Original Article

Transurethral Anatomical Enucleation of Prostate (TUAEP) in Benign Prostatic Hyperplasia with Bipolar System: First Study in Thailand

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Objective: To evaluate the outcomes and safety of the surgical technique transurethral anatomical enucleation of prostate (TUAEP) in patients with prostatic hyperplasia for whom surgery was indicated.

Materials and Methods: The authors conducted a retrospective pilot study and analyzed the medical records of 80 patients who underwent TUAEP by a single surgeon between December 2016 and January 2018 in the Minimally-Invasive Surgery (MIS)-Urology Department in Rajavithi Hospital. Only 40 cases had complete review data, and these were included in the present study. The authors analyzed International Prostate Symptom Score, quality of life score, peak flow rate, and post-void residual urine volume pre-operatively, and then 1, 3 and 6 months postoperatively. The TUERP operative time, enucleated tissue weight, catheterization time, and post-operative complications were recorded.

Results: The participants' mean age was 70.90±5.55 years. There were statistically significant differences between mean preoperative and postoperative hemoglobin (13.36±1.49 and 12.42±1.57), and hematocrit (%) (41.13±3.54 and 38.73±4.41), $p<0.01$. Mean blood transfusion was 0.10±0.37 units, mean prostatic specific antigen (PSA) decreased from 7.50 (0.90 to 35.50) postoperatively ($p<0.001$) to PSA 1.13±0.78 ng/ml at 3 months postoperatively ($p<0.02$) and to PSA 1.54±0.78 ng/ml at 6 months postoperatively ($p<0.01$). Maximum flow rate (Qmax), post void residual urine (PVR), international prostatic symptoms score (I-PSS) and quality of life (QOL) score improved significantly immediately after surgery and continued to improve up to follow-up at 6 months ($p = 0.01$). At 6 months, mean Qmax had increased from 9.05 to 21.19 ml/sec ($p<0.01$) and mean PVR had decreased from 124.30 to 61 ml ($p<0.03$). Mean I-PSS improved from 17.82 to 1.54 ($p<0.01$) and mean QOL score improved from 3.97 to 0.92 ($p<0.01$). There were no serious complications or incidences of TURP syndrome in any patient in the present study.

Conclusion: TUAEP is a true anatomical enucleation and seems to be the best modern alternative to transurethral resection of the prostate and open prostatectomy for bladder outlet obstruction caused by benign prostatic hyperplasia. The long-term results in terms of efficacy and safety need to be validated in further prospective randomized controlled studies.

Keywords: Prostate, Prostatic hyperplasia, Transurethral enucleation of prostate, Transurethral anatomical, Transurethral resection of prostate, Surgical procedures, Minimally invasive, TUAEP, TUERP

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The first resectoscope and transurethral resection of the prostate (TURP) was introduced in 1926 by Maximilian Stern, allowing him to cut slithers of prostate tissue with a tungsten loop under direct vision. Since then, Monopolar-TURP (M-TURP) has evolved and remains the gold standard and comparator for surgical treatment of benign prostatic obstruction because of its excellent, well-documented, and long-term efficacy[1]. To the present day, it remains the standard therapy for obstructive prostatic hypertrophy, and it is the surgical treatment of choice and the standard of care when other methods fail. TURP has long been the standard treatment, but it still has some limitations, especially when resection size is over 80 ml[2,3], such as bleeding and transurethral resection of prostate (TURP) syndrome[4,5] which can cause serious complications. The bipolar TURP system was introduced to reduce the risk of TURP syndrome, but it does not reduce the risk of intra-operative bleeding, especially in large prostate glands[6-8]. Currently, the developing technique of transurethral enucleation and resection of prostate (TUERP) using the bipolar system can remove prostate tissue after enucleation by resection of small pieces. This technique reduces the limitation in terms of size and bleeding of conventional bipolar TURP[9-11]. This article aims to study outcomes of TUAEP, especially its technical points, functional results, and complications.

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Materials and Methods

The study was approved by the Research Ethics Committee of Rajavithi Hospital. The authors performed a

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retrospective review of the first 80 consecutive patients who underwent TUERP with the same surgeon for hyperplasia of prostate between December 2016 and January 2018 at MIS-Urology Rajavithi Hospital. Only 40 cases met the inclusion criteria to enable complete data collection for this research. Exclusion criteria were neurogenic bladder, history of adenocarcinoma of the prostate, urethral stricture or any previous prostatic, bladder neck or urethral surgery and loss to follow-up. The authors recorded and analyzed data including mean age, International Prostate Symptom Score, quality of life score, peak flow rate and post-void residual urine volume pre-operatively, and then 1, 3 and 6 months postoperatively. The TUAEP operative time, enucleated tissue weight, catheterization time and post-operative complications were also recorded. The authors followed the technique of TUERP described by Liu[13] with some modifications for TUAEP. The procedure was performed by a single surgeon and the instrument used was a 27Fr resectoscope with bipolar loop. Normal saline served as irrigation fluid. Under general or regional anesthesia, the patient was placed in the lithotomy position. The 27Fr resectoscope was placed in the bladder under a video-assisted endourological system, and the ureteral orifices, bladder neck and verumontanum were identified. The enucleation was begun close to the verumontanum from the 5 to the 3 o'clock positions, and the urethral mucosa was split deep to the level of the surgical capsule (Figure 1). After identification of the level of surgical capsule that was the marker for depth level during enucleation, the distal mid lobe and mucosa were dissected in retrograde fashion toward the bladder neck by the resectoscope tip enucleation technique. The loop was used to coagulate at bleeding points. Thus, adenoma of the distal mid lobe was detached from the surgical capsule, and the smooth surgical capsule was identified. The partial mid lobe was raised, and the procedure progressed toward the bladder neck until the circular fiber of the bladder neck was identified (Figure 2). After complete separation of the median lobe from the surgical capsule and both lateral lobes, the piece of median lobe was pushed to float into the bladder. The left lateral lobe's enucleation was started from the 5 to the 12 o'clock positions, and the prostate adenoma was split from the surgical capsule (Figure 3). The right lobe was treated in the same fashion from the 7 to the 12 o'clock position toward the bladder neck by the resectoscope tip enucleation technique (Figure 4), and the loop electrode was used to coagulate the bleeding point. At this point of enucleation, there remained only three points at which the prostate was attached to the prostatic adenoma fossa: the bladder neck at the 5 and 7 o'clock positions, and the urethral mucosa at 12 o'clock, close to the external sphincter (Figure 5). The

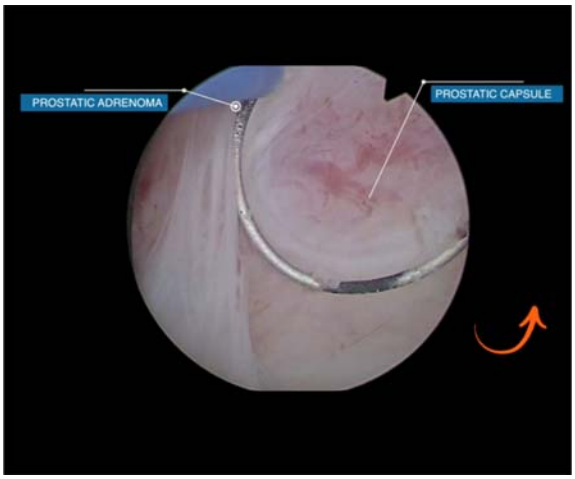

Figure. 1 Identified plain of surgical capsule.

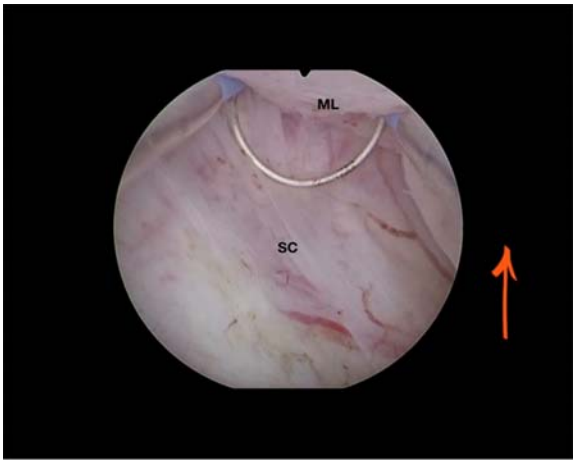

Figure. 2 Identified plain and enucleated median lobe (ML) and surgical capsule (SC).

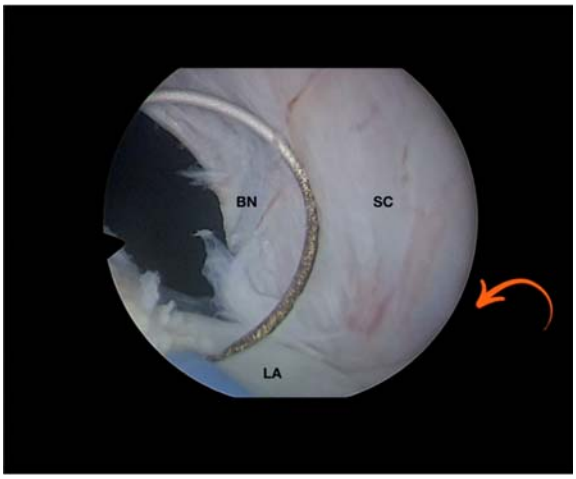

Figure. 3 Enucleated left adenoma (LA) until bladder neck (BN).

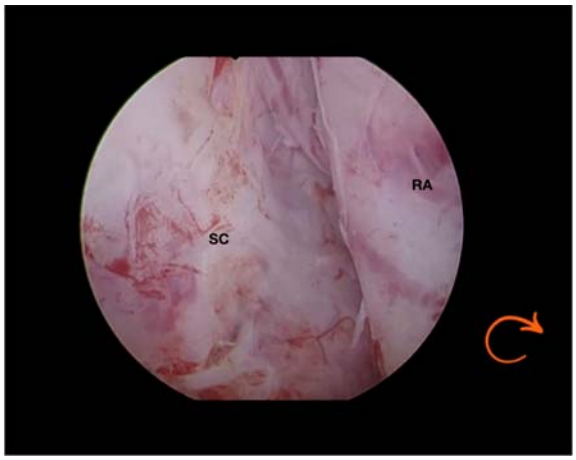

Figure. 4 Enucleated right adenoma (RA).

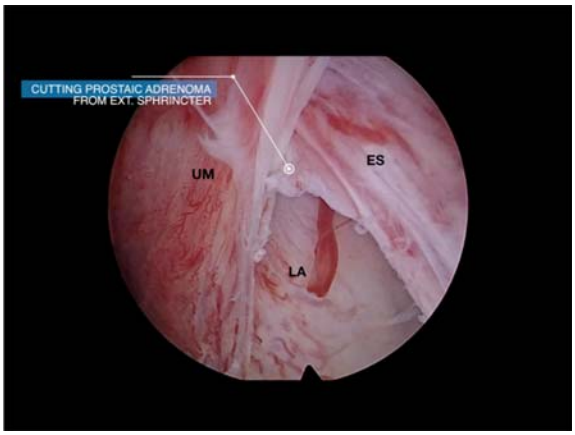

Figure. 5 Identified plain of external sphincter (ES), urethal mucosa (UM).

three points of attachment were cut by the loop on the urethral mucosa at 12 o'clock taking care not to damage the external urethral sphincter beneath the urethral mucosa and cutting at both points of attachment on the bladder neck to free the adenoma completely (Figure 6). After completing enucleation, the author used the tip of the resectoscope to push all adenoma to float into the bladder (Figure 7). In the final step, a morcellator was used to remove the floating adenoma from the bladder and insert a three-way Foley catheter with continuous bladder irrigation by normal saline (Figure. 8 to 10). There was no need for traction of Foley catheter in the present study. The authors recorded all demographic data, pre-operative and postoperative international prostatic symptoms score (I-PSS) and Quality of life (QOL) score, prostate specific antigen (PSA) level, maximum flow rate (Qmax), and post-void residual urine (PVR), at 1, 3 and 6 months postoperatively. The operative time, intra-operative and postoperative complications, blood transfusion rate, and

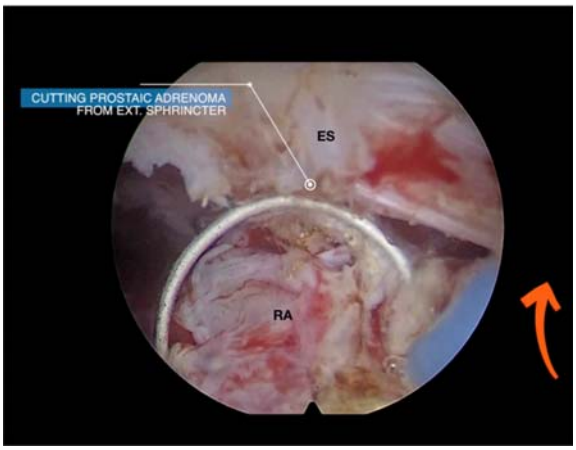

Figure. 6 Identified plain of external sphincter (ES) and cut urethal mucosa (UM).

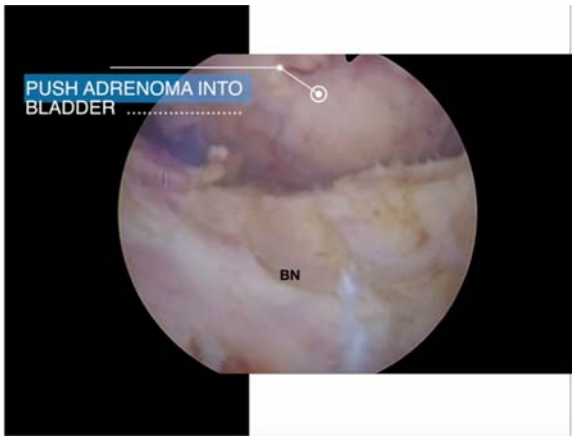

Figure. 7 Push adenoma into bladder, bladder neck (BN).

pain control were recorded. After TUERP evaluations were done in all patients at follow-up visits at 1, 3 and 6 months postoperatively, mean PSA, Qmax, PVR, I-PSS and QOL scores were compared with pre-operative values using the paired Student t-test, with $p<0.050$ considered significant, and Chi-square test for non-continuous data. The IBM SPSS Statistics version 22.0 was used.

Results

The demographic data of patients who underwent TUAEP are shown in Table 1. Mean age was 70.90±5.55 years. Twenty percent of participants had DM, 62.5% had hypertension, and 5.0% had heart disease. Pre-operative scores were as follows: mean IPSS score was 17.80±6.93; QOL was 3.97±1.18; Qmax was 9.05±3.31 ml/sec; PVR was 124.30±98.95 ml; and TRUS volume was 56.01 (21 to 110 gm). Resection tissue weight was 42.32±26.99 gm, operative

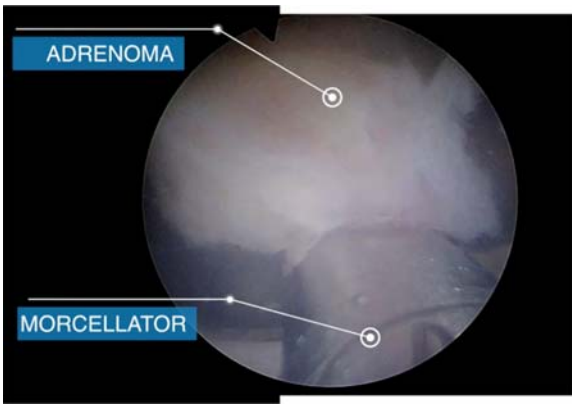

Figure. 8 Morcellator removed adenoma.

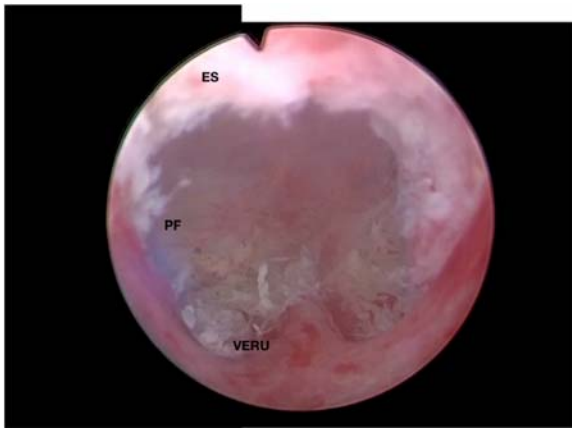

Figure. 9 Check external sphincter (ES), prostatic fossa (PF), verumontanum (VERU).

time was 108.05±54.48 min, PSA level was 7.50±7.23 ng/ml, and length of stay was 3.45±2.112 days. There were statistically significant differences between mean pre-operative and postoperative hemoglobin (13.36±1.49 and 12.42±1.57) and hematocrit (%) (41.13±3.54 and 38.73± 4.41), $p<0.010$. Mean blood transfusion was 0.10±0.37 units, Mean PSA had decreased from 7.50 (0.90 to 35.50) postoperatively ($p<0.001$), to 1.13±0.78 ng/ml at 3 months postoperatively ($p<0.020$), and to 1.54±0.78 ng/ml at 6 months postoperatively ($p<0.010$). Pathological examination of enucleated tissue revealed BPH in all patients. Qmax, PVR, I-PSS and QOL score improved significantly immediately after surgery and continued to improve during follow-up to 6 months postoperatively ($p = 0.010$) (Table 2). At 6 months, mean Qmax had increased from 9.05 to 21.19 ml/sec ($p<0.010$), and mean PVR had decreased from 124.30 to 61 ml ($p<0.030$). Mean I-PSS improved from 17.82 to 1.54 ($p<0.010$), and mean QOL score improved from 3.97 to 0.92 ($p<0.010$). There were no serious complications or instances of TURP syndrome in any patient in the present study. The total rate of complications was 20%: acute urinary retention 5.0%; urinary tract infection 5.0%; subtrigonal injury 2.5%; urgency incontinence 5.0%; and hematuria 2.5%.

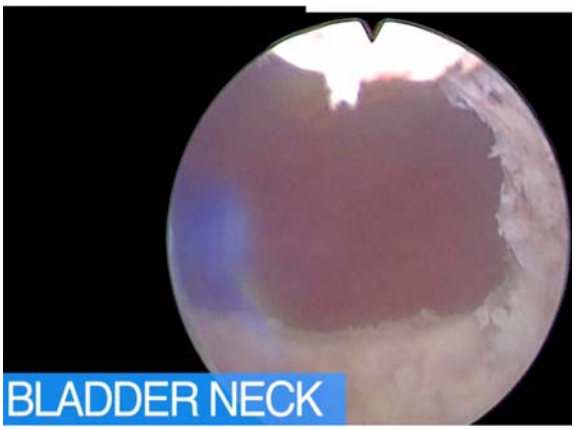

Figure. 10 Preserve bladder neck.

Table 1. preoperative and perioperative data

Data	n	Mean ± SD
Age (years)	40	70.90±5.55
Pre-op IPSS	40	17.83±6.93
Pre-op QOL	40	3.98±1.18
Pre-op QMAX (cc/sec)	21	9.05±3.31
Pre-op PVR (ml)	13	124.31±98.95
Pre-op PSA (ng/ml)	38	7.51±7.23
Pre-op TRUS volume (gm)	12	56.01±25.83
Operative time (min)	40	108.05±54.48
Catherization (days)	40	3.45±2.11
Resection weight (kg)	40	42.33±26.99
Length of stay (days)	40	3.45±2.11

Values are represented as mean±SD

Discussion

After open prostatectomy was first performed using enucleation, M-Turp became the new standard treatment for benign prostatic hyperplasia, and it remains so today; however, it still has limitations because of its attendant complications which include bleeding, transurethral resection (TURP) syndrome, extravasation and bladder neck stenosis, and complication rates as high as 11.1% were reported in a prospective study of 10,564 men[12]. The bipolar TURP system can reduce the risk of TURP syndrome, but it is still restricted in terms of the size of prostate that can be treated. The TUAEP is a new surgical technique that is a combination of enucleation in open simple prostatectomy and endoscopic treatment of prostate with bipolar systems. TUAEP is anatomical enucleation using the tip of a resectoscope in a similar fashion to index finger enucleation in open simple prostatectomy, pushing the entire gland into the bladder and removing prostatic tissue with a morcellator. As TUAEP is a

Table 2. Post-operative outcomes

Data	n	Mean ± SD Qmax (ml/sec)	Mean ± SD PVR (ml)	Mean ± SD IPSS	Mean ± SD QOL	*p*-value
Pre-op	40	9.05±3.31	124.31±98.95	17.83±6.93	3.98±1.19	
Follow-up						
1 Month	40	22.39±8.34	55.59±75.92	6.47±4.08	1.47±1.03	<0.001*
3 Month	40	20.26±8.85	36.26±31.43	5.62±4.09	1.07±0.97	<0.001*
6 Month	40	21.59±8.44	42.64±51.07	4.55±2.94	0.92±0.88	<0.001*

Values are represented as mean ± SD
* = Significant at $p<0.05$

new surgical technique, there are many issues that need to be addressed regarding areas such as its feasibility, safety and cost-effectiveness. Neill et al, who first reported bipolar prostate enucleation, concluded that the technique was safe and technically feasible for BPH[13]. Lui's retrospective study of 1,000 cases who underwent TUERP confirmed the immediate, durable effects of this technique. Of 1,100 patients 1,057 (96%) voided easily and smoothly after urethral catheter removal without obvious complaints. At follow-up, mean PSA had decreased from 7.50 (0.90 to 35.50) to 1.54±0.78 ng/ml after 6 months, and a mean improvement of up to 24.8 ml per second was seen in Qmax with a 90.8% decrease in PVR, a 78.7% decrease in I-PSS, and a 67.4% improvement in the QOL score compared to preoperative baseline data[14]. In the present study, after 6 months mean Qmax had increased from 9.05 to 21.19 ml/sec ($p<0.010$) and mean PVR had decreased from 124.30 to 61 ml ($p<0.030$). Mean I-PSS improved from 17.82 to 1.54 ($p<0.010$) and mean QOL score improved from 3.97 to 0.92 ($p<0.010$). These dramatic improvements and outcomes were most likely due to more complete adenoma removed, especially the in apical lobe. In the present study TUAEP proved to be a valid, safe treatment for any size prostate. The largest gland treated with TUAEP at our institution was 110 gm. The incidence of incontinence may be higher after the nucleation procedure than after TURP due to the excessive removal of the distal urethral mucosa, and it is important to take special precautions to ensure that the external sphincter beneath the distal urethral mucosa is not damaged. A recent study showed an incidence of transient incontinence of 13.6% for TUERP compared to 4.7% for TURP[15]. However, most patients recovered with time with the help of pelvic floor exercise. Initial circumferential incision of the mucosa around the apex of the prostate and enucleating towards the bladder neck in a retrograde fashion, may help to cut down on the incidence of temporary stress incontinence[15]. In the present study, the urgency incontinence rate was about 5.0% and complete recovery was achieved within one month. The total complication rate was twenty percent: acute urinary retention (5.0%) was managed by retaining foley catheter for three more days; urinary tract infections (5.0%) were managed by oral antibiotic 7 to 14 days and case review related with acute urinary retention (AUR) and urinary tract infection (UTI) before surgery; subtrigonal injury (2.5%) was managed by prolonging catheter use by fourteen more days; and hematuria 2.5% occurred two days after discharge because of the patient's straining to lift a heavy object. In the present study no patient had any serious complications or incidence of TURP syndrome.

Conclusion

While monopolar TURP has been the gold standard surgical treatment for BPO, it has certain disadvantages, namely bleeding, TUR syndrome and incompleteness of resection. Various techniques and technology have evolved over the last 2 decades, and surgeons have a wide range of choice for improvement. In addition to being safe and effective in relieving obstruction, their effectiveness should also be durable. With the advent of bipolar technology, bleeding and TURP syndrome incidences are much less frequent; however, incompleteness of resection remains a problem. Enucleation of prostate adenoma by TUAEP or TUERP greatly increases the likelihood that most obstructing adenomas are removed. The future adoption of these techniques is likely to be influenced by their costs and learning curve, and randomized control trials are needed to confirm the benefits and long term outcomes of these new techniques.

What is already known on this topic?

Monopolar TURP is the standard endoscopic treatment of hyperplasia of prostate for patients for whom surgery is indicated, but it still entails serious complications (TURP syndrome). Bipolar TURP can reduce the risk of TURP syndrome, but it is still limited in terms of the size of prostate gland that can be treated.

What this study adds?

TUAEP is a technique which was developed from TUERP for true anatomical enucleation. The TUERP reduced blood loss and limitations of size of prostate gland, but it has a lengthy resection operative for removal of prostatic tissue. The TUAEP can reduce the resection operative time by using a morcellator to remove all lobes of the prostate gland floating in the urinary bladder.

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Potential conflicts of interest

The authors declare no conflicts of interest.

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