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A Study of the Role of 180W XPS Lithium Triborate Laser in the Treatment of Patients With Lower Urinary Tracts Symptoms Due to Benign Prostatic Hyperplasia

Omar Salim Akhtar[1*], Shailesh Raina[2]

[1]Department of Urology, Super Specialties Hospital, Government Medical College, Srinagar – J&K – 190010, India
[2]Director of Urology and Robotics, Jaslok Hospital & Research Centre, Mumbai - 400026, Maharashtra, India

***Correspondence to**
Omar Salim Akhtar,
Lecturer, Department of Urology
Super Specialties Hospital,
Government Medical College,
Srinagar – J&K – 190010,
India
Tel: +91 9987633365;
Email: omarakhtar@hsshcc.org

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Abstract

Introduction: Benign prostatic hyperplasia (BPH) is a disease of the prostate commonly seen in elderly males known to cause lower urinary tract symptoms (LUTS) that may require surgery as a part of treatment. Transurethral resection of the prostate (TURP) is considered the gold standard of surgical treatment, but it is not without complications. Laser photoselective vaporisation of the prostate (PVP), introduced in 1998 as an 80 W Nd:YAG laser which passed through a KTP (potassium-titanyl-phosphate) crystal, emerged as a safe alternative to TURP in selected cases. A recent upgrade to the Greenlight XPS 180 W powered with an LBO (lithium triborate) crystal has been available for use since 2012. Data on the use of this new upgrade is still being collected and analysed, especially in patients with large prostates or high risk cases. We analysed cases done at Jaslok Hospital over a 2-year period.

Methods: A total of 34 patients who underwent Laser PVP using XPS 180W for LUTS due to BPH at Jaslok Hospital were part of this study. We analysed the pre- and postoperative variables and the intraoperative parameters of all patients.

Results: The XPS 180W was found to be safe and efficacious. Eighteen patients were high-risk cases, classified as ASA (American Society of Anesthesiologists) Classes 3 and 4. Average postoperative catheter duration was 40.18 hours. In prostates of size <80 mL, an average of 229 kJ of energy was used. In large prostates (>80 mL), an average of 390 kJ of energy was used. No major complications were seen in any of the high-risk patients, classified as Clavien Dindo Class 3 and 4. The postoperative drop in IPSS (International Prostate Symptom Score) was 8.7.

Conclusion: We found that Green Light Laser XPS 180W may be used for large (>80 g) prostates, hitherto an indication for open surgery, and that it may be used in high-risk patients, who were otherwise unfit for TURP. It is safe and efficacious. Further, multicenter trials are required to confirm the findings.

Keywords: LUTS; BPH; GreenLight™ Laser; PVP; XPS 180W; Laser Prostatectomy.

Introduction

Benign prostatic hyperplasia (BPH) is a commonly seen problem of adult males, characterised by bladder outlet obstruction and varying degrees of lower urinary tract symptoms (LUTS).[1] Open prostatectomy (OP) for large glands (>80 mL) is considered for treatment of patients in whom medical therapy has failed to alleviate symptoms of BPH.[2] For smaller glands (>30 mL-80 mL) in patients in whom medical therapy has failed, transurethral resection of the prostate (TURP) is recommended. However, TURP is not without complications. A recent review of over 10000 patients showed complications of TURP include failure to void (4.5%-5.8%), repeat surgery (1.1% to 5.6%), infection of the urinary tract (3.6%-4.2%), bleeding requiring blood transfusions (2.0% to 2.9%) and TUR syndrome (0.8%-1.4%). In this series, the mortality rate was 0.10% and the short-term morbidity rate was 11.1%.[3] In elderly patients on anticoagulant medication and antiplatelet drugs, the risk of TURP-related hemorrhage increases, necessitating the use of alternative sources of energy for BPH.[4]

The first study on photoselective vaporisation of the prostate (PVP) involving the GreenLight™ KTP laser was published in 1998 by Malek et al.[5] GreenLight™ laser emits radiation at a wavelength of 532 nm. It is selectively absorbed in tissue by haemoglobin ('red' in colour), and has a penetration depth of 0.8 mm. The tissue target chromophore is the haemoglobin molecule, and the laser is delivered using a side-firing, silica-based, fibre through a special visual 'scope.' PVP has been extensively studied with incrementally improved systems, the GreenLight™ HPS 120W system and in 2010, the GreenLight™ XPS

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180W systems (Boston Scientific, Marlborough, MA, USA). In the improvement of the XPS 180W system, there was 50% increase in power, and a 50% increase in the laser beam, diameter, which kept power density the same as before[6]. Also added on were liquid cooling (with normal saline) of the fibre, an automatic system to shut down power with overheating of the fibre, and new coagulation settings that provided a pulsed as opposed to quasi-continuous low power mode.[7] PVP has been used in patients taking oral anticoagulant medications and found to be safe.[8,9] The mechanism of PVP relies on its photoselective absorption of oxyhemoglobin in the prostate, causing 'photovaporization' of the tissue of the prostate, reducing intra-operative bleeding.[10]

Methods

Study Population

Thirty-four patients, who were diagnosed with LUTS due to BPH, were operated upon using the GL-XPS system. One of 4 experienced surgeons performed all the procedures, done between July 2013 and June 2015. All data was collected and recorded prospectively.

Surgery indications were based on criteria set by the American Urological Association[11] and the European Association of Urology.[2] The baseline parameters and surgery outcomes were collected (Tables 1 and 2). Patients on anticoagulant medication and those who were catheterized before surgery or had a history of urinary retention were also included. Patients on aspirin (acetylsalicylic acid) were asked to continue taking the medication. We excluded patients with bladder neck stenosis or urethral stricture, suspected prostatic malignancy, bladder tumours, neurogenic bladder.

The surgical procedures were performed as per the steps given by International GreenLight™ Users group.[12] GreenLight™ XPS was used throughout the procedure, and pure vaporization was used. The irrigant was room temperature normal saline which was used in a 24F laser cystoscope. The highest power setting reached was 180W, adjusted in 10W steps.

Assessment

Standard parameters related to prostate surgery and complications of surgery and symptoms of patients were assessed prospectively, and one month after the surgery. In the preoperative assessment, prostate volume (mL), International Prostate Symptom Score (IPSS), and maximum urinary flow rate (Qmax, mL/s) were measured. The preoperative assessments also included physical examination, and medical history, urine analysis and renal function tests, a serum prostate-specific antigen level (PSA, ng/mL), and serum electrolytes. Patients with suspicious DRE's and/or high PSA levels were further evaluated for carcinoma of the prostate (CaP) prior to subjecting them to GreenLight™ Laser PVP, in the form of biopsy. The intraoperative readings recorded were total lasing time (min), total energy usage (kJ), as well as total operating time (min), measured from start of cystoscopy to insertion of catheter.

Table 1. Patient Characteristics

Age, years (range)	68.74 (53–87)
PSA, ng/dL (range)	2.51 (0.6–6.15, SD = 1.39)
Prostate volume, mL (range)	57.1 (10–162, SD = 35.46)
Post-void residue (PVR), mL (range)	137.8 (0–916, SD = 201.1)
Operating time, min (range)	87 (60–240, SD = 32.4)
Lasing time, min (range)	44.23 (25–130, SD = 18.62)
Applied energy, kJ (range)	267 (171–800, SD = 109)
IPSS pre-operative score (range)	20.0 (15–25, SD = 2.81)

Statistical Analysis

Statistical analysis was performed using the Google Sheets online software. For numerical data, independent *t* tests were performed. To compare two sets of before and after surgery data, a paired *t* test was used. Categorical data was analysed using the chi-square test. We took a *P* value of <0.05 as statistically significant. Statistical results were shown as mean with standard deviation (SD) as a percentage of total patients.

Number of Patients

A total of 37 patients underwent the GreenLight™ Laser PVP at Jaslok Hospital between May 2013 and May 2015. Three patients were excluded from the study because of suspected carcinoma. The average age was 68.74 years. There was one Arab patient, the rest were of Indian ethnicity.

Table 2. Characteristics of Patients

Number (n)	34
Average IPSS	20 (15-25, SD = 2.81)
History of retention	9/34 (24%)
Catheterised on admission	9/34 (24%)
Duration of catheterisation (days)	29 (2-100, SD = 20.57)
Urinary tract infection	5/34 (16%)
Diabetes	9/34 (26%)
Heart disease	13/34 (38%)
Hypertension	16/34 (47%)
Antiplatelet medication	14/34 (41%)
Aspirin (acetylsalicylic acid)	14/34 (41%)
Clopidogrel	11/34 (31%)
H/o TURP	3/34 (9%)
Bladder wall thickness (mm)	4.5
ASA Class III & IV	18 (54%)

Symptoms

Patients presented due to LUTS. They were evaluated using the IPSS score. The average IPSS score was 20, range 15-25. A total of 9 patients had a history of retention of urine. The average number of episodes of retention was 1.55. Nine patients were catheterised on admission.

History of Surgeries

Fifteen patients (44%) had undergone some type of surgery. Pertinently, 3 (9%) had undergone TURP in the past.

Admission Status

Two (6%) patients were referred to the Urology Department from Intensive Care (ICU) for their symptoms. The rest were scheduled admissions for planned procedures.

Examination Findings

The 2 patients referred from ICU were unstable; one of them required continuous oxygen and had a poor left ventricular function of 15%. The other had undergone an angioplasty recently and was on vasopressor support for stabilisation. The rest of the patients were stable on admission.

None of the patients had a palpable bladder on examination in hospital. The DRE findings of patients in this study were not suspicious for malignancy. A total of 4 patients (12%) had Grade I prostatomegaly (Upper border of prostate easily reached), 26 (76%) had Grade II prostatomegaly (Upper border reached with difficulty) and 4 (12%) had Grade III prostatomegaly (Upper border not reached)

Investigations

The haemoglobin (Hb) levels for the patients ranged from 8 g/dL to 17 g/dL, with an average of 12.78 g/dL. Four patients (12%) had Hb levels of <10 g/dL. The average packed cell volume (PCV) was 38.8 (Range 25-50). The average platelet count was 252 000/dL (Range 150 000-450 000). Serum creatinine levels averaged 1.14 mg/dL, with a range of 0.7 mg/dL-2.7 mg/dL.

PSA Levels

The average PSA levels were 2.5, with a range of 0.5-6.15 ng/dL. Four (12%) of patients had a PSA level of >4.0. One patient with a PSA of 6.15 had a history of UTI at the time of measurement, and tissue taken during the procedure was negative for malignancy. One patient (PSA of 5.3) had undergone a TRUS guided biopsy which was negative, and the other two had reasonably large glands of sizes 130 g (PSA of 4.5), and 87 g (PSA of 5.9) respectively to offset the relatively high PSA level.

Prostate Size

The average size of the prostate was 57.0 g, with a range from 10-162 g. Eight patients (24%) had prostates of >80 g size.

Post-void Residue and Bladder Findings

The average post-void residue (PVR) was 137.8 mL (Range from 0-916 mL). Seventeen patients (50%) had PVR of over 75 mL. No patient had bladder diverticuli, and the average documented bladder wall thickness was 4.5 mm (range 3.5 - 6.0 mm)

Surgery Characteristics

Duration of Surgery

The average duration of surgery was 1.27 hours, or 76 minutes, including anaesthesia time. The range was from 1 hour to 4 hours.

Energy Used

The average energy used across all cases was 267.2 kJ per case. In cases where the size of the prostate was >80 g (n=8), the energy used averaged 390 kJ per case.

Fibres Used

The advantage of having the 180W XPS system remains the ability to deliver high amounts of energy in low periods of time with reliability. We used 1.02 fibres per case, with only one (3%) of cases requiring more than one fibre.

Lasing Time

The average lasing time was 44.2 minutes per case, with a range from 25-130 minutes.

Postoperative Characteristics

In all patients, there was mild haematuria postoperatively. In 5 patients (15%) irrigation had to continue more than 24 hours. Four (80%) of these patients were anticoagulated. Seven patients (21%) had their catheters removed on day 1, and 22 patients (64%) were still catheterised after 24 hours, but without any irrigation, and the urine was clear (Table 3).

Catheter Removal

The average duration of catheterisation was 1.91 days, or 40.17 hours. Seven (21%) patients had their catheters removed on day 1, in 23 (67.7%) patients catheter was removed on day 2, and 4 (12%) had their catheters removed on day 3. No patient was postoperatively catheterised beyond day 3, unless catheter had been removed and patient was re-catheterised because of retention. Three (9%) patients did not pass urine after removal of catheter, they required re-catheterisation.

Other Characteristics

Dysuria was reported by 6 (18%) patients (Clavien Dindo Scale (CS) 0). Frequency (having to go to pass urine every < 2 hours) was seen in 24 (70.6%) patients (CS 0), urgency (without bacteriuria, not treated) was seen in 6 (18%)

Table 3. A List of Adverse Events Based on Peyronnet et al[16]

Clavien Dindo Grade	Complication	No. of AEs
1	Dysuria	5
	Frequency	25
	Urgency	7
	Haematuria	2
	Retention of urine postoperatively in patient with urinary catheter previously	1
	Retention of urine postoperatively in patient without urinary catheter previously	2
2	Storage symptoms requiring treatment on discharge	1
	Sepsis	0
	Blood transfusion	0
3	Gross haematuria requiring cystoscopy	0
	Rectal wound	0
4a	Severe sepsis	0
	Acute renal failure	0
	Haemorrhagic shock	0
4b	Acute respiratory failure	0
5	Death	0

Abbreviation: AE, adverse event.

patients (CS 0), retention in 3 (9%) patients (CS 1), and gross haematuria in 2 (6%) patients (CS 1) (Table 3).

Postoperative Symptoms

An average drop in IPSS score (measured 30 days after discharge) of 8.7 was noted on follow-up (Range 5-13).

Total Admission Days

Mean admission duration was 3.5 days (range: 2-6 days). No patient stayed longer than 6 days postoperatively. Most (26, 82%) patients were admitted a day before surgery, or were already admitted (2, 6%) for evaluation and optimisation in view of comorbidities. Only 6 (12%) were admitted on the day of surgery, and the average admission stay was 2 days in this group.

Discussion

To the best of the author's knowledge, this is the first case series published on Laser PVP using an XPS 180W from an Indian setup.

Age

The average age of the patients in our study was 68.7 years. It compares favourably with the average age of 65.4 years in the GOLIATH Trial,[13] of 70.7 years in the Bachmann et al[14] study of 201 consecutive cases, and of 68.9 years in the paper by Hueber et al[15] (cohort undergoing Laser PVP using XPS 180W).

In our study, age was not found to be an independent risk factor for complications, which was also determined in the study by Peyronnet et al.[16]

Symptoms

The average IPSS score in our patients was 20 which is slightly lower than some contemporary studies. In the GOLIATH Trial[13] the average IPSS score was 21.2 in the GreenLight™ group, in the series by Ben-Zvi et al[17] the average IPSS score was 24.2 and in the study by Eken et al[10] the average IPSS of patients who had Laser PVP with XPS 180W was 23.8.

Antiplatelet Medications

Patients on acetylsalicylic acid (aspirin): In our study 14 (41%) of patients were on aspirin. No patient required blood transfusion perioperatively in our study. Five out of 27 patients had their catheter in place on day 2 and required saline irrigation to keep their urine clear. All these 5 (100%) were on Aspirin perioperatively which could not be stopped because of comorbidities. Of the 2 patients in our study who developed haematuria after catheter removal, requiring conservative treatment neither was on aspirin/clopidogrel.

This compares well with the GOLIATH trial,[13] where in 28/134 patients (20.9%) were on aspirin perioperatively. In the study by West and Woo,[18] 24 (17.5%) of 137 patients treated by XPS 180W were anticoagulated. In their study of 201 consecutive patients Bachmann et al[14] had 55/201 patients (27.4%) who were on aspirin. They did not report any specific complications to this patient group.

Patients on Clopidogrel

A total of 11 out of 34 (32.5%) patients in our study were on clopidogrel at the time of surgery. No patient in this group required blood transfusions postoperatively. One out of 3 (33%) patients who developed postoperative retention was on clopidogrel and aspirin. This patient required catheterisation and bladder washes for treatment of the retention.

PSA Level

The average PSA level of our patients was 2.51. In the GOLIATH trial[13] the PSA was 2.7 in the cohort of patients who underwent XPS 180W. The PSA level in the study by Eken et al[10] the PSA level was 2.79 in the patients undergoing the XPS 180W Laser PVP.

Relationship of PSA Level to Complications

Our study did not show any statistically significant relationship between the PSA levels and postoperative complications.

Prostate Size

The impact of prostate size on surgical outcomes has been studied in previous papers. West and Woo[18] concluded

that there was no increase in the complication rate with increasing prostate size.

Hueber et al[19] studied the impact of preoperative size of the prostate on safety and outcome of surgery. Median prostate size was 50 mL (n=387 patients) vs 108 mL (n=741 patients) in the groups prostate volume (PV) <80 mL vs PV ≥80 mL respectively. Conversion to TURP was significantly higher in the ≥80 mL prostate group with a rate of 8.4% compared to 0.6% in the <80 mL prostate group (P<0.01). In this study, the average fibre usage was 1.1/case in the <80 mL group, and 1.5/case in the >80 mL group. Duration of hospital stay was almost similar in the two groups (Tables 4 and 5).

Duration of Catheterisation

The average duration of catheterisation in our study was 1.91 days, or 40.17 hours. This compares favourably with the GOLIATH study[13] in which the average catheter duration was 40.8 hours in 128 patients of the XPS-180W arm. In the study by Hueber et al[19] the catheterised duration was 26 hours in the patients who had PV <80 mL and was 34 hours in the patients who had PV >80 mL. In the study by Eken et al,[10] the average catheterised duration was 17.8 hours for the patients who underwent the XPS-180W.

Blood Transfusions

There were no blood transfusions in any of our patients in this study. In the study by Hueber et al,[19] no patient required a transfusion. Bachmann et al[14] also reported no blood transfusions in their series of 201 patients. In the GOLIATH Trial,[13] there was none in the XPS-180W arm.

Reduction in IPSS Score

The average fall in IPSS score in our study was 8.7 per case at 1 month follow-up. The 30 days mean IPSS score in our patient population was 11.35. Similar observations have been noted by Bachmann et al[14] who noted a fall of 11.5 in his study at 1 month follow-up, with a mean IPSS score of 8.1 and in the GOLIATH Trial[13] where the average fall was 9.3 in the XPS group at 3 weeks follow-up with a mean IPSS score of 11.9. Eken et al[10] showed a drop in IPSS at 6 months of 15.46 (2-24).

Table 5. Comparison of the 2 Groups in Our Study

Parameters	Group I[a]	Group II[b]	*P* Value[c]
Prostate size average (mL)	40.4	111.3	0.07
Lasing time, average (min)	38.1	64.6	1.0
Energy used (kJ), average	229.4	390	0.98
Fibres used	1.0/case	1.12/case	0.16

[a]Prostate size <80 mL (n = 26).
[b]Prostate size >80 mL (n = 8).
[c]There was no statistically significant difference between the two groups in our study (P<0.05 significant).

High-Risk Patients

A total of 18 patients in our study were high surgical risk patients, defined as ASA class 3 or 4. The outcomes of those patients were comparable; there were no Clavien Dindo Class 4a, 4b, or 5 complications in these patients. The statistical analysis of the duration of stay and adverse effects of the patients based on ASA class failed to show any significant difference between the two groups, showing that XPS-180W was safe in the high-risk patients in our study.

Total Admission Days

Average duration of admission in our study was 3.5 days, more than the average of 24 hours in the study of Hueber et al.[19] It compares favourably with the patients enrolled in the XPS-180W arm of the GOLIATH Trial,[13] with an average stay of 65.5 hours (2.7 days) (Table 6).

Table 6. Comparison of Duration of Admission Between Our Study and Other Studies

Study, year	Patients who underwent XPS-180W (n)	Mean duration of hospital stay (days)
GOLIATH, 2014	134	2.7
Benejam-Gaul et al[20], 2014	39	1.3
Hueber et al,[19] 2015	1196	1.0
Our study, 2013-2015	34	3.5

Table 4. Surgical Characteristics of Patients With Prostate Sizes >80 mL

Number	Prostate Size (mL)	Lasing Time (min)	Energy Used (kJ)	Fibres Used
1	130	75	400	1
2	162	130	800	2
3	87	48	320	1
4	100	55	350	1
5	84	50	300	1
6	113	59	370	1
7	100	52	280	1
8	115	48	300	1
Patients n=8	Average size = 111.3 mL	Average lasing time = 64 min	Average energy used = 390 kJ/case	Average number of fibres = 1.12/case

Limitations

The limitations of this study were a small sample size and its non-randomised design. There was no comparison with TURP. The surgeons who participated in this study were proficient in 120W-HPS Green Light Laser techniques, and this study may not reflect a learning curve that may occur when the XPS-180W is introduced in a setting previously inexperienced with 120W-HPS.

Conclusion

Our study shows that XPS-180W is a safe, efficacious method and that it can be used for the treatment of patients with LUTS due to BPH. It has also demonstrated efficacy in patients who are on antiplatelet medications even up to and during the surgery. Rates of haematuria, postoperative retention and blood transfusions were low. Our study also showed that XPS-180W can be potentially used in large prostates (>80 mL) hitherto not considered optimal cases for minimal access techniques. We had a total of 18 (53%) high surgical risk (ASA class 3,4) patients in our study, and there was no significant difference in outcome in this group using the XPS-180W when compared with the ASA class 2 patients, proving it to be safe.

Conflict of Interests

The authors have no conflict of interest.

Ethical Considerations

The Institutional Ethics Board approval of the study was obtained.

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