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Monopolar versus Plasmakinetic™ Energy Effect on Prostatic Tissue Damage in Terms of PSA Levels: A Prospective Randomized Trial

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Key Words
Transurethral resection of prostate · Prostatic specific antigene · Chronic prostatitis · Benign prostate hyperplasia

Abstract
Introduction: We investigated the monopolar and bipolar energy effects on prostate and correlated the results with the type of pathology, thus determining the relationship between tissue damage and the PSA level. ***Material and Methods:*** One hundred and twenty four patients underwent TURP and according to the energy source, 2 groups were designed as monopolar (Group 1) and bipolar energy (Group 2). Hemoglobin and free and total PSA were measured preoperatively and 6 hours postoperatively, and differences were calculated. The weight of resected tissue and operation time were also recorded. Two groups were also formed later according to the pathology as chronic prostatitis (CP) and BPH. The findings were analyzed. ***Results:*** There were no statistical differences between the groups in terms of age; prostate volumes; resected tissue; operation times; pre- and postoperative Hb, total-free PSA, IPSS, PVR, and quality of life scores; or postoperative maximum flow rates. Changes in total-free PSA (25.7 and 10.8 ng/dl for PSA; 13.2 and 5.76 ng/dl for free PSA for Groups 1 and 2, respectively) were significantly different between Groups 1 and 2. There was a statistical difference in total PSA between the groups among CP patients (28.18 and 11.73 ng/dl for Groups 1 and 2, respectively). But no statistical difference existed among BPH patients. The change in Hb differed based on pathological results. ***Conclusion:*** Bipolar TURP is less invasive than monopolar TURP on the basis of postoperative PSA levels. In addition, bleeding during TURP is affected not by the kind of energy, but by the pathology.

Introduction

Transurethral resection of the prostate (TURP) continues to be the gold standard treatment for relief of lower urinary tract symptoms (LUTS) from benign prostate hyperplasia (BPH) [1]; yet alternate management methods have been developed, including laser enucleation, prostate vaporization, transurethral microwave therapy, transurethral needle ablation, and prostatic stents. These management methods are designed to address complications such as perioperative or postoperative bleeding, transurethral resection (TUR) syndrome, prolonged hospital stay and nosocomial infection, urinary incontinence, retrograde ejaculation, and erectile dysfunction.

Bipolar TURP was developed as an alternative to monopolar TURP to reduce complications such as bleeding, TUR syndrome, urinary incontinence, and erectile dysfunction. Some of these complications, especially erectile dysfunction and urinary incontinence, can be associated with problems in the neurovascular bundle around the prostate because of the depth of the tissue damage during TURP.

In this study, we investigated the effects of monopolar and bipolar energy on prostate-specific antigen (PSA)

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levels early in the postoperative process and correlated the results with the type of pathology, thus determining the relationship between tissue damage and the PSA level. We hypothesize that the PSA level is positively related to the tissue damage, so if the depth of tissue damage is superficial, the PSA level should be lesser. We wanted to confirm the effect of bipolar TURP on prostate tissue by using PSA level at an early stage of the operation.

Materials and Methods

This study was designed as a randomized prospective study and was approved by the local ethics committee of our institution and performed in accordance with the Helsinki Declaration of the World Medical Association. Informed consent was obtained from all patients prior to operation. Between 2013 and 2014, a total of 124 patients who had obstructive patterns in their uroflowmetric analysis underwent TURP by 2 different energy methods. The pathologic result was not known before the operation. Two groups were formed according to the energy used during the operation. Sixty patients were enrolled into Group 1 and they received monopolar energy, while 64 patients enrolled into Group 2 received bipolar energy. The operations with an odd number were randomized into Group 1 and those with an even number into Group 2.

Inclusion Criteria

Inclusion criteria were maximum urinary flow rate <10 ml/s or obstructive pressure flow, severe LUTS requiring surgical treatment based on IPSS, and recurrent hematuria or urinary tract infections. Patients who were suspected to have chronic prostatitis (CP), who had obstructive patterns in their follow-up uroflowmetric analysis despite the treatment with an antibiotic in combination with an alpha-blocker were included in the study.

Exclusion Criteria

Exclusion criteria were neurogenic bladder, prostate cancer, preoperatively catheterized patients and urethral stricture. And during the cystoscopy, the prostatic urethral length was measured over 5 cm (in this situation, the resectoscope length will not be enough for TURP). The open prostatectomy was performed in such patients.

Surgical Method

Patients were operated on by the same experienced surgeons (A.D., M.A.K.) who had been specialists for over 8 years and had performed about 1,000 TURP procedures. All patients received spinal anesthesia in the lithotomy position. Cephazolin sodium (1 g) was administered intravenously as antibiotic prophylaxis. Nesbitt's TURP method was used.

A 26 F continuous-flow resectoscope was used in Group 1. Resectisol™ (Eczacıbaşı, Turkey) solution, which contains 5% mannitole, was used for irrigation. We used a diuretic agent if the creatinine levels were normal as a prophylaxy in order to prevent TUR syndrome in operations that lasted over 90 min.

A 27 F continuous-flow resectoscope with a plasmakinetic loop electrode (Plasmakinetic system™; Gyrus Medical Ltd., Bucks, UK) was used in Group 2. Isotonic saline was used for irrigation.

We performed a routine physical examination, including digital rectal examination, complete blood count, urinalysis and culture, uroflowmetry (minimum acceptable urinary volume, 150 ml), postvoid residual urine (PVR), serum creatinine, urinary system ultrasonography, and free and total PSA, in all patients admitted to our outpatient clinic for LUTS. The International Prostate Symptom Score (IPSS) of each patient was compiled.

Hemoglobin (Hb) and free and total PSA were measured preoperatively and 6 h postoperatively, and differences were calculated. The weight of resected tissue and operation time were also recorded. Preoperative IPSS and uroflowmetric analysis with PVR were compared with one-month postoperative values. Patients were diagnosed with either BPH that contained the CP component or only BPH according to pathological reports. Differences in Hb and total and free PSA were analyzed by group as well as by pathologic subdivision.

Statistical Analysis

This study was designed to detect a 30% difference in PSA levels between the groups with 90% power, assuming a significance level of 0.05 using two-tailed statistical tests. The sample size was calculated based on the results of a pilot study of PSA and free PSA levels, in consultation with a biostatistics specialist. Results were presented as mean ± standard deviation. Data were analyzed using SPSS 16.0 for Windows (SPSS Inc., Chicago, Ill., USA). Differences between the groups in terms of PSA and free PSA were analyzed using independent student t-tests and the Mann-Whitney test when needed. Differences between the pathologic subdivisions in terms of changes in Hb and total and free PSA were analyzed using univariate analysis.

Results

There were no statistical differences between the groups in terms of age; prostate volumes; resected tissue amounts; operation times; pre- and postoperative Hb, total PSA, free PSA, IPSS, PVR, and quality of life scores; or postoperative maximum flow rates (table 1). There was also no statistical difference in terms of complications. No TUR syndrome, incontinence, erectile dysfunction or a bleeding that required blood transfusion were observed during the postoperative process until the third month.

Changes in total and free PSA were significantly different between Groups 1 and 2 ($p < 0.05$; table 1).

There was a statistically significant difference in the increase of total and free PSA after surgery between groups among CP patients (28.18 ± 22.57 ng/dl and 11.73 ± 13.09 ng/dl for Groups 1 and 2, respectively; $p = 0.02$; table 2), but no statistical difference among BPH patients (22.9 ± 32.27 ng/dl and 10.32 ± 18.84 ng/dl for Groups 1 and 2, respectively; $p = 0.15$; table 2). However, the change in PSA among the BPH patients was nearly twofold in Group 1 when compared to Group 2.

There was no statistical difference between the pathological divisions in terms of change in PSA within the

Table 1. The characteristics of the groups, $p < 0.05$; statistical difference

Parameters	Monopolar group (n = 60)	Bipolar group (n = 64)	p
Age, years	65.63±7.6	68.29±7.5	0.16
Preoperative PSA, ng/dl	11.89±22.49	10.8±19.58	0.84
Preoperative free PSA	3.29±9.27	3.13±8.66	0.94
Postoperative PSA, ng/dl	37.65±41.1	21.74±31.26	0.09
Postoperative free PSA	16.5±19.07	8.9±9.22	0.08
Mean PSA difference	25.7±27.1	10.8±16.67	0.01
Mean free PSA difference	13.2±15.33	5.76±8.24	0.02
Mean Hb difference	1.36±1.07	1.59±1.3	0.45
Prostate volume, abdominal USG, cc	70.7±37.1	63.44±27.6	0.38
Resected tissue amount, g	20.73±10.5	18.26±7.01	0.28
Operation time, min	57.83±17.45	51.18±13.37	0.09
Preoperative IPSS	26.13±3.07	26.79±4.49	0.17
Postoperative IPSS	4.46±2.25	5.5±1.81	0.1
Preoperative quality of life score	4.7±0.7	5.06±0.9	0.08
Postoperative quality of life score	1.3±8.76	1.43±0.56	0.08
Preoperative Qmax, ml/s	5±4.4	4.5±4.1	0.64
Postoperative Qmax, ml/s	23.9±6.61	21.05±4.17	0.1
Preoperative PVR, cc	321.5±148.6	309.4±251.1	0.76
Postoperative PVR, cc	42.8±20.4	48.5±16.3	0.22

Table 2. The mean PSA difference with regard to pathologic results according to the groups, $p < 0.05$; statistical difference

Pathological result	Monopolar group CP (n = 31) BPH (n = 29)	Bipolar group CP (n = 28) BPH (n = 36)	p
CP	28.18±22.57	11.73±13.09	0.02
BPH	22.9±32.27	10.32±18.84	0.15

Table 3. The mean PSA difference with regard to pathological results within groups, $p < 0.05$; statistical difference

Groups	CP Monopolar group (n = 31) Bipolar group (n = 28)	BPH Monopolar group (n = 29) Bipolar group (n = 36)	p
Monopolar	28.18±22.57	22.99±33.27	0.61
Bipolar	11.73±13.09	10.32±18.84	0.79

Table 4. The mean Hb difference between preoperative and postoperative values with regard to pathological results, $p < 0.05$; statistical difference

Parameter	CP	BPH	p
Mean Hb difference	1.85±1.36	1.18±0.95	0.03

groups ($p = 0.61$ for Group 1 and $p = 0.79$ for Group 2; table 3).

The change in Hb differed based on pathological results (1.85 ± 1.36 for CP and 1.18 ± 0.95 for BPH, $p = 0.03$; table 4).

Discussion

Despite technical improvements in TURP (high-performance electrosurgery generators, better resectoscope and loop materials, etc.), the technical principle behind TURP remains the same as it was nearly 80 years ago [1]. Initially, monopolar TURP used an active resection electrode loop and a return electrode at the skin level to close the circuit [2]. The energy circulated through the body, raising the risk of nervous stimulation and eventual pacemaker failure; moreover, significant bleeding could occur during cutting with a monopolar loop, raising the need for frequent coagulation [3].

Bipolar devices have both active and return poles incorporated in the electrode or in the electrode and the resectoscope [1]. Unlike monopolar electrosurgery, the current does not flow through any part of the body. The bipolar method has much shorter tissue penetration, in the 50–100 μm range, generating less collateral thermal damage and less tissue charring [3].

In this study, we investigated the effect of tissue damaged by electrosurgery on free and total PSA levels early in the operation and correlated these results with pathological results. It is suggested that any intervention to the prostate, including a digital rectal examination [4], may increase PSA levels, relative to the severity of the intervention. The effect on PSA of bipolar energy is less than that of monopolar energy. In addition, fewer or less severe complications are expected using bipolar energy because it penetrates tissue to a lesser degree. According to Ko et al., bipolar TURP generated significantly less heat and histopathological evidence of thermal damage compared to monopolar TURP, using a canine model [5]. Also, Karaman et al. showed thermal injury extending as far as 3 mm during plasmakinetic vaporization of the prostate, demonstrating a thermal margin of <0.5 mm [6]. It can then be expected that PSA levels early in bipolar TURP could be less. We have now confirmed that the use of bipolar energy is less invasive.

According to our analysis, the mean PSA change among the CP patients was significantly higher in Group 1 than in Group 2. While the change in mean PSA among the BPH patients was not statistically different, it was nearly twofold higher for those who received monopolar TURP. This result can be associated with the number of BPH patients.

There was no statistical difference between the groups in terms of change in Hb, but when separated according to pathological results, the differences were significant ($p = 0.03$; table 4). To our knowledge, this is the first time that these results are reported. Huang et al. showed that pathological changes in the prostate after bipolar and monopolar TURP are similar in the canine model, but the intraoperative coagulation zones of bipolar TURP are deeper and become thinner early after the operation [7]. However, the specimens were not distinguished as CP or BPH.

According to our results, resected tissue amount, and operation time were similar between groups, and one-month postoperative results were similar in terms of IPSS, quality of life scores, maximum flow rates, and PVR values (table 1). Similar results were shown in other studies [8–13].

Limitations of the Study

Our study benefits from its prospective design and sample size. All operations were performed by same experienced two urologists for each type of surgery, removing the surgical ability factor, which could have determined outcomes, operation times, and complications.

There are also several limitations. The research was not a multicenter investigation and included data only from one department. If parameters such as cost analysis, erectile dysfunction and urethral stricture rates, analgesic use, return to normal daily life, and pain while voiding were included in this study, its impact would be greater.

Conclusion

We have confirmed that bipolar TURP is less invasive than monopolar TURP on the basis of postoperative PSA levels. In addition, bleeding, which is one of the most important complications during TURP, is affected not by the kind of energy, but by the pathology.

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Disclosure Statement

None declared.

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