

# Safe Resection of Bladder Tumors with Plasma Kinetic Energy

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## ABSTRACT

The purpose of this study was to compare the bipolar Plasma Kinetic (PK) energy and conventional monopolar energy in the transurethral resection of bladder lateral wall tumors (TURB) for preventing ONR and bladder perforation. Thirty patients undergone TURB between September 2005 and December 2007 were included to the study. TURB was performed with monopolar energy in first (n:15) and with bipolar energy in second (n:15) groups. Maximum tumor size and number of active ONR, minor and major (required open bladder repair) bladder perforations and hospitalization periods were noted. In the first group, 6 minor and 1 major ONR related bladder perforations were seen. No complications were observed in the second group. The number of minor perforations and hospitalization periods were also statistically significant between two groups. Our results showed that TUR of lateral wall bladder tumors by using PK energy is safer than conventional monopolar energy in preventing ONR related bladder perforations.

**Key Words:** Bladder cancer, Caution, Obturator nerve reflex, Plasma kinetic, Transurethral resection

## ÖZET

### Mesane Tümörlerinin Plazma Kinetik Enerji ile Güvenli Rezeksiyonu

Bu çalışmanın amacı, mesane yan duvar tümörlerinin transüretal rezeksiyonunda, obturatuvar refleks ve perforasyondan kaçınmak için bipolar plazmakinetik enerji ile konvansiyonel monopolar enerjinin kıyaslanmasıdır. Çalışmaya Eylül 2005 - Aralık 2007 tarihleri arasında 30 hasta dahil edildi. Transüretal rezeksiyon birinci grupta (15 hasta) monopolar enerji ve ikinci grupta (15 hasta) bipolar enerji kullanılarak yapıldı. Maksimum tumor boyutu ve sayısı, aktif obturatuvar sinir refleks sayısı, major (açık mesane tamiri gerektiren) ve minor mesane perforasyonları ve hastanede kalış süresi değerlendirildi. Birinci grupta obturatuvar sinir refleks ile ilişkili 6 minör 1 major mesane perforasyonu gözlemlendi. Hastanede kalış süresi 1. grupta daha uzundu. İkinci grupta herhangi bir komplikasyon gözlemlenmedi. Çalışmamızın sonuçları ışığında mesane yan duvarlarında lokalize tümörlerin plazmakinetik enerji ile rezeksiyonun, obturatuvar sinir refleks ve ilişkili mesane perforasyonundan kaçınılmasında monopolar enerjiden daha güvenli olduğunu düşünmekteyiz.

**Anahtar Kelimeler:** Mesane kanseri, Koter, Obturatuvar refleks, Plazmakinetik, Transüretal rezeksiyon

## INTRODUCTION

Bladder cancer is the second most common cancer of the genitourinary system with an estimated 40,000 new cases diagnosed and 10,000 deaths reported each year in the United States.<sup>1</sup> Cystoscopy and transurethral resection of bladder tumors (TURB) remains the mainstay of diagnostic and at times therapeutic techniques of identification of such a lesion. In conventional TURB, monopolar energy is used for resection. During TURB with monopolar systems under either spinal or general anesthesia without muscular relaxation, obturator nerve reflex (ONR) may occur and can cause bladder perforation, especially in tumors at lateral wall of the bladder.<sup>2</sup> There have been several published reports on perforation during transurethral resection of bladder tumors. However, the number of such reports is far less than we expect many practicing physicians to admit to and perhaps far less than we expect to have occurred but gone unnoticed.<sup>3-5</sup> Because of perforation, open repair of the bladder may be required, complications like infection and hemorrhage may occur and the hospitalization period of these patients becomes longer.

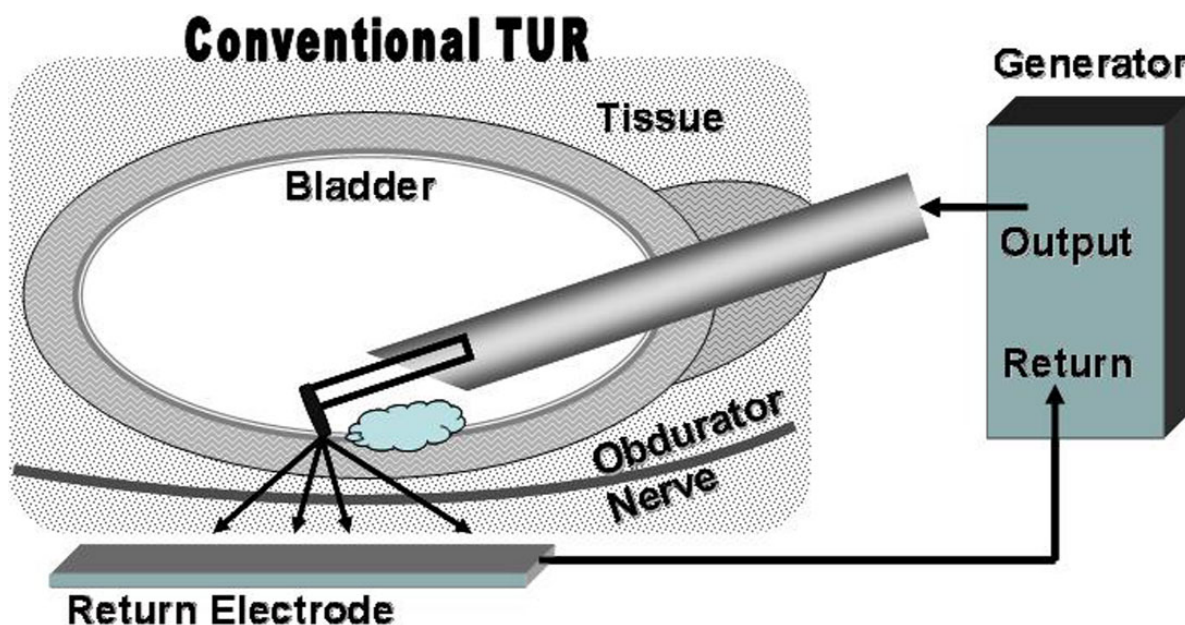
Plasma Kinetic (PK) generator and specific instruments are designed as a system. Radio frequency

energy is a part of the electromagnetic spectrum and refers to frequencies between 3 kHz and 300 GHz. The term Plasma Kinetics describes the formation of vapor pockets within tissue.<sup>6</sup> The PK system uses high-powered pulsed bipolar energy to produce a plasma kinetic field around the working elements and is designed to operate at temperatures that allow effective tissue dissection but result in minimal collateral damage and adherence to tissue.<sup>6-8</sup> PK energy is being widely used in transurethral resection (TUR) of prostate safely.

The purpose of this study was to compare the bipolar PK energy and conventional monopolar energy in the transurethral resection of bladder lateral wall tumors for preventing ONR and ONR related bladder perforations.

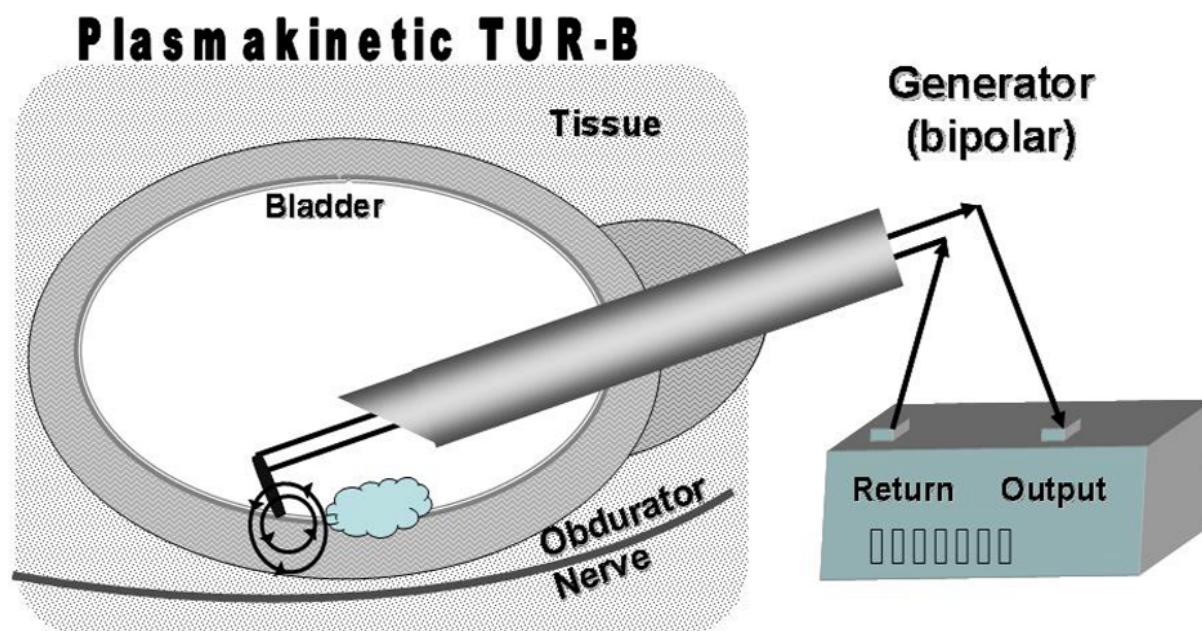
## MATERIAL AND METHOD

The study included 30 patients, who undergone transurethral resection for lateral wall located bladder tumors in our clinic between September 2005 and December 2007. In this study we divided the patients into two groups. After obtaining informed consent TURB was performed with monopolar energy in 15 cases in the first group and with bipolar PK energy in 15 cases in the second group. Pa-



**Figure 1.** In the conventional monopolar TUR system, the electric current flow produced from the generator passes through the electrode loop, human body tissues, the return electrode pad, and the generator.

TUR : Transurethral resection



**Figure 2.** In the bipolar TUR system, the active and return electrodes are located inside the surgical instrument. When bipolar energy is applied to tissue, the current flows through the electrodes. Only the touched tissue is effected. Surrounding tissues are not affected.

TURB: Transurethral resection of bladder tumor

tients in the first group were the first 15 consecutive patients who undergone TURB with monopolar energy. In both groups, patients had single or multiple primer tumors on bladder lateral walls  $\geq 1$  cm in size. Patients with cerebrovascular accident history, any bladder operation (open or endoscopic), and diabetes mellitus were excluded from the study.

All the operations were performed under spinal anesthesia without relaxation or nerve block by the same surgeon and antibiotic prophylaxis was administered. In the first group TURB was performed by using 24 F Sheath Storz resectoscope and glycine solution. In the second group PK TURB was performed with the accompaniment of irrigation with isotonic saline solution by using 25 F Sheath (Gyrus Medical, Bourne End, UK) and plasma sect electrode (Figure 1). The plasma kinetic generator 160 W worked at  $\Omega$  radiofrequency range of 340-450 Hz. The tissue resection was performed on PK3 mode with 340 V (Figure 2). Numbers of occurred ONR were noted during all procedures. Bladder perforations were classified in two groups as minor and major perforations by evaluating the degree of defect occurred on the bladder wall during resection and extravasations of irrigation solution. Perforation was defined as major perforation

when perivesical fat was seen during resection. Minor perforations were treated with longer foley catheterization without open bladder repair and major perforations were treated with open bladder repair. In all cases the bladder perforation types and active ONR number were defined by the same surgeon (Table 1).

At the end of the procedure, 22 F 3-way foley catheter was inserted. In patients with no complications, foley catheter was removed when the urine was clear. If perforation occurred foley catheter was removed at postoperative 5th day supplied that the urine was clear.

Mann-Whitney U test and Fisher's exact test were used for statistical analysis.

## RESULTS

The median age value of the patients was 60 (48-72) years in the first group (monopolar TURB group) and 62 (45-73) years for the second group (PK TURB group). Number of ONR and occurred perforations during resection procedure are shown in table 1 for both groups. There was no statistically significant difference between the two groups in age, maximum tumor size and tumor number

**Table 1.** Demographic data and characteristics of group 1 (Monopolar TURB) and group 2 (PK TURB).

	Group 1	Group 2	p
Age*	60 (48-72)	62 (45-73)	0.624
Maximum tumor size*	1.5 (1-2)	1.5 (1-2)	0.539
Number of active obturator nevre reflex*	2 (0-3)	0	< 0.001***
Number of minor perforations**	6	0	0.017***
Number of major perforations**	1	0	0.483
Hospitalisation period*	2 (2-5)	2 (2-2)	0.003***

\* Mann-Whitney U Test, \*\* Fisher's Exact Test, \*\*\* Statistically significant difference (p < 0.05)

(p>0.05). Number of Active ONR, number of minor perforations and hospitalization periods were also compared between the groups and statistically significant difference was noticed (p > 0.05). In the first group 1 patient needed open bladder repair due to ONR related bladder perforation and foley catheter removed at postoperative 5th day . In 6 patients of the first group, foley urethral catheter was removed at postoperative 5th day because of ONR related minor bladder perforation. No infection occurred and no blood transfusion was required in any of the groups.

The pathologist commented that they had no difficulty in histopathological evaluation of TURB materials in either group.

## DISCUSSION

Cystoscopy and transurethral resection of bladder tumors remain the mainstay of diagnostic and at times therapeutic techniques of identification of such a lesion. Usually, tumor resection is performed with monopolar energy. During transurethral resection of bladder tumors under either spinal or general anesthesia without muscular relaxation, direct stimulation of the obturator nerve by the electroresectoscope is likely. The resulting ONR may lead to severe complications; at the worst to a perforation of the bladder.<sup>2</sup> In the conventional monopolar TUR system, an electric current passes through a resection loop to the return electrode pad (patient pad). The current may stimulate the obturator nerve and cause spontaneous thigh adductor contraction.<sup>9</sup> To avoid this complication, an obturator nerve block is performed preoperatively, and this is especially im-

portant for tumors located on the lateral bladder wall.<sup>3-5</sup> However, a nerve block is not always the perfect method and also it involves increased time and cost.<sup>10</sup>

Because of perforation, acute complications like infection and hemorrhage may occur and the hospitalization period of these patients become longer. Perforations increase the incidence of urinary tract infections from 12% to 25% and septicemia from 3.5% to 11%. The incidence of transfusions is also increased from 13% to 24%.<sup>3</sup>

Plasma Kinetic resection of prostate is one of newly developed methods. With this technique, the prostatic tissue is resected through radiofrequency energy by using bipolar PK technology.<sup>11</sup> In this prospective study, we applied TURB with conventional monopolar energy or bipolar PK techniques in the patients with primer bladder tumors, which were located on lateral bladder walls and greater than 1 cm size. We aimed to evaluate the safety of PK energy by comparing with monopolar energy in patients who had undergone TURB.

In the monopolar circuit, the current flows through the body between the electrodes. There is an active electrode at the surgical site, where the desired electrosurgical effect takes place, and a return electrode at a distant site that is usually placed on the patient's thigh. The generator has three waveform settings: Cut, coagulation, and blend (Figure 1).<sup>6,12,13</sup> During monopolar resection of bladder tumors (especially those located at lateral walls) obturator nerve can be activated and ONR occurs easily. This condition may cause longer operation time, hemorrhage and perforation of bladder.

In the bipolar system, the active and return electrodes are located inside the surgical instrument. The output from the generator is a continuous sine wave at a low voltage, like a monopolar cutting waveform, and the power is usually limited to 70 watts.<sup>6,12,14</sup> When bipolar energy is applied, the current flows through the electrodes. Only the touched tissue is affected and surrounding tissues are not (Figure 2).

In our study we demonstrated that monopolar energy activates ONR significantly higher than PK energy does. In the first group 1 patient needed open bladder repair due to ONR related perforation. Also in 6 patients in the first group, foley urethral catheter removed at postoperative 5th day because of ONR related minor bladder perforations. During resection with PK no ONR activity occurred. No perforation occurred due to ONR in PK group. No infection occurred and no blood transfusion was required in any of the groups.

In this study we demonstrated that the bipolar transurethral resection of bladder tumors located on lateral walls using Gyrus™ Plasma Kinetic System seems safer than conventional monopolar energy in preventing ONR and ONR related bladder perforation. Preventing bladder perforations by using bipolar energy the costs of the patients can be reduced (shot catheterization and hospitalization periods). Further studies are needed in order to find the exact place of bipolar energy during TURB on a daily practice.

#### REFERENCES

1. Mydlo JH, Weinstein R, Shah S, et al. Long-term consequences from bladder perforation and/or violation in the presence of transitional cell carcinoma: results of a small series and a review of the literature. *J Urol* 161: 1128-1132, 1999.
2. Schwillick R, Steinhoff H. Elimination of the obturator reflex as a specific indication for dilute solutions of etidocaine. A study of the suitability of a local anesthetic for reflex elimination in the 3-in-1 block technic. *Reg Anaesth* 10: 65-69, 1987.
3. Dick A, Barnes R, Hadley H, et al. Complications of transurethral resection of bladder tumors: prevention, recognition and treatment. *J Urol* 124: 810-811, 1980.
4. Boreham P. The surgical spread of cancer in urology. *Br J Urol* 28: 163-175, 1956.
5. Melicow MM. Tumors of the urinary bladder: a clinicopathological analysis of 2500 specimens and biopsies. *J Urol* 74: 498-521, 1955.
6. Santa-Cruz RW, Auge BK, Lallas CD, et al. Use of bipolar laparoscopic forceps to occlude and transect the retroperitoneal vasculature: a porcine model. *J Endourol* 17: 181-185, 2003.
7. Erian J, El-Toukhy T, Chandakas S, et al. One hundred cases of laparoscopic subtotal hysterectomy using the PK and Lap Loop systems. *J Minim Invasive Gynecol* 12: 365-369, 2005.
8. Pietrow PK, Weizer AZ, L'Esperance JO, et al. PlasmaKinetic bipolar vessel sealing: burst pressures and thermal spread in an animal model. *J Endourol* 19: 107-110, 2005.
9. Yoshimura R, Adachi T, Funao K, et al. Treatment of Bladder Tumors and Benign Prostatic Hyperplasia with a New TUR System Using Physiological Saline as Perfusate. *World J Surg* 30: 473-477, 2006.
10. Akata T, Murakami J, Yoshinaga A, et al. Life-threatening haemorrhage following obturator artery injury during transurethral bladder surgery: a sequel of an unsuccessful obturator nerve block. *Acta Anaesthesiol Scand* 43: 784-788, 1999.
11. Nuhoglu B, Ayyıldız A, Karaguzel E, et al. Plasmakinetic Prostate Resection in The Treatment Of Benign Prostate Hyperplasia: Results Of 1-Year Follow Up. In *J Urol* 13: 21-24, 2006.
12. Smith TL, Smith JM. Electrosurgery in Otolaryngology-Head and Neck surgery: Principles, Advantages and Complications. *Laryngoscope* 111: 769-780, 2001.
13. Phipps JH. Understanding electrosurgery: safety and efficiency. In: Introduction to gynecological endoscopy. Lower A, Sutton C, Grudzinskas G (eds). Iris Medical Media, Oxford UK, 39-56, 1996.
14. Malis LI. Electrosurgery and bipolar technology. *Operative neurosurgery* 58: 1-11, 2005.

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