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Original article

Management of prostate enlargement with acute urinary retention: Diode laser vaporization in combination with bipolar transurethral resection of the prostate

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ABSTRACT

Objective: Transurethral resection of prostate (TURP) has long been the gold standard for the management of benign prostate enlargement (BPE). Over the years, laser techniques have been developed as major alternative treatment for BPE. Retrospectively, we compared the preoperative status and surgical outcomes of conventional TURP with those of high-intensity diode laser vaporization in combination with bipolar TURP (DV + bTURP) in patients with BPE who are suffering from refractory acute urinary retention.

Materials and methods: This is a retrospective chart review study. A total of 60 patients with BPE who were suffering from refractory acute urinary retention were enrolled between July 2011 and July 2013. Thirty-four patients were included in the TURP group and 26 in the DV + bTURP group. Perioperative parameters, including operation time, hemoglobin decrease, length of hospital stay, and time for catheter removal, were all recorded. Patients were followed postoperatively with peak flow rate measurement, international prostate symptom scores, and postvoid residual volume, and all adverse events were also recorded.

Results: DV + bTURP was superior to TURP in terms of hospital stay (3.1 d vs. 4.2 d), catheter removal time (1.3 d vs. 3.2 d), hemoglobin reduction (0.8 g/dL vs. 2.5 g/dL), and fewer adverse events. However, it was inferior to TURP in terms of operation time (93.2 min vs. 68.5 min). Complications are also comparable. No significant differences were observed in peak flow rates, international prostate symptom score, and postvoid residual volume between the two procedures.

Conclusion: DV + bTURP is comparable with monopolar TURP for relieving acute urinary retention in men with BPE in terms of complications and functional outcomes. The combined technique can provide better intraoperative hemostasis and shorter catheterization time, with no significant postoperative irritative symptoms.

1. Introduction

Acute urinary retention (AUR) commonly occurs in the elderly aged >70 years, and more than 10% of men in their 70s experience AUR within the next 5 years.[1] It is a urologic emergency. Urethral catheterization or suprapubic cystostomy drainage is needed to treat this condition. The most common cause of AUR is benign prostate enlargement (BPE), and a large prostate will increase the risk. Transurethral resection of prostate (TURP) has long been the most commonly performed surgical procedure and also a gold standard for the management of BPE. Surgical complications of TURP are more for a prostate volume of >50 mL than for a smaller volume. In a recent study, BPE patients with AUR who underwent TURP have been found to be associated with a higher risk of complications than those without AUR.[2]

Over the years, laser prostate ablation techniques have been developed as the major alternative treatment for BPE. Chen et al[3] introduced a combined technique of high-intensity diode laser

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(980 nm) and bipolar transurethral resection of prostate (DV+ bTURP), which could provide better intraoperative hemostasis. We assume that DV + bTURP can reduce the surgical morbidity and mortality in BPE patients with AUR. The aim of this study was therefore to examine whether this combined technique could reduce mortality and morbidity, by comparing it with TURP among patients with AUR, and to evaluate functional outcomes.

2. Materials and methods

We retrospectively reviewed the data of our patients who were treated surgically for BPE by diode laser or TURP between July 2011 and July 2013. Patients with a prostate volume of >50 mL who suffered from refractory AUR prior to surgery were included in this study. We excluded patients who had prostate cancer proved by surgical specimens, received prostate or urethral surgery previously, or suffered from neurogenic bladder dysfunction. Detailed medical histories, physical findings, and data of laboratory tests, including hemogram, test for prostate-specific antigen (PSA), and urinalysis, were all collected from medical charts. Prostate volumes were measured by preoperative transabdominal ultrasound.

2.1. Intervention and technique

All procedures were performed or supervised by a single surgeon who is highly experienced in laser surgery of prostate. The laser surgery was performed using a combination of a side-fire 980 nm high-intensity diode laser (Limmer Laser, Berlin, Germany) and bipolar TURP. Laser power could be set at either a continuous wave mode or a pulsed mode with a maximum power of 200 W. After diode laser vaporization, bipolar TURP, with power settings of 320 W for cutting and 200 W for coagulation, was used only to remove residual coagulated tissue, as cutting at the depth beyond this zone could result in further hemorrhage. The TURP surgery was performed by a monopolar cutting loop with a 26F continuous irrigation resectoscope. The generator was set at 100 W for coagulation and 130 W for cutting. After both surgeries, a 22F triple-lumen urethral catheter was indwelled with continuous saline irrigation. After hematuria subsided, the urethral catheter was removed and saline irrigation was discontinued.

2.2. Effectiveness and complication measures

In addition to baseline demographic data and perioperative data, we also evaluated the pre-existing comorbidity using the Charlson comorbidity index.[4] The peri- or post-operative complications were recorded, including blood transfusions, severe bleeding requiring reoperation, urinary retention requiring recatheterization, or TUR syndrome. All surgical complications of two groups were graded according to the modified Clavien system.[5] For measuring the effectiveness, several functional outcomes were assessed in this study, including the international prostate symptom score (IPSS), the rate of urine flow (Q_{max}), and postvoid residual volume (PVR) at baseline and at 6 months of follow-up.

2.3. Statistical analyses

Data are expressed as the mean ± standard deviation and were analyzed by IBM SPSS Statistics for Windows, version 20.0 (IBM Corp., Armonk, NY). Parameters were compared between the two groups by Chi-square test (categorical variables) and the independent t test (continuous variables), considering $p < 0.05$ as a significant difference.

3. Results

During the study period, a total of 60 patients were enrolled according to the inclusion and exclusion criteria. Thirty-four patients were treated with TURP and 26 with DV + bTURP. All patients were already catheterized due to previous AUR in the outpatient clinic or emergency department. Table 1 lists the demographic data of the two groups. There was no significant difference between the two groups with regard to patients' age, prostate volume, serum prostate-specific antigen value, baseline serum hemoglobin value, and Charlson comorbidity indexes.

3.1. Perioperative findings

Perioperative results are shown in Table 2. Compared with the TURP group, in the DV + bTURP group, significantly more time was required to perform surgery ($p < 0.005$), but catheterization time was significantly shorter ($p = 0.007$) and the decrease in hemoglobin level was less ($p < 0.001$).

3.2. Postoperative complications

Table 3 summarizes surgical complications of the two groups, which were graded according to the modified Clavien system. This suggests that the TURP group has a higher number of surgical complications than the laser group. However, in the absence of statistically significant results, no definite conclusion can be drawn. The immediate postoperative sepsis developed in four patients in the TURP group (11.8%) within 3 days of surgery, but in none of the patients in the laser group. Three patients (8.8%) in the TURP group and two (7.1%) in the DV + bTURP group developed acute epididymitis within 3 months of follow-up, even after receiving oral antibiotic prophylaxis. Three patients in the TURP group (8.8%) who had difficulty in voiding and bladder clot tamponade needed further blood evacuation in the operating room, whereas it occurred in only one patient in the laser group (3.8%). One patient in the TURP group had severe water intoxication (TUR syndrome) with acute renal failure. The patient was transferred to the intensive care unit (ICU) for further care, and it took more than 15 days for recovery.

3.3. Postoperative follow-up parameters

Table 4 shows that, compared with the baseline data, there were significant improvements in IPSS, Q_{max}, and PVR in both groups ($p < 0.01$ for each). At the 6-month follow-up, postoperative IPSS, Q_{max}, and PVR were comparable between the two groups.

Table 1
Demographic data.

Mean (SD)	Monopolar ($n = 34$)	DV + bTURP ($n = 26$)	p
Age (y)	72.19 (8.73)	72.81 (9.12)	0.796
AUR episodes	1.68 (0.79)	1.77 (0.82)	0.669
CCI score	0.52 (0.68)	0.73 (0.78)	0.270
Prostate size (mL)	62.45 (16.4)	71.64 (26.69)	0.215
PSA	7.07 (2.95)	5.72 (2.29)	0.312
Baseline Hb (g/L)	13.1 (1.41)	13.2 (1.85)	0.762
IPSS	24.2 (3.2)	25.2 (4.1)	0.307
Q_{max} (mL/s)	6.4 (1.9)	7.1 (2.3)	0.229
PVR (mL)	177.1 (47.0)	172.5 (66.4)	0.762

AUR = acute urinary retention; CCI = Charlson comorbidity index; DV + bTURP = high-intensity diode laser vaporization in combination with bipolar transurethral prostate resection; Hb = hemoglobin; IPSS = international prostate symptom score; PSA = prostate-specific antigen; PVR = postvoid residual volume; Q_{max} = peak flow rate; SD = standard deviation.

Table 2
Comparison of perioperative findings.

Mean ± SD	TURP	DV + bTURP	*p*
Length of procedure (min)	66.31 ± 27.27	96.15 ± 32.38	<0.005
Resected tissue by TUR (g)	32.2 ± 18.3	22.5 ± 14.9	0.034
Hospitalization stay (d)	4.2 ± 3.34	3.1 ± 1.63	0.076
Time to remove catheter (d)	3.2 ± 2.87	1.3 ± 0.51	0.007
Baseline Hb (g/L)	13.1 ± 1.41	13.2 ± 1.85	0.762
Postop Hb decrease (g/L)	1.49 ± 0.89	0.80 ± 0.67	0.001

DV + bTURP = high-intensity diode laser vaporization in combination with bipolar transurethral prostate resection; Hb = hemoglobin; SD = standard deviation; TURP, transurethral resection of prostate.

Table 3
Peri- and post-operative complications.

Complication *n* (%)	TURP	DV + bTURP	*p*
Grade 1			
Urgent incontinence	3 (8.8%)	4 (15.4%)	0.454
Grade 2			
Blood transfusion	3 (8.8%)	1 (3.8%)	0.626
Sepsis (<3 d after surgery)	4 (11.8%)	0	0.126
Epididymitis (UTI)	3 (8.8%)	2 (7.1%)	>0.99
Inability to voiding			
Early (failed TOV)	6 (17.6%)	4 (15.4%)	>0.99
Late (AUR)	0	1 (3.8%)	0.433
Grade 3			
Bladder blood clot tamponade	3 (8.8%)	1 (3.8%)	0.626
Urethral stricture	0	0	
Grade 4			
TUR syndrome with ARF	1 (2.9%)	0	>0.99

ARF = acute renal failure; AUR = acute urinary retention; DV + bTURP = high-intensity diode laser vaporization in combination with bipolar transurethral prostate resection; TOV = trial of voiding; TURP, transurethral resection of prostate; UTI = urinary tract infection.

Table 4
Functional outcomes.

Clinical measure	Treatment group	Baseline	6 mo	*p*
IPSS	DV + bTURP	25.2 (4.1)	8.0 (3.1)	0.266
	TURP	24.2 (3.2)	8.7 (2.5)	
Q_{max} (mL/s)	DV + bTURP	7.1 (2.3)	19.1 (2.6)	0.227
	TURP	6.4 (1.9)	19.4 (1.6)	
PVR (mL)	DV + bTURP	172.5 (66.4)	39.2 (25.0)	0.616
	TURP	177.1 (47.0)	35.6 (16.0)	

Data are presented as mean (standard deviation).
DV + bTURP = high-intensity diode laser vaporization in combination with bipolar transurethral prostate resection; IPSS = international prostate symptom score; PVR = postvoid residual volume; Q_{max} = peak flow rate; SD = standard deviation; TURP = transurethral resection of prostate.

4. Discussion

AUR is a common symptom in patients with BPE. However, refractory AUR was one of the indications for surgical intervention. Chen et al[2] reported in their study that 32.6% of patients had AUR before TURP. In a prospective multicenter study by Reich et al,[6] AUR would increase the intra- or post-operative morbidity of TURP, including blood transfusion [odds ratio (OR) 2.59], TUR syndrome (OR 1.85), surgical revision (OR 1.85), and urinary tract infections (UTIs; OR 2.29). In order to reduce the morbidity and mortality of TURP, several laser-type surgical techniques were introduced, such as potassium titanyl phosphate, diode, holmium, and thulium lasers.[7]

Among these lasers, diode laser offers a simultaneous absorption in water and hemoglobin. Therefore, it had the high simultaneous tissue ablation and excellent hemostatic properties in clinical application.[8] We proposed that it could reduce intraoperative blood loss by coagulating most of the blood vessels that supply blood to the prostatic adenomas in these patients with refractory AUR. Chiang and Chen[9] also reported good ablative and hemostatic abilities of diode laser.

On the other hand, diode laser vaporization could result in postoperative irritative symptom due to sloughing tissue (18.2%).[10] The combination of diode laser vaporization and bipolar TURP could provide excellent hemostatic properties and effective removal of residual necrotic tissue. Chen et al[3] introduced this combination surgery, which is a feasible alternative treatment strategy in the management of BPE. In this retrospective study, the demographic data, perioperative data, postoperative complications, and functional outcomes of TURP and DV + bTURP were all compared. Our results revealed that DV + bTURP could reduce intraoperative blood loss (0.8 g/dL vs. 1.49 g/dL) and catheterization time (1.3 d vs. 3.2 d) with comparable functional outcomes as compared with TURP. Our results are consistent with those of Chen et al.[3] Due to limited patient size, no significant difference was observed with regard to complications. However, these results do not go against our hypothesis that DV + bTURP reduced morbidity of patients with AUR.[9] In addition, time of removal of urethral catheter, which could affect the length of hospital stay, is highly associated with postoperative hematuria.

With regard to surgical complications, we found that more patients in the TURP group needed blood transfusion postoperatively and surgery for blood clot evacuation, although there was no statistical significance. BPE patients with AUR usually have serious intraoperative bleeding. The more likely explanation is a larger prostate size or prostate inflammation, preoperative catheterization, or recurrent urinary tract infection in AUR patients. Reich et al[6] reported that patients with preoperative retention were found to have a higher resection weight than the rest of the patients (31.6 g vs. 27.2 g). Certain morbidities were mainly caused by severe perioperative bleeding, including operative blood loss requiring blood transfusion, bladder clot tamponade, and irrigation fluid absorption (TUR syndrome). In the study by Chen et al,[2] they also found increased rates of recatheterization and postoperative hematuria after TURP in patients in the AUR group. They proposed that prostate infarction results in fragile vessel, which may lead to increased postoperative bleeding. Compared with the results of diode laser enucleation of the prostate (DiLEP) reported by Yang et al,[11] in our study, the combination technique had comparable hemoglobin drop (0.8 g/dL vs. 0.9 g/dL) and operation time (96.1 min vs. 95.2 min, total prostate size 71.6 g vs. 70.0 g). However, an earlier failure of voiding trial was observed in the diode group of the current study than DiLEP in the study by Yang et al[11] (15.4% vs. 9.5%); this could be explained by the refractory AUR history of our patients, who might have poorer detrusor muscle function. In addition, compared with the results of the oyster technique reported in the study of Shih et al,[12] a slightly steeper hemoglobin drop (0.8 g/dL vs. 0.6 g/dL) but reduced operation time (96 min vs. 117 min) were observed in our combination group. However, no subtrigonal injury occurred in our study, whereas it had occurred in two of the first five patients in the study of Shih et al.[12] This is because we removed tissue by bipolar TURP, which is a more formal resection technique and easy to learn.

In our hospital, all patients underwent a preoperative urinalysis study and received empiric antibiotic treatment if UTI was diagnosed. Patients without UTI received only antibiotic prophylaxis since the operative day. In the current study, we found a higher rate of postoperative sepsis in the TURP group during hospitalization, but no one developed postoperative sepsis in the DV + bTURP group, although all the patients routinely received first-generation cephalosporin as a prophylactic antibiotic during the postoperative period. The possible explanation for this is that concurrent UTI occurred in patients with refractory AUR. Intraoperative exposure

of vessels would contribute to not only bleeding, but also translocation of bacteria from urine into the blood stream, which causes septicemia or sepsis postoperatively. Chen et al[2] reported higher rates of UTI (18.9%), septicemia (1.1%), and septic shock (0.3%) during hospitalization, which occurred in patients with AUR after TURP. It is consistent with our findings.

Diode laser vaporization showed good hemostatic property, but a large coagulation zone and tissue sloughing were noted in several studies.[8,9,13,14] Necrotic tissues were highly associated with postoperative irritative symptoms. Coagulation depth is related to laser power setting. Lower laser power would decrease the coagulation zone, but it would reduce laser vaporization efficiency.[15] Chen et al[3] introduced the combination technique of diode laser and bipolar TURP. They showed a decreasing rate of postoperative lower urinary tract symptoms (LUTS) because of the removal of coagulated tissue by bipolar TURP, compared with that by diode laser alone. It is noteworthy that we used only bipolar TURP to remove the necrotic and carbonized prostate tissue. If bipolar TURP is performed extensively beyond the depth of coagulation zone, it may result in further hemorrhage and lose the hemostatic property of diode laser. In the current study, four (15.4%) patients in the laser group experienced transient urge incontinence during the 1st month after surgery, but no one had persisting urge incontinence. According to our experience, irritative symptoms could almost be relieved within 4 weeks. Rieken et al[16] reported that 30.3% and 10.7% of patients who received diode laser prostatectomy had transient and persisting urge incontinence. In our study, the failure rate of first trial of voiding after surgery was almost the same between the two groups (15.4% vs. 17.6%). It may be associated with the refractory AUR history, which results in detrusor muscle dysfunction or edema in prostate fossa. One (3.8%) patient in the laser group had postoperative AUR after discharge. It was associated with the sloughing of larger devitalized tissue, which obstructed the urethra. This was also noted in the study by Chen et al.[14] No patients needed reoperation for residual adenoma at 6-month follow-up.

There are limitations to our study. First, the study design was a retrospective subgroup analysis. There may be a selection bias because the choice of surgical modality depended on the patient's decision. However, because the demographic characteristics of patients in the two groups were not significantly different, selection bias could be minimized. Second, it is a combined technique. For patients with a larger prostate volume, we had to spend more time performing bipolar TURP to remove more necrotic tissue. It is difficult to spend same time performing bipolar TURP individually. Third, the limited sample size was not large enough to show the statistical significance. Fourth, the 6-month follow-up was not long enough to prove the long-term effect and efficacy of the intervention. Further large-scale, prospective studies with long-term follow-up data are obviously needed to draw a solid conclusion.

5. Conclusion

DV + bTURP is comparable with TURP for relieving AUR in men with benign prostate obstruction. It allows earlier catheter removal and hospital discharge, although more operation time is required. Similar efficacy was observed between the two procedures in terms of peak flow rates, AUA symptom scores, and postvoid residual urine volume.

Conflicts of interest

The authors declare that they have no financial or non-financial conflicts of interest related to the subject matter or materials discussed in the manuscript.

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