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Diode Laser Ablation of Prostate versus Monopolar Transurethral Electro-Resection of Prostate for Treating Symptomatic BPH: A Prospective Study

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Abstract

Background Benign prostate hyperplasia (BPH) can be treated with endoscopic urological procedures, which includes both laser ablation of prostate and transurethral resection of the prostate (TURP).

Objective To determine the advantages and disadvantages of using diode laser procedure in treating patients with BPH in contrast to TURP treatment.

Methods In a prospective non-randomized study at a single center, 40 patients presenting with symptoms of lower urinary tract symptoms attributable to BPH between the ages of 50 to 90 years were enrolled from November 2014 to June 2015. TURP was used in Group A, and transurethral laser ablation of prostate (TULAP) was used in Group B. Outcomes, including International Prostate Symptom Score (IPSS) and higher maximum flow rate (Qmax) were compared at 3 months.

Results At 3 months, patients treated with TULAP had a significantly Qmax than those treated with TURP ($p<0.001$). There was a significantly lower hospital stay for BPH patients treated with the TULAP technique ($p<0.001$). Patients treated with the TULAP procedure had a significantly shorter catheter time ($p=0.001$). There was a non-significant difference in procedure time between the two methods ($p=0.2$). There was a significant increase in prostate-specific antigen (PSA) among those treated with the TURP technique ($p=0.01$).

Conclusion Lower urinary tract problems induced by BPH can be successfully treated by diode laser ablation of prostate. Our findings suggest that diode laser is reliable and efficient when patients are carefully chosen for surgery.

Keywords BPH, Ablation of Prostate, TULAP, TURP

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List of abbreviations: IPSS = International Prostate Symptom Score, TULAP = Transurethral laser ablation of prostate

Introduction

The prostate is glandular and a fibromuscular structure located immediately under the bladder. The average prostate weighs approximately 20 g and includes the posterior urethra, which measures nearly 2.5 cm in length [1]. More than 30% of men over 65 years old have either irritative or obstructive urinary problems as their chief complaints [2]. Lower urinary tract symptoms (LUTS) affect a large percentage of males [3-5]. Although younger men may have LUTS as well, as men age, the frequency, and severity of LUTS increase, while LUTS may vary greatly to a certain degree [6,7]. As populations age, costs associated with LUTS care are expected to rise rapidly, emphasizing the critical nature of comparing the efficacy and costs of conservative and surgical therapies. [8].

LUTS due to benign prostate hyperplasia (BPH) continues to be a significant issue for men in the United States of America; 75.1% of men over the age of 70 have at least one complaint associated with benign prostate hyperplasia (BPH) [9]. BPH was surgically treated in 8.0% of men aged 60 to 69 years but 22.4% of the men above 70 years. [10]. The best care for LUTS must be determined on an individual basis based on clinical results and the level of discomfort caused by symptoms. Surgery is the preferred therapeutic option in complex situations, such as urinary retention, renal insufficiency caused by urinary retention, or bladder calculi [11-14]. However, trials have demonstrated the success of surgical therapy for LUTS [15,16]. LUTS caused by a urethral obstruction are surgically treated with transurethral resection of the prostate (TURP) for prostates less than 80 ml in volume and open prostatectomy for prostates greater than 80–100 ml in volume. Transurethral resection (TUR) syndrome occurs following the intake of irrigating fluid throughout the surgical procedure [17]. Clot retention has been confirmed to occur in approximately 6% of patients following monopolar and bipolar TURP [18,19].

In spite of the advent of various ways, TURP remains the gold standard for the surgical management of BPH [20]. The TURP procedure is divided into four stages: middle lobe resection, paracollicular resection, resection of lateral lobes and ventral parts, and apical resection [21]. A further significant development was video-assisted resection. Monopolar, high-frequency current with a maximum cutting power of 200 watts is used for electro resection [22]. Complications and morbidity associated with this treatment, including loss of blood, altered fluid balance, improper fluid intake, incontinence, and sexual dysfunction, prompted the advancement and evaluation of novel procedures. Innovations such as laser surgery can aid in mitigating further the risks associated with this technically challenging technique [23,24]. Coagulation of prostatic tissues using diode laser through the urethra is the most common technique applied, with excellent homeostasis, minor morbidity, and decreased patient complaints due to obstruction of the urethra and finally improvement of their quality of life [25,26]. Diode lasers produce energy through a particular diode, since the working wavelength of 980 nm is close to the infrared spectrum, it is readily absorbed by water and hemoglobin. This leads to better coagulation and tissue evaporation properties. Visual laser ablation of the prostate (VLAP) and holmium inoculation of the prostate (HoLEP) are two laser procedures. For even more than 15 years, laser technology was often used to treat LUTS related to BPH [27,28]. Laser therapy is progressively seen as an alternative to TURP for surgical treatment of BPH of almost any volume [29]. Diodes are semiconductors capable of producing and releasing monochromatic light. This light is then refracted into a crystal, producing the ultimate wavelength. Diode lasers come in a variety of wavelengths and fiber configurations (side-firing and end-firing) [29-30]. Depending on the wavelength, energy, and sort of laser emission, techniques such as coagulation (photoselective vaporization of the prostate [PVP]), vaporization (PVP), and diode resection, and enucleation are available [30-31].

The primary drawback of these lasers is their near-infrared wavelength, which causes coagulation necrosis due to its precisely established deep spatial intrusion. Dysuria, sloughing, and long-lasting storage effects are caused by this necrotic tissue [32].

The objectives of this study is to define the pros and cons of using diode laser ablation in the management of patients with BPH in contrast to TURP at 3 months following surgery.

Methods

A prospective, non-randomized, research was conducted between November 2014 to June 2015 at a single center at Sulaimani. Forty patients diagnosed with symptomatic BPH, 20

of whom underwent monopolar TURP, and 20 underwent transurethral laser ablation of prostate (TULAP), the choice of the surgery type was according to patients' decision depending on their personal opinion and perspective. Patients' age in group A ranged from 50 to 79 years (76±7), prostate volume 65 to 81 g (71±26.2), International Prostate Symptom Score (IPSS) 11-35 (23±7), quality of Life (QoL) 2.3-5.6 (4.1±0.1), maximum flow rate (Qmax) 8-14 ml/s (11.8±1.9), while in group B, patients' age range was 60-90 years (81±13), prostate volume 83 to 150 g (118.3±47.3), IPSS 12-35 (21±8), QoL 2.1-5.4 (3.9±1.1), Qmax 7-14 ml/s (11.5±2.06). In each case, pharmacological therapy was attempted but resulted in a marginal or non-responsive reaction. Patients were assessed using physical examination, including the digital rectal examination (DRE), IPSS, prostate-specific antigen (PSA), uroflowmetry, and transrectal ultrasonography (TRUS). Outcomes at 3 months following surgery, including IPSS, Qmax, PSA together with complications were compared between the two groups.

Inclusion criteria

Patients complaining of moderate to severe LUTS, as calculated by the IPSS (score ≥ 8), and a Qmax of less than 15 ml/s during flowmetry, with and without substantial post-void residual volume (PVR) as determined by ultrasound. Urine analysis, and blood testing including serum PSA, complete blood count (CBC), prothrombin time (PT), partial thromboplastin time (PTT), international normalized ratio (INR), blood group, renal function tests, and blood glucose level, were also performed for all patients.

Exclusion criteria

An active urinary tract infection at presentation, the presence of a vesical stone, urethral strictures that could preclude the insertion of a rigid 20 F cystoscope, previous TURP or laser treatments, pelvic operation, prostate-specific antigen concentration of more than 10 ng/l or abnormal DRE, medical history of prostate or bladder cancer, evidence of neurogenic bladder dysfunction as confirmed by urodynamic study.

Methods

Before they participated in the present study, all participants were interviewed and fully informed about the procedures and signed a written informed consent.

Both groups of patients who underwent treatment procedures received spinal anesthesia, and the operation was conducted by three surgeons, one of the surgeons who conducted the TURP surgery was also the surgeon performing TULAP, which had been done by him over many years for large number of patients in the same center. Monopolar TURP was conducted using a Storz 25 F resectoscope, and a STORZ ICC 350 generator (Germany) set to 130/50 W (cutting/coagulation mode). Every resection was performed using regular loops and manufacturer glycine-containing irrigating fluid. On the other hand, Prostate ablation was performed on those who experienced TULAP using a diode laser at 980 nm (CERELAS, BIOLITEC, GERMANY) using a 600 nm side-firing and end-firing fiber endowed inside a 1 mm diameter spot, with a 150 W of maximum output power. Irrigation with saline solution or glycine solution (in case of unavailability of the 3000 mL normal saline solution irrigation bags) was performed using a 22 F cystoscope. Ablation was initiated clockwise at the bladder neck by moving the resectoscope farther out and concurrently revolving the laser fiber at a power setting of 140 to 150 W. As with TURP, all prostatic tissue obstructing the prostate was extracted before a fine surgical cavity was created. Regardless of the presence of clear urine or mild hematuria in all circumstances, a 24 F three-way catheter was mounted. A urethral catheter was inserted following the procedure and removed the following day in all cases of TULAP, while 3 to 5 days were needed in cases of TURP, depending on the degree of hematuria. Three months after the operation, postoperative Qmax, PVR, and IPSS with QoL scores were collected and compared between the two groups. The time of the operation and

catheterization were determined and compared for both groups.

Fisher's exact test and non-paired student t tests were used by IBM statistical package for social sciences (SPSS) statistics for windows, version 23, with a p value <0.05 considered as significant.

Results

There were a whole number of forty male patients, with a mean age for those treated with TURP as (76±7 years). About two-thirds of TURP patients were self-employed, and their mean weight was (73±8.9 Kg). The Mean age of patients treated with TULAP was (81±13 years). About two-thirds of TULAP patients were retired, and their mean weight was (85.3±10.8 Kg) as shown in table (1).

Table 1. Baseline criteria of BPH patients treated with TURP and TULAP

Variable	Group A (TURP)	Group B (TULAP)
Age (year)	76±7	81±13
Weight (kg)	73±8.9	85.3±10.8
Prostate size (g)	71±26.2	118.3±47.3
DM	4	3
IPSS	23±7	21± 8
QoL	4.1±0.1	3.9±1.1
Qmax (ml/s)	11.8±1.9	11.5±2.06
PSA (ng/ml)	4.9±2.5	3.2±1.2

DM: Diabetes mellitus, IPSS: International Prostate Symptom Score, QoL: Quality of Life, Qmax: Maximum flow rate, PSA: Prostate-specific antigen

The weight of BPH patients treated with TULAP was significantly higher than those treated with TURP (p<0.001). The prostate size was significantly larger in patients who underwent the TULAP procedure (p<0.001). The Qmax was significantly improved in BPH patients receiving TULAP (p<0.001). Those patients of BPH operated with the TULAP procedure had a significantly shorter hospital stay (p<0.001). Catheter time was greatly decreased in patients undergoing TULAP (p<0.001). No major variation in technique time was found between both the TURP and TULAP therapies. (p=0.2). Regarding IPSS, QoL scores, and PSA for the two groups; there was no significant difference among those parameters for both groups (p>0.05) as shown in table (2).

There was no difference in postoperative complication between the TURP and TULAP procedures (p=0.2). 35% of BPH patients managed by TURP did not experience any complications; the common postoperative complications of TURP were urine retention (due to clot retention or due to a small piece of prostatic chips that obstructed the openings of the catheter (15%), dysuria (35%), hematuria (15%), UTI (10%), epididymo-orchitis (5%), and blood transfusion (10%). 45% of BPH patients treated with TULAP had no postoperative complications; the common postoperative complications of TULAP were urine retention (15%), dysuria (40%), re-insertion of the catheter (10%), urge incontinence (10%), retrograde ejaculation (5%), UTI (5%), and epididymo-orchitis (5%). While no patient treated with TULAP had blood transfusion as shown in table (3).

Table 2. Post-operative (3 months) outcome: prostate size, Qmax, hospital stay, catheter time, procedure time, and PSA between the two groups according to TURP & TULAP techniques

Variable	TURP Mean±SD	TULAP Mean±SD	P value
Prostate size (gm)	23±3.5	15.7±2.3	<0.001
Qmax (ml/s)	17.3±1.19	18.5±1.81	0.4
Hospital stay (day)	2.2±1.1	0.6±0.5	<0.001
Catheter Time (day)	4.7±1.7	1.8±0.4	<0.001
Procedure time (hour)	0.9±0.3	1.07±0.4	0.2
PSA (ng/ml)	3.2±1.92	3.6±1.01	0.3

Qmax: Maximum flow rate, PSA: Prostate-specific antigen

Table 3. Distribution of postoperative complications according to TURP & TULAP techniques

Complication	TURP		TULAP		P value
	No.	%	No.	%	
No	7	35.0	9	45.0	
Urine retention	3	15.0	3	15.0	
Dysuria	7	35.0	8	40.0	
Hematuria	3	15.0	0	0.0	
Re-insertion of catheter	0	0.0	2	10.0	
Retrograde ejaculation	0	0.0	1	5.0	0.2
Urge incontinence	0	0.0	2	10.0	
UTI	2	10.0	1	5.0	
Epididymo-orchitis	1	5.0	1	5.0	
TUR syndrome	0	0.0	0	0.0	
Blood transfusion	2	10.0	0	0.0	

UTI: Urinary tract infection, TUR syndrome: Transurethral resection syndrome

Discussion

Laser surgical therapy of patients complaining of BPH and LUTS achieves comparable results and clinical outcomes similar to TURP [33-37]. However, the concept that TURP could be substituted in favor of laser surgery as the gold standard is not generally recognized owing to a paucity of large-scale trials [32]. In recent episodes, mortality following TURP has decreased significantly in the last few decades to 0.25% [38]. This may be primarily due to improvements in anesthesia and advancements in the technology of TURP [3].

Compared with monopolar TURP, thulium, holmium and diode lasers were associated with better efficacy and fewer complications [39].

Up to 30-40% of patients experience early urge incontinence; nevertheless, late iatrogenic stress incontinence is uncommon (<0.5%). Notwithstanding an aging population (55% of patients are over the age of 70), TURP has low related morbidity (1%) and a mortality rate of (0-0.25%). Bladder neck contractures (0.3-9.2%) and urethral strictures (2.2-9.8%) are the most common late complications. In this study, there was no blood transfusion needed, no TUR syndrome, we have 15% urine retention which is due to clot retention, 10% LUTS, which may be related to catheter blockage, theater infection control, no cases reported as early urethral stricture or bladder neck contracture, may be due to short-duration study.

Additionally, we discovered that laser surgery for the treatment of BPH had a low risk of intraoperative and postoperative complications. Patients who received diode laser therapy did not need withdrawal of anticoagulants or blood transfusions. Additionally, 15% of patients had urine retention, which was due to irritative symptoms, re-catheterization rate was 10%, while in other trials, patients in the diode laser category had a re-catheterization rate of about 17%, this may be attributed to the limited sample size [40-41].

According to Rieken et al., [34] 9.6% of patients who received diode laser therapy needed reoperation for bladder neck closure, opposed to 3.6% of all those who received TURP, whereas there were no such problems in this research. Likewise, although a urethral stricture formed in 5.5% of those receiving diode laser surgery against 0% among those undertaking TURP [42-43], there has been no urethral stricture in this analysis throughout follow-up with either TURP or TULAP, although this may be due to the short duration of follow-up in this study.

In the present study, for those treated with TURP, there was a significant decrease in post-voiding residual volume postoperatively ($p<0.001$), which can be explained by the fact that more than 50% total prostate volume is excised during TURP which leads to immediate post-operative improvement in those parameters [44].

Fagerström et al. [45] in a case study reported that (71%) of catheters were withdrawn during 24 hours, and a further (12%) of catheters were removed within 48 hours in patients treated with TURP. Patients left the hospital with an indwelling catheter if a second attempt to remove the catheter was unfruitful. While in this study, the meantime of catheter removal time in TURP patients is 4.7 days and in TULAP cases is 1.8 days (43 hr) for all cases. Akman et al., [46] reported to have prostate dissection via monopolar transurethral resection (TURP) followed up for 12 months. The mean procedure duration was (58.7 minutes) for monopolar TURP. The incidence of TUR syndrome was 1.4% for monopolar TURP. In the TURP sample, the duration of hospital stay (2.7 days compared with 2.2 days). There were fewer rates of clot retention (0.8% vs 15%) and mean time to catheter removal (2.4 days compared with 4.7 days), which is near to a similar study [47].

Razzaghi et al., [48] reported similar figures to our study; in TURP and diode groups, the operation time was 54.9 vs 60.6 minutes ($P = 0.14$), Foley catheterization time was 88.9 vs 20.1 hours ($P<.0001$) and postoperative hospital stay was 59.9 vs 25.8 hours ($P < .0001$) respectively. Other similar studies done in Iraq and involving laser treatment for BPH showed similar results and any slight differences may be due to difference in type of laser used and the sample size as well as the duration of the follow up [49-51].

Most problems, which arose during the perioperative phase (up to just the end of the first month also for a period of 3 months following procedure) were recorded. Of course, the cost difference between TURP and TULAP may affect the choice of surgical treatment option as the laser is more expensive procedure, that may make it unaffordable option for some patients.

There are limitations in the present study like small sample, single center, no randomization, short follow up that precluded the assessment of long-term complications such as urethral stricture, bladder neck contracture, and erectile dysfunction.

In conclusions, the choice to treat BPH using TURP or Laser can be influenced by patient's factors such as age, co-morbidities, and concurrent anticoagulation. Laser ablation of the hypertrophied prostate has been shown to be a reasonable and reliable surgical procedure for relieving symptoms associated with symptomatic urinary outlet obstruction with comparable results to TURP. However, long term follow up studies are recommended to follow up the TULAP patients to assess long term complications and acceptance by urologists and patients.

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Author contribution

Both authors have contributed to the scientific work and investigations, writing and editing of all data included in this study.

Conflict of interest

The authors declared that they have no conflict of interest.

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