Vaporization of the Prostate with 150-W Thulium Laser: Complications with 6-Month Follow-Up

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Abstract

Purpose: To analyze the efficacy and safety of vaporization of the prostate (VP) with the 150-W thulium:yttrium-aluminum-garnet (Tm:YAG) laser.

Patients and Methods: In a prospective series of 55 patients with small- and medium-size prostates undergoing major outpatient surgery (MOS), the primary objectives were to analyze changes in maximum flow (Qmax) and International Prostate Symptom Score (IPSS) after 6 months. Immediate (<30 days) and late (>30 days) complications were subsequently recorded.

Results: An increase in mean Qmax of 9.33 mL/s (95% confidence interval [CI] of the mean difference 6.73–11.93; \( P < 0.001 \)) was recorded, and mean IPSS was reduced by 16.88 points (95% CI 14.22–19.54; \( P < 0.001 \)). The immediate complications recorded were acute urinary retention (one patient), urinary tract infection without fever (two patients), and macroscopic hematuria (two patients). The only late complication observed was bladder neck sclerosis (one patient).

Conclusion: After 6 months, VP with 150-W Tm:YAG presents promising results in the clinical improvement of patients with small- and medium-size prostates. Its complication rate is low and it offers excellent hemostasis. The data from our study provide the basis for the design of clinical trials to compare this technique with other procedures.

Introduction

The use of lasers in urology was based in the neodymium-yttrium-aluminum-garnet laser\(^ 1 \) in the beginning. Vaporization of the prostate (VP) with potassium-titanyl-phosphate (KTP) laser was first reported in 1998\(^ 2 \). Two meta-analyses have recently been published comparing the functional results of transurethral resection of the prostate (TURP) with those of VP with 80-W KTP and 120-W lithium borate (LBO) lasers\(^ 3,4 \). These outcomes were achieved with a shorter catheterization time, shorter hospital stay, and fewer complications (bleeding, need for transfusion, and clot retention).

Other types of laser that reproduce the same vaporization technique have been developed. These include the thulium:yttrium-aluminum-garnet (Tm:YAG) laser that, because of its physical properties (wavelength and continuous laser energy emitting mode), combines the best features for performing VP techniques. Only one study on VP with Tm:YAG has been published to date\(^ 5 \), although its conclusions are limited because the results of two surgical procedures (vaporization and vapo-resection) are presented together. No clinical trials comparing VP using Tm:YAG with other techniques have been published.

The objective of this study was to assess the functional results and complications obtained after VP with 150-W Tm:YAG.

Patients and Methods

A prospective clinical case series was performed using VP with 150-W Tm:YAG on 55 patients on a major outpatient surgery (MOS) basis between January 2011 and December 2012.

The inclusion criteria were prostate volume (abdominal ultrasonography) < 80 cc, International Prostate Symptom Score (IPSS) > 16, and maximum flow rate (Qmax) < 15 mL/s.

The exclusion criteria were serum prostate-specific antigen (PSA) value > 10 ng/mL, suspicious digital rectal examination, history of urethral stricture or prostate surgery, bladder calculus, neurogenic bladder dysfunction, anticoagulant treatment, and American Society of Anesthesiologists score of IV or higher.

The primary study objectives were to assess functional outcomes after 6 months measured with Qmax and IPSS, and to record possible immediate- and late-onset complications. These complications were reported following the recommendations of the European Association of Urology\(^ 6 \), and the modified Clavien-Dindo classification was used\(^ 7 \).

In addition to the patients’ baseline demographic characteristics, the variables analyzed were duration of surgery and laser use (minutes), amount of energy used (kilojoules), and
bladder catheter removal date. In patients with a bladder catheter at the time of surgery, the last flowmetry, postvoid residual volume, and IPSS performed before presenting urinary retention were recorded.

Surgical technique

The procedures were performed by four different urologists, all experienced in TURP and photovaporization of the prostate with LBO.

Patients were operated on under epidural anesthesia. A 150-W Tm:YAG laser in continuous energy emitting mode was used (Quanta System, Italy; Coupler Medical, Spain). Application was performed with a 23F continuous flow cystoscope (Karl Storz, Germany) and a 600-μm side-firing laser fiber with numerical aperture of 0.32. The VP was performed from the basal to the apical area with 0.9% saline irrigation. The procedure began at 80-W.

In the first phase of the surgery, the bladder neck was opened and the median lobe resected. The lateral lobes were then resected until a working channel was created in the prostate. This provided a good irrigation flow to displace the bubbles generated by the vaporization, facilitating vision. A power of 120- to 150-W was used from then on, completing vaporization of the median and lateral lobes. When hemostasis of a specific point was necessary, work proceeded on this area at 40-W. At the end of surgery, a three-way 20F silicone urethral catheter was inserted, and continuous bladder irrigation with saline was maintained.

Patients were discharged the same day of surgery with the urethral catheter, which was scheduled for removal 48 hours later. Treatment was prescribed with tamsulosin 0.4 mg/24 hours and solifenacin 5 mg/24 hours for 4 weeks in combination with diclofenac 50 mg/8 hours for the first 5 days.

Follow-up

Immediate complications were assessed after 1 month. Qmax, IPSS, and late complications were assessed after 6 months. The data were collected in a personal interview with each patient, conducted by one of the team physicians.

Statistical analysis

In the descriptive analysis of the quantitative variables, the mean and the standard deviation was used. The absolute frequencies were considered for the qualitative variables. The quantitative variables were analyzed using the Student t test if they followed normal distribution and with the nonparametric Mann-Whitney U test if they did not fulfill the assumption of normality. For all the tests used to contrast the null hypothesis, P value was <0.05. The analysis was performed using SPSS statistical package version 17 for Windows (IBM Corp).

Results

Baseline and perioperative characteristics

Table 1 describes the baseline and perioperative characteristics of the 55 patients. Fifteen (27.3%) of these patients were receiving antiplatelet treatment and eight (14.5%) had bladder catheters at the time of surgery because of acute urinary retention.

Table 1. Baseline and Perioperative Characteristics (n=55 Patients)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>69.41</td>
<td>9.19</td>
</tr>
<tr>
<td>Prostate volume (cc)</td>
<td>42.53</td>
<td>17.41</td>
</tr>
<tr>
<td>PVR (mL)</td>
<td>97.11</td>
<td>91.26</td>
</tr>
<tr>
<td>PSA (ng/dL)</td>
<td>2.27</td>
<td>1.72</td>
</tr>
<tr>
<td>Qmax (mL/s)</td>
<td>8.92</td>
<td>3.04</td>
</tr>
<tr>
<td>IPSS</td>
<td>25.60</td>
<td>4.54</td>
</tr>
<tr>
<td>Operative time (min)</td>
<td>51.62</td>
<td>19.76</td>
</tr>
<tr>
<td>Laser time (min)</td>
<td>22.84</td>
<td>9.80</td>
</tr>
<tr>
<td>Energy (kilojoules)</td>
<td>177.98</td>
<td>84.59</td>
</tr>
</tbody>
</table>

PVR = postvoid residual; PSA = prostate-specific antigen; Qmax = maximum flow rate; IPSS = International Prostate Symptom Score.

No intraoperative complications were recorded. In all cases, bladder irrigation was removed between 3 and 5 hours after the end of vaporization. All patients were discharged on the day of surgery with the urethral catheter (hospital stay less than 8 hours), which was removed 2 days later in all cases.

First follow-up visit (first month)

All patients attended this control. Five (9.1%) patients had presented some type of early complication (<30 days). Table 2 shows these complications, detailing their definition and classification according to the modified Clavien-Dindo classification. None of the patients with hematuria were receiving antiplatelet treatment or required surgical revision or blood transfusion.

Second follow-up visit (sixth month)

Fifty-two patients were assessed, because three were lost to follow-up. Table 3 specifies these late complications, detailing their definition and classification according to the modified Clavien-Dindo classification.

An increase in mean Qmax of 9.33 mL/s was recorded in the remaining 52 patients, which constitutes a change of 104.6% with regard to the initial recording. Mean postoperative IPSS was reduced by 16.88 points (67.5%). Table 4 shows the functional results. Seven (13.5%) of these 52 patients needed treatment with anticholinergics because of the presence of irritative lower urinary tract symptoms (LUTS).

Table 2. Early Complications (<30 Days, n=55 Patients)

<table>
<thead>
<tr>
<th>Complication</th>
<th>n (%)</th>
<th>Management</th>
<th>Clavien modified classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUR</td>
<td>1 (1.8%)</td>
<td>Catheterization</td>
<td>I</td>
</tr>
<tr>
<td>Hematuria</td>
<td>2 (3.6%)</td>
<td>Catheterization and</td>
<td>I</td>
</tr>
<tr>
<td>Nonfebrile UTI</td>
<td>2 (3.6%)</td>
<td>Antibiotics</td>
<td>II</td>
</tr>
</tbody>
</table>

Irritative LUTS with positive urine culture. Hematuria: Macroscopic hematuria necessitating catheterization and bladder irrigation. AUR = acute urinary retention (>500 mL after catheterization); UTI = urinary tract infection.
Only one article analyzing the clinical outcomes obtained with this technique has been published, however.\textsuperscript{5} This study describes the results after performing VP with 70-W Tm:YAG (Revolix) on 99 patients with prostates smaller than 35 cc. These results were presented together with those obtained after vaporization performed on 101 patients with larger prostate volumes. Overall, a 50% improvement in the IPSS score was achieved. Because the results obtained with two different techniques were presented jointly, the specific results of VP with Tm:YAG cannot be assessed. Other different thulium laser technical approaches have been described, such as resection and enucleation of the prostate. None has been evaluated at the 150-W energy level.

Our study is the first to analyze the outcomes of VP with 150-W Tm:YAG. In patients with a mean prostate volume of 43.5 cc, we recorded an improvement of 9.33 mL/s in the mean Q\textsubscript{max} and a reduction of 16.88 points in the mean IPSS. There are no clinical trials comparing the results obtained after VP using Tm:YAG with other techniques, although the results were quantitatively similar to those described in clinical trials analyzing VP performed with KTP, LBO, or Ho:YAG (Table 5).

The short-term VP complication rate with Tm:YAG was similar to the rate described after VP with other laser systems\textsuperscript{13–19} and less than that with TURP. Reich and associates\textsuperscript{20} specified a rate of acute urinary retention of 5.8% for TURP and bleeding necessitating transfusion of 2.9%. The safety of VP with Tm:YAG allows it to be performed as a MOS procedure.

In our series, 13.7% of the patients remained on anticholinergic treatment, complaining of irritative LUTS 6 months after vaporization. Because of the study characteristics, it is impossible to ascertain whether the symptoms were de novo or existed before the surgery. The possible role of the bladder in irritative LUTS in men must be considered. It is estimated that approximately 35% of patients presenting with obstructive LUTS may report concomitant irritative symptoms\textsuperscript{21}. Moreover, up to one-third of patients undergoing prostatectomy may present with urgency symptoms up to 11 months postsurgery.\textsuperscript{22} Pereira-Correia and colleagues\textsuperscript{13} described the appearance of urge urinary incontinence not associated with detrusor hyperactivity in 50% of patients who underwent VP with 120-W LBO, which remitted in the subsequent 3 to 12 months. A smaller coagulated tissue area has been described with Tm:YAG (0.4 mm)\textsuperscript{10} than with LBO (0.84 mm) in ex-vivo models.\textsuperscript{15} It would be interesting to determine whether these differences at tissue level involve changes in the incidence of dysuria and/or irritative LUTS.

The short follow-up time and lack of a comparative group for the technique are two of the limitations of our study. Because it is a quasi-experimental study, in which each subject acts as his own control, the results may be biased by

### Table 4. Results at 6 Months (n=52 Patients)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Before surgery\textsuperscript{1}</th>
<th>Follow-up 6 months\textsuperscript{2}</th>
<th>Mean difference</th>
<th>95% CI\textsuperscript{3}</th>
<th>P\textsuperscript{4}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q\textsubscript{max} (mL/s)</td>
<td>8.92 (3.04)</td>
<td>18.26 (8.24)</td>
<td>9.33</td>
<td>6.73 to 11.93</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>IPSS</td>
<td>25.00 (4.54)</td>
<td>8.12 (6.63)</td>
<td>16.88</td>
<td>14.22 to 19.54</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

\textsuperscript{1,2}Mean, standard deviation in parentheses.

\textsuperscript{3}95% confidence interval (CI): 95% confidence interval of the mean difference.

\textsuperscript{4}Statistical significance.

Q\textsubscript{max} = maximum flow rate.
regression to the mean phenomena. In any case, the intense improvement observed renders it unlikely that the change is because of nonsurgery-related phenomena. Another limitation is the lack of observer and analyst blinding techniques.

Conclusions

VP with 150-W Tm:YAG presents promising results in the clinical improvement of patients with small- and medium-size prostates after 6 months. Its complication rate is low, and it offers excellent hemostasis. The process is safe, enabling it to be performed as MOS. The data from our study could form the basis for the design of studies to compare this technique with other surgical procedures.

Disclosure Statement

No competing financial interests exist.

References


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Abbreviations Used
Ho:YAG = holmium:yttrium-aluminum-garnet laser
IPSS = International Prostate Symptom Score
KTP = potassium-titanyl-phosphate laser
LBO = lithium borate
LUTS = lower urinary tract symptoms
MOS = major outpatient surgery
PSA = prostate-specific antigen
Q_{max} = maximum flow rate
Tm:YAG = thulium: laser
TURP = transurethral resection of the prostate
VP = vaporization of the prostate