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ORIGINAL PAPER

Evaluation of bipolar Transurethral Enucleation and Resection of the Prostate in terms of efficiency and patient satisfaction compared to retropubic open prostatectomy in prostates larger than 80 cc. A prospective randomized study

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Summary *Objectives: To compare the outcomes of bipolar Transurethral Enucleation Resection of the Prostate (TUERP) and simple retropubic prostatectomy in patients with prostate volumes larger than 80 cc.*

Patients and methods: A prospective randomized study included all patients amenable to surgeries for benign prostate hyperplasia (BPH) with prostate size over 80 cc at a tertiary care hospital between January 2020 to February 2022. Bipolar TUERP and Retropubic open prostatectomy techniques were compared regarding patients' demographics, intraoperative parameters, outcomes, and peri-operative complications.

Results: Ninety patients were included in our study and randomly assigned to bipolar TUERP (Group 1 = 45 patients) and retropubic open prostatectomy (Group 2 = 45 patients).

The TUERP group demonstrated significantly lower operative time (77 ± 11 minutes vs. 99 ± 14 minutes, p < 0.001), hemoglobin drop (median = 1.1 vs. 2.5, p < 0.001), and resected tissue weight (71 ± 6.6 cc vs. 84.5 ± 10.6 cc, p < 0.001).

Postoperatively, the TUERP group demonstrated significantly lower catheter time (median = 2 vs. 7 days, p < 0.001) and less hospital stay. IPSS, Q_{max}, and patient satisfaction were better in the TUERP group within six months of surgery. We reported 90-day complications after TUERP in 13.3% of patients compared to 17.8% after retropubic prostatectomy, with a statistically insignificant difference. Urethral stricture predominated after TUERP, while blood transfusion dominated in retropubic prostatectomy.

Conclusions: The present study found that TUERP had equivalent efficacy and safety to open retropubic prostatectomy for patients with BPH and prostate volumes > 80 ml.

KEY WORDS: TUERP; Simple retropubic prostatectomy; Complications.

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INTRODUCTION

Open prostatectomy is considered the most durable surgical option for large (> 80 gm) prostates. Meanwhile, it is the most invasive and associated with high operative morbidity (1). The rate of open prostatectomy surgeries has been progressively decreasing with the advent of minimally invasive techniques, including monopolar and bipolar TURP and diferent laser therapies (2). *Holmium laser enucleation of the prostate* (HoLEP) has shown a comparable functional outcome to open prostatectomy in treating prostates larger than 80 cc (3). However, due to its steep learning curve and higher cost, HoLEP gained little popularity, especially in developing countries (4). *Transurethral enucleation resection of the prostate* (TUERP) incorporated the enucleation technique with standard *transurethral resection of the prostate* (TURP). It is available in all urology theaters, is cost-effective, and could be considered a treatment option resembling LASER enucleation, specifically bipolar TUERP (5).

In the present study, we aimed to assess the efficacy and safety of bipolar TUERP compared to retropubic prostatectomy in patients with LUTS secondary to benign prostatic hyperplasia with prostate volumes larger than 80 cc.

PATIENTS AND METHODS

A prospective randomized study included all patients amenable to *benign prostate hyperplasia* (BPH) surgeries to control lower urinary tract symptoms with prostate size over 80 cc at the *Urology Department of Al-Azhar University Hospitals* between January 2020 to February 2022. We excluded patients with neurogenic bladder dysfunction, previous prostatic or urethral surgeries, urethral stricture or bladder neck contracture, renal impairment, and comorbidities that render them at high anesthetic risk. The local ethical committee approved our research, and all participants signed informed consent. Patients were randomly allocated into one of the two groups; Group 1 included patients who underwent bipolar TUERP, and Group 2 had retropubic open prostatectomy. A stratified block randomization method (1:1 ratio) was used for patient allocation.

All recruited patients were assessed through the following regimen: full medical history including *International Prostate Symptom Score* (IPSS) assessment and *international index of erectile function* (IIEF); complete clinical examination, including *digital rectal examination* (DRE) and focused neurological examination; urine analysis, urine culture and sensitivity, serum creatinine, coagulation profile, CBC, serum Na and potassium, blood sugar, and *prostate specific antigen* (PSA). Objective evaluation of LUTS carried out through uroflowmetry with post-void residual urine, transrectal ultrasound for estimation of prostate volume, and pelvic-abdominal ultrasound in cases with recurrent hematuria, infection, loin pain, or high post-void residual urine. TUERP procedure was performed using a Plasma kinetic resection using a KLS Martin maximum with Storz Fr 26 resectoscope with plasma kinetic electrode using the bipolar current and normal saline irrigation. The procedure involved the creation of the plane of the surgical capsule at a level closely proximal to the verumontanum with vaporization; the adenoma was dissected from the capsule plane by unclenching it using the beak of the resectoscope sheath from one side to the other. The blood vessels to the adenoma were coagulated at the time of dissection. When the whole adenoma was almost dissected from the capsule, a small proportion of adenoma was allowed to anchor the capsule at the bladder neck, which helped the surgeon to harvest the whole adenoma in pieces with resection. The adenoma slices were evacuated manually.

The retropubic open prostatectomy procedure was performed following the standard operative technique (6).

Intraoperative adverse events, operative time, and enucleated prostatic weight were recorded. Similarly, postoperative reporting of hemoglobin, hematocrit, serum sodium and *potassium* (K), hospital stay, catheterization period, and 90-day complications were recorded.

Patients were booked for clinic visits after one, three, and six months from surgery for clinical evaluation, including IPSS questionnaire, physical assessment, uroflowmetry, and PVR. The study groups were compared in terms of patient demographics, intraoperative parameters, outcomes, and peri-operative complications.

Table 1.
Baseline general and clinical characteristics of the study groups.

	Group 1 (n = 45)	Group 2 (n = 45)	P-value
Age (years), mean ± SD	66 ± 6	66 ± 7	0.7
Co-morbidities, N (%)	31(68.9)	28 (62.2)	0.506
IPSS, median(range)	25 (18-32)	24 (16-35)	0.209
Quality of life, N (%)			0.418
Mostly dissatisfied	8 (17.8)	5 (11.1)	
Unhappy	14 (31.1)	11 (24.4)	
Terrible	23 (51.1)	29 (64.4)	
IEEF, median(range)	7 (5-14)	7 (5-13%)	0.239
Prostate size (cc), mean ± SD	110 ± 8 cc	112 ± 7 cc	0.211
Residual urine (ml), median(range)	195 (90 - 590)	190 (107-240)	0.721
TRUS (TV) (cc), mean ± SD	104 ± 12 cc	108 ± 10	0.085
TZ (cc), mean ± SD	89 ± 8.7 cc	91.4 ± 7.9	0.169
Q_{max} (ml/sec), mean ± SD	9.4 ± 14	8.9 ± 1.5	0.819

IPSS: International Prostate Symptom Score; IEEF: International index of erectile function; TV: total volume of prostate; TZ: transition zone of prostate.

Table 2.
Baseline laboratory findings of the study groups.

	Group 1 (n = 45)	Group 2 (n = 45)	P-value
Pyuria, N (%)	23 (51.1)	28 (62.2)	0.288
Positive urine culture, N (%)	23 (51.1)	28 (62.2)	0.288
Serum creatinine (mg/dl), mean ± SD	1.12 ± 0.34	1.03 ± 0.18	0.114
Hemoglobin (gm/dl), mean ± SD	13.2 ± 1.8	13.6 ± 1	0.235
Hematocrit (%), mean ± SD	40.3 ± 4.7	41.3 ± 2.9	0.199
Serum Na (mEq/l), mean ± SD	136.9 ± 4.2	135.8 ± 1.5	0.081
K (mEq/l), mean ± SD	4.12 ± 0.66	4.05 ± 0.36	0.509
PSA-total (ng/ml), median (range)	4 (1.1-20)	3.8 (1.9-10.9)	0.707
PSA-free (ng/ml), median (range)	1 (0.3-2.3)	0.8 (0.4-1.9)	0.084
INR, mean ± SD	0.99 ± 0.03	0.97 ± 0.04	0.129
Random blood sugar (mg/dl), mean ± SD	107 ± 16	104 ± 15	0.361

K: potassium; PSA; prostate specific antigen; INR; international normalized ratio.

Statistical analysis

Statistical analysis was done utilizing the SPSS version 28 (*IBM, Armonk, New York, United States*). Quantitative data were assessed for normality using the Shapiro-Wilk test and direct data visualization methods. According to normality, quantitative data were summarized as means and standard deviations or medians and ranges. Categorical data were expressed as numbers and percentages. Quantitative data were compared between the studied groups using the independent t-test or Mann-Whitney U test for normally and non-normally distributed quantitative variables. Categorical data were compared using the Chi-square or Fisher's exact test. All statistical tests were two-sided. P values less than 0.05 were considered significant.

Results

Ninety patients were included in our study and randomly assigned to bipolar TUERP (Group 1 = 45 patients) and retropubic open prostatectomy (Group 2 = 45 patients). The study groups were comparable regarding the patients' demographics and preoperative laboratory investigations, as shown in Tables 1 and 2. The TUERP group demonstrated significantly lower operative time (77 ± 11 minutes *vs.* 99 ±14 minutes, $p < 0.001$), hemoglobin drop (median = 1.1 *vs.* 2.5, $p < 0.001$), resected tissue weight (71 ± 6.6 cc *vs.* 84.5 ± 10.6 cc, $p < 0.001$), serum potassium (3.9 ± 0.4 *vs.* 4.1 ± 0.3, $p = 0.002$), hematocrit (*vs.* 29 ± 2 *vs.* 31 ± 2, $p < 0.001$), and bleeding (22.2% *vs.* 57.8%, $p < 0.001$). No significant difference was observed regarding serum Na ($p = 0.948$) (Table 3).

Postoperatively, the TUERP group demonstrated significantly lower catheter time (median = 2 *vs.* 7 days, $p < 0.001$) and lower serum potassium level (2.9 ±0.3 vs. 4.1 ± 0.3, $p < 0.001$). Additionally, hospital stay significantly differed between the studied groups ($p < 0.001$), with 57.8% and 42.2% of the TUERP patients having a hospi-

Table 3.
Intraoperative findings in the studied groups.

	Group 1 (n = 45)	Group 2 (n = 45)	P-value
Operative time (min), mean ± SD	77 ± 11	99 ± 14	< 0.001
Hemoglobin drop (gm/dl), median(range)	1.1 (0.2-3.7)	2.5 (0.9-6.5)	< 0.001
Resected tissue weight (gm), mean ± SD	71 ± 6.6	84.5 ± 10.6	< 0.001
Na (mEq/l), mean ± SD	132 ± 4	132 ± 2	0.948
K (mEq/l), mean ± SD	3.9 ± 0.4	4.1 ± 0.3	0.002
Hematocrit (%), mean ± SD	29 ± 2	31 ± 2	< 0.001
Bleeding, N (%)	10 (22.2)	26 (57.8)	< 0.001

K: potassium.

Table 4.
Postoperative findings in the studied groups.

	Group 1 (n = 45)	Group 2 (n = 45)	P-value
Catheter time (days)	2 (2-3)	7 (7-7)	< 0.001
Hospital stays (days), N (%)			< 0.001
Two days	26 (57.8)	0	
Three days	19 (42.2)	0	
Seven days	0	45 (100)	
Na (mEq/l), mean ± SD	134.7 ± 4.2	133.9 ± 2.6	0.265
K (mEq/l), mean ± SD	3.9 ± 0.3	4.1 ± 0.3	< 0.001
Hemoglobin (gm/dl), mean ± SD	10.8 ± 1.3	11.1 ± 0.9	0.243
Hematocrit (%), mean ± SD	30 ± 1.8	29.6 ± 3.3	0.495

K: potassium.

Table 5.
One-month follow-up in the studied groups.

	Group 1 (n = 45)	Group 2 (n = 45)	P-value
IPSS, median(range)	6 (5-8)	7 (6-17)	< 0.001
Quality of life, N (%)			
Mostly satisfied	34 (75.5)	30 (66.6)	
Equivocal	11 (24.4)	11 (24.4)	
Mostly dissatisfied	0	4 (8.9)	
IIEF, median(range)	7 (5-13)	6 (5-12)	0.065
Dysuria, N (%)	11 (24.4)	7 (15.6)	0.292
Pyuria, N (%)	0 (0)	11 (24.4)	< 0.001
Uroflow (ml/sec), mean ± SD	20.1 ± 3.1	17.1 ± 1.9	< 0.001
Residual urine (ml), median (range)	20 (10-70)	25 (0-120)	0.868

IPSS: International Prostate Symptom Score; IEEF: International index of erectile function.

tal stay of two and three days compared to seven days in patients in the open group. No significant differences were observed regarding serum Na (p = 0.265), hemoglobin (p = 0.243), and hematocrit (p = 0.495) levels (Table 4).
After one month from surgery, the TUERP group demonstrated significantly lower IPSS (median = 6 *vs.* 7, p < 0.001) and pyuria (0% *vs.* 24.4%, p < 0.001). In contrast, it showed a significantly higher urinary flow (20.1 ± 3.1 ml/sec *vs.* 17.1 ± 1.9 ml/sec, p < 0.001). Additionally, the quality of life differed between the studied groups, with most TUERP patients being mostly satisfied (75.5%) compared to the open group (66.6%).
No significant differences were observed regarding IIEF (p = 0.065), dysuria (p = 0.292), and residual urine (p = 0.868) (Table 5).
After three months, the TUERP group demonstrated significantly lower IPSS (median = 4 *vs.* 5, p = 0.049) and dysuria (0% *vs.* 15.6%, p = 0.012). In contrast, it showed a significantly higher urinary flow (19.7 ± 2.6 ml/sec *vs.* 18.5 ± 2.5 ml/sec, p = 0.022) and residual urine (median = 16 ml *vs.* 10 ml, p = 0.014). Additionally, the quality of life differed between the studied groups, with most TUERP patients being mostly satisfied (95.5%) compared to the open group (88.8%). No significant differences were observed regarding IIEF (p = 0.588) and pyuria (p = 0.242) (Table 6).
After six months, the TUERP group demonstrated significantly higher urinary flow (19.3 ± 2.7 ml/sec *vs.* 17.7 ± 2.4 ml/sec, p = 0.005) and residual urine (median = 15 ml *vs.* 0, p < 0.001) compared to the open group. No significant differences were observed regarding IPSS (p = 0.189), QOL (p = 0.523), IIEF (p = 0.361), dysuria (p = 0.242), and pyuria (p = 0.242) (Table 7).
As regards the complications in the bipolar TUERP

Table 6.
Three-month follow-up in the studied groups.

	Group 1 (n = 45)	Group 2 (n = 45)	P-value
IPSS, median(range)	4 (2-6)	5 (3-18)	0.049
Quality of life, N (%)			
Mostly satisfied	43 (95.5)	40 (88.8)	
Equivocal	2 (4.4)	5 (11.1)	
IIEF, median(range)	7 (5-13)	7 (5-13)	0.588
Dysuria, N (%)	0 (0)	7 (15.6)	0.012
Pyuria, N (%)	0 (0)	3 (6.7)	0.242
Uroflow (ml/sec), mean ± SD	19.7 ± 2.6	18.5 ± 2.5	0.022
Residual urine (ml), median (range)	16 (5-50)	10 (0-140)	0.014

IPSS: International Prostate Symptom Score; IEEF: International index of erectile function.

Table 7.
Six-month follow-up in the study groups.

	Group 1 (n = 45)	Group 2 (n = 45)	P-value
IPSS, median(range)	3 (2-5)	3 (2-18)	0.189
Quality of life, N (%)			0.523
Pleased	37 (82.2)	34 (75.6)	
Mostly satisfied	8 (17.8)	8 (17.8)	
Equivocal	0 (0)	1 (2.2)	
Mostly dissatisfied	0 (0)	2 (4.4)	
IIEF, median(range)	7 (5-13)	7 (5-13)	0.361
Dysuria, N (%)	0 (0)	3 (6.7)	0.242
Pyuria, N (%)	0 (0)	3 (6.7)	0.242
Uroflow (ml/sec), mean ± SD	19.3 ± 2.7	17.7 ± 2.4	0.005
Residual urine (ml), median(range)	15 (4-40)	0 (0-160)	< 0.001

IPSS: International Prostate Symptom Score; IEEF: International index of erectile function.

Table 8.
Postoperative complications in the study groups.

	Group 1 (n = 45)	Group 2 (n = 45)	P-value
Secondary hemorrhage, N (%)	1 (2.2)	2 (4.4)	1.0
Retention, N (%)	1 (2.2)	0 (0)	1.0
Blood transfusion, N (%)	0 (0)	2 (4.4)	0.494
LUTS, N (%)	2 (4.4)	3 (6.7)	1.0
Bladder neck contracture, N (%)	0 (0)	1 (2.2)	1.0
Urethral stenosis, N (%)	2 (4.4)	0 (0)	0.494

group, two patients developed persistent LUTS postoperatively and were treated with anticholinergics for one month. One patient was catheterized due to urine retention and needed a re-cystoscopy with resection of remnant prostatic tissue. Another patient was hospitalized due to secondary hemorrhage and received IV fluids, antibiotics, and hemostatic drugs for three days without re-catheterization or need for blood transfusion. Two patients developed urethral stenosis, which was treated by visual internal urethrotomy (VIU).
In the open group, two patients needed blood transfusion postoperatively. Three patients developed persistent LUTS and were treated with anticholinergics for six weeks. Two patients were hospitalized due to secondary hemorrhage and received IV fluids, antibiotics, and hemostatic drugs for two days without re-catheterization or need for blood transfusion. At the same time, one patient developed bladder neck contracture and was treated by *bladder neck incision* (BNI).
The study groups had no statistically significant difference (Table 8).

Discussion

BPH is a prevalent condition with substantial costs, leading to increased interest in its management (7). Surgical treatments include resection, enucleation, vaporization, alternative ablative techniques (*Aquablation- Prostatic artery embolization- The Rezum System*), and non-ablative techniques (*Prostatic urethral Lift, Intra-prostatic injections*) (8).
TUERP is a recently developed procedure in which the prostate is transurethrally enucleated and resected using a bipolar plasma kinetic resectoscope.
Many studies suggested that TUERP is a safe and feasible treatment for BPH with few complications (9-11). Although several studies have demonstrated better clinical benefits for TUERP than other treatments, this procedure has yet to be widely accepted for prostates larger than 60 g (12).
Therefore, the current study aimed to compare the safety and efficacy of *transurethral enucleation resection of the prostate* (TUERP) versus open retropubic prostatectomy in patients with LUTS secondary to benign prostatic hyperplasia with prostate volumes larger than 80 cc.
In the current study, the TUERP group demonstrated significantly lower operative time, smaller drop in serum hemoglobin level, less resected tissue weight, smaller drop in hematocrit concentration, and lower incidence of bleeding.
In line with our results, a study by *Wei et al.* found that TUERP had a better outcome regarding operative time and less tissue removal, which may indicate a more precise and targeted approach to prostate surgery (9). *Rao et al.* found that TUERP generated a smaller serum hemoglobin level drop than trans-vesical prostatectomy (2).
In contrast, *Ou et al.* found no significant difference in operative time between the two procedures (p = 0.107) (10). The resected adenoma weight harvested in the trans-vesical prostatectomy group was more than that in the TUERP group, but the difference between the groups was insignificant (p = 0.062).
Similarly, *Wang and Wang* found no statistically significant differences in operative time between both techniques (13).
Some authors reported no significant differences regarding the volume of tissue retrieved and postoperative Hb in both groups (p >0.05) (13, 14). However, some authors reported shorter operative time in open prostatectomy procedures compared to TUERP (2, 14). These findings may be due to variations in the study populations, prostate size, surgical techniques, and outcome measures used in each study.
As supported by several authors (9, 10, 13, 14), we have found that TUERP has advantages over simple prostatectomy in terms of shorter postoperative catheter time and hospital stay.
The current study shows the superiority of the urinary functional outcome of TUERP compared to retropubic prostatectomy. IPSS, Q_{max}, and patient satisfaction were better in the TUERP group within six months of surgery. However, IPSS and patient satisfaction were similar for both techniques six months after surgery.
A study by *Wei et al.* (9) supports our findings that TUERP is better regarding functional outcomes such as IPSS and Q_{max}.
Conversely, other authors reported no superiority for TUERP regarding postoperative urinary functional outcomes compared to simple open prostatectomy.
Giulianelli et al. found no significant differences in the Q_{max} score, QoL score, PSA, and Post-void residual urine between both techniques (14). The smaller prostate size may explain it compared to the populations in our study. Additionally, differences in the follow-up period can contribute to differences in study results. Patients were followed up for 12 months, whereas our study followed up patients for a shorter period.
There were no significant differences in Q_{max} between TUERP and open prostatectomy during the postoperative 1, 3, 6, 12 months, and two years when followed by *Chen et al.* (3). Analysis by *Geavlete et al.* showed no significant differences in QoL or PSA between TUERP and open prostatectomy at each follow-up time point (11). The lack of significant differences in Q_{max}, QoL, and PSA between TUERP and open prostatectomy at multiple follow-up time points in these studies suggests that the two procedures may have similar long-term outcomes in terms of these measures. However, the findings could be affected by patient characteristics, surgical technique, and follow-up period.

Other measures, such as operative time, blood loss, and length of hospital stay, may still favor TUERP over open prostatectomy. Therefore, the choice of procedure may depend on various factors, including patient preference and surgeon experience.

Similarly, *Ou et al.* found no significant difference between the groups regarding IPSS and PVR at 3 and 12 months postoperatively. However, the patients in the open prostatectomy group appeared to have a better Q_{max} at three months, but the difference was insignificant ($p = 0.081$). Each group's mean postoperative PSA reductions were similar ($p = 0.12$) (10).

In contrast, *Giulianelli et al.* observed significantly lower IPSS and PVR scores at 12, 24, and 36 months in the TUERP group when compared with the open prostatectomy group ($p < 0.05$) (14).

We reported 90-day complications after TUERP in 13.3% of patients compared to 17.8% after retropubic prostatectomy with a statistically insignificant difference; urethral stricture predominated after TUERP while blood transfusion dominated in retropubic prostatectomy.

Giulianelli et al. found that dysuria was the most common Grade I complication in the TUERP group ($p < 0.05$) and urinary urge incontinence up to 30 days in the open prostatectomy group ($p < 0.05$). In the Grade II complications, the results favored the TUERP group (postoperative acute urinary retention, $p < 0.05$ and blood transfusion requirement, $p < 0.05$) than the open prostatectomy group. The study favored the TUERP group (capsular perforation and reintervention, $p < 0.05$) over the open prostatectomy group for Grade III complications (14).

Also, *Gratzke et al.* reported a higher incidence of blood transfusion, stress incontinence, and urethral stricture in a large series of open prostatectomies for large prostates (15). UTI and re-catheterization rates were slightly lower in a study by *Tubaro et al.* (16). *Serretta et al.* detected a higher incidence of bleeding, blood transfusions, and sepsis in open prostatectomies. Reinterventions were also higher, mainly due to bladder neck stenosis (17). Also, *Wang and Wang* (13) and *Wei et al.* (9) found that the incidence of complications in the TUERP group was statistically lower ($p < 0.05$). *Geavlete et al.* found no statistical differences between TUERP and open prostatectomy concerning transient incontinence, bladder neck contracture, or urethral stricture (11).

Limitations of the study

Despite being a prospective randomized trial, the current study has some limitations. Firstly, it has a small sample size. Secondly, the follow-up period is short.

Additionally, it is essential to note that the study only included patients with prostate volumes larger than 80cc, which may not represent patients with smaller prostate volumes.

Conclusions

The number of patients with large prostate volumes undergoing surgical therapy is increasing, and the trend is likely to continue as the population ages. The present study found that TUERP had equivalent efficacy and safety to open retropubic prostatectomy for patients with BPH and prostate volumes > 80 ml.

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