reported.

In this study, we aimed to investigate the effect of saline perfusion before catheter removal,

https://doi.org/10.62347/ZWRQ6068

evaluate the perioperative adverse events associated with PVP, and compare the clinical outcomes with those of the control group.

Materials and methods

Study population

According to EAU GuideLines and Chinese Urological Association (CUA) Guidelines, the indication for surgical treatment of BPH was as follows: (1) severe LUTS secondary to BPH, refractory to medical therapy with alpha-blockers and/or 5-alpha reductase inhibitors, prostate volume (PV) ≥30 mL; (2) International Prostate Symptom Score (IPSS) >19; (3) maximum urinary flow rate (Qmax) <15 mL/s. In addition, patients with neurogenic bladder or detrusor underactivity, bladder neck or urethral stricture, prostate cancer, incomplete clinical data were exclued from present study. In this retrospective study, a total of 200 patients with BPH treated with PVP at our institution between January 2020 and December 2020 were included.

Assessment parameters

Patients were randomized in a 1:1 ratio to the perfusion (n=100) and control groups (n=100) using a random number table, and baseline information was collected before PVP surgery.

IPSS and Quality of Life score (Qol) were evaluated using a standardized questionnaire. IPSS was used to assess the severity of LUTS, which consists of a questionnaire with seven questions relating to urinary symptoms over the past month. Each question is scored from 0 (not at all) to 5 (almost always), with a total score of 0-35, assessing the frequency of symptoms such as incomplete emptying, frequency, intermittency, urgency, weak stream, straining, and nocturia. The IPSS score is categorized as asymptomatic (0 point), mildly symptomatic (1-7 points), moderately symptomatic (8-19 points), and severely symptomatic (20-35 points). QoL score is a single question that asks patients to rate their overall satisfaction with their urinary situation, on a scale of 0 (delighted) to 6 (terrible), where a higher score indicates lower satisfaction with the urinary condition.

Comorbidities and medical history were evaluated using a questionnaire, and PV was measured using transrectal ultrasound and pelvic MRI. Qmax, maximum detrusor pressure (Pdet. max), and postvoid residual (PVR) were analyzed using urodynamic examination. This study was approved by the Institutional Ethics and Research Committee of Tianjin union medical Center.

Surgical procedure

PVP was performed using a 180 W GreenLight XPS laser system (Laserscope, USA) with a MoXy fiber, and standardized surgical procedures were performed by experienced urologists [11]. The operation time was recorded from the beginning of laser cystoscope implantation to the end of the indwelling catheter. The laser time and energy were obtained using the GreenLight XPS laser system, and the laser energy density was calculated according to the laser energy consumption/preoperative PV. Intraoperative adverse events (bleeding, capsule perforation, and transfer to TURP) were also recorded.

Intervention

Catheter removal in patients with BPH treated with PVP was performed 3-9 days following the PVP operation. In the perfusion group, 200 mL saline [or maximum capacity tolerated (<200 mL)] was irrigated into the bladder after standardized external urethra disinfection, and the filling rate was less than 5 mL/s. The catheter was then removed, and the pain level on catheter removal and first urination, waiting time for first urination, and satisfaction grade of first urination was observed and recorded. Qmax and PVR of the first urination were evaluated using the urine flow rate and transabdominal ultrasonography, and clean midstream urine on the day and 2 weeks after catheter removal was used to perform urinalysis. For the control group, catheter removal was performed routinely; the indicators of first urination were investigated using the same method used for the perfusion group.

Follow-up

All cases were evaluated postoperatively for 6 months with respect to adverse events, including transient hematuria, blood transfusion, clot retention, transient urinary incontinence, stricture, and retreatment. IPSS, QoL, Qmax, PSA

Table 1. Baseline characteristics of the participants

Variables	Perfusion group (N=100)	Control group (N=100)	*P*-value
Age-years	70.44±7.87	69.46±7.70	0.375
BMI-kg/m^2	24.19±3.23	24.81±3.04	0.164
IPSS	23 (20-26)	23 (20-26)	0.810
QoL	5 (4-5)	5 (4-5)	0.598
PSA-ng/mL	4.40 (2.09-7.55)	4.20 (2.12-6.35)	0.468
PV	62.46±24.99	59.74±23.59	0.916
Qmax	7 (4-8.25)	6 (4-9)	0.747
PVR	50 (17.5-200)	40 (10-155)	0.308
Pdet.max	82 (54.5-110)	77.5 (60-109)	0.567

Table 2. Comorbidities and medical history of the perfusion and control groups

Variables	Perfusion group (N=100)	Control group (N=100)	*P*-value
Smoking	23 (23)	30 (30)	0.262
Drinking	12 (12)	18 (18)	0.235
Hypertension	44 (44)	36 (36)	0.248
T2DM	17 (17)	21 (21)	0.471
Myocardial infarction	22 (22)	17 (17)	0.372
Cerebral infarction	21 (21)	15 (15)	0.260
Oral anticoagulation	14 (14)	11 (11)	0.521

level, and PVR were assessed 6 months after PVP.

Statistical analyses

First, the quantitative data were tested for normality and homogeneity of variance. Normally distributed data with homogeneity of variance were expressed as mean ± standard deviation. Two independent samples *t*-tests were used for comparison of age, BMI, PV operation time, laser time, laser energy, and laser energy density between groups. Otherwise, data are expressed as median (interquartile range), and the Mann-Whitney U test was used for comparison of IPSS, QoL, PSA-ng/mL, PV, Qmax, PVR, Pdet.max, pain level on catheter removal, pain level during first urination, anxiety level before PVP surgery, anxiety level before catheter removal, waiting time for first urination, satisfaction grade of first urination, and white blood cell count of urinalysis between groups. Wilcoxon signed rank test was used for comparison of preoperative and postoperative IPSS, Qol, PSA, Qmax, and PVR.

The qualitative data are expressed as the number of cases (percentage). Chi-square tests were performed when the theoretical frequency was greater than 5, such as smoking, drinking, hypertension, T2DM, myocardial infarction, cerebral infarction, oral anticoagulation, bleeding conversion to TURP transient hematuria transient urinary incontinence, and all adverse events. The continuous correction chi-square test was performed when the theoretical frequency was less than 5 but greater than or equal to 1, such as for capsule perforation and conversion to TURP. Fisher's exact probability method was used when the theoretical frequency was less than 1, such as for blood transfusion, clot retention, stricture, retreatment. P<0.05 was considered statistically significant.

Results

The average age of the participants was 69.95±7.78 years, and the median preoperative IPSS and QOL scores were 23 (20-26) and 5 (4-5), respectively. The preoperative PV was 61.10±24.28 mL, and the Qmax and PVR were 6 (4-9) mL/s and 50 (10-190) mL, respectively. As shown in **Table 1**, the baseline characteristics of the two groups were similar.

Comorbidities and medical histories were also investigated; there were 80 cases of combined hypertension and 38 cases of type 2 diabetes mellitus. In addition, 39 patients experienced myocardial infarction, and 25 received oral anticoagulation. Fifty-three and 30 patients had a history of smoking and drinking, respectively. No significant difference in comorbidities and medical history was found between the perfusion and control groups, indicating the comparability of the two groups (**Table 2**).

All patients with BPH underwent standardized PVP surgery, and the total procedure and laser times were 62.89±17.43 and 45.09±11.78 min, respectively. The mean laser energy consumption was 340.97±99.19 kJ, and the laser energy density was 3.69±0.80 kJ/mL. During the PVP operation, 13 patients experienced

Table 3. Intraoperative parameters of the perfusion and control groups

Variables	Perfusion group (N=100)	Control group (N=100)	*P*-value
Operation time	62.15±16.51	63.63±18.37	0.550
Laser time	44.52±11.07	45.66±12.48	0.495
Laser energy	345.47±101.36	336.47±97.29	0.523
Laser energy density	3.76±0.78	3.63±0.82	0.258
Bleeding	7 (7)	6 (6)	0.774
Capsule perforation	2 (2)	3 (3)	1.000
Conversion to TURP	3 (3)	5 (5)	0.718

bleeding and 5 had capsule perforation. Due to bleeding or unclear endoscopic vision, 8 cases were converted to TURP method. No statistically significant between-group differences were observed with respect to operation time, laser time, laser energy, laser energy density, and intraoperative complications (**Table 3**).

Catheter removal was performed 3-9 days after the PVP surgery, and the pain level on catheter removal, anxiety level, waiting time, and satisfaction grade of first urination were compared. As shown in **Table 4**, patients in the perfusion group had shorter waiting times [3 (0-4) vs. 15 (8.75-26) min; *P*<0.001] and a better satisfaction grade [24 (21.75-26) vs. 23 (20-25); *P*=0.016] of first urination than those in the control group. Patients in the perfusion group had lower anxiety levels at first urination than those in the control group [1 (1-2) vs. 1.5 (1-2); *P*=0.012]; however, the anxiety level before PVP surgery did not differ significantly between the groups [3 (3-4] vs. 3 (3-4); *P*=0.140]. Urinalysis revealed that the WBC count in the perfusion group was significantly lower than that in the control group on the day [25.5 (8-37.75) vs. 43.5 (24.0-64.75); *P*<0.001] and 2 weeks [20.5 (11-27) vs. 31.0 (20-42); *P*<0.001] after catheter removal (**Table 4**).

All postoperative complications that occurred during the 6-month follow-up period are summarized in **Table 5**. Sixteen patients experienced transient hematuria and 17 had transient urinary incontinence; no true urinary incontinence was investigated at the end of follow-up. Treatment-related adverse events did not differ significantly between the perfusion (n=15) and control (n=20) groups.

At the end of the 6-month follow-up period, IPSS [preoperative: 23 (20-26) vs. postoperative: 10 (8-12); *P*<0.001], QoL [preoperative: 5 (4-5) vs. postoperative: 2 (1-3); *P*<0.001], Qmax [preoperative: 7 (4-8.25) mL/s vs. postoperative: 17 (15-18) mL/s; *P*<0.001], and PVR [preoperative: 50 (17.5-200) mL/s vs. postoperative: 10 (0-10) mL/s; *P*<0.001] of patients in the perfusion group were significantly improved, and the PSA level also decreased [preoperative: 4.40 (2.09-7.55) ng/mL vs. postoperative: 1.88 (0.96-3.14) ng/mL; *P*<0.001]. There were no statistically significant differences between the two groups, and the clinical outcomes are summarized in **Table 6**.

Discussion

Although surgical and clinical outcomes of PVP have been confirmed worldwide, the time of catheter removal after PVP is inconclusive [12], and saline perfusion before catheter removal has not yet been reported. Patients treated with PVP usually require catheterization for 1-9 days, which is determined by the patient and PVP surgery. Over 20% of patients experience transient storage symptoms upon catheter removal, and approximately 5% may experience urinary retention due to urethral edema and blood clots [13, 14]. Inflammatory secretion was produced by the prostate wound and wearing-catheter's urethra, and accumulated secretion aggravated inflammation, edema, and congestion of the prostate and urethra, which was the cause of frequent urination, urgency, hematuria, and urinary retention [15, 16]. Postoperative dysuria and urinary retention may result in increased bladder pressure, and the rate of adverse events, such as acute prostatitis and epididymitis, is also increased [17]. Patients who undergo urinary retention after PVP surgery may experience more negative emotions, such as anxiety and fear, which induce unnecessary physical and mental health effects and economic losses.

Conventional intervention after catheter removal includes encouragement of patients to drink more water to enable complete urethral self-cleaning [18]. However, delayed first voiding after surgery and decreased urine output may influence the evaluation of first urination after

Table 4. Urinary catheter removal and first urination of the perfusion and control groups

Variables	Perfusion group (N=100)	Control group (N=100)	*P*-value
Pain level on catheter removal	2 (1-4)	2 (0.75-3.25)	0.365
Pain level during first urination	2 (0-4)	2 (1-4)	0.330
Anxiety level before PVP surgery	3 (3-4)	3 (3-4)	0.140
Anxiety level before catheter removal	1 (1-2)	1.5 (1-2)	0.012
Waiting time for first urination	3 (0-4)	15 (8.75-26)	<0.001
Satisfaction grade of first urination	24 (21.75-26)	23 (20-25)	0.016
White blood cell count of urinalysis	25.5 (8-37.75)	43.5 (24.0-64.75)	<0.001
White blood cell count of urinalysis 2 Weeks later	20.5 (11-27)	31.0 (20-42)	<0.001

Table 5. Adverse events in the perfusion and control groups

	Perfusion group	Control group	*P*-value
Transient Hematuria	5 (5)	11 (11)	0.118
Blood transfusion	0 (0)	0 (0)	-
Clot retention	0 (0)	1 (1)	1.000
Transient urinary incontinence	9 (9)	8 (8)	0.800
Stricture	1 (1)	0 (0)	1.000
Retreatment	0 (0)	0 (0)	-
All adverse events	15 (15)	20 (20)	0.191

PVP and may also increase patient suffering and medical workload. In this study, we irrigated 200 mL saline [or the maximum capacity tolerated (<200 mL)] into the bladder before catheter removal in BPH patients treated with PVP, and a quick evaluation of first urination was performed successfully.

In the present study, we confirm that saline perfusion before catheter removal has several advantages for patients with BPH who underwent PVP, including reduced waiting time for the first urination [saline perfusion: 3 (0-4) vs. control: 15 (8.75-26) min; $P<0.001$], improved patient satisfaction [saline perfusion: 24 (21.75-26) vs. control: 23 (20-25); $P=0.016$], and lowered anxiety levels regarding first urination [saline perfusion: 1 (1-2) vs. control: 1.5 (1-2); $P=0.012$]. These results are consistent with the study by Cheng et al. (2012), which reported shortened waiting times for urination and recovering time to normal urination, and concluded that bladder saline perfusion before catheter removal in TURP patients is simple and effective for the restoration of normal voiding [19].

A study by Kim et al. (2015) found that urinary WBC count may have adverse effects on treatment outcomes after PVP [20]. We also observed a marked decrease in urinary WBC count in the saline perfusion group [saline perfusion: 25.5 (8-37.75) vs. control: 43.5 (24.0-64.75); $P<0.001$; after 2 weeks, saline perfusion: 20.5 (11-27) vs. control: 31.0 (20-42); $P<0.001$]. WBC count on urinalysis in the perfusion group was significantly lower than that in a previous study [21]. The reason may be that the saline rapidly flushed accumulated inflammatory secretions and reduced irritation of the prostate wound and urethra.

In this study, we found no significant difference in treatment-related adverse events between those with saline perfusion and those without, indicating that saline perfusion before catheter removal did not increase the risk of complications. All postoperative adverse events and clinical outcomes at the end of the 6-month follow-up period were analyzed, and we observed that patients in the two groups had similar complication rates and clinical outcomes, which indicated that saline perfusion before catheter removal did not affect the clinical outcomes of PVP surgery. These results are consistent with the study by Lai et al. (2019), which reported that PVP has equivalent long-term IPSS, Qmax, QoL, PVR, and IIEF efficacy with fewer complications [22].

This study has some limitations. First, this was a retrospective study which has intrinsic limitations. Second, the sample size was relatively small, and all patients treated with PVP were recruited from one medical center; future multicenter studies will strengthen our findings. Prospective multicenter trials with large sample sizes are required to confirm our conclusion.

Table 6. Clinical outcomes of patients with BPH treated with PVP

	Perfusion group			Control group		
	Preoperative	Postoperative	*P*-value	Preoperative	Postoperative	*P*-value
IPSS	23 (20-26)	10 (8-12)	<0.001	23 (20-26)	10 (8-13)	<0.001
	Preoperative (Perfusion vs. Control): P>0.05			Postoperative (Perfusion vs. Control): P>0.05		
QoI	5 (4-5)	2 (1-3)	<0.001	5 (4-5)	2 (1-2.25)	<0.001
	Preoperative (Perfusion vs. Control): P>0.05			Postoperative (Perfusion vs. Control): P>0.05		
PSA	4.40 (2.09-7.55)	1.88 (0.96-3.14)	<0.001	4.20 (2.12-6.35)	1.80 (0.97-2.66)	<0.001
	Preoperative (Perfusion vs. Control): P>0.05			Postoperative (Perfusion vs. Control): P>0.05		
Qmax	7 (4-8.25)	17 (15-18)	<0.001	6 (4-9)	16 (15-19)	<0.001
	Preoperative (Perfusion vs. Control): P>0.05			Postoperative (Perfusion vs. Control): P>0.05		
PVR	50 (17.5-200)	0 (0-10)	<0.001	40 (10-155)	0 (0-20)	<0.001
	Preoperative (Perfusion vs. Control): P>0.05			Postoperative (Perfusion vs. Control): P>0.05		

In conclusion, saline perfusion before catheter removal in patients treated with PVP could shorten the waiting time for the first urination, improve patient anxiety and satisfaction, and reduce postoperative urinary WBC levels. Saline perfusion is a safe, effective, and economical intervention that could be clinically applied to enhance patient outcomes.

Acknowledgements

This study was sponsored by Tianjin Union Medical Center Fund (No. 2020YJHL029) in the design of the study and collection, analysis, and interpretation of data.

Disclosure of conflict of interest

None.

Address correspondence to: Dong Zhang, Department of Urology, Tianjin Union Medical Center of Nankai University, Tianjin, China. Tel: +86-022-27557496; Fax: +86-022-27557496; E-mail: mnwkhlb@163.com

References

[1] Kim EH, Larson JA and Andriole GL. Management of benign prostatic hyperplasia. Annu Rev Med 2016; 67: 137-151.

[2] Langan RC. Benign prostatic hyperplasia. Prim Care 2019; 46: 223-232.

[3] Schwartz RN, Couture F, Sadri I, Arezki A, Nguyen DD, Zakaria AS, Law K, Elterman D, Rieken M, Cash H and Zorn KC. Reasons to believe in vaporization: a review of the benefits of photoselective and transurethral vaporization. World J Urol 2021; 39: 2263-2268.

[4] Law KW, Tholomier C, Nguyen DD, Sadri I, Couture F, Zakaria AS, Bouhadana D, Bruyère F, Cash H, Reimann M, Cindolo L, Ferrari G, Vasquez-Lastra C, Borelli-Bovo TJ, Becher EF, Misrai V, Elterman D, Bhojani N and Zorn KC. Global Greenlight Group: largest international Greenlight experience for benign prostatic hyperplasia to assess efficacy and safety. World J Urol 2021; 39: 4389-4395.

[5] Thomas JA, Tubaro A, Barber N, d'Ancona F, Muir G, Witzsch U, Grimm MO, Benejam J, Stolzenburg JU, Riddick A, Pahernik S, Roelink H, Ameye F, Saussine C, Bruyère F, Loidl W, Larner T, Gogoi NK, Hindley R, Muschter R, Thorpe A, Shrotri N, Graham S, Hamann M, Miller K, Schostak M, Capitán C, Knispel H and Bachmann A. A multicenter randomized noninferiority trial comparing GreenLight-XPS laser vaporization of the prostate and transurethral resection of the prostate for the treatment of benign prostatic obstruction: two-yr outcomes of the GOLIATH study. Eur Urol 2016; 69: 94-102.

[6] Brassetti A, DE Nunzio C, Delongchamps NB, Fiori C, Porpiglia F and Tubaro A. Green light vaporization of the prostate: is it an adult technique? Minerva Urol Nefrol 2017; 69: 109-118.

[7] Knapp GL, Chalasani V and Woo HH. Perioperative adverse events in patients on continued anticoagulation undergoing photoselective vaporisation of the prostate with the 180-W Greenlight lithium triborate laser. BJU Int 2017; 119 Suppl 5: 33-38.

[8] Meskawi M, Hueber PA, Valdivieso R, Karakiewicz PI, Pradere B, Misrai V, Chughtai B and Zorn KC. Complications and functional outcomes of high-risk patient with cardiovascular disease on antithrombotic medication treated with the 532-nm-laser photo-vaporization Greenlight XPS-180 W for benign prostate hyperplasia. World J Urol 2019; 37: 1671-1678.

[9] Piotrowicz G, Syryło T, Jedynak R and Zieliński H. Efficacy and safety of photoselective vaporization of the prostate with 120 W 532 nm laser in patients with benign prostatic hyperplasia on anticoagulation or antiplatelet therapy: observations on long-term outcomes. Photomed Laser Surg 2018; 36: 273-283.

[10] Chen CH, Lin SE and Chiang PH. Outcome of GreenLight HPS laser therapy in surgically high-risk patients. Lasers Med Sci 2013; 28: 1297-1303.

[11] Luo F, Sun HH, Su YH, Zhang ZH, Wang YS, Zhao Z and Li J. GreenLight laser photoselective vaporization of the prostate for treatment of benign prostate hyperplasia/lower urinary tract symptoms in patients with different postvoid residual urine. Lasers Med Sci 2017; 32: 895-901.

[12] Bae WJ, Ahn SG, Bang JH, Bae JH, Choi YS, Kim SJ, Cho HJ, Hong SH, Lee JY, Hwang TK and Kim SW. Risk factors for failure of early catheter removal after Greenlight HPS laser photoselective vaporization prostatectomy in men with benign prostatic hyperplasia. Korean J Urol 2013; 54: 31-35.

[13] Kim SJ, Bae WJ and Kim SW. Influence of solifenacin on the improvement of storage symptoms in the early period after photoselective vaporization of the prostate. Investig Clin Urol 2019; 60: 480-487.

[14] Skolarus TA, Dauw CA, Fowler KE, Mann JD, Bernstein SJ and Meddings J. Catheter management after benign transurethral prostate surgery: RAND/UCLA Appropriateness Criteria. Am J Manag Care 2019; 25: e366-e372.

[15] Kavanagh LE, Jack GS and Lawrentschuk N; Medscape. Prevention and management of TURP-related hemorrhage. Nat Rev Urol 2011; 8: 504-514.

[16] Wu Y, Chen B and Liu C. Multivariate analysis of the failure of removal of the urinary catheter within 48 hours after transurethral enucleation and resection of the prostate. Biomed Res Int 2020; 2020: 8241637.

[17] Schoeb DS, Schlager D, Boeker M, Wetterauer U, Schoenthaler M, Herrmann TRW and Miernik A. Surgical therapy of prostatitis: a systematic review. World J Urol 2017; 35: 1659-1668.

[18] Cao Y, Gong Z, Shan J and Gao Y. Comparison of the preventive effect of urethral cleaning versus disinfection for catheter-associated urinary tract infections in adults: a network meta-analysis. Int J Infect Dis 2018; 76: 102-108.

[19] Cheng R, Wang H, Li L, Hei L, Jia S, Han L and Xu Y. Bladder saline perfusion before catheter removal in TURP patients. Chin J Urol 2012; 33: 448-450.

[20] Kim JK, Bae J, Lee HW, Lee KS and Cho MC. Does postoperative leukocyturia influence treatment outcomes after photoselective vaporization of the prostate (PVP)? A prospective short-term serial follow-up study. Urology 2015; 86: 581-586.

[21] Huang X, Shi HB, Wang XH, Zhang XJ, Chen B, Men XW and Yu ZY. Bacteriuria after bipolar transurethral resection of the prostate: risk factors and correlation with leukocyturia. Urology 2011; 77: 1183-1187.

[22] Lai S, Peng P, Diao T, Hou H, Wang X, Zhang W, Liu M, Zhang Y, Seery S and Wang J. Comparison of photoselective green light laser vaporisation versus traditional transurethral resection for benign prostate hyperplasia: an updated systematic review and meta-analysis of randomised controlled trials and prospective studies. BMJ Open 2019; 9: e028855.