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Risk Factors for Failure of Early Catheter Removal After Greenlight HPS Laser Photoselective Vaporization Prostatectomy in Men With Benign Prostatic Hyperplasia

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Purpose: To assess the risk factors for developing urinary retention after removal of the urethral catheter on postoperative day 1 in benign prostatic hyperplasia patients who underwent Greenlight HPS laser photoselective vaporization prostatectomy (PVP).

Materials and Methods: The study included 427 men who underwent Greenlight HPS laser PVP between 2009 and 2012, excluding patients in whom a catheter was maintained for more than 1 day because of urethral procedures. In all patients, a voiding trial was performed on postoperative day 1; if patients were unable to urinate, the urethral catheter was replaced before hospital discharge. The patients were divided into two groups: early catheter removal (postoperative day 1) and late catheter removal (urethral catheter reinsertion). Preoperative and perioperative parameters were compared between the groups.

Results: Catheters were successfully removed in 378 (88.6%) patients on postoperative day 1. In 49 patients, the catheters were reinserted and removed a mean of 6.45±0.39 days after surgery. In a multivariate analysis, a history of diabetes was the most significant predictor (p=0.028) of failure of early catheter removal, followed by operative time (p=0.039). There were no significant differences in age, prostate volume, International Prostate Symptom Score, or urodynamic parameters between the two groups.

Conclusions: It is feasible, safe, and cost-effective to remove the urethral catheter on postoperative day 1 after Greenlight HPS laser PVP, but the procedure should be done carefully in patients who have history of diabetes or an extended operative time.

Keywords: *Laser therapy; Prostatic hyperplasia; Urethral catheterization*

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INTRODUCTION

Lower urinary tract symptoms (LUTS) are a common problem affecting old men, and the prevalence of LUTS related to benign prostatic hyperplasia (BPH) increases with age, approaching 50% by the age of 60 years and 90% by the age of 85 years [1]. Treatment strategies include watchful waiting, medical therapy, and surgery. With the increase in the aging population worldwide, more symptomatic BPH patients will require surgical intervention. Although transurethral resection of the prostate (TURP) remains the gold standard surgical technique, the evolution of minimally invasive surgical options has challenged TURP. These newer options have the potential for decreased morbidity in older patients who have medical comorbidities. An example is potassium-titanyl-phosphate (KTP) laser photoselective vaporization prostatectomy (PVP) [2]. Laser prostatectomy was developed to reduce the complications

and costs associated with TURP in the treatment of LUTS secondary to BPH.

Al-Ansari et al. [3] showed that 120 W Greenlight laser PVP is a safe and effective treatment for patients suffering from BPH in comparison with the gold standard treatment of TURP. Greenlight laser PVP provides better intraoperative and early postoperative outcomes. The average duration of catheterization was 1.4 days for the PVP group and 2.7 days for the TURP group. The average time of hospital stay was significantly shorter in the PVP group (4.1 days vs. 2.3 days for the TURP and PVP groups, respectively). With the growing aging population, the risk of developing postoperative complications and he extended catheter indwelling time resulting in a prolonged hospital stay directly impact our health care provision.

The interval to catheter removal following TURP is variable, ranging from 24 hours [4] to 5 days [5]. Previous studies have tried to determine the variables responsible for early catheter removal after transurethral resection, so that catheters could be removed earlier without increasing morbidity, thus reducing the length of hospital stay and ultimately leading to savings in the health care budget. It is evident that the average duration of catheter indwelling is shorter in patients undergoing PVP than in those undergoing TURP, but no study has yet been conducted on the risk factors associated with failure of catheter removal on postoperative day 1. The purpose of this study was therefore to analyze the risk factors for failure of early catheter removal after 120 W Greenlight laser PVP in BPH patients on the basis of the experience of a single institute.

MATERIALS AND METHODS

Approval by our Institutional Review Board was obtained. From March 2009 to January 2011, 469 consecutive patients with LUTS secondary to BPH were treated with 120 W Greenlight laser PVP. The inclusion criteria were the presence of moderate to severe LUTS, failed previous medical therapy, and BPH-associated complications, such as hematuria, recurrent urinary tract infections, and urinary retention. A total of 427 patients were selected for the present study, excluding patients who underwent surgery owing to urethral stricture or who used urethral catheters on a long-term basis. Patients were also excluded if they had evidence of neurogenic bladder disorder, bladder or prostatic malignancy, or a history of prostate surgery. The presence of a large median lobe, patient age, and the use of anticoagulants were not criteria for exclusion.

All patients were assessed with a complete medical history, physical examination, International Prostate Symptom Score (IPSS), maximum urinary flow rate (Qmax), postvoid residual volume (PVR), transrectal ultrasonography (TRUS), prostate-specific antigen (PSA), complete blood cell count including hemoglobin, urine analysis, and urodynamic study. Regarding the medical history of the subjects, the presence of preoperative urinary retention was investigated, as was the presence of comorbidities such as diabetes mellitus (DM), hypertension, cardiovascular disease, and coronary artery diseases. If patients were found to have an elevated serum PSA value (>4 ng/mL) or abnormal findings on a digital rectal examination, they underwent concomitant transrectal prostate needle biopsy to exclude prostate cancer. Urodynamic investigations and evaluations were performed according to the standards recommended by the International Continence Society [6].

The bladder outlet obstruction index (BOOI) and the bladder contractility index (BCI) were calculated by urodynamic study by use of the following formulas:

BOOI=PdetQmax-2×Qmax

BCI=PdetQmax+5×Qmax

(PdetQmax, detrusor pressure at maximum flow rate)

PVP was performed by a single urologist, and all procedures were carried out under general or spinal anesthesia. A continuous running irrigation system 22 Fr resectoscope and a laser fiber were used. The 120 W HPS laser system (Laserscope, GreenLight, American Medical Systems, Minnetonka, MN, USA) was used, and all prostate tissue causing obstruction was removed until a fine surgical cavity was formed, as in TURP. An 18 Fr urethral catheter was placed after the operation and irrigation with saline solution was begun in the operating room. When the patients recovered from anesthesia and if the urine was clear, irrigation was stopped. Voiding trials were performed the morning after surgery. If patients were unable to urinate, a urethral catheter was replaced before hospital discharge and the patient was returned to our outpatient clinic for a second voiding trial. The perioperative variables, including operative time, amount of applied energy, catheterization time, and any intraoperative or postoperative complications, were recorded. Patients were divided into two groups: patients with successful urination after urethral catheter removal on postoperative day 1, and patients in whom a catheter was reinserted after urethral catheter removal on postoperative day 1 owing to urinary retention. The descriptive statistics are presented as mean±standard deviation, and variables were analyzed with the Mann-Whitney test, chi-square test, and logistic regression analysis by use of SPSS ver. 16 (SPSS, Inc., Chicago, IL, USA).

RESULTS

Table 1 summarizes the patient demographics of both groups. Catheters were successfully removed in 378 (88.6%) patients on postoperative day 1. Catheters were reinserted in a total of 49 patients owing to unsuccessful urination, and the catheters were removed at a mean of 6.45±0.39 days postoperatively. Consequently, the mean period of catheter indwelling was 1.63±0.10 days. The difference in age between the groups was not significant. The percentage of patients with a history of preoperative urinary retention in the successful urination group and the catheter reinsertion group was 16.9% and 28.6%, respectively, and thus was significantly higher in the catheter reinsertion group ($p<0.05$). In terms of comorbidities,

TABLE 1. Patient demographics

Variable	Catheter removal			p-value
	Postoperative day 1	Reinsertion	Overall	
Patients	378 (88.6)	49 (11.4)	427 (100)	
Age (y)	70.62±0.42	70.82±1.30	70.64±0.40	0.692
Urinary retention	64/378 (16.9)	14/49 (28.6)	78/427 (18.3)	0.047[a]
Comorbidities				
Diabetes mellitus	58/378 (15.3)	14/49 (28.6)	72/427 (16.9)	0.020[a]
Hypertension	161/378 (42.6)	24/49 (49.0)	185/427 (43.3)	0.396
Cardiovascular disease	31/378 (8.2)	5/49 (10.2)	36/427 (8.4)	0.635
Coronary artery disease	40/378 (10.6)	5/49 (10.2)	45/427 (10.5)	0.935
Prostate volume (mL)	48.73±1.22	48.32±2.93	48.68±1.13	0.959
IPSS	21.32±0.57	22.29±1.77	21.45±0.54	0.426
Quality of life	4.29±0.15	4.32±0.21	4.30±0.13	0.571
Qmax (mL/s)	10.65±1.40	7.61±0.75	10.36±1.27	0.444
PVR (mL)	200.62±11.72	244.54±38.67	210.22±11.52	0.443
BOOI >40	135/268 (50.4)	17/29 (58.6)	152/297 (51.2)	0.399
BCI <100	138/268 (51.5)	20/29 (69)	158/297 (53.2)	0.073

Values are presented as number (%) or mean±standard deviation.
IPSS, International Prostate Symptom Score; Qmax, maximal urinary flow rate; PVR, postvoiding residual urine volume; BOOI, bladder outlet obstruction index; BCI, bladder contractility index.
[a]:$p<0.05$.

TABLE 2. Perioperative parameters

Parameter	Postoperative day 1	Reinsertion	Overall	p-value
Operative time (min)	78.88±2.22	96.76±9.55	80.93±2.26	0.040[a]
Lasing time (min)	24.05±0.81	27.89±2.06	24.50±0.76	0.440
Applied energy (kJ)	122.68±4.57	148.36±12.79	125.64±4.32	0.133
Catheter duration (d)	1	6.45±0.39	1.63±0.10	

Values are presented as mean±standard deviation.
[a]:$p<0.05$.

differences in the ratios of hypertension, cardiovascular disease, and coronary artery disease were not significant, whereas the ratio of DM was 15.3% and 28.6% in the successful urination group and the catheter reinsertion group, respectively ($p<0.05$). Preoperative prostate volume was about 48 mL, which was not significantly different between the groups, and the differences in IPSS and quality of life scores were also not significant. In the urodynamic evaluation, the catheter reinsertion group showed a lower Qmax, higher PVR, and more obstructive and weak contractile patterns than did the successful urination group, but these differences were not statistically significant. Intraoperative outcomes are summarized in Table 2. The mean operative time was significantly shorter in the early catheter removal group ($p<0.05$). In terms of lasing time and amount of applied energy, no significant differences were observed between the groups.

In the univariate analysis of the variables, we noticed that history of DM, history of urinary retention, and longer operative time were statistically significant predictors of failure of early catheter removal. These three factors were entered into the multivariate analysis. History of DM was found to be the most significant predictor (p=0.028), followed by operative time (p=0.039) (Table 3). There were no significant differences in age, prostate volume, IPSS, or urodynamic parameters between the two groups.

TABLE 3. Analysis of the factors predicting Foley catheter reinsertion

Factor	Significance	Odds ratio (95% CI)
Diabetes mellitus	0.028[a]	2.156 (1.084–4.286)
Urinary retention	0.128	1.719 (0.856–3.450)
Operative time	0.039[a]	1.006 (1.000–1.012)

CI, confidence interval.
[a]:$p<0.05$.

DISCUSSION

TURP has been regarded as the gold standard surgical treatment of BPH. In an attempt to overcome the limi-

tations and morbidities of TURP, a number of minimally invasive techniques have been introduced into clinical practice. KTP laser PVP and, subsequently, Greenlight HPS laser PVP are such alternatives, with a large body of clinical evidence [3,7,8]. In a comparison of Greenlight laser PVP with TURP, the outcome parameters were significantly improved compared with preoperative values, with no significant differences between the two groups [9]. However, patients undergoing TURP experienced more severe adverse effects than did PVP patients, thus giving the latter a more favorable perioperative safety profile. Performing conventional TURP in patients who are on oral anticoagulant therapy has a high complication rate, with a transfusion rate of 30% [10]; however, PVP laser treatment has been successfully used in patients on anticoagulant therapy [11]. If catheter indwelling or transfusion is required owing to bleeding, the duration of postoperative hospitalization is extended. Therefore, compared with TURP, the decrease in development of complications with PVP laser treatment contributes to a shortened hospital stay. Studies have reported that early catheter removal reduces the length of the hospital stay, which in turn would be beneficial to health care costs [12]. In addition to cost savings, early catheter removal and early discharge may have advantages, especially for patients for whom an early return to their employment is required. In our study, 88.6% were catheter-free on postoperative day 1 and were discharged home on the same day. The mean duration of indwelling catheterization, 1.63 days, was similar to other reports [13]. However, no study that analyzed risk factors in patients whose urethral catheters were not removed on postoperative day 1 has previously been reported. In the case of TURP, Nakagawa and Toguri [14] suggested risk factors such as age, postoperative bleeding, and several comorbidities, including coronary heart disease, renal insufficiency, and Alzheimer's disease. Das Bhagia et al. [15] reported that a history of acute urinary retention does not affect the duration of catheter indwelling after the TURP procedure. In the case of Greenlight HPS laser PVP, patients are discharged after removal of the catheter within 24 hours after surgery and a voiding trial if postoperative complications do not develop. However, if voiding is unsuccessful, patients are discharged with the catheter reinserted or the hospital stay is extended for a few more days. Catheter reinsertion leads to not only discomfort but also a prolonged hospital stay. If a patient has risk factors for difficulty with early postoperative voiding, it would be preferable to discharge the patient on postoperative day 1 with the catheter to save on cost and to reduce the pain caused by repeated catheter insertions.

In studies on TURP, clot retention caused by postoperative bleeding was suggested as a major risk factor. In the case of PVP laser treatment, the matter is of little importance, because the risk of developing complications such as clot retention is considered very low. According to the present study, there was a significant difference in the presence of a history of urinary retention between the groups, but in the multivariate analysis, no difference was observed. Instead, history of DM and longer operative time were confirmed as significant risk factors.

DM cystopathy is traditionally described as a triad of decreased sensation, increased capacity, and poor emptying, but many inconsistencies have been found in those classic findings. A review by Kaplan et al. [16] of urodynamic findings in 182 diabetes cases revealed that 55% had detrusor overactivity with 10% areflexic and 11% indeterminate. Diabetic bladder dysfunction includes time-dependent manifestations of storage and emptying problems [17]. Therefore, symptoms of bladder dysfunction may not be detected in an early stage of DM, but even after BPH is solved, voiding difficulty may remain. A continuous running irrigation system can help to secure a clear view during surgery but may result in consistent bladder distension. Because the duration of surgery is prolonged, the duration of bladder distension is also extended, and increased fatigability of the detrusor muscle is considered to result in temporary bladder dysfunction.

The limitations of the present study include the following: limited analysis of risk factors owing to insufficient numbers of subjects, lack of confirmation of increased costs resulting from the extended catheter indwelling time, and lack of confirmation of differences in functional outcomes between the two groups after several postoperative months. Through multi-institutional study in the future with more data, the correlation between the period of catheter indwelling and total costs and the risk factors affecting the period of catheter indwelling may be confirmed. Then, the advantages of the fewer complications of PVP laser compared with TURP will be understood more clearly.

CONCLUSIONS

It is feasible, safe, and cost-effective to remove the urethral catheter on postoperative day 1 after Greenlight HPS laser PVP, but it should be done carefully in patients with a history of DM or in those who experienced an extended operative time.

CONFLICTS OF INTEREST

The authors have nothing to disclose.

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