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ORIGINAL ARTICLE

The efficacy of green light laser prostatectomy in the management of urinary retention due to prostate hyperplasia

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Abstract

To evaluate the efficacy and safety of 120 W potassium titanyl phosphate (KTP) in the treatment of urinary retention (UR) due to benign prostate hyperplasia in high-risk patients. Forty-six male patients with mean age of 73.78 ± 9.82 years who had UR and underwent 120 W KTP laser vaporization of the prostate between January 2015 and June 2017 were included. We evaluated perioperative parameters including serum prostate specific antigen, prostate volume, period of postoperative catheterization, vaporization time, delivered energy, hospitalization period, as well as intraoperative and postoperative complications. In the follow-up protocols, International Prostate Symptom Score and quality-of-life questionnaire (IPPS-QoL) and postvoid residual volume (PVR) were also assessed. The mean follow-up period was 15.57 ± 9.26 (1–42) months. All patients get rid of UR, except 1 patient (2.1%) remained on Foley catheter and standard TURP was done. Mean vaporization time was 8.57 ± 4.19 min, and mean energy delivered was 51.7 ± 29.9 kJ. No intraoperative complications were observed and no blood transfusion was done. The mean postoperative IPSS at the last follow-up was 9.64 ± 6.65 and the QoL score was 1.61 ± 1.31. Green light laser prostatectomy is a safe, simple, and effective procedure for the treatment of UR secondary to BPH in high-risk patients. Short hospitalization, low rate of intra operative and postoperative complications with rapid improvements in the objective, and subjective voiding parameters are important considerations of this procedure.

Keywords Prostate · Green light laser · BPH

Introduction

Benign prostate hyperplasia (BPH) is one of the most commonly diagnosed conditions of the male genitourinary tract and worldwide results in 1.2 million surgical procedures per year. BPH is a benign enlargement of the prostate gland that affects 30% of men between 50 and 60 years in age and up to 90% of men over the age of 85 years, causing lower urinary tract symptoms (LUTS) which can severely impact a man's quality of life [1, 2]. Transurethral resection of the prostate (TURP) is considered the preferred treatment for LUTS due to BPH. However, the efficacy of this procedure remains questionable, especially in patients with large prostate volumes and/or comorbid diseases (e.g., cardiac problem). Over the last decade, there have been efforts to identify new technologies that can replicate the efficacy achieved by monopolar TURP but with an improved safety profile [2]. Malek et al. was the first who reported the results of the first generation 60 W high power 532-mm potassium titanyl phosphate (KTP) laser photoselective vaporization for the treatment of BPH in 1998 [3]. The green light laser (GLL) technology was initially commercialized as an 80-W KTP 532 mm then the laser generator was subsequently improved to the 120-W LBO and to the current laser at 180-W LBO (lithium triborate)/532 mm XPS with side-firing MoXy liquid cooled fiber. Green light laser (GLL) prostatectomy has been used as an alternative to TURP especially for those with small volume of the prostate and moderate lower urinary tract symptoms [4]. Patients with cardiac problems, vascular disease on anticoagulation, heart pacemakers, old age, comorbid diseases, and high risk of anesthesia represent a feasible option for GLL prostatectomy. Many recent studies concluded that GLLP using different generators is equivalent to TURP for small to mid-size prostate and has gain wide acceptance among urologist [5, 6].

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However, there is scarcity of studies regarding the efficacy of GLL prostatectomy for patients with UR, huge prostate, or with sever comorbid diseases [7–10]. Herein, we evaluated the efficacy and safety of GLL prostatectomy using 80–120 W KTP in high-risk patients with UR due to BPH where standard TURP is difficult to be performed.

Materials and methods

From January 2015 to June 2107, 46 consecutive high-risk patients with mean age of 73.78 ± 9.82 years who underwent GLL prostatectomy due to UR were included. Laser vaporization was performed by one surgeon under spinal or general anesthesia using 80–120 W AMS KTP green light laser with wave length 532 nm. All patients were diagnosed to have BPH and transrectal ultrasound-guided (TRUSG) biopsy was performed in case of elevated serum PSA or an abnormal digital rectal examination. Continuous flow 21 F cystoscopy with 30° lens and laser set to 80 W first then 120 W for vaporization and 35 W for coagulation. The fiber was inserted through the continuous flow laser cystoscope with separate irrigation channel. Normal saline 0.9 at room temperature was used as irrigant; vaporization was performed at direct vision using laser fiber with near contact. Sweeping technique to achieve efficient tissue vaporization with a close working distance of about 2 mm is maintained. Like in TURP starting at the bladder neck and then to lateral lobes, the anterior lobe, and finally, the apical portion at the end, three ways 20 Foley catheter was placed with continuous irrigation with normal saline at slow rate. Patients were discharged with oral antibiotics. Our definition of high risk was an American Society of Anesthesia (ASA) score more than 3. Six patients (13%) had history of previous standard TURP. Seven patients (15.2%) had neurogenic bladder and all of them underwent urodynamic study before surgery. Mean period of preoperative catheterization was 33.52 ± 38.00 days, mean prostate volume was 65.24 ± 22.91 ml, and the mean preoperative PSA was 4.97 ± 4.50 ng/ml. Overall baseline demographics characteristics of the patients are presented in Table 1. The majority of patients (42 patients, 91.3%) had at least 2 comorbid diseases: cardiac or vascular with anticoagulant therapy, pacemaker, diabetes, and hypertension Table 1. Preoperative evaluation included digital rectal examination (DRE), TRUSG, routine analysis, blood analysis, coagulation parameters, prostate volume, prostate specific antigens (PSA), heart function, and lung function. The medical records were evaluated in terms of perioperative parameters including serum PSA value, prostate volume, period of postoperative catheterization, vaporization time, delivered energy, hospitalization period, as well as intraoperative and postoperative complications. All patients were evaluated 1, 6, and 12 months postoperatively; International Prostate Symptom Score and quality-of-life questionnaire (IPPS-QoL), postvoid residual volume (PVR), urethral stricture, urinary incontinence, and erectile dysfunction were also assessed. The mean follow-up period was 15.57 ± 9.26 months.

Table 1 The preoperative demographic characteristics of the study group

Parameter	Mean ± SD/percentage
Age (year)	73.78 ± 9.82
< 60	4 (8.7%)
60–69	9 (19.6%)
70–79	20 (43.5%)
80+	13 (28.3%)
Marital status	
- Married (*n*)	42 (91.3%)
- Widowed or divorced (*n*)	4 (8.7%)
Smoker (*n*)	11 (23.9%)
BMI (Kg/m^2)	27.02 ± 4.54
-Normal (18.5–24.9)	17 (37.0%)
-Overweight (25–29.9)	20 (43.5%)
-Obese (30 or above)	9 (19.6%)
HTN (*n*)	28 (60.9%)
DM (*n*)	18 (39.1%)
Cardiac disease(*n*)	18 (39.1%)
Pacemaker (*n*)	7 (15.2%)
Anticoagulation (*n*)	9 (19.6%)
Neurogenic bladder (*n*)	7 (15.2%)
History of TURP (*n*)	6 (13.0%)
Urinary stones (*n*)	8 (17.4%)
Inguinal hernia (*n*)	8 (17.4%)
Erectile dysfunction (*n*)	21 (45.7%)

N number of patients, *BMI* body mass index, *HTN* hypertension, *DM* diabetes millets, *TURP* transurethral resection of prostate

Statistical analysis

All data were presented as mean ± standard deviation (SD). IBM SPSS Statistics Version 20.0 software was used for the statistical analysis. A p value of greater than 0.05 was accepted as insignificant. Comparison between the parameters of subgroups was calculated by the use of Wilcoxon Signed-Rank Test and Fisher's Exact test. Pearson correlation test was used to measure the correlation pairs of continuous variables.

Results

All patients became free of catheter except one patient (2.1%) remained on Foley and standard TURP was done. There was no intraoperative complication, no patient required blood

transfusion and non-showed any evidence of intraoperative fluid absorption leading to serum electrolyte abnormalities. Mean vaporization time was 8.57 ± 4.19 min, and mean energy delivered was 51.7 ± 29.9 kJ. Three patients could urinate but with significant PVR (300 cc) thus, Foley was placed for 3–4 weeks and alpha blocker was started, then they urinated without significant PVR: 2 of these patients had neurogenic bladder and one of them had huge prostate volume. There is a significant improvement in the mean of IPSS (9.64 ± 6.65) and QoL score (1.61 ± 1.31). Postoperative PSA serum value at the last follow-up was 3.2 ± 3.06 ng/ml without significant change. Mean catheterization and hospitalization periods times were 7.77 ± 5.34 and 1.41 ± 0.86 days, respectively. Urethral strictures were observed in only one (2.2%) patient. Data on urinary incontinence was available in 39 patients and 4 patients (10.3%) had incontinence. Urinary incontinence was defined as any kind of leakage of urine. Retrograde ejaculation was seen in one patient (2.2%). Data on sexual function was available on 25 patients. Erectile dysfunction was seen in 4 patients (16%). In Table 2, the functional outcomes were illustrated.

Discussion

In the current unique study, only high-risk patients regardless to prostate volume with UR were included. Not surprisingly, such challenges cases required experienced surgeon and well-qualified center as the majority of the patient were unfit for standard open prostate surgery or standard TURP. Fortunately, we had no intraoperative complication and almost all the patients were discharged in the first postoperative day. However, in literature rate of 3% for capsular perforation and 6.5% of conversion to TURP were reported [11]. Although, such patients with huge prostate volume, urinary retention, history of previous TURP, and/or with anticoagulation are expected to have more intraoperative complications like capsular perforation, intraoperative bleeding, long hospitalizations, and operative periods [2, 12]. Hospital stay was 1 day for the majority of patients (35, 76.1%) and only 11 patients were hospitalized for more than 1 day and this was due to associated comorbid diseases and not due to postoperative complication of GLL prostatectomy.

Table 2 Postoperative functional outcomes

Parameter	Mean ± SD or frequency
Period of hospitalization (days)	1.41 ± 0.858
Catheterization period	7.77 ± 5.34 days
IPSS	9.64 ± 6.65
QoL score	1.61 ± 1.31
Retrograde ejaculation (*n*)	1 (2.2%)
Urinary incontinence (*n*)	4(10.3%)
Urethral strictures (*n*)	1 (2.2%)
Erectile dysfunction after surgery (*n*)	4(16%)
Postoperative PSA	3.24 ± 3.06

N number of patients, *IPSS* international prostates symptoms score, *PSA* prostate-specific antigens

Regarding the catheterization, we used to keep Foley for few days; however, in the literature, some author reported 1 day of catheterization [11]. In such trial, 10% failed to urinate after removal of catheter and the majority of these cases were of men with indwelling catheter [11]. One of the causes of keeping Foley catheter for few days is this reason as all patients were with UR and indwelling catheter. The high comorbidity and the associated diseases like neurogenic bladder, huge volume of the prostate in some patients, and the advance age in the majority of the patients lead us to keep Foley for furthers few days. Three patients were (6%) unable to urinate after catheter removal: 2 of these patients were with spastic neurogenic bladder, thus partial resection of the prostate was done in case not to have urinary incontinence. We believe that GLLP is preferable for such patients with spastic neurogenic bladder as partial resection of the prostate is more possible than with standard TURP. Also, we believe that keeping the Foley for longer period allow the resolution of edema in the prostatic tissue, thus risk of UR and irritative symptoms after the catheter removal will be less likely.

The operative time was short in our study, the mean of vaporization time was 8.57 ± 4.19 min, and the mean energy delivered was 51.7 ± 29.9 kJ. In comparison to other studies in the literature, we had short vaporization and less energy delivered. Malek et al. reported a mean of 467 kJ over 98 min of operative time [11]. Even in 40% of the patients, more than one fiber was used [11]. The long operative period and higher delivered energy may increase the risk of intra and postoperative complications. In our study, it is difficult to apply the same long operative time and high-delivered energy as our patients were high risk. Altay et al. reported mean operative time of 65.5 min and mean lasing time of 44.7 min in patients with prostate volume more than 80 cc using 180-W xps green light laser vaporization which is less than the reported period in similar studies using 80-W KTP and 120 HPS in patient with similar prostate volume [2, 12–14]. According to the European Association of Urology (EAU) and American Association of Urology (AUA) endoscopic management of huge prostate volume more than 100 cc other than open prostatectomy, Holmium laser enucleation of the prostate (Holep) is the preferred treatment option in patients with large prostate [15, 16]. Holep has the disadvantage of long learning curve and long operative time, difficulty in access to additional surgical material, and use of intravesical morcellation [17]. Moreover, we believe that Holep laser does not easily allow partial resection of prostate in patient with neurogenic bladder like that of KTP green light laser prostatectomy.

Urethral stricture rate was (2.2%) lower than the published rates. Horasanli et al. reported 5.1% of urethral stricture after KTP laser prostate vaporization for prostate volume between 70 and 100 cc with median operative time of 87 min [10]. However, not with similar prostate volume but with less operative time and less delivered energy, Altay et al. reported 2.9% rate of urethral stricture [18]. It is clear that long operative times and high delivered energy may increase the risk of urethral stricture and negatively affect the functional outcomes.

The amount of delivered energy depends mainly on the preoperative prostate volume as our study findings show. We believe that the lasing time per 1 ml tissue vaporization and the amount of vaporized tissue per joule can vary a cross surgeons and patients as well. Working distance energy setting sweep speed and sweeping angle and surgeons experience may affect the efficacy of laser vaporization, thus affect vaporization time and delivered energy. The efficiency of vaporization decreased when distance became 3 mm. In our study, we used to start with 80 W, then vaporization setting increased up to 120 W, then faster sweeping and larger sweeping angles generated wider bur more superficial vaporization defects leading to smaller vaporized tissue volume per joule.

Urinary symptoms (IPSS, QoL) were significantly improved. In the postoperative period, the IPSS and QoL scores were 9.64 ± 6.65 and 1.61 ± 1.31, respectively which means that there is no need for any further treatment or medical therapy. No patient was in need for retreatment till the last follow-up. However, in the literature after 2 years, the retreatment rate was reported to be 5.4 and up to 9.3% at 3 years [11]. Bouchier-Hayes et al. reported decrease of serum PSA level after both TURP and KTP at 1-year follow-up. However, this decrease was not statistically significant in the KTP group [19]. Similarly, in our study, though, we had no significant reduction in the serum PSA value.

Sexual function was assessed using the first question of the International Index of Erectile Function (IIEF): Over the past 6 months, how do you rate your confidence that you could get and keep an erection? Thus, the erectile function was classified as very low, low, moderate, high, and very high. Altay et al. reported no significant change in the ED during the follow-up period [18]. Retrograde ejaculation after TURP may occur in 70–100% [20]. On the other hand, KTP laser vaporization of prostate may lead to development of retrograde ejaculation in 15–26% of the patients. [21, 22]. KTP may be preferable to those who want to preserve their sexual function especially in younger population.

We believe that one of the advantages of using GLL is the low impact of this procedure on the erection. This may be due to the short penetration depth to the prostatic tissue, thus the harmful effect on the pericapsular neurovascular bundle is less likely to occur. In our study group, the patients had advances ages with comorbid diseases which make the evaluation of erectile function is suboptimal. However, only 4 patients (16%) had significant reduction in their score; the average age of these patients was 73 years, and average of prostate volume were 60 cc and the average energy delivered was 50,000 joules. There was no significant relation between the delivered energy and the post-op erectile function. It is also difficult to make solid comment regarding this issue because of the low number and advance age of the study group.

Urinary incontinence was seen only in 4 patients (10.3%). The average age of these 4 patients was 82 years, with average volume of 86 cc and average of 86,000 kJ as delivered energy. The average age of patients without incontinence was 72 years (average of delivered energy was 46,000 kJ, average prostate volume was 61 cc). It is clear that the age and delivered energy in patients with incontinence were more than in those without incontinence, but due to the low number of patients, it is difficult to make comment on the relation between incontinence and delivered energy. We believe that like in erectile dysfunction, low penetration of laser energy may reduce the destructive effect on the external sphincter.

Conclusion

Green light laser prostatectomy is a safe, simple, and effective procedure for the treatment of UR secondary to BPH in high-risk patients. Short hospitalization, low rate of intra operative and postoperative complication with rapid improvements in the objective, and subjective voiding parameters are important considerations of this procedure. Favorable functional outcomes in terms of low risk of stricture, incontinence, and ED are also important considerations of this procedure. Our observation suggests that significant improvement in outcomes is durable.

Compliance with ethical standards

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Conflict of interest The authors declare that there is no conflict of interest.

Informed consent The study was retrospective; therefore, no need for informed consent to be obtained from the patients.

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