Bipolar plasmakinetic transurethral resection of the prostate vs. transurethral enucleation and resection of the prostate: pre- and postoperative comparisons of parameters used in assessing benign prostatic enlargement

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ABSTRACT

Introduction: Transurethral enucleation and resection of the prostate (TUERP) may offer a better treatment for benign prostatic enlargement. We compared the perioperative parameters and outcome following bipolar plasmakinetic transurethral resection of the prostate (TURP) and TUERP.

Methods: Data from two independent institutions were reviewed retrospectively. 50 and 45 consecutive patients were enrolled in the TURP and TUERP groups, respectively. Pre- and postoperative parameters, including prostatic specific antigen (PSA), prostate volume (PV), International Prostate Symptom Score (IPSS), quality of life (QOL) score, uroflowmetry and prostate volume (PV), were compared.

Results: Age at surgery, preoperative PSA (5.8 +/− 4.0 versus 7.6 +/− 5.9 ng/ml) and PV (55.8 +/− 31.6 versus 53.2 +/− 26.8 g) showed no significant difference (p-value greater than 0.05). However, postoperative PSA (2.8 +/− 3.0 versus 0.8 +/− 0.4 ng/ml; p-value less than 0.05) and PV (15.2 +/− 7.7 versus 10.5 +/− 5.4 g; p-value less than 0.01) differed significantly between the TURP and TUERP groups, respectively. There were no significant differences in IPSS, QOL, and Qmax between the two groups during follow-up (p-value is 0.62, 0.68 and 0.13, respectively). However, for the TUERP group, the postoperative post-void residual urine volume (PVR) was significantly better (13.8 +/− 19.5 versus 25.2 +/− 18.7 ml; p-value less than 0.01).

Conclusion: The TUERP technique achieved more complete resection than TURP, with a smaller post procedure PV and lower PSA and PVR after surgery. This may predict better long-term results for patients who had TUERP.

Keywords: benign prostatic enlargement, enucleation, prostate, resection

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INTRODUCTION

Transurethral resection of the prostate (TURP) is an established surgical treatment for symptomatic and obstructing benign prostate enlargement (BPE). Prior to the development of TURP, simple open prostatectomy and enucleation of the prostatic adenoma was the mainstay of surgical therapy. However, open simple prostatectomy has significant postoperative pain, considerable intraoperative bleeding requiring transfusion and a small but significant perioperative mortality rate of 0.2%.[1] The development of TURP and the ensuing technical modifications led to improved haemostasis and outcome, with reduced transfusion rates (from 0.4% to 2.0%) and lower perioperative mortality rates (from 0% to 0.1%).[2,3]

Nevertheless, resected adenomas have been reported to recur in at least 15% of reported cases with adequate follow-up data that required repeat surgical intervention, even by experienced surgeons in high-volume centres.[4,5] Incomplete removal of these obstructing prostatic adenomas at the time of the primary surgery, rather than recurrent adenomas after adequate resection, may be a significant cause of the recurrent lower urinary tract symptoms on long-term follow-up, manifesting as recurrent haematuria or poor urinary stream.

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The technique of transurethral enucleation and resection of the prostate (TUERP) was conceived and developed to replicate the open enucleation of prostatic adenomas in an endoscopic fashion, combining the benefits of complete enucleation and minimally invasive approach to BPE.[6] We analysed early data from a comparison of these two techniques in order to evaluate the adequacy of endoscopic resection using the bipolar plasmakinetic resectoscope and report on the initial perioperative outcomes between the techniques.

METHODS

We reviewed the data retrieved from 95 patient charts in two independent institutions retrospectively. 50 consecutive patients who underwent bipolar plasmakinetic TURP by a single surgeon between January 2006 and February 2007 were enrolled in the TURP group, while 45 consecutive patients who underwent TUERP by a single surgeon between January 2005 and December 2006 were enrolled in the TUERP group. The surgical indication for both groups was symptomatic benign prostate obstruction. Patients with a history of prostate cancer, bladder neck stricture or cystopathy were excluded from this study. Pre- and postoperative prostate volume (PV) and prostate specific antigen (PSA), together with the postoperative parameters, International Prostate Symptom Score (IPSS), quality of life score (QOL) and uroflowmetry, were compared. Postoperative PV and intravesical prostatic protrusion (IPP) were assessed by a single surgeon using transabdominal ultrasonography, applying the ellipsoid formula for PV in all patients from both institutions.[7] All the patients had histologically confirmed benign prostatic hyperplasia.

Bipolar transurethral prostate resection was performed using the plasmakinetic system (Gyrus ACMI, Olympus Corporation, Tokyo, Japan) for the TURP arm, using the technique described by Blandy et al.[8] This is the standard technique for all TURP for BPE in the authors' institutions. TUERP was also performed using the plasmakinetic system, with a standard TURP resectoscope (Fig. 1). Briefly, a cutting current through a standard loop was used to incise the prostatic apex just proximal to the verumontanum until the level of the prostatic capsule was reached. The beak of the resectoscope sheath was then used in a similar fashion as the surgeon's finger in conventional simple open prostatectomy to enucleate the whole gland toward the bladder neck to near completion from the capsule. The enucleated adenoma attached at the bladder neck was then resected into smaller prostatic chips with the bipolar plasmakinetic loop. No morcellator was used. The chips were evacuated with an Ellik evacuator, and haemostasis was secured in the prostatic fossa.

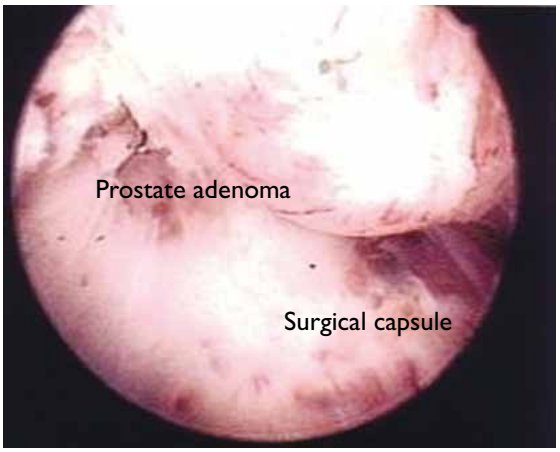

Fig. 1 Endoscopic image shows smooth interspaces between the prostate adenoma and surgical capsule with the enucleation technique using the tip of a resectoscope.

Statistical analysis was performed using NCSS version 07.1.4 for windows (NCSS LLC, Kaysville, UT, USA). Differences in the median values between the two groups were evaluated using the Mann-Whitney U test. The changes in the pre- and postoperative parameters within each group were analysed using paired *t*-test, and correlation analysis was performed using Spearman's correlations. Statistical significance was established at $p < 0.05$.

RESULTS

Comparing TURP and TUERP patients, there was no significant difference in the mean patient age (68.5 ± 9.6 vs. 71.5 ± 8.1 years, $p = 0.22$), mean preoperative PSA (5.8 ± 4.0 vs. 7.6 ± 5.9 ng/ml, $p = 0.39$), mean preoperative PV (55.8 ± 31.6 vs. 53.2 ± 26.8 g, $p = 0.87$) and mean follow-up (19.8 ± 10.0 vs. 23.0 ± 8.4 months, $p = 0.08$) (Table I). There were significant differences between the two groups in terms of mean postoperative PSA (2.8 ± 3.0 vs. 0.8 ± 0.4 ng/ml, $p < 0.05$) and PV (15.2 ± 7.7 vs. 10.5 ± 5.4 g, $p < 0.01$) (Table I). There were also significant differences in the operative time (65.8 ± 29.3 vs. 42.3 ± 5.4 min, $p < 0.01$) and estimated resection rate (ERR) (ERR = [PVpre-op – PVpost-op]/ PVpre-op × 100%) (72.8% vs. 80.2%, $p < 0.01$) (Table II). However, there was no significant difference between the two groups in IPSS, QOL and Qmax during follow-up ($p = 0.62$, 0.68 and 0.13, respectively), except for the post-void residual urine volume (PVR) (25.2 ± 18.7 vs. 13.8 ± 19.5 ml, $p < 0.01$) (Table I).

DISCUSSION

Although the advent of pharmacotherapy has resulted in a decline in surgical treatment, open prostatectomy and

Table I. Results of pre- and postoperative parameters.

Variable*	TURP (n = 50)			TUERP (n = 45)			p-value†	
	Pre-op	Post-op	p-value	Pre-op	Post-op	p-value	Pre-op	Post-op
IPSS	16.0 ± 8.4	7.0 ± 5.6	< 0.0001	-	6.1 ± 4.8	-	-	0.62
QOL	3.6 ± 1.4	1.6 ± 1.1	< 0.0001	-	1.9 ± 1.5	-	-	0.67
Qmax (ml/s)	8.8 ± 4.6	17.1 ± 7.7	< 0.0001	-	19.6 ± 10.5	-	-	0.14
PVR (ml)	95.1 ± 58.8	25.2 ± 18.7	< 0.0001	-	13.8 ± 19.5	-	-	< 0.01
PSA (ng/ml)	5.8 ± 4.0	2.8 ± 3.0	< 0.001	7.6 ± 5.9	0.8 ± 0.4	< 0.0001	0.39	< 0.05
PV (g)	55.8 ± 31.6	15.2 ± 7.7	< 0.0001	53.2 ± 26.8	10.5 ± 5.4	< 0.0001	0.87	< 0.01
IPP (mm)	14.8 ± 5.8	1.1 ± 3.3	< 0.0001	-	0.6 ± 1.8	-	-	0.08
Age (yrs)		68.5 ± 9.6			71.5 ± 8.1		0.22	
Follow-up (mths)		19.8 ± 10.0			23.0 ± 8.4		0.08	

* Data is presented as mean ± standard deviation. † Between TURP and TUERP groups.
TURP: transurethral resection of the prostate; TUERP: transurethral enucleation and resection of the prostate; IPSS: International Prostate Symptom Score; QOL: quality of life; Qmax: maximum urinary flow rate; PVR: post-void residual urine volume; PSA: prostate specific antigen; PV: prostate volume; IPP: intravesical prostate protrusion.

Table II. Comparison of TUE, TUDP, HoLEP, TURP and TUERP

Study	Method	Pre-op PV (g)	RTW (g)	Post-op PV(g)	Residual adenoma rate (%)
Shimizu et al[15]	TUE (n = 64)	37.4	20.1	8.9	23.8
Hiraoka et al[16]	TUDP (n = 46)	47.75	37.11	9.56	20.0
Tan et al[22]	HoLEP (n = 30)	77.8	40.4	28.4	36.5
Present study	TURP (n = 50)	55.8	29.1	15.2	27.2
Present study	TUERP (n = 45)	53.2	-	10.5	19.7

Residual adenoma rate = ($PV_{post\text{-}op}$ / $PV_{pre\text{-}op}$) ×100%
TUE: transurethal enucleation; TUDP: transurethral detaching prostatectomy; HoLEP: holmium laser enucleation of the prostate; TURP: transurethral resection of the prostate; TUERP: transurethral enucleation and resection of the prostate; PV: prostate volume; RTW: resected tissue weight

TURP remain the most efficacious forms of surgical therapy for relieving outlet obstruction and alleviating symptoms in men with BPE.[9] Contemporary indications for surgical intervention in BPE include progressive lower urinary tract symptoms from bladder outlet obstruction and the presence of complications, including urinary retention, recurrent urinary tract infections, recurrent macroscopic haematuria, bladder stones or renal failure, and development of large bladder diverticula.[2]

TURP has replaced simple open prostatectomy and enucleation of the prostatic adenoma in many countries, but its role in the surgical treatment of BPE has been increasingly challenged by newer minimally invasive techniques, such as holmium laser enucleation of the prostate (HoLEP) and photoselective vaporisation of the prostate.[10-13] However, these new techniques require expensive and specialised equipment that are not always accessible to all urologists. TUERP was developed to emulate the complete removal of prostatic adenoma from open simple prostatectomy but without the attendant morbidity, using the same equipment for TURP. Over the last five years, 1,600 cases were performed at the Department of Urology, Zhujiang Hospital, Guangzhou.[14] In this study, we evaluated the initial perioperative outcomes of TUERP and compared it with TURP.

Our findings showed that TUERP could achieve a more complete resection than TURP (ERR 80.2% vs. 72.8% respectively, $p < 0.01$). In our study, the estimated ERR of TURP was higher than that previously (45.5%) reported by Shimizu et al.[15] Our higher TURP resection rate may be attributable to the level of experience of the surgeon and our technique of estimating ERR, which factors in tissue vaporisation during the resection. The postoperative residual PV after TUERP was also smaller compared to that after TURP (10.5 ± 5.4 vs. 15.2 ± 7.7 ml, respectively, $p < 0.01$). In our study, the TUERP technique permitted faster resection than TURP

(42.3 ± 5.4 vs. 65.8 ± 29.3 min, respectively, $p < 0.01$), as the enucleation was performed along the plane of the adenoma, with early diathermy of the perforating vessels supplying the adenoma. Resection of the detached adenoma is virtually bloodless. Therefore, the greatest benefit of this technique is demonstrated when resecting large prostate glands. However, for those who are new to the enucleation technique, the index patient should have a moderate prostate size of 40–80 g. Small prostate adenoma may not be ideal due to the associated prostatitis, and hence, it is difficult to find the correct surgical plane. Very large gland weighing more than 100 g, on the other hand, may require a more experienced surgeon, as one can be disorientated during the procedure, with the creation of too many potential spaces.

Recently, Hiraoka and Akimoto[16] reported transurethral detaching prostatectomy (TUDP), a technique that is similar to TUERP. The TUDP technique is modified from a previous transurethral enucleation (TUE) technique, in which a blade to detach the prostate is attached to a resectoscope in place of a loop.[17,18] After the detachment is completed, the prostate is removed by a morcellator. It was reported that TUE had no re-operations for residual adenoma in over 2,000 cases, as it enabled complete resection of the adenoma.[15] In the TUDP series,[16] the mean postoperative PV, Qmax, IPSS and PSA were 9.56 g, 18.25 ml/s, 5.62, and 0.80 ng/ml, respectively, which were similar to the results of our TUERP group. The comparison of postoperative PV following different surgical procedures (Table II) suggests that the enucleating techniques of TUE, TUDP and TUERP may achieve a more complete resection than the TURP technique. A similar technique called transurethal enucleation with bipolar (TUEB) was developed by the Olympus company.[19] Both TUDP and TUEB require an initial circle incision and an extra instrument to detach or enucleate the prostate. In comparison, the TUERP technique can be performed without any extra instrument, thus proving to be more cost-effective. There is a learning curve for the beginner to find the correct dissection plane to enucleate; however, it is very convenient to change from TUERP to TURP at any time during the procedure.

The main limitations of our study relate to the non-randomised retrospective nature of our study, the relatively short follow-up period, the missing pre-operative data on IPSS, QOL and PVR in the TUERP group and the mild differences in follow-up protocol. However, our study utilised the same ultrasonographer for the postoperative evaluation, thus minimising inter-observer differences; moreover, it is the postoperative data which is of importance. For benign prostate surgery, it is not how much has been removed but how much is left that is important, as it is the residual remnant adenoma which would determine the long-term results of transurethral procedures.

It is expected that a longer term follow-up of at least 5–10 years would demonstrate a lower repeat resection rate, as shown by Kuntz et al, who found that the recurrent resection rate for HoLEP compared with open simple prostatectomy was equally low.[20] TUERP is basically similar to HoLEP, as the prostate adenoma causing obstruction is completely removed as in open simple prostatectomy. The other limitation is the measurement of postoperative PV in the current study. Transabdominal measurement of PV using the ellipsoid formula had been found to correlate well with the transrectal measurement proposed by Yuen et al,[7] with the bladder comfortably full but not overdistended (< 400 ml). However, it may still be difficult to measure the exact size of the residual adenoma due to the resected cavity, but it has been shown that the size of the prostate cavity post TURP would have shrunk by 16 weeks.[21] In this study, the measurements were done at a mean of about two years (20 months for TURP and 23 months for TUERP).

Our study suggests that postoperative PSA is a good parameter to gauge the completeness of TURP. In fact, PSA is easier to measure, and may be more objective than postoperative PV measurement. The mean postoperative PSA in each group was < 4 ng/ml, which is consistent with evidence from other investigators who reported that the PSA levels normalised (to < 4 ng/ml) following complete TURP with a benign histology.[22] Postoperative PSA also correlates well with the extent of tissue resection, since the PSA level after TUERP is lower than that after TURP (0.8 vs. 2.8 ng/ml, $p < 0.05$). Thus, one may infer that a low postoperative PSA is a consistent parameter for assessing the completeness of surgical resection, and may predict good long-term outcome, as reported by Tinmouth et al in their HoLEP study.[23] However, the precise cut-off for postoperative PSA to predict good long-term outcome is still unclear, and further studies to evaluate this issue would be required.

In conclusion, our data suggests that more complete resection is achieved using the TUERP technique compared with TURP, with a smaller PV and a reduced PVR after surgery. Postoperative PV and PSA may be used as indicators of completeness of prostatic resection, and may predict the long-term outcome of TURP/TUERP. Longer term and larger studies are needed in order to validate these results.

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