# Transurethral Resection of the Prostate With Monopolar Resectoscope: Single-surgeon Experience and Long-term Results of After 3589 Procedures

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**OBJECTIVE** To present our clinical outcomes and to assess the impact of technological improvements that have occurred recently in transurethral resection of the prostate (TURP) on its morbidity.

**METHODS** The data from the 3589 patients who underwent conventional monopolar TURP for BPH from March 2000 to December 2008 were evaluated retrospectively. Data were analyzed to obtain perioperative and postoperative complications, operative time, weight of prostate chips resected, time to catheter removal, and hospitalization time. Patients were followed at 3 months and then yearly. The follow-up included the International Prostate Symptom Score (IPSS), quality of life score (QoL), maximum urinary flow rate ($Q_{max.}$), and prostate-specific antigen. The significant improvements in mean the IPSS, QoL score, and $Q_{max.}$ were observed in postoperative visits.

**RESULTS** Intraoperative perforation of prostatic capsule or bladder neck was observed in 27 (0.75%) patients. In the early postoperative period, clot retention with secondary bleeding was observed in 81 (2.3%) patients. Recatheterization was required in 195 (5.4%) patients. Mild to moderate dysuria was observed in 819 (23%) patients. Urinary tract infection occurred in 234 (6.5%) cases. Severe dysuria, urgency, and urge incontinence was observed in 93 (2.6%) patients in the first week after surgery. During the follow-up period, urethral stricture and bladder neck contracture occurred in 117 (3.2%) and 39 (1.08%) patients, respectively. There was no the iatrogenic incontinence. Re-operation as a result of rest prostatic adenoma was required in 158 (4.4%) patients.

**CONCLUSION** These data demonstrate that a technical improvement in TURP provides a lower complication rate. Conventional monopolar TURP can now be performed with excellent long-term efficacy combined with reduced complications. UROLOGY 78: 1151–1155, 2011. © 2011 Elsevier Inc.

Lower urinary tract symptoms (LUTS) secondary to benign prostatic hyperplasia (BPH) are a common condition in the present aging male population. Despite the development of new minimally invasive methods, transurethral resection of the prostate (TURP) remains the gold standard surgical treatment for LUTS related to BPH, with >90% of the patients reporting normal or improved voiding after 10-year follow-up period.[1,2] The considerable morbidity rate associated with TURP[3,4] has led to the development of several less invasive technologies to relieve benign prostatic obstruction. The development of medical, and, particularly minimally invasive, treatment modalities has decreased the number of TURPs performed. However, many of these minimally invasive therapy options are characterized by the absence of long-term data on efficacy and durability.

TURP has also undergone enormous evolution over the past 20 years. Numerous technical improvements of TURP have been implemented, including video-assisted TURP, continuous-flow instruments, special loop designs, and modifications of high-frequency generators. Preoperative medical treatment reducing prostate size and perioperative bleeding, and appropriate use of antibiotics reducing infection rates, have contributed to decreasing the morbidity of TURP, and it has evolved into a safer operation while maintaining its excellent efficacy.

In the present study, we have reviewed our clinical outcomes and complications rate in a large group of

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patients treated with conventional monopolar TURP for BPH over the past 8 years. The aim of this study was to present our clinical outcomes and to assess the impact of technical improvements of TURP that have been implemented within the past years on its morbidity.

## MATERIAL AND METHODS

### Patients

The data from the 4320 patients who underwent TURP for obstructive BPH with electrosurgical resection from March 2000 to December 2008 were evaluated retrospectively. Patients who were diagnosed with prostate cancer, lost to follow-up, or died were excluded from the analysis.

Before the surgery, patients were evaluated with a detailed clinical history, a digital rectal examination (DRE), uroflowmetry, and a measurement of postvoid residual urine volume (PVR). Patients were also asked to complete the International Prostate Symptoms Score (IPSS) and quality-of-life (QoL) questionnaires. The following routine analyses and tests were also carried out: complete blood count, urea, creatinine, electrolytes, bleeding and clotting tests, prostate-specific antigen (PSA) and a urine analysis. Prostate volume was measured by transrectal ultrasound, and PVR was measured by transabdominal ultrasonography.

Indications for TURP were the presence of moderate or severe LUTS (IPSS >8), failed previous medical therapy, and a maximum urinary flow rate ($Q_{max.}$) <10 mL/s. Prostate cancer was excluded by measuring serum PSA level, a DRE, and, if necessary, by prostate biopsy. Previous diagnosis of urethral stricture, detection of ureteral stricture during the operation, dementia, previous TURP operation, prostatic or bladder malignancy, or neurogenic bladder were exclusion criteria from the study.

Antibiotic prophylaxis was applied by 1 g second-generation cephalosporin used preoperatively and after 12 hours after the operation. Patients were prescribed oral ciprofloxacin for two weeks, postoperatively. Paracetamol was used for postoperative pain.

### Surgical Technique

Operations were performed under spinal anesthesia with the exception of contraindications or technical failure of spinal anesthesia. Conventional TURP was performed using a standard technique (26 Ch rotatable sheath continuous flow-type; Storz, Tuttlingen, Germany) without special modifications, as described in the literature, and a Valleylab (Foece FX, Boulder, CO) electrosurgical instrument system with the setting at 120 W for cutting and 100 W for coagulation. All procedures were performed by a single surgeon. During TURP, continuous irrigation was achieved using mannitol 5% solution in 3000-mL bags. Mannitol bags were hung in the minimum height sufficient for appropriate fluid flow (maximum 60 cm).

In patients with meatal stenosis, for which convenient resectoscope passage was not possible, meatal dilatation was performed. In patients with urethral diameter inconvenient for easy resectoscope passage and movement, a 24 Ch Storz single-way flow or 22 Ch Storz continuous-flow resectoscope was used.

Resection of the prostate was started from the middle lobe if it existed. Resection was performed until development of plain track between the bladder and veru montanum on the posterior wall of the prostate. Lateral, anterior, and apical prostatic tissues were resected until the prostatic capsula. At the end of the surgery, after control of bleeding, 22Ch 3-way in-dwelling Foley catheter was placed and closed continuous irrigation was applied with isotonic saline solution. Bladder irrigation with normal saline was continued until there was no hematuria. The catheter was then removed within 24 hours of clear urine voiding except in patients who developed complications such as hematuria and clot retention. After stabilization, a complete blood count, urea, creatinine, and electrolytes were measured. Signs and symptoms of transurethral resection (TUR) syndrome were also assessed clinically.

**Table 1.** Baseline characteristics of patients undergoing conventional monopolar TURP

| Characteristics | Mean ± SD |
|---|---|
| Number of patients | 3589 |
| Age (y) | 65 ± 6.9 |
| Prostate volume (mL) | 62.4 ± 12 |
| $Q_{max}$ (mL/s) | 7.1 ± 2.4 |
| PVR (mL) | 142 ± 11 |
| IPSS | 26 ± 3 |
| QoL | 4 ± 1 |
| PSA (ng/mL) | 3.9 ± 0.9 |
| Duration of symptoms (mo) | 25 ± 8 |

Perioperative and postoperative complications, operative time, weight of prostate chips resected, time to catheter removal, and hospitalization time were recorded. Patients were followed at 3 months and then yearly. The follow-up included the IPSS, QoL, $Q_{max.}$, PVR, and PSA. Complications were categorized into perioperative (intraoperative or immediate postoperative) complications, early postoperative complications (within the first 30 day after surgery), and late-term complications (>30 day after surgery).

### Statistical Analysis

Data are presented as mean ± SD. The Mann-Whitney *U* test was used for baseline characteristics; the Wilcoxon rank-sum test was used for gathering preoperative and postoperative data. A *P* value <.05 was considered statistically significant.

## RESULTS

Of the 731 patients excluded from the data analysis, 325 were lost to or refused follow-up, 270 had died of unrelated causes, 105 had developed and were treated for prostate cancer, and 31 had developed and been treated for bladder carcinoma.

### Baseline Characteristics

Baseline characteristics of the patients are presented in Table 1. The mean age of the patients was 65 ± 6.9 years. Mean volume of the prostate and PVR were 62.4 ± 12 mL and 142 ± 11 mL, respectively. Mean IPSS, QoL score, and $Q_{max.}$ were 26 ± 3, 4 ± 1, and 7.1 ± 2.4 mL/s, respectively. Mean preoperative PSA level was 3.9 ± 0.9 ng/mL. Mean duration of the symptoms was 25 ± 8 months.

**Table 2.** Perioperative parameters of patients undergoing conventional monopolar TURP

| Variable | Mean ± SD |
|---|---|
| Operative time (min) | 42 ± 11.7 |
| Catheterization time (h) | 24 ± 2.3 |
| Hospital stay (h) | 29 ± 1.2 |
| Resected prostatic tissue (g) | 32 ± 10.8 |
| Hemoglobin (g/dL) | |
| Preoperative | 14.6 ± 1.2 |
| Postoperative | 13.9 ± 0.9 |
| Serum sodium (mmol/L) | |
| Preoperative | 138 ± 2.5 |
| Postoperative | 137 ± 2.3 |
| Irrigated mannitol during TURP (mL) | 12,000 |
| Irrigated saline after TURP (mL) | 3000 |

## Perioperative Data

Detailed perioperative data are shown in Table 2. Mean operative time, mean catheterization time, and mean length of hospitalization stay were 42 ± 11.7 minutes and 24 ± 2.3 and 29 ± 1.2 hours, respectively. Pre- and postoperative hemoglobin values were 14.6 ± 1.2 and 13.9 ± 0.9 g/dL, respectively. Pre- and postoperative serum sodium values were 138 ± 2.5 and 137 ± 2.3 mmol/L, respectively. Mean irrigated mannitol volume for each TURP was 12,000 mL, and mean irrigated saline volume after each procedure was 3000 mL. The average resected prostatic tissue was 32 ± 10.8 g.

## Pathologic Results

Resected prostatic specimens were evaluated by a urological pathologist. Prostate cancer was revealed by pathologic examination in 105 patients. These patients were treated for prostatic carcinoma and their data were excluded from the data analysis.

## Functional Outcome

The median follow-up was 42 months (range 3-84). Significant clinical improvement compared with baseline levels was noted in all cases, as shown in Table 3. The vast majority of patients were satisfied with their voiding outcome. IPSS and QoL scores decreased from 26 ± 3 and 4 ± 1 to 6.5 ± 3.1 and 1.7 ± 0.4, respectively, on follow-up at postoperative month 3. PSA level and prostate volume decreased from 3.9 ± 0.9 mL and 62.4 ± 12 mL to 2.5 ± 1.4 mL and 22.3 ± 3 mL, respectively, at postoperative month 3. $Q_{max.}$ increased from 7.1 ± 2.4 to 20.7 ± 3.5 mL/s, and PVR decreased from 142 ± 11 to 23.9 ± 6.5 mL on follow-up at postoperative month 3 (Table 3). These results were significantly different from preoperative data ($P < .05$). The results of postoperative months 3 and 84 were not statistically different and postoperative changes were constant on postoperative month 84 compared with month 3.

## Complications

Preoperative, early, and late complications are shown in Table 4. Intraoperative perforation of prostatic capsule or

**Table 3.** The follow-up of subjective and objective voiding variables after TURP

| | Preoperative | Postoperative Months | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 3 | 12 | 24 | 36 | 48 | 60 | 72 | 84 |
| Number of patients | 3589 | 3561 | 3277 | 3188 | 2803 | 2554 | 1992 | 1655 | 942 |
| IPSS | 26 ± 3 | 6.5 ± 3.1 | 6.4 ± 5.3 | 6.0 ± 4.3 | 6.8 ± 3.0 | 6.7 ± 2.3 | 6.9 ± 4.1 | 6.4 ± 3.4 | 6.8 ± 2.9 |
| QoL | 4.0 ± 1.1 | 1.7 ± 0.4 | 1.5 ± 0.7 | 1.4 ± 1.1 | 1.6 ± 0.9 | 1.8 ± 1.0 | 1.8 ± 0.5 | 1.9 ± 1.0 | 2.3 ± 1.0 |
| $Q_{max.}$ (mL/s) | 7.1 ± 2.4 | 20.7 ± 3.5 | 21.9 ± 4.5 | 20.8 ± 3.5 | 21.2 ± 5.0 | 20.3 ± 4.3 | 20.0 ± 8.5 | 19.7 ± 6.6 | 19.5 ± 2.9 |
| PVR (mL) | 142 ± 11 | 23.9 ± 6.5 | 22.4 ± 5.0 | 22.7 ± 5.8 | 24.0 ± 7.1 | 24.4 ± 5.0 | 25.4 ± 8.1 | 26.9 ± 5.2 | 27.2 ± 2.3 |
| PSA (ng/mL) | 3.9 ± 0.9 | 2.5 ± 1.4 | 2.5 ± 0.7 | 2.5 ± 0.9 | 2.6 ± 0.9 | 2.6 ± 0.5 | 2.3 ± 1.9 | 2.4 ± 1.2 | 2.7 ± 1.1 |
| PV (mL) | 62.4 ± 12 | 22.3 ± 3 | 23.7 ± 6 | 23.36 ± 3.7 | 24.1 ± 4.6 | 24.9 ± 4.9 | 26.45 ± 4.2 | 27.1 ± 3.8 | 27.5 ± 4.1 |

Data presented as mean ± SD.
PV = prostate volume.

**Table 4.** Complications observed after TURP

| | Number of (%) of Patients |
|---|---|
| Intraoperative | |
| Death | 0 |
| Bleeding requiring transfusion | 7 (0.25) |
| TUR syndrome | 0 |
| Perforation (capsule or bladder neck) | 27 (0.75) |
| Early postoperative (<30 d) | |
| Clot retention caused by bleeding | 81 (2.3) |
| Recatheterization | 195 (5.4) |
| Mild to moderate dysuria | 819 (23) |
| Severe dysuria, urgency, and urge incontinence | 93 (2.6) |
| UTI | 234 (6.5) |
| Early re-TURP | 31 (0.86) |
| Late postoperative | |
| Urethral stricture | 117 (3.2) |
| Bladder neck contracture | 39 (1.08) |
| Incontinence | 0 |
| Re-operation owing to BPH | 158 (4.4) |

bladder neck was observed in 27 (0.75%) patients. Excessive bleeding caused by capsular perforation was controlled by catheter traction.

Severe bleeding necessitating intraoperative or postoperative blood transfusion occurred in 7 patients. There was no TUR syndrome or intraoperative death.

In the early postoperative period, clot retention with secondary bleeding was observed in 81 (2.3%) patients. These patients required readmission for cystoscopy and bladder irrigation.

Recatheterization was required in 195 (5.43%) patients. The catheters of these patients were removed after a few days and 164 patients were able to void spontaneously afterward. The remaining 31 patients (0.86%) needed early re-TURP.

Mild to moderate dysuria was observed in 819 (23%) patients. These patients were usually treated successfully with nonsteroid antiinflammatory drugs and oral analgesics for several days. The complaints of all of these patients resolved spontaneously within a mean time of 2 months. Urinary tract infection (UTI) occurred in 234 (6.51%) cases. Severe dysuria, urgency, and urge incontinence were observed in 93 (2.59%) patients in the first week after surgery. These patients were treated successfully with anticholinergics and antiinflammatories. There was no incontinence found during the follow-up period.

During the follow-up period, urethral stricture and bladder neck contracture occurred in 117 (3.25%) and 39 (1.08%) patients, respectively. These patients underwent internal ureterotomy procedure. There was no late stress incontinence during the follow-up period. Re-operation towing to LUTS secondary to rest prostatic adenoma was required in 158 (4.4%) patients.

## COMMENT

Further improvements in TURP instrumentation or technology during the last decade may have a major impact on the clinical outcomes and the incidence of intra- and postoperative complications. In the present study, we aimed to present our clinical outcomes and to update the complications of conventional monopolar TURP.

In 1962, Holtgreve et al reported the morbidity and mortality of TURP in 2015 cases,[5] and they found a mortality rate of 2.5%. Mortality after TURP has decreased substantially during the past few decades to <0.25% in contemporary series.[6] This might be attributable mainly to the advances in anesthesia and to the technical improvements in TURP procedure.[7] In our series there was no intraoperative mortality.

The major intraoperative complication remains bleeding, defined as patients requiring blood transfusions. Whereas in the early series, transfusion rates of up to 22% were reported, the incidence has decreased to 0.4-7.1%.[8,9] Improved resectoscopes and electrosurgical equipment can reduce bleeding and optimize the endoscopic views with better-controlled hemostasis. In our study there was no intraoperative bleeding requiring blood transfusion. Postoperative irrigation requirement can be reduced by preventing intraoperative bleeding.

In addition to the improved surgical techniques and instrumentations, the use of modern irrigating fluids has significantly decreased the incidence of TUR syndrome during the past few decades from >2% to <1%.[3,4,9] There was no TUR syndrome in our series.

The most frequent complications that occurred within the first month after TURP in our series were secondary bleeding requiring evacuation or irrigation (2.3%), recatheterization (5.4%), and UTI (6.5%). The rates of these postoperative complications were significantly less than the early series[4,8] but in accordance with those of the recent studies.[7,1]

In a meta-analysis conducted by Rassweiler et al, incidence of complications after TURP was analyzed for 3 subsequent periods: early (1979-1994), intermediate (1994-1999), and recent (2000-2005). They observed that video-assisted TURP and training helped to reduce perioperative complications (recent vs early), such as transfusion rate (0.4% vs 7.1%), TUR syndrome (0.0% vs 1.1%), clot retention (2% vs 5%), and UTI (1.7% vs 8.2%).[1]

The major late complication after TURP is urethral stricture (2.2-9.8%) and in a meta-analysis conducted by Rassweiler et al there was no relationship to time period.[1] According to Hoffmann et al, meatal strictures usually occur because of an inappropriate relationship between the size of the instrument and the diameter of the urethral meatus. Bulbar strictures occur because insufficient isolation by the lubricant causes the monopolar current to leak.[10] The rate of urethral stricture and bladder neck contracture in our series was 3.2% and 1.08%, respectively.

The re-treatment rate of TURP is 3-14.5% and is lower than the rates of other minimally invasive alternative therapy.[7] A total of 20,671 patients who underwent

TURP between 1992 and 1996 were followed for up 8 years, and the incidence of a secondary TURP at 1 year was 2.9%.[6] In our series, re-treatment owing to recurrent BPH rate was 4.4%.

We observed the significant improvements in IPSS, QoL score, $Q_{max.}$, and PVR in postoperative visits. Our data on functional outcome with a mean follow-up of 60.3 ± 3 months show sustained improvements and underline the long-term efficacy and durability of TURP. These results were similar to the report of Madersbacher et al.[7]

TURP remains the most frequently performed surgery for patients with BPH,[11] despite the availability of numerous minimally invasive alternatives, because these fail to equal the success of TURP, require more costly instruments, and have a steep learning curve. In addition, many of these minimally invasive therapy options are characterized by the absence of long-term data on efficacy and safety.[12-14] A controversial issue concerning many of these minimally invasive therapy options compared with TURP is the lack of histology, with the possible risk of overlooking prostate carcinoma.

## CONCLUSIONS

TURP has undergone significant technical improvements during the last decade, with a major impact on the incidence of associated morbidity. The intra- and postoperative complications rate of contemporary TURP is lower than that reported previously. The results of this large series of 3589 patients demonstrate that technical improvements in TURP provide a lower complications rate. Conventional monopolar TURP can now be performed with excellent long-term efficacy combined with reduced complications.

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## EDITORIAL COMMENT

The study has a good number of patients and it was a single-surgeon experience. Four-hundred-six patients were excluded from the analysis, 270 patients died before the time of the analysis, 31 patients developed bladder cancer, and 105 patients' transurethral resection of the prostate (TURP) chips revealed prostatic adenocarcinoma. We believe that reporting their outcome up to the last observation point would have been useful in assessing their lower urinary tract symptoms improvement and would have provided more accurate analysis of complications and hemoglobin and sodium levels changes.

We also believe that the authors should have used the median and the variant (or range) instead of the mean and the standard deviation as measures of central tendency and dispersion respectively. The data may not have been normally distributed.

The quality of life score is a nominal variable and the median is more meaningful in reporting central tendency as opposed to the mean, which is applicable for scale or continuous variables.

Regarding the technique, the authors mentioned that they established a "plain track from the bladder to the veru." It would be interesting to know whether they modified their technique and sequence of resection according to gland size and configuration.

The reported prostate volumes 3 months post resection are much smaller than expected given the resected volumes. There also seems to be little change in hemoglobin levels after resection. Furthermore, lack of a single TUR syndrome occurrence in a series of >3500 monopolar TURPs seems a bit unusual.

In the study, 2.3% of the patients had clot retention caused by bleeding. It would be interesting to know the post operative hemoglobin levels. Reporting the complications according to the Clavien criteria would have been more useful as well. A contemporary series of bipolar TURP would be a welcome addition to the literature.


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