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Comparative Analysis of the Efficacy and Safety of Conventional Transurethral Resection of the Prostate, Transurethral Resection of the Prostate in Saline (TURIS), and TURIS-Plasma Vaporization for the Treatment of Benign Prostatic Hyperplasia: A Pilot Study

Yong Taec Lee, Young Woo Ryu, Dong Min Lee, Sang Wook Park, Seung Hee Yum, June Hyun Han

Department of Urology, Korea Electric Power Corporation Medical Foundation Han-il General Hospital, Seoul, Korea

Purpose: This study was conducted to perform a comparative analysis of the efficacy and safety of conventional transurethral resection of the prostate (TUR-P), transurethral resection in saline (TURIS), and TURIS-plasma vaporization (TURIS-V) when performed by a single surgeon for benign prostatic hyperplasia (BPH).

Materials and Methods: The clinical data of 73 consecutive men who underwent conventional TUR-P (39), TURIS (19), or TURIS-V (15) for BPH were retrospectively analyzed. All procedures were carried out by a single surgeon between October 2007 and April 2010. The patients were assessed preoperatively and perioperatively and were followed at 1, 3, and 6 months postoperatively. Patient baseline characteristics, perioperative data, and postoperative outcomes were compared, and major complications were recorded.

Results: In all groups, significant improvements in subjective and objective voiding parameters were achieved and were sustained throughout follow-up. TURIS-V had the shortest operation time compared with conventional TUR-P and TURIS (p=0.211). TURIS-V significantly decreased procedural irrigation fluid volume, postoperative irrigation duration, catheter duration, and hospital stay compared with conventional TUR-P and TURIS. There were no significant differences between the groups in hemoglobin levels or serum sodium levels before and after the operations. There were three transfusions and four clot retentions in the TUR-P group, and one transfusion and one clot retention in the TURIS group. The TURIS-V group had no complications.

Conclusions: TURIS and TURIS-V were effective for the surgical treatment of BPH in addition to conventional TUR-P. TURIS-V was not inferior to conventional TUR-P or TURIS in terms of safety.

Key Words: *Male; Prostatectomy; Prostatic hyperplasia; Transurethral resection of prostate; Urologic surgical procedures*

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Corresponding Author:
June Hyun Han
Department of Urology, Korea Electric Power Corporation Medical Foundation Han-il General Hospital, 388-1, Ssangmun 3-dong, Dobong-gu, Seoul 132-703, Korea
TEL: +82-2-901-3159
FAX: +82-2-901-3467
E-mail: junuro@naver.com

INTRODUCTION

Benign prostatic hyperplasia (BPH) is one of the most common diseases in Korean men of middle age and older. The prevalence of clinical BPH in a community-based study of Chungbuk province was 27.7% with use of the definition of BPH of a prostate volume ≥20 ml and an International Prostate Symptom Score (IPSS) ≥8 [1]. BPH frequency and importance are rising, owing to gradual changes in lifestyle and rapid increases in the elderly population [2]. Although benign, this disease has a progressive evolution and has a negative impact on the health-related quality of life of the patients, marked by obstructive and irritative lower urinary tract symptoms (LUTS) [3].

Transurethral resection of the prostate (TUR-P) is the most effective surgical modality for symptomatic BPH [4]. According to the European Association of Urology Guidelines 2009, monopolar TUR-P is the treatment of choice for prostates of 30 to 80 ml [5]. However, postoperative morbidity after TUR-P is significant. TUR-P can result in complications such as postoperative bleeding, urethral stricture, urinary incontinence, retrograde ejaculation, and transurethral resection (TUR) syndrome. In particular, complications causing hemorrhage lead to delayed hospital discharge and possible blood transfusion [6]. In the past decade, several technologies have been developed to treat BPH with minimal risks and acceptable efficacy. Currently, approximately 30% of patients who are admitted for surgery have concomitant cardiovascular diseases and ongoing anticoagulant therapy; this is responsible for an increased risk of hemorrhagic complications [4,7]. The use of bipolar electrosurgical technology, namely, transurethral resection of the prostate in saline (TURIS), has shown fewer complications and comparable results to standard TUR-P in early and short follow-ups [8]. Additionally, the use of 0.9% saline as the irrigation fluid has greatly reduced the risk of TUR syndrome, owing to reduced fluid absorption [9]. Recently, a new development of this technique, the TURIS-plasma vaporization (TURIS-V) technique, which uses the Olympus UES-40 Surgmaster generator (Olympus, Tokyo, Japan) and 'mushroom' vapo-resection electrode, was introduced in clinical practice.

In the present study, we aimed to evaluate and compare the efficacy and safety of conventional TUR-P, TURIS, and TURIS-V for the treatment of BPH when carried out by a single surgeon.

MATERIALS AND METHODS

We retrospectively analyzed the clinical data of 73 consecutive men who underwent conventional TUR-P (39 cases), TURIS (19 cases), or TURIS-V (15 cases) for the treatment of BPH. All procedures were carried out by a single surgeon (JHH) between October 2007 and April 2010. All patients underwent history taking, physical examination, transrectal ultrasonography, and a blood test for prostate-specific antigen (PSA) before surgery. Patients with palpable nodules on the digital rectal exam or with PSA levels greater than 3 ng/ml before surgery underwent prostate tissue biopsy to assess for prostate cancer. Those diagnosed with prostate cancer were excluded from the study. Patients showing a neurogenic bladder in the urodynamic studies, those with urinary tract infection or urethral stricture, and those with previous prostate surgery, chronic renal failure, or receiving anticoagulant therapy were also excluded. Those with an American Society of Anesthesiologists classification of 2 or less were included, but all patients discontinued anticoagulant agents for 2 weeks before surgery. Indications for surgery were an IPSS of 12 points or more before surgery and a maximal urinary flow rate (Qmax) lower than 15 ml/s. All patients were assessed preoperatively and perioperatively and were followed at 1, 3, and 6 months postoperatively. The preoperative and postoperative parameters included IPSS, quality of life (QoL), prostate volume, serum PSA levels, maximal urinary flow rates, and post-voiding residual urine volume. Perioperative parameters included operation time, resection weight, irrigation fluid volume during the procedure, postoperative irrigation duration, catheter duration, hospital stay, and hemoglobin and serum sodium levels before and after the operation. Patient baseline characteristics, perioperative data, and postoperative outcomes were compared and major complications were recorded.

Conventional TUR-P was performed in 39 cases with a 24 Fr Storz monopolar resectoscope (Karl Storz, Tuttlingen, Germany) with a single wire loop and Urosol (CJ, Seoul, Korea). TURIS was conducted by using the Olympus SurgMaster UES-40 bipolar generator and a 24 Fr resectoscope, and saline irrigation was performed in 19 patients. TURIS-V procedures used the same bipolar generator, and the special 'mushroom' type vapo-resection electrode was used in 15 patients. This new spherical electrode displays a plasma corona on its surface and is gradually moved into direct contact with the enlarged prostatic adenoma tissue (the 'hovering' technique), thus producing virtually bloodless vaporization at 280 W. Several prostatic fragments were resected for pathological analysis in conventional TUR-P and TURIS. Coagulation of any hemorrhagic sources was practically concomitant, while for larger vessels, hemostasis was achieved by reducing the power of the generator to 80 W. In all cases, a 22 Fr 3 way Foley catheter was placed at the end of the procedure and continuous saline irrigation was applied.

Statistical variables were analyzed with the Korean version of SPSS ver. 12.0 (SPSS Inc., Chicago, IL, USA). Comparison of preoperative and postoperative baseline values and perioperative parameters between the three groups was done by ANOVA test. The relationship of complications to operative methods was examined by using Pearson chi-square tests. Postoperative follow-up outcome parameters according to each operation method were analyzed by Student's t test between preoperative data and each scheduled follow-up time. Each statistical value was determined to have a significant difference when $p < 0.05$.

RESULTS

Among 73 consecutive patients, the 39 patients who underwent conventional TUR-P were 56 to 86 years old (Mean ± SD age, 69.79±6.33), the 19 patients treated with TURIS were 61 to 78 years old (70.16±4.32), and the 15 patients who underwent TURIS-V were 61 to 91 years old (73.40± 7.62). Average prostate volumes were 62.34±18.25 ml in the TUR-P group, 68.83±21.59 ml in the TURIS group, and 61.45±21.59 ml in TURIS-V group. The PSA level of the TUR-P group was 3.70±2.50 ng/ml, that of the TURIS group was 3.82±2.52 ng/ml, and that of the TURIS-V group was 3.35±2.01 ng/ml. There were no statistically sig-

TABLE 1. Baseline characteristics of the patients according to operation method

Characteristics	Conventional TUR-P	TURIS	TURIS-V	p-value
Number	39	19	15	
Age	69.79±6.33	70.16±4.32	73.40±7.62	0.153
Prostate volume (ml)	62.34±18.25	68.83±14.94	61.45±21.59	0.382
Serum PSA (ng/ml)	3.70±2.50	3.82±2.52	3.35±2.01	0.845
IPSS	23.77±4.41	25.26±3.31	24.47±5.10	0.462
QoL	4.33±0.74	4.05±0.91	4.20±0.86	0.462
Qmax (ml/s)	8.38±3.90	8.74±2.28	8.07±3.56	0.855
PVR (ml)	79.59±83.09	59.63±100.19	91.73±100.28	0.577
ASA score	1.44±0.55	1.79±0.42	1.80±0.41	0.12

TUR-P: transurethral resection of the prostate, TURIS: transurethral resection of the prostate in saline, TURIS-V: TURIS-plasma vaporization, PSA: prostate-specific antigen, IPSS: International Prostate Symptom Score, QoL: quality of life, Qmax: maximal urinary flow rate, PVR: postvoiding residual urine, ASA: American Society of Anesthesiologists

TABLE 2. Comparison of operative parameters, hospital courses, and postoperative complications according to operation method

	Conventional TUR-P	TURIS	TURIS-V	p-value
Operative parameter				
Operation time (min)	73.85±29.70	71.84±24.96	58.67±28.88	0.211
Resection weight (g)	12.27±8.67	16.87±6.64		0.047[a]
Irrigation fluid volume during the procedure (x3,000 ml)	9.85±3.51	10.05±3.37	7.00±3.09	0.016
Hospital course				
Postoperative irrigation duration (hr)	38.00±13.93	38.26±6.00	24.27±5.66	<0.001
Catheter duration (days)	4.26±0.99	4.05±0.40	2.80±0.41	<0.001
Hospital stay (days)	6.66±1.22	6.00±0.58	4.86±0.52	<0.001
Complication				
Transfusion (%)	3 (7.7)	1 (5.3)	0 (0)	0.538[b]
Clot retention (%)	4 (10.3)	1 (5.3)	0 (0)	0.389[b]

TUR-P: transurethral resection of the Prostate, TURIS: transurethral resection of the prostate in saline, TURIS-V: TURIS-plasma vaporization, [a]: Student's t-test, [b]: Pearson chi-square test

TABLE 3. Comparison of changes in hemoglobin and serum sodium levels before and after the operation according to operation method

	Conventional TUR-P	TURIS	TURIS-V	p-value
Hemoglobin decrease (mg/dl)	−0.77±1.33	−0.71±1.09	−0.19±1.14	0.302
Serum sodium decrease (mmol/l)	−0.05±3.30	1.46±3.42	−0.50±3.06	0.165

TUR-P: transurethral resection of the prostate, TURIS: transurethral resection of the prostate in saline, TURIS-V: TURIS-plasma vaporization

nificant differences among the 3 groups in baseline parameters (Table 1).

The mean operation times were 73.85±29.70 minutes, 71.84±24.96 minutes, and 58.67±28.88 minutes in the TUR-P group, the TURIS group, and the TURIS-V group, respectively. Although TURIS-V showed the shortest operation time, the differences between the groups were not statistically significant. The mean amount of prostatic tissue (±SD) resected was 12.27±8.67 g in the TUR-P group and 16.87±6.64 g in the TURIS group (p=0.047). TURIS-V significantly decreased irrigation fluid volume during the operation in comparison with conventional TUR-P and TURIS (p=0.016) and also significantly decreased postoperative irrigation duration, catheter duration, and hospital stay (all $p < 0.001$) (Table 2). There were three transfusions and four clot retentions in the TUR-P group, and one transfusion and one clot retention in the TURIS group. There were no complications in the TURIS-V group. There were no significant differences across the three groups in changes to hemoglobin and serum sodium levels before and after the operations (Table 3).

The follow-up data are presented in Fig. 1. All patients completed 6 months of follow-up. Compared with baseline, there were significant improvements in IPSS, QoL, Qmax, and postvoiding residual urine after surgery in all groups.

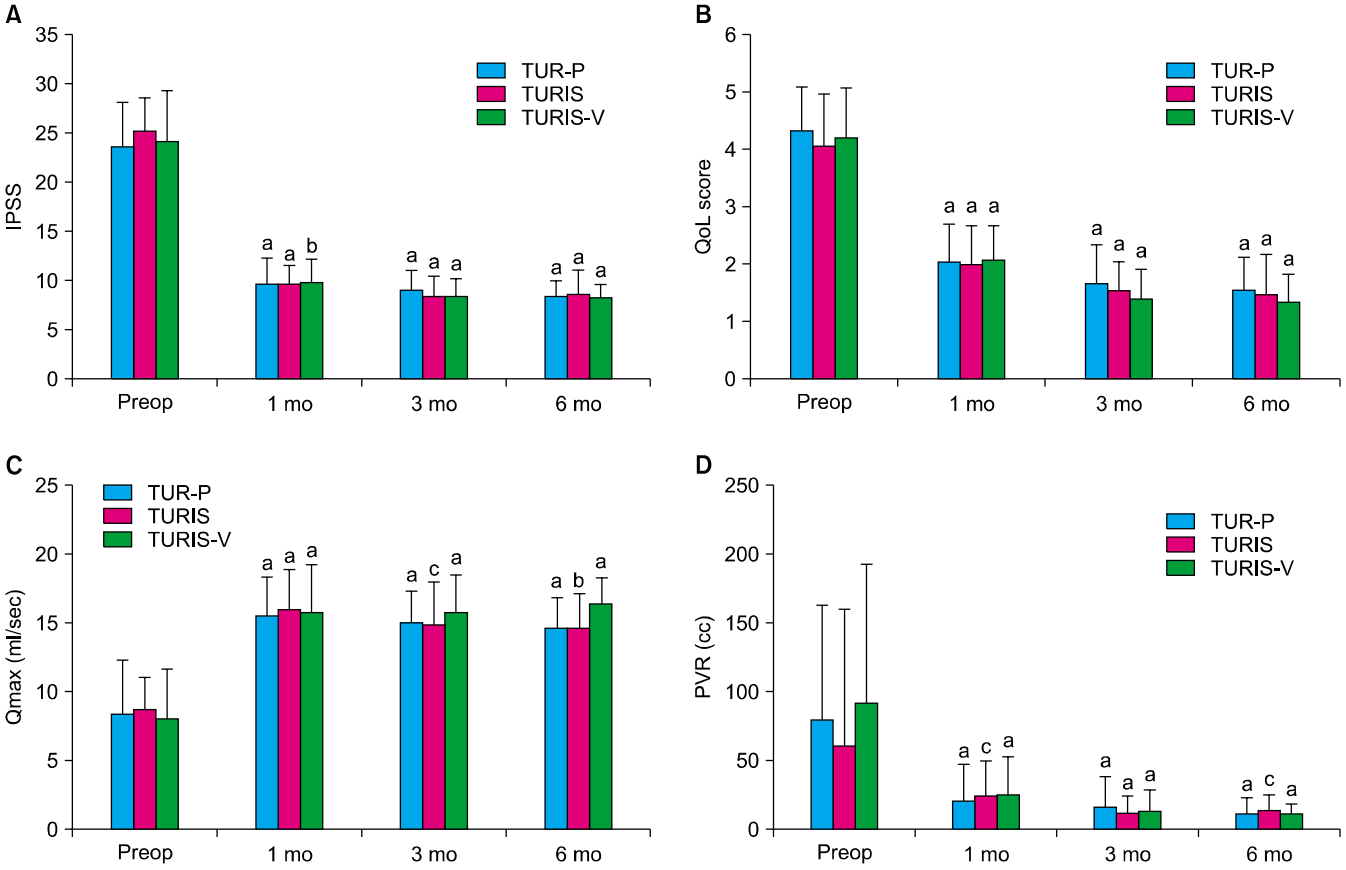

FIG. 1. Postoperative follow-up outcome parameters according to the operation methods: transurethral resection of the prostate (TUR-P), transurethral resection of the prostate in saline (TURIS), and TURIS-plasma vaporization (TURIS-V). (A) International Prostate Symptom Score (IPSS), (B) quality of life (QoL), (C) Maximal urinary flow rate (Qmax), (D) postvoiding residual urine (PVR), [a]: $p<0.01$, [b]: $p<0.05$, [c]: $p>0.05$ (preoperative value vs. present value, Student's t-test).

DISCUSSION

In the past 10 to 15 years, most men diagnosed with BPH were primarily treated medically, commonly with α-adrenergic blockers. Despite the availability of medical treatment, a significant proportion of BPH patients require surgical intervention, for which the available options range from minimally invasive techniques to open procedures. When the side effects of pharmacotherapy, such as dry mouth and orthostatic hypotension, are severe, patients may choose surgical treatment instead [10]. Surgical treatment is more effective in improving LUTS and urinary flow rate than is medical treatment [11].

In Korea during 2004 to 2008, over 3.8 million men visited clinics and were prescribed one or more BPH medications, and more than 44,000 men underwent surgical treatment. Compared with the year 2004, the number of TUR-P cases increased by a factor of 1.2 in 2008. Before 2006, TUR-P was the most commonly used surgical option, but laser therapy such as KTP vaporization for the treatment of BPH has been carried out at levels similar to TUR-P since then [12]. According to a recent online survey in the United States, the percentages of urologists performing the various types of BPH surgery are as follows: monopolar TUR-P, 73%; photoselective vaporization of the prostate (PVP), 58%; TURIS-V, 24%; bipolar TUR-P, 20%; holmium laser ablation of the prostate, 18%; thulium laser ablation of the prostate, 4%; and laparoscopic and robotic simple prostatectomy, 1% and 3% [13].

TUR-P has been considered the gold standard for the surgical treatment of BPH for many years [4]. However, the morbidity after TUR-P is significant [4,14]. In the past decade, several technologies have been developed to treat BPH with minimal risks and acceptable efficacy. Recently, the use of bipolar electrosurgical technology, TURIS, has shown lower complication rates and comparable results to standard TUR-P [8,15]. Additionally, the use of 0.9% saline as the irrigation fluid has greatly reduced the risk of TUR syndrome, owing to reduced fluid absorption [9]. Bipolar electrosurgical technology made transurethral electro-vaporization increasingly popular, especially after the development of the Gyrus PlasmaKinetic (PK) Tissue Management System (Gyrus Medical Ltd, Bucks, UK). Several studies involving plasma vaporization using the Plasma Kinetic Tissue Management System have been performed in recent years to compare the method with standard TUR-P in a prospective, randomized fashion. Hon et al reported that this technique was as effective as

TUR-P for BPH, because it provided good long-term results and incurred fewer early complications [16]. A study by Karaman et al determined favorable outcomes for plasma kinetic vaporization of the prostate during a 1-year follow-up [17]. Another study by Patankar et al described the PK Superpulse system, which provides faster removal of tissue, in a bloodless field and with better views and a safer environment of saline irrigation, and with an efficacy comparable to that of conventional TUR-P [18].

TURIS-V, using the Olympus® UES-40 Surgmaster generator (Olympus, Tokyo, Japan) and the 'mushroom' vapo-resection electrode, was recently introduced in clinical practice. The basis of TURIS-V is represented by the ability of the UES-40 bipolar electrosurgical generator to produce a plasma corona on the surface of the spherical or 'mushroom' shaped electrode. Plasma vaporization occurs by direct, gentle contact with the tissue surface and performs concomitant hemostasis. TURIS-V is associated with less bleeding during surgery than TUR-P. It also secures a better endoscopic view and less hematuria after surgery and improves the Foley catheter maintenance period. Vapo-resection brings about a remarkably smooth surface and sharp margins, with few irregularities or debris, and no supplementary thermal injury to the subjacent tissue. Due to the lack of bleeding, visibility remains excellent throughout the operation.

The merits of TURIS-V, including fast vaporization, concomitant hemostasis, and quick evacuation of the few resected tissue fragments, result in a significantly reduced operation time and increased efficacy of operations on the prostate [19]. Recently, TURIS-V was shown to represent a valuable endoscopic treatment alternative for patients with BPH, with superior efficacy, short-term results, and complication rates compared with monopolar TUR-P [19].

The present study showed that TURIS-V had the shortest operation time in comparison with conventional TUR-P and TURIS, but this difference had no statistical significance (p=0.211). However, TURIS-V significantly decreased the irrigation fluid volume used during the procedure in comparison with conventional TUR-P and TURIS. TURIS-V also significantly decreased postoperative irrigation duration, catheter duration, and the length of hospital stay.

With regard to the postoperative complications in this study, there was no significant difference in the changes in hemoglobin levels or serum sodium levels before and after surgery among the three groups. The TURIS-V group had no specific complications, but there were three transfusions and four clot retentions in the TUR-P group, and one transfusion and one clot retention in the TURIS group. There were no differences among the three groups in terms of IPSS, QoL, uroflowmetry, or residual urine during the follow-up period at 1, 3, and 6 months postoperatively, demonstrating the comparable efficacy of the three techniques. In addition, significant improvements in the subjective and objective voiding parameters were achieved in all groups, and these improvements were sustained for the period under observation.

In Korea, laser therapy such as KTP vaporization for the treatment of BPH has been carried out as frequently as TUR-P since 2006 [12]. The Korea health care system applies similar medical insurance fees to TUR-P and PVP. The medical insurance fee of TURIS-V is equal to that of TUR-P in Korea. The treatment effects of TURIS-V are similar to those of TUR-P, and the safety of TURIS-V is similar to that of PVP by laser. However, TURIS-V may be more cost-effective than PVP by laser owing to the relative prices of the system equipment.

This study had the limitations of being a retrospective observational study with a small sample size, which imposed limitations on statistical power. However, we know there are few reports about the efficacy and safety of TURIS-V in Korea. This pilot study showed the trends that TURIS-V significantly improved objective and subjective urination symptoms, even in patients with prostate volumes of 60 ml or more. TURIS-V significantly decreased the irrigation fluid volume used during the operations in comparison with conventional TUR-P and TURIS and also significantly decreased postoperative irrigation duration, catheter duration, and hospital stay. Further studies of the efficacy and safety of TURIS-V are warranted to explore and validate the benefits for urologists.

CONCLUSIONS

In this pilot study, we confirmed that TURIS and TURIS-V were effective surgical treatments for BPH in addition to conventional TUR-P, and TURIS-V was not inferior to conventional TUR-P and TURIS for safety. TURIS-V represents a promising endoscopic treatment alternative for patients with BPH, showing good efficacy, reduced morbidity, fast recovery, and satisfactory follow-up. Our results suggest that further studies with a prospective randomized design and a long-term follow-up are warranted.

Conflicts of Interest

The authors have nothing to disclose.

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