Bipolar Transurethral Resection in Saline (TURis®): Outcome and Complication Rates After the First 1000 Cases

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Abstract

Objective: TURis® is an emerging technique that shows the same efficacy of monopolar resection. However, there is currently little available data on the safety of bipolar devices. We assessed outcome and safety of TURis on a large cohort of patients with at least 6 months’ follow-up.

Patients and Methods: Between January 2006 and October 2007, 1000 consecutive transurethral resection (TUR), 376 transurethral resection of prostate, 480 transurethral resection of bladder neoplasm, and 144 transurethral incision of prostate were performed. All procedures were carried out with a bipolar device in physiologic saline (TURis). The resectoscope used was an Olympus 26F in continuous flow–type Iglesias with continuous aspiration. The loops were all disposable/single use. The incidence of unwanted stimulation of the obturator reflex, TUR syndrome, thermal skin lesion, blood transfusion, urethral strictures, and bladder neck contractures were recorded.

Results: None of the patients operated experienced a TUR syndrome or a thermal skin lesion. The median follow-up of the entire cohort was 12 months (range, 6–24 months); 663 patients had at least 1-year follow-up (66.3%). Urethral stricture occurred in 27 patients (2.7%). Four patients developed a bladder neck contracture after transurethral resection of prostate (1%). Early postoperative clot retention occurred in 21 patients (2.1%), and 11 patients needed one or more transfusion (1.1%). Only six patients (2%) submitted to TUR of a neoplastic lesions at the lateral bladder wall experienced an unwanted trigger of the obturator reflex.

Conclusions: TURis offers the patient the same results as monopolar technology guaranteeing maximum safety without increasing the incidence of urethral strictures.

Introduction

Video transurethral resection today is the gold standard for the treatment of benign prostatic hyperplasia and superficial bladder cancer.1 Notwithstanding the continuous amelioration of the surgical equipment and the progress made in anesthesiology, the intervention still has a certain morbidity.2,3 Transurethral resection (TUR) syndrome, for example, is a rare4 but serious clinical complication of a monopolar resection carried out with a electrolyte-free irrigation solution (e.g., glycine). The latter irrigation solution is further toxic in particular concentrations and can aggravate the clinical picture. To reduce the risks of the monopolar circuit, resectoscopes are today commercially available, which, by behaving like electric dipoles, allow the patient to be excluded from the circuit. This allows the use of physiologic saline as irrigation solution annulling the risk of a TUR syndrome and an intoxication by glycine. These bipolar electrosurgical units are available from different manufacturers. In the literature many papers confirm the equivalence in clinical outcome between mono and bipolar resection,5 but there is currently little available data on the more effective safety of bipolar devices, especially on the incidence of urethral stricture.

Patients and Methods

Between January 2006 and October 2007, 1000 consecutive bipolar TUR, 376 transurethral resection of prostate (TURP), 480 transurethral resection of bladder neoplasm (TURB), and 144 transurethral incision of prostate (TUIP) were performed.
The procedure started always with a urethrotomy in cases with an inappropriate relationship between the size of the instrument and the diameter of the external urethral meatus. Starting from the assumption that the clinical results of the bipolar resection should be at least equal to the monopolar resection,5 the end point of our study was to analyze with an adequate sample size, 1000 patients, and sufficient follow-up, at least 6 months, whether bipolar resection is safe particularly looking into the incidence of TUR syndrome, bladder neck contracture, urethral strictures, blood loss, and unwanted stimulation of the obturator reflex.

**TURP**

Criteria of inclusion for patients undergoing TURP. Diagnosis of benign prostatic hyper trophy–induced obstruction, prostatic volume between 20 and 80 mL, International Prostate Symptom Score (IPSS) \( > 13 \), and maximum urinary flow (Qmax) \( < 10 \text{ mL/second} \).

**End points.** Median resection time, median amount of resected tissue, median hemoglobin difference between the preoperative values and the values of the second postoperative day, average catheterization time, average hospital stay, incidence of TUR syndrome, incidence of bladder neck contracture or urethral strictures, number of postoperative vesical tamponade, number of patients requiring blood transfusions, number of patients with unachieved obstructive clearance (Qmax \( < 15 \text{ mL/second} \)), and change in preoperative respect to postoperative prostate-specific antigen (PSA), IPSS, and Qmax.

**Follow-up.** Physical examination (including digital rectal examination), PSA, IPSS, uroflowmetry, and cystoscopy were routinely performed at 6 and 12 months and then yearly.

**TURB**

Criteria of inclusion for patients undergoing TURB. Echographic/endoscopic evidence of intravesical lesions. Patients submitted to radical cystectomy within 6 months from the procedure were not included in the present analysis.

**End points.** Median resection time, median hemoglobin difference between the preoperative values and the values of the second postoperative day, triggering of the obturator nerve, incidence of urethral strictures, occurrence of urinary retention–induced through blood clots, and number of patients requiring blood transfusions.

**Follow-up** of low-grade neoplasms. Cystoscopy was routinely performed the third and the ninth month after TURB and then yearly.

**Follow-up** of high-grade or highly recurrent neoplasms. Urinary cytology and cystoscopy were performed every 3 months the first year and every 6 months thereafter. Intravenous urography or CT scan was performed yearly.

**Equipment**

The Olympus TURs @ SurgMaster UES–40 electrosurgical unit generates a high-frequency alternating current from the electrode inside the resectoscope. The entire resectoscope ex-

### Table 1. Characteristics of Patients Submitted to Transurethral Resection of Prostate

<table>
<thead>
<tr>
<th>No. of patients</th>
<th>Median age (range)</th>
<th>Median PSA (range)</th>
<th>Median IPSS (range)</th>
<th>Median Qmax (range)</th>
<th>Median prostate volume (range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>376</td>
<td>66.5 (47–86) years</td>
<td>3.2 (0.12–18.7) ng/mL</td>
<td>24 (13–35)</td>
<td>6 mL/second (0–10)</td>
<td>52 mL (20–80)</td>
</tr>
</tbody>
</table>

PSA = prostate specific antigen; IPSS = International Prostate Symptom Score; Qmax = maximum urinary flow.

### Table 2. Characteristics of Patients Submitted to Transurethral Resection of Bladder Neoplasm

<table>
<thead>
<tr>
<th>No. of patients</th>
<th>Median age (range)</th>
<th>No. of men (%)</th>
<th>No. (%) of lesions greater than 3 cm</th>
<th>No. (%) of multifocal lesions</th>
<th>No. (%) of cases with at least one lesion of the lateral wall</th>
</tr>
</thead>
<tbody>
<tr>
<td>480</td>
<td>64 (32–88) years</td>
<td>393 (82)/87 (18)</td>
<td>67 (14)</td>
<td>201 (42)</td>
<td>301 (63)</td>
</tr>
</tbody>
</table>

### Table 3. Characteristics of Patients Submitted to Transurethral Incision of Prostate

<table>
<thead>
<tr>
<th>No. of patients</th>
<th>Median age (range)</th>
<th>Median Qmax (range)</th>
<th>Median prostate volume (range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>144</td>
<td>34 (29–57) years</td>
<td>7 (3–10) mL/second</td>
<td>16 mL (8–25)</td>
</tr>
</tbody>
</table>
including the loop of the electrode is used as return electrode in conductive fluid. The UES 40 supplies 6 forms of monopolar waveforms and 4 bipolar (two for the cutting mode and two for the coagulation mode). The resistive charge in the bipolar function is about 100 Ohm, and the output power can be regulated in steps of 1.2 and 5 W to ensure the necessary precision. A conductive irrigation solution as, for example, physiologic saline is necessary for creation of plasma at the loop electrode.

The setting used for cutting and coagulation was 280 W, respectively, 120 W to allow for ignition of the plasma. Immediately thereafter, the generator will downregulate the wattage to the necessary level to allow for reliable maintenance of the plasma. The UES-40 HF-unit is able to supply both monopolar and bipolar current. The resectoscope used was an Olympus 26F in continuous flow–type Iglesias with continuous aspiration. The loop electrodes were all disposable/single use.

Results

The median follow-up of the entire cohort was 12 months (range, 6–24 months); 663 patients had at least 1-year follow-up (66.3%). None of the patients operated experienced a TUR syndrome or a thermal skin lesion. Urethral stricture occurred overall in 6 patients out of 301 with a neoplastic lesion of the lateral wall (2%). Urethral strictures occurred in 12 patients (2.5%). About 10 patients (2%) experienced postoperative clot retention. Four patients (0.8%) required blood transfusions of up to 2 units of erythrocyte concentrate.

TUIP results

The median time for performing a TUIP was 23 minutes (Table 9). There was no measurable postoperative hemoglobin decline. Only two urethral strictures (1.3%) were recorded. No bladder neck contracture occurred. The median catheterization time was 1 day. The median hospital stay was 2 days. Only two patients (1.3%) had a Qmax <15 mL/second at 6 months after the procedure.

Discussion

The clinical efficiency and safety profile of monopolar TUR has notably improved over the years. Any technique that today aspires to become an alternative to TUR must be able to offer the patient the same results by reducing the risks associated with the use of the monopolar device (thermal lesions and faradic effect) and equally with the use of electrolyte-free irrigation solution (TUR syndrome). Starting from these assumptions, several resectoscopes equipped with a bipolar resection technology were developed.

Bipolar resection is theoretically safer because it excludes the patient from the electrical circuit and uses a physiological solution as an irrigant. The phase III comparative studies (monopolar vs. bipolar) demonstrated that both technologies have similar clinical results, but the bipolar device showed to have less intra—postoperative complications resulting in a greater safety of use as, for example, the absence of TUR syndrome. Further, it was stated that the bipolar technology appears to be more cost effective at the investigating institution, with savings peaking at $1200. It must be emphasized that these papers are not directly comparable because of the different devices that have been used (PK system from Gyrus [Maple Grove, MN] and the TURis® system from Olympus® [Tokyo, Japan]). In a recent review of the literature Ho and Cheng8 observed that in the majority of published papers the patients were treated with the PK system by

<table>
<thead>
<tr>
<th>No. of patients</th>
<th>Median resection time (range)</th>
<th>Median resected tissue (range)</th>
<th>Median decline in postoperative Hb (range)</th>
<th>Median catheterization time (range)</th>
<th>Median hospital stay (range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>376</td>
<td>42 (14–92) min</td>
<td>24.6 (3.4–64) mL</td>
<td>0.8 (0.4–8) g/dL</td>
<td>3 (3–14) days</td>
<td>4 (3–7) days</td>
</tr>
</tbody>
</table>

Table 4. Transurethral Resection of Prostate Operative Characteristics

Table 5. Complications Related to Transurethral Resection of Prostate

<table>
<thead>
<tr>
<th>No. of patients</th>
<th>Clot retention</th>
<th>Blood transfusion</th>
<th>Urethral stricture</th>
<th>Bladder neck contracture</th>
</tr>
</thead>
<tbody>
<tr>
<td>376</td>
<td>11 (2.9%)</td>
<td>7 (1.8%)</td>
<td>11 (2.9%)</td>
<td>4 (1%)</td>
</tr>
</tbody>
</table>

TUR = transurethral resection.
Table 6. Transurethral Resection of Prostate Outcome

<table>
<thead>
<tr>
<th>No. of patients</th>
<th>Median PSA (range)</th>
<th>Median Qmax (range)</th>
<th>Median IPSS (range)</th>
<th>No. of patients with a Qmax &lt; 15 mL/second at 6 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>376</td>
<td>0.6 (0.07–9.3) ng/mL</td>
<td>19 (6–39) mL/second</td>
<td>5 (0–25)</td>
<td>17 (4.5%)</td>
</tr>
</tbody>
</table>

Table 7. Transurethral Resection of Bladder Neoplasm Operative Characteristics

<table>
<thead>
<tr>
<th>No. of patients</th>
<th>Median resection time (range)</th>
<th>Median decline in postoperative Hb (range)</th>
<th>Median weight of the resected tissue (range)</th>
<th>Obturator nerve stimulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>480</td>
<td>27 (5–82) min</td>
<td>0.7 (0–6) g/dL</td>
<td>3 (1–36) mL</td>
<td>6 (2%)</td>
</tr>
</tbody>
</table>

Table 8. Complications Related to Transurethral Resection of Bladder Neoplasm

<table>
<thead>
<tr>
<th>No. of patients</th>
<th>Urethral stricture</th>
<th>Blood clot retention</th>
<th>Transfusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>480</td>
<td>12 (2.5%)</td>
<td>10 (2%)</td>
<td>4 (0.8%)</td>
</tr>
</tbody>
</table>

Gyrus. Ho reports that this technology is capable of supplying identical clinical results to monopolar TUR in terms of resection time, bleeding, duration of catheterization, and hospital stay but with a greater rate of urethral strictures (6%). The author concludes by defining bipolar resection as being safer compared to monopolar (absence of TUR syndrome, slightly less blood loss, and absence of thermal lesions), while being economically disadvantageous (about 300 US dollars) and burdened with a greater incidence of urethral strictures (6%). The same author published the results of a randomized study over 100 patients treated with an Olympus high-frequency generator, whereby 52 patients underwent resection with a monopolar technique and 48 with a bipolar technique. In this case too the differences in terms of bleeding, intervention duration, catheterization, hospital stay, and incidence of TUR syndrome were not statistically significant but with a notable reduction in costs in favor of the Olympus system (TURis 60 US dollars vs. PK 300 US dollars). However, Ho describes a greater incidence of urethral strictures in the group of patients operated with the bipolar device TURis, 3/48 patients in the monopolar group versus 1/52 submitted to the bipolar resection, although these results did not reach statistical significance. The problem of pathogenesis of urethral strictures was discussed in an editorial by Oliver Reich. He postulates that the increased electrical density on the outer sheath of the resectoscope and any small damage on the surface of the outer sheath can cause dispersions of flow on the urethral mucosa. He also emphasizes that in the TURis system, as opposed to the Gyrus system, the outer sheath of the resectoscope acts as return electrode, and thus theoretically this could lead to an increased risk of urethral lesions. However, in the Ho’s paper it is reported that a careful check of each resectoscope used for the study did not reveal any damage. Any electrosurgical device has the so-called dispersion flow, which according to directive IEC60601-2-2 for medical devices to be safe must be less than 150 mA. All situations responsible for an increase in the impedance of the circuit or a defect in insulation cause an increase in the dispersion flow with possible thermal-induced lesions in the urethral mucosa. The use of conductive lubricants can increase this risk. Morishita et al. have shown that the main cause of the increase in resistance in a circuit is the multiuse of loops (officially single use) and have calculated that the threshold of 100 mA is reached after the third use by the bipolar loop and after the first use with the monopolar device. Returning to the technical data supplied by Olympus, we observe that in the TURis case in question there is a dispersion flow in optimal conditions of about 6–7 mA and in abnormal conditions (multiuse) of about 50 mA, and hence 20/25 times below the limit in normal conditions and 3 times below in abnormal conditions (multiuse). Accordingly, we decided to use a new loop for each resection.

Our study represents the only currently available published data using the Olympus TURis bipolar resectoscope on a larger cohort of patients (376 TURP, 144 TUIP, and 480 TURB) with a follow-up of at least 6 months. In our series bipolar resection appears to be a safe procedure. In none of the 1000 cases there was any TUR syndrome, while the incidence was 1.4% in one of the largest series of monopolar TURP. Moreover, bipolar resection provides unremarkable clinical results in terms of duration of intervention, peri- and postoperative bleeding, catheterization, and hospital stay time. The higher

Table 9. Transurethral Incision of Prostate Operative Characteristics, Complications, and Outcome

<table>
<thead>
<tr>
<th>No. of patients</th>
<th>Median surgery time (range)</th>
<th>Median decline in postoperative Hb (range)</th>
<th>Median catheterization time (range)</th>
<th>Median hospital stay (range)</th>
<th>No. of urethral patients with a stricture Qmax &lt; 15 mL/second at 6 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>144</td>
<td>23 (15–32) min</td>
<td>–</td>
<td>1 (1–7)</td>
<td>2 (2–9)</td>
<td>2 (1.3%)</td>
</tr>
</tbody>
</table>
current flow in the TURis device was not associated in our series with a greater incidence of urethral strictures compared to the literature data obtained with monopolar devices. The main reason is probably that we used a new loop for each intervention. Another reason could be that the median resection time, related to TURP, was sensibly less, 42 minutes, compared to what reported by Ho et al. The incidence of bladder neck contraction is, respectively, about 3.8% and 2.9% for TURP and TUIP, while monopolar TURP stricture incidence was, respectively, 2.9% for TURP and 1.3% for TUIP, while monopolar TURP and TUIP stricture incidence is, respectively, about 3.8% and 1.7% in literature. The incidence of bladder neck contraction after TURP was 1% in our series, whereas in literature an incidence of 4% is reported after TURP and 0.4% after TUIP. Concerning the unwanted stimulation of the obturator nerve during a TURB procedure, it was recorded in six cases with a neoplastic lesion of the lateral wall (2%). We actually doubt that the problem of the unwanted triggering of the obturator nerve could be totally solved by the use of bipolar devices as the dispersion current is transmitted into the bladder wall for several millimeters, especially in women and young subjects with a reduced wall thickness.

Conclusions

Resection with bipolar technology (TURis) offers the patient the same results as monopolar technology, still considered today the gold standard for endoscopic surgery of the lower urinary tract, guaranteeing maximum safety without increasing the incidence of urethral strictures. Single use of the loop electrode, at least in longer procedure as TURP, is strongly advisable.

Acknowledgment

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Disclosure Statement

No competing financial interests exist.

References


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Abbreviations Used

PSA = prostate specific antigen
IPSS = International Prostate Symptom Score
Qmax = maximum urinary flow
TUIP = transurethral incision of prostate
TUR = transurethral resection
TURB = transurethral resection of bladder neoplasm
TURis = bipolar transurethral resection in saline
TURP = transurethral resection of prostate