Bipolar Transurethral Resection in Saline—An Alternative Surgical Treatment for Bladder Outlet Obstruction?

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Purpose: The transurethral resection in saline system uses bipolar energy for transurethral prostate resection, thus, avoiding the need for glycine irrigation and its associated complications. We compared the clinical efficacy and safety of bipolar transurethral resection in saline and of monopolar transurethral prostate resection for symptomatic benign prostate hyperplasia.

Materials and Methods: From January 2005 to June 2006, 238 consecutive patients with symptomatic benign prostate hyperplasia were randomized into a prospective, controlled trial comparing the 2 treatment modalities. Patient demographics, operative time, hospital stay and complications were noted. Serum hemoglobin and electrolytes were determined in all patients immediately before and after the endoscopic procedure.

Results: During 18 months 120 patients were randomized to the conventional transurethral prostate resection group and 118 were randomized to the transurethral resection in saline group. Patient profiles, weight of resected prostatic tissue and duration of hospitalization were similar in the 2 groups. The decrease in serum sodium and serum chloride was statistically significantly greater in the transurethral prostate resection group than in the transurethral resection in saline group (each $p = 0.05$). The transurethral resection in saline procedure required significantly more time (mean 56 vs 44 minutes, $p < 0.01$). There was 1 case (0.8%) of transurethral resection syndrome in the transurethral prostate resection group but none in the transurethral resection in saline group. Postoperative bleeding did not significantly differ between the 2 groups. Clot retention was observed in 6 (5%) and 4 patients (3%) in the transurethral prostate resection and transurethral resection in saline group, respectively. Two repeat interventions were required in the transurethral prostate resection group.

Conclusions: The bipolar transurethral resection in saline system is as efficacious as monopolar transurethral prostate resection but it is safer than the latter because of the lesser decrease in postoperative hypernatremia and the smaller risk of transurethral resection syndrome. However, probably due to technical reasons, transurethral resection in saline operative time is significantly longer.

Key Words: prostate, transurethral resection of prostate, prostatic hyperplasia

Transurethral prostate resection is still the most popular operation for symptomatic BPH. In 1966 in the United States 105,514 TURPs were performed at an average cost of $6,830.[1] The Agency for Health Care Policy and Research reported that the subjective success ratio after TURP was 88%[1] and the United Kingdom National Prostatectomy Audit found a 64% rate of great symptomatic improvement after TURP.[2] The morbidity rate associated with TURP is 7% to 43% in the Agency for Health Care Policy and Research report.[1] In the National Prostatectomy Audit study the inpatient complication rate after TURP was about 10% and the outpatient complication rate was greater than 35%.[2] These inpatient complications include perioperative bleeding and TUR syndrome.[3] TURP is associated with a relatively long hospital stay of up to 5 days.[3] These complications and the high costs associated with prolonged hospitalization have fueled the interest to develop alternative surgical procedures that would be equally efficient for relieving obstruction by removing prostatic tissue but would decrease morbidity, hospitalization and possibly the cost.

The absorption of irrigating fluid is a cause of complications. The ideal irrigant for endoscopic resections would be a user friendly, nonconductor medium that does not interfere with diathermia, has a high degree of translucency and osmolality similar to that of serum, and causes only minimal side effects when absorbed. Originally sterile water was used as irrigation fluid but water absorption caused hemolysis, resulting in postoperative and occasionally lethal hemoglobinuria. Today 1.5% glycine solution is widely used for irrigation during monopolar TURP procedures. Saline can be used in bipolar systems, such as the Gyrus ACMI (Maplegrove, Minnesota), Olympus® and Storz™ systems.

We compared perioperative morbidity, operative time and length of hospital stay for bipolar TURIS vs conventional monopolar TURP in a prospective, randomized trial in patients with moderate to severe bladder outlet obstruction due to BPH.

Submitted for publication March 15, 2007.
Study received ethics committee approval.
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DOI:10.1016/j.juro.2007.07.038

MATERIALS AND METHODS

Patient Data

Between January 2005 and June 2006 after ethics committee approval of the study protocol 238 men with bladder outlet obstruction due to BPH consented to be included in a single center study. Voiding symptoms and QOL were graded according to the International Prostate Symptom Score and its QOL assessment index.[4] The minimal criteria for entry were an International Prostate Symptom Score of 13 or greater, QOL index of 3 or greater and maximal urinary flow rate less than 15 ml per second. Patients with known neurogenic bladder, prostate cancer, previous prostatic or urethral surgery, or bladder stones and those receiving anticoagulant therapy were excluded.

The diagnostic evaluation included a history, physical and digital rectal examination, urinalysis and urine culture, serum electrolytes, renal function, full blood count, prostate specific antigen determination, uroflowmetry and abdominal ultrasound measurement of post-void residual urine volume. Transrectal ultrasound was done to measure prostate volume.

After initial cystoscopy and examination with the patient under anesthesia the patient was randomized to monopolar TURP or bipolar TURIS by drawing a closed envelope. The 2 procedures were performed with intermittent glycine or saline irrigation and using general or spinal anesthesia. At the end of the procedure a 22Fr 3-way Foley catheter with a closed drainage system was inserted. All patients were treated postoperatively with continuous saline bladder irrigation until bleeding ended. In all patients a full blood count and serum electrolytes were determined immediately after surgery.

Parameters

Operative time, changes in hemoglobin and serum sodium, catheterization time, duration of hospital stay and all perioperative complications were recorded. TUR syndrome was defined as a sodium of 125 mmol/l or less after TUR[5] with 2 or more symptoms or signs of TUR syndrome, such as nausea, vomiting, bradycardia, hypotension, hypertension, chest pain, mental confusion, anxiety, paresthesia and visual disturbance.

Equipment

A standard Olympus resectoscope and an Olympus UES-40 SurgMaster electrical current generator were used for TURP and TURIS. TURP was done with a standard 26Fr resectoscope and standard loops using 175 W cutting power and 75 W coagulation power. TURIS was performed using a 24Fr resectoscope with bipolar electrodes set at 270 W for cutting and 75 W for coagulation.

TABLE 1. *Characteristics of 2 groups*

Parameters	Mean TUR	Mean TURIS	p Value
Age	73.1	73.8	0.536
Operative time (mins)	44	56	0.001
Resection wt (gm)	21.3	21.0	0.872
Catheterization time (days)	4.5	4.0	0.201
Hospital stay (days)	5.1	4.9	0.591

TABLE 2. *Duration of operations performed by staff members and trainees*

	No. Operative Time (%)	
	60 Mins or Less	Greater Than 60 Mins
Staff:		
TURP	92 (82)	20 (18)
TURIS	55 (69)	25 (31)
Trainees:		
TURP	5 (62)	3 (38)
TURIS	19 (50)	19 (50)

Statistics

All statistical tests were 2-sided and at the 5% level of performance. The 2 groups were compared using the independent t test. Comparisons of the complication rate were done by Fisher's exact test. The interaction effect was analyzed with forward logistic regression using SPSS®, 2001 version.

RESULTS

The 120 patients undergoing traditional TURP were 52 to 92 years old (mean ± SD age 73.1 ± 8.6). The 118 patients treated with TURIS were 53 to 92 years old (mean age 73.8 ± 8.1 years). There was no statistically significant difference between the 2 groups (table 1). In the TURP group 112 procedures were done by staff members and 8 were done by trainees. In the TURIS group 81 procedures were done by staff members and 38 were done by trainees.

The mean operative times of 44 ± 20 and 56 ± 25 minutes in the TURP and TURIS groups, respectively, differed significantly (table 1). This was statistically longer but only by an average of 12 minutes. Although our policy was to keep resection time as short as possible and not to exceed 60 minutes, 22 conventional resections and 44 TURIS procedures required more than 1 hour. Differences in resection time were seen in procedures done by staff members as well as by trainees (table 2). Although trainees performed more TURIS procedures, statistical analysis showed no significant interaction effect. The TURIS procedure prolonged operative time in the 2 groups equally.

The mean amount of prostatic tissue resected was 21.3 gm (range 10 to 164) in the TURP group and 21.0 gm (range 10 to 65) in the TURIS group. These values did not differ significantly (table 1). Only in 6 resections in the TURP group and in 7 in the TURIS group did the amount of tissue removed exceed 45 gm. Histological examination of the specimens revealed prostate cancer in 19% of cases. BPH and cancer were equally represented in the 2 groups (table 3).

Table 4 lists chemical and hematological values at predetermined times in the TURP and TURIS groups. Changes in serum sodium and serum chloride after TURP and TURIS differed significantly, whereas other chemical parameters did not (table 5). In the TURP group 1.6%, 0.8% and 0.8% of all patients showed a decrease in postoperative serum so-

TABLE 3. *Histological findings after resection*

	No. Hyperplasia	No. Adenoca
TURP	96	24
TURIS	93	25

TABLE 4. *Chemical and hematological values in TURP and TURIS groups*

	Mean Preop	Mean Immediate Postop	Difference
TURP:			
Hemoglobin (mg/dl)	14.1	12.8	−1.26
Sodium (mmol/l)	142.0	139.0	−2.23
Potassium (mEq/l)	4.2	4.1	−0.09
Chloride (mEq/l)	103.9	104.6	0.73
TURIS:			
Hemoglobin (mg/dl)	13.4	12.1	−1.44
Sodium (mmol/l)	142.2	140.8	−1.47
Potassium (mEq/l)	4.2	4.0	−0.15
Chloride (mEq/l)	105.1	106.6	1.48

dium of greater than 10, greater than 15 and greater than 20 mmol/l, respectively. In the TURIS group only 1 patient experienced a decrease of more than 10 mmol/l.

The indwelling catheter was removed after 4.5 ± 3.5 days in the TURP group and after 4.0 ± 3.0 days in the TURIS group ($p = 0.2$). There was no statistically significant difference in hospital stay. TURP patients were discharged home at an average of 5.1 days (range 3 to 34) and TURIS patients were discharged at an average of 4.9 days (range 2 to 14).

In each group 24 patients (10%) showed 1 early complication. These complications were noted in 11% of patients treated with TURP and in 9% of those who underwent TURIS (p not significant). The most common complication, clot retention, occurred in 10 patients (4%), including 6 in the TURP group and 4 in the TURIS group. Two patients in the TURP group needed transurethral revision with cauterization.

Table 6 lists the perioperative complications of TURP and TURIS. One patient in the TURP group needed a blood transfusion. Four men in the TURIS group who experienced a decrease in hemoglobin to less than 9 gm/dl were transfused with 2 or more U packed cells. In 3 of these 4 patients adenocarcinoma of the prostate was present and preoperative hemoglobin was barely more than 9.5 gm/dl. TUR syndrome developed in 1 patient in the TURP group but in none in the TURIS group.

DISCUSSION

Today many transurethral procedures are performed to resolve voiding difficulties due to prostatic obstruction. Alternative procedures are being investigated and compared with this standard treatment on grounds of efficacy, morbidity, hospital stay and cost.

Although the basic concept of TUR remains, TURIS is performed with saline instead of glycine as the irrigating fluid. Not surprisingly some differences between conventional TURP and TURIS have been observed. Different aspects of the procedure have been analyzed in clinical studies to point out these differences.

TABLE 5. *Chemical and hematological parameters*

	Mean TURP	Mean TURIS	p Value
Hemoglobin (mg/dl)	1.26	1.44	0.294
Sodium (mmol/l)	2.23	1.47	0.052
Potassium (mEq/l)	0.09	0.15	0.317
Chloride (mEq/l)	0.73	1.48	0.049

TABLE 6. *Perioperative complications of TURP and TURIS*

Complication	No. TURP (%)	No. TURIS (%)	p Value
Clot retention	6 (5.0)	4 (3.4)	0.749
Blood transfusion	1 (0.8)	4 (3.4)	0.211
TUR syndrome	1 (0.8)	0	1.00
Postop urinary retention	5 (4.2)	3 (2.5)	0.722

Perioperative Morbidity

Transurethral interventions are usually performed using general, spinal or local anesthesia. The type of anesthesia does not alter the outcome of surgery. McGowan and Smith evaluated patients who underwent TURP under spinal and general anesthesia, and observed no differences in blood loss, postoperative morbidity or mortality.[6]

Glycine, which was introduced in 1948, is an endogenous amino acid in a reasonably inexpensive, transparent (2.2%) iso-osmotic solution.[7] Its resorption during TURP may cause general, cardiac and neurological side effects, which are classified as TUR syndrome. The reported incidence is 0% to 10%.[8] However, TUR syndrome is often not recognized and mild cases can be falsely attributable to older patient age, anesthetic complications or excessive bleeding.

It is commonly accepted that fluid absorption is more likely in longer operations with more blood loss.[9] Especially procedures lasting more than 1 hour are particularly dangerous. Other factors that might affect the amount of absorbed irrigant are the use of intermittent rather than continuous flow resectoscopes and the height of the irrigation fluid column above the patient.[10]

Other factors were also suggested as plausible causes of TUR syndrome. Glycine is metabolized to glycolic acid and ammonium. Ammonium intoxication and a possible direct toxic effect of glycine were reported to be potentially harmful. Glycine may also induce the short-term and long-term risk of cardiac injury.[11]

It seems that irrigation fluid absorption during TURP depends as much on the intricacies of the individual prostate as on surgeon ability and experience. In view of this it is difficult to predict which patient is at risk for absorbing excess irrigant during TURP.

Prostate capsule perforation during TURP is probably more common than assumed with many small perforations going unrecognized. In his original description of TURP Blandy stated that "Perforation of the capsule is inevitable if an adenoma is to be completely resected. Tell-tale glistening of extravesical fat is often seen in the capsule at the 3 and 9 o'clock positions but may usually be safely disregarded and gives rise to no harm."[12] Obviously the advent of capsular perforation early in the procedure, a large perforation from an obturator nerve stimulation incident or any perforation due to poor surgical technique will make a difference regarding the risk of irrigation fluid absorption. The multifactorial risk together with the unpredictable character of irrigation fluid absorption highlights the need for safer or even completely safe irrigation fluids.

A potentially safer alternative to glycine irrigation is normal saline to be used with bipolar diathermy. This new development allows prostate resection using a familiar technique. Normal saline is obviously a more physiological solution because it can be given intravenously and with minimal known side effects. Several studies compared bipolar TURP

in normal saline with standard monopolar resection in glycine.[13–17] The advantages of the former technique are minimal changes in blood sodium even after longer operations and the fact that no cases of TUR syndrome were noted, as confirmed in our study and that by Seckiner et al.[17]

Complications in the 2 groups are consistent with data from the literature. The transfusion rate after TURP and TURIS was 0.8% and 3.4%, respectively, which are lower than in previously published studies.[5,18] The risk of postoperative clot retention and the need for transurethral revision were of similar magnitude, as reported in the literature.[19] The distribution of benign and malignant histological findings approximates those of other studies.[5]

Operative Time

In contrast with the study by Tefekli et al,[15] the comparison between TURP and TURIS revealed some disadvantages of bipolar resection. Staff members as well as trainees needed more operative time with the new system. Staff members needed more than 1 hour with TURIS in 30% of patients, while trainees needed it even in 50% of cases. Although we do not discard the importance of the learning curve, this prolonged operative time was unquestionably also related to specific TURIS characteristics. The size of the resection loops for TURIS is 24Fr, whereas with the conventional method one can use 26Fr or even 28Fr loops (see figure). The availability of larger resection loops could resolve this technical limitation. Furthermore, coagulation with the resection loop and roller ball electrode was believed to be slower and less effective. On the other hand, the use of smaller endoscopes with bipolar TURIS could theoretically be an advantage with respect to postoperative urethral strictures. In our series no strictures were recorded to date.

Left, 26Ch resection loops for monopolar TURP. Right, 24Ch resection loops for bipolar TURIS.

Hospital Stay

Hospitalization at our institution includes a 1-day preoperative assessment, the intervention and at least 24 hours of observation. The transurethral catheter is usually removed as soon as the urine clears. Patients in the TURP and TURIS groups were catheterized a mean of 4.5 ± 3.5 and 4.0 ± 3.0 days, respectively. The patient is discharged home when there is no fever and no major micturition problems. Hospitalization lasted a mean of 5.1 days for TURP and 4.9 days for TURIS, which corresponds to European norms.[3] In similar studies Tefekli[15] and de Sio[16] et al reported shorter catheterization and hospitalization times in the bipolar resection group.

CONCLUSIONS

TURIS seems to be safer than TURP, especially in regard to the avoidance of TUR syndrome, but it prolongs operative time substantially. Further technical improvements are awaited.

Abbreviations and Acronyms

BPH	=	benign prostatic hyperplasia
QOL	=	quality of life
TUR	=	transurethral resection
TURIS	=	TUR in saline
TURP	=	TUR of prostate

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EDITORIAL COMMENT

This is a randomized study in the field of BPH resection comparing a newer bipolar system (the Olympus TURIS system) and standard monopolar TURP. The good news is that this bipolar system is associated with fewer cases of TUR syndrome. The bad news is that TURIS is associated with the same degree of bleeding as standard monopolar TURP. This is important because we and others have already shown that other bipolar systems, like the Gyrus system, greatly decrease the amount of bleeding associated with prostate resection. It is unclear to me why readers would want to use the TURIS system when the widely studied and seemingly better Gyrus system has been available for years.

This study reminds us that the field of TURP is finally moving forward. In my opinion old-fashioned monopolar TURP should be considered obsolete, version 1.0 technology and bipolar TURP should be considered version 2.0. KTP laser photovaporization of the prostate (GreenLight, LaserScope®) or holmium laser ablation of the prostate can be considered version 3.0. In my reckoning version 4.0 is the newer GreenLight HPS™ for photovaporization of the prostate. It seems to work more rapidly and it is easier to learn than standard GreenLight TURP. If you are still doing old-fashioned, version 1.0 TURP, you must run, not walk, and get yourself a bipolar system. (I like the Gyrus, but I accede that the largely untested Olympus or Storz products might also be good.) You will be rewarded with shorter catheterization time and much less bleeding, and you will never look back. You should also seriously consider taking advantage of the latest 21st century technology and learn how to use the GreenLight laser or newer photovaporization-HPS system. It is rapid, can be performed even in patients on active anticoagulation and can often be completed without subsequently placing a Foley catheter. The winds of TURP change are blowing. Are you being left behind?

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