Vaporization of Prostate by 160W GreenLight Laser on Postoperative Erectile Function

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OBJECTIVE To evaluate the impact of photoselective vaporization of the prostate (PVP) on erectile function (EF) utilizing a 160W GreenLight laser system with up to 36 months of follow-up in men with lower urinary tract symptoms caused by benign prostatic hyperplasia.

METHODS A prospectively maintained database of patients who underwent GreenLight PVP was retrospectively reviewed. International Index of Erectile Function-5 (IIEF-5) questionnaire was used to assess EF. In total, 265 sexually active patients who underwent 160W GreenLight laser PVP were identified and divided into Group A with baseline IIEF-5 <19 and group B with baseline IIEF-5 ≥19. IIEF-5, International Prostate Symptom Score, quality of life, postvoid residual, and Qmax were recorded preoperatively, perioperatively, and at follow-up after 1, 3, 6, 12, 24, and 36 months. Recorded data were analyzed statistically using *t*- and χ^2 tests.

RESULTS The preoperative and perioperative data of the 2 groups were comparable. Significant improvements in International Prostate Symptom Score, Qmax, quality of life, and postvoid residual were observed in both groups at every follow-up visit throughout the 36 months with no significant difference between the groups. EF was sustained postoperatively compared with the baseline in the whole study population. In Group A (preoperative IIEF-5 <19), EF was significantly improved at 1 month and 12 month (P= .02 and P= .002).

CONCLUSION In patients undergoing PVP by 160W GreenLight laser for lower urinary tract symptoms secondary to benign prostatic hyperplasia, no significant detrimental effect was observed in the EF at up to 3 years of follow-up. However, in patients with preoperative erectile dysfunction (ED), we showed a significant improvement. UROLOGY 132: 164–169, 2019. © 2019 Elsevier Inc.

Transurethral resection of the prostate (TURP) has been utilized worldwide for 30 years and is still a gold standard surgical treatment for benign prostatic hyperplasia (BPH).[1] However, serious complications including blood loss, transurethral resection syndrome, and capsular perforation are still significant in patients treated with this approach. These deficiencies led to the pursuit of less invasive surgical treatments, and many excellent minimally invasive devices came into existence as alternatives to TURP. In recent years, photoselective vaporization of the prostate (PVP) has emerged as an efficient and durable first line alternative to TURP for the surgical treatment of BPH. The GreenLight laser is transmitted completely through the saline irrigation but selectively absorbed by tissue with high hemoglobin content, such as prostatic tissue. This offers superior focused vaporization capacity and perfect coagulation property.[2] Some previous studies demonstrated that PVP has similar efficacy and lower complication rates, such as hematuria and clot retention, compared to TURP.[3,4] However, the studies published regarding the effect of PVP on erectile function were inconclusive. Therefore, we conducted this retrospective study to assess the effect of PVP by 180W GreenLight laser on erectile function in patients presenting with lower urinary tract symptoms (LUTS) secondary to BPH.

PATIENTS AND METHODS

We conducted a retrospective review of prospectively maintained databases of patients who underwent GreenLight laser PVP at First Hospital of Shanxi Medical University and Tianjin Union Medical Center between October 2012 and June 2016. The patients with LUTS secondary to BPH and refractory to medication were selected for surgery based on the criteria

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established by EAU guidelines on BPH.[5] Accordingly, the patients with a maximum urinary flow rate (Qmax) <15 mL/sec, total serum prostate-specific antigen (TPSA) <4 ng/mL or total serum prostate-specific antigen= 4-10 ng/mL with negative prostate biopsy were candidates for the laser therapy. Those with a previous diagnosis of urethra/bladder neck stricture, urogenital trauma, prostate/bladder cancer, and neurologic disorders were excluded from the study. The patients with uncontrolled diabetes, hepatic dysfunction, and patients with history of coronary artery disease were also excluded. In addition, patients who were sexually inactive or did not complete the International Index of Erectile Function (IIEF-5) questionnaire were also not considered. The erectile function was assessed by the patients themselves, using the IIEF-5 questionnaire, which is an accepted and effective diagnostic questionnaire. It is also easy to use, understand, and complete.[6,7] Erectile dysfunction (ED) was defined as severe (IIEF-5 = 6 to <7), moderate (IIEF-5 = 7-15), mild (IIEF-5 = 16-21) and potent (IIEF-5 = 22-25). The patients were divided into 2 groups based on preoperative erectile function with no or mild ED as potent (IIEF-5 ≥19) (Group A) and those with moderate or severe ED as impotent (IIEF-5 <19) (Group B). General or spinal anesthesia was given to the patients depending upon their anticoagulation status. The procedures were performed according to the international GreenLight user guidelines and the surgeThorsten Bachon's experience and preference.[8] All patients received side-fiber vaporization. At first, the anatomic landmarks of prostate verumontanum were identified, especially the ureteral orifices avoiding ablating them. The vaporization was started from at 5-7 o'clock location for an initial plane, with starting laser power of 80W, which was increased to 160W with the widening of the cavity, until obstructive prostate tissues were removed. The lateral lobes were vaporized first and then the middle lobe, if present, was vaporized after completing the vaporization of lateral lobes. The periverumontanum prostate tissues were preserved to preserve ejaculatory function. The prostatic apex and the sphincteric area were vaporized at 80W laser power and a fast sweeping technique was followed at this point. At the end of the procedure, perioperative parameters, laser energy, and time taken for the laser were recorded. The urethral catheter was usually removed on the next morning after gross hematuria was improved or stopped. If the patient was unable to void, a urethral catheter was reinserted before the hospital discharge. The patient then was attempted to void after the removal of the urethral catheter at an outpatient clinic visit. The preoperative prostate volume was determined using transrectal ultrasound or CT scan. Baseline function parameters including International Prostate Symptom Score (IPSS), quality of life (QoL), postvoid residual (PVR), Qmax, and IIEF were assessed. These parameters were also recorded at follow-up visits scheduled at 1, 3, 6, 12 months, and once a year up to 36 months. The primary outcome measure for the analysis was the IIEF-5 score, while the secondary outcome measures for analysis were IPSS, Qmax, PVR, and QoL scores. The recorded parameters were tabulated using Microsoft Excel spreadsheets and analyzed by the SPSS version 20.0 software package. The parametric outcomes were expressed as the mean ± standard deviation (SD) for the groups. A 2-tailed Student's *t* test was used as a statistical tool for continuous variables. χ^2 test and Fisher's exact test were used to analyze categorical data. *P* values <.05 were considered statistically significant.

RESULTS

After applying the exclusion criteria of patient recruitment, 265 patients with known preoperative IIEF-5 value were reviewed. Of the patients, 169 and 96 were categorized in Groups A and B, respectively. Mean follow-up time was 16.8 months (8-36 months). The baseline characteristics of the groups are summarized in Table 1. The patients in group B were significantly older than those in Group A and also had higher American Society of Anesthesiologists (ASA) risk and a higher percentage on anticoagulants. Preoperative prostate volume, IPSS, Qmax, PVR, QoL, and the number of patients with an indwelling catheter were comparable between the 2 groups. Perioperative variables such as operation time and delivered laser energy were comparable between the 2 groups. The functional parameters, including Qmax, IPSS, PVR, and QoL at 1, 3, 6, 12, 24, and 36 months of follow-up, are summarized in Figure 1. Statistically significant improvements in the urinary functional values compared to the preoperative values were observed and were durable up to 36 months. Although, these functional parameters were not significantly different between the 2 groups throughout the follow-up period. Figure 2 demonstrates the trend of follow-up for the mean IIEF-5 scores. Considering all patients, the mean IIEF-5 value at the baseline was 14.9 ± 7.0, and at follow-up visits, after 1, 3, 6, 12, 24, and 36 months, were 16.2 ± 7.6, 17.9 ± 7.6, 15.9 ± 6.9,

Table 1. Clinical and demographic characteristics of patients

	Total	Group A	Group B	*P* Value
Number of patients	265	169	96	
Age (mean)	69.08	70.82	65.98	< .0001
Indwelling catheter (%)	59 (21.3%)	40 (22.7%)	19 (19.2%)	.59
Anticoagulant (%)	169 (61%)	122 (69.3%)	47 (47.5%)	< .0001
ASA score (ASA <3) (%)	189 (70.8%)	102 (61.4%)	87 (91.6%)	< .0001
(ASA ≥3) (%)	72 (27%)	64 (38.6%)	8 (8.4%)	
Prostate volume in cc (mean ± SD)	82.7 ± 49.0	87.9 ± 51.7	73.6 ± 42.7	.062
IPSS (mean ± SD)	21.5 ± 7.2	22.0 ± 6.7	20.6 ± 7.8	.106
QoL (mean ± SD)	4.3 ± 1.2	4.4 ± 1.2	4.1 ± 1.2	.09
Qmax (mL/min) (mean ± SD)	7.1 ± 3.8	7.1 ± 4.2	7.1 ± 3.0	.99
PVR (mL) (mean ± SD)	204.4 ± 260.3	183.9 ± 211.3	237.0 ± 324.7	.198
Delivered Energy (kJ) (mean ± SD)	251.5 ± 190.5	265.1 ± 192.4	226.8 ± 185.6	.14
Operation time (min) (mean ± SD)	30.5 ± 20.5	32.4 ± 21.6	29.1 ± 18.1	.09

IPSS, International Prostate Symptom Score; OIU, optical internal urethrotomy; PSA, prostate-specific antigen; PVR, postvoid residual; Qmax, maximum flow rate; QoL, quality of life; SD, standard deviation; TURP, transurethral resection of the prostate.
Group A: International Index of Erectile Function-5 (IIEF-5) <19; Group B: IIEF-5 ≥ 19.

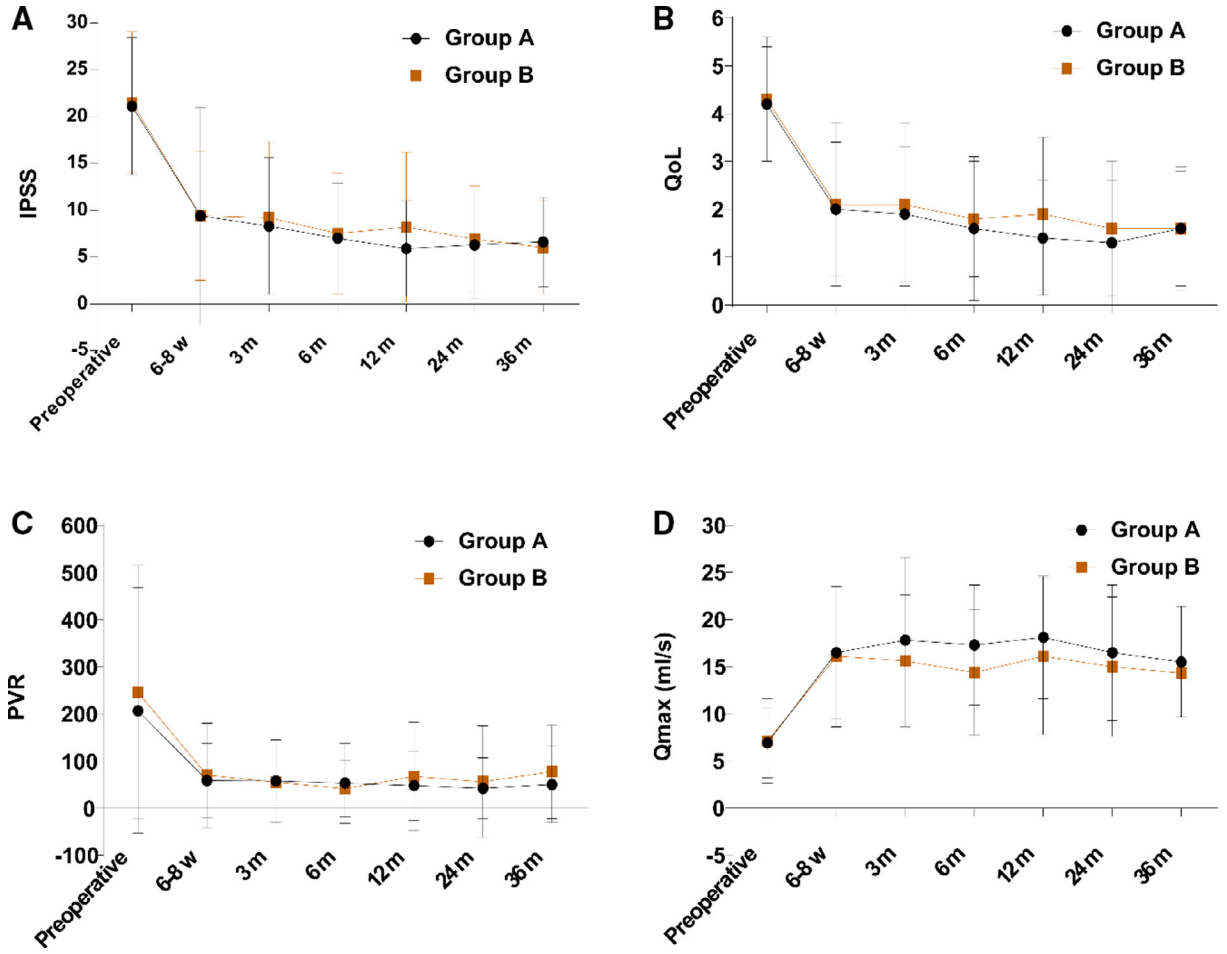

Figure 1. Functional parameters; (**A**): IPSS, (**B**): QoL, (**C**): PVR, and (**D**): Qmax; black spheres indicate Group A and brown squares indicate Group B. The functional parameters were significantly improved after PVP compared to the baseline. PVP, photoselective vaporization of the prostate. (Color version available online.)

16.9 ± 7.1, 17.2 ± 6.8, and 17 ± 7.6, respectively, without any significant change from baseline. When patients were classified into ED categories, the mean IIEF-5 scores in Group A (patients were classified into impotent category) were 10.5 ± 4.8, at the baseline, and 12.1 ± 6.8, 13.5 ± 7.6, 12.6 ± 5.9, 13.7 ± 6.3, 13.5 ± 6.3, and 13.4 ± 7.9 at 1, 3, 6, 12, 24, and 36 months of follow-up, respectively. The differences were significant when IIEF-5 was compared at 1 month and 12 months with the baseline values (P= .02 and P= .002). As for Group B (patients were classified into potent category), the mean preoperative IIEF score was 22.5 ± 2.2, and at 1, 3, 6, 12, 24, and 36 months of follow-up, the scores were 22.4 ± 3.6, 22.2 ± 4.8, 21.6 ± 4.4, 21.2 ± 5.7, 21.5 ± 4.5 and 20.6 ± 5.7, respectively. There was no significant difference at each follow-up visit compared to the preoperative data.

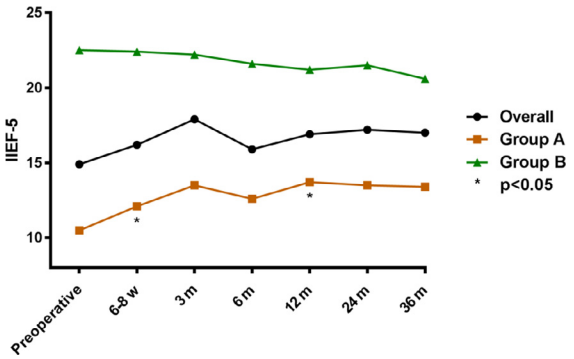

Figure 2. The brown curve (squares) indicates that, in Group A (impotent patients before PVP), IIEF score changed from baseline to each follow-up visits (a slightly rising trend can be seen). At first visit and after 12 months, there were significant improvements compared to the baseline. The green curve (triangles) indicates that in Group B (potent patients before PVP) IIEF score was maintained after PVP (slightly declining trend can be seen). The black curve (spheres) represents total population, where the IIEF scores were sustained after PVP and throughout the follow-ups. (Color version available online.)

DISCUSSION

BPH has become a public health concern. LUTS due to BPH are one of the most common clinical complaints in elderly men. With a growing concern for the postoperative QoL, patients pay more attention to erectile function after an operation in the choice of surgical treatments. TURP is the gold standard procedure for BPH, which solves many

problems of open surgery, but has limitations due to consequent complications such as dilutional hyponatremia caused by absorption of irrigation fluid, the risk of bleeding, and prolonged catheterization and hospitalization. PVP by GreenLight laser has emerged as a successful surgical technique, owing to its superiority in terms of less blood loss, effectiveness, and safety.[9-11] However, its effect on EF is still under investigation. Although some studies have reported the effect of PVP by GreenLight laser on erectile function, the available data are inconclusive.

Paick et al[12] studied erectile function using the self-administered Korean version of the IIEF questionnaire, where erectile function scores ranged from 6 to 30 for sexually active men. In their study, they used high-power 80W KTP laser PVP and observed significant improvement in total IIEF score from a baseline mean of 27.4 ± 3.8-34.9 ± 3.7 (P = .010) at 6-month follow-up (P <.05). Lukacs et al compared the effect of TURP and PVP on postoperative EF using Danish Prostate Symptom Score Sexual items (DAN-PSSsex) questionnaire and the results showed that EF was not different in the 2 groups at 1-year follow-up. In PVP group, 23.1% patients experienced improved EF, while it remained unchanged in 48.7% patients. There was a trend for improvement in erection and sexual satisfaction in the PVP arm when 1-year values were compared with baseline.[13] There have been several prospective studies on PVP efficacy and safety concluding that EF after PVP is maintained. Hamann et al[14] observed no effect on erectile function and libido score with 80-W KTP laser; IIEF-5 score was changed from 12.8 ± 9.2 at baseline to 12.1 ± 8.7 and 13.8 ± 8.0 at 3 and 12 months, respectively. Likewise, Spaliviero et al[15] prospectively evaluated EF in 72 patients after PVP by 120-W HPS laser up to 1-year follow-up; their median IIEF-5 was changed from 15 to 12, 16, 19, 16, and 17 during the 52 weeks follow-up period (P= .032, .427, .074, .081, and .259). They concluded that PVP by GreenLight HPS laser does not have a detrimental effect on EF. However, a negative impact on EF after PVP has also been reported. Hossack et al[16] found that 120-W LBO laser is associated with a major decline in EF in 12.4% of men at 3 months and 24% of men at 1 year, despite producing significant improvement in voiding parameters such as IPSS, Qmax, PVR, and prostate size reduction with minimal complications. In our study, we divided all 265 patients with an active sexual ability that underwent a PVP into 2 groups based on if they were potent before the PVP. We observed an improving trend of EF in patients during follow-ups who were defined as impotent (Fig. 2). Significant improvements were seen at 1 month (10.5 ± 4.8-12.1 ± 6.8, P= .02) and 12 months (10.5 ± 4.8-13.7 ± 6.3, P = .002). The patients with preoperative IIEF ≥19 (Group B) experienced no change in EF after PVP, while a slight decline, but statistically nonsignificant, can be seen throughout the 36 months of follow-up (Fig. 2, green curve). However, the level of EF was sustained during the follow-up, while considering the total population (Fig. 2, black curve), a nonsignificant improving trend can be seen.

The main risk factors for EF impairment are injuries to nerve and vasculature. The injuries include perforation, which can break the integrity of the capsule and directly hurt the nerve and vasculature. Other types of injuries include heat penetration from the electrode or laser cutting and coagulation.[16] GreenLight laser has a wavelength of 532 nm and a corresponding depth of penetration of 800 μm in tissues, which is relatively superficial. Previous studies showed that nearly 6%[17] of patients experienced capsule perforation during TURP while in our study none of the patients experienced capsule perforation. In addition, we utilized a fast sweeping technique, so the diffusion of the heat penetrating through the capsule was less, which could harm the nerve, especially at the apex than the base. Thus, we usually start from a relatively low power at the apex and then increase to 160W when lasing other sites. That is the possible reason why our general population did not show any detrimental effect in preoperative potent patients. The declining trend in Group B patients could possibly be due to the natural loss of erectile function by advancing age during the 3 years of follow-up.

LUTS symptoms secondary to BPH have a significant impact on the QoL.[18-20] On the other hand, BPH was regarded as an independent risk factor of ED in aging men. Many men with BPH showed concomitant ED, suggesting that there might be a link between both conditions.[21,22] In a cohort of men scheduled for the surgical management of BPH, more than one-third with moderate BPH symptoms and nearly 95% with severe LUTS due to BPH were found to have ED.[23] This leads us to conclude that surgical treatments for BPH like TURP, PVP, or by other methods can improve LUTS and EF as well.[24,25] Both groups of patients, in our study, experienced comparable significant improvements on IPSS and QoL score and these improvements were maintained up to 36 months, demonstrating that their LUTs had been relieved greatly. In our opinion, relieved nocturia postoperatively significantly improved sleeping quality which improved sexual function subsequently. Therefore, we deduced the patients who had ED (baseline IIEF-5 <19) experienced enhanced EF immediately after PVP possibly because of the greatly relieved urinary symptoms.

Kumar et al[26] conducted a prospective study on 143 patients to assess the effect of PVP by 120W HPS laser on erectile function with a follow-up of up to 12 months. They divided patients into 2 groups using the same IIEF-5 cut-off value as we did. The patients with preoperative IIEF-5 <19 showed a change from 14.67 ± 2.05 to 12.79 ± 1.42 (P = .53) after PVP, while those with IIEF-5 ≥19 showed a change from 21.06 ± 1.21 to 19.84 ± 1.55 (P = .43). These results were different from ours, as their groups showed a nonsignificant decline in IIEF-5 postoperatively, while our data showed significant improvement among the impotent patients postoperatively. We assume that one of the possible reasons for the different outcomes

between these 2 studies could be the different levels of LUTS. In Kumar's study, the patients in the impotent group experienced a change in LUTS from preoperative 20.34 ± 1.87 to 10 ± 1.3 (while ours from 22.67 ± 6.7 to 9.66 ± 4.4) at first month, QoL from 3.83 ± 1.17 to 2.11 ± 0.61 (ours from 4.4 ± 1.2 to 2.01 ± 1.1). Impotent patients in our study experienced greater relief in LUTS and QoL which consequently improved their erectile function.

In our study, PVP using 160W GreenLight laser was found to be a safe and effective alternative to the gold standard TURP. With the growing concern for erectile function after BPH surgery, we could recommend that PVP using 160W GreenLaser may be considered as one of the techniques of choice not detrimental to EF.

Our study has several limitations, the first was its retrospective nature. The second limitation was that we used a simplified version of IIEF questionnaire (IIEF-5), which did not allow us to precisely estimate changes in the different components of erectile function. Furthermore, IIEF-5 is focused on partnered/penetrative intercourse and may not be appropriate to measure erectile function in other settings. Thirdly, we did not perform an analysis of risk factors affecting erectile function such as specific diseases and medication that some patients were taking which could affecting EF. Fourth, surgeon experience in this study is a major driver of BPH outcomes. We did not perform comparative study using different energies such as thullium, holmium, etc.

CONCLUSION

In our study, the erectile function appears to be sustained in a general population after PVP, however, in patients with normal preoperative EF, we also observed a sustained EF after PVP. In men with pre-existing ED prior to surgery, we observed improvement in EF up to 3 years of follow-up. Future well-designed studies are needed to validate our findings.

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