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Comparison of Deep Biopsy Tissue Damage from Transurethral Resection of Bladder Tumors between Bipolar and Monopolar Devices

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Purpose: Bipolar energy has recently been used for transurethral resection of bladder tumor (TURBT). Although this modality is thought to be safe, there are some controversies concerning the pathologic accuracy of the biopsy specimens. We compared clinical efficacy, safety, and pathologic characteristics of deep biopsy specimens between bipolar and monopolar devices.
Materials and Methods: From January 2002 to June 2007, a total of 115 patients underwent TURBT with deep biopsy with the use of bipolar (bipolar group, n=64) or monopolar (monopolar group, n=51) devices. We retrospectively analyzed tumor size, tumor number, urine cytology, perioperative blood loss (postoperative changes in hemoglobin levels), complications, duration of catheterization, duration of hospitalization, pathologic stage, WHO grade, deep biopsy specimen thickness, and grade of thermal damage.
Results: There were no statistical differences in tumor size, tumor number, urine cytology, complications, duration of hospitalization, pathologic stage, or WHO grade between the two groups. Postoperative changes in hemoglobin levels were significantly lower in the bipolar group (p=0.038), and the duration of catheterization was shorter in the bipolar group (p=0.026). The deep biopsy specimen thickness was significantly thinner in the bipolar group (2.25±0.94 mm vs. 3.02±1.39 mm, $p<0.05$). The grade of thermal damage was not statistically different between the two groups (p=0.862).
Conclusions: In terms of clinical efficacy and safety, bipolar TURBT is comparable to monopolar TURBT, having advantages in perioperative blood loss and duration of catheterization. In addition, pathologic changes in deep biopsy after bipolar and monopolar TURBT are similar. Bipolar TURBT can be properly used for bladder tumors without pathologic error.

Key Words: *Artifacts; Surgical pathology; Urinary bladder neoplasms*

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INTRODUCTION

Bladder cancer is the second most common urological malignancy in Korea [1,2]. Transurethral resection of bladder tumor (TURBT) is commonly performed for the diagnosis and initial therapy of bladder cancer. Deep biopsy is a crucial element in TURBT for proper pathologic diagnosis and for deciding whether conservative treatment is sufficient or if more radical treatment is necessary [3-5].

Previously, TURBT was commonly performed by use of a monopolar electrocautery resecting loop with hypotonic irrigation fluid. The potential complications of this method include hypotonic fluid absorption and electrolyte imbalance [3,6]. Recently, however, bipolar energy has been used for TURBT. There are several reports of favorable results of bipolar TURBT, including lower risk of transurethral resection syndrome (TUR syndrome), better hemostasis, and shorter hospital stay. Although this modality is thought to be safe, there are some controversies concerning the pathologic accuracy of the biopsy specimens collected owing to differences in tissue resection principles between the bipolar and monopolar devices.

To address these controversies, we compared the clinical efficacy, safety, and pathologic quality of deep biopsy tissues obtained by use of these two electrosurgical modalities.

MATERIALS AND METHODS

A total of 115 patients with various bladder lesions underwent TURBT with deep biopsy. In 51 cases from January 2002 to June 2004, TURBT was performed by monopolar electrocautery. Another 64 patients from July 2004 to May 2007 underwent TURBT by bipolar electrocautery. All patients were operated on by one surgeon under either general or spinal anesthesia. Bipolar TURBT was performed by using a bipolar electrocautery system (Gyrus Medical Ltd., Bucks, United Kingdom) with a 24 Fr resectoscope and Foroblique telescope (Karl Storz®). An angled loop wire with a width of 4.5 mm was used. Power settings were generally 160 W for cutting and 100 to 120 W for cautery. Isotonic saline was used for irrigation. Monopolar TURBT was performed by using a standard 26 Fr resectoscope (Iglesia®) and Foroblique telescope (ACMI®) in the power setting with energy levels of 150 to 200 W for cutting and 60 W for cautery. Hypotonic fluid (Urione®) was used for irrigation. At the end of the procedures, a 22 Fr three-way Foley catheter was placed. Saline irrigation was continued as required. The catheter was removed once urine had been completely clear for 24 hours.

All resected specimens were submitted to a department of pathology and fixed in formalin, sectioned, and stained with hematoxylin and eosin. Pathologists evaluated tissues for tumor stage, WHO grade, presence of lamina propria and muscle invasion, and pathologic characteristics, including thermal damage. All pathologic results were confirmed by one interpreting pathologist.

We retrospectively analyzed tumor size, tumor number, urine cytology, perioperative blood loss (postoperative changes in hemoglobin levels), complications, duration of

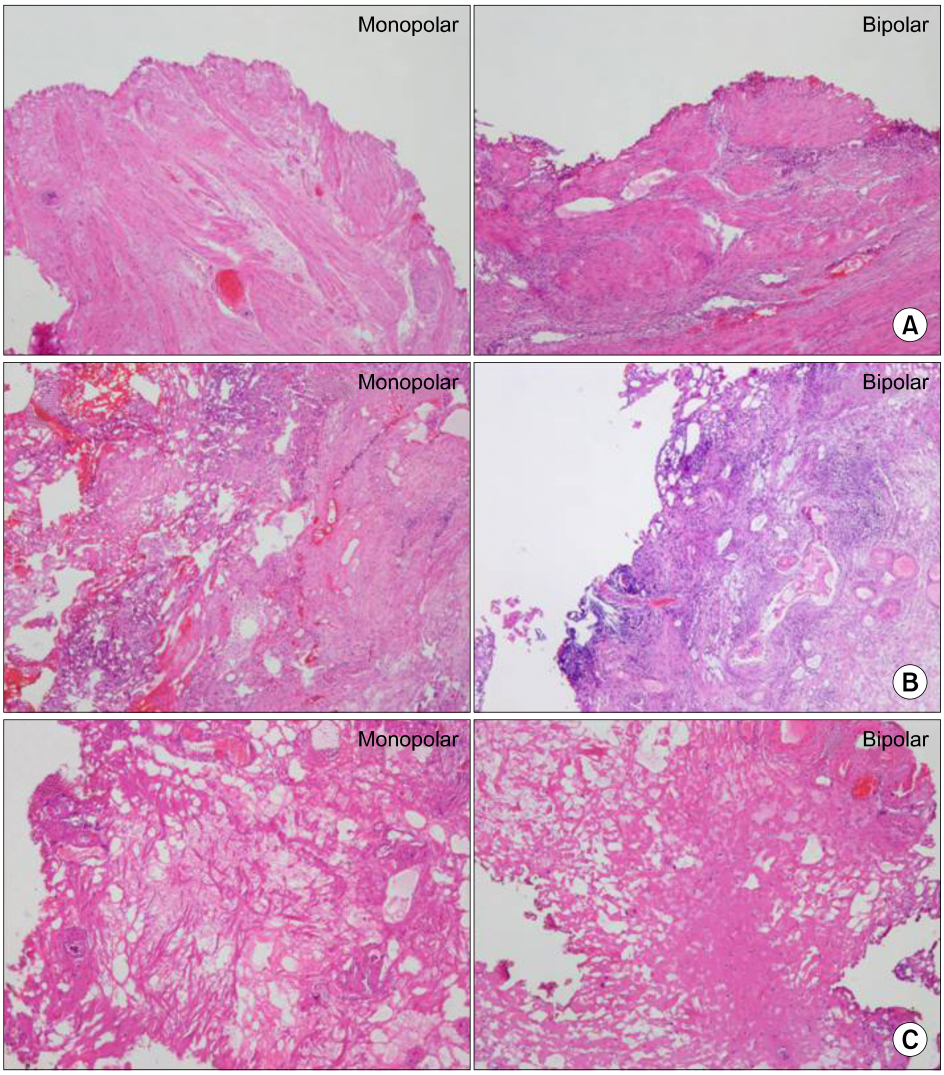

FIG. 1. Thermal damage seen with monopolar and bipolar cautery. (A) Grade I: cautery artifacts involving less than 1/3 of the entire specimen. (B) Grade 2: cautery artifacts involving 1/3 to 2/3 of the specimen. (C) Grade 3: cautery artifacts involving over 2/3 of the specimen.

catheterization and hospitalization, pathologic stage, WHO grade, deep biopsy specimen thickness, and grade of thermal damage.

Thermal damage was categorized into 3 groups according to quantity of cautery artifacts. Grade 1 for a given case was defined as cautery artifacts involving less than one third of the entire specimen. Tissue chips with one third to two thirds cautery artifacts were categorized as grade 2, and tissue chips with over two thirds cautery artifacts were categorized as grade 3 (Fig. 1).

All data were statistically analyzed by using the statistical software SPSS ver. 14.0.2 (SPSS Inc., Chicago, IL, USA). Student's t-test was used to compare mean values of continuous variables, whereas the chi-square test was used to compare categorical (ordinal) variables. A p-value less than 0.05 was considered statistically significant.

RESULTS

1. Patients and distributions of tumor size and number

The monopolar group consisted of 51 patients and the bipolar group consisted of 64 patients. The mean age of each group was 63.29±15.54 years and 65.03±11.09 years, respectively. Tumor size, tumor number, and urine cytology were not significantly different between the two groups (p > 0.0) (Table 1).

2. Postoperative changes in hemoglobin levels and perioperative complications

Postoperative changes in hemoglobin levels were significantly lower in the bipolar group (−0.58±0.91 g/dl vs. −0.95±1.28 g/dl, p=0.038), but the changes were minimal and none of the patients required transfusions. Perioperative complications such as TUR syndrome, electrolyte imbalance, and severe hematuria with or without clots did not occur in any patients.

3. Duration of catheterization and hospitalization

The duration of catheterization was significantly shorter in the bipolar group (2.20±0.96 days vs. 2.65±1.45 days, p=0.026), but there was no statistical difference in the duration of hospitalization (4.22±1.86 days vs. 4.55±1.45 days, p=0.150).

4. Pathologic stage, WHO grade, and characteristics of deep biopsy tissue

There were no statistical differences in pathologic stage or WHO grade between the two groups (p > 0.05) (Fig. 2). The deep biopsy specimen thickness was 2.25±0.94 mm in the bipolar group and 3.02±1.39 mm in the monopolar group. There was grade 3 thermal damage in 21 (41.2%), grade 2 thermal damage in 19 (37.3%), and grade 1 thermal damage in 11 (21.6%) of 51 monopolar specimens. In the 64 bipolar specimens, there was grade 3 thermal damage in 24 (37.5%), grade 2 thermal damage in 23 (35.9%), and grade 1 thermal damage in 17 (26.6%). Although the deep biopsy

TABLE 1. Preoperative evaluation of patients and distributions of tumor size, number, and urine cytology

	Mean±SD or No. of patients (%)		p-value
	Monopolar group (n=51)	Bipolar group (n=64)	
Age (yr)	63.29±15.54	65.03±11.09	0.243[a]
Tumor size (cm)	2.55±1.43	2.45±1.33	0.352[a]
Tumor number (n)	2.59±1.17	2.36±1.17	0.150[a]
Urine cytology			0.479[b]
Class I	21 (41.2)	31 (48.4)	
Class II	4 (7.8)	10 (15.6)	
Class III	3 (5.9)	4 (6.3)	
Class IV	4 (7.8)	3 (4.7)	
Class V	19 (37.3)	16 (25.0)	

SD: standard deviation, [a]: Student's t-test, [b]: Fisher's exact test

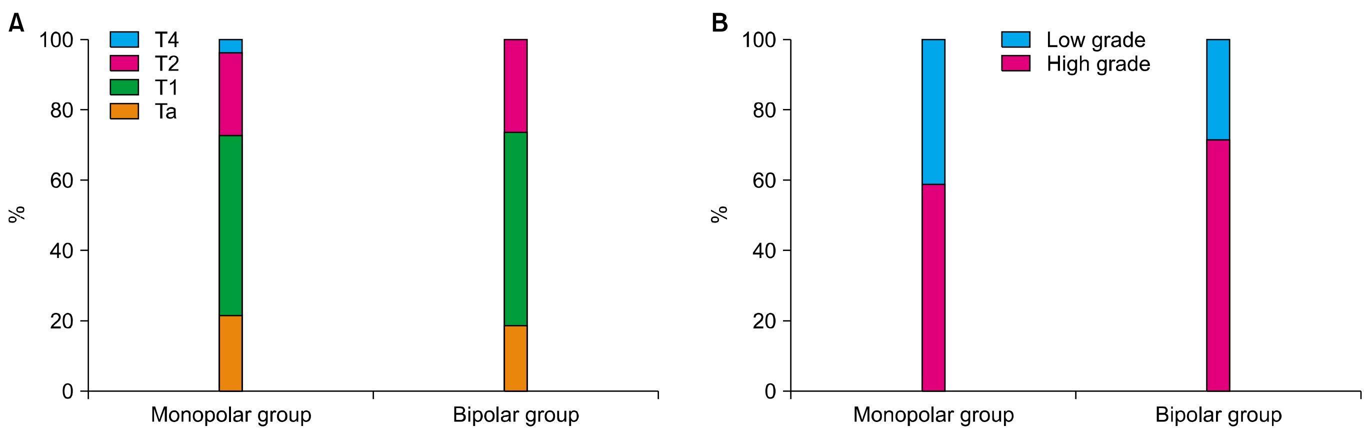

FIG. 2. Comparisons of pathologic stage and WHO grade between the monopolar and bipolar groups. (A) Distribution of pathologic stage (p=0.521). (B) Distribution of WHO grade (p=0.168).

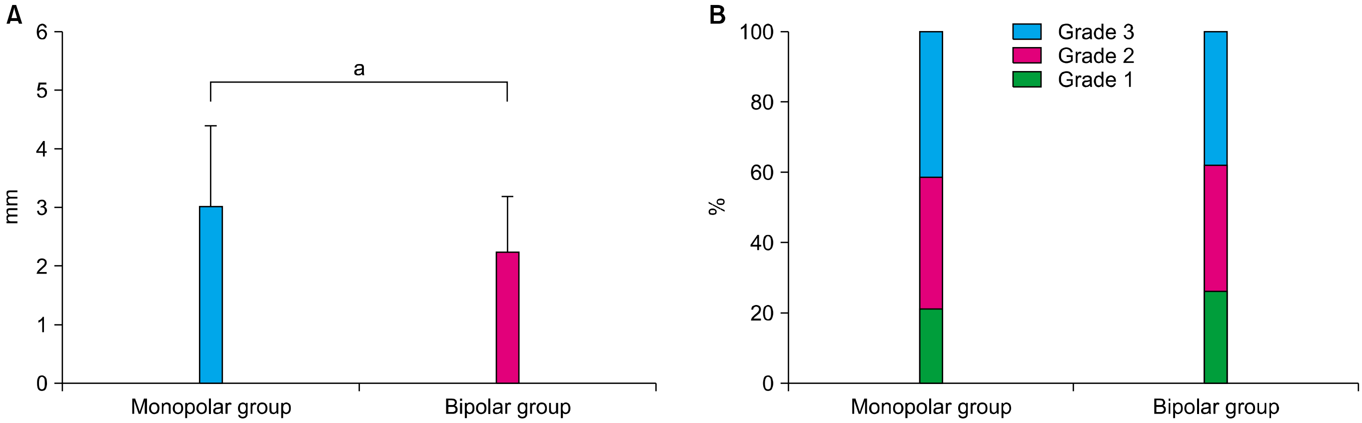

FIG. 3. Comparisons of deep biopsy tissue characteristics. (A) Specimen thickness of deep biopsy (3.02±1.39 mm vs. 2.25±0.94 mm, [a]: $p<0.001$ by Student's t-test). (B) Grade of thermal damage ($p=0.862$).

specimen thickness was significantly thinner in the bipolar group ($p<0.001$), the grade of thermal damage was not significantly different between the two groups ($p=0.862$) (Fig. 3).

DISCUSSION

The aim of initial TURBT is to remove all visible tumors and to obtain tissues for pathologic diagnosis. Successful management of bladder tumors, particularly non-muscle-invasive tumors, relies on adequate initial resection and accurate pathologic diagnosis [7]. Previously, TURBT was most commonly performed with a monopolar electrocautery resecting loop and hypotonic irrigation fluid. However, we have recently begun to use bipolar energy, which is already widely used for the resection of the prostate, to perform TURBT. The feasibility and efficacy of bipolar electrocautery has been compared with monopolar electrocautery previously [3,8].

The main advantage of bipolar electrocautery is the ability to resect in saline, which helps to avoid TUR syndrome [3]. Because hypotonic/hypo-osmolar fluid irrigation is necessary when performing monopolar electrocautery, massive fluid absorption can result in TUR syndrome [6,9]. In the bipolar electrocautery system, by contrast, isotonic saline is used for irrigation. This advantage is very important because all issues relating to hypotonic/hypo-osmolar fluid irrigation such as dilutional hyponatremia and TUR syndrome are expected to be eliminated [10]. As in our study, TUR syndrome was not encountered in any patients.

Although TURP and TURBT are different procedures, several reports have established other potential benefits of bipolar cautery for TURP, including decreased blood loss because of better hemostasis and possibly a shorter duration of catheterization or hospitalization [11-13]. In our study, data showed significantly lower postoperative changes in hemoglobin levels and shorter duration of catheterization in the bipolar group. Although the duration of hospitalization was not significantly different between the two groups, the decision for hospital discharge can vary according to the patient's characteristics or general condition; thus, further analysis is needed.

Although there are several reports of the benefits of bipolar TURBT, as described above, one concern with the use of bipolar electrocautery for TURBT was that the resected tissues might contain more cautery artifacts, thus impairing the ability of the pathologist to make an accurate and complete diagnosis [3]. For bladder tumors in particular, an exact pathologic diagnosis is important because of the consequences for adequate treatment. If thermal artifacts make a pathologic diagnosis impossible, this alone would constitute a major disadvantage of this technique [14]. There are not enough studies of the tissue damage caused by bipolar electrocautery in TURBT, and evaluations of thermal artifacts in deep biopsy are not described in the literature.

In the case of TURP, however, there are some studies about cautery artifacts. Akgül et al evaluated 65 TURP specimens for the degree of cautery artifacts [15]. They found that bipolar TURP had a lower number of severe cautery artifacts than did monopolar TURP. These results seem to be related to the principles of bipolar electrosurgical technology. In monopolar systems, electrical energy is directed into the tissue, where its electrical resistance creates temperatures as high as 400°C, which leads to tissue desiccation along with significant collateral and penetrative tissue damage. In bipolar systems, however, the radiofrequency energy converts the conductive medium into a plasma field of highly ionized particles, which disrupts the organic molecular bonds between the tissues. This molecular dissociation reduces into elementary molecules. By directing the radiofrequency current from an active electrode to an adjacent return electrode, this technique allows the thermal effect to occur at a much lower temperature (40 to 70°C) than during monopolar surgery [16-18]. Thus, compared with the conventional monopolar system, thermal damage to the surrounding tissues can be reduced [19].

Even though TURP is a different procedure in several aspects than is TURBT, our data for TURBT were similar in that bipolar energy did not seem to cause any increase in artifacts on pathologic assessment. In addition, pathological stage and WHO grade did not differ significantly between the two groups, and the pathologic quality of all specimens obtained by deep biopsy was sufficient for the pathologist to correctly grade and stage the specimens.

Bipolar electrocautery has an added benefit of being less charring. In a multicenter experience, urologists favored bipolar TURP for sharpness of cutting (64%), better precision at the apex (61%), and less charring (93%) [20]. We also experienced the cleanness of cutting and absence of charring during bipolar TURBT, which consequently provided better visibility.

Our study was designed to assess the pathologic characteristics of bladder tumor tissue resected by use of bipolar electrocautery. The surgeons noted that the loop size of the bipolar device was somewhat smaller than the monopolar loop typically used. This may have resulted in smaller chips associated with each cut. Although the thickness of the deep biopsy tissue was thinner in the bipolar group, there was no significant difference in the percentage of cautery artifacts. This suggested that bipolar energy does not appear to cause excessive thermal damage compared with monopolar energy. Perhaps most importantly, all specimens obtained by using bipolar and monopolar TURBT were sufficient for the pathologist to make an appropriate diagnosis.

However, the extent of thermal damage in tissues and the thickness of the chip size are multifactorial. These variables depend on the location of the tumor, material, surgical skill, and the energy that is used [14]. Therefore, further study in which these features are included as selection criteria is needed to establish a more valuable and reasonable comparison.

CONCLUSIONS

Accurate pathologic results and efficient surgical technique are crucial elements in TURBT for proper treatment. In terms of clinical efficacy and safety, bipolar electrocautery is comparable to monopolar electrocautery, having advantages in perioperative blood loss and duration of catheterization. Furthermore, the pathologic changes in the deep biopsy specimens after bipolar and monopolar TURBT were similar. Thus, bipolar TURBT can be properly used for bladder tumors without pathologic error.

Conflicts of Interest

The authors have nothing to disclose.

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