

·Clinical Experience·

Evaluation of greenlight photoselective vaporization of the prostate for the treatment of high-risk patients with benign prostatic hyperplasia

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Abstract

Aim: To explore the feasibility and safety of greenlight photoselective vaporization of the prostate (PVP) on high-risk patients presenting with lower urinary tract symptoms suggestive of benign prostatic hyperplasia (BPH) and to evaluate their clinical and voiding outcome. **Methods:** A total of 85 high-risk patients with obstructive BPH underwent PVP with an 80 W potassium-titanyl-phosphate laser, which was delivered through a side-deflecting fiber with a 23 Fr continuous flow cystoscope. Operative time, blood loss, indwelling catheterization, international prostate symptom score (IPSS), quality of life score (QoL), uroflowmetry, postvoid residual urine volume and short-term complication rates were evaluated for all patients. **Results:** All patients got through the perioperative period safely. The chief advantages of PVP were: short operative time (25.6 ± 7.6 min), little bleeding loss (56.8 ± 14.3 mL) and short indwelling catheterization (1.6 ± 0.8 d). The IPSS and QoL decreased from (29.6 ± 5.4) and (5.4 ± 0.6) to (9.5 ± 2.6) and (1.3 ± 0.6), respectively. The vast majority of patients were satisfied with voiding outcome. The mean maximal urinary flow rate increased to 17.8 mL/s and postvoid residual urine volume decreased to 55.6 mL. These results are significantly different from preoperative data ($P < 0.05$). No patient required blood transfusion or fluid absorption. There were few complications and very high patient satisfaction after operation. **Conclusion:** PVP has a short operative time and high tolerance, and is safe, effective and minimally invasive for high-risk patients, therefore it might be considered as a good alternative treatment for high-risk patients with obstructive urinary symptoms as a result of BPH. (*Asian J Androl* 2006 May; 8: 367–371)

Keywords: benign prostatic hyperplasia; photoselective vaporization of the prostate; high-risk; laser surgery; prostate

1 Introduction

Men with lower urinary tract symptoms as a result of

benign prostate hyperplasia (BPH) who are at high cardiovascular risk and those with bleeding disorders or who are on anticoagulant therapy are often denied conventional transurethral resection of the prostate (TURP). TURP is generally considered the gold standard for the surgical relief of bladder outlet obstruction as a result of BPH. However, The morbidity of complication of TURP is still rather high [1]. Various surgical treatment alternatives, including laser techniques, have been introduced in the last decade [2]. Greenlight photoselective vaporization of the prostate (PVP)

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is a novel, rapidly emerging technique that promises instant hemostatic tissue ablation [3]. To decrease operative complications and postoperative morbidity, the most recently-developed PVP is one of the most promising minimally-invasive treatments. The PVP is considered to be safe and evidently superior to so-called minimal invasive alternatives [4]. In our prospective study, we evaluated the outcome and morbidity rate of this procedure in high-risk patients with severe lower urinary tract symptoms.

2 Materials and methods

2.1 Patients

A prospective study was conducted between December 2003 and March 2005. Eighty-five patients aged 72 years to 91 years (mean age of 79.3 ± 5.2 years) with symptomatic bladder outlet obstruction as a result of BPH underwent PVP with an 80 W potassium-titanyl-phosphate (KTP) laser at our institution. Lower urinary tract obstruction symptoms as a result of BPH had lasted for 5–20 years (mean 15.6 ± 0.8 years). Prior to surgery, 26 patients (30.6%) had acute urinary retention. In the present study, high risk was defined as patients older than 70 years, and patients presenting with various kinds of total body diseases, such as hypertensive disease ($n = 36$), coronary heart disease ($n = 25$), atrioventricular block ($n = 6$), myocardial infarction ($n = 2$), chronic bronchitis accompanied by pulmonary emphysema ($n = 17$), cerebral infarction ($n = 12$), renal insufficiency ($n = 5$), diabetes mellitus ($n = 26$). Of these patients, 22 had simultaneous cardiac and pulmonary or more other diseases. Of these patients, 28 received oral anticoagulant therapy. Furthermore, the vast majority of patients presented with an American Society of Anesthesiology (ASA) score of 3 or higher. BPH grading was applied by digital examination of the rectum: grade I 12, grade II 38, grade III 35. The mean baseline prostate weight was (72.5 ± 22.8) g (range: 36–128 g) by transrectal ultrasonography (TRUS). The mean maximal urinary flow rate (Q_{max}) was (5.5 ± 2.6) mL/s (range: 2.0–11.5 mL/s), pre-operative serum prostate specific antigen (PSA) was (1.8 ± 0.7) ng/mL (range: 0.2–17.5 ng/mL). All patients completed a preoperative evaluation, which included medical history, international prostate symptom score (IPSS), quality of life score (QoL), physical examination with digital rectal examination (DRE), routine urine and blood analyses, determination of serum PSA level, Q_{max}, estimation of prostate volume by TRUS, and post-void

residual urine volume (PVR). TRUS guided biopsies were done in patients with a serum PSA measurement greater than 4.0 ng/mL, abnormal digital rectal examination, and/or suspicious and irregular echogenicity on TRUS. Patients with a diagnosis of prostate cancer were excluded from the study. Patients were evaluated preoperatively, and at a postoperative follow-up after 6 and 12 months.

2.2 Preoperative management

The decompression medicine therapy was applied for these patients with primary hypertension to control blood pressure below 140/90 mmHg. Medicine to ameliorate cardiac function, such as digitora and diuretic, was given to those with cardiac insufficiency. Generally, PVP was not performed on myocardial infarction patients until after 6-month medical treatment. A temporary or permanent artificial heart driver-extractor was implanted for those patients with atrioventricular block grade II or more. Medicine for the amelioration of pulmonary function, for example, antibiotics, oral medicine for dilatation of bronchus or expectorant were used for those patients with pulmonary function insufficiency, such as those with chronic bronchitis or pulmonary emphysema. If renal function insufficiency was caused by urine retention of the lower urinary tract resulted from obstruction as a result of BPH, a catheter was inserted for 2 weeks to drain urine to correct renal function. Application of insulin or oral biguanides for those diabetes patients aimed to decrease empty stomach blood sugar to below 8.0 mmol/L or post-meal blood sugar to below 10 mmol/L. Urinary tract infection patients received anti-infection therapy.

2.3 Surgical technique

Laser vaporization of the prostate was performed under sacral canal anesthesia. Using an 80 W KTP laser produced from a Greenlight PVP system, a StarPulse quasicontinuous wave laser (Laserscope, San Jose, California) emits the green light with a wavelength of $\lambda = 532$ nm. The 600 μ m optical fiber with a 70-degree side-deflecting quartz element is inserted through a 23 Fr continuous flow laser cystoscope (ACMI, Southborough, Massachusetts, USA). Endoscopic examination of the bladder and prostatic urethra was made before the procedure. Sterile water at room temperature was used as irrigation fluid.

Sacral canal anesthesia with lignocaine chloride was used in all patients. Laser vaporization of the prostate was performed under video endoscopy guidance using the laser fiber in a near contact sweeping technique. Laser vaporization

began at the bladder neck and then the lateral lobes, the anterior lobe and finally the apical portion of the prostate. The end point of the procedure was to achieve an adequate TUR-like cavity with subsequent visual observation of the transverse fibers of the surgical capsule and carefully toward the apical tissue to protect the external sphincter. The decision to insert a catheter is based on prostate size, applied energy and bladder function. An antibiotic was given before the procedure and continued at least 7 d after the operation.

2.4 Operative effect

Operative effect evaluation included the operative time, volume of bleeding and blood transfusion and postoperative catheter duration. Follow-up evaluations were carried out using the following outcome parameters: IPPS, QoL, PSA, Qmax, PVR, blood count and serum electrolytes. In addition, any early adverse events were recorded at each follow-up.

2.5 Statistical analysis

Data were presented as the mean $\pm$ SD and statistical software SPSS version 8.0 was adopted for statistical analysis. We considered $P < 0.05$ to be statistically significant.

3 Results

3.1 Operative condition

All patients at high risk who underwent PVP got through the perioperative period safely. No perforation of the bladder wall or prostatic capsule during the operation was observed. One laser fiber was used per patient, except for 5 patients for whom two fibers were needed for effective vaporization of the adenoma tissue. The mean operative time was (25.6 ± 7.6) min (range: 20–90 min). Total average energy delivery was (24 ± 35) kJ (range: 44–178 kJ).

The mean bleeding loss was (56.8 ± 14.3) mL (range: 30–140 mL). Mean preoperative hemoglobin was (143.0 ± 11.5) g/L (range: 100–165 g/L) and mean postoperative hemoglobin was (139.0 ± 10.5) g/L (range: 96–158 g/L) ($P > 0.05$). No perioperative bleeding required blood transfusion. Mean preoperative serum sodium was (142.5 ± 6.8) mmol/L (range: 132–145 mmol/L) and mean immediate postoperative serum sodium (140 ± 3.2) mmol/L (range: 130–144 mmol/L) ($P > 0.05$). No patients showed any evidence of fluid absorption leading to serum electrolyte abnormalities at the time of the operation. The mean urethral catheter drainage time was (1.6 ± 0.8) d (range: 0–8 d). For 48 patients (62.3%) the Foley catheter was removed the second morning following surgery, whereas

8 patients (9.4%) did not require catheterization at all. Catheter irrigation was required postoperatively by 26 of the 77 catheterized patients (30.6%).

3.2 Postoperation follow-up

Significant clinical improvement compared to baseline levels was noted in all cases, as shown in Table 1. The vast majority of patients were satisfied with their voiding outcome. IPSS and QoL decreased from 29.6 ± 5.4 and 5.4 ± 0.6 to 9.5 ± 2.6 and 1.3 ± 0.6 , respectively. Qmax increased to 17.8 mL/s and PVR decreased to 55.6 mL. These results are significantly different from preoperative data ($P < 0.05$).

Despite the poor medical disposition in these patients at high risk, none of the patients have complained of any significant perioperative complication. There were few complications and very high patient satisfaction after operation. Postoperative mild transient urinary tract irritation, including urgency, frequency and mild dysuria, were experienced by 39 patients (45.8%) within 2 weeks of the operation, which resolved without medical intervention. Mild to moderate delayed gross hematuria was noted in two patients (2.4%), one patient was treated successfully with short-term catheterization because of clot retention, and the other patients were generally transient and clinically insignificant. No other surgery related complications, such as urinary incontinence or impotence, developed throughout the mean follow-up period of 12 months.

4 Discussion

BPH is one of the most common diseases in middle-aged and elderly men, with as many as 75% of men older than 50 years experiencing some lower urinary tract

Table 1. Preoperative and postoperative assessment of patients with benign prostatic hyperplasia (BPH) treated with photoselective vaporization of the prostate (PVP). All postoperative values were statistically different from the baseline measurements. IPSS, the international prostate symptom score; QoL, quality of life score; Qmax, maximal urinary flow rate; PVR, post-void residual urine volume.

	baseline	6 months	12 months
Number of points	85	74	68
IPSS	29.6 ± 5.4	9.5 ± 2.6	8.7 ± 3.2
QoL	5.4 ± 0.6	1.3 ± 0.6	1.3 ± 0.7
Qmax (mL/s)	5.5 ± 2.6	17.8 ± 3.4	20.5 ± 6.4
PVR (mL)	165.0 ± 21.5	55.6 ± 8.6	43.8 ± 4.3

symptoms suggestive of BPH [5]. For many decades, open prostatectomy and TURP were the two most common surgical treatments for patients with BPH. Despite TURP currently being the gold standard method for the treatment of BPH, it can cause immediate and postoperative morbidity, such as a hemorrhage requiring blood transfusion, and the risk of dilutional hyponatremia (transurethral resection syndrome). Considering the relatively high rate of complications of TURP, alternative procedures might be more appropriate for the aged and patients at high risk. Because conventional TURP failed to provide acceptable safety in high-risk symptomatic patients, recently, several less invasive transurethral laser prostatectomy have become available; for example, holmium laser enucleation [6] and PVP [7]. Several studies show an excellent safety profile for these procedures, with clinical efficacy parameters similar to those of traditional TURP [8]. The early clinical experience with PVP provided preliminary evidence of significant improvement in treating symptomatic BPH, which was similar to that for patients undergoing TURP [9]. Based on these findings, we consider that the most recently-developed PVP promises to become one of the most commonly used minimally invasive techniques for high risk patients and for those on anticoagulant therapy.

The major advantage of PVP is the virtually bloodless tissue ablation. In our series, the mean bleeding loss was (56.8 ± 14.3) mL. Mean preoperative and postoperative hemoglobin was (143.0 ± 11.5) g/L and (139.0 ± 10.5) g/L ($P > 0.05$). No clinically significant bleeding was noted that required transfusion or resulted in a significant decrease in hemoglobin [10]. With the use of the KTP laser, heat is concentrated into a small volume. The optical properties and absorption characteristics of the 532 nm KTP frequency wavelength provide favorable parameters for BPH treatment [11]. Laser energy at a wavelength of 532 nm is selectively absorbed by oxyhemoglobin but less so by water, and lyses the tissue by rapidly vaporizing cellular water, leaving only a 2-mm rim of coagulated tissue. Histological examinations revealed larger coagulation zones for the PVP group compared to conventional TURP tissue resection [12]. On the basis of these findings and previous favorable experiences with the PVP, we consider high-risk patients with severe systemic medical problems to be candidates for this surgical treatment.

The short indwelling catheterization, for less than 2 d after the operation, is also a significant advantage

[13]. The decision to leave patients catheter-free was subject to surgeon discretion and it was based on a combination of factors, such as prostate size, hemostasis during surgery and bladder function. To date, the outcome of the PVP offers the patients an outpatient modality with clinical outcomes similar to those of TUR with short catheterization time and greater safety [14].

Our current clinical experience with the PVP procedure seems to perform well with sacral canal anesthesia, and its specific merits provide safe and immediate symptomatic relief for patients with bladder outlet obstruction as a result of BPH. Clinical improvement was significantly noted in all cases compared to baseline levels. For example, Qmax increased to 17.8 mL/s postoperatively. The outcome of PVP has been gratifying, with significant reduction in symptoms, increase in flow rate, diminution of residual urine and a low incidence of postoperative discomfort [15]. The procedure is safe, essentially bloodless, not accompanied by fluid absorption and performed on an outpatient basis. Therefore, it is particularly suited for patients at high risk, such as those with severe cardiac or pulmonary comorbidities.

The PVP is associated with a favorable safety profile for anticoagulated patients or patients in exceptionally poor medical condition. Contrary to other so-called minimally invasive surgical alternatives, the PVP is a truly ablative technique. Higher power output and laser energy delivery would lead to a deeper evaporation cavity and coagulation necrosis, and the PVP would generate a TURP-like cavity with excellent and immediate relief of obstructive voiding [16].

Complications with PVP have been relatively scarce. The rate of postoperative irritative voiding symptoms in our study was 45.8%. Irritative voiding symptoms might be caused by necrotic prostatic tissue, edema of the prostatic urethra, infection, and perhaps, most importantly, incomplete ablation of prostatic tissue. The other disadvantage of PVP is that it cannot provide tissue for diagnostic examination to exclude patients with prostate cancer. Therefore, using DRE, TRUS and PSA measurements, the patients were evaluated before the PVP procedure [17].

Although delayed mild to moderate gross hematuria has been noted in two patients (2.4%), hemorrhage was less than that with standard TURP; no serious postoperative bleeding occurred, and no blood transfusion was required in our group. Because the laser has the thermal coagulation and deep penetration effect on prostatic

tissue, careful electrocoagulation should be performed because large vessels are in the area close to the capsule. Strenuous physical activity should be prohibited postoperatively to decrease delayed hematuria.

No TURP syndrome and serum electrolyte disturbances was detected, because isotonic saline solutions are used for irrigation. The tissue is efficiently coagulated, fluid absorption is negligible, minimizing the development of dilutional hyponatremia [18]. Most importantly, that venous sinus damage is rare with PVP therapy reduces risk of morbidity.

5 Conclusion

The results of the present study show that PVP has the advantage of virtually bloodless, clear visualization, instant ablation of prostatic tissue. When the patient's medical condition precludes open prostatectomy or using the TURP procedure, PVP might be considered as an ideal procedure; for example, for these patients with heart disease who have severe lower urinary tract symptoms as a result of BPH. PVP is emerging as a safe, effective, easy to learn, rapid outpatient surgical procedure for the treatment of patients at high risk. However, further evaluation is needed, with larger randomized clinical trials and more follow-up data, to determine its long-term efficacy and to reveal its durability and limitations.

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