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Photoselective vaporization of the prostate using the 180W lithium triborate laser

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Abstract

Introduction: Photoselective vaporization of the prostate (PVP) is widely used to treat benign prostatic obstruction (BPO), but there is little experience reported on the new more powerful 180W lithium triborate (LBO) laser. This study evaluates the safety and efficacy of using the 180W LBO laser to treat BPO by examining a multicentre Australian experience.

Methods: Retrospective review of prospectively collected data on all men treated by 180W LBO laser PVP by eight urologists across six Australian hospitals, from July 2011 to August 2011, was performed. Perioperative and functional outcomes were examined at baseline and 3 months.

Results: Of the 85 men (median age 70 years, prostate volume 51 cm^3) identified, 27% (23/85) were in urinary retention and 44% (37/85) were taking antiplatelet/anticoagulant medication. Median operating time was 46 min, laser time 27 min, energy use 211 kJ, post-operative duration of catheterization 15 h and hospitalization 22 h. Functional outcomes from baseline to 3 months, respectively, were for IPSS 25–7; QoL 5–2; Qmax 7.7–18.4; and PVR 147–38. All improvements were statistically significant ($P < 0.01$). Thirty-eight per cent (32/85) of patients experienced at least one adverse event. Most adverse events were low Clavien–Dindo grade I–II. There were five grade III, two grade IV and no grade V adverse events. Sixty per cent (51/85) of men were able to be discharged home voiding successfully without a catheter within 24-h post-PVP.

Conclusions: Our early multicentre Australian experience indicates the 180W LBO laser PVP is an efficacious and safe treatment for BPO.

Introduction

Photoselective vaporization of the prostate (PVP) is a widely used modality for the treatment of lower urinary tract symptoms due to benign prostatic obstruction (BPO). There is a large body of literature that describes the international experience of PVP using the 80-W potassium-titanyl-phosphate (KTP) and 120-W lithium triborate (LBO) laser, but since the recent introduction of the 180W LBO laser in late 2010, there has been little experience reported on the efficacy and safety associated with this significantly more powerful laser.[1–5]

The 180W LBO laser differs from previous versions of the laser. There is a 50% increase in maximum power output and the laser fibre is significantly different. The new side firing laser fibre has a liquid-cooled irrigation channel and has a 50% greater laser beam footprint. The coagulation mode at lower power no longer has a quasi-continuous waveform as in the vaporization mode, but is now pulsed, thereby resulting in more efficient coagulation. This novel TruCoag feature is helpful for haemostasis. Software modifications also allow automatic shut-off of energy delivery in the event of overheating of the fibre, as can occur when there is excessive tissue contact or reflected energy from prostatic calculi or brachytherapy seeds. This new FiberLife feature helps to protect the fibre and increase its longevity.

The aim of this study is to evaluate the safety and efficacy of PVP using the 180W LBO laser for the surgical treatment of BPO by examining a multicentre Australian experience.

Methods

Data were prospectively collected on all men treated with the 180W LBO laser PVP by eight urologists across six Australian hospitals from July 2011 to August 2011 inclusive.

The surgical technique used was modular and shared the same principles across all surgical centres, as had been previously described by the International Greenlight Users Group.[6] However, there was probably some difference in the execution of each step across the various centres. In all centres, a 23Ch Storz continuous flow laser cystoscope was used with room temperature saline irrigation. Saline was also used for the irrigation of the liquid-cooled laser fibre. The technique in brief involved the creation of a working channel at the 80W power setting and this was progressively increased to 180W once there was sufficient space.

The inclusion criteria were all men undergoing PVP for reasons consistent with established guidelines and indications for the surgical treatment of lower urinary tract symptoms due to benign prostatic hyperplasia. Men with a history of prostate cancer were excluded from analysis.

Perioperative outcomes such as operating time, laser time, energy usage, post-operative duration of catheterization and post-operative duration of hospital stay were measured. Functional outcomes in terms of International Prostate Symptom Score (IPSS), IPSS Quality of Life Score (QoL), maximum urinary flow (Qmax) and post-void residual urine (PVR) were examined at baseline and 3 months post-operation.

Statistical analysis was performed using Microsoft Excel 2011. Where comparisons were made, the Student's *t*-test was employed, with statistical significance defined at the level of $P < 0.05$, for a one-sided probability.

Results

Eighty-five patients were identified forming the cohort for this study. The median age was 70 years (interquartile range (IQR) 65–75), and median prostate volume was 51 cm^3 (IQR 35–96). Among this cohort, 27% (23/85) was in urinary retention requiring catheterization, and 44% (37/85) was taking antiplatelet and/or anticoagulant medication.

Regarding antiplatelet and/or anticoagulant medication use, aspirin as a single agent was being taken by 16 men, clopidogrel as a single agent was being taken by six men, warfarin as a single agent was being taken by seven men, and asasantin was being taken by three men. One of these men ceased aspirin perioperatively as standard precaution, and two men ceased warfarin perioperatively as standard precaution. In addition, there were three men taking both aspirin and clopidogrel, and two men taking both aspirin and warfarin. Two of the three men taking both aspirin and clopidogrel ceased their clopidogrel perioperatively, but continued on their aspirin throughout the perioperative period. The remainder of the men continued on their antiplatelet and/or anticoagulant medications throughout the perioperative period.

Perioperative outcomes are displayed in Table 1. For operating time, laser time and energy usage, there were three values missing due to incomplete data recording. For post-operative length of catheterization and post-operative duration of hospital stay, there were 12 values missing for the same reason.

Table 1 Perioperative outcomes

	Median	IQR
Operating time (min)	46	35–59.5
Laser time (min)	27	20–36
Energy usage (kJ)	211	130–321
Post-operative duration of catheterization (h)	15	13–19
Post-operative duration of hospital stay (h)	22	18–26

Table 2 Functional outcomes at baseline and 3 months of follow-up

	IPSS	QoL	Qmax	PVR
Baseline				
Median	25	5	7.7	147
IQR	18–29	4–5	5–10	54–270
n (% follow-up)	64 (75%)	76 (89%)	56 (66%)	65 (80%)
3 months				
Median	7	2	18.4	38
IQR	4–11	1–2	14–24	9–73
n (% follow-up)	61 (72%)	61 (72%)	56 (66%)	43 (51%)
Magnitude of improvement from baseline to 3 months (% increase/ decrease)	18 (72%)	3 (60%)	10.7 (139%)	109 (74%)
T statistic	1.76×10^{-19}	1.04×10^{-19}	1.29×10^{-11}	1.20×10^{-3}
P value	<0.01	<0.01	<0.01	<0.01

Functional outcomes at baseline and 3 months, respectively, are shown in Table 2. There is statistically significant and clinically meaningful improvement in all these functional parameters (IPSS, QoL, Qmax and PVR) between baseline and 3 months of follow-up ($P < 0.01$). Three patients did not attend their 3-month follow-up appointment as they had moved overseas, moved interstate or followed up with a different urologist, respectively. Three patients did not attend 3-month follow-up for unknown reasons. The remainder of the missing functional measurements at baseline and follow-up tended to be missing in random fashion due to incomplete data recording.

Thirty-eight per cent (32/85) of men experienced at least one adverse event. There were 39 adverse events. Adverse events are shown in Table 3, and are listed according to the Clavien–Dindo classification of surgical complications.[7] The majority of adverse events were of low Clavien–Dindo grade, and there were no deaths. Intraoperative bleeding from the opening of prostatic venous sinuses occurred in two cases – in one case PVP was completed and a three-way catheter was left *in situ* post-operatively for irrigation; in the other case, the bleeding prompted conversion to standard transurethral resection of the prostate (TURP). Thirteen men failed to void on trial of removal of the catheter but only four of these recatheterizations were due to bleeding or clot retention. The case of ureteric orifice injury was managed by insertion of a percutaneous nephrostomy tube and antegrade ureteric stent, and went on to recover well. One man underwent re-operation with TURP 4 months post-PVP – this man had a large prostate volume of 140 cm^3 but laser time was only 43 min and energy usage was only 370 kJ, so it seems there was inadequate tissue ablation at the initial operation. Both Clavien–Dindo grade IV complications were not directly related to PVP – they involved pre-existing mental illnesses requiring treatment.

Table 3 Complications classified by Clavien–Dindo grade

Clavien–Dindo grade	Adverse event	Number of cases (%)
Grade I		
	Intraoperative bleeding from prostatic venous sinus	2 (2%)
	Secondary bleeding/clot retention	4 (5%)
	Recatheterization	13 (15%)
Grade II		
	Urinary tract infection (treated with oral antibiotics)	8 (9%)
	Urosepsis (treated with intravenous antibiotics)	2 (2%)
	Stress urinary incontinence	2 (2%)
	Urge urinary incontinence	1 (1%)
Grade III		
	Ureteric injury	1 (1%)
	Intraoperative conversion to TURP	3 (4%)
	Re-operation TURP	1 (1%)
Grade IV		
	Depression	2 (2%)
Grade V		0

Sixty per cent (51/85) of men were able to be discharged home voiding successfully without requiring a catheter within 24-h post-operation.

Three of the six participating surgical centres had not had previous experience with PVP prior to commencing 180W LBO laser PVP. Furthermore, only two centres had experience in excess of 100 cases. A subanalysis of data regarding complications was performed by comparing the results of the two more experienced centres with the results of the four less experienced centres. At the two experienced centres, 28% (8/29) of treated men experienced at least one adverse event. There were 10 adverse events experienced in total in these two centres. All PVP procedures were completed; there were no conversions to TURP. At the six less experienced centres, 43% (24/56) of treated men experienced at least one adverse event. There were 29 adverse events across these six centres. Intraoperative adverse events (such as intraoperative bleeding from prostatic venous sinuses, ureteric injury and conversions to TURP) occurred in the less experienced centres and not in the two more experienced centres.

Discussion

Until now, there has been little experience reported on the performance of the 180W LBO laser PVP in the treatment of lower urinary tract symptoms due to BPO. TURP had, for a long time, been established as the 'gold standard' surgical treatment for BPO. However, in the last few years, PVP, such as with the 120W LBO laser, had been demonstrated to be as safe and efficacious as TURP but with specific advantages in terms of short duration of post-operative catheterization, short duration of hospital stay and reduction of blood loss, which made it particularly useful in men taking antiplatelet and/or anticoagulant medications as these medications did not have to be ceased perioperatively.[1,8] This study on PVP using the 180W LBO laser is the first to evaluate any multicentre study of PVP in Australia.

We have found that PVP using the 180W LBO laser affords good perioperative outcomes. Sizable prostates are able to be treated within appropriate operating times and energy usage parameters. When treating prostates of similar sizes, there appears to be significant reduction in operating time when using the 180W LBO laser, compared with using the 120W LBO laser. Al-Ansari *et al*. reported a mean operating time of 89 min when using the 120W LBO laser to treat a mean prostate size of 61.8 cm^3. In our series, the median operating time was much shorter relatively at 46 min when using the 180W LBO laser to treat a median prostate size of 51 cm^3.[1] In comparing our results to a previous study by Woo and Hossack, we have also experienced slightly shorter operating time (median 46 min versus mean 67 min) and laser time (median 27 min versus 53 min), but in the previous study by Woo and Hossack, the prostate volume was larger (mean 66 cm^3) than in our study.[3]

Tugcu *et al*. and Al-Ansari *et al*. have previously reported that the use of previous PVP technologies has had specific benefits over TURP in terms of shorter duration of catheterization and shorter duration of hospital stay.[1,8] In our study, the short median duration of catheterization of merely 15 h and median duration of hospital stay of 22 h reflects these previously described benefits of PVP surgery. Furthermore, it compares favourably with the reported mean duration of catheterization of 33.6 h and hospital stay of 55.2 h described following 120W LBO laser PVP by Al-Ansari *et al*.[1] In comparing our multicentre study to a previous study by Woo and Hossack whereby PVP was performed using the 120W LBO laser, post-operative duration of catheterization and hospital stay are only slightly greater (median 15 versus mean 13.7 h, and median 22 h versus mean 18.7 h, respectively).[3]

Following PVP using the 180W LBO laser, there is statistically significant improvement in all functional outcomes (IPSS, QoL, Qmax and PVR) between baseline and 3 months of follow-up, and the magnitude of these improvements is clinically meaningful. The improvement in functional outcomes is consistent with those described following TURP and PVP using the 80W KTP or 120W LBO lasers.

Because the 180W LBO laser is a significantly more powerful laser than its predecessors, surgeons are naturally concerned about its safety profile. Although the 180W LBO laser is associated with good perioperative and functional outcomes, it is not without potential risks. We have reported 39 adverse events experienced by 32 men, but the majority of these adverse events were classified as low Clavien–Dindo grade.[7] There were two Clavien–Dindo grade IV complications, but both of these were due to pre-existing mental health issues and not a direct result of PVP itself.

Regarding the intraoperative experience, PVP using the 180W LBO laser is safe in experienced hands. In our series, there were no cases of capsular perforation (compare with 4% incidence with TURP).[9] Although there is a 50% increase in power output with the 180W LBO laser compared with the 120W LBO laser, there is also a 50% increase in beam area (spot size; footprint) such that depth of vaporization remains similar, hence maintaining a good safety profile as with the 120W LBO laser, yet with increased efficiency of tissue removal.[10] As with the case of any transurethral prostatectomy procedure, there is the potential of inadvertent tissue injury. There was one case of ureteric injury, which is also a described complication of TURP.[9] There is no potential for TURP syndrome in PVP, as saline irrigation fluid is used. This is in contrast to the 5% rate of complication by TURP syndrome reported following TURP.[1]

Regarding early post-operative complications, in our study, 10% of treated men were recatheterized for urinary retention which was

not related to bleeding, compared with 4–9% post-TURP. This apparently unfavourable recatherization rate post-PVP is misleadingly overinflated, because these patients were given a post-operative trial of void without catheter much earlier in their post-operative course than was done for patient post-TURP. Overall, the men treated by PVP had a shorter duration of catheterization than men treated by TURP. The rate of urinary tract infection in our study is consistent with the experience post-TURP (11% in our study versus 1.7–21.6% post-TURP), but higher than the rate of 5.3% described post-PVP with the 120W LBO laser by Woo and Hossack.[3] Our incontinence rate of 3% at 3 months is also consistent with the incontinence rates post-TURP (30–40% rate of early incontinence post-TURP; <0.5% rate of iatrogenic stress incontinence beyond 6 months post-TURP).[9]

The rate of clot retention in our series is consistent with the experience post-TURP (4% in our series versus 2–5% post-TURP), but higher than a reported series of PVP using 120W LBO laser in which there were no cases of clot retention.[3,9] The reported blood transfusion rate post-TURP is 0.4–7.1%.[9] A limitation of the present study is that although data regarding bleeding complications in terms of intraoperative bleeding necessitating a change in standard surgical procedure, and readmissions to hospital for secondary bleeding or clot retention, were recorded, blood transfusions, if any, were not specifically recorded.

Of the two patients who experienced intraoperative bleeding from prostatic venous sinuses, one man was on asasantin, and the other man was not taking any antiplatelet/anticoagulant medication. Of the four patients who experienced secondary bleeding or clot retention, three men were taking clopidogrel and one man was not taking any antiplatelet/anticoagulant medication. Patients who continued to take at least one antiplatelet/anticoagulant medication had an 11% risk of experiencing a bleeding-related complication, compared with patients who were not taking antiplatelet/anticoagulant medications who had a 4% risk of experiencing a bleeding-related complication. Our experience does not appear to demonstrate any concerns with the policy to perform PVP while anticoagulation medications are continued throughout the perioperative period, and this is consistent with previous reports in the literature.[11]

One of the limitations in this study is that the PVP was performed by surgeons with differing amounts of experience. We identified some potential issues regarding learning curve in the use of PVP, as there usually is with the use of new surgical technology. Our analysis of differences between experienced and less experienced centres suggests that there is a learning curve. As an example, the 4% intraoperative conversion rate to TURP in this series would likely diminish as PVP experience is gained and operators become as technically comfortable with using PVP in difficult situations, as they are with TURP. Additionally, the single case of re-operation by TURP within 4 months post-PVP occurred in a less experienced centre, and the large prostate size when correlated with the laser time and energy used, suggests that there was inadequate tissue removal at the time of PVP.

Another limitation of this study is the frequency of missing values in random fashion, with sparse record of the reason for the missing values in data. Being a multicentre study, it is challenging to encourage compliance and obtain data from patients who have neglected to follow up for reasons unknown.

Conclusions

Our early multicentre Australian experience indicates that the 180W LBO laser PVP is an efficacious and safe treatment for BPO. Significant improvements in functional outcome measurements were demonstrated at 3 months of follow-up, and the majority of adverse events were low grade. Adverse outcomes were, in the main, minor and complications reduce with experience as is common in surgical practice. These results are promising, despite the complexity of the patient cohort. This short-term follow-up confirms that PVP appears safe in the management of BPO. Studies evaluating longer-term outcomes are in progress.

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