Nephro-Urol Mon. 2023 May; 15(2):e135572. https://doi.org/10.5812/numonthly-135572.

Published online 2023 August 14. **Research Article**

An Evaluation of Monopolar and Bipolar Electrocautery in Transurethral Resection of Urinary Bladder Tumors

Ahsan Ahmad [1], Md. Zaid Imbista [1,*], Khalid Mahmood [1], Rajesh kumar Tiwari [1] and Bipin Kumar [2]

[1]Department of Urology, IGIMS, Patna, India
[2]Department of Pathology, IGIMS, Patna, India

[*]*Corresponding author*: Department of Urology, IGIMS, Patna, Bihar, India. Email: zaidimbisat09@gmail.com

Received 2023 February 13; **Revised** 2023 May 30; **Accepted** 2023 July 19.

Abstract

Background: Transurethral resection of bladder tumor (TURBT) has a role in the diagnostic evaluation and treatment of bladder cancer, which is traditionally conducted through monopolar electrocautery; however, bipolar electrocautery has gained attention these days. Cautery artifacts are known as the drawbacks of TURBT and can be seen in both monopolar and bipolar electrocautery but with varying severity. Studies comparing bipolar to monopolar TURBT have shown conflicting results.
Objectives: This study was carried out to compare the occurrence of cautery artifacts and a number of important clinical outcomes between patients undergoing monopolar and bipolar electrocautery during TURBT.
Methods: This prospective study included adult patients with age 18 years old or higher diagnosed with primary bladder tumors with a size $\leq$4 cm. The patients were randomized into monopolar and bipolar groups (34 patients per group). The occurrence of cautery artifacts, duration of surgery, the incidence of urinary bladder perforation, fall in hemoglobin, need for blood transfusion, transurethral resection syndrome, and postoperative hospital stay were compared between the two groups.
Results: In our study, the incidence of cautery artifacts was significantly lower in the bipolar group than in the monopolar group (P-value $<$ 0.0001). The two groups were comparable in terms of the duration of surgery, urinary bladder perforation, fall in hemoglobin, need for blood transfusion, transurethral resection syndrome, and postoperative hospital stay.
Conclusions: Bipolar TURBT is superior to monopolar TURBT regarding a reduction in the incidence of cautery artifacts.

Keywords: Bladder Tumors, TURBT, Electrocautery, Cautery Artifacts

1. Background

Bladder cancer is a common neoplasm of the genitourinary system and the 10th most common cancer worldwide (1, 2), accounting for 2.1% of all cancer deaths (3). Transurethral resection of the bladder tumor (TURBT) plays a significant role in the diagnosis and management of bladder cancer (4). The concept of transurethral resection dates back to 1910 when, for the management of urinary bladder papillary tumors, electric current was applied endoscopically using a cystoscope by Edwin Beer (5). In 1962, TURBT was first described by Jones and Swinney and, since then, has gained enormous popularity for managing urinary bladder tumors (6). Along with bimanual examination, TURBT is important for the pathologic confirmation and clinical staging of bladder tumors (7).

Monopolar electrocautery is the traditional way of performing TURBT. The heat generated in the monopolar system is sufficient to cause the desiccation of small cells, which may cause difficulty in performing adequate histological analysis for severely cauterized pieces of tissues. Moreover, electrolyte-free solutions in monopolar electrocautery may lead to transurethral resection (TUR) syndrome (8). In the bipolar system, the radiofrequency current applied to the conducting irrigant generates plasma, leading to the dissociation of bonds between tissues. Temperature only modestly rises in the resected tissues during bipolar surgery, and the use of isotonic normal saline reduces the risk of TUR syndrome (9).

The occurrence of cautery artifacts is a drawback of TURBT and is seen in both monopolar and bipolar electrocautery but in varying severities (10). In the literature, this phenomenon has been defined as tissue distortion, swelling, homogenization, spindling artifact, stromal coagulation, tissue crushing, vacuolization,

blurred nuclei, atypical morphological changes, and abnormal cellular orientations (10, 11).

Truong et al. in their study evaluated the effects of cautery artifacts on the adequacy of histopathological evaluation of TURBT specimens. In their study, they included 119 patients and reported that cautery artifacts interfered with accurate staging in 6% (7 out of 119) of cases. Out of these 7 cases, they performed re-staging TURBT in 6 cases, of whom 50% were upgraded to the muscle invasive stage, highlighting the significance of cautery artifacts (10). There are conflicting results regarding the clinical outcomes of bipolar and monopolar TURBT, including the occurrence of cautery artifacts.

2. Objectives

Our study aimed to compare the occurrence of cautery artifacts (the primary objective), as well as the duration of surgery, the incidence of urinary bladder perforation, fall in hemoglobin, the need for blood transfusion, the incidence of transurethral resection syndrome, and post-op hospital stay (secondary objectives) between patients with bladder cancer undergoing monopolar or bipolar electrocautery during TURBT.

3. Methods

This was a randomized (via the chit and box method), prospective, two-group (monopolar and bipolar TURBT) comparative study conducted in the Department of Urology, IGIMS Patna, Bihar, India. Our study's protocol was approved by our institutional ethics committee (279/IEC/IGIMS/2021).

3.1. Inclusion Criteria

(1) Adult patients with an age equal to or above 18 years

(2) Being diagnosed with primary bladder tumors

(3) Tumor size of $\leq$ 4 cm on contrast computed tomography (CT)

3.2. Exclusion Criteria

(1) Age of $<$ 18 years

(2) Having recurrent bladder tumors

(3) Contraindications for performing contrast CT

(4) Evidence of locally-advanced or metastatic disease in CT scans

(5) Tumor size of $>$ 4 cm

(6) Not giving consent to participate in the study

(7) Being non-eligible for undergoing anesthesia or surgery

3.3. Sample Size and Randomization

This was a randomized study in which the patients giving consent for participation were randomized into either monopolar or bipolar cautery groups using the chit-and-box method. The sample size for each group was calculated according to a previous study regarding a study power of 80% at a significance level of 5%. The proportions of thermal artifacts in the monopolar and bipolar groups were considered 0.048 and 0.021, respectively. Finally, the sample size was determined to be n = 34 in each group (12).

All the patients underwent a complete history taking, physical examination, routine procedural investigations to determine hemoglobin, serum electrolytes, and coagulation profile, as well as urinary analysis, urine culture and cytology, chest X-ray, and contrast CT scans of the abdomen and pelvis along with urography. All the patients underwent surgery under general anesthesia at the lithotomy position. Cystoscopy was performed using a 30° lens and 17 French cystoscope, followed by TURBT after cystoscopy. Bipolar electrocautery was used for bipolar TURBT. For both bipolar and monopolar TURBT, we used the 26-Fr resectoscope. For bipolar TURBT, the power used for cutting was 120 Watts, and for coagulation, the power setting was 100 Watts. For monopolar TURBT, the power setting was set at 100 Watts for cutting and 90 Watts for coagulation. Glycine was used as the irrigant for monopolar TURBT and normal saline for bipolar TURBT. Tumor resection was started from the periphery and proceeded toward the center, with the tumor stalk being the last to be resected.

Duration of surgery, incidence of urinary bladder perforation, fall in hemoglobin, need for blood transfusion, transurethral resection syndrome, and post-op hospital stay were recorded for all the patients.

The duration of surgery was calculated based on the resection time, defined as the interval from the start of the operation till the removal of the device. Bladder perforation was defined as the visual appearance of extravesical fat, bowel, or peritoneal cavity during the operation. Serum sodium was measured 12 hours after the surgery, and the patient was monitored for the symptoms of hyponatremia (i.e., headache, visual disturbance, altered sensorium, and hiccups). Hemoglobin was measured 48 hours after the surgery to overcome dilutional effects. The pathologist in our study was unaware of the type of electrocautery (i.e., blinded). In each specimen, 20 fields were examined (x400), and the number of fields showing cautery artifacts was noted.

Cautery artifacts were characterized by tissue distortion, swelling, homogenization, spindling artifacts, stromal coagulation, tissue crushing, vacuolization,

blurred nuclei, atypical morphological changes, and abnormal cellular orientations.

3.4. Statistical Analysis

SPSS software version 15.0 was used for statistical analysis. The chi-square test and independent *t*-test were utilized. Observations with a P-value of < 0.05 were considered statistically significant.

4. Results

The mean age of the patients was 63.50 ± 12.17 years in the monopolar electrocautery group and 58 ± 12.78 years in the bipolar electrocautery group (P-value = 0.097). In the monopolar electrocautery group, 26 patients were male, and 8 patients were female. In the bipolar electrocautery group, males and females constituted 28 and six patients, respectively (P-value = 0.549).

The mean value of preoperative hemoglobin was 10.8 g/dL in the monopolar electrocautery group and 10.5 g/dL in the bipolar electrocautery group. In the monopolar group, 22 patients had papillary tumors on cystoscopy, while 12 patients had tumors with a solid appearance. In the bipolar group, 21 and 13 patients had papillary and solid tumors on cystoscopy, respectively.

Out of 20 fields examined for each specimen, the mean number of microscopic fields showing cautery artifact was 8.06 ± 1.455 in the monopolar electrocautery group and 2.21 ± 0.978 in the bipolar electrocautery group, indicating a statistically significant difference (P-value < 0.001, Table 1).

The mean duration of surgery was 37.44 ± 4.33 minutes in the monopolar electrocautery group and 37.68 ± 3.40 minutes in the bipolar electrocautery group (P-value = 0.808). The mean fall in hemoglobin level after surgery was recorded as 0.815 ± 0.24 g/dL in the monopolar electrocautery group and 0.847 ± 0.25 g/dL in the bipolar electrocautery group (P-value = 0.587). The mean duration of postoperative hospital stay in the monopolar electrocautery group was 4.71 ± 0.68 days, and in the bipolar electrocautery group, this value was 4.65 ± 0.65 days (P-value = 0.715) (Table 1).

In the monopolar electrocautery group, one patient had urinary bladder perforation, while this complication was observed in none of the patients in the bipolar electrocautery group (P-value = 1.0). Finally, two and three patients in the monopolar electrocautery and bipolar electrocautery groups needed blood transfusions, respectively (P-value = 1.0). No patient in our study developed TUR syndrome. Table 1 summarizes these observations in the two study groups.

5. Discussion

Transurethral resection of bladder tumor (TURBT) offers a diagnostic and therapeutic role in the management of bladder tumors. Instrumental and technological advances have improved the safety and efficiency of this procedure. However, this procedure is still associated with noteworthy complications (13). Moreover, adequate histopathological evaluation of TURBT-acquired specimens is indispensable for the proper management of patients. Therefore, optimization of patient management based on TURBT is still a topic of research and improvement.

Monopolar electrocautery is the conventional technique used for TURBT, but nowadays, the use of bipolar electrocautery is increasing. The direction of the electric current during monopolar electrocautery is from the resection loop to the grounding pad through the patient's body. This electrical route may cause obturator nerve stimulation and a sudden adductor muscle contraction, which may cause urinary bladder perforation. Also, due to the use of non-conductive irrigation solutions (e.g., water, glycine, sorbitol, mannitol) during monopolar TURBT, the vascular absorption of the fluid may lead to life-threatening electrolyte disbalance. One more disadvantage of monopolar TURBT is the high resection temperature, which can result in significant collateral and penetrative tissue injury and charring of the specimen. However, during bipolar electrocautery, both electrodes are incorporated in the resectoscope, and the electric current runs between these two electrodes. Highly ionized particles used in bipolar electrocautery produce a plasma field around the resection tool. This plasma field breaks molecular bonds between tissues, and temperature modestly rises (40 - 70°C) during the process. So, bipolar TURBT seems to inflict less thermal damage to the resection bed and histopathological samples and is hypothesized to be a safer procedure (14).

In our study, significantly more cautery artifacts were observed in the monopolar TURBT group. Del Rosso et al., in their randomized study, compared monopolar and bipolar TURBT and reported more thermal damage causing histopathological artifacts in the monopolar group ($P < 0.01$) (15). In the study of Venkatramani et al., severe cautery artifacts were found to be significantly lower in the bipolar TURBT group (16). However, Saini et al. reported no statistically significant difference in the incidence of cautery artifacts between the monopolar and bipolar groups (11).

In our study, the duration of surgery, fall in hemoglobin, and postoperative hospital stay were comparable between the monopolar and bipolar

Table 1. Observations in the Monopolar and Bipolar Electrocautery Groups [a]

Variables	Monopolar Group	Bipolar Group	P-Value
Age	63.50 ± 12.17	58 ± 12.78	0.097
Number of fields with cautery artifact	8.06 ± 1.455	2.21 ± 0.978	< 0.001
Duration of surgery	37.44 ± 4.33	37.68 ± 3.40	0.808
Fall in hemoglobin (g/dL)	0.815 ± 0.24	0.847 ± 0.25	0.587
Duration of postoperative hospital stay (days)	4.71 ± 0.68	4.65 ± 0.65	0.715
Number of patients with urinary bladder perforation	1	0	1.0
Number of patients requiring blood transfusion	2	3	1.0

[a] Values are presented as mean ± SD.

electrocautery groups. Teoh et al. in their study found that the mean operation duration was similar between the monopolar group (36.3 ± 25.0 minutes) and the bipolar group (34.6 ± 27.2 minutes) (P-value = 0.696) (17). Liem et al. also reported no significant difference in operation duration between the two groups (P = 0.536) (18).

Mahmoud et al. reported that the mean drop in hemoglobin in the monopolar group was 1.28 ± 0.67 g/dL compared to 1.32 ± 0.50 g/dL in the bipolar group, showing no statistically significant difference (P-value = 0.830) (19). However, in a study by Yang et al., postoperative changes in hemoglobin levels were found to be significantly lower in the bipolar TURBT group (- 0.58 ± 0.91 g/dL) than in the monopolar TURBT group (- 0.95 ± 1.28 g/dL) (P = 0.038) (20).

Mashni et al. also reported no significant difference in the postoperative recovery time between monopolar and bipolar TURBT groups (21). Hashad et al., in their study, compared monopolar and bipolar TURBT and reported a significantly shorter postoperative hospital stay in the bipolar TURBT group (P-value < 0.001) (22).

In our study, one patient in the monopolar electrocautery group and no patient in the bipolar electrocautery group had urinary bladder perforation, which the difference was not statistically significant. Liem et al. also reported no significant difference in the incidence of bladder perforation (P = 0.195) between these two procedures (18). Mashni et al. in their study also compared monopolar and bipolar TURBT, reporting that no patient in any of their study groups developed bladder perforation (21).

In our study, two patients in the monopolar electrocautery group and three patients in the bipolar electrocautery group needed blood transfusions, which showed no statistically significant difference. Gyawali et al. and Balci et al. also reported similar results (23, 24).

Hahn described post-TURBT transurethral resection syndrome for the first time, reporting that four patients had signs of TUR syndrome after TURBT due to the absorption of the irrigating fluid through the extravascular route (25). However, TUR syndrome after TURBT is rare and develops slowly. It may also be associated with the intraperitoneal extravasation of the irrigant fluid caused by bladder perforation (26). No patient in our study developed TUR syndrome. In our study, only patients with tumor sizes of ≤ 4 cm were included, and the duration of surgery in both groups was < 1 hour. So, there was a minimal chance for fluid absorption and the development of dilutional hyponatremia. Yang et al., Balci et al., and Pu et al. in their studies also reported no cases of TUR syndrome in the patients undergoing TURBT (20, 24, 27).

In our study, both groups were comparable in terms of the age and gender of the patients; however, the surgery was performed by different surgeons, which could be a limitation of our study. It is noteworthy that all the surgeons were consultants and experienced in the procedure.

5.1. Conclusions

Our study demonstrated that bipolar electrocautery was associated with a lower incidence of cautery artifacts. However, other intraoperative and postoperative outcomes were comparable to monopolar electrocautery.

Footnotes

Authors' Contribution: A. A. participated in the study concept and design, analysis and interpretation of data, and critical revision of the manuscript for intellectual content. M. Z. I. participated in the study concept and design, acquisition of data, statistical analysis, and drafting of the manuscript. K. M. participated in the acquisition of data and drafting of the manuscript. R. K. T. participated in administrative and technical support and study supervision. B. K. participated in the study concept and design and acquisition of data.

Conflict of Interests: For this study, none of the authors received any payment or services from a third party for any aspect of the submitted work. None of the authors have any patents broadly relevant to the work. None of the authors have any relationships or activities that readers could perceive to have influenced the submitted work. The authors have no conflict of interest.

Data Reproducibility: The dataset presented in the study is available on request from the corresponding author during submission or after publication. The data are not publicly available due to privacy.

Ethical Approval: This study was approved by our institutional ethics committee via letter number 279/IEC/IGIMS/2021.

Funding/Support: There is no funding/support.

Informed Consent: An information sheet was prepared and explained to the patients in their language to inform them of the disease, investigations, treatment, research protocol, and data collection. They were given the full opportunity of asking questions. They were assured that they would not have to face any extra cost, and they were included in the study only after giving informed consent.

References

1. Saginala K, Barsouk A, Aluru JS, Rawla P, Padala SA, Barsouk A. Epidemiology of bladder cancer. *Med Sci (Basel)*. 2020;**8**(1). [PubMed ID: 32183076]. [PubMed Central ID: PMC7151633]. https://doi.org/10.3390/medsci8010015.
2. Miyazaki J, Nishiyama H. Epidemiology of urothelial carcinoma. *Int J Urol*. 2017;**24**(10):730–4. [PubMed ID: 28543959]. https://doi.org/10.1111/iju.13376.
3. Richters A, Aben KKH, Kiemeney L. The global burden of urinary bladder cancer: An update. *World J Urol*. 2020;**38**(8):1895–904. [PubMed ID: 31676912]. [PubMed Central ID: PMC7363726]. https://doi.org/10.1007/s00345-019-02984-4.
4. Bansal A, Sankhwar S, Goel A, Kumar M, Purkait B, Aeron R. Grading of complications of transurethral resection of bladder tumor using clavien-dindo classification system. *Indian J Urol*. 2016;**32**(3):232–7. [PubMed ID: 27555684]. [PubMed Central ID: PMC4970397]. https://doi.org/10.4103/0970-1591.185104.
5. Beer E. Landmark article May 28, 1910: Removal of neoplasms of the urinary bladder. By Edwin Beer. *JAMA*. 1983;**250**(10):1324–5. [PubMed ID: 6348311].
6. Mostafid H, Brausi M. Measuring and improving the quality of transurethral resection for bladder tumour (TURBT). *BJU Int*. 2012;**109**(11):1579–82. [PubMed ID: 21992712]. https://doi.org/10.1111/j.1464-410X.2011.10638.x.
7. Zainfeld D, Daneshmand S. Transurethral resection of bladder tumors: Improving quality through new techniques and technologies. *Curr Urol Rep*. 2017;**18**(5):34. [PubMed ID: 28283914]. https://doi.org/10.1007/s11934-017-0680-0.
8. Osman Y, Harraz AM. A review comparing experience and results with bipolar versus monopolar resection for treatment of bladder tumors. *Curr Urol Rep*. 2016;**17**(3):21. [PubMed ID: 26874533]. https://doi.org/10.1007/s11934-016-0579-1.
9. Thirugnanasambandam V, Ramanathan J. Comparative study of histological changes (thermal artefacts) in resected specimens of monopolar and bipolar trans-urethral resection of bladder tumours. *annals of urologic oncology*. 2020:1–7. https://doi.org/10.32948/auo.2020.10.30.
10. Truong M, Liang L, Kukreja J, O'Brien J, Jean-Gilles J, Messing E. Cautery artifact understages urothelial cancer at initial transurethral resection of large bladder tumours. *Can Urol Assoc J*. 2017;**11**(5):E203–6. [PubMed ID: 28503235]. [PubMed Central ID: PMC5426942]. https://doi.org/10.5489/cuaj.4172.
11. Saini AK, Ahuja A, Seth A, Dogra PN, Kumar R, Singh P, et al. Histomorphological features of resected bladder tumors: Do energy source makes any difference. *Urol Ann*. 2015;**7**(4):466–9. [PubMed ID: 26692666]. [PubMed Central ID: PMC4660697]. https://doi.org/10.4103/0974-7796.157970.
12. Bolat D, Gunlusoy B, Aydogdu O, Aydin ME, Dincel C. Comparing the short - term outcomes and complications of monopolar and bipolar transurethral resection of bladder tumors in patients with coronary artery disese: A prospective, randomized, controlled study. *Int Braz J Urol*. 2018;**44**(4):717–25. [PubMed ID: 29617081]. [PubMed Central ID: PMC6092640]. https://doi.org/10.1590/S1677-5538.IBJU.2017.0309.
13. De Nunzio C, Franco G, Cindolo L, Autorino R, Cicione A, Perdona S, et al. Transuretral resection of the bladder (TURB): analysis of complications using a modified Clavien system in an Italian real life cohort. *Eur J Surg Oncol*. 2014;**40**(1):90–5. [PubMed ID: 24284200]. https://doi.org/10.1016/j.ejso.2013.11.003.
14. Krajewski W, Nowak L, Moschini M, Mari A, Di Trapani E, Xylinas E, et al. Systematic review and meta-analysis on bipolar versus monopolar transurethral resection of bladder tumors. *Transl Androl Urol*. 2021;**10**(1):37–48. [PubMed ID: 33532294]. [PubMed Central ID: PMC7844499]. https://doi.org/10.21037/tau-20-749.
15. Del Rosso A, Pace G, Masciovecchio S, Saldutto P, Galatioto GP, Vicentini C. Plasmakinetic bipolar versus monopolar transurethral resection of non-muscle invasive bladder cancer: A single center randomized controlled trial. *Int J Urol*. 2013;**20**(4):399–403. [PubMed ID: 23003110]. https://doi.org/10.1111/j.1442-2042.2012.03174.x.
16. Venkatramani V, Panda A, Manojkumar R, Kekre NS. Monopolar versus bipolar transurethral resection of bladder tumors: A single center, parallel arm, randomized, controlled trial. *J Urol*. 2014;**191**(6):1703–7. [PubMed ID: 24333244]. https://doi.org/10.1016/j.juro.2013.12.004.
17. Teoh JY, Chan ES, Yip SY, Tam HM, Chiu PK, Yee CH, et al. Comparison of detrusor muscle sampling rate in monopolar and bipolar transurethral resection of bladder tumor: A randomized trial. *Ann Surg Oncol*. 2017;**24**(5):1428–34. [PubMed ID: 27882470]. https://doi.org/10.1245/s10434-016-5700-7.
18. Liem E, McCormack M, Chan ESY, Matsui Y, Geavlete P, Choi YD, et al. Monopolar vs. bipolar transurethral resection for non-muscle invasive bladder carcinoma: A post-hoc analysis from a randomized controlled trial. *Urol Oncol*. 2018;**36**(7):338 e1–338 e11. [PubMed ID: 29661592]. https://doi.org/10.1016/j.urolonc.2018.03.015.
19. Mahmoud MA, Tawfick A, Mostafa DE, Elawady H, Abuelnaga M, Omar K, et al. Can bipolar energy serve as an alternative to monopolar energy in the management of large bladder tumours >3 cm? A prospective randomised study. *Arab J Urol*. 2019;**17**(2):125–31. [PubMed ID: 31285924]. [PubMed Central ID: PMC6600073]. https://doi.org/10.1080/2090598X.2019.1590517.
20. Yang SJ, Song PH, Kim HT. Comparison of deep biopsy tissue damage from transurethral resection of bladder tumors between bipolar and monopolar devices. *Korean J Urol*. 2011;**52**(6):379–83. [PubMed ID: 21750747]. [PubMed Central ID: PMC3123812]. https://doi.org/10.4111/kju.2011.52.6.379.
21. Mashni J, Godoy G, Haarer C, Dalbagni G, Reuter VE, Al-Ahmadie H, et al. Prospective evaluation of plasma kinetic bipolar resection of bladder cancer: Comparison to monopolar resection and pathologic findings. *Int Urol Nephrol*. 2014;**46**(9):1699–705. [PubMed ID: 24792236]. [PubMed Central ID: PMC4524777]. https://doi.org/10.1007/s11255-014-0719-9.

22. Hashad MM, Abdeldaeim HM, Moussa A, Assem A, Youssif TMA. Bipolar vs monopolar resection of bladder tumours of >3 cm in patients maintained on low-dose aspirin: A randomised clinical trial. *Arab J Urol*. 2017;**15**(3):223–7. [PubMed ID: 29071156]. [PubMed Central ID: PMC5651943]. https://doi.org/10.1016/j.aju.2017.04.001.
23. Gyawali PR, Sharma UK, Chalise PR, Luitel BR, Chapagain S, Poudyal S, et al. Safety and efficacy of bipolar vs monopolar transurethral resection of bladder tumor- a randomized controlled trial. *Nepal Medical College Journal*. 2020;**22**(3):123–8. https://doi.org/10.3126/nmcj.v22i3.32630.
24. Balci M, Tuncel A, Keten T, Guzel O, Lokman U, Koseoglu E, et al. Comparison of monopolar and bipolar transurethral resection of non-muscle invasive bladder cancer. *Urol Int*. 2018;**100**(1):100–4. [PubMed ID: 28380492]. https://doi.org/10.1159/000467397.
25. Hahn RG. Transurethral resection syndrome after transurethral resection of bladder tumours. *Can J Anaesth*. 1995;**42**(1):69–72. [PubMed ID: 7889587]. https://doi.org/10.1007/BF03010574.
26. Dorotta I, Basali A, Ritchey M, O'Hara JJ, Sprung J. Transurethral resection syndrome after bladder perforation. *Anesth Analg*. 2003;**97**(5):1536–8. [PubMed ID: 14570683]. https://doi.org/10.1213/01.ANE.0000085299.24288.8C.
27. Pu XY, Wang HP, Wu YL, Wang XH. Use of bipolar energy for transurethral resection of superficial bladder tumors: Long-term results. *J Endourol*. 2008;**22**(3):545–9. [PubMed ID: 18257673]. https://doi.org/10.1089/end.2007.0467.