ORIGINAL ARTICLE

Analysis of predictive factors of success for prostate photovaporization in benign prostatic hyperplasia by greenlight laser

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Benign prostatic hyperplasia; Greenlight laser; Predictive success factors

Abstract
Objective: To conduct a descriptive study of the implementation of greenlight laser photovaporization in a local hospital and to identify the ideal preoperative and intraoperative conditions to obtain a successful outcome.

Materials and methods: A retrospective review of 179 photovaporizations performed between January 2007 and June 2010 was performed. Preoperative data (age, prostate volume, PSA, IPSS, $Q_{\text{max}}$, medical history, ASA classification), intraoperative parameters (surgeon’s experience, operating time, transfusion requirements, type of laser used, reconversion to transurethral resection of the prostate or TURP) and post-operative data (post-op complications, post-op PSA, post-op IPS score, post-op $Q_{\text{max}}$ and reoperations) were analyzed.

We performed a univariate and multivariate analysis to identify which preoperative and intraoperative parameters influence therapeutic failure.

Results: The descriptive study shows similarity in all parameters compared to the available literature. In the multivariate analysis, it was found that the surgeon’s experience and prostate volume over 40 cc were independent predictive factors for success of greenlight laser photovaporization.

Conclusions: Greenlight laser photovaporization is an effective and reproducible procedure for treating lower urinary tract obstruction due to benign prostatic hyperplasia (BPH). Multicenter, prospective and randomized studies are needed to confirm the results of this study. There are few studies available in the literature that provide a high level of evidence and grade of recommendation.

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Introduction

In the historical evolution of the surgical treatment of benign prostatic hyperplasia (BPH), we can observe how minimally invasive techniques have imposed to open surgery, with a higher rate of complications.1,2

Among these techniques, prostate photovaporization with greenlight laser has shown a safe, effective option with few complications, especially useful for anticoagulated patients or with high comorbidity, due to their little bleeding and reduced probe and hospital stay.3

Since there are not many studies in the literature that evaluate the predictors of success of prostate photovaporization, we performed a descriptive study of the series of patients operated in our prostate unblocking surgery center by greenlight laser photovaporization, and we tried to determine if there are preoperative or intraoperative variables that can determine the success of unblocking surgery by means of a univariate and multivariate study.

Material and methods

We performed a retrospective review of the patients undergoing greenlight laser photovaporization. The energy sources used were generators of potassium-titanyl-phosphate 80 W KTP (GreenLight PV, AMS) and lithium triborate HPS 120 W (GreenLight PV AMS).

We analyzed a total of 179 operations performed between January 2007 and June 2010, in which 9 surgeons were involved.

The inclusion criteria considered for the prostate photovaporization were the following:

- Maximum flow (Q
max
) < 15 ml/s.
- International Prostate Symptom Score (IPSS) > 7 or <7 with objective obstruction parameters.
- PSA < 4 or PSA > 4 ng/ml with previous negative prostate biopsy (10 cylinders).
- Ultrasound prostate volume > 30 ml.

All the patients underwent complete anamnesis including IPSS, general examination, and DRE. The study was complemented by urological ultrasound and PSA.

The following parameters were evaluated: surgeon’s experience, age, prostate volume, preoperative and postoperative serum PSA, IPSS preoperatively and at 3 months, flowmetry preoperatively and at 3, 6, 9, and 12 months, urological and medical history, ASA classification, surgical time, and intraoperative complications.

We defined as success of surgery: lack of conversion to another technique, improvement in the IPSS score, and lack of reoperation (incontinence, persistent LUTS, etc.).

A descriptive analysis was performed with the variables under study. Subsequently, a univariate study was carried out determining which variables cause the success of the procedure by the Chi-square, Cramer’s V, and Fisher tests for qualitative variables, and Student’s t, Wilcoxon, and logistic regression for quantitative variables (p = 0.05). Finally, we carried out a logistic regression with the statistically significant parameters in the univariate analysis to determine independent predictors of success. The SPSS v.15 statistical package was used.
Results

Descriptive study

179 surgeries were performed in which 9 surgeons of the Department took part. The number of surgeries performed by each one ranged between 65 and 3 interventions, with a mean age of 67.97 years (66.69–69.24). The mean ultrasound volume was 45.72 cc (43.78–57.66). The mean preoperative PSA was 2.55 ng/ml (95% CI: 2.18–2.92 ng/ml). The median IPSS was 20 points, 7% of the patients showing mild symptoms, 45.7% moderate symptoms, and 53% severe symptoms. The included patients with mild IPSS present objective signs of infravesical obstruction, such as very low $Q_{\text{max}}$, high postvoid residual, bladder stones, or associated urinary tract infections. The mean preoperative $Q_{\text{max}}$ was 7.39 (6.94–7.84) and had a postoperative evolution at 3, 6, 9, and 12 months as shown in Table 1 and Fig. 1.

The median postvoid residual was 172.55 cc. The distribution according to the ASA classification was: I (5%), II (60.3%), III (31.8), and IV (2.8%). The median follow-up was 9 months (4–32 months).

The intraoperative, postoperative, and follow-up parameters are described in Table 2. According to the definition of treatment failure raised in the methodology, in 30 cases (16.8%) the result was not satisfactory (Table 3).

### Table 1: Preoperative and intraoperative data.

<table>
<thead>
<tr>
<th>Surgical time (min)</th>
<th>48.11 (45.8–50.41)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intraoperative</td>
<td></td>
</tr>
<tr>
<td>complications</td>
<td></td>
</tr>
<tr>
<td>Reconversion (6.1%)</td>
<td></td>
</tr>
<tr>
<td>Perforation (2.5%)</td>
<td></td>
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<tr>
<td>Cardiovascular c. (0.5%)</td>
<td></td>
</tr>
<tr>
<td>Total (9%)</td>
<td></td>
</tr>
<tr>
<td>Days of stay (median)</td>
<td>1 (range = 5)</td>
</tr>
<tr>
<td>Probing days (median)</td>
<td>1 (range = 29)</td>
</tr>
<tr>
<td>Postoperative</td>
<td></td>
</tr>
<tr>
<td>complications</td>
<td></td>
</tr>
<tr>
<td>AUR (8.3%)</td>
<td></td>
</tr>
<tr>
<td>Incontinence (4%)</td>
<td></td>
</tr>
<tr>
<td>Irritative syndrome (12%)</td>
<td></td>
</tr>
<tr>
<td>Hematuria (2%)</td>
<td></td>
</tr>
<tr>
<td>Urethral stenosis (0.5%)</td>
<td></td>
</tr>
<tr>
<td>Sepsis (2%)</td>
<td></td>
</tr>
<tr>
<td>Readmission</td>
<td>4 cases (0.02%): 2</td>
</tr>
<tr>
<td></td>
<td>hematuria, 2 UTI</td>
</tr>
<tr>
<td>Postoperative</td>
<td>3 months: 17 (12.26–23.09)</td>
</tr>
<tr>
<td>$Q_{\text{max}}$ ml/s</td>
<td>6 months: 8.69</td>
</tr>
<tr>
<td></td>
<td>(15.27–22.12)</td>
</tr>
<tr>
<td></td>
<td>9 months: 18.12</td>
</tr>
<tr>
<td></td>
<td>(15.73–21.40)</td>
</tr>
<tr>
<td></td>
<td>12 months: 18.35</td>
</tr>
<tr>
<td></td>
<td>(15.53–21.17)</td>
</tr>
<tr>
<td>Postoperative PSA</td>
<td>2.25 (1.34–3.16)</td>
</tr>
<tr>
<td>(median)</td>
<td>6 (range = 26)</td>
</tr>
<tr>
<td>Follow-up months</td>
<td>9 (range = 4–32)</td>
</tr>
<tr>
<td>(median)</td>
<td></td>
</tr>
</tbody>
</table>

### Figure 1: Evolution of the urinary flow. There is a statistically significant improvement between the mean preoperative $Q_{\text{max}}$ and the controls at 3, 6, 9, and 12 months after the surgery ($p < 0.001$).

### Univariate analysis

#### Experience of the surgeon

Better results were observed as the surgeon’s experience increased (logistic regression: $p = 0.02$; OR = 1.068).

#### Age of the patients

Dividing the patients into 3 age groups (<60, 60–70, and >70 years) showed no statistically significant differences in the outcome of the surgery in terms of age (V Cramer; $p = 0.985$).

#### Ultrasound volume

Better results were observed with larger prostates ($p = 0.02$; OR = 1.048).

#### Preoperative prostate specific antigen

The patients were divided into 2 groups (PSA < 4 ng/dl, and PSA > 4 ng/dl), observing statistically significant differences (Chi-square; $p = 0.032$); in the normal PSA range group, a higher success rate of the surgery (86%) was observed compared to the doubtful-pathological range group (72%).

### Preoperative International Prostate Symptom Score

The patients with mild and moderate symptoms were grouped on the one side and the patients with severe symptoms on the other side, obtaining a success rate of 87.7 and 80.7%, finding no statistically significant differences (Chi-square; $p = 0.229$).

### Urological and medical history and classification of the American Society of Anesthesiologists

An inferential study was carried out showing no differences in the success of the surgery depending on the presence or absence of relevant medical history.

### Table 2: Reasons for failure.

<table>
<thead>
<tr>
<th>Failure</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe IPSS</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>Incontinence</td>
<td>6</td>
<td>3.4</td>
</tr>
<tr>
<td>Cell sclerosis</td>
<td>6</td>
<td>3.4</td>
</tr>
<tr>
<td>Incontinence that requires sphincter</td>
<td>1</td>
<td>0.6</td>
</tr>
<tr>
<td>TUR reversion</td>
<td>1</td>
<td>0.6</td>
</tr>
<tr>
<td>BPH remains</td>
<td>3</td>
<td>1.7</td>
</tr>
<tr>
<td>Unknown</td>
<td>3</td>
<td>1.7</td>
</tr>
<tr>
<td>Hematuria</td>
<td>1</td>
<td>0.6</td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
<td>16.8</td>
</tr>
</tbody>
</table>
The absence of urological or medical history (Chi-square; $p = 0.55$ and $p=0.978$, respectively).

No differences were evidenced in the outcome of the surgery according to the ASA classification (Cramer’s V $p = 0.9$).

**Peak flow**

The peak flow did not condition the result of the surgery (logistic regression; $p = 0.191$).

**Greenlight laser used**

2 types of devices were used throughout the series. The first 86 interventions were carried out with the 80 W KTP laser, later moving to the 120 W laser, with success rates of 77.7 and 87.7%, respectively, but this difference was not statistically significant (Chi-square = 0.75). There were differences indeed in the surgical time, being significantly shorter in the 120 W group (52 [±17]) vs. 44.79 min [±13.1; $p = 0.02$], although the prostate volume was significantly higher in the 120 W group (48.18 cc [±2.7] vs. 42.6 cc [±2.61]).

**Multivariate model**

After the univariate analysis, we got 3 variables in which there were differences in the outcome between subgroups:

1. The surgeon’s experience: the greater the experience, the higher the success rate of the surgery.
2. Ultrasound volume: the larger the prostate volume, the higher the success rate of the surgery.
3. PSA: the higher the PSA level, the higher the failure rate of the surgery.

We performed a logistic regression, including the 3 variables that were statistically significant in the univariate model.

We only identified as an independent factor of success the surgeon’s experience with a 1.067 OR ($p = 0.014$). The results are shown in Table 3.

**Discussion**

The use of new technologies for the surgical treatment of BPH should be evaluated by conducting retrospective, prospective randomized studies, and subsequent meta-analyses, evaluating the safety, efficacy, and reproducibility of the processes.

The TUR and open surgery are currently considered the gold standard for prostates smaller than 80 cc and greater than 100 cc, respectively. The greenlight laser already has enough experience to be recommended for the treatment of BPH, due to its better intraoperative complication rate compared to the TUR (LE3, RG B), especially in patients at high risk of bleeding. The oldest, and therefore with more articles in the literature, is the 80 W KTP laser, and since Malek published the first results in humans in 1998, its use has been increasing. It drags the problem of the vaporization rate of the prostate tissue, significantly slower than in the TUR. In contrast, in the randomized studies comparing the 120 W laser to the TUR-P, there was no consensus; while the group of Al-Ansari observed significantly lower operative times with TUR-P, Capitan et al. found no statistically significant differences.

Only a randomized study comparing the HPS 120 W laser to open surgery, with shorter surgical times for the endourologic procedure, fewer transfusion requirements, shorter time of probe and hospital stay, without any differences in functional outcomes. We studied the vaporization rate of both lasers, noting that the HPS laser has a vaporization rate of 7.01 g/10 min versus the 3.99 g/10 min of the KTP laser. In our series, the median surgical time was 45 min, significantly shorter in the group operated with the 120 W laser for an ultrasound volume of 45.72 cc (95%CI = 43.78–57.66), within the range described in the literature, between 32 and 132 min. Our sample does not differ with respect to preoperative or intraoperative parameters ($Q_{max}$, IPSS, prostate volume, surgical time, hospital stay, and days of catheterization, transfusion requirements, etc.) compared to previous publications.

Early postoperative complications were very scarce (3%), as only 2 cases of readmission for non-tractable hematuria and 2 cases of urinary sepsis were reported, which resolved with conservative treatment.

It is worth stressing the hospital stay and probing time, which in our series showed a median of one day in both variables, and no red blood cell transfusions were required in any case, which makes photovaporization the technique of choice in patients at high surgical risk.

A total of 15 reoperations were recorded (7 cases of persistent BPH, 5 cases of cell sclerosis, and 2 cases of minimal effort incontinence that required artificial sphincter) and represent 9% of all procedures. According to the recommendations of the International Greenlight Laser Users Group (IGHLU), the long-term results are still unable to be determined due to the absence of works that support them.

In the second part of the work, which attempts to identify the determinants of a successful outcome of the photovaporization, there is no consensus in the literature. There are few studies that attempt to determine them and there is no consensus on the definition of success. In our group, strict success criteria were established (need for reconvulsion, lack of improvement in the IPSS questionnaire, and obviously need for reintervention, either due to remains of obstructive prostate tissue, or cell sclerosis or incontinence).

High surgical experience was established as a success factor. The prostate volume does not seem to be
determinant of the outcome. Gu et al. studied the impact of the prostate volume on the postoperative outcome, finding no differences in the AUA-SI, quality of life, $Q_{\text{max}}$, and postvoid residual in large prostates.\footnote{There is a study that suggests the low detrusor contractility as a risk factor of dissatisfaction.}\footnote{Unfortunately, in our protocol we have not performed a urodynamic study to evaluate this issue.} In another study, the association with postoperative irritative symptoms with low scores in the AUA-SI and treatment with finasteride was suggested.\footnote{Other risk factors for worsening of the outcomes are identified in the literature as PSA at $>6$ ng/mL,\footnote{A result which is also statistically significant in our sample in the univariate study, although it does not achieve significance in the multivariate analysis. This study also assesses the impact of the prostate volume on the outcome of the procedure. They achieve improvements in the $Q_{\text{max}}$ and AUA symptom questionnaire in all the prostate volume groups, but without differences between the groups, as seen in our study.} the results are not influenced by the laser power in our series. Now, the subgroups operated with the 80 and 120W laser are not comparable, because the experience of the surgeons and the prostate volume was greater in the 120W group.}

Conclusions

The greenlight laser photovaporization is an increasingly present technique in the Urology Departments. The technological development, with the introduction of more powerful lasers with the same safety profile, allows for this technique to be a safe procedure, with results comparable to the current gold standard, regardless of preoperative objective and subjective parameters, except for the surgical experience. They offer a clear advantage over the classical unblocking techniques in terms of operative bleeding, proving days, and hospital stay.

Prospective comparative studies that attempt to identify the predictive factors to obtain a successful outcome to ratify the results obtained in this work are required.

Conflict of interest

The authors declare that they have no conflict of interest.

References


