Role of Prostate Ultrasonography to Predict The Efficacy of Bipolar Prostatectomy in Benign Prostatic Hyperplasia

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Abstract

Background: We evaluated the role of prostatic ultrasonography to predict the clinical outcomes of Bipolar Transurethral resection of the prostate.

Methods: 109 Patients complaining of lower urinary tract symptoms (LUTs) due to Benign Prostatic Hyperplasia **(**BPH) were evaluated preoperatively and postoperatively (at 1, 3, and 6 months) using ultrasonography (pelvi-abdominal and transrectal), the International Prostate Symptom Score (IPSS), uroflowmetry, post-void residual urine volume (PVR), ejaculatory domain, and the erectile function domain of the International Index of Erectile Function (IIEF-ED). The safety of the procedure was assessed by Modified Clavien classification of complications.

Result: There was a close correlation between residual tissue of prostate detected by ultrasonography and clinical outcomes. The prostate volume was significantly decreased postoperatively with a concomitant significant improvement of IPSS, Qmax, and PVR over six months of follow-up (P <0.001). 57.8 % of the cases in this study were sexually active, and there was no significant difference in the IIEF-ED score between preoperative and postoperative evaluation.

Conclusion: Prostate ultrasonography has a significant predictive value as a single investigating tool to evaluate the clinical outcomes after bipolar transurethral resection of the prostate (TURP). The maximum improvement in IPSS and ultrasonographic measurements were detected at six months postoperatively.

Background

Lower urinary tract symptoms caused by BPH can impact daily activity and may lead to serious outcomes [1]. The prevalence of BPH is estimated to begin its increase in the fourth decade of life from 5–10% to greater than 90% for men above 85 years old [2].

Bladder outlet obstruction results from various functional and anatomical factors such as mechanical compression of the prostatic urethra by an enlarged prostate, increased prostate urethral angle and increased smooth muscle tone in the prostatic urethra[3]. Several methods have been used to evaluate BPH subjectively by IPSS and objectively by ultrasonography (for estimation of prostate volume and PVR) and urinary flow rate[4].

By the mid-1980s, Transrectal ultrasonography (TRUS) had become a standard diagnostic tool for urologists and radiologists. The first description of prostate volume using TRUS was by **Watanabe et al.** and reported accurate results [5]. Few studies have assessed the correlation between prostate volume and outcome after TURP [6].

According to the European Association of Urology guidelines (EAU), TURP is the current surgical standard procedure for men with prostate sizes of 30–80 mL [7]. However, monopolar TURP is still associated with

a risk of hemorrhage, particularly in patients with larger prostates or bleeding disorders. There is also a risk of Trans-urethral Resection (TUR) syndrome [8].

The most significant improvement of TURP was the incorporation of bipolar technology. The electric current completes the circuit without passing through the patient. This allows the saline solution to be used for irrigation during resection instead of electrolyte-free solutions, thereby eliminating hyponatremia and TUR syndrome with excellent hemostasis[9].

The aim of study is to evaluate the role of prostatic ultrasonography to predict the clinical outcomes of bipolar transurethral resection of the prostate.

Materials And Methods

Between December 2018 and June 2019, 109 patients were enrolled in the study and underwent bipolar TURP. Informed consent was obtained from all patients, and the institutional ethics committee approved the study.

A full medical history was obtained. The patients were evaluated preoperatively and postoperatively at (1,3,6) months using IPSS, ultrasonography, uroflowmetry, and laboratory investigations (urine analysis, urine culture, serum electrolytes, kidney function, complete blood count, PSA). The patient's sexual function (erection and ejaculation) was assessed preoperatively and at 3,6 months postoperatively using a score derived from IIEF-ED.

Pelvi-abdominal ultrasonography and TRUS were carried out preoperatively while postoperatively at (1,3,6) months pelvi-abdominal ultrasonography was done, but TRUS was done only (3,6) months by an experienced sonographer. TRUS was not done early postoperatively at one month due to the painful manipulation of the rectal probe. Prostate volumes (total and transition zone) and PVR were estimated using TRUS and abdominal ultrasonography, respectively. Also, urinary bladder wall thickness and diverticulae were estimated by the pelvi-abdominal US.

The patients who met the following inclusion criteria were enrolled in our study, symptomatic BPH that required surgery owing to urinary retention, failed medical therapy, urinary bladder stones, obstructed uroflowmetry, and IPSS more than 19. Patients with neurogenic bladder, previous prostatic or urethral surgery, prostate cancer, significant co-morbidities (liver failure, congestive heart failure), and Patient unable or unwilling to comply with follow-up schedule were excluded.

Under spinal anesthesia, cystourethroscopy is followed by bipolar resection of the prostate by a single experienced urologist under saline irrigation followed by a 22-F or 24-F three-way Foley catheter fixation.

Operating time, length of hospitalization, intraoperative and postoperative complications, catheterization time, changes in hemoglobin levels were recorded.

Statistical Analysis

Data were analyzed using SPSS 21.0 for Windows (SPSS, USA). Normality tests (Kolmogorov–Smirnov test) were performed to evaluate the distributions of numeric variables. If the distribution of numeric variables were normal, statistical analysis was performed using parametric Student's t-tests. Mann–Whitney U-tests were used to evaluate numerical variables with a skewed distribution. Categorical variables were analyzed using chi-squared or Fisher's exact tests. The level of statistical significance was set at 5% ($P < 0.05$). A highly significant difference was present if $p \leq 0.001$.

Results

One hundred nine patients with BPH met the inclusion criteria underwent bipolar-TURP, with follow up for at least six months. The mean age (mean ± SD) 65.53 ± 6.27, The mean body mass index was 24.6 ± 1.7. Other patient demographic data were shown in **Table (1)**

Table (1) Distribution of the studied patients regarding demographic data and baseline characteristics :

	Mean ± SD	Range
Age (year)	65.53 ± 6.27	47 – 83
BMI (kg/m2)	24.61 ± 1.77	20.5 – 27.7
PSA (ng/mL)	4.03 ± 3	0.13 – 20
	N=109	**%**
Sexual history:		
Sexual active	63	57.8%
Sexual inactive	46	42.2%
Complaint:		
Obstructive LUTS	57	52.3
Urine retention	17	15.6
Obstructive and irritative LUTS	35	32.1
DRE:		
Mild	24	22.0
Moderate	41	37.6
Marked	44	40.4
Anal tone:		
Intact	109	100
ASA score:		
1	82	75.2
2	23	21.1
3	4	3.7

The initial estimation of total prostate volume preoperatively using ultrasonography (TRUS, pelvi-abdominal) was ranged from 30–195 gm with a mean 86 gm (mean ± SD 86.32 ± 43.61 gm) while the transition zone volume was ranged from 19–105 gm with a mean 47.5 gm (mean ± SD 47.52 ± 25.84 gm). After the operation, there was a significant decrease in the mean ± SD residual prostate tissue estimated by ultrasonography, which was as follows: 43.24 ± 17.09, 29.17 ± 9.42, 23.67 ± 6.03 gm at (1, 3, 6 months), respectively (P < 0.001), **Figure (1)** this decrease was associated with a significant improvement of IPSS, Qmax, and PVR.

As regard, preoperative IPSS (mean ± SD) 25.68 ± 2.67 was significantly improved postoperatively 9.17 ± 4.32, 5.19 ± 4.53, 4.87 ± 3.30 at (1, 3, 6 months) respectively (P < 0.001). Preoperative Qmax (mean ± SD) 8.94 ± 2.71 ml/sec was significantly improved postoperatively 16.14 ± 3.58, 18.20 ± 4.54, 19.77 ± 5.22 ml/sec at (1, 3, 6 months) respectively (P < 0.001) .

Preoperative PVR (median) 100 ml (10–660) was significantly improved postoperatively 35 ml (10–180), 20 ml (10–170), 15 ml (10–150) at (1, 3, 6 months) respectively (P < 0.001). **Table (2)**

Of the total 109 patients, 63 patients were sexually active. There was no change observed in IIEF-ED scores at 3, 6-month postoperatively (mean ± SD) 33.60 ± 8.3, 34.75 ± 9.93 respectively compared with the preoperative scores 32.79 ± 6.64 (P = 0.9, 0.6)at 3,6 months, respectively. Regarding the ejaculatory function, our study reported a significant decrease (median) 3(0–12), 5(0–15) at 3, 6 months, respectively, compared with the preoperative scores 19 (0–32) (P < 0.001). Forty-six sexually inactive patients did not show any improvement of sexual function postoperatively. **Table (2)**

Table (2) Distribution of the studied patients according to procedure outcomes :

Variable (Mean± SD)		Preoperative	1 month	3 month	6 months	P	
Prostate volume (TRUS)	total	86.32 ±43.61	43.24±17.09	29.17± 9.42	23.67 ± 6.03	<0.001	
	TZ	47.52 ± 25.84					
IPSS		25.68 ± 2.67	9.17± 4.32	5.19 ± 4.53	4.87± 3.30	<0.001	
QOL **(Median)**		6(4 – 6)	2(1 – 4)	1(0 – 4)	0(0 – 5)	<0.001	
PVR (**Median**)		100 (10-660)	35(10-180)	20(10-170)	15(10-150)	<0.001	
Q max		8.94 ± 2.70	16.14± 3.58	18.20± 4.54	19.77 ± 5.22	<0.001	
IIEF-15		32.79 ± 6.64	----------	33.60 ± 8.3	34.75 ±9.93	0.9 (3m)	0.6 (6m)
Ejaculatory function **(Median)**		19	----------	3	5	<0.001	
Hemoglobin (g/dl)		13.57 ± 1.62	12.02± 1.58 (After24hours)	----------	----------	0.37	
Hematocrit (%)		39.79 ± 4.99	36.06 ± 4.73 (After24hours)	----------	----------	0.39	
Sodium level (Na)		138.53 ± 4.77	136.46±3.42 (After24hours)	----------	----------	0.33	
PSA (ng/dl)		4.04 ± 3.0	----------	----------	2.16± 1.33	<0.001	

The mean operative time of 63.05 ± 20.5 minutes. Patients were catheterized for a mean ± SD of 4.86 ± 1.84 days. Patients were discharged home at a mean ± SD 2.13 ± 0.53 days. **Table (3)**

Table (3) Distribution of the studied patients according to operative data:

	N=109	%
Cystoscopy:		
Diverticulum	10	9.2%
High bladder neck	26	23.9%
Trabeculations	57	52.3%
Trilobar	16	14.7%
Blood transfusion:		
No	106	97.2
Packed RBCs	3	2.8
	Mean ± SD	**Range**
Operative time (minutes)	63.06 ± 20.53	20 – 95
intraoperative saline Irrigation (litres)	21.05± 6.17	7 – 35
Length of hospital stay (days)	2.14 ± 0.54	2 – 5
Catheterization days	4.86 ± 1.84	2 – 7

Modified Clavien classification of complications was used to assess complications. Blood transfusions were required in 3 patients (2.8%). Preoperative hemoglobin was 13.27 ± 1.67 g/dL, while Postoperative hemoglobin was 12.02 ± 1.58 g/dL after 24 h of follow-up (P 0.37). TUR syndrome did not occur in any of our patients. **Table (4)**

Table (4) Distribution of the studied patients according to operative complications:

Clavian Grading	Graded complications	N=109	Management
I	• Fever	1 (0.9%)	• Fomentations + antipyretics
II	• Anemia necessitating transfusion • Meatal stenosis • Meatal stenosis • • • Urethral stricture • Failedtrial of voiding (clot retention)	3 (2.8%) 2 (1.8%) 2(1.8%) 9 (8.3%)	• Blood transfusion • Meatotomy • DVIU • Recatheterization followed by another trial of voiding
III a	• --		• --
III b	• --		• --
IV a	• Ischaemic stroke • Hypovolemic shock	1 (0.9%) 1 (0.9%)	• Conservative measures (ICU admission)

			• Conservative measures (ICU admission)

Discussion

According to the EAU (European Association of Urology) guidelines, the “gold standard” approaches for surgical treatment BPH are monopolar TURP for patients when the prostate size ranges from 30 to 80 cc, and open prostatectomy or holmium laser enucleation (HoLEP) or Bipolar TURP for patients with prostate size > 80 ccs [10]. Bipolar TURP is associated with a high success rate reflected by substantial improvements in symptom scores, urinary flow rate, PVR, and low retreatment on long-term follow-up. Bipolar electrosurgical technology is a new modality, where the current flows from the loop (the active electrode) to the loop tube and the resectoscope itself [11]. In our study, 109 patients underwent bipolar TURP using saline irrigation with a good success rate postoperatively.

The correlation between prostate volume and many variables of BPH has been evaluated using different investigations, e.g., ultrasonography and cystourethroscopy. While **Green et al.** concluded that TRUS provided an accurate measurement of the prostate volume and could be used to evaluate the response to therapy for patients with BPH [12]. In our study, we use TRUS to evaluate the preoperative and postoperative prostate volume. We also detected that pelvi-abdominal ultrasonography is also essential for the assessment of PVR and urinary bladder changes.

The efficacy of bipolar TURP had been measured by the impact of such technique on residual prostatic tissue volume, Qmax, IPSS, and PVR, compared to baseline, which was provided at follow-up periods of 1,3 and 6 months. In our study, residual tissue measured by ultrasonography 1,3,6 months after TURP provided a good estimate of the clinical result; the correlation of the residual tissue with all outcome variables suggested that the smaller the residual tissue, the greater the improvement in the outcome variables. The explanation is that the better clinical result after TURP correlates significantly with the completeness of resection of the obstructing adenoma, and the maximum effect was obtained at six months.

In our study, The reported progressive decrease in the estimated residual prostate volume was associated with a dramatic improvement of IPSS, Qmax, and PVR over the six months of follow up. The mean preoperative prostate volume estimated by ultrasonography, IPSS, Qmax, PVR were 86.32 ± 43.61, 25.68 ± 2.67, 8.94 ± 2.70, (median) 100ml, respectively ($P < 0.001$). The mean postoperative (at 6 month) prostate volume estimated by ultrasonography, IPSS, Qmax, PVR were 23.67 ± 6.03, 4.87 ± 3.30, 19.77 ± 5.22, (median) 15ml, respectively ($P < 0.001$).

In agreement with our results, **Hassona et al.** In bipolar TURP group, the mean postoperative prostate size has decreased from 63.33 ± 9.71 to 25.87 ± 3.76 at three months follow up ultrasound and also showed improved mean Qmax from 8.47 ± 1.36 to 19.87 ± 3.78 at three months; the mean PVR improved from

131.20 ± 32.48 to 30.93 ± 7.06 at three months [13]. **ZhengX et al.**, in their study, indicated that bipolar TURP had improvement in 6-month IPSS, 1-, 6- and 12-month Qmax, 6-month PVR, and 3- and 6-month QoL [14]. **Kumar et al.** showed improvement of Qmax in Bipolar TURP group from 7.05 ± 1.87 to 18.07 ± 5.88, 19.27 ± 5.17, 20.48 ± 5.15, 19.93 ± 5.17 1,3,6,12 months, respectively [15].

Hastak et al. suggested that normal prostate tissue, which is compressed by the enlarged adenoma, is released after resecting the adenoma and occupies part of the resection cavity [16]. The same observation was reported in our study explaining the residual tissue at six months of follow up, despite resection of the enlarged adenoma of the transitional zone.

Suspected mechanisms in ED following TURP are thermal and/or chemical injuries of the erectile nerves traveling just beneath the prostatic capsule and may be due to the psychological effects post TURP [17,18,19,20]. In our study, according to IIEF-15 validated questionnaire, no change was observed in IIEF-ED scores at 3,6 months postoperatively compared with the preoperative scores. For the ejaculatory function, our study reported a significant decrease at 3, 6 months of follow up.

Mean operative time was 63.05 ± 20.53 in our study. **Bogdan et al.** have demonstrated in their study that the mean operative time was 52.1 and 55.6 minutes in the bipolar TURP and Plasma kinetic vaporization of the prostate (PKVP) group, respectively [21]. Our study's longer operative time is that a considerable number of our patients presented with a larger prostate adenoma size than those described in their study. The mean catheterization time and mean hospital stay were 4.86 ± 1.84 and 2.13 ± 0.53 days. In similar studies, **Tefekli** and **de Sio** et al. reported shorter catheterization and hospitalization times in the bipolar resection group [22,23].

Three patients (2.8%) of our study needed a blood transfusion after the surgery comparison to previously published studies where the transfusion rate in Bipolar TURP was 3.4% [24,25]. **Bogdan et al.**, in their study, stated that 5.9% of patients who underwent Bipolar TURP needed recatheterization [21].while in this study, the cases needed recatheterization was nine patients (8.3%) due to clot retention .

Conclusion

The Pelvi-abdominal and Transrectal ultrasonography as a single non-invasive imaging tool is effective for predicting the clinical outcomes of Bipolar prostatectomy. The smaller the residual adenoma postoperatively correlates significantly with improvement in IPSS and bother scores mostly at six months after Bipolar TURP.

List Of Abbreviations

lower urinary tract symptoms (LUTs)

Benign Prostatic Hyperplasia (BPH)

the International Prostate Symptom Score (IPSS)

post-void residual urine volume (PVR)

International Index of Erectile Function (IIEF-ED)

Transrectal ultrasonography (TRUS)

the European Association of Urology guidelines (EAU)

Transurethral Resection of the Prostate (TURP)

Declarations

Ethics approval and consent to participate: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all subjects .

Consent for publication: Formal consent was signed by the participants for sharing in this research.

Availability of data and materials: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests: there is no conflict of interest

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Authors' Contributions:

A.I; methodology, idea formulation and reference collection – D.T; review writing and revision, editing final draft - M.T; formal analysis, data collection –H.N; Supervision T.A; data collection, final revision

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Figures

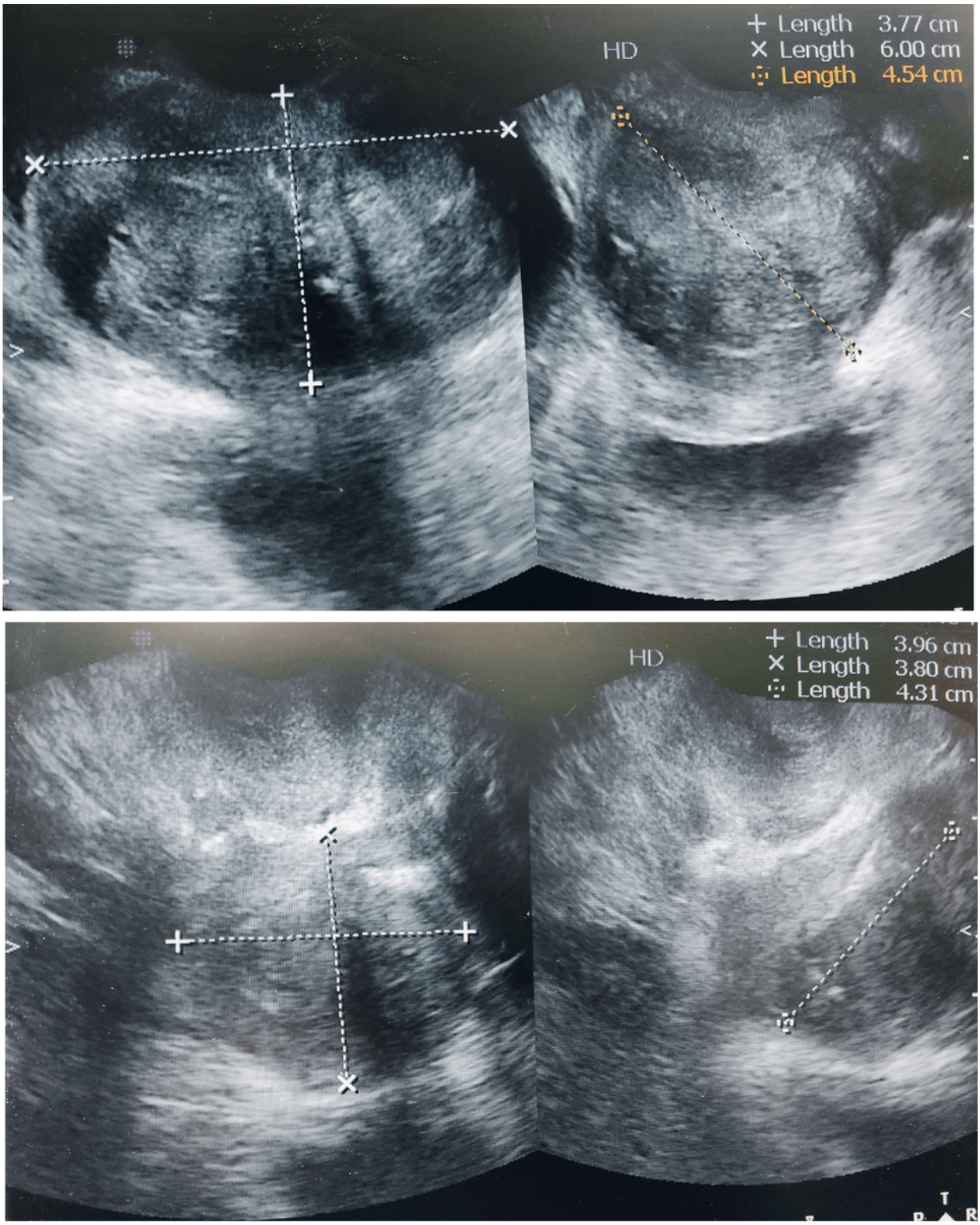

Figure 1

Prostate volume preoperatively (a) and at 6 months postoperatively(b) respectively by ultrasonography