

Comparison of Two Different Bipolar Energy Resources in Transurethral Resection of Bladder Tumors

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Keywords

Bladder tumor · Bipolar energy · PlasmaKinetic system · Transurethral resection in saline · Obturator jerk

Abstract

Purpose: To determine whether the use of different bipolar resources is associated with different results on tissue and perioperative parameters in patients undergoing bipolar transurethral bladder tumor resection (bTURBT). **Methods:** In this single-center prospective study, patients diagnosed with bladder tumor randomized to undergo TURBT either with a Gyrus PlasmaKinetic system ($n = 62$) or Olympus TUR in saline (TURis) system ($n = 51$). Primary endpoint was to evaluate the alteration of patients' perioperative parameters, while secondary aim was to assess the thermal effect of these 2 different bipolar devices on the resected tissue samples by a grading system determined by tissue characteristics. **Results:** One hundred thirteen patients were randomized in the study, and 43 were excluded from the analysis due to the exclusion criteria. There were no significant differences between the groups in terms of mean age, tumor site, number of tumors, operative time, alteration in hemoglobin or hematocrit, blood transfusion rate, catheterization time,

and postoperative stay. On the other hand, the ratio of obturator jerk was significantly higher in the Olympus TURis group ($p = 0.028$). The histopathological analyses of both groups determined muscularis propria and cautery artifact presence without a statistically significant difference (χ^2 : 0.476, $p = 0.788$). **Conclusion:** Although the perioperative complications of bTURBT are low in nature, bladder perforation resulted from obturator jerk still poses a risk for extravesical tumor implantation. Urologists should be aware of this risk especially when they are using a TURis system.

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Introduction

Among the most common cancer types, bladder cancer (BC) ranks as the tenth most commonly diagnosed cancer and the fourteenth leading cause of cancer deaths in the world [1]. Definite diagnosis is only possible with pathological specimen investigation obtained via transurethral resection of bladder tumors (TURBT) enabling histopathological diagnosis, staging, grading, and further treatment decision-making process for BC.

Since its inception, monopolar electrocautery has been used for performing TURBT conventionally. However, the efficacy and safety of bipolar TURBT (bTURBT) over monopolar TURBT (mTURBT) have been shown in terms of terminal artifacts, operation time, catheterization period, hospital stay, and complications including bleeding, obturator jerk, and bladder perforation [2, 3]. Currently, in the clinic, several different models of bipolar resection devices are used to perform bTURBT such as the PlasmaKinetic (PK) system (Gyrus), Karl Storz (AUTOCON® II 400), transurethral resection in saline (TURis) system (Olympus), and Richard Wolf [4]. Although the benefits of these bipolar electrocautery systems are well established, no high-level evidence exists comparing the characteristics of different bipolar systems on tissue and perioperative parameters.

In this prospective randomized study, we, therefore, aimed to compare the safety and efficacy of most common different bipolar energy sources – PK and TURis – in bladder tumor (BT) resection. To our knowledge, it is the first prospective randomized study that compared the different bipolar resection systems for TURBT.

Materials and Methods

After obtaining the approval of the institutional review board and ethics committee (No. 2014/273), the study included all consecutive patients who had BT and planned for TURBT regardless of site, size, and multiplicity of tumors. Diagnosis of BC was based on imaging and/or cystoscopy.

Patients were randomized to undergo bTURBT either with Gyrus™ PK (Gyrus Medical Ltd., Cardiff, UK) or ESG-400 TURis® (Olympus, Tokyo, Japan) by the simple randomization method using a computer. In all cases, spinal anesthesia was performed without obturator nerve block. Patients who were unwilling to have spinal anesthesia or had general anesthesia (endotracheal intubation) following failure of spinal anesthesia attempt were excluded from the study. Besides, cases performed by surgeons who were experienced <5 years in TURBT were also excluded. Only the cases performed by 3 surgeons with at least 5 years of experience in the field of uro-oncology were included. The resectoscopes used for both surgeries were 26F (continuous flow-type), and all the PK loop electrodes were single use/disposable.

The power level for PK thin Superloop was initially set as recommended by the manufacturer, delivering 160 W in the cutting mode and 80 W in the coagulation mode, while the power was set to 200 W for the cutting mode and 100 W for the coagulation mode for the TURis® device [5]. During tumor resection, a stepwise approach was used as the resection from the periphery to the base of the tumor. Then, tumor base was resected to take a sample of deep muscle, and hemostatic control was achieved by coagulation of the tumor base and its margins. Postoperative irrigation was started following placement of a 22-F 3-way Foley catheter and continued

until the color of the urine became normal. In uncomplicated cases, the catheter stayed at up to 72 h.

The primary endpoint of the study was to evaluate the safety parameters of the devices. For this reason, perioperative and postoperative parameters for every patient were recorded such as tumor size, tumor site, number of tumors, obturator jerk, bladder perforation, operation time, the change in hematocrit, blood transfusion, catheterization time, clot retention, and hospital stay.

Histopathological Evaluation

Resected tissue samples were evaluated by 2 pathologists (who are blinded to study) to determine the histological characteristics of tumor such as tumor grade, pathological T stage, presence of muscularis propria, and muscle invasion. The secondary endpoint of this study was to evaluate the thermal artifacts caused by different bipolar resources. For this reason, the presence and degree of cautery artifact were evaluated regarding edema and distortion in tissues, homogenization in connective tissue fibers, vacuolization, and turbidity in cell nuclei. The degree of cautery artifact was segregated into 3 grades based on its prevalence as follows:

- Grade I: cautery artifact exists in <1/3 of the specimen
- Grade II: cautery artifact exists in 1/3–2/3 of the specimen
- Grade III: cautery artifact exists in >2/3 of the specimen

Statistical Analysis

SPSS-18 program was used to evaluate the data statistically. χ^2 tests were used for the categorized data. According to the size of the expected value in the tables of 2×2 type, Pearson χ^2 , Yates χ^2 , and Fisher's exact χ^2 were taken into account. In the comparison of group means of continuous variables, when the parametric test assumptions were provided by the Kolmogorov-Smirnov test, independent t test was used. The intraclass correlation coefficient was used for agreement on the determination of grade with a value of 0.89.

Results

In this prospective trial, a total of 156 patients were included, 113 of whom were eligible and randomized into 2 groups as group I which consisted of 62 patients who underwent Gyrus PK TURBT and group II which consisted of 51 patients who underwent Olympus TURis TURBT. No significant differences were observed between 2 groups in terms of mean age, tumor site, number of tumors, operative time, alteration in hemoglobin or hematocrit, blood transfusion rate, catheterization time, and postoperative stay (Table 1). Complete resection was achieved in both groups. The incidence of obturator jerk was 11.29% (7 of 62) in group I and 27.45% (14 of 51 patients) in group II, suggesting a statistically significant difference ($p = 0.028$). Bladder perforation rates were comparable between 2 groups ($p = 0.069$; Table 1). Repair surgeries for bladder perforation were not required in both groups. When comparing the 2 groups in terms of

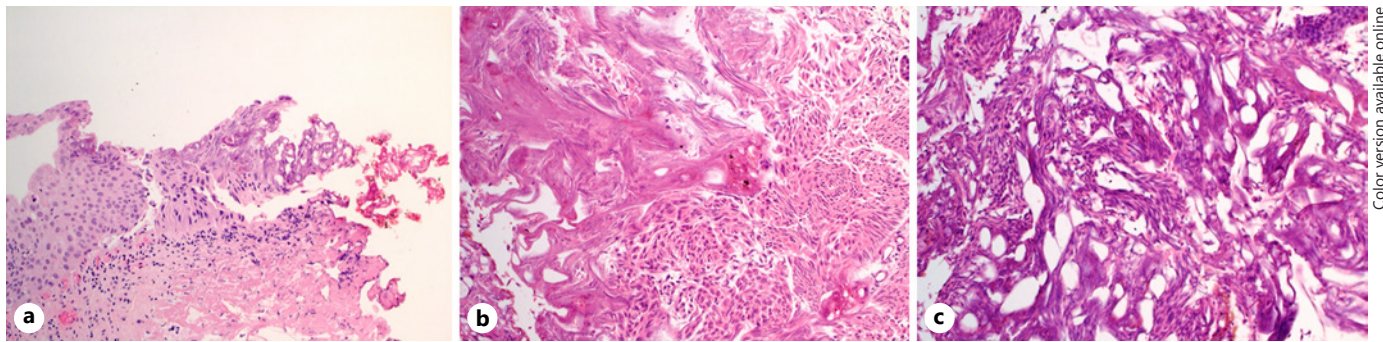


Fig. 1. The effect of bipolar system on the resected bladder tissue. **a** Grade I (less than whole tissue) artifact in bladder tissue with tissue distortion and blurring in cell nuclei in a case of papillary hyperplasia (HE. $\times 200$). **b** Grade II (between 1/3 and 2/3 of whole tissue) artifact with a large amount of tissue distortion and blurring

in cell nuclei in a case of infiltrating urothelial carcinoma (HE. $\times 200$). **c** Grade III (>2/3 of whole tissue) artifact with a large amount of tissue distortion and blurring in cell nuclei as well as vacuolization in a case of infiltrating urothelial carcinoma (HE. $\times 200$).

lateral wall tumors, no statistical difference was shown (χ^2 : 6,322; p : 0.176).

None of the patients required laparotomy and perforation closure. Although, in both groups, no significant alteration was observed regarding transfusion rate or hematocrit drop, 1 patient who had multiple tumors in each group required blood transfusion. Clot retention requiring recoagulation and TUR syndrome were not observed in any patient in the study.

The histopathological analyses of both groups determined muscularis propria and cautery artifact presence without a statistically significant difference (χ^2 : 0.476, p = 0.788). Deep muscle was detected in >95% of the samples in both groups. Figure 1 shows samples of grade 1, 2, and 3 cautery artifacts in both groups.

Discussion

A thorough histopathological analysis has utmost importance for BTs as it determines the course of the therapy. For the resection of BTs, bipolar and monopolar systems are being used in the clinics. The comparison of these systems has been sought in several studies, and bipolar systems proved some advantages over monopolar systems for bTURBT such as reduced stimulation of obturator nerve and lower incidences of perioperative complications [6–8]. However, there exist different kinds of bipolar systems in circulation and the effect of different bipolar systems on the parameters of tissue and patient's characteristics is vague. In this study, we compared 2 different bipolar systems (Gyrus PK vs. Olympus TURis) for TURBT and found that obturator jerk and bladder perforation

Table 1. Baseline characteristics of patients and the effect of different bipolar resection devices on perioperative parameters

| | Gyrus™ PK ($n = 62$) (mean \pm SD) | Olympus TURis* ($n = 51$) (mean \pm SD) | p value |
|--------------------------------|--|--|-----------|
| Mean age | 64 \pm 25.1 | 65 \pm 23.2 | 0.189* |
| Tumor size, cm | 2.27 \pm 2.0 | 2.01 \pm 1.2 | 0.397* |
| Tumors, n | 1.74 \pm 1.65 | 2.07 \pm 2.38 | 0.379* |
| Operative time, min | 32.5 \pm 23.4 | 27.0 \pm 14.3 | 0.133* |
| Drop in hemoglobin | 1.00 \pm 0.65 | 0.84 \pm 0.09 | 0.302** |
| Drop in hematocrit | 3.05 \pm 2.11 | 2.96 \pm 2.57 | 0.842** |
| Catheterization time, days | 2.62 \pm 1.10 | 2.34 \pm 1.42 | 0.206* |
| Postoperative stay | 2.24 \pm 1.54 | 3.04 \pm 1.16 | 0.175* |
| Obturator jerk (n ; %) | 7; 11.2% | 14; 23.4% | 0.028*** |
| Bladder perforation (n ; %) | 2; 3.22% | 4; 7.84% | 0.069*** |

PK, PlasmaKinetic; TURis, transurethral resection in saline. * One sample t test. ** Paired t test. *** χ^2 test.

rates were the only parameters that showed significant difference between the 2 systems.

The obturator nerve runs in close proximity to the inferolateral bladder wall, bladder neck, and lateral prostatic urethra during its intrapelvic course. When the electric current transmitted by the resectoscope directly stimulates the obturator nerve, an obturator reflex may occur [9]. The result of this reflex is adductor muscle contraction which may lead to bladder perforation [10]. The most notable finding in our study is that the incidence of bladder perforation observed in the PK group was about half that in the TURis group. The significant difference of

this unwanted complication might have been derived from different characteristics of the devices.

Although basically the bipolar resection system excludes the patient from the electrical circuit and uses saline as fluid, technically there exist some modifications among the bipolar resection systems in respect of the arrangement of active and return electrodes and in their loop sizes. In the Gyrus system, the active and return electrodes are placed in the same axis and separated by a ceramic insulator, which makes active-to-return contact ratio low [11]. Besides, it uses the distal end of resection loop as neutral electrode. On the other hand, the Olympus system uses the resection sheath as the return electrode [12]. No neutral electrode is used in the TURis system; therefore, there may be a small fraction of the current passes through the tissue. This may lead to stray current in the resection area, which may stimulate the obturator nerve.

In general, bladder perforation rates during TURBT ranged from 0.5 to 9%, although these rates are believed to be underreported [2, 13]. The importance of bladder perforation is that it can be a trigger of extravesical recurrence. Several case reports demonstrated extravesical transitional cell carcinoma implantation years after intraperitoneal bladder perforation during TURBT [14–17]. Besides, surgical repair of bladder perforation increases the risk of tumor seeding and extravesical recurrence [18]. In our study, all the bladder perforations were on the lateral sides of the bladder and none of the cases required bladder repair. Since bladder perforation poses a risk of seeding tumor cells extravesical [19], urologists should be aware of its possibility especially using the TURis system.

There are some limitations to this study. First, the power of statistical analysis has not been performed and consequently the statistically significant or nonsignificant findings may not reflect true clinical significance and should be addressed with caution. Second, we included the cases performed by 3 different surgeons. This bias could have been further eliminated if they included the cases performed by a single surgeon instead of different experienced surgeons. Furthermore, we did not compare the different anesthesia techniques (spinal vs. general) in terms of perioperative complications as the high rates of obturator jerk might be due to the spinal anesthesia. Besides, we did not seek long-term follow-up complications, which might have improved the general quality of the paper.

Using bipolar diathermy has a lower risk of obturator jerk; however, it is still one of the bothersome complications of bTURBT and may lead to bladder perforation.

Urologists should be aware that this risk is higher with the TURis system compared with the PK system and should take necessary precautions while using the TURis system. A large-scale, multicenter, long-term randomized controlled trial comparing PK to TURis is justified and may help to provide better evidence.

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Statement of Ethics

The ethics committee of Faculty of Medicine, Selcuk University, approved our study (Approval Reference No. 2014/273).

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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Author Contributions

Study concept and design: Kaynar, Altintas, and E. Celik. Acquisition of data: Kaynar, Altintas, and Gul. Analysis and interpretation of data: Kaynar, Gul, Akand, and Batur. Drafting of the manuscript: Kaynar, Gul, E. Celik, and Altintas. Critical revision of the manuscript: Kaynar, Gul, Kilic, and Goktas. Supervision: Kaynar and Gul.

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