Early postoperative outcome of bipolar transurethral enucleation and resection of the prostate

CL Cho *, Clarence LH Leung, Wayne KW Chan, Ringo WH Chu, IC Law

ABSTRACT

Objectives: To report the early postoperative outcome of bipolar transurethral enucleation and resection of the prostate. Our results were compared with those published from various centres.

Design: Case series.

Setting: Regional hospital, Hong Kong.

Patients: A total of 28 consecutive patients who had undergone bipolar transurethral enucleation and resection of the prostate by a single surgeon between January and June 2014. All patients were evaluated preoperatively by physical examination, digital rectal examination, transrectal ultrasonography, and laboratory studies, including measurement of haemoglobin, sodium, and prostate-specific antigen levels. Patients were assessed perioperatively and at 4 weeks and 3 months postoperatively.

Results: The mean resected specimen weight of prostatic adenoma in 28 patients was 48.2 g with a mean enucleation and resection time of 13.6 and 47.7 minutes, respectively. There was a mean decrease in serum prostate-specific antigen by 85.9% (from 6.4 ng/mL to 0.9 ng/mL) postoperatively. Prostate volume was decreased by 68.2% (from 71.9 cm^3 to 22.9 cm^3) at 4 weeks postoperatively. The mean postoperative haemoglobin drop was 11.5 g/L. The rate of transient urinary incontinence at 3 months was 3.6%. Patients who underwent bipolar transurethral enucleation and resection of the prostate had a short catheterisation time and hospital stay, which is comparable to conventional transurethral resection of the prostate.

Conclusions: Bipolar transurethral enucleation and resection of the prostate should become the endourological equivalent to open adenomectomy with fewer complications and short convalescence. The technique of bipolar transurethral enucleation and resection of the prostate can be acquired safely with a relatively short learning curve.

▸ A video clip showing transurethral enucleation and resection of the prostate technique is available at <www.hkmj.org>.

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CL Cho *, FRCSEd (Urol), FHKAM (Surgery)
CLH Leung, MRCSEd
WKW Chan, FRCSEd (Urol)
RWH Chu, FRCSEd (Urol), FHKAM (Surgery)
IC Law, FRCSEd (Urol), FHKAM (Surgery)

Division of Urology, Department of Surgery, Kwong Wah Hospital, Yaumatei, Hong Kong

* Corresponding author: chochaklam@yahoo.com.hk

New knowledge added by this study

- Bipolar transurethral enucleation and resection of the prostate (TUERP) achieves satisfactory early functional outcomes and is associated with low morbidity. The technique is applicable to prostates of all size.
- Outcomes comparable with large case series could be achieved with a short learning curve.

Implications for clinical practice or policy

- Bipolar TUERP should be the technique of choice for a large-sized prostate.
- Bipolar TUERP is an alternative to conventional transurethral resection for small and medium-sized prostates.

Introduction

Despite the availability of numerous minimally invasive techniques, transurethral resection of the prostate (TURP) remains the most common surgical treatment for lower urinary tract symptoms (LUTS) caused by benign prostatic enlargement (BPE) in small to medium-sized prostates.[1] Nonetheless, TURP has been associated with significant complication rates.[2]

Bipolar TURP uses saline irrigation, which decreases the risk of TURP syndrome compared with monopolar TURP, and both bipolar and monopolar TURP result in comparable functional outcomes.[3] The bipolar system can also be broadened to enucleate the prostate gland along the surgical capsule, using a resectoscope combined with a loop. This transurethral enucleation and resection of the prostate (TUERP) technique can potentially remove more prostatic tissue than TURP and requires no additional devices.

In the present study, we describe the technique and early postoperative outcomes of bipolar TUERP and compare our results with major international series.

Methods

Patients

Between January 2014 and June 2014, 28 consecutive patients underwent bipolar TUERP at Kwong Wah Hospital, Hong Kong. All patients were evaluated preoperatively by physical examination, digital rectal examination, transrectal ultrasonography (TRUS) of the prostate, and laboratory studies that included measurement of haemoglobin, sodium, and prostate-specific antigen (PSA). Patients were offered the option of ultrasound-guided transrectal prostate biopsy if the PSA level was >4 ng/mL or if the digital rectal examination showed suspicion of prostate cancer. Abnormal digital rectal examination findings included prostate nodule, asymmetry of the lateral lobes, or irregularity of the prostate. The TRUS was performed to measure the maximum length, width, and anteroposterior height of the prostate to calculate the prostate volume using the ellipse formula, where prostate volume (mL) = 0.52 x length x width x height. Patient baseline characteristics, indications for surgery, and operative data and complications were recorded by doctors. Patients with neurogenic bladder, previous genitourinary tract surgery, urethral stricture, or known bladder or prostate carcinoma were excluded from the technique of bipolar TUERP.

經尿道前列腺等離子雙極電切剜除術的術後早期結果

曹澤霖、梁樂希、陳冠衛、朱永康、羅賢澤

目的：報告經尿道前列腺等離子雙極電切剜除術的術後早期結果，並與文獻記載的其他研究結果進行比較分析。

設計：病例系列研究。

安排：香港一所分區醫院。

患者：2014年1月至6月期間由一位外科醫生進行經尿道前列腺等離子雙極電切剜除術的所有28名患者。他們均於術前接受體格檢查、直腸指檢、經直腸超聲檢查，並經實驗室化驗的血紅蛋白、鈉和前列腺特異性抗原水平評估。患者在圍手術期間，以及術後4星期及3個月接受評估。

結果：28名患者被切除前列腺腺瘤的平均重量為48.2 g。剜除術平均需時13.6分鐘，切除術則需時47.7分鐘。血清前列腺特異性抗原水平由術前6.4 ng/mL減至術後的0.9 ng/mL，下降幅度為85.9%。前列腺體積則由術前71.9 cm^3減至術後4星期的22.9 cm^3，下降幅度為68.2%。術後平均血紅蛋白水平降至11.5 g/L。術後3個月的短暫性尿失禁的發生率為3.6%。接受經尿道前列腺等離子雙極電切剜除術的患者有較短插管時間和住院時間，可媲美傳統的經尿道前列腺切除術。

結論：經尿道前列腺等離子雙極電切剜除術可媲美開放式腺瘤切除術，而且併發症較少，復原期也較快。這種切剜除術安全性高，學習曲線也相對較短。

Equipment and technique

All bipolar TUERP procedures were performed by a single surgeon. This surgeon had performed 37 TUERPs using various techniques and devices previously, before the procedure was standardised as described below and shown in Figure 1. The technique used in this report was first described by and adopted from Prof CX Liu at Zhujiang Hospital of Southern Medical University in Guangzhou.[4]

Antiplatelet medications were stopped 3 days prior to surgery. Patients received general or spinal anaesthesia and were placed in the lithotomy position. Bladder stones where present were fragmented with a holmium laser via a 21-Fr rigid cystoscope and were evacuated with an Ellik evacuator before bipolar TUERP. A 26-Fr Olympus SurgMaster TURis resectoscope (Olympus Europe, Hamburg, Germany) with a standard loop was used. The incision was begun immediately proximal to the verumontanum using a cutting current. The surgical capsule plane was identified, and the whole gland dissected in a retrograde fashion from the cleavage plane using the resectoscope sheath, until the circular fibres of the bladder neck were identified. The loop electrode was used to coagulate all of the denuded vessels immediately during the detachment process. The adenoma was subtotally enucleated with a narrow pedicle attached to the bladder neck at the 6 o'clock position. The devascularised adenoma was rapidly resected in pieces by the loop electrode. The bladder neck at 5 to 7 o'clock was removed if it appeared relatively high. The anterior commissure at 12 o'clock was preserved except when it appeared obstructive endoscopically. The chips were evacuated with an Ellik evacuator. Finally, the prostatic fossa was inspected and haemostasis secured. A 24-Fr three-way urethral catheter was inserted at the end of the procedure for bladder irrigation. One of the patients in the series had open inguinal hernia repair performed after bipolar TUERP. Haemoglobin level and serum sodium concentration were measured on the same day after surgery. The protocol for postoperative care following bipolar TUERP was the same as that for monopolar and bipolar TURP in our unit. Bladder irrigation was stopped the following morning, and the catheter was removed on the second day postoperatively.

Follow-up

All patients were evaluated following bipolar TUERP during clinic visits at 4 weeks and 3 months. At each visit, history, physical examination, International Prostate Symptom Score (IPSS), and TRUS of the prostate were evaluated. The presence or absence of transient urinary incontinence was documented with direct questioning of the patient. Uroflowmetry was performed at 8 weeks, and serum PSA levels were measured at 3 months.

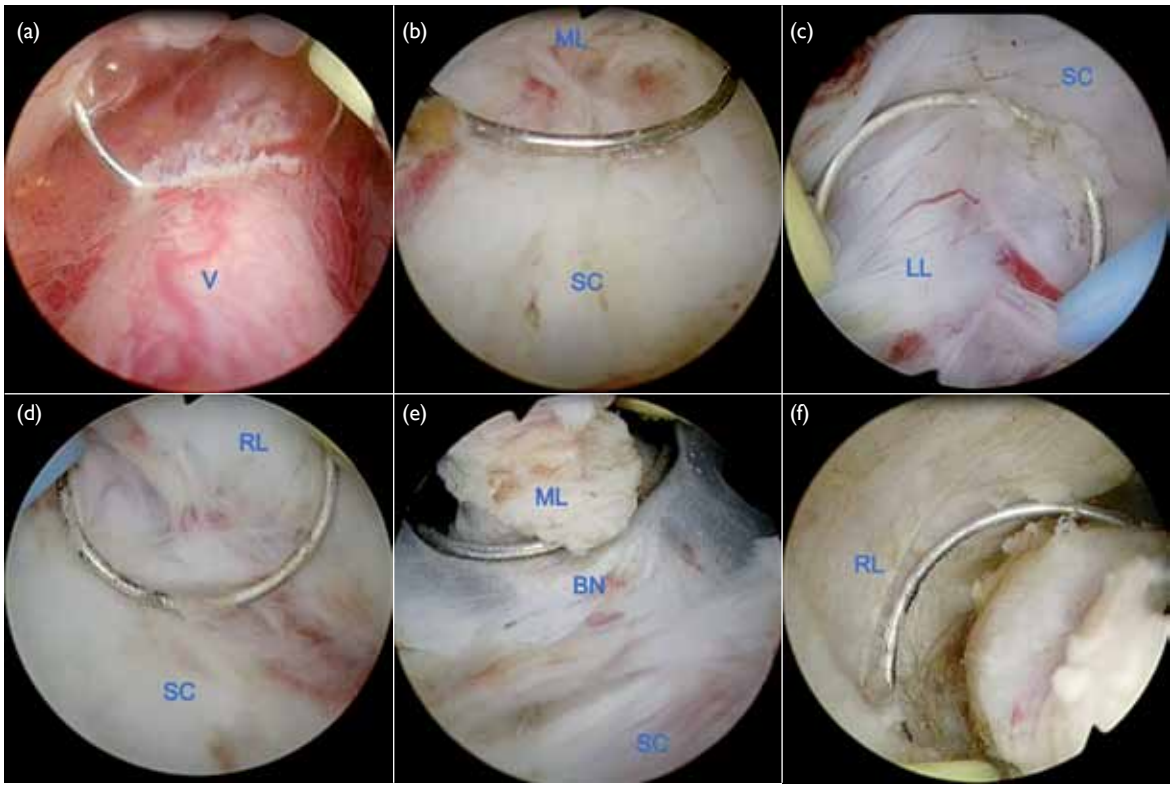

FIG 1. Operative steps of bipolar transurethral enucleation and resection of the prostate
(a) Incision starts close to verumontanum (V). (b) Distal median lobe (ML) is dissected from surgical capsule (SC). (c and d) Left and right lateral lobes (LL and RL) are detached from surgical capsule by resectoscope sheath and denuded vessels are cauterised. (e) Median lobe is detached from bladder neck (BN) by loop electrode. (f) Subtotally enucleated right lobe is resected rapidly without haemorrhage

Results

Table 1 lists the patients' baseline characteristics, operative data, and early postoperative outcomes. Enucleation time was defined as the time from incision to completion of subtotal enucleation of the adenomatous tissue. Resection time was defined as the time needed for fragmentation of the en-bloc adenoma into chips. The mean enucleation and resection times were 13.6 (median, 15; range, 10-30) minutes and 47.7 (median, 35; range, 15-120) minutes, respectively, with a mean of 48.2 g of adenoma resected.

The mean PSA level decreased from 6.4 ng/mL to 0.9 ng/mL at 3 months postoperatively, representing an 85.9% decrease. Pathological examination of enucleated tissue revealed prostatic adenocarcinoma in one patient who had T1a disease with a Gleason score of 6; the serum PSA level decreased from 4.6 ng/mL to 1.7 ng/mL in this patient. There was a significant decrease in mean TRUS volume from 71.9 cm^3 to 22.9 cm^3 at 4 weeks and to 15.1 cm^3 at 3 months postoperatively, corresponding to decreases of 68.2% and 79.0% at 4 weeks and 3 months, respectively.

More than half of the patients in our series (16 of 28 patients) presented with refractory acute urinary retention or obstructive uropathy and had required catheterisation prior to surgery. Preoperative uroflowmetry within the last year was available in only 15 patients, thus comparison between preoperative and postoperative urodynamic parameters was less representative. The mean peak urinary flow rate was 20.9 mL/s, and the mean post-void residual was 31.6 mL at 8 weeks postoperatively. The mean IPSS was 9.4, and the mean quality-of-life score was 1.9 at 4 weeks.

There was no requirement for blood transfusion nor incidence of clot retention in any patient. The mean decrease in haemoglobin was 11.5 g/L. Urinary tract infection presenting as acute epididymitis was noted in two (7.1%) patients. One (3.6%) patient required re-catheterisation on day 2 postoperatively and was successfully weaned off the catheter on day 5. Transient urinary incontinence was noted in three patients and one patient at 1 and 3 months postoperatively, respectively (10.7% at 1 month and 3.6% at 3 months). An average of two incontinence pads were required daily, and all cases of transient urinary incontinence subsided within 4 months. No urethral stricture, meatal stenosis, or bladder neck contracture was noted at 3 months.

TABLE 1. Baseline characteristics, operative data, and early postoperative outcomes in patients with transurethral enucleation and resection of the prostate

	Mean ± SD (range)
Age (years)	69.4 ± 7.0 (54-82)
Preoperative	
PSA (ng/mL)	6.4 ± 4.0 (1.8-15.9)
TRUS volume (cm^3)	71.9 ± 33.5 (30.0-199.6)
Haemoglobin (g/L)	135.0 ± 17.0 (94-163)
Serum sodium (mmol/L)	138.0 ± 1.6 (135-141)
Qmax (mL/s)*	9.2 ± 3.7 (4.2-16.0)
PVR (mL)*	100.7 ± 92.2 (5-381)
Operative	
Theatre time (mins)	86.1 ± 37.1 (35-180)
Enucleation time (mins)	13.6 ± 5.0 (10-30)
Resection time (mins)	47.7 ± 26.0 (15-120)
Resected prostate weight (g)	48.2 ± 26.8 (14-120)
Pathological specimen weight (g)	51.3 ± 22.8 (16-108)
Decrease in haemoglobin (g/L)	11.5 ± 14.0
Change in serum sodium (mmol/L)	1.6 ± 2.3
Catheter time (hours)	45.3 ± 16.6
Hospitalisation time (days)	2.3 ± 0.8
Postoperative	
PSA at 3 months (ng/mL)	0.9 ± 0.6 (0.2-2.2)
TRUS volume at 4 weeks (cm^3)	22.9 ± 8.4 (10.6-48.9)
TRUS volume at 3 months (cm^3)	15.1 ± 4.0 (7.8-20.9)
Qmax (mL/s) at 8 weeks	20.9 ± 12.8 (2.0-60.0)
PVR (mL) at 8 weeks	31.6 ± 20.7 (0-87)
IPSS at 4 weeks	9.4 ± 5.1
QoL at 4 weeks	1.9 ± 1.3

Abbreviations: IPSS = International Prostate Symptom Score; PSA = prostate-specific antigen; PVR = post-void residual; Qmax = mean peak urinary flow rate; QoL = quality of life; SD = standard deviation; TRUS = transrectal ultrasonography

* Data from 15 patients who had preoperative uroflowmetry performed

Discussion

The TURP has been considered the standard surgical therapy for LUTS caused by BPE. Despite improvements in equipment and techniques over the years, TURP remains associated with significant morbidity and re-treatment rates, particularly in patients with a large prostate.[5] Open prostatectomy (OP) is therefore still considered a valid option for patients with a prostate of >80 g.[6]

Surgical enucleation for the treatment of LUTS caused by BPE remains the most complete method to remove adenomas of any size; the history of surgical enucleation dates back more than 100 years.[7] In spite of the low re-operation rate and high success rate, OP is an invasive procedure associated with higher transfusion rates, longer catheterisation time, and longer hospital stay. As a result, the popularity of OP has declined.

The concept of surgical enucleation was revisited with the advent of endoscopic alternatives to open enucleation. Endoscopic enucleation allows for maximal removal of the adenoma and results in potentially equivalent efficacy compared with its open counterpart, with significantly lower morbidity. Holmium laser enucleation of the prostate (HoLEP) was the first endoscopic enucleative technique described.[8] This technique has been compared with OP and TURP in various randomised controlled trials, yielding at least comparable outcomes and a favourable safety profile.[9] The use of expensive high-energy holmium laser equipment and a steep learning curve, however, have limited the extensive application of HoLEP worldwide. There has also been a significant risk of bladder injury associated with the use of the mechanical tissue morcellator that is required for HoLEP.

The use of normal saline as an irrigant was made possible by the introduction of bipolar devices. As a result, the risk of TURP syndrome has been virtually eliminated, and bipolar TURP has been widely adopted for resection of larger prostates with longer operating times. The use of a bipolar device in endoscopic enucleation was first reported by Neill et al,[10] and bipolar TUERP requires no additional devices in comparison with bipolar TURP. Moreover, the sheath of the resectoscope is used for mechanical enucleation of the adenoma along the plane of the surgical capsule, instead of the holmium laser used in HoLEP. The subtotally enucleated adenoma is then resected into chips by the loop electrode, and the use of a mechanical tissue morcellator is eliminated.

The nomenclature for this procedure has not been standardised, with terms such as TUERP, plasmakinetic enucleation of the prostate, and bipolar plasma enucleation of the prostate reported in the literature. All of these names generally refer to the same procedure with minor differences. The term 'bipolar TUERP' is used in this article.

Several modifications in technique and equipment since the introduction of bipolar TUERP have been suggested. For example, a spatula-like enucleation loop, combined with a loop electrode for haemostasis, was introduced by Olympus and is especially designed for this procedure. Alternatively, the use of thick loop electrodes and button electrodes has been described in some series to facilitate the enucleation process. Based on personal experience with these different loops, the alternative loops with different designs are generally stronger than the conventional loop electrode, and they can be used for mechanical enucleation without breakage. The use of the loop in performing enucleation, instead of the resectoscope sheath, also provides better, more direct visualisation during the enucleation process

and potentially shortens the learning curve and improves the safety of the procedure, particularly in the early phase of learning. The resectoscope sheath, however, facilitates a shorter enucleation time without compromising safety with the surgeon's experience. The initial technique adopted for bipolar TUERP was the 'three-lobe' technique. This procedure starts with deep incisions down to the surgical capsule at the 5 and 7 o'clock positions from the bladder neck to the verumontanum, with an additional incision at the 12 o'clock position also reported. The median and lateral lobes of the prostate are then subtotally enucleated and resected in sequence. Some authors have reported 'hybrid' techniques, with the median lobe resected as in conventional TURP and only the lateral lobes enucleated. It has also been noted that deep incisions might not be necessary, as the surgical capsule plane can generally be identified with a small incision immediately proximal to the verumontanum, and the whole gland can be enucleated without separation of the lobes. This procedure avoids the bleeding associated with deep incisions of the bladder neck and adenoma although a small lobe can sometimes be difficult to enucleate after separation of the lobes. The 12 o'clock incision has been mostly abandoned, as has also been advocated for HoLEP. The anterior commissure, particularly the distal part, has been preserved to decrease the rate of transient urinary incontinence postoperatively. The technique used in our centre is currently the most widely practised among different centres.

Several series have reported the perioperative outcomes of bipolar TUERP using similar surgical techniques. Only the largest series from each centre was included for comparison; most of the published series are from China. The results of our series were compared with the TUERP arms of the various published series; this list of series and a comparison of the preoperative parameters are listed in Table 2. After the first published article by Neill et al[10] comparing HoLEP and bipolar TUERP in 2006, Liu et al[11] published the largest series with 1600 patients in 2010. Zhao et al[12] and Liao and Yu[13] followed by comparing bipolar TUERP and TURP in medium-sized prostates. Kan et al[14] compared bipolar TUERP and TURP in large prostates, and Rao et al,[15] Ou et al,[16] Geavlete et al,[17] and Chen et al[18] compared bipolar TUERP with OP. The operative and early postoperative outcomes of bipolar TUERP from various studies are listed in Table 3.

The operating time was generally longer when the preoperative TRUS volume and resected prostate weight increased. Although Liu et al[11] reported enucleation and resection times without reporting the total operating time, the preoperative TRUS volume and resected prostate weight were comparable between Liu et al's report[11] and our series. In addition, the resection time was prostate-size–dependent, and a resection efficacy of approximately 1 g/min was reported in both Liu et al's report[11] and our series. The enucleation time was less size-dependent, varying from 10 to 30 minutes, despite the large range of prostate sizes in our series.

The decrease in haemoglobin of approximately 10 g/L was reported for both medium-sized and large prostates. Early control of denuded vessels during the enucleation process made the removal of large glands possible, with minimal blood loss during the resection process.

The catheterisation and hospitalisation times varied greatly among the series evaluated. Longer times for both have typically been reported in series from China.[11-13,15,16,18] In addition, no standard protocols were stated in most of the series, and the decision for catheter removal and hospital discharge were at the discretion of the surgeons. We report short catheterisation and hospitalisation times

TABLE 2. Comparison of preoperative parameters of patients with transurethral enucleation and resection of the prostate

Study	Mean ± standard deviation					
	No. of patients	Age (years)	TRUS volume (cm^3)	PSA (ng/mL)	Qmax (mL/s)	PVR (mL)
Neill et al,[10] 2006	20	67.0 ± 1.7	51.0 ± 3.9	NA	7.5 ± 0.8	114.0 ± 23.2
Liu et al,[11] 2010	1600	66.7 ± 7.3	67.7 ± 12	7.8 ± 1.9	6.2 ± 2.1	142 ± 34.7
Zhao et al,[12] 2010	102	67.3 ± 6.6	69.2 ± 13.5	2.20 ± 1.1	8.3 ± 2.0	92 ± 33
Liao and Yu,[13] 2012	160	76	77.3	NA	7.5 ± 2.3	132 ± 38
Rao et al,[15] 2013	43	66.6 ± 7.5	116.2 ± 32.4	4.77 ± 2.21	5.8 ± 2.0	83.4 ± 11.8
Ou et al,[16] 2013	50	69.8 ± 10.2	132.2	5.9	5.9	89.6
Geavlete et al,[17] 2013	70	70.4	132.6	8.5	5.9	164
Kan et al,[14] 2014	74	75.7	115.1	11.6	7.5	209
Chen et al,[18] 2014	80	64.7 ± 3.7	110	2.92 ± 0.88	4	240
Present series	28	69.4 ± 7.0	71.9 ± 33.5	6.4 ± 4.0	9.2 ± 3.7	100.7 ± 92.2

Abbreviations: NA = not available; PSA = prostate-specific antigen; PVR = post-void residual; Qmax = mean peak urinary flow rate; TRUS = transrectal ultrasonography

TABLE 3. (a) Operative parameters and (b early postoperative parameters

(a)

Study	Mean ± standard deviation					
	Operating time (mins)	Resected prostate weight (g)	Gland removal rate (%)†	Decrease in Hb (g/L)	Catheter time (hours)	Hospitalisation time (days)
Neill et al,[10] 2006	60.5	21.7 ± 3.2*	42.5	NA	24.8 ± 6.3	1.32 ± 0.25
Liu et al,[11] 2010	15.5 ± 4.8 (Enucleation) 46 ± 13.7 (Resection)	42.8 ± 7.7	63.2	NA	43.2 ± 9.6	5.3 ± 2.5
Zhao et al,[12] 2010	62.8 ± 18.6	56.4 ± 12.8	81.5	7.4 ± 3.3	51.7 ± 26.3	4.1 ± 0.85
Liao and Yu,[13] 2012	71 ± 15.4	51 ± 14.3	66.0	146 ± 48.6 mL (EBL)	93.6 ± 26.4	8.7 ± 3.1
Rao et al,[15] 2013	111.2 ± 27.1	65.9 ± 20.8	56.7	10.2 ± 4.5	79.2 ± 26.4	5.4 ± 1.2
Ou et al,[16] 2013	100.4 ± 15.8	98.7 ± 37.9	74.6	12 ± 10	103.2 ± 28.8	5.8 ± 2.0
Geavlete et al,[17] 2013	91.4	108.3	81.7	17	36	2.1
Kan et al,[14] 2014	156.2 ± 55.1	61.4 ± 32.8	53.3	18 ± 15	NA	5.3 ± 3.8
Chen et al,[18] 2014	121.2 ± 18.3	118.2 ± 22.0	107.5	10	40	3
Present series	86.1 ± 37.1	48.2 ± 26.8	67.0	11.5 ± 14.0	45.3 ± 16.6	2.3 ± 0.8

Abbreviations: EBL = estimated blood loss; Hb = haemoglobin; NA = not available; TRUS = transrectal ultrasonography

* Pathological specimen weight

† Gland removal rate = resected specimen weight (g)/preoperative TRUS volume (cm^3)

(b)

Study	Mean ± standard deviation									
	TRUS volume (cm^3)			PSA (ng/mL)			Qmax (mL/s)	PVR (mL)	IPSS	QoL
	Preop	Postop	% Decrease	Preop	Postop	% Decrease				
Neill et al,[10] 2006	51.0 ± 3.9	NA	NA	NA	NA	NA	19.8 ± 2.5	NA	7 ± 1.5	NA
Liu et al,[11] 2010	67.7 ± 12	NA	NA	7.8 ± 1.9	0.89	-88.6	21.1 ± 2.5	20 ± 10.7	5.5 ± 3.5	1.3 ± 1.3
Zhao et al,[12] 2010	69.2 ± 13.5	20.7 ± 6.5	-70.1	2.20 ± 1.1	0.96 ± 0.52	-56.1	23.8 ± 7.5	8.7 ± 8.3	5.5 ± 4.8	1.8 ± 1.8
Liao and Yu,[13] 2012	77.3	NA	NA	NA	NA	NA	25 ± 4.3	23 ± 8.9	6.1 ± 1.3	1.3 ± 0.5
Rao et al,[15] 2013	116.2 ± 32.4	NA	NA	4.77 ± 2.21	1.18 ± 0.69	-75.3	25.8 ± 6.4	7.6 ± 4.8	5.3 ± 2.5	2.2 ± 1.2
Ou et al,[16] 2013	132.2	NA	NA	5.9	1.6	-72.9	13.1 ± 2.3	25.7 ± 16.9	9.1 ± 2.2	1.5 ± 0.6
Geavlete et al,[17] 2013	132.6	NA	NA	8.5	0.8	-90.6	25.0	31.6	4.8	1.3
Kan et al,[14] 2014	115.1	33.4	-71.0	11.6	3.7	-68.1	19.5	52.5	6.4	1.7
Chen et al,[18] 2014	110	NA	NA	2.92 ± 0.88	0.53 ± 0.3	-81.8	24.3 ± 7.3	14*	4*	1*
Present series	71.9 ± 33.5	22.9 ± 8.4	-68.2	6.4 ± 4.0	0.9 ± 0.6	-85.9	20.9 ± 12.8	31.6 ± 20.7	9.4 ± 5.1	1.9 ± 1.3

Abbreviations: IPSS = International Prostate Symptom Score; NA = not available; PSA = prostate-specific antigen; PVR = post-void residual; Qmax = mean peak urinary flow rate; QoL = quality of life; TRUS = transrectal ultrasonography

* Median

with the adoption of the same protocol as TURP in our institution. Specifically, bladder irrigation was stopped on postoperative day 1, the catheter was removed, and the patient was discharged from the hospital on postoperative day 2. A total of 92.9% of the patients (26 of 28 patients) complied with the postoperative protocol.

Postoperative TRUS volume was rarely reported by the series despite the consistent reporting of preoperative volume. This lack of reporting reflects the difficulty in accurately estimating residual tissue volume by TRUS, as illustrated by the postoperative TRUS photo shown in Figure 2. In addition, the central cavity remaining after TUERP can lead to overestimation of the prostate volume with the application of the traditional ellipse formula. Instead, preoperative estimation of the peripheral zone volume, obtained by subtracting the volume of the central zone from the total prostate volume, may represent a better method for estimating the residual tissue volume after TUERP. A decrease in TRUS volume of approximately 70% after TUERP was consistently reported, despite the pitfalls of postoperative TRUS measurements.

It has also been shown from the experience of HoLEP that a reduction in PSA level correlated with the amount of prostate tissue removed.[19] Thus, serum PSA may serve as a better surrogate marker in the estimation of postoperative residual tissue volume. A postoperative PSA level of approximately 1 ng/mL

FIG 2. Postoperative transrectal ultrasonography of the prostate

and a decrease in PSA by >70% were commonly reported in most of the series.

Adverse events were poorly and inconsistently reported, as shown in Table 4. The standard Clavien classification was not adopted. There was no Clavien grade 3 or 4 complication in our series. The transfusion rate was low, with the exception of the series by Ou et al,[16] and clot retention was rare. The rate of urinary tract infection ranged from 2% to 7.3%, and the re-catheterisation rate was <5%. Major complications were not common but did occur, as reported by Kan et al[14]; four admissions to intensive care units and nine conversions to other procedures were reported in this series of 74 patients. The rate of urethral stricture or bladder neck stenosis was low and comparable with conventional TURP as reported by the series by Liu et al.[11] Long-term outcome was not reported in our series due to the short duration of follow-up. Temporary urinary incontinence was the major concern with enucleative procedures, and OP resulted in temporary urinary incontinence in approximately 10% of cases. The reporting of transient urinary incontinence after TUERP was poor and did not feature in three of the nine series analysed. Furthermore, the definition, timing, and severity of urinary incontinence were not stated in the other studies. Dramatic changes in the symptomatology of the patients over time following benign prostatic hyperplasia–related surgery, however, likely explain the difficulty in defining transient urinary incontinence. In our experience, transient urinary incontinence is not uncommon after TURP, although it is difficult to differentiate the type of urinary incontinence, stress, urge or mixed, by history or urodynamic studies. The natural history of this phenomenon has rarely been reported in the literature. It was interesting to note that the rate of transient urinary incontinence was much higher for the TURP group (16.1%) compared with the TUERP group (7.5%) in the series by Liao and Yu.[13] In our experience, 17.9% of patients reported episode(s) of urinary incontinence at any time point after TUERP; the rate of transient urinary incontinence was 10.7% and 3.6% at 1 and 3 months postoperatively, respectively. Patients who had transient urinary incontinence used two pads daily on average, and all cases of transient urinary incontinence subsided by 4 months. Further investigations with, for example, measurement of pad weight and urodynamic studies will better delineate the cause and natural history of postoperative transient urinary incontinence. There

TABLE 4. Comparison of preoperative parameters of patients with transurethral enucleation and resection of the prostate

Study	Transfusion rate (%)	Clot retention (%)	UTI (%)	Re-catheterisation (%)	Temporary urinary incontinence at 3 months (%)
Neill et al,[10] 2006	0	NA	5	NA	10
Liu et al,[11] 2010	0.8	NA	7.3	NA	3.5
Zhao et al,[12] 2010	0	NA	2	NA	2
Liao and Yu,[13] 2012	0	0	NA	NA	7.5
Rao et al,[15] 2013	0	NA	7	2.3	4.7
Ou et al,[16] 2013	6	0	6	4	NA
Geavlete et al,[17] 2013	1.4	NA	2.9	1.4	NA
Kan et al,[14] 2014	7 Units*	1.35	NA	0	NA
Chen et al,[18] 2014	0	0	6.25	0	8.75
Present series	0	0	7.1 (2/28)	3.6 (1/28)	3.6 (1/28)

Abbreviations: NA = not available; UTI = urinary tract infection

* Mean transfusion

is currently no predictive factor identified for the phenomenon.

Comparison of outcome and complications between patients with and without urinary retention was limited by the small patient number in our study. No significant difference between outcome and complications was identified even though patients with retention were significantly older.

A learning curve of 50 cases was reported for HoLEP,[20] and this learning curve was expected to be shorter for bipolar TUERP. The instrumentation for TUERP should be familiar to an endourologist experienced in TURP because no additional devices are required. Xiong et al[21] analysed the learning curve of bipolar TUERP. The ratio of conversion to conventional TURP decreased after 30 cases, and the efficiency of enucleation and resection increased with accumulative experience after 50 cases. Our series showed that the early postoperative outcomes were comparable to those of large series after approximately 35 cases, without an increase in adverse events. The findings were based on analysis of the learning curve of a single surgeon and may not be applicable to all surgeons. Nevertheless, an estimation of a learning curve in a magnitude of 30 to 50 cases seems reasonable and serves as a valuable reference.

Conclusions

Our study suggests that bipolar TUERP is a safe technique for prostates of any size. This procedure should become the endourological equivalent to open adenomectomy, with fewer complications and shorter convalescence. This technique can also be acquired safely with a relatively short learning curve.

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