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ORIGINAL ARTICLE

Outcome of diode laser vaporization for high risk patients with benign prostatic hyperplasia.

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ABSTRACT…. Objective: To determine the outcome of laser vaporization of prostate using diode at 980/1470 nm for the treatment of BPH among high risk patients. **Study Design:** Longitudinal Observational Study. **Setting:** Shalamar Hospital, Lahore. **Period:** June 2009 till June 2022. **Material & Methods:** Total of 500 patients with associated co-morbid illnesses and benign prostate hyperplasia not responding to medical therapy, failed trial without catheter, chronic urinary retention, refusal for TURP were assessed for eligibility to enter the study. Inclusion criteria were patients with refractory urinary retention, chronic urinary retention, failure of previous medical treatment. Exclusion criteria were patients with neurogenic bladder, carcinoma of prostate, carcinoma of bladder, abnormal digital rectal examination, known neurological disorder or history of spinal cord injury also were excluded from study. **Results:** The patients' mean age was 68.57 ± 7.98 years, Baseline mean maximum urinary flow rate was 5.57±2.44 mL/s, post void residual was 130.91±24.18 mL, and international prostate symptom score was 26.09 ±2.40 at preoperative. At 3 months follow-up, Qmax was 23.31±8.0, PVR was 22.43±5.21 and IPSS was 7.27±1.42. On the other hand, mean Qmax was 25.83±6.84 mL/s, PVR was 18.38±4.53 mL, and IPSS was 5.29 ±0.61 at 6 months follow-up. **Conclusion:**Treatment of BPH by 980/1470 nm diode laser have effective and safe clinical outcome for high risk patients as we found significant improvements in Qmax, IPSS, and PVR at 3 months and 6 months follow up.

Key words: Lasers, Prostatic Hyperplasia, Semiconductor Diode Lasers, Treatment Outcome, Vaporization.

INTRODUCTION

Photo-selective vaporization of the prostate has been introduced as one of gold standards of care in the treatment and management of benign prostatic hyperplasia.[1] Benign Prostatic Hyperplasia (BPH) is a condition in men in which the prostate tissues become enlarged but not cancerous. BPH is also termed as Benign Prostatic Obstruction (BPO). There are several surgical methods have been developed to treat BPH in elderly men such as transurethral resection of prostate (TURP). There has been massive growth in the prevalence of BPH with an increase in elderly men population and hope for better quality of treatment. Despite TURP has a higher rate of success, operative safety and perioperative morbidity specifically in terms of bleeding have posed a serious threat to the quality of life.[2] Additionally, Qian et al. stated that transurethral resection syndrome and retrograde ejaculation due to irrigant absorption are the major complications associated with the TURP that have reduced the success and effectiveness of TURP in the BPH treatment.[3] The technical advancements for BPH treatment with TURP have not made sufficient improvement in the safety of TURP and rate of blood transfusion, retrograde ejaculation, prolonged catheterization time, bladder neck contractures, and urethral strictures are still high. With regard to it, alternatives to TURP treatment is required that provide similar clinical outcomes with fewer complications.

LVP (Laser Vaporization of Prostate) is one of the effective alternative treatment method to TURP that creates different effects in prostate tissues,

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including vaporization and coagulation. In the treatment of BPH, different types of laser such as holmium, potassium-titanyl phosphate (KTP), thulium, and diode have been available.[4] Among these, PVP through holmium and KTP laser has acquired more popularity. Multiple laser devices at different wavelength have been developed to be used in the treatment of BPH. PVP using KTP laser is working at the wavelength of 532 nm and providing efficient vaporization of prostate. It is stated that PVP through KTP laser at 532 nm provides efficient hemostasis due to its ability to get absorbed greatly by hemoglobin.[5] However, it has minimal absorption in water that cause slow ablation and prolonged operation time. In this regard, the semiconductor diode laser has found to be the best due to its hemostatic properties. However, due to its severe complications such as pain, dysuria, and urinary symptoms, it is less preferable in BPH the treatment. A newly developed diode laser working on the wavelength of 980 nm is thought to be efficient for the treatment of BPH due to its significant absorption in hemoglobin and water causing high ablative properties of tissues, new fiber design, and effectual hemostasis.[6] Moreover, laser vaporization of prostate using diode at 980 nm has reduced risk of perioperative complications and reduced stay at the hospital.

Considering this, the aim of this research is to assess the outcome of laser vaporization of prostate using diode at 980 nm for the treatment of BPH.

MATERIAL & METHODS

Patients

Five hundred high risk patients from Shalamar Hospital were included within the duration of 14 years from June 2009 till June 2022 after approval from ethical committee (18.03.23). Patients associated with co-morbid illnesses and benign prostate hyperplasia not responding to medical therapy, failed trial without catheter, chronic urinary retention, refusal for TURP were assessed for eligibility to enter the study. Preoperative workup includes routine blood chemistry including prostate specific antigen, complete blood count, serum creatinine and urea, serum electrolytes, bleeding profile, urine analysis and culture sensitivity, ECG, chest x-ray, digital rectal examination and transrectal ultrasound was performed to estimate the size of prostate. IPSS was completed by self assessment. Inclusion criteria were patients of ASA-III, ASA-IV with refractory urinary retention, chronic urinary retention, failure of previous medical treatment. Exclusion criteria were fit patients of ASA-I or ASA-II with neurogenic bladder, carcinoma of prostate, carcinoma of bladder, abnormal digital rectal examination, known neurological disorder or history of spinal cord injury also were excluded from study. A systematic assessment was performed for all patients with detailed medical history, clinical examination and routine laboratory and imaging workup. Residual volume, Urine culture and TRUS were done in all patients. the average prostate volume was 45-120ml, and the residual volume was 150±80ml. Assessment of anesthesia risk was performed with American society of anesthesiologists (ASA) score.

Mode of Anesthesia

Regional anesthesia was given to all patients with intensive monitoring of vitals heart rate, blood pressure, oxygen saturation and ECG.

Surgical Method

The non-contact Diode laser was employed. All models are from the same manufacturer i.e Biolitec . either straight side firing or twister side firing laser fibers with a 600mm core diameter was placed in cavity through a modified resectoscope with continuous flow sheath with physiological saline as irrigation fluid. Laser output power could be adjusted from 05 to 200 watts however we used powers between 50 -120 watts, rarely 140 watts. Vapo-resection technique was adapted. With this technique we never needed to jump over to higher levels than these power settings. In medium sized prostatic enlargement we started ablating from median lobe at bladder neck working in circular motion, gradually proceding on both lateral lobes up to verumontanum.

In larger glands modified Butterfly technique was adapted. (giving multiple longitudinal ablative groves extending from neck to distal end of prostate, along with performing vaporesection where ever needed). It saved our operative time and more over provided adequate biopsy material for histological examination. Median lobe if grossly enlarged was dealt with by first coagulating / ablating its neck with too and fro motion from both right and left sides. Once it was seen to be blood less, then it was resected out easily with resectoscope. Our custom build instruments allowed us with the advantage of obviating the need for changing outer and inner sheath of rescetoscope once they have been introduced at the beginning of the procedure. Only the working element needed to be interchanged when switching over from ablation to resection mode. Thus making the procedure less cumbersome, much easier and quicker. before coming out we had made a principle to slowly irradiate the whole prostatic bed with low watt laser (20-50 watts) under low irrigant flow, thus stopping even the smallest visible bleeders at the end. As all of our patients were high risk cases so after surgery a three way foley catheter was left in place to irrigate the bladder postoperatively for a day. However,we were not in a hurry to remove foleys catheter in these patients and it was removed usually with in a week. Bladder drill was advised in patients with history of prolonged pre operative catheterization (one of our patient had been catheterized for more than three years). Mostly in all instances the patients were discharged on next day with Foley catheter and removal advised depending upon the condition of the patient. Post void residual urine was assessed the next day after catheter removal and patient was called back on 8th day, at month intervals for 2 to 3 months and 6 months again assessed for post void residual and IPSS.

Statistical Analysis

Data were analyzed using SPSS version 27. The mean and standard deviation were calculated for the quantitative variable. Frequency and percentage were calculated for qualitative variables.Mean comparsion was done by independent t-test. p value ≤0.05 was considered significant.

RESULTS

A total of 500 patients were enrolled in this study who were not responding to medical treatment and refused to take TURP treatment for BPH. Out of 500 patients, 4 patients were lost to follow and 496 patients were enrolled in the study. Table-I illustrates the baseline characteristics of the patients enrolled in this study. The patients' mean age was 68.57±7.98 years, while body mass index was 23.82±2.40 kg/m^{2}. The mean prostate size of the patients was 89.66±22.36 mL, operation time was 45.25±8.92, catheterization time was 43.72±8.46 min. The mean prostate-specific antigen (PSA) was 2.09±0.48 ng/mL, and mean hospital stay was 5.95±1.81 days. Out of 496 patients, post-operative complications found in 86 patients. 46 patients were complained of burning micturition, 11 patients experienced stress incontinence, and 29 patients were experiencing terminal dysuria.

	Mean±SD
Age (years)	68.57±7.98
Height (kg)	66.44±8.91
Weight (cm)	166.76±6.05
Body mass index (kg/m^2)	23.82±2.40
Prostate size (mL)	89.66±22.36
Catheterization time (h)	43.72±8.46
Operation time (min)	45.25±8.92
Irrigation fluid (L)	16.05±2.15
Prostate-specific antigen (ng/mL)	2.09±0.48
Quality of life	4.48±0.93
Blood loss(mL)	21.06±11.52
Bladder irrigation time(hours)	18.76±5.46
Hospital stay (days)	5.95±1.81
Post op Complications, n (%)	
Yes, n (%)	86 (17.3)
No, n (%)	410 (82.7)
Post op Complications (n=86)	
Burning micturition, n (%)	46 (53.5)
Stress incontinence, n (%)	11 (12.8)
Terminal dysuria, n (%)	29 (33.7)

Table-I. Characteristics of study population (n=496)
SD; Standard Deviation

Table-II demonstrates the comparison of preoperative outcomes at three and six follow up. Baseline mean maximum urinary flow rate (Qmax) was 5.57±2.44 mL/s, post void residual (PVR) was 130.91±24.18 mL, and international prostate symptom score (IPSS) was 26.09±2.40 at preoperative. At 3 months follow-up, Qmax was 23.31±8.0 mL/s, PVR was 22.43±5.21 mL and IPSS was 7.27±1.42. On the other hand, mean Qmax was 25.83±6.84 mL/s, PVR was 18.38±4.53 mL, and IPSS was 5.29±0.61 at 6 months follow-up. At 3 months and 6 months, significant improvement were observed with the p value of 0.001.

Table-III illustrates the laboratory parameters observed in preoperative and postoperative stage. Mean hemoglobin was 13.02±0.81 g/dl in perioperative and 12.86±0.89 g/dl in postoperative. There was significant improvement in hemoglobin level was observed in postoperative with the p value of <0.001. Sodium in preoperative was 14.12±2.12 mmol/L and was 138.00±1.68 mmol/L in postoperative. Potassium and creatinine in preoperative were 4.03±0.21 mmol/L and 1.09±0.16 mg/dL while postoperative potassium and creatinine were 3.62±0.26 mmol/L and 0.89±0.16 mg/dL, respectively. Significant improvement in postoperative potassium and creatinine was observed with the p value of <0.001.

Parameter	Preoperative	3 months	Mean Difference	P-Value	6 Months	Mean Difference	P-Value
Qmax (mL/s)	5.57±2.44	23.31±8.05	17.7458	<0.001	25.83±6.84	20.27	<0.001
PVR (mL)	130.91±24.18	22.43±5.21	-108.48	<0.001	18.38±4.53	-112.54	<0.001
IPSS	26.09±2.40	7.27±1.42	-18.83	<0.001	5.29±0.61	-20.8	<0.001

Table-II. Comparison of preoperative outcomes at three and six months (n=496)
Qmax;Maximum flow rate, PVR;Post void residual, IPSS;International prostate symptom score

Parameter	Preoperative	Postoperative	Mean Difference	P-Value
Sodium-Na (mmol/L)	141.27±2.12	138.66±1.68	2.60	<0.001
Potassium-K(mmol/L)	4.03±0.21	3.62±0.26	0.40	<0.001
Creatinine-Cr (mg/dL)	1.09±0.16	0.89±0.16	0.20	<0.001
Hemoglobin-Hb (g/dl)	13.02±0.81	12.86±0.89	0.16	<0.001

Table-III. Preoperative and postoperative's laboratory parameters

DISCUSSION

Transurethral resection of the prostate (TURP) is widely recognized as the prevailing and benchmark approach for the surgical treatment of benign prostatic hyperplasia (BPH).[7] Several factors have been identified as being related with higher complication rates of transurethral resection of the prostate (TURP). These factors include the learning period, older age of patients, the presence of cardiac comorbidities, and hemostatic illnesses.[8] The most notable problems that persist include bleeding necessitating urethral stenosis, blood transfusion, lengthy catheterization durations, and TUR syndrome.[9] The elevated incidence of difficulties associated with this clinical outcome has necessitated the exploration of alternate procedures for prostate ablation that yield comparable clinical outcomes while minimizing complications. Among these surgical approaches, vaporization procedures and laser ablation, including KTP, diode, and HOLEP, exhibit considerable potential. It is challenging to select a suitable laser for the treatment of BPH but the necessary consideration encompasses the mechanism, effectiveness, durability, catheterization time, rate of complications, duration of hospital stays, and cost-effectiveness.[10]

The study demonstrates that DVP using a diode laser at 980 nm is safe and efficacious in treating BPH as it reported fewer complications than TURP. In addition, DVP using a diode laser at 980 nm provided effective BPH outcomes with catheter indwelling times and shorter hospitalization stays. The findings of our study are in conjunction with the study by Kou et al. and indicated that a 50% prevalence of BPH was prevalent among men older than 50 years.[11] Despite TURP being considered the gold standard treatment approach for BPH, it become less preferable for BPH than PVP due to its significant drawbacks of TURS and bleeding.[12] It is evaluated in a study by Kim et al. that lasers have become extensively used for vaporization of the prostate, which provided better clinical efficacy and safety for high-risk patients with benign prostatic hyperplasia.[13]

The outcomes of the present study revealed that postoperative parameters are significantly improved with the treatment of BPH using a laser diode at 980 nm than PVP and DVP at 940nm and 1470nm. 980nm wavelength diode has shown improved absorption of water and hemoglobin, leading to better and quick tissue ablation with excellent hemostasis than 1470nm and 940nm.[9] One significant drawback of these lasers is their utilization of near-infrared wavelength, which results in coagulation necrosis due to their profound optical penetration.[14] The presence of necrotic tissue can lead to the manifestation of dysuria, sloughing, and persistent storage symptoms.[15] To address this issue, novel diode laser systems have been developed to minimize the extent of tissue penetration by controlling several parameters such as pulsation, frequency, power, and fiber design.[16] The implementation of a laser fiber with a quartz head contact has been employed to mitigate the depth of penetration, resulting in a reduction in the incidence of dysuria.[17] The comparable rates of bleeding, with values of 0.21-0.14g of hemoglobin per minute[9], respectively, and our results are in conjunction with it, as depicted in Table-I. The diode laser exhibits a coagulation rim measuring 0.5 mm (with a range of 0.2–1 mm) when applied to prostate tissue, and it does not induce any hemorrhage.[18] The absorption of energy primarily occurs at the surface of prostatic tissue, resulting in enhanced ablative and hemostatic qualities. This effect remains significant even in patients who are undergoing oral anticoagulant therapy.[19] Hence, it is unnecessary to cease anticoagulant therapy prior to the procedure. In the context of the 980 nm diode laser, the rate of vaporization remains unaffected by the specific tissue type, whether it is mucosa or fibromuscular stroma.[18,19] This distinguishes the diode laser from other laser systems. In addition, the diode laser possesses the notable benefit of reduced energy consumption and obviates the need for high-voltage connections, hence enhancing the portability of the laser generator. Moreover, DVP offers several advantages, including reduced catheterization time and hospitalization duration without discontinuing anticoagulant treatment.[20]

Previous studies have documented a significant prevalence of dysuria and burning micturition.[21] The prevalence rates of dysuria and burning micturition in this study were 29% and 46%, respectively. In addition, a limited number of studies have documented elevated re-operation rates ranging from 8% to 33% and a persistent prevalence of stress urine incontinence at 9.1%, while we have found 11% stress incontinence.[20] Before diode laser vaporization, patients should undergo evaluation for prostate cancer using prostate-specific antigen (PSA) testing, digital rectal examination (DRE), and prostate biopsy if necessary. All individuals presenting with clinical suspicion of prostate cancer are not included in the study. Another disadvantage of diode lasers is their high cost, while the cost of laser treatment for benign prostatic hyperplasia (BPH) is lower than other alternatives, it remains more expensive than transurethral resection of the prostate (TURP).[9]

In conclusion, Diode vaporization of the prostate (DVP) with a diode laser has been shown as a secure and efficacious intervention for benign prostatic hyperplasia (BPH). Moreover, it has been demonstrated to be a safe therapeutic option even for concurrently receiving anti-platelet medicines. Its results show no significant difference between pre- and post-operative hemoglobin, less burning micturition, reduced rates of dysuria, and less urine incontinence. It is also a privilege for this study because it is one of the initial studies performed on diode laser vaporization for benign prostatic hyperplasia in Pakistan.

CONCLUSION

Treatment of BPH by 980/1470 nm diode laser have effective and safe clinical outcome for high risk patients as we found significant improvements in Qmax, IPSS, and PVR at 3 months and 6 months follow up.

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