Photoselective Vaporization of the Prostate: Initial Experience with a New 80 W KTP Laser for the Treatment of Benign Prostatic Hyperplasia

MAHMOOD A. HAI, M.D.,1 and REZA S. MALEK, M.D.2

ABSTRACT

Purpose: To study the safety and efficacy of a new high-power potassium–titanyl-phosphate laser (KTP/532; Niagara PV™ laser system; Laserscope, San Jose, CA) for transurethral photoselective vaporization of benign obstructive prostate tissue.

Patients and Methods: The KTP/532 laser energy at 80 W was delivered by a 6F side-firing fiber through a 23F continuous-flow cystoscope. Photoselective vaporization of the prostate (PVP) using sterile water irrigation was performed under spinal anesthesia on an outpatient basis in 10 patients with a preoperative mean prostate volume of 41.3 ± 18.5 cc (range 24–76.3 cc). The mean lasing time was 19.8 ± 4.9 minutes.

Results: Two patients experienced 1 to 7 days of mild dysuria, and one who was taking warfarin had mild transient hematuria, but none had urinary retention or other complications. The mean catheterization time was 17.2 ± 9.6 hours (range 0–28 hours). At 1 year, the outcomes, which had showed significant improvement sustained throughout the follow-up, were as follows: mean American Urological Association Symptom Score decreased from 23.2 ± 4.7 to 2.6 ± 0.5 (88.8%), the mean quality of life score improved from 4.3 ± 0.7 to 0.4 ± 0.5 (90.7%), the mean peak urinary flow rate increased from 10.3 ± 1.4 mL/sec to 30.7 ± 5.8 mL/sec (198.1%), and the mean postvoiding residual volume decreased from 137.6 ± 112.2 mL to 3.0 ± 4.8 mL (97.8%). The mean prostate volume decreased by 27%.

Conclusions: This pilot study indicates that PVP with the new 80 W KTP/532 laser is a simple, safe, and efficacious outpatient procedure for the treatment of obstructive BPH.

INTRODUCTION

Benign Prostatic Hyperplasia (BPH) and its obstructive sequelae are commonly experienced by men over age 50. During the last decade, there has been an eruption of research and development in an attempt to discover less-invasive alternatives to standard transurethral resection of the prostate (TURP) for treatment of obstructive BPH. Despite its prevalence and its gold standard appeal, TURP is costly and associated with some morbidity.1–3 Over the years, various laser therapies have been investigated as alternatives to TURP. Although initially greeted as major advancements in treatment, most laser therapies fell into disfavor or failed to attract urologic practitioners because of the prolonged postoperative irritative symptoms, urinary retention, or user unfriendliness. A recent study by Malek and associates4 showed that high-power potassium–titanyl-phosphate (KTP) laser vaporization prostatectomy was user friendly and patient friendly and compared favorably with TURP in terms of complications and objective and subjective outcomes. That study utilized a prototype continuous-wave KTP laser with a maximum power of 60 W whose 532-nm wavelength is selectively absorbed by hemoglobin, thus confining thermal energy to a small volume of superficial prostatic tissue, which is vaporized rapidly and hemostatically with only a 1- to 2-mm rim of coagulation, hence the term “photoselective vaporization of the prostate” (PVP). However, despite the technical simplicity, there was a size limitation on the prostate glands treated (generally in the 60-cc range) because of the less than ideal speed of vaporization at 60 W. On the basis of these findings and to improve the speed...
of vaporization, a StarPulse™ quasi-continuous-wave KTP/532 laser (Niagara PVTM, Laserscope, San Jose, CA) was developed that emits an average power of 80 W and a peak power of 280 W. A pilot study using the 80 W laser is the subject of this report.

**PATIENTS AND METHODS**

*Patient selection*

This study was approved by the Institutional Review Board of Oakwood Annapolis Hospital. Ten men with a mean age of 64.1 ± 7.6 years (range 58–73 years) having symptomatic BPH were studied. All patients had a thorough medical history taken and underwent physical examination. Questionnaires, namely, the American Urological Association (AUA) Symptom Score and quality of life (QoL) score, were completed by all patients in the study. The QoL score consisted of one question that quantitatively measured the extent of the decrease in patient QoL as a result of BPH symptoms. It uses a 6-point scale, 6 being the worst possible condition. Patients also were asked postoperatively if they had experienced any deterioration in their erectile function. Urodynamic investigation consisted of uroflowmetry with peak urinary flow rate (Q_{max}) and measurement of postvoiding residual volume (PVR) by ultrasonography. The size and the appearance of the prostate as well as status of the bladder were determined by transrectal ultrasonography and cystoscopy, respectively. The preoperative prostate volumes, as measured by ultrasonography, ranged from 24 to 76.3 cc (mean 41.37 ± 18.5 cc). Laboratory evaluations included a complete blood cell count, serum chemistry, serum prostate specific antigen (PSA), and urine culture. Patients were included in the study if they presented with moderate to severe lower urinary tract symptoms (LUTS) as determined by a standardized AUA Symptom Score of ≥12; a Q_{max} of ≥12 mL/sec with a voided volume of ≥125 mL; and a PVR of ≤350 mL. Transrectal ultrasonography of the prostate was repeated at 3, 6, and 12 months after treatment to determine tissue volume reduction. The criteria for exclusion from the study were urinary retention, urethral strictures, bladder neck contracture, neurogenic bladder, urinary tract infection, and prostate cancer. All subjects were surgical candidates for TURP, and none had undergone any open surgical or minimally invasive therapy of their prostates.

*Operative technique*

The men underwent PVP under spinal anesthesia. Vaporization of the prostate was performed with the LaserscopeADD (Angled Delivery Device) side-firing fiber, which is a 600-μm bare fiber with a quartz capsule over a 70° lateral deflecting quartz element and a beam diameter of 1.2 mm at a distance of 2 mm. The laser fiber was introduced through the lumen of a standard 23F continuous-flow laser cystoscope, and sterile water was used as irrigant. Laser power of 80 W, generated by a StarPulse KTP/532 laser, was used in all patients. Lasing time ranged from 14 to 28 minutes (mean 19.8 ± 4.9 minutes). The total applied laser energy ranged from 44 to 102 kJ, with a mean of 68 ± 22 kJ. Laser vaporization was performed under direct vision using a free-beam technique, holding the laser fiber 1 to 2 mm away from the tissue and vaporizing the lateral lobes beginning at the bladder neck. The laser beam was moved slowly along the breadth and length of each lateral lobe as the tissue was immediately vaporized. The laser was carefully directed toward the apical tissue, making sure to protect the external sphincter. Both lateral lobes were vaporized evenly to the level of the capsular fibers. The median lobe was vaporized evenly to the level of the transverse fibers of the vesicle neck. If the median lobe was too large, it was partially vaporized before ablation of the lateral lobes to facilitate the movement of the cystoscope and irrigation, and the remainder was flattened out later during the procedure. The distal crista urethralis and the verumontanum were preserved. The endpoint of the procedure was determined by the size and appearance of the large transurethral resection-like cavity and by the diminished efficacy of the vaporization effect at the prostatic capsule. The capsular fibers were easily observable at the end of the procedure.

Once the procedure was complete, the cystoscope was removed and a 22F/5-mL Foley catheter was inserted at physician discretion. All 10 patients were treated as outpatients and sent home with a 10-day course of antibiotics. All patients were followed at 10 days and 1, 3, 6, and 12 months postoperatively.

**RESULTS**

There was no arterial bleeding during any of the procedures. The occasional minor venous bleeder were readily coagulated by defocusing the laser beam (increasing the distance). None of the patients required catheter irrigation or blood transfusion. All patients had normal renal function and none displayed any clinical evidence of intraoperative fluid absorption. Preoperative and immediate postoperative serum sodium concentrations were within the normal range in all patients and ranged from 134 to 142 mEq/L and from 134 to 140 mEq/L, respectively. Only one patient, who was on anticoagulant therapy (warfarin), experienced mild transient hematuria immediately postoperatively, which necessitated recatheterization; his urine cleared in 28 hours. In eight patients, including the one on warfarin, indwelling catheters were removed 18 to 28 hours postoperatively. The remaining two patients did not require catheterization at all, resulting in a mean catheterization time of 17.2 ± 9.6 hours (range 0–28 hours) for the full cohort. The decision to leave these two patients catheter free was subjective and based on a combination of factors such as the small to average size of the prostate (≤40 cc), low PVR, bloodless outcome, and absence of comorbidity or advanced age, which could slow postoperative recovery. Both patients voided satisfactorily in the recovery room and were sent home without catheterization.

All 10 patients completed each of the required follow-up examinations at 1, 3, 6, and 12 months. Preoperative and up to 1 year postoperative observations on symptomatic and urodynamic outcomes, mean prostate volumes, and PSA values are summarized in Table 1. Postoperative complications included mild transient dysuria for 1 to 7 days in two patients; it resolved without therapy. None of the patients experienced postoperative urinary retention, infection, incontinence, or onset of erectile dysfunction. Additionally, none of the patients developed...
KTP LASER PROSTATECTOMY

### DISCUSSION

All lasers do not interact with tissue the same way and thus do not share the same therapeutic technique or outcome. In the early 1990s, visual laser ablation of the prostate (VLAP) utilizing Nd:YAG laser coagulation was introduced. The results of VLAP were less than favorable because of a high incidence of postoperative dysuria and urinary retention. Application of the Ho:YAG laser for treatment of BPH dates back to 1995. Holmium laser enucleation of the prostate (HoLEP) takes advantage of the cutting capabilities of this laser wavelength. Although the outcomes of HoLEP are similar to those of TURP, HoLEP is lengthy and is associated with a steep learning curve. Previous experiences with 60 W KTP/532 laser PVP, dating back to 1998, demonstrated relatively easy technique, impressive subjective and objective outcomes, and a low rate of complications. However, the vaporization efficiency, reflected in the length of the procedure, needed improvement so that all “TUR-able” prostates could be treated. The current study shows that by increasing the average laser power to 80 W and by applying StarPulse technology generating a peak power of 280 W, the goal of a faster and more efficient vaporization has been achieved. The outcomes remain as favorable as those in the earlier larger study with the 60 W KTP/532 laser. The PVP procedure, which uses a highly hemostatic wavelength, is nearly bloodless and is not accompanied by any clinical or hypotensive evidence of fluid absorption. Moreover, the procedure does not have a steep learning curve. Technically, in many ways, this procedure mimics the standard TURP. The PVP technique utilizes the same landmarks as those in TURP for precise tissue removal using localized and shallow tissue vaporization that results in a similar debulking of the adenoma, as evidenced by the postoperative reduction of the volume of the prostate and PSA values by 30% and 40%, respectively (see Table 1). Additionally, PVP offers such advantages as outpatient status, less than 24-hour catheterization time or, indeed, no catheter drainage at all in some patients (2 of the 10 patients in this series), little or no bleeding, relatively short treatment times (depending on gland size), and the ability of patients to get back to normal activities and work in 2 to 3 days. Furthermore, all 10 patients in this series have remained very satisfied with their treatment outcomes to date with more than 90% improvement in QoL score at 1 year. As more data on this tech-

### TABLE 1. OUTCOMES OF PVP IN 10 PATIENTS

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<thead>
<tr>
<th></th>
<th>Preop.</th>
<th>1 month</th>
<th>3 months</th>
<th>6 months</th>
<th>12 months</th>
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<tbody>
<tr>
<td><strong>AUA Symptom Score</strong></td>
<td></td>
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<td></td>
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<tr>
<td>Mean ± SD</td>
<td>23.2 ± 4.7</td>
<td>6.4 ± 2.6</td>
<td>5.3 ± 1.8</td>
<td>3.4 ± 1.2</td>
<td>2.6 ± 0.5</td>
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<tr>
<td><strong>QoL score</strong></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Mean ± SD</td>
<td>4.3 ± 0.7</td>
<td>1.6 ± 0.5</td>
<td>0.78 ± 0.6</td>
<td>0.40 ± 0.5</td>
<td>0.40 ± 0.5</td>
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<tr>
<td><strong>Qmax (mL/sec)</strong></td>
<td>10.3 ± 1.4</td>
<td>22 ± 5.8</td>
<td>25.6 ± 6.3</td>
<td>29.4 ± 6.1</td>
<td>30.7 ± 5.8</td>
</tr>
<tr>
<td>Range</td>
<td>5.3–11.5</td>
<td>12.5–32.8</td>
<td>18.5–38.3</td>
<td>21.2–40.8</td>
<td>21.9–31.3</td>
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<tr>
<td><strong>PVR (mL)</strong></td>
<td>137.6 ± 112</td>
<td>20.4 ± 25.1</td>
<td>5.4 ± 8.3</td>
<td>4.0 ± 6.6</td>
<td>3.0 ± 4.8</td>
</tr>
<tr>
<td>Range</td>
<td>30–344</td>
<td>0–68</td>
<td>0–24</td>
<td>0–20</td>
<td>0–15</td>
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<tr>
<td><strong>Prostate volume (cc)</strong></td>
<td>41.4 ± 18.5</td>
<td>N/D</td>
<td>24.8 ± 7.4</td>
<td>29.4 ± 15.4</td>
<td>30.3 ± 14.6</td>
</tr>
<tr>
<td>Range</td>
<td>24–76.3</td>
<td>N/D</td>
<td>20.5–50.4</td>
<td>17.1–62.4</td>
<td>19.6–64.2</td>
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<tr>
<td><strong>PSA (ng/mL)</strong></td>
<td>3.3 ± 4.7</td>
<td>2.2 ± 2.6</td>
<td>1.9 ± 2.6</td>
<td>1.8 ± 2.4</td>
<td>1.9 ± 2.4</td>
</tr>
<tr>
<td>Range</td>
<td>0.3–15.5</td>
<td>0.3–8.1</td>
<td>0.2–7.7</td>
<td>0.2–7.3</td>
<td>0.2–7.2</td>
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N/D = not done.
CONCLUSIONS

Photoselective vaporization of the prostate with the 80 W StarPulse KTP/532 laser appears to offer a safe, easy, effective, and, relative to the older 60 W continuous-wave laser, more rapid outpatient surgical procedure for the treatment of BPH. Our 1-year pilot study shows significant sustained improvement in subjective and objective outcomes. To date, the results have been extremely encouraging, with minimal postoperative discomfort and a low rate of complications. Despite these early promising results, longer follow-up and a larger cohort of patients are needed to further validate this technique. Currently, a multicenter study is in progress.

REFERENCES


Address reprint requests to:
Mahmood A. Hai, M.D.
Cherry Hill Medical Center
33545 Cherry Hill Road
Westland, MI 48185