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ORIGINAL RESEARCH

Photoselective vaporization of the prostate with the 120W lithium triborate laser for the treatment of acute urinary retention

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Purpose: Whilst photoselective vaporization of the prostate (PVP) is used to treat benign prostatic hyperplasia, there is little reported about its performance in urinary retention. The objective of this study is to evaluate the efficacy and safety of GreenLight™ high performance system 120W lithium triborate laser (American Medical Systems, Inc, Minnetonka, MN) PVP in men with urinary retention.

Patients and methods: Retrospective analysis of data of all men in urinary retention who underwent treatment with the 120W lithium triborate laser PVP by a single surgeon from November 2006 to July 2010 was performed (n = 78), median age 71 years (interquartile range, 64–80), median prostate volume 91 mL (interquartile range, 58–121). Perioperative outcomes and functional outcomes at baseline, and at 3 and 12 months post-operation were examined.

Results: Patients managed preoperatively by urethral catheterization (n = 61) and suprapubic catheterization (n = 5) were of greater age (by 8.2 years, $P < 0.05$) and higher American Society of Anesthesiologists scores ($P = 0.000$, Fisher's exact test mid P) than patients managed by intermittent self-catheterization (n = 12), but there was no difference in outcomes. There were three Clavien grade III, two Clavien grade IV, and no Clavien grade V complications. There were also no blood transfusions. Fifty-three men (68%) voided successfully post-PVP and went home catheter-free within 24 hours. At 3 months, 62 out of 64 evaluable men (97%) were voiding well without needing any form of catheterization. At 3 months and 12 months, median International Prostate Symptom Score was 7 and 6; International Prostate Symptom Score Quality of Life Index 1 and 1; peak urinary flow 19 and 22 mL/sec; and post-void ultrasound measured residual urine volume 52 and 60 mL, respectively.

Conclusion: PVP for urinary retention is an efficacious and safe treatment modality.

Keywords: benign prostatic hyperplasia, laser prostatectomy

Introduction

Benign prostatic hyperplasia (BPH) has been demonstrated to be a progressive condition.[1] One manifestation of disease progression is the development of urinary retention which is regarded generally as an indication for surgical intervention. The optimal initial treatment for urinary retention is intermittent self-catheterization (ISC) but for those for whom this is not possible, urethral catheterization (UC) or suprapubic catheterization (SPC) is necessary.

Transurethral resection of the prostate (TURP) is a well-established surgical treatment for urinary retention. More recently, other methods of surgical treatment have been gaining in popularity. In particular, laser prostate surgery has emerged as an effective treatment for urinary retention.[2,3] Whilst photoselective vaporization

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of the prostate (PVP) has been demonstrated as a safe and efficacious treatment for benign prostatic obstruction,[4–6] there is little reported about its performance in the treatment of men in urinary retention.

The objective of this study was to evaluate the efficacy and safety of PVP using the GreenLight™ high power system (HPS) 120W lithium triborate (LBO) laser (American Medical Systems, Inc, Minnetonka, MN) as treatment for men in urinary retention.

Materials and methods

Retrospective analysis of a database of all men treated with PVP using the HPS 120W LBO laser by a single surgeon between November 2006 and July 2010, inclusive, identified 78 men who had presented in acute urinary retention and failed to void on trial of removal of the catheter. The median patient age was 71 years (interquartile range, 64–80) and median prostate volume measured on transrectal ultrasound was 91 mL (interquartile range, 58–121). Perioperative outcomes including operating time, laser time, energy used, postoperative duration of catheterization, and postoperative length of stay were examined. Functional outcomes in terms of International Prostate Symptom Score (IPSS), IPSS Quality of Life Index (QoL), peak urinary flow (Q_{max}) and post-void ultrasound-measured residual urine (PVR) were assessed at 3 and 12 months post-PVP.

All PVP cases were performed using a 23 Ch continuous flow laser cystoscope (Storz Medical, Tägerwilen, Switzerland) with room-temperature saline irrigation. The technique of PVP used was that as previously described by the International GreenLight Users Group.[7] In brief, a working space was created between the lateral lobes of the prostate with subsequent expansion of the cavity and vaporization of the middle lobe. The median operating time was recorded from the time of cystoscope insertion to the time of catheter placement. Laser time, as recorded by the console, reflects the cumulative duration of time that the pedal was being depressed to activate the laser. Catheterization was routinely performed using a 16 Ch latex Foley catheter. If indicated, an irrigation catheter was used.

Each laser fiber was limited to 275 kJ, after which amount the software prevents further use of the fiber and the fiber must be replaced with a new fiber. In Australia, additional fibers used within a single case were provided by the manufacturers at no additional cost under their "One Fiber Guarantee Program".

Statistical analyses were performed using data analysis tools in Excel 2011 (Microsoft, Redmond, WA) and STATA (v. 11; StataCorp LP, College Station, TX). Where comparisons were made, the Student's *t*-test was used with significance defined at $P < 0.05$, except in the comparison of the American Society of Anesthesiologists (ASA) scores amongst the three catheter groups, for which Fisher's exact test was used.

This study was prepared in accordance with the guidelines of the World Medical Association (Declaration of Helsinki, 1964 and Declaration of Tokyo, 1975, as revised in 1983). All patients were provided with a privacy document which they all signed prior to their inclusion in the study; all patients were given the opportunity to opt out.

Results

Of the 78 men, 12 were managed preoperatively by ISC, 61 by UC, and five by SPC. The median ASA score was 2 (range, 1–4); ten men had a score of 1, 27 men had a score of 2, 31 men had a score of 3, three men had a score of 4, and no men had a score of 5. For seven men the ASA score was unknown. A subgroup analysis of the cohort when grouped according to preoperative treatment modality (that is, ISC, UC, or SPC) showed that patients treated by UC and SPC tended to be of a greater age (mean difference 8.2 years, $P < 0.05$) and higher ASA score ($P = 0.000$, Fisher's exact test mid *P*) compared with patients treated by ISC. Seventeen men were anticoagulated on warfarin, six on aspirin, three on clopidogrel, one on both aspirin and clopidogrel, and one on both aspirin and warfarin. All antiplatelet and anticoagulant medications were continued throughout the operative period. One patient was having a revision PVP – he had previously had potassium-titanyl-phosphate (KTP) laser PVP several years earlier.

Perioperative parameters are summarized in Table 1. A 16 Ch latex catheter was used in all but five cases, where an irrigation catheter was used. Four of those five men were taking warfarin and one was taking clopidogrel. Fifty-three (68%) treated men voided successfully post-PVP and went home catheter-free within 24 hours, without requiring a blood transfusion. Sixty (77%) treated men voided successfully without the need for catheterization by the time they were discharged.

Table 1 Perioperative parameters

	Median	IQR
Prostate volume (mL)	91	58–121
Operating time (minutes)	86	63–105
Laser time (minutes)	72	48–79
Energy use (kJ)	499	275–550
Duration of catheterization (hours)	13	11–17
Postoperative length of stay (hours)	18	15–21

Abbreviation: IQR, interquartile range.

Regarding the duration of catheterization, an outlier result was obtained from a patient who developed cardiac issues postoperatively and remained catheterized for 216 hours and an inpatient for 456 hours. Four patients were discharged with an SPC in situ. Of these, two already had had SPCs inserted preoperatively. One patient had a subsequent successful trial of void, whereas the other subsequently received urethral dilatation after which he achieved good urinary flow. The latter two of the four patients had their preoperative urinary retention managed by UC but had SPCs inserted at the time of PVP. One patient was discharged 14 hours post-operation and his SPC remained in situ for 3 months; the other patient was discharged at 19 hours post-operation and passed a successful trial of void 2 weeks post-discharge.

Regarding the length of postoperative hospitalization, there was an outlier result from the same previously mentioned case in which a patient who experienced cardiac problems postoperatively remained an inpatient for 456 hours. Another outlier related to a patient on warfarin who stayed in hospital 144 hours with prolonged hematuria. Four patients had planned intensive care unit (ICU) admissions postoperatively due to significant medical comorbidities. Two patients had unplanned ICU admissions: one developed urosepsis, and the other hyponatremia as a result of medical comorbidity. Two patients were readmitted to hospital within 24 hours post-discharge: one with sepsis and the other with an exacerbation of chronic back pain.

Adverse events are summarized in Table 2.[8] Twenty-four (31%) patients experienced one or more adverse events postoperatively, but the majority of these were low Clavien grade and of minimal consequence. Seven patients experienced urinary tract infection, of whom one was an inpatient who required an unplanned admission to the ICU with urosepsis, and one was an outpatient who required readmission for treatment. The patient with prolonged hematuria was anticoagulated on warfarin, but did not require a blood transfusion. Five patients required recatheterization for failure to void on trial without catheter, one of whom had been taught ISC prior to discharge but required recatheterization with an introducer. An additional eight patients were instructed to perform ISC upon discharge, and six patients were discharged with SPCs in situ for voiding and residual measurements. One of these patients did not need to use his SPC and so it was subsequently removed. There were no recatheterizations required for bleeding or clot retention. Two men developed a bladder neck stricture and had a subsequent bladder neck incision 6–7 months post-PVP. One man had urethral dilatation for urethral stricture 3 months post-PVP and subsequently voided well independently of his SPC. An exacerbation of cardiac comorbidities was experienced by one patient. All four patients with planned ICU admissions had an uncomplicated postoperative course. Of the two unplanned ICU admissions, one was due to urosepsis and the other was due to hyponatremia. There was one readmission within 24 hours due to urosepsis, and one readmission due to back pain.

Table 2 Adverse events following PVP

Clavien classification of surgical complications	Number of patients (%)
Grade I	
Grade Id*	
Prolonged hematuria	1 (1%)
Recatheterization	13 (17%)
Exacerbation of preexisting comorbidity (back pain)	1 (1%)
Grade II	
Urinary tract infection	5 (6%)
Exacerbation of preexisting comorbidity (cardiac)	1 (1%)
Grade IId*	
Urinary tract infection	1 (1%)
Grade III	
Grade IIIa	0
Grade IIIb	0
Stricture of bladder neck or urethra	3 (4%)
Grade IV	
Grade IVa	0
Urosepsis	1 (1%)
Hyponatremia	1 (1%)
Grade IVb	0
Grade V	0

Note: *Suffix "d" (for "disability") is added to the respective grade of complication if the patient suffers from the complication at the time of discharge.

At 3 months, 97% (62/64) of men were confirmed to be voiding well without needing any catheterization. Eighteen percent (14/78) of men did not attend their 3-month follow-up appointment. Of these, five men did not attend a 3-month follow-up appointment because they had moved interstate or overseas, and two men had died before their 3-month follow-up due to unrelated causes. Two men did not follow up due to other comorbidities: one suffered dementia in a nursing home, and one was hospitalized with cardiac problems but stated he was well from the urological point of view. One man stated he was passing urine urethrally but also continued to intermittently self-catheterize, and did not want to attend a follow-up. Four men did not follow up, for reasons unknown, as the men were not contactable. Outcomes at 3-month follow-up are summarized in Table 3. For three patients, limited outcome measurements were obtained due to SPC use in two men and an indwelling urethral catheter in the other.

At the 12-month follow-up, data was collected from 19 of the original 78 men; that is, 76% (59/78) of the men were

Table 3 Functional outcomes at 3-month follow-up and 12-month follow-up

	IPSS	QoL	Q_{max} (mL/sec)	PVR (mL)
3 months				
Median	7	1	19	52
(IQR)	3–11	0–2	13–27	25–104
n (%)	58 (74%)	58 (74%)	56 (72%)	56 (72%)
12 months				
Median	6	1	22	60
(IQR)	4–9	0–2	18–30	0–128
n (%)	19 (24%)	19 (24%)	17 (22%)	19 (24%)

Abbreviations: IPSS, International Prostate Symptom Score; QoL, IPSS Quality of Life Index; Q_{max}, peak urinary flow; PVR, post-void residual urine; IQR, interquartile range.

lost to follow-up at 12 months. Of the men who did not follow up, one was living overseas, three living interstate, and two living in rural areas. One man was at that time hospitalized for unrelated reasons and stated he was well from a urinary viewpoint, two men were nursing home residents, and three men were deceased. One man was not available for follow-up for other reasons. Two men declined follow-up, and for three patients a 12-month follow-up appointment was not pursued by the surgeon. No appointment was made for 22 men, and another 19 men did not follow up for unknown reasons. The results at 12-month follow-up are displayed in Table 3.

Subgroup analysis was performed and revealed a statistically significant difference in mean age between the preoperative ISC group versus the preoperative UC/SPC group (66 vs 74 years, $P < 0.05$), but no significant differences in prostate volume, perioperative parameters (operation time, laser time, energy use, duration of catheterization, postoperative length of stay), or outcome measures (IPSS, QoL, Q_{max}, and PVR) at 3-month follow-up and 12-month follow-up.

Discussion

In the literature, there has only been one other similar publication that has specifically examined the use of PVP in men with urinary retention.[3] However, a weakness in that study was that lasers other than 532 nm were used, and it is unclear as to how many were PVP and, of these, as to how many were with KTP or LBO, if any. To date, our study is the only one which specifically examines men in urinary retention being treated by the HPS 120W LBO laser.

Our evaluation of men with refractory urinary retention is unusual in that it includes not only men with either a UC or SPC, but also men performing ISC. These three management strategies are considered initial and temporary treatments for acute urinary retention. The latter group is of relevance with the increasing popularity of ISC in the temporary management of refractory urinary retention.[9] Given that ISC is becoming the standard of care for men with refractory urinary retention, this group sub-analysis is likewise of increasing relevance. However, although there was a significant difference in the age of men being treated with ISC versus UC or SPC, there was no statistically significant difference demonstrated in prostate volume, perioperative parameters (operation time, laser time, energy use, postoperative duration of catheterization, and postoperative length of stay), nor outcome measures (IPSS, QoL, Q_{max}, and PVR).

Unfortunately, baseline functional parameters such as IPSS and Q_{max} cannot be validly compared to postoperative functional parameters at 3 months and 12 months in order to obtain a statistically meaningful magnitude of improvement. The reason for this is that IPSS and Q_{max} in patients with a urethral catheter cannot be determined; and for men with an SPC or performing ISC the parameters are either of questionable reliability or unattainable. The men in this study tended to have very large prostates with the median gland size being 91 mL. This is significantly larger than the average gland size reported for the majority of PVP series that examine men without urinary retention combined with those in urinary retention. In the largest PVP studies in the literature, the prostate size is typically between 50–60 mL.[10–13] Consequently in this study, the median amount of energy required to perform PVP at 499 kJ is notably higher and the median operating time of 86 minutes is notably longer than in the great majority of series. Urinary retention can be challenging for all forms of BPH-related surgery but when associated with a very large prostate, the complexity of surgery increases. This is largely due to the urothelium of large, engorged prostates being prone to contact bleeding with minimal instrumentation as well as to the physical impairment of optimal working space and the large anatomical configuration of these glands physically impairing optimal working space and visibility. Additionally, 31% (24/78) of men were on warfarin, clopidogrel, or aspirin or a combination of these agents, which together with a large prostate and urinary retention create a trifecta of complexity for any form of BPH-related surgery.

Initial experiences of the PVP HPS 120W laser showed that it was associated with a low incidence of perioperative adverse effects,[14] and that it can be used effectively and safely in patients with urinary retention, on anticoagulant therapy, or with large prostates >80 mL.[15,16] With an overall complication rate of 31% in our study, HPS 120W LBO PVP is not without risks. However, the great majority of these were low Clavien grade and of minimal consequence to the patient. In our study, not all men were able to establish

urethral voiding following PVP. Whilst some men required recatheterization after their post-PVP catheter removal, others had to either commence or continue ISC. Our study, however, does confirm that PVP using the HPS 120W LBO laser is a safe and effective way of treating men in urinary retention, and the results are comparable to other cavitating treatments for BPH.

Holmium laser enucleation of the prostate has also been used as an effective treatment for men in urinary retention. Elzayat et al studied 169 patients with a mean preoperative prostate volume of 101 mL, and demonstrated post-holmium laser enucleation of the prostate a mean catheter duration of 38.4 hours, and length of hospital stay of 40.8 hours.[17] Another series of 154 patients with urinary retention and a mean prostate volume of 107.1 mL, described a mean catheter time of 22.5 hours and length of hospital stay of 33.7 hours.[2] Our study of 78 men in urinary retention with median prostate volume of 91 mL had comparatively favorable results in terms of duration of catheterization (median 13 hours) and length of hospital stay (median 18 hours).

Al-Ansari et al conducted a randomized clinical trial with 3-year follow-up, and concluded that compared with TURP, HPS 120W laser PVP is safe and effective in the treatment of BPH.[4] The mean operative time was significantly shorter for TURP, but the duration of catheterization and hospital stay was significantly shorter for HPS PVP. There was significant improvement in IPSS and Q_{max} for both TURP and HPS PVP patients, and the degree of improvement was comparable between the two groups. A more recent randomized clinical trial with 2-year follow-up demonstrated that the HPS 120W laser PVP is as effective as TURP for symptom reduction and improvement of QoL.[18] In this series by Capitan et al, there were no differences seen in the response of storage and voiding symptoms, and the complication rates were similar. Similar to the study by Al-Ansari, the length of hospital stay was shorter for the HPS 120W laser PVP group than the TURP group. Our study likewise demonstrates that treatment of urinary retention with HPS 120W laser PVP allows a short duration of catheterization and hospitalization.

In contrast to some series which examined the use of PVP using a KTP laser in men in urinary retention, our patients had a much shorter duration of catheterization and a much shorter length of hospital stay.[19,20] Compared to one series by Fu et al, our patients tended to have lower IPSS, similar or slightly lower QoL, and higher Q_{max}.[19] The preoperative PVR was dissimilar and therefore comparison of follow-up PVR between the series would be inaccurate. However, compared to a different series by Ruszat et al which also examined PVP by KTP laser in men in urinary retention, although our patients had a higher preoperative IPSS, the results were similar at 3- and 12-month follow-up, as was QoL.[20] Q_{max} was greater in our series, but PVR was also greater, despite being lower in the preoperative period.

Conclusion

In a contemporary series of men in urinary retention, PVP is technically demanding but in spite of this, all cases were able to be completed, 68% (53/78) of men voided successfully and went home catheter-free within 24 hours, and none required blood transfusion. At 3 months, 97% (62/64) of men were voiding successfully without needing catheterization. PVP in men in urinary retention has been demonstrated to be safe, efficacious, and similarly effective to other forms of cavitating surgery for urinary retention. Furthermore, PVP appears to have significant benefits in terms of a short duration of postoperative UC, and short duration of stay in hospital, even when used in men who are anticoagulated.

Disclosures

Amanda SJ Chung reports no conflict of interest. Henry H Woo is a paid consultant to American Medical Systems. The publication fee for this manuscript was supported by an unrestricted educational grant from American Medical Systems.

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