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PROSPECTIVE RANDOMIZED STUDY OF TRANSURETHRAL VAPORIZATION RESECTION OF THE PROSTATE USING THE THICK LOOP AND STANDARD TRANSURETHRAL PROSTATECTOMY

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ABSTRACT

Objectives. Transurethral vaporization resection of the prostate (TUVRP) is a recent modification of the standard transurethral prostatectomy (TURP). The procedure uses one of the novel, thick resection loops coupled to augmented electrocutting energy. We evaluated the safety and efficacy of TUVRP in comparison with TURP.

Methods. Sixty-eight patients with prostatic outflow obstruction were prospectively randomized between equal TUVRP and TURP treatment groups. Safety parameters evaluated included changes in serum hemoglobin, hematocrit, and sodium 1 and 24 hours after resection. Operative time, catheterization time, and incidence of complications were noted. Efficacy parameters included evaluation by the International Prostate Symptom Score and maximum flow rate.

Results. Patients of both groups were balanced for the different baseline variables. One hour after TURP, patients had significantly lower levels of hemoglobin, hematocrit, and sodium (P = 0.03, 0.03, and 0.01, respectively). The prostate resection weight was similar in both groups; however, the difference in the mean operative time was significant (TUVRP group 42.4 minutes and TURP group 35.9 minutes, P = 0.02). The postoperative catheterization time was significantly shorter for the TUVRP group (23.1 ± 10.3 versus 36 ± 17.3 hours, P <0.0001). All patients were followed up for an average of 9 months. The International Prostate Symptom Score was 4 ± 3.4 and 5.6 ± 3.1 and the maximum flow rate was 19 ± 6.5 and 15.2 ± 10 mL/s for the TUVRP and TURP groups, respectively; these differences were statistically significant (P = 0.03 and 0.01, respectively). Complications included urethral strictures (6 patients) and delayed hemorrhage with clot retention (2 patients); no differences in the incidence of complications were noted between the two groups.

Conclusions. The results of the present study have demonstrated that TUVRP is as safe and efficacious as TURP in the treatment of men with prostatic outflow obstruction. The shorter catheterization time observed after TUVRP may be clinically significant, considering the demand for lower morbidity profiles by patients. The longer operative time in TUVRP was related to the slower motion of the Wing electrode needed to add the advantages of electrovaporization. UROLOGY **55:** 886–891, 2000. © 2000, Elsevier Science Inc.

Benign prostatic obstruction is a common cause of urinary symptoms in men older than 40 years of age.[1] Transurethral resection of the prostate (TURP) is still regarded as the reference standard for treatment of patients with symptomatic benign prostatic hyperplasia requiring surgical intervention.[2] TURP is not a procedure without associated morbidity; bleeding, transurethral syndrome, urinary incontinence, infection, and erectile dysfunction are all recognized complications reported with varying frequency.[1,3] Various laser and electrovaporization prostatectomy techniques have been gaining popularity in recent years by reducing the two most important morbidities noted with TURP; namely, hemorrhage and electrolyte disturbance due to excessive irrigation fluid absorption.[1,4]

Transurethral vaporization resection of the prostate (TUVRP) is one of the more recent modifica-

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Submitted: December 20, 1999, accepted (with revisions): January 19, 2000

0090-4295/00/$20.00
PII S0090-4295(00)00520-3

TABLE I. *Patient characteristics*

	TUVRP	TURP
Age (yr)	70.9 ± 9.3 (55–94)	70.4 ± 8.8 (53–86)
Presentation (n)		
Urinary retention	15	18
Symptomatic BPH	19	16
IPSS	24.9 ± 6 (15–31)	20.1 ± 6.8 (11–30)
Qmax	7.5 ± 3.5 (2–14.6)	9.1 ± 6.3 (1–15)
Prostate size (g)	52.4 ± 18.7 (20–100)	57.2 ± 22.5 (20–105)

Key: TUVRP = transurethral vaporization resection of the prostate; TURP = transurethral resection of the prostate; BPH = benign prostatic hyperplasia; IPSS = International Prostate Symptom Score; Qmax = maximum urinary flow rate. Data presented as the mean ± SD, with the range in parentheses, unless otherwise noted.

tions to standard TURP.[5] The procedure uses one of the novel, thick resection loops coupled to a higher electrocutting energy.[5,6] Several new "thick loops" or "band electrodes" are on the market for use in TUVRP, including the Wing by Wolf, the Vaportome by ACMI, the Vapor cut electrode by Storz, and the wedge by Microvasive, to name a few.[5] The thick loops make better use of the electrocutting energy by enhancing contact with the prostatic tissue to achieve simultaneous vaporization, resection, and coagulation.[6] TUVRP was found to be a safe and efficacious modality in several single-arm, sequential studies for the treatment of men with prostatic outflow obstruction.[2,5,7] The procedure has the potential to add the advantages of minimal blood loss and electrolyte disturbances seen with electrovaporization prostatectomy using the Vaportrode to the excellent debulking capabilities of TURP.[5] Furthermore, a high-quality prostatic tissue specimen is produced for histopathologic examination.[2,8] We report in this prospective randomized study on the safety and efficacy of TUVRP using the Wing cutting electrode (Richard Wolf) in comparison with the standard wire-loop TURP.

MATERIAL AND METHODS

All men with prostatic urinary outflow obstruction requiring prostate surgery were considered as possible candidates for the study. A total of 68 consecutive patients satisfying the inclusion and exclusion criteria were prospectively randomized into two equal treatment groups: the first group underwent TUVRP and the second group standard TURP. Patients with urinary retention or lower urinary tract symptoms were included. Symptomatic patients were considered for surgery if the International Prostate Symptom Score was more than 15 and the maximum urinary flow rate was less than 15 mL/s. Exclusion criteria included a history of previous prostate surgery, suspected carcinoma of the prostate, and neurogenic bladder.

The preoperative assessment included a detailed medical history and physical examination, including a digital rectal examination. A sexual history questionnaire was answered by all men who were sexually active. Laboratory investigations included urinalysis, urine culture, complete blood count, serum electrolytes, creatinine, and prostate-specific antigen. The complete blood count and serum electrolyte tests were repeated 1 and 24 hours postoperatively to check for changes in the serum concentration. All patients underwent ultrasound of the urinary tract to rule out concomitant pathologic findings and to estimate the prostate size. The urine flow rate for patients not in retention was measured using a Dantec Urodyne 1000 machine.

All patients provided signed informed consent. Consultant urologists performed all operations. A standard 27F Wolf continuous flow resectoscope using glycine for irrigation and an Eschmann TD411-RS electrosurgical unit (Eschmann Brothers & Walsh) were used for all patients. In group 1, TUVRP was carried out using the Wing resection electrode. The Wing retains the semicircular design of the wire loop but has a wider and uniformly thicker surface that is gold-plated. In group 2, a standard wire loop was used. The electrosurgical generator was set to 250 and 150 W pure cutting current and 80 and 50 W for coagulation in groups 1 and 2, respectively. The TUVRP technique follows the same principles as described for TURP. The motion of the loop is, however, slowed in TUVRP to allow for maximal simultaneous coagulation and vaporization of the prostatic tissues. The slower passage of the loop is also imperative for the formation of the desiccation zone, as evidenced by the formation of char in the resection bed, which can be identified visually during the procedure. At the end of the procedure, a Foley catheter was inserted, and the balloon was inflated with 30 mL of normal saline. No traction was applied to the catheters nor was Lasix used prophylactically during the prostatectomy. These variables were consistent for all patients in both groups.

The resection weight, resection time, intraoperative complications, and postoperative catheterization time were recorded for both groups. Urinary catheters were removed routinely on the first morning after prostatectomy, unless the degree of hematuria in the drainage bag dictated additional catheterization. Patients were evaluated every 3 months with the International Prostate Symptom Score, maximum urinary flow rate, and sexual function questionnaire. The results were assessed statistically using the mean ± standard deviation (SD) and the range. The significance of changes between the two treatment groups was determined using the unpaired (two-sample) *t* test. Nonparametric tests were used when significant differences were found between variances. A *P* value less than 0.05 was considered significant.

RESULTS

The data of patients in both groups were adjusted for the different baseline variables, including age, clinical presentation, and prostate size (Table I). Patients after wire-loop TURP had significantly

TABLE II. ***Blood test results before, during, and 24 hours postoperatively***

	TUVRP	TURP	*P* Value
Hemoglobin (g/dL)			
Preoperative	13.6 ± 1.1	13.2 ± 1.4	NS
1 hour after treatment	13.1 ± 1.1	12.5 ± 1.5	0.03
1 day after treatment	12.8 ± 1.1	12.2 ± 1.6	0.03
Hematocrit (mL/dL)			
Preoperative	40.4 ± 3.1	39.3 ± 4.0	NS
1 hour after treatment	38.6 ± 3.0	37.0 ± 4.2	0.03
1 day after treatment	37.8 ± 3.2	35.8 ± 5.1	0.05
Serum sodium (mEq/L)			
Preoperative	140.5 ± 3.5	140.4 ± 2.6	NS
1 hour after treatment	140.5 ± 3.4	139.2 ± 2.5	0.01
1 day after treatment	138.6 ± 3.0	137.3 ± 3.2	0.04

Key: NS = not significant; other abbreviations as in Table I.
Data presented as the mean ± SD.

lower levels of hemoglobin, hematocrit, and serum sodium at 1 and 24 hours postoperatively (Table II). One patient in the TURP group required a repeated cystoscopy and diathermy of bleeding vessels in the prostatic resection fossa within 24 hours of the procedure. No major perioperative complications were noted in either group. None of the patients required blood transfusion, and no cases of transurethral resection syndrome occurred. The mean resection weight was comparable in both groups (22.4 ± 10.5 g and 20.2 ± 9.5 g for groups 1 and 2, respectively, $P = 0.18$). The resection time, however, was longer in the TUVRP group, 42.4 ± 15 minutes (range 15 to 75) versus 35.9 ± 12.8 minutes (range 15 to 60) in the TURP group. This difference was statistically significant ($P = 0.02$).

A significant difference in the postoperative catheterization time was also noted between the two groups ($P < 0.0001$). Thirty-two patients (94%) in the TUVRP group had their urinary catheter removed within the first 24 hours of the operation compared with 20 patients (60%) in the TURP group. The mean postoperative catheterization time was 23.1 ± 10.3 hours and 36 ± 17.3 hours in the TUVRP and TURP groups, respectively.

Patients were followed up for a mean of 9.2 and 8.8 months (range 6 to 15) for groups 1 and 2, respectively. Symptomatic improvement was noted for both groups. The International Prostate Symptom Score was 4 ± 3.4 and 5.6 ± 3.1 and the maximum urinary flow rate was 19 ± 6.5 and 15.2 ± 10 mL/s for the TUVRP and the TURP groups, respectively, at 6 months; these differences were statistically significant ($P = 0.03$ and 0.01, respectively). Complications included urethral strictures (3 patients) and delayed hemorrhage with clot retention (1 patient) in each group. One additional patient in the TURP group developed urethral meatus stenosis. The 6 patients in both groups with urethral stricture presented with poor urinary stream and frequency within the first 3 months postoperatively. Urethral stricture was confirmed at diagnostic cystoscopy and was managed by visual internal urethrotomy. Sixteen patients in each group were either sexually inactive or impotent before treatment and remained so after their respective operations. We did not encounter new cases of erectile dysfunction in either group after treatment.

COMMENT

The principles of electrosurgery as described by McLean[9] in 1929 form the basis for the transurethral electrosurgical procedures on the prostate. The magnitude of the electrocutting energy and the design of the transurethral device will determine whether an incision, resection into chips, or vaporization of the prostate will result. The use of a high-energy cutting current in conjunction with the thick resection loops leads to rapid heating of the cells in contact with the resection electrode and their rupture into steam, creating a vaporization groove, and the prostatic tissue superficial to the vaporized cells is resected into chips.[2,5] The higher cutting energy provides for simultaneous coagulation at the time of vaporization and resection.[2] It has been previously reported that the most striking feature in TUVRP is that resection is accompanied simultaneously by effective coagulation, which provides excellent hemostasis and dramatically improves visibility during resection.[2,5] Our results in this randomized study support that finding. The drop in hemoglobin and hematocrit levels after TUVRP in this series was consistent with previous reports on thick loops[2,5,7] and was less than in the TURP group both immediately after surgery and on the first postoperative day. The reduced blood loss in conjunction with TUVRP may explain the shorter period of postoperative catheterization time in this group of patients. Several investigators have pointed out that the catheterization time after transurethral prostatectomy, whether using the thick loop, the Vaportrode electrovaporization, or the holmium laser resection technique, is related to the amount of bleeding during the procedure.[2,10,11] The reduction of postoperative catheterization time will allow future planing of TUVRP as a day case procedure. We have not evaluated the impact of a shorter postoperative catheterization time on the hospital stay, since our patients' wishes dictated to a great extent the length of their hospital stay. Most of our patients were referred from distant centers and therefore did not feel comfortable leaving the hospital immediately after catheter removal. Another potential advantage of the reduced bleeding during TUVRP might be the impact on training of junior residents in transurethral resection of prostates. Although this is difficult to evaluate objectively, we believe that the improved visibility during TUVRP was beneficial to both the resectionist and the attendant monitoring the progress of the procedure on the video recording.

Another benefit of the higher electrocutting energy that is applied through the wider and thicker band resection electrodes is the creation of a desiccation zone. Electrodesiccation results from heat production sufficient to drive water out of the cells but not high enough to tear these cells apart.[12] The resection technique in TUVRP requires slower passage of the band electrode to allow for maximum coagulation and desiccation of the prostatic tissue and is directly related to the speed of the resection.[2,13] This will inevitably result in longer operating times, as noted with our TUVRP patients. The desiccation zone acts as a barrier that minimizes intraoperative fluid absorption and electrolyte disturbances.[12] No change in serum sodium concentrations was observed immediately after TUVRP; the drop in serum sodium was greater at 1 and 24 hours after TURP. Although excessive desiccation of the prostatic tissues may interfere with further effective vaporization of the tissues in procedures that rely solely on electrovaporization,[14] we did not encounter such difficulties during TUVRP, since the progress of the procedure depends on the resection of one desiccation zone while a deeper one is formed with consecutive passes of the band loops.

Improvement in both symptomatic and urodynamic parameters was noted in both groups. This improvement was expected, since the principles of both procedures depend on debulking of the obstructing prostatic tissue. The resection weight was similar in both groups; however, the additional prostatic tissue removed by vaporization in TUVRP cannot be estimated with accuracy. Patel and associates[15] demonstrated that accurate quantification of the tissue that is removed in electrovaporization procedures is not possible in practical terms. Approximately 50% to 75% of the removed prostatic tissue in procedures that involve vaporization is lost in the process and cannot be retrieved as chips.[5,10] Therefore, we believe that the greater symptomatic and urodynamic improvement noted in the TUVRP group may be related to the greater debulking of the prostatic tissues achieved by vaporization.

Some forms of morbidity seen with TURP, including urethral stricture disease, bladder neck contracture, erectile dysfunction, and retrograde ejaculation, cannot be expected to improve with TUVRP. These complications are related to the transurethral instrumentation, prostatic capsule perforation with irrigant extravasation, or the principles of prostatic tissue debulking and bladder neck fiber disruption applicable in TUVRP just as in TURP or transurethral laser prostatectomy. The complications in our two groups were similar. It was interesting, however, to note that we did not encounter any cases of bladder neck contracture, particularly in the TUVRP group, in which higher levels of energy were used. Bladder neck contracture is a well-known complication of TURP and electrovaporization prostatectomy, particularly in small-size adenomas. Chen and associates[14] reported a 10% incidence of bladder neck contracture after transurethral vaporization prostatectomy and attributed this to the higher energy level used in their series. Experimental studies on both animal models and human subjects to try and determine the effects of the higher energy requirements and greater heat production in electrovaporization did not demonstrate any ill effects on the periprostatic tissues[16,17] nor on the quality of the resected prostate specimen submitted for histologic examination.[2,8] The irrigation fluid dissipates the increased heat production in the electrovaporization techniques, including TUVRP.[8,15] No differences in the complications between the groups could be attributed to the higher energy used in TUVRP in our series.

CONCLUSIONS

The results of this prospective randomized study confirmed earlier reports on the safety and efficacy of TUVRP. Although our results suggest that the Wing vaporization resection prostatectomy has the advantage of less blood loss and smaller electrolyte disturbances, the differences between the two groups were not clinically relevant. The short catheterization time seen with TUVRP may allow future planning of this procedure as a day case operation. The differences in operative and catheterization times between TUVRP and TURP may be clinically significant, when considering the procedure costs and the demand for lower morbidity profiles by patients. The change to this new modification of transurethral electrosurgical prostatectomy is easy. It is not necessary to invest in new technology, since TUVRP uses the standard resectoscope and electrosurgical generators used for TURP that are available in any modern urology unit. Furthermore, the technique is familiar to urologists, although the speed of resection must be slowed to achieve the advantages of electrovaporization. Investigators of novel technologies for the treatment of prostatic obstruction compare their results to the reference standard TURP. We believe that the lower levels of bleeding and electrolyte disturbances seen with the thick loop should set the new standard against which comparisons are made in the future.

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EDITORIAL COMMENT

This study compares the safety and efficacy of new thick-loop (Wing resection electrode) to standard-loop TURP. Both techniques were efficacious, as judged by the standard subjective (International Prostate Symptom Score [IPSS]) and objective (maximum urinary flow rate [Qmax]) parameters. The improvement in the IPSS and Qmax were significantly better after thick-loop than standard TURP. After thick-loop TURP, patients enjoyed a 40% lower IPSS and 25% higher Qmax than those who underwent standard-loop TURP, although the follow-up was limited (6 to 15 months). The absolute numbers responsible for these percentage differences, although statistically significant, may not be as significant in clinical practice.

The authors report significantly shorter resection times with the standard-loop TURP (averaging 18% quicker) than the thick-loop TURP. On the other hand, they report significantly less bleeding, less hyponatremia, and shorter catheterization after the thick-loop than the standard-loop TURP. The differences in the postoperative hematocrit and serum sodium were minor and although statistically significant, they should not pose any adverse sequelae. The duration of postoperative catheterization was significantly shorter after the thick-loop than the standard-loop TURP (2 versus 3 days). This finding may have significant clinical impact, particularly regarding patient comfort and cost savings (shorter hospitalization). Having said that, the decision to leave the catheter in the bladder in this study was entirely based on the surgeon's subjective opinion regarding the degree of hematuria. A 3-day catheterization after standard TURP seems excessive, since the current practice in the United States is to remove the catheter within 24 to 48 hours. Therefore, one has to consider whether there was any element of bias.

The advent of new thick loops for TURP seems advantageous initially; however, one has to wonder whether the claimed benefits, if any, have a true clinical impact. The need for truly hemostatic TURP continues. The suggestion that a single-source radiofrequency (RF) delivered by a single electrode assembly can be capable of dual function and tissue effect (cutting and coagulation) is, I believe, rather simplistic. The physical characteristics of single RF energy do not allow for such a dual tissue effect. In my opinion, the ultimate dual function (cutting and coagulation) rests in having two independent RF energies capable of exerting the desired hemostatic tissue cutting. Indeed, we have recently been successful in demonstrating this by splitting RF energy from a single-source generator into multiple energies (in phase) capable of various tissue effects. This technology will make it possible to perform truly hemostatic surgery. Until such time when the technology becomes commercially available, urologists will have to contend with various loops, attempting to manipulate the RF energy density and delivery through various contact surfaces, power wattage, and duration of tissue contact (speed