Usage of GreenLight HPS 180-W Laser Vapourisation for Treatment of Benign Prostatic Hyperplasia

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Introduction: Laser therapy has gained increasing acceptance as a relatively less invasive treatment for lower urinary tract symptoms (LUTS) due to benign prostatic hyperplasia (BPH). From the early procedure of interstitial laser coagulation through to the use of holmium laser enucleation of the prostate, there has been an expanding body of evidence on the efficacy of such procedures. One of the newer lasers is the Green Light HPS 180 W laser. Studies with this GreenLight laser (GLL) (American Medical Systems, Inc, Minnetonka, MN, USA) showing results as good as those of transurethral resection of the prostate (TURP). In this paper, the efficacy of the new GLL 180-W versus the gold standard TURP in patients with LUTS due to BPH was tested in a prospective clinical trial. Objective: To compare results of Green light laser (GLL) evaporation of the prostate and transurethral resection of the prostate (TURP). In this paper, the efficacy of the new GLL 180-W versus the gold standard TURP in patients with LUTS due to BPH was tested in a prospective clinical trial. Objective: To compare results of Green light laser (GLL) evaporation of the prostate and transurethral resection of the prostate (TURP) for treatment of BPH. Materials and methods: A total of 62 patients with BPH were randomly assigned to two equal groups: TURP or GLL. Results: Both groups were compared regarding all relevant preoperative, operative, and postoperative parameters. Functional results in terms of improvement of International Prostate Symptom Score (IPSS), maximum flow rate (Q\text{max}), and postvoid residual (PVR) urine were assessed at 1, 3, 6 and 12 mo. A total of 62 patients completed 12 mo of follow-up in the TURP and GLL groups, respectively. Baseline characteristics were comparable. Mean operative time was significantly shorter for TURP. Compared to preoperative values, there was significant reduction in hemoglobin levels at the end of TURP only. A significant difference in favor of GLL was achieved regarding the duration of catheterization and hospital stay. In the GLL, no major intraoperative complications were recorded and none of the patients required blood transfusion. Among TURP patients, 6 required transfusion, 1 developed TUR syndrome, and capsule perforation was observed in 5 patients. There was dramatic improvement in Q\text{max}, IPSS, and GLL compared with preoperative values and the degree of improvement was comparable in both groups at all time points of follow-up. Four TURP patients and one GLL patients developed bladder neck contracture treated by bladder neck incision; none in either group experienced urethral stricture or urinary incontinence. Conclusions: Compared to transurethral resection of the prostate, GreenLight HPS 180-W laser photoselective vaporisation of the prostate is safe and effective in the treatment of patients suffering from lower urinary tract symptoms due to benign prostatic hyperplasia.

Keywords: GreenLight laser (GLL), Benign prostatic hyperplasia, Transurethral resection of the prostate (TURP)

INTRODUCTION

Transurethral resection of the prostate (TURP) is the most common surgical intervention for benign prostatic hyperplasia (BPH), largely due to lower urinary tract symptoms refractory to medical therapy. TURP remains the gold standard for men with prostates sized 30g-80g, while open prostatectomy has been the preferred option for men with glands larger than 80g-100g and those with other lower urinary tract anomalies such as large bladder stones or bladder diverticula. Unfortunately, these procedures have complications including bleeding (often requiring transfusion in 7%-13% of cases), electrolyte abnormalities (2% TURP syndrome), erectile dysfunction (6%-10%), and retrograde ejaculation (50%-75%). The overall incidence of a second intervention (repeat TURP, urethrotomy and bladder neck incision) has been reported in 12% and 15% of men at 5 and 10 years following TURP.

Alternative therapies have been developed with the aim of reducing the level of complications while maintaining efficacy. These include microwave therapy, transurethral needle ablation, and a range of laser procedures (Holmium, Diode, Thulium and 532nm-Greenlight)\textsuperscript{12}. 

Keywords: GreenLight laser (GLL), Benign prostatic hyperplasia, Transurethral resection of the prostate (TURP)
Photoselective vaporization of the prostate (PVP), initially launched as a 60W prototype, was ultimately introduced to the urology community as a 80W system (American Medical Systems, Minnetonka, Minnesota, USA), has been the predominant device used in clinical trials. This 1st generation used an Nd:YAG laser beam passed through a potassium-titanyl-phosphate (KTP) crystal, halving the wavelength to 532nm, doubling the laser’s frequency, and resulting in a green light. Outcomes have demonstrated a reduced frequency and severity of clinical complications, however it was limited to smaller prostate sizes\(^1\). In 2006, the 120W lithium triborate laser (LBO), also known as the GreenLight HPS (High Performance System) laser was introduced. This laser utilizes a diode pumped Nd:YAG laser light that is emitted through an LBO instead of a KTP crystal, resulting in a higher-power red 532nm wavelength green light laser while still using the same 70-degree deflecting, side firing, silica fiber delivery system. The HPS offered an 88% more collimated beam and smaller spot size, resulting in much higher irradiance or power density in its 2 predecessors (60W and 80W) with a beam divergence of 8 versus 15 degrees. The primary aim for this upgrade was to reduce lasing time and improve clinical outcomes while demonstrating the same degree of safety for patients. Limitations of the 120W system included treatment of large prostates greater than 80g-100g and increased cost related to fiber devitrification and fracture\(^1\). In 2010, the 180W-Greenlight XPS (GLL) system was introduced, not only with increased power setting to vaporize tissue quicker but significant fiber-design changes. Internal cooling, metal-tip cap protection and FiberLife (temperature sensing feedback), better preserve the integrity of the fiber generally producing a 1-fiber per case expectation. Initial personal experience with XPS has provided comparable outcomes related to morbidity, but with the opportunity to perform a more complete and rapid procedure.

**MATERIALS AND METHODS**

Between March 2011 and April 2013, a total of 62 patients with LUTS due to BPH were assessed for eligibility to enter the study. Inclusion criteria were patients with moderate or severe LUTS (International Prostate Symptom Score IPSS >16), failure of previous medical treatment with a washout period of at least 2 wk, maximum flow rate \(Q_{\text{max}}\) <15ml/s, PVR urine >100ml, prostate volume <100ml on transrectal ultrasonography (TRUS), and ability to give a fully informed consent. Exclusion criteria were patients on permanent anticoagulants, those with urethral strictures, bladder stone, or neurogenic bladder. Patients diagnosed or suspected of having prostate cancer were also excluded.

All patients were subjected to the standard urologic preoperative evaluation, including history taking, clinical examination including digital rectal examination (DRE), urine analysis (with or without urine culture), routine blood chemistry including prostate-specific antigen (PSA). TRUS was needed to estimate the size of the prostate and transabdominal ultrasound was needed to measure PVR urine excluding those with an indwelling catheter. Urine flowmetry was carried out to measure \(Q_{\text{max}}\).

### TABLE 1

| **BASELINE CHARACTERISTICS OF PATIENTS OF BOTH GROUPS** |
|----------------|-------|-------|
| Patients, No   | 31    | 31    |
| Median age, yr | 67.1±8| 66.3±9.4|
| Mean prostate volume, ml | 60.3±20 | 61.8±22 |
| Mean PSA, ng/ml | 2.8±1.4 | 2.6±1.8 |
| Mean IPSS      | 27.9±2.7 | 27.2±2.3 |
| Mean Qmax, ml/s | 6.4±2   | 6.9±2.2 |
| Mean PVR, ml   | 114±21  | 106.2±25 |
| Patients preoperatively catheterized | 5     | 6     |

TURP-transurethral resection of the prostate; GLL green light laser; PSA-prostate-specific antigen; IPSS-international prostate symptom score; Qmax-maximum flowrate (urine); PVR-postvoid residual

### TABLE 2

| **INTRAOPERATIVE AND EARLY POSTOPERATIVE OUTCOMES IN THE TWO STUDY GROUPS** |
|----------------|-------|-------|
| Patients, No   | 31    | 31    |
| Mean operative time, min | 82±13  | 92±18  |
| Mean hemoglobin, g/l | 14.1±1.2 | 13.8±1.6 |
| Preoperative    | 11.7±1.9 | 13.2±1.5 |
| Intraoperative  | 2.9±0.9  | 1.1±0.6 |
| Mean catheterization time, d | 4.4±0.6 | 1.9±0.8 |

IPSS was completed by self assessment after translation and validation to the patient’s language. All procedures were carried out under epidural anesthesia. TURP was performed in the standard manner with a 26-F continuous irrigation resectoscope using a diathermy machine. GLL was carried out using the 180-W GLL HPS (American Medical Systems, Inc, Minnetonka, MN, USA).

In both groups, preoperative parameters were recorded together with intraoperative data, including operative time (time that the resectoscope remained in the urethra),
changes in hemoglobin and transfusion rate. Postoperative data were also recorded, including catheterization time, hospital stay, and peri- and postoperative complications. Functional results in terms of improvement of IPSS, Qmax, and PVR urine were assessed at 1, 3, 6, and 12 mo. Patients suspected of developing complications such as bladder neck contracture, residual prostate, or urethral stricture were investigated accordingly and treated.

**RESULTS**

Table 1 provides a summary of the baseline characteristics of both groups. There was no significant difference between the groups regarding any of the studied parameters.

Intraoperative and early postoperative outcomes are summarized in Table 2. The mean operative time was significantly shorter for TURP (82±13min vs 92±18min for TURP and GLL, respectively; p<0.01). Compared to preoperative values, there was no significant reduction in the hemoglobin levels at the end of GLL procedure. In contrast, there was significant reduction in the hemoglobin levels in the TURP group compared with preoperative values. The average duration of catheterization was 1.1±0.6 d for GLL group and 2.9±0.9 d for TURP group (p<0.0001). The average time of hospital stay was shorter in the GLL group (4.4±0.6 vs 1.9±0.8 d for the TURP and GLL groups, respectively; p=0.0001).

Intraoperative, and postoperative complications are summarized in Table 3. In the GLL group, no major intraoperative complications were recorded and none of the patients required blood transfusion. Among patients of TURP, 6(19.4%) required blood transfusion (intraoperative or immediate postoperative) and 1 (3.1%) developed TUR syndrome during surgery. Capsule perforation was observed in 5 patients (16.1%) in the TURP group and none in the GLL group (p<0.001).

Clot retention was observed during the early postoperative course in two patients in the TURP group and in none of the patients in the GLL group (p<0.01).

During the follow-up period, four patients in the TURP and one in the GLL group experienced bladder neck contracture. Those patients were treated by bladder neck incision. None of the patients in either group developed urethral stricture or urinary incontinence.

There was dramatic improvement in the three parameters compared with preoperative values and the degree of improvement was comparable in both groups at all time points of follow-up. Compared with the preoperative values, there were significant increase in Qmax, decrease in IPSS, and decrease in PVR urine. Postoperative value for Q max was 18.5 for patients with TURP and 18.7 ml/s for GLL group, IPSS 4.8 for TURP group and 5.2 for group treat with GLL.

**DISCUSSION**

The outcome parameters of GLL PVP and TURP were significantly improved when compared with preoperative values, with no significant difference between the two groups. Moreover, patients undergoing TURP experienced more severe adverse effects as compared with GLL patients, thus giving the latter a more favorable preoperative safety profile.

Twelve patients (20%) in the TURP group developed significant bleeding, confirming the previous observation that bleeding is a major complication after TURP often requiring transfusion. Clot retention may occur as a consequence as well as premature termination of procedure, with consequent inadequate relief of obstruction. The laser vaporization prostatectomy causes very little bleeding and has been used successfully in patients on anticoagulant therapy. Performing conventional TURP in patients who are on oral anticoagulant therapy has a high complication rate with a transfusion rate of 30%. Usually the patient is commenced on low-molecular-weight heparin preoperatively as bridging therapy. This, however, is associated with longer hospital stay and catheterization time.

Three patients in the TURP group also experienced TUR syndrome during surgery, an incidence of 3.1%. In contrast, none of the patients in the GLL group developed significant change in the hemoglobin levels compared with the preoperative levels, an advantage of GLL over TURP. This could be explained by the fact that GLL uses saline as an irrigant, thus almost removing the risk of TUR syndrome.

The laser is fully transmitted through the aqueous irrigant but is highly absorbed by oxyhemoglobin in the tissue. This allows the laser energy to be selectively absorbed by tissue with high oxyhemoglobin content, such as prostatic tissue. This results in vaporization that is focused and the short optical penetration at this wavelength confines high-power laser energy to a superficial layer of prostatic tissue with only 1–2mm of coagulation with optimum technique. This explains the fact that perforation of the capsule occurred in none of our patients in the GLL group compared with 5 patients in the TURP group.

In a recent update, significantly lower rates of intraoperative bleeding, blood transfusion, capsular perforation, and early postoperative clot retention were reported in the GLL group as compared with the TURP group.
The cost issue was not calculated in the present study. Nevertheless, the high initial and maintenance cost of laser therapy may be partially compensated by the shorter hospital stay and the more rapid return to work. Goh and Gonzalez recently studied the cost of laser evaporation of prostate versus TURP and concluded that the former procedure has a lower cost.14 Long-term functional results showed dramatic improvement in both groups regarding reduction of IPSS and GLL and improvement of Qmax, with no significant difference between both groups. The improvement in Qmax was greater following the TURP. The change in IPSS and PVR volumes postoperatively was similar in both groups. After 12 mo, the overall reduction in prostate size was 60% after TURP and 48% after GLL PVP.5

CONCLUSIONS

The present study showed that GLL prostatectomy is a safe and effective treatment for patients suffering from LUTS due to BPH in comparison with the gold standard treatment of TURP. It provides better intraoperative and early postoperative outcomes.

SUMMARY

Transurethral resection of the prostate is gold standard in terms of shrinking BPH. It has been demonstrated that laser transurethral prostatectomy (TURP) is a gold standard procedure. The latest advancements in laser technology have made its use increasingly popular for the treatment of BPH. This procedure is minimally invasive and provides quick relief from symptoms. Goh and Gonzalez recently studied the cost of laser evaporation of prostate versus TURP and concluded that the former procedure has a lower cost.14 Long-term functional results showed dramatic improvement in both groups regarding reduction of IPSS and GLL and improvement of Qmax, with no significant difference between both groups. The improvement in Qmax was greater following the TURP. The change in IPSS and PVR volumes postoperatively was similar in both groups. After 12 mo, the overall reduction in prostate size was 60% after TURP and 48% after GLL PVP.5

REFERENCES


