Mid term outcomes of initial 250 case experience with GreenLight 120W-HPS photoselective vaporization prostatectomy for benign prostatic hyperplasia: comparison of prostate volumes < 60 cc, 60 cc-100 cc and > 100 cc

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Introduction: *The aim of this study was to compare the efficacy of GreenLight 120-HPS (American Medical Systems, Minnetonka, Minnesota, USA) laser vaporization for men with obstructive benign prostatic hyperplasia (BPH) according to prostate volumes < 60 cc, 60 cc-100 cc and > 100 cc.*

Material and methods: *The clinical data of 250 men with symptomatic BPH who underwent photoselective vaporization prostatectomy (PVP) by a single surgeon between July 2007 and August 2009 were retrospectively analyzed. Prostate volumes were measured by using transrectal ultrasonography (TRUS). Functional evaluations were performed at 3, 6 and 12 months with a prostate-specific antigen (PSA) obtained at 6 months. All men were stratified into three groups according to TRUS volume.*

Results: *Among the 250 consecutive PVP patients, 134, 76 and 40 men had prostate volumes < 60 cc, 60 cc-100 cc and > 100 cc, respectively. Mean laser time and delivered energy were 31, 44 and 59 minutes; 163, 309 and 473kJ respectively (p < 0.01 for all). At 1 year, mean International Prostate Symptom Score (IPSS) improved by 69%, 63% and 50%, Qmax increased by 194%, 175% and 162% and post void residual (PVR) decreased by 88%, 81% and 71%, respectively (p < 0.01 for all). Mean decrease in preoperative PSA at 6 months was 63%, 52% and 41% (p < 0.01), respectively. Hospital stay, catheterization time and complication rates were comparable between groups, however retreatment rates were significantly higher for prostates >100 cc (1.5% versus 2.6% versus 9%; p = 0.02).*

Conclusions: *Although larger prostates require more time and energy delivery, PVP is safe and efficacious for patients with lower urinary tract symptoms (LUTS) regardless of prostate size. Laser vaporization for glands > 100 cc appears to have a reduced reduction in PSA and a higher 9% rate of retreatment indicating that PVP for larger prostates remains to be optimized.*

Key Words: laser photoselective vaporization, prostatectomy, prostate size, GreenLight 120W-HPS

Introduction

With the recent advancement in the development of photoselective vaporization prostatectomy (PVP), the use of laser therapy for the treatment of symptomatic benign prostatic hyperplasia (BPH) has become accepted as a safe and efficacious alternative to transurethral resection of the prostate (TURP).

PVP was initially developed using Potassium-Titanyl-Phosphate (KTP) non-linear crystal. KTP-laser uses a green visible light that is generated by passing the 1046 nm laser produced by a neodymium-doped: yttrium-aluminum-garnet (Nd:YAG) lasing medium through a KTP crystal. This process doubles the

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frequency and thus the energy of the initial photons. The generated green light, because of its shorter 532 nm wavelength and its photoselective absorption by oxyhemoglobin, confines its thermal energy to a superficial volume of prostatic tissue, which is vaporized selectively and hemostatically. Although originally introduced as a 60W KTP laser, clinical trials using the 80W KTP laser have demonstrated favorable outcomes with minimal side effects, however these studies have been limited to smaller prostate sizes less than 80 cc.[1]

Subsequently, GreenLight laser technology (American Medical Systems, Minnetonka, Minnesota, USA) improved with the introduction of a high performance system (HPS) 120W laser. The HPS system uses a lithium triborate (LBO) crystal to deliver a 532 nm green light with a more collimated beam resulting in higher power density and a reduced divergence. Such features deliver higher tissue ablation capacity while reducing lasing time.[2] An increasing number of randomized clinical trials using the 120W-HPS laser have established its therapeutic equivalence with transurethral resection with regards to symptom improvements and quality of life with a reduced rate of intraoperative and perioperative complications.[3,4] More specifically, PVP confers a significantly lower rate of bleeding, blood transfusion, capsular perforation and fluid absorption compared to standard TURP.[3-5]

Short and intermediate outcomes studies have shown that GreenLight 120W-HPS laser was safe and effective in men with large prostate glands.[6-8] Although the durability of the outcomes has been questioned based on the significant re-treatment rates for larger glands, a recent study by Gu et al showed in a long term study that prostate volume does not affect the efficacy and the safety of GreenLight 120W-HPS.[3,8,9]

As such, the aim of our study was to analyze the clinical efficacy and complication outcomes of 120W-HPS laser vaporization in the treatment of obstructive BPH according to transrectal ultrasound prostate volume in 250 patients stratified according to prostate volume < 60 cc, 60 cc-100 cc and > 100 cc with a minimum follow up of 12 months.

Materials and methods

The Institutional Review Board granted approval for this study. Data was collected prospectively by reviewing the files of patients who underwent GreenLight laser 120W-HPS PVP for BPH performed by a single surgeon between July 2007 and August 2009.

Patient characteristics

Preoperative evaluation included a complete medical history, physical examination as well as the assessment of the American Urological Association Symptom Score (AUASS), Quality of Life (QoL) score and Sexual Health Inventory for Men (SHIM). Routine urine and blood analysis were performed measuring CBC, creatinine, electrolytes and serum prostate-specific antigen (PSA). Post void residual (PVR) volume and uroflowmetry (Qmax) were obtained. Cystoscopy and transrectal ultrasnonography (TRUS) were performed in all men to assess for other lower urinary tract pathology and prostate volume. Surgical indication was reviewed in accordance with BPH guidelines of the American Urological Association (AUA).[10] All men undergoing PVP had either persistent LUTS despite medical therapy or refractory urinary retention. If patients were found to have an elevated serum PSA value or abnormal digital rectal examination (DRE), prostate biopsies were performed preoperatively to exclude malignancy. Men with prostate cancer were excluded from the study.

Surgical procedure

General or spinal anesthesia was employed for the procedure and broad-spectrum antibiotic prophylaxis was given intravenously at induction. Transurethral PVP was performed using the 120 W GreenLight 120W-HPS according to technical recommendations of the international GreenLight user group.[11] The 2090 laser fibre (275 kj maximum energy lifespan) was used in all men. A 23 F cystoscope with a 30-degree angle lens was used with the lasing parameters set at 120W and 30W for vaporization and coagulation respectively. Continuous flow of room temperature normal saline (NS) was used for irrigation. Tissue vaporization was carried out until the transverse fibers were visualized and a TURP-like defect was created.

At case completion, a urethral catheter was placed and a voiding trial was performed 6 hours postoperatively. If patients were unable to urinate, the catheter was replaced prior to discharge. These patients returned the next day to our outpatient clinic for a second voiding trial. All interventions were performed as an outpatient's procedure and all men were discharged the same day with an oral prescription of antibiotics and analgesics. Perioperative parameters including laser utilization, energy and fiber usages, was recorded. In addition, serum hemoglobin and electrolytes levels were measured postoperatively.

Statistical analysis

The functional clinical outcomes (AUASS, QoL, SHIM, Qmax and PVR) were assessed prospectively at 3, 6 and 12 months and expressed a percent change of baseline.

TABLE 1. **Patient demographics**

	Group 1 < 60 g	**Group 2 60 g-100 g**	**Group 3 > 100 g**	**p value**	**Overall**
N =	134	76	40		250
Mean age	62.3	67.8	74.1	< 0.01	65.86
Mean PSA (ng/mL)	2.2	3.8	7	< 0.01	3.45
Mean TRUS volume (cc)	47	75.2	116	< 0.01	66.61
Mean AUA-SS	23	26	30	0.02	25.03
Mean QoL	4.2	4.4	4.5	0.56	4.31
Mean SHIM	16	14	10	0.03	14.43
Mean PVR (mL)	190	272	410	< 0.01	250.13
Mean QMax (mL)	9.2	7.3	6.3	0.01	8.16
Urinary retention (%)	14 (10.4%)	15 (19.7%)	15 (37.5%)	< 0.01	44 (17.6%)
Prostate configuration (%)					
Bilobar	101 (76%)	50 (66%)	21 (53%)	< 0.01	172 (68.8%)
Trilobar	33 (24%)	26 (34%)	19 (47%)	< 0.01	78 (31.2%)
Medication for BPH	44 (33%)	30 (40%)	22 (55%)	< 0.01	96 (38.4%)
Prior BPH surgery (%)	4 (3%)	4 (5%)	5 (12%)	< 0.01	9 (3.6%)

PSA = prostate-specific antigen; TRUS = transrectal ultrasonography; AUA-SS = American Urological Association Symptom Score; QoL = quality of life; SHIM = sexual health inventory for men; PVR = post void residual; Qmax = uroflowmetry for maximum flow rate; BPH = benign prostatic hyperplasia.

All adverse events were documented. Continuous variables were presented as mean ± standard deviation (SD) and range and categorical variables were presented as a percentage. Statistical analysis was performed using ANOVA test and $p < 0.05$ was considered to indicate statistical significance.

Results

Preoperative patient characteristics are summarized in Table 1. Patients were older in the group of larger prostates with a mean of 61.3, 67.8 and 74.1 years, respectively for groups 1, 2 and 3 respectively ($p < 0.01$). Mean PSA and mean prostate volume were significantly different amongst groups with a mean volume of 47 cc and PSA of 2.2 ng/mL in group 1, 75.2 cc and 3.8 ng/mL in group 2 and 116 cc and 7 ng/mL in group 3. The proportion of patients that were on medical treatment for BPH (alpha-blocker or alpha-reductase inhibitor) prior to surgery was significantly higher in patients with larger glands compared to medium and smaller glands (55% versus 40% versus 33% for large, medium and small prostates respectively; $p < 0.01$). Baseline data revealed no significant difference in prostate volume with respect to mean AUA-SS and mean QoL. SHIM scores were significantly lower in men with prostates > 100 cc ($p = 0.03$).

TABLE 2. **Operative parameters**

	Group 1 <60 g	**Group 2 60 g-100 g**	**Group 3 > 100 g**	**p value**	**Overall**
N =	134	76	40		250
Mean laser time (min)	31	44	59	< 0.01	39.43
Mean OR time (min)	47	62	89	< 0.01	58.28
Mean laser 2090 fiber	1.4	2.2	3.2	< 0.01	1.93
Mean energy (kJ)	163	309	473	< 0.01	256.98

With regards to surgical outcomes, mean laser time, fiber usage and laser energy delivery were all significantly increased proportionally in function of prostate size, Table 2; all p < 0.01. Mean laser energy and mean fiber usage were (163 kj; 1.4 2090-fiber), (309 kj; 2.2 2090-fiber), and (473 kJ; 3.2 2090-fiber) for small medium and larger glands respectively (all p < 0.01). Accordingly, the time in the operating room was significantly longer in prostates > 100 cc group with 89 min compared with 62 min in the 60 cc-100 cc group and almost twice as long in the < 60 cc group in which mean OR time was 31 minutes.

The overall follow up objective and subjective voiding parameters are listed in Table 3. Qmax was improved at 3 and 6 month in the overall cohort (94.62 % and 92.48% respectively) with no significant differences between prostate sizes (p = 0.09 and p = 0.08 respectively). Of note, glands > 100 cc showed statistically significantly less improvement in Qmax than medium and smaller glands (p = 0.04). Although improvement in PVR tended to trend towards treatment of smaller prostates, this was never statistically significant (88% versus 81% versus 71% for prostate < 60 cc, 60 cc-100 cc, > 120 cc respectively; p > 0.05). IPSS and QOL were similar for all prostate groups at 3, 6 and 12 months with no significant difference between prostate sizes (p > 0.05 for all).

As postoperative TRUS volumes were not available, mean PSA reduction measured at 6 months. Re-treatment rates were significantly higher in group 3 with 9% of men requiring surgical relief of lower urinary tract obstruction (p = 0.02). Complication rates such as delayed hematuria, defined as hematuria lasting after 14 days (p = 0.18), and urgency-dysuria symptoms (p = 0.21) were comparable regardless of prostate size.

Discussion

Surgical treatment of large prostates (> 80 cc) remains a challenge. According to AUA guidelines on the

TABLE 3. **Postoperative functional outcomes**

	Group 1 < 60 g	Group 2 60 g-100 g	Group 3 > 100 g	p value	Overall
N =	134	76	40		250
Improvement in Qmax %, (n =)					
3 months	205% (128)	212% (72)	234% (37)	0.35	211.65% (237)
6 months	197% (117)	191% (58)	171% (27)	0.12	191.8% (202)
12 months	194% (79)	175% (43)	162% (19)	0.04	183.89% (141)
Improvement in PVR %, (n =)					
3 months	98% (130)	95% (74)	82% (37)	0.09	94.62% (241)
6 months	95% (120)	97% (60)	72% (28)	0.08	92.48% (208)
12 months	88% (83)	81% (45)	71% (20)	0.11	83.57% (148)
Mean PSA reduction %, (n =)					
6 months	63% (123)	52% (61)	41% (30)	< 0.01	56.78% (214)
Mean IPSS (n =)					
3 months	9.1 (128)	9.7 (72)	10.2 (37)	0.71	9.45 (237)
6 months	8.3 (117)	8.7 (58)	8.9 (27)	0.54	8.49 (202)
12 months	8.1 (79)	8.2 (42)	9.0 (18)	0.38	8.25 (139)
Mean QoL (n =)					
3 months	2.5 (128)	2.4 (72)	2.7 (37)	0.21	2.5 (237)
6 months	2.3 (117)	2.5 (58)	2.7 (27)	0.31	2.41 (202)
12 months	1.9 (79)	2.2 (42)	2.5 (18)	0.1	2.07 (139)
Complications (%)					
Delayed hematuria (> 14d)	21 (16%)	10 (14%)	7 (18%)	0.18	38 (15.2%)
Urgency/dysuria	22 (17%)	11 (15%)	8 (20%)	0.21	41 (16.4%)
Retreatment	2 (1.5)	2 (2.6)	4 (9%)	0.02	8 (3.2%)

Qmax = uroflowmetry for maximum flow rate; PVR = post void residual; PSA = prostate-specific antigen; IPSS = IPSS = International prostate symptom score; QoL = quality of life managementof BPH, open prostatectomy remains the gold standard approach for men with very enlarged prostate glands.[10] TURP has been considered an appropriate, effective and safe alternative to open prostatectomy. Mortality associated with TURP has been decreasing over the years with a reported rate of 0.1 % in 2008. However, rates of bleeding requiring transfusions and transurethral resection syndrome have been estimated at 2.9% and 1.4% of patients respectively.[12] Specifically, these risks are increased if the gland is larger and the resection time is longer.[13] In a small series of prostates larger than 100 cc, Kwon et al reported a transfusion rate of 15.5% and TUR syndrome of 10.5% with the use of standard monopolar TURP.[13] Although this risk of TUR syndrome can be eliminated by the use of bipolar TURP, the risk of bleeding remains significant.

The more recent transurethral laser approaches, which have continued to evolve over the last decade, have been associated with less perioperative morbidity in addition to shorter catheterization time, length of stay and postoperative recovery with comparable improvements in LUTS.[4,10] In particular, although initially reserved for smaller glands, increasing evidence suggests a possible role of laser vaporization for men with very large prostates of > 100 cc.[4,10]

In our study, baseline PSA, mean Qmax and PVR, urinary retention, prior BPH medication, presence of median lobe and mean age were all significantly higher in prostate volume > 100 cc as compared to smaller glands (all $p < 0.01$). Notwithstanding these baseline differences, men with larger prostate volume, enjoyed important improvement in clinical outcomes similar to patients with smaller glands. Most importantly, prostate volume was not associated with statistically significant differences in postoperative AUASS, PVR and QoL. Similarly, no difference in Qmax was seen at 3 and 6 months ($p = 0.35$ and $p = 0.12$ respectively) confirming the short term efficacy of PVP regardless of prostate size.

Our analysis showed that increasing prostate size was associated with less efficient Qmax reduction at 12 months ($p = 0.04$), suggesting a diminished mid term efficacy of PVP for the treatment of prostate > 100 g. This difference in Qmax in large versus small prostates was not observed in other series using the 120W-HPS system, Table 4. For example, in the study of Gu et al.[8] At 12, 24 and 36 months they found no differences in postoperative Qmax between patients with prostate size > 80 cc compared with patients with prostate < 80 cc.[8] This distinction between the current study and that of Gu et al could not strictly be attributed to prostate volume cutoffs, since mean gland volumes were similar in the larger gland cohort (our cohort mean =116 cc versus Gu et al cohort mean = 118.1 cc). However, preoperative parameters such as IPSS and Qmax were considerably less favorable in our larger group, Table 4, and may underlie the difference of surgical outcomes. In addition, in the other reports assessing the performance of PVP 120W-HPS in larger prostates, either the follow up was very short < 6 months,[6,7] or the mean volume of the larger prostate group was considerably smaller than in our group (mean volume < 96 cc versus 116 cc in our group),[14] Table 4.

Furthermore, the marked difference in preoperative PSA value (mean value of 7 ng/mL in our large gland group versus 4.5 ng/mL in their group) might have contributed to this difference in outcomes. PSA level has been previously shown to correlate with prostate volume.[15] In addition, preoperative PSA value has been described as a potential marker on the level of clinical efficacy for treating symptomatic BPH with 80W of KTP laser. More specifically, Te and colleagues suggested that there was a significant difference in efficacy between patients presenting with a total PSA of < 6 or > 6 ng/mL.[16] A potential confounding variable that may have affected the Qmax with time in our large gland cohort is the older age (74.1 years) possibly associated with diminished detrusor function. Using the former generation KTP 80W, Buse and colleagues found that age independently affects both IPSS and QoL results at 12 months post PVP treatment.[17]

Our study demonstrated that laser utilization and operating time were significantly longer reflecting the need of higher energy delivery in bigger prostates. This was expected and comparable to other studies that show that prostate above 80 cc (mean 118.1 cc) compared with prostate below 80 cc (mean = 48.5 cc) requires approximately double operating time, laser utilization time and energy usage.[8] Interestingly, we applied more than twice the energy and laser time than they delivered in their larger prostate group (473 kj; 59 min in our study vs. 152.7 kj; 22.8 min in Gu et al). In a study analyzing the outcome of 120W-HPS PVP in men with enlarged prostate > 120 cc (mean = 156 cc), Woo et al reported an average laser time of 86 min and a mean energy utilization of 582 kJ. However, in their series they found that prostate size does not necessarily correlate well with energy utilization ($r = 0.35$) [6].

Vaporization of very large prostate glands with volume > 100 cc presents several particularities. The ultimate goal is rigorous vaporization of prostatic tissue down to the surgical capsule. For this it is critical to identify the anatomic landmarks, which can be more difficult in very enlarged prostates. Preoperative TRUS can indicate prostate configuration (ie. the presence of a median lobe) but also allows measurements of the various distances from the urethra to the capsule at 5- and 1-o'clock positions.

TABLE 4. **Comparison of published preoperative, operative and postoperative clinical data according to prostate size, in patients with larger prostate gland using PVP 120W-HPS**

Reference	Prostate Volume (cc)	Patient (n)	Age	Preop PSA	Preop IPSS	Preop Qmax
Present study	< 60 (47.2)	134	62.3	2.2	23	9.2
	60-100 (75.2)	76	67.8	3.8	26	7.3
	>100 (116)	40	74.1	7	30	6.3
Gue et al[8]	< 80 (48.5)	150	67.1	1.8	23.1	9.35
	> 80 (118.1)	57	72.1	4.5	21.5	8.62
Tasci et al[14]	< 70 (51.66)	301	67.48	3.26	22.88	9.35
	> 70 (96.45)	249	67.83	4.01	22.67	8.62
Woo et al[6]	> 120 (156)	33	71	16.2	24	7.5
Woo et al[7]	< 80 (48.6)	235	68.1	NA	22.6	7.6
	> 80 (118.4)	52	71.2	NA	22.1	5.8

Reference	Laser time (min)	Energy (kj)	Fiber use (mean #, or % ≥ 2 fibers)	Time point (mo)	Postop IPSS	Postop Qmax	Postop PSA (% reduction)	Retreatment rate (%)
Present study	23	163	1.4	12	8.1	17.85	63	1.5
	26	309	2.2		8.2	12.8	52	2.6
	30	473	3.2		9	10.2	41	9
Gu et al[8]	10.4	70.9	2	12	4	22.2	29	0
	22.8	152.7	5.3		3.6	21.2	33.1	0
Tusci et al[14]	NA	146.16	9.63	12	5.15	9.62	11.65	2.3
	NA	186.69	4.65		5.29	19.72	26.7	16
Woo et al[6]	86	582	2.3	3	8.6	9.6	38	3
Woo et al[7]	NA	NA	NA	4.2	8.1	21.7	NA	0.9
					8	19.7		0

PVP = photoselective vaporization prostatectomy; PSA = prostate-specific antigen; IPSS = International prostate symptom score; Qmax = uroflowmetry for maximum flow rate

Creation of the working space at the beginning of the procedure is essential to allow fiber movement and avoid contact with tissue and consequent fiber degradation. The creation of the working space requires more debulking in larger glands because of space restraints. We believe that it is best achieved by making two treatment groove incisions down to the capsule at 5 and 7 o'clock respectively from the bladder neck to the verumontanum using the power setting at 80W.

Another challenge is to deliver appropriate energy to optimize vaporization efficiency while minimizing energy delivery directly on to the capsules that can cause perforation, bleeding or unwanted postoperative irritative symptoms. The power setting can then be increased at 120W to vaporize the adenoma within the groove from the bladder neck to apex. Lateral lobes are particularly time consuming in large prostate glands. Using bladder neck and the urethral sphincter as landmarks, vaporization can be achieved with minimal lasing poses. Incising long pillars of tissue along the capsule and freeing them into the bladder can help to reduce OR time. Nevertheless vaporization remains laborious particularly when prostatic tissue is composed of less vascular stromal adenoma. The key of efficient vaporization is to treat tissue with the laser fiber maintaining working distance between 1 mm and 3 mm and constant rotation to maintain the incidence of the beam as perpendicular as possible and with a speed adapted to efficiency of vaporization.

In an attempt to optimize outcomes in larger prostates, alternative modified vaporization-resection techniques have recently been reported. More specifically, vapor incision technique (VIT) may potentially help to save laser time and energy in these patients with larger prostate volumes.[18] Son et al compared VIT to standard PVP in 104 males with prostate size > 40 mL (mean = 64.5 mL). Although not statistically significant, the VIT showed a potential trend towards a shorter and more efficient procedure compared to the standard PVP: in VIT versus standard PVP, mean laser time was (31.3 min versus 35.4 min; p=0.115), mean operating room time was (66.3 min versus 69.8 min; p = 0.491) and mean laser energy was (128.8 kj versus 151.4kj; p = 0.086).[18] Although it remains to be demonstrated, this potential advantage of VIT may be further enhanced when applied to larger prostate as their increased vascularization may possibly confer a greater absorption of the GreenLight energy. Vaporization efficiency was not assessed in our study but the comparison of vaporization efficiency between prostate < 80 cc versus > 80 cc, favored larger glands in the study by Gu et al (3.7 mL/min, versus 2.8 mL/min; p = 0.042).[8]

Potentially affected by the difference in ages and the prior use of alpha-reductase inhibitor medication between the groups, we found that mean PSA reduction measured at 6 months was significantly lower with a 41% reduction in the large prostates (p < 0.01). In our study, patients with larger prostates were significantly older (74.1 years; p < 0.01) and amongst them a significantly higher proportion were on BPH medical therapy prior to surgery (55%; p < 0.01). Thus the preoperative use of 5 alpha-reductase inhibitors may have limited the PSA drop expected from surgery. This PSA drop of 41% at 6 months is consistent with the 38% decrease at 3 months observed by Woo et al in prostate > 120 cc.[6] The fall in PSA observed with PVP in our study is less than would be expected following holmium enucleation of the prostate (HoLEP) or open prostatectomy. For example, in a series of 139 patients at the Methodist Hospital with average prostate size of 111.9 cc and a mean preoperative PSA of 8.6, a reduction of 86% was reported at 6 months after HoLEP treatment.[15] In another study, HoLEP treatment in 57 patients with a mean pre-treatment volume of 217.8 cc resulted in a mean PSA drop from 14.6 ng/mL to 0.78 ng/mL at 6 months post surgery.[19] Similarly, in a study that included 125 patients with large prostate > 80 cc randomized to open prostatectomy or 80W KTP PVP PSA, Alivizatos et al showed an average PSA reduction of 70% versus 40% respectively at 12 months.[20]

Neither the quantity of tissue removed nor the reduction of prostate size was measured in our study. However, if we assume that the fall in PSA levels after surgery can be used as a surrogate marker of tissue removal, this diminished PSA reduction may reflect less efficient tissue removal of PVP in large prostates.

Although this remains to be demonstrated, VIT may circumvent this issue, allowing resection and extraction of the tissue along the capsule, rather than vaporized centripetally layer by layer.[18] Accordingly we have sought to analyze the comparison of PVP and VIT in bigger prostate in another study and our results are forthcoming.

Safety is a topic of primary concern when treating men with larger prostates. Our data demonstrated that the HPS laser PVP can be performed on patients with varying gland sizes including bigger prostate > 100 cc. The incidence of adverse events was low and similar in both cohorts. This finding is consistent with others that also found low adverse events in treating large prostates confirming that PVP is a safe procedure regardless of prostate size.[6,8]

We observe a re-treatment rate that was significantly higher in the group of prostate size > 100 cc with a rate of 9% at 12 months. In Al-Ansari series, the reoperation rate in the PVP group was 11% over 36 months and all cases in this group had prostate size > 80 g.[3] An even higher reoperation rate of 16% was reported by Tasci et al in their large prostate > 70 cc at 12 months. versus 2.3% in prostate < 70 cc. Remarkably, Gu et al who examined the re-treatment rate in prostates > 80 cc versus < 80 cc with a 36 months follow up reported no re-treatment patients in either arms. Nevertheless, a high reoperation rate remains a concern in larger prostate glands and should be considered when choosing this procedure for this category of patients. Despite this limitation, PVP may still be considered an acceptable option for treating enlarged prostates > 100 cc, particularly in those patients who would not be ideal candidates for open surgery.

Alternatively, HoLEP is a well-established procedure for larger prostates and is considered an effective endourological alternative to open prostatectomy (OP). Several randomized trials comparing the two approaches have shown similar outcomes whereas catheterization time, hospital stay, and blood loss were reduced in the HoLEP group.[21,22] For prostates greater than 100 g, HoLEP compared to OP in a randomized trial, showed after a 5 year follow up similar outcomes and reoperation rate (5% versus 6.7% respectively).[23] Despite these excellent results in particular for larger prostate glands, HoLEP has not gained widespread use among practicing urologists and it is believed that its acceptance as a standard procedure may be hindered by its technical difficulty.[24]

Several studies have also suggested that PVP is cost effective when compared to TURP.[25,26] While a dedicated cost analysis was not performed in our study, the longer operating time and fiber usage required in larger prostates would inevitably be associated with greater cost. Similarly, additional cost owing to the higher re-treatment rate would also need to be taken into consideration in the economic analysis of laser PVP, particularly in an era of escalating healthcare costs. Interestingly, Litsikos et al found that PVP for 40 mL-70 mL prostate is less costly than TURP and is preferable particularly for patients still active in the workforce as hospitalization time and return to work is shorter.[26]

Despite its merits, there are several limitations of our study worthy of mention. These include the mid term follow up and the potential lack of power to detect significant differences in the outcomes of patients with larger prostates. However, the main weakness is the baseline difference of patients amongst treatment arms (Qmax and IPSS) and for age in particular. Because of the known deleterious effect of age on bladder function, this parameter emerges as a likely confounding variable making the analysis difficult to interpret. However, in absence of postoperative prostate volume and UDS we must concede that these arguments remain speculative. In addition, all procedures were performed by a single surgeon at a single institution. Patients were not systematically randomized to surgeon and therefore this may have introduced a bias. Comorbidities and the use of anticoagulant could have been recorded in the baseline parameters to ensure equal distribution between cohorts. Also, perioperative data such as prostate volume post PVP would have been useful to calculate vaporization efficacy. A multi-institutional prospective analysis of HPS PVP with long term follow up would be ideal to validate the prostate size relationship to outcomes.

Conclusion

Although larger prostates require more time and energy delivery, 120W-HPS PVP is safe and efficacious as an outpatient procedure for the treatment of patients with symptomatic BPH regardless of prostate size at 12 months. Vaporization for glands larger than 100 cc appears to require retreatment more often than smaller prostates indicating that there is still a need for further improvement in the laser performance and technique. Although PVP may be still an appropriate choice for these patients with larger prostates because of its attractive perio-operative safety profile, this limitation needs to be discussed. Alternatives such as HoLEP or open prostatectomy if the patient is a surgical candidate should be considered.

Further research is required to address optimal surgical management for men with prostate volume > 100 cc. More efficient forms of PVP such as VIT or 180W-XPS system with higher power vaporization may improve the effectiveness of tissue removal and address this issue.

Disclosure

Dr. Kevin C. Zorn is consultant for American Medical Systems (AMS) Inc. ☐

References

1. Hai MA, Malek RS. Photoselective vaporization of the prostate: initial experience with a new 80 W KTP laser for the treatment of benign prostatic hyperplasia. *J Endourol* 2003;17(2):93-96.
2. Heinrich E, Wendt-Nordahl G, Honeck P et al. 120 W lithium triborate laser for photoselective vaporization of the prostate: comparison with 80 W potassium-titanyl-phosphate laser in an ex-vivo model. *J Endourol* 2010;24(1):75-79.
3. Al-Ansari A, Younes N, Sampige VP et al. GreenLight HPS 120-W laser vaporization versus transurethral resection of the prostate for treatment of benign prostatic hyperplasia: a randomized clinical trial with midterm follow-up. *Eur Urol* 2010;58(3):349-355.
4. Capitan C, Blazquez C, Martin MD, Hernandez V, de la Pena E, Llorente C. GreenLight HPS 120-W laser vaporization versus transurethral resection of the prostate for the treatment of lower urinary tract symptoms due to benign prostatic hyperplasia: a randomized clinical trial with 2-year follow-up. *Eur Urol* 2011;60(4):734-739.
5. Ruszat R, Wyler SF, Seitz M et al. Comparison of potassium-titanyl-phosphate laser vaporization of the prostate and transurethral resection of the prostate: update of a prospective non-randomized two-centre study. *BJU Int* 2008;102(10):1432-1438; discussion 1438-1439.
6. Woo HH. Photoselective vaporization of the prostate using the 120-W lithium triborate laser in enlarged prostates (>120 cc). *BJU Int* 2011;108(6):860-863.
7. Woo HH RO, Bachmann A, et al. Outcome of GreenLight HPS 120-W laser therapy in specific patient populations: those in retention, on anticoagulants, and with large prostates (≥80ml). *Eur Urol* 2008(Suppl 7):378-383.
8. Gu X, Vricella GJ, Spaliviero M, Wong C. Does size really matter? The impact of prostate volume on the efficacy and safety of GreenLight HPS laser photoselective vaporization of the prostate. *J Endourol* 2012;26(5):525-530.
9. Pfitzenmaier J, Gilfrich C, Pritsch M et al. Vaporization of prostates of > or =80 mL using a potassium-titanyl-phosphate laser: midterm-results and comparison with prostates of <80 mL. *BJU Int* 2008;102(3):322-327.
10. McVary KT, Roehrborn CG, Avins AL, et al. Update on AUA guideline on the management of benign prostatic hyperplasia. *J Urol* 2011;185(5):1793-1803.
11. Muir G SFG, Bachmann A, Choi B et al.Techniques and training with Greenlight HPS 120-W laser therapy of the prostate: position paper. *Eur Urol* 2008(Suppl 7):370-377.

12. Reich O, Gratzke C, Bachmann A et al. Morbidity, mortality and early outcome of transurethral resection of the prostate: a prospective multicenter evaluation of 10,654 patients. *J Urol* 2008; 180(1):246-249.
13. Kwon JS, Lee JW, Lee SW, Choi HY, Moon HS. Comparison of effectiveness of monopolar and bipolar transurethral resection of the prostate and open prostatectomy in large benign prostatic hyperplasia. *Korean J Urol* 2011;52(4):269-273.
14. Tasci AI, Ilbey YO, Luleci H et al. 120-W GreenLight laser photoselective vaporization of prostate for benign prostatic hyperplasia: midterm outcomes. *Urology* 2011;78(1):134-140.
15. Tinmouth WW, Habib E, Kim SC et al. Change in serum prostate specific antigen concentration after holmium laser enucleation of the prostate: a marker for completeness of adenoma resection? *J Endourol* 2005;19(5):550-554.
16. Te AE, Malloy TR, Stein BS, Ulchaker JC, Nseyo UO, Hai MA. Impact of prostate-specific antigen level and prostate volume as predictors of efficacy in photoselective vaporization prostatectomy: analysis and results of an ongoing prospective multicentre study at 3 years. *BJU Int* 2006;97(6):1229-1233.
17. Buse S, Pfitzenmaier J, Wagener N, Haferkamp A, Hohenfellner M. Functional results 1 year after laser vaporization of the prostate: the impact of age. *J Endourol* 2009;23(8):1339-1342.
18. Son H, Ro YK, Min SH, Choo MS, Kim JK, Lee CJ. Modified vaporization-resection for photoselective vaporization of the prostate using a GreenLight high-performance system 120-W Laser: the Seoul technique. *Urology* 2011;77(2):427-432.
19. Krambeck AE, Handa SE, Lingeman JE. Holmium laser enucleation of the prostate for prostates larger than 175 grams. *J Endourol* 2010; 24(3):433-437.
20. Alivizatos G, Skolarikos A, Chalikopoulos D et al. Transurethral photoselective vaporization versus transvesical open enucleation for prostatic adenomas >80ml: 12-mo results of a randomized prospective study. *Eur Urol* 2008;54(2):427-437.
21. Elzayat EA, Elhilali MM. Holmium laser enucleation of the prostate (HoLEP): the endourologic alternative to open prostatectomy. *Eur Urol* 2006;49(1):87-91.
22. Naspro R, Suardi N, Salonia A et al. Holmium laser enucleation of the prostate versus open prostatectomy for prostates >70 g: 24-month follow-up. *Eur Urol* 2006;50(3):563-568.
23. Kuntz RM, Lehrich K, Ahyai SA. Holmium laser enucleation of the prostate versus open prostatectomy for prostates greater than 100 grams: 5-year follow-up results of a randomised clinical trial. *Eur Urol* 2008;53(1):160-166.
24. Gilling PJ, Wilson LC, King CJ, Westenberg AM, Frampton CM, Fraundorfer MR. Long-term results of a randomized trial comparing holmium laser enucleation of the prostate and transurethral resection of the prostate: results at 7 years. *BJU Int* 2012;109(3):408-411.
25. Goh AC, Gonzalez RR. Photoselective laser vaporization prostatectomy versus transurethral prostate resection: a cost analysis. *J Urol* 2010;183(4):1469-1473.
26. Liatsikos E, Kyriazis I, Kallidonis P, Sakellaropoulos G, Maniadakis N. Photoselective GreenLight laser vaporization versus transurethral resection of the prostate in Greece: A comparative cost analysis. *J Endourol* 2012;26(2):168-173.

