

**Original Research Article**

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## **Bipolar Transurethral Resection (B-TURP) versus vaporization (B-TUVP) in management of benign prostatic hyperplasia.**

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### **Abstract**

**Objectives:** To compare the perioperative complications and outcome of bipolar transurethral vaporization of the prostate (TUVP) with bipolar transurethral resection of the prostate (TURP).

**Patients and methods:** From October 2015 to February 2019, 80 patients underwent bipolar TUVP (B-TUVP, N = 40) or bipolar TURP (B-TURP, N = 40) in a single-center prospective randomized trial who were referred for surgical management of moderate to severe LUTS secondary to BPH. The inclusion criteria were age > 52 years, serum total PSA < 4ng/ mL, prostate volume 35-85 ml, IPSS 20 and Qmax 10mL/s. The intraoperative parameters including operative time, irrigation fluid volume and complications were evaluated and Q max and IPSS were assessed preoperative and 3m postoperative in all patients.

**Results:** No significant difference in the mean patient age, prostate volume, pre-operative IPSS and Qmax in both groups. The mean values of operative time, post-operative hospital stay, catheterization period, irrigation fluid volume, mean hemoglobin drop and mean changes in sodium level in the B-TUVP group were significantly lower than the B-TURP group. No significant differences were seen in overall complication and modified Clavien classification of complication between the B-TUVP and the B-TURP groups. No TUR syndrome, obturator reflex or epididymitis were seen in both groups. Post-operative hematuria and clot retention [N=2], urethral stricture [N=1] occurred only in those patients who underwent B-TURP. Urinary retention after catheter removal [N=2] were reported only in the B-TUVP groups. Three months after procedure, significant improvement in the mean values of IPSS and Qmax were seen in the B-TUVP and the B-TURP groups. But the B-TUVP had significantly higher efficacy compared the B-TURP.

**Conclusion:** Bipolar TUVP represents a high efficacy, safety and low cost procedure among minimally invasive surgeries of BPH. In a comparison to B-TURP, B-TUVP had similar complications but give better perioperative and postoperative outcomes, higher efficacy and superior hemostasis.

**Keywords:** TURP, TUVP, Post-operative hematuria, BPH.

## Introduction

Benign prostatic enlargement is a common problem in the aging men and may lead to lower urinary tract symptoms (LUTS). Several endourologic minimally invasive procedures have been suggested and used for surgical treatment of moderate to severe LUTS related to benign prostatic hyperplasia (BPH). [1].

Although conventional monopolar transurethral resection (TUR) of the prostate (TURP) has been applied as a gold standard surgical modality [2], its outcomes including patient discomfort, prolonged catheterization and hospitalization duration, need to transfusion and re-admission due to hemorrhage or clot retention, high volume of irrigation fluid, electrolyte imbalance and TUR syndrome, urinary retention, or incontinence, elicited the tendency to the use of newer technologies such as bipolar energy or laser energy for resection, vaporization, ablation or enucleation and changing the irrigation fluid from glycine to normal saline in the endoscopic management of BPH [3].

Bipolar technology using saline conductive medium accompanies with proper translucency, similar osmolality to the serum, minimal risk of dilutional hyponatremia, and TUR syndrome, larger removal of prostate tissue, smaller coagulation depth, longer time for safe resection and coagulation, less tissue damage due to lower energy, and lower temperature and thermal damage [4].

Nowadays bipolar TURP is used in many centers due to several benefits and superior or similar results in comparison with monopolar TURP [5]. Bipolar transurethral vaporization of the prostate (TUVP) in saline using hovering technique is an easy learning low cost procedure in comparison to laser technique. Bipolar TUVP provides suitable depth of coagulation, high hemostasis and proper outcomes in comparison with monopolar TUVP and monopolar TURP [6].

In this study, the perioperative and post-operative outcomes of bipolar TUVP and bipolar TURP in a prospective randomized trial will be compared in

patients with moderate to severe LUTS secondary to BPH.

## Patients and Methods

From October 2015 to November 2018, 80 patients underwent bipolar TUVP (B-TUVP, N = 40) or bipolar TURP (B-TURP, N = 40) in a single center prospective randomized trial who were referred for surgical management of moderate to severe LUTS secondary to BPH. All procedures were performed successfully under spinal anesthesia.

**Before operation**, all patients were assessed by medical history, general physical and regional neurological examinations, digital rectal examination (DRE), laboratory tests (CBC, hemoglobin and hematocrit, coagulation tests, serum prostate specific antigen [PSA], ESR, BUN, serum creatinine and electrolytes [sodium, potassium], urine analysis, urine culture and sensitivity test), abdominal ultrasonography (including measurement of the prostate volume), international prostate symptom score (IPSS) questionnaire and uroflowmetry (measurement of maximum flow rate [Qmax]).

**The inclusion criteria** were age > 50 years, prostate volume of 30-80mL, serum PSA < 4ng/mL, IPSS 20, Qmax 10mL/s and failed BPH-related medical therapy.

**The exclusion criteria** were abnormal DRE or ultrasonography with suspicion of prostate cancer, history of prostate cancer, serum PSA 4ng/mL, previous urethral or prostate surgery, urethral stricture, neurogenic bladder, bladder calculi, renal insufficiency and severe co-morbidities or co-existing diseases.

**The procedures** were accomplished under direct sight by continuous flow irrigation with normal saline (0.9% NaCl), the storz bipolar generator (cutting: 280 W; coagulation: 125 W), the classical and traditional surgical steps of transurethral resection in saline (TURis) for TURP and hovering technique for TUVP. A standard resection loop and a "button-type" vaporization electrode were used for TUR is and

vaporization without resection respectively. In all patients, a 20-24Fr three-way Foley catheter was placed at the end of the procedure.

**The parameters** including operative time, irrigation fluid volume, catheterization period, postoperative hospital stay, complications and postoperative changes in hemoglobin, serum creatinine, sodium and potassium levels were assessed in all patients. Also three months after procedure, the IPSS and Qmax were measured for evaluation of efficacy in all cases.

A preoperative cystoscopy is usually not recommended unless there is suspicion of urethral or bladder pathologies.

#### **Statistical methods:**

Data were coded and entered using the statistical package SPSS version 25. Data was summarized using mean, standard deviation, standard error of the mean, median, minimum and maximum in quantitative data and frequencies (number of cases) and relative frequencies (percentages) for categorical variables.

Comparisons between groups were done using **unpaired t test** in normally distributed quantitative variables while non-parametric **Mann-Whitney test** was used for non-normally distributed quantitative variables. For comparison of serial measurements within each patient the non-parametric **Wilcoxon signed rank test** was used [7].

For comparing categorical data, **Chi square ( $\chi^2$ )** test was performed. **Exact test** was used instead when the expected frequency is less than 5 [8]. P-values less than 0.05 were considered as statistically significant.

#### **Results**

The mean **patients age** ( $69.73 \pm 5.02$  vs.  $69.20 \pm 5.40$  years) and mean **prostate volume** ( $54.70 \pm 9.55$  vs.  $57.98 \pm 9.11$  mL) were similar between B-TUVP and B-TURP groups **Table[1]**.

No significant differences were seen in **pre-operative IPSS** ( $P = 0.865$ ) and **Qmax** ( $P = 0.145$ ) between B-TUVP ( $25.53 \pm 2.30$ ;  $8.52 \pm 0.82$  mL/s) and B-TURP ( $25.68 \pm 2.21$ ;  $8.17 \pm 1.06$  mL/s) groups. **Table [1]**.

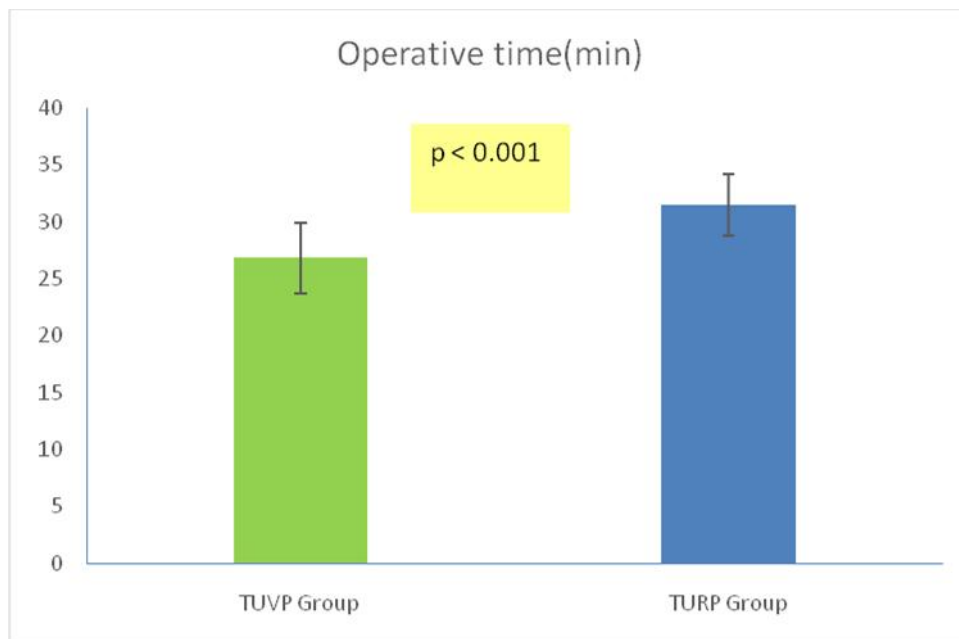
The mean values of **operative time** ( $26.83 \pm 3.10$  vs.  $31.45 \pm 2.71$  minutes), postoperative **hospital stay** ( $1.75 \pm 0.67$  vs.  $2.15 \pm 0.89$  days) (hospitalization was calculated by the time the patients were discharged after the operation), **catheterization period** ( $4.25 \pm 0.44$  vs.  $4.78 \pm 0.62$  days) and **irrigation fluid volume** ( $10.38 \pm 1.33$  vs.  $13.80 \pm 0.94$  liters) in the B-TUVP group were significantly ( $P < 0.05$ ) lower than the B-TURP group.

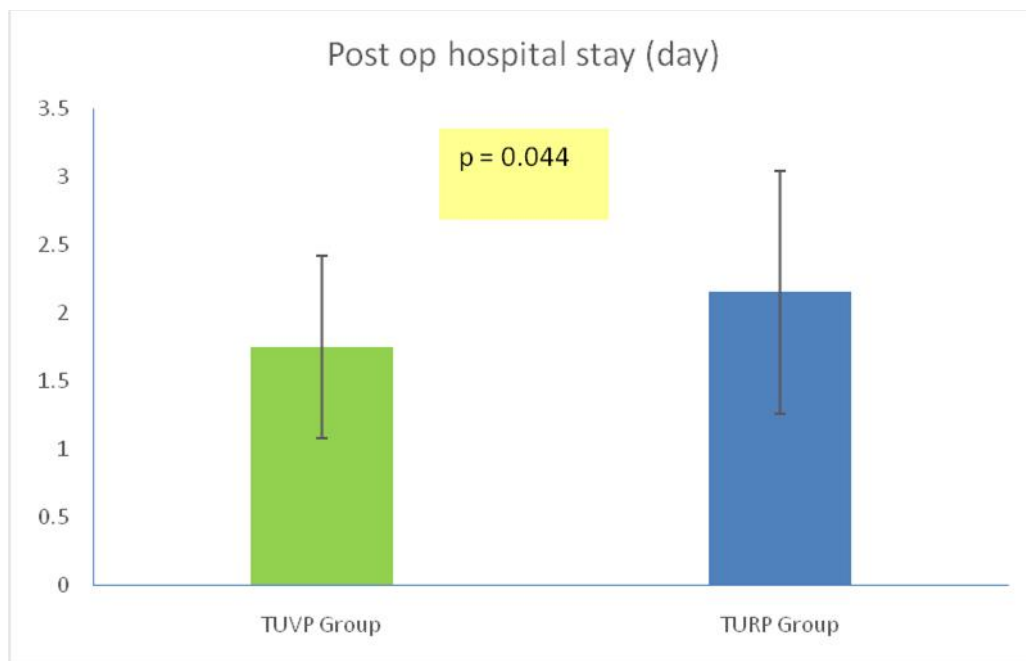
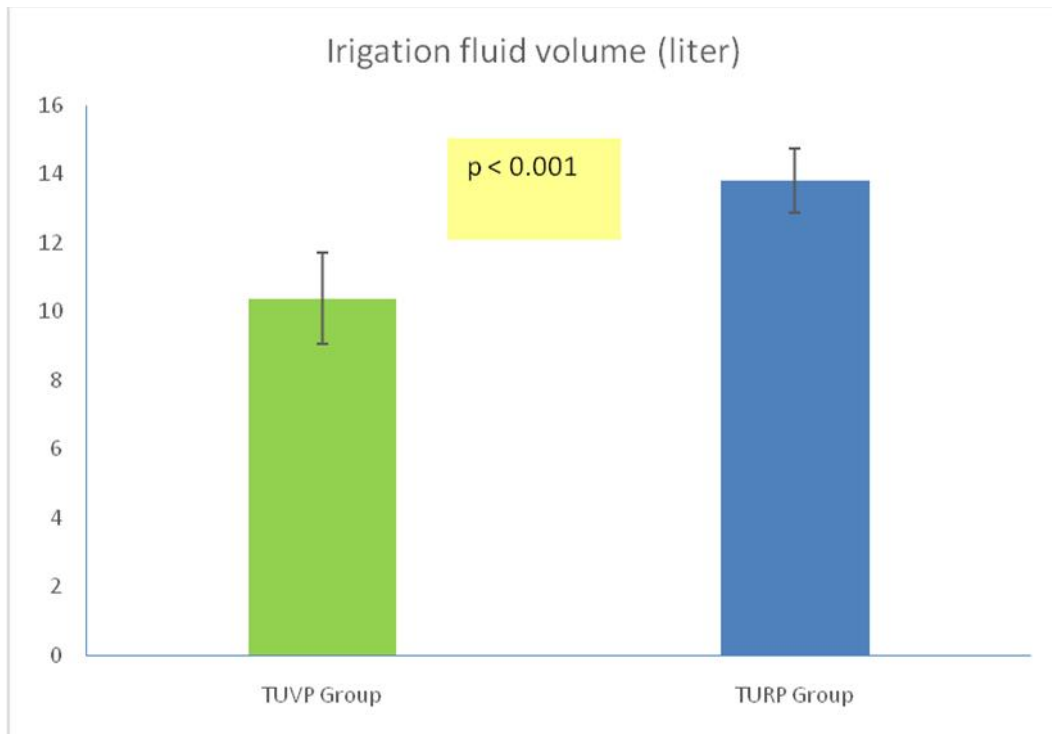
Compared with the B-TURP group, the mean **hemoglobin drop** ( $0.58 \pm 0.26$  vs.  $1.52 \pm 0.58$  g/dL) and the mean changes in **sodium** level were significantly ( $P < 0.05$ ) lower for the B-TUVP group [**Table 1**].

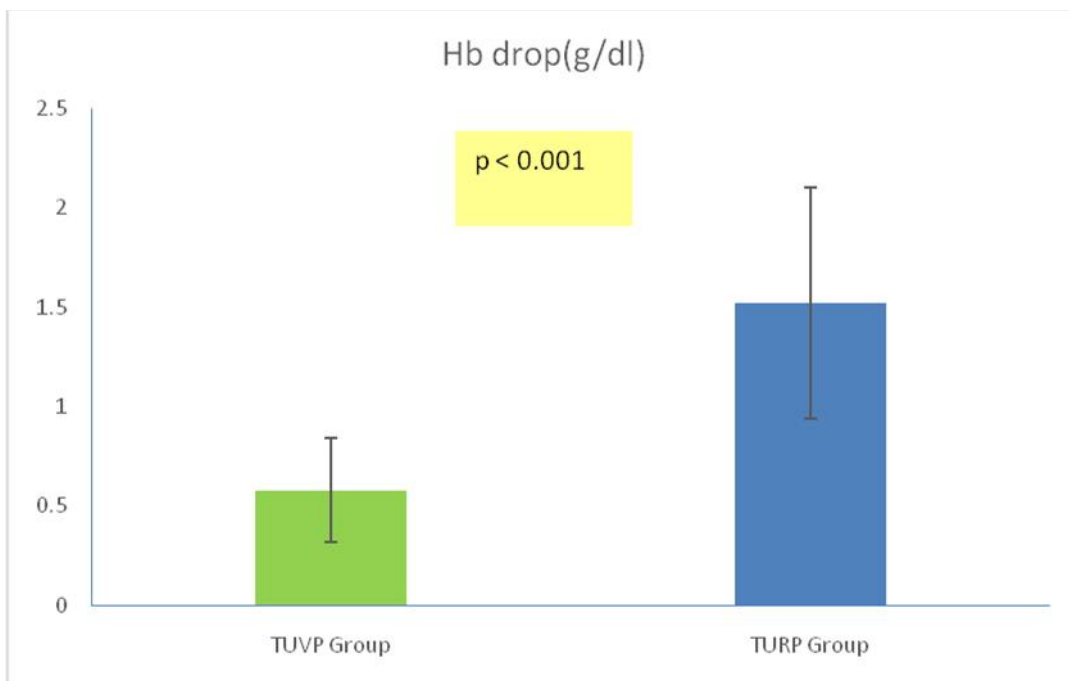
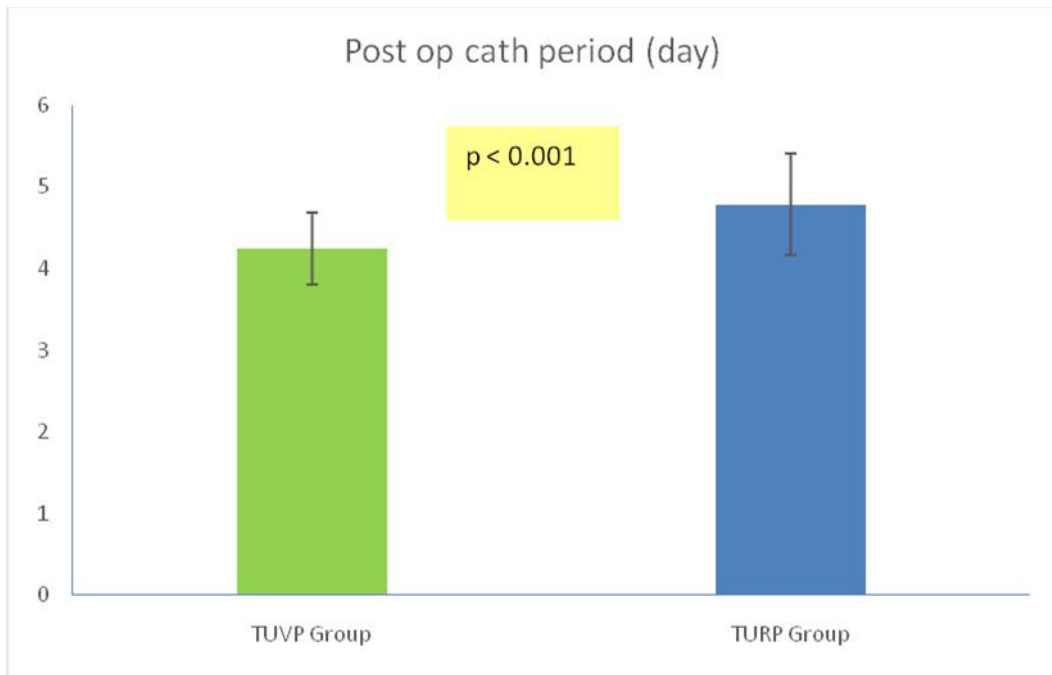
[Table 1 ]: - Patient- and operation-related parameters in Bipolar TUVP and Bipolar TURP groups.

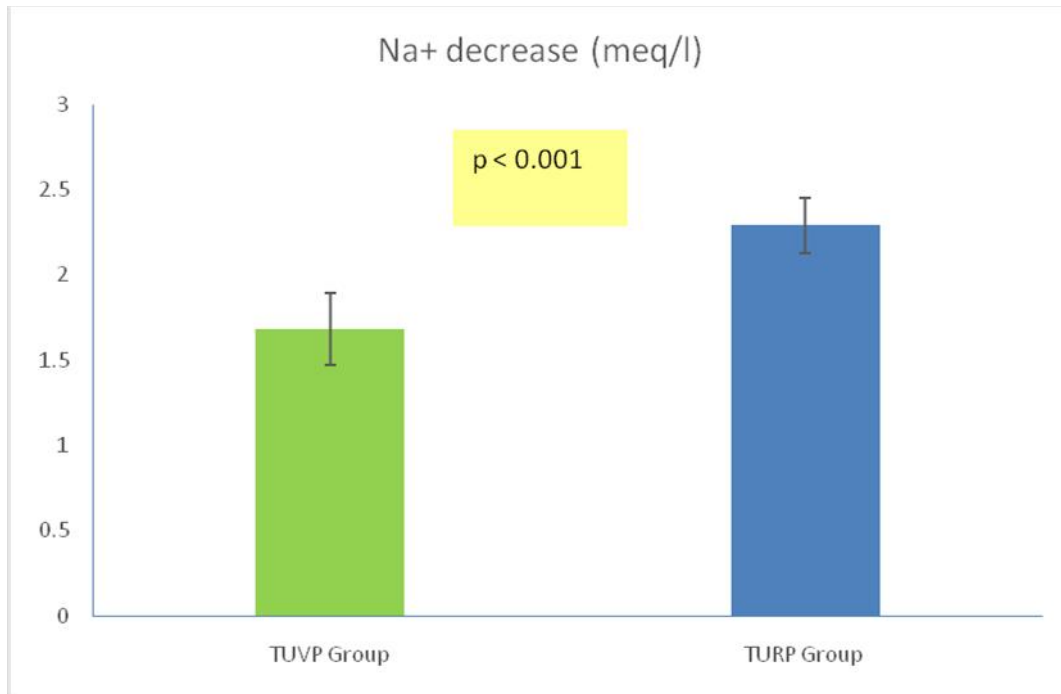
<i>Parameter</i>	<b>Bipolar TUVP</b>	<b>Bipolar TURP</b>	P-value
<b>Patients, n</b>	<b>40</b>	<b>40</b>	
<b>Mean Age</b> (range; SE), year	<b>69.73± 5.02</b> (59-80 ; 0,79)	<b>69.20± 5.40</b> (58-82 ; 0,85)	0.645 §
<b>Mean Prostate Volume</b> (SE), mL	<b>54.70± 9.55</b> (37-75 ; 1.51)	<b>57.98± 9.11</b> ( 40-78 ; 1,44)	0.121 §
<b>Mean Operative Time</b> (range; SE), minute	<b>26.83± 3.10</b> (22-35 ; 0,49)	<b>31.45± 2.71</b> (25-35 ; 0,43)	< 0.001 §
<b>Mean Irrigation Fluid Volume</b> (range; SE), liter	<b>10.38± 1.33</b> (8-13 ; 0,21)	<b>13.80± 0.49</b> (12-15 ; 0,15)	< 0.001 §
<b>Mean Postoperative Hospital stay</b> (range; SE), day	<b>1.75± 0.69</b> (1-3 ; 0,67)	<b>2.15± 0.89</b> (1-4 ; 0,89)	0.044*
<b>Mean Postoperative Catheterization Period</b> (range; SE), day	<b>4.25± 0.44</b> (4-5 ; 0,07)	<b>4.78± 0.62</b> (4-6 ; 0,10)	< 0.001§
<b>Mean Hemoglobin Drop</b> (range; SE), g/dL	<b>0.58± 0.26</b> (0.1-1.5 ; 0,04)	<b>1.52± 0.58</b> (0.5-3 ; 0,09)	< 0.001*
<b>Mean Serum Creatinine Level Increase</b> (range; SE), mg/dL	<b>0.14± 0.07</b> (0.02-0.3 ; 0,01)	<b>0.18± 0.09</b> (0.06-0.4 ; 0,01)	0.072*
<b>Mean Serum Sodium (Na+) Level Decrease</b> (range; SE),meq/l	<b>1.68± 0.21</b> (1.3-2.2 ; 0,03)	<b>2.29± 0.16</b> (2-2.6 ; 0,03)	< 0.001*
<b>Mean Serum Potassium (K+) Level Increase</b> (range; SE), meq/l	<b>0.37± 0.26</b> (0.02-0.9 ; 0,04)	<b>0.36± 0.15</b> (0.1-0.7 ; 0,02)	0.570*

SE = Standard error of mean; \* = Mann-Whitney test; §= Independent T test.









The overall **complication** rate was 10.0 % in the B-TUVP group and 15.0 % in the B-TURP group. No significant differences ( $P > 0.05$ ) were seen in overall complications and modified Clavien classification of complications between the B-TUVP and the B-TURP groups.

Low grade self-limited **fever** occurred in two patients ( 5.0 %) of the B-TUVP group and in three patients (7.5 %) of the B-TURP group and this difference was non-significant ( $P = 0.626$ ).

No **TUR syndrome**, **obturator reflex** or **epididymitis** were seen in both groups.

Two patients (5.0 %) experienced **postoperative hematuria** and **clot retention** during one week

after B-TURP procedure and were re-hospitalized. These patients were treated by bladder fluid irrigation and required blood transfusion.

**Urinary retention** occurred after catheter removal in the two patients who underwent B-TUVP. One of them was re-catheterized for a short period and the other one re-treated with repeat B-TUVP.

During a three month follow-up, **urethral stricture** occurred only in one patient following B-TURP who was treated by endoscopic urethral dilation **Table[2]**.

**Table[2]:-** Complications in Bipolar TUVP and Bipolar TURP groups.

Parameter	Bipolar TUVP	Bipolar TURP	P-value
Complication, n (%)	4 (10%)	6 ( 15%)	0.499†
TUR syndrome, n (%)	0 (0%)	0 (0%)	-
Obturator Reflex, n (%)	0 (0%)	0 (0%)	-
Epididymitis, n (%)	0 (0%)	0 (0%)	-
Fever, n (%)	2 (5%)	3 (7.5%)	1*
Postoperative Hematuria, n (%)	0 (0%)	2 (5%)	0.494*
Transfusion, n (%)	0 (0%)	2 (5%)	0.494*
Clot Retention, n (%)	0 (0%)	2 (5%)	0.494*
Re-hospitalization, n (%)	1 (2.5%)	3 (7.5%)	0.615*
Urinary Retention, n (%)	2 (5%)	0 (0%)	0.494*
Re-catheterization, n (%)	1 (2.5%)	0 (0%)	1*
Repeat Surgery, n (%)	1 (2.5%)	0 (0%)	1*
Urethral Stricture, n (%)	0 (0%)	1 (2.5%)	1*
<b>Modified Clavien Classification of Complications</b>			
Grade 0, n (%)	36 (90%)	34 (85%)	0.499†
Grade I, n (%)	1 (2.5%)	3 (7.5%)	0.615 †
Grade II, n (%)	1 (2.5%)	2 (5%)	1 *
Grade III, n (%)	2 (5%)	1 (2.5)	1 *
Grade IV, n (%)	0 (0%)	0 (0%)	-
Grade V, n (%)	0 (0%)	0 (0%)	-

\* = Fisher Exact test; † = Chi-Square test

Three months after procedure, significant ( $P < 0.001$ ) improvement in the mean values of IPSS and Qmax were seen in the B-TUVP and the B-TURP groups. But the B-TUVP had significantly higher efficacy compared The B-TURP.

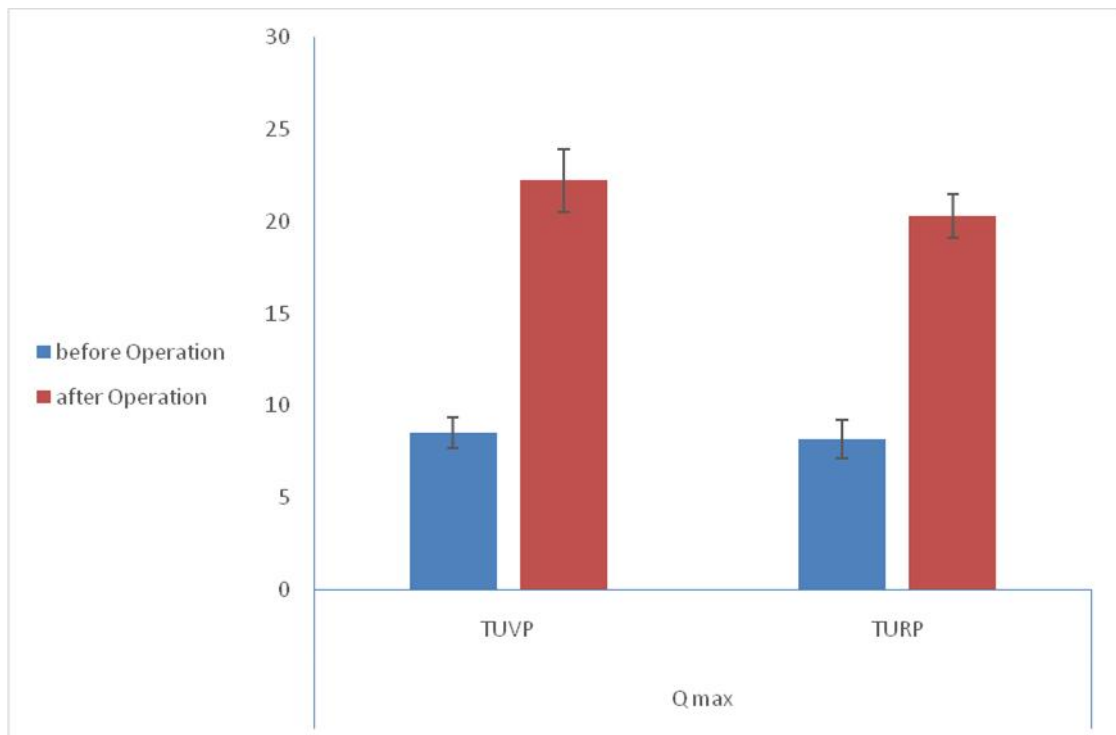
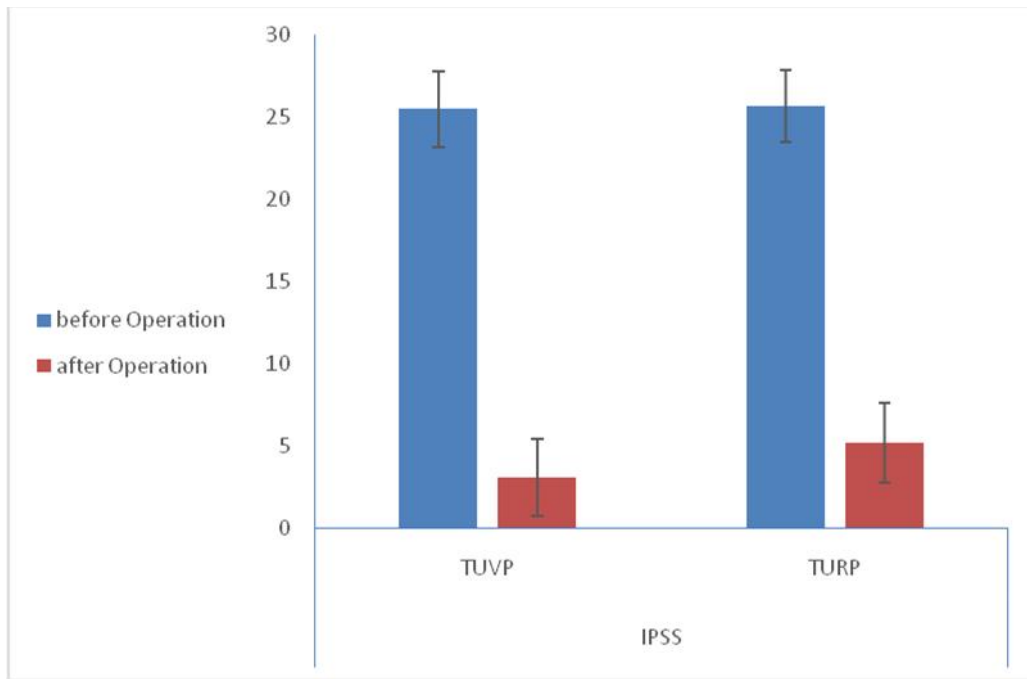
The B-TUVP group ( $3.13 \pm 2.36$ ) had significantly ( $P < 0.001$ ) lower mean IPSS than the B-TURP group ( $5.23 \pm 2.42$ ). Also in the B-TUVP group ( $22.24 \pm 1.71$  mL/s), mean Qmax was significantly ( $P < 0.001$ ) higher than B-TURP group ( $20.28 \pm 1.19$  mL/s) **Table [3]**.

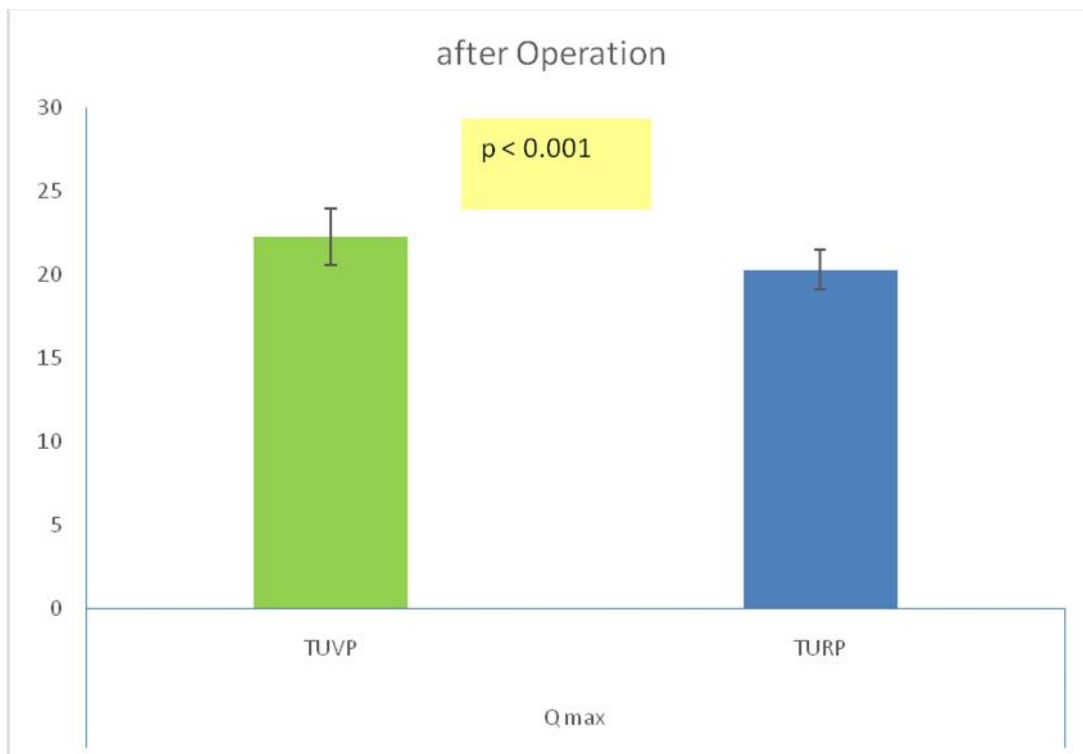
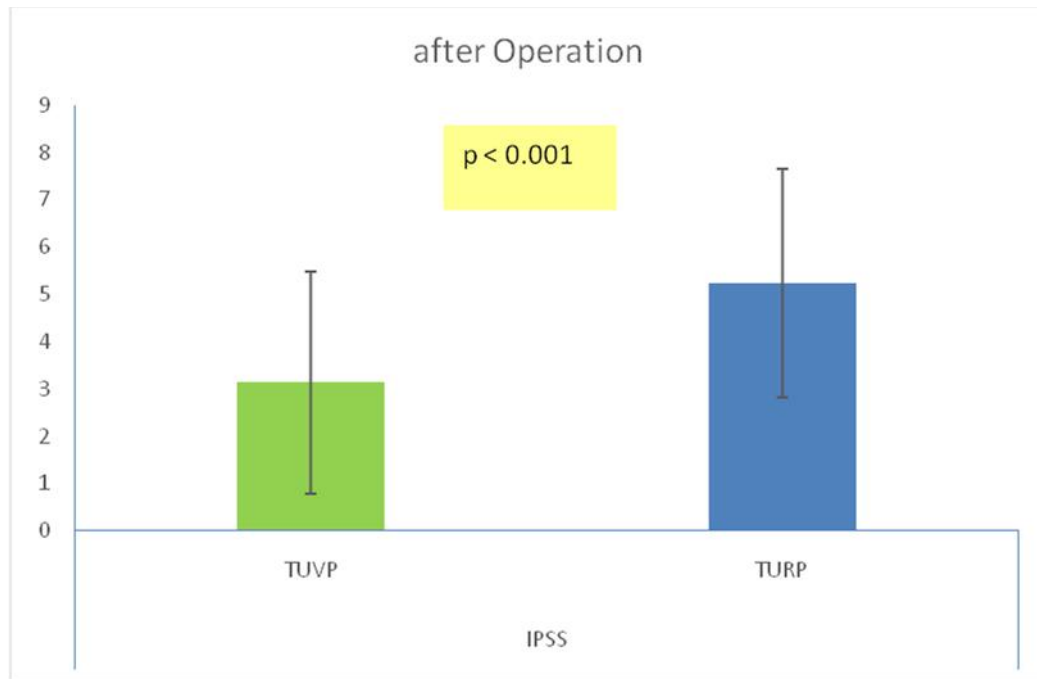
**Table [3] :** IPSS and Qmax in Bipolar TUVP (B-TUVP) and Bipolar TURP (B-TURP) groups.

	Before Operation	After Operation	P-value
<b>B-TUVP:</b> mean IPSS (range; SE)	<b>25.53</b> $\pm$ 2.30 (20-30;0.36)	<b>3.13</b> $\pm$ 2.36(0-10;0.37)	< 0.001*
<b>B-TURP:</b> mean IPSS (range; SE)	<b>25.68</b> $\pm$ 2.21 (20-30;0.35)	<b>5.23</b> $\pm$ 2.42 (0-10;0.38)	< 0.001*
<b>P-value</b>	0.865 †	< 0.001†	
<b>B-TUVP:</b> mean Qmax (range; SE), mL/s	<b>8.52</b> $\pm$ 0.82 (7-10;0.82)	<b>22.24</b> $\pm$ 1.71 (18-24;0.27)	< 0.001*
<b>B-TURP:</b> mean Qmax (range; SE), mL/s	<b>8.17</b> $\pm$ 1.06 (6-10;0.17)	<b>20.28</b> $\pm$ 1.19 (18-22;0.19)	< 0.001*
<b>P-value</b>	0.145 †	< 0.001†	

SE = Standard error of mean; \* = Wilcoxon test; † = Mann-Whitney test.







## Discussion

**The quality of life and health care cost** may be affected in the aging males due to LUTS following benign progressive enlargement of the prostate gland [9].

**The monopolar TURP** has been used as the traditional therapeutic procedure of LUTS/BPH for several decades. But for reducing adverse events such as bleeding and clot retention, TUR syndrome, damage of surrounding or deeper tissues, and urethral stricture, bipolar technology and conductive irrigation fluid of normal saline have been applied instead of monopolar energy and glycine nonconductive medium as the popular and the most important alternatives in the recent years [10].

**The Increase in life expectancy** and higher prevalence of surgical risk and comorbid diseases such as cardio-pulmonary diseases, coagulation disorders and anti-platelet or anticoagulant therapies in the old patients may lead to the limitation in the use of bipolar TURP [11]. Also fluid absorption betides in the bipolar TURP and volume overload may be problematic in patients with severe cardio-pulmonic disorders[12].

In the last decade, **laser energy** has been applied with high safety and efficacy for vaporization or enucleation of hypertrophic large volume prostate . But laser therapy may be accompanied with the use of multiple techniques and different wattage, technical complexity, prolonged operative time, higher applied energy and re-operation rate in the larger prostate volume cases, high cost equipment and inaccessibility in many centers [13].

Beside morbidity and complication, attention to other outcomes, prostate volume, anesthesia risk, patient satisfaction, cost-benefit or cost-effectiveness, learning curve, easy accessing and performing is important in the selection of preferable procedure.

**The bipolar TUVP** profits the advantages of monopolar TURP and bipolar TURP and is devoid of their limitations in the high risk patients. Also the bipolar TUVP can compete

with TURP and laser-related techniques due to easy learning and lower cost procedure, superior hemostasis, decreased fluid absorption and TUR syndrome, low morbidity and comparative outcomes [14].

In a prospective randomized trial, we compared the perioperative complications and outcomes between bipolar TUVP and bipolar TURP in patients with moderate to severe LUTS due to BPH.

**The mean values of pre- and postoperative hemoglobin** were 13.8-14.3 and 12.7-13.1g/dL without transfusion requirement in two experiences about bipolar TUVP (B-TUVP) [6,13]. The mean hemoglobin drop in the B-TUVP (0.5g/dL) was significantly ( $P = 0.0001$ ) lower than bipolar TURP (B-TURP) (1.2g/dL) and monopolar TURP (M-TURP) (1.6g/dL) in Geavlete et al. randomized comparison [15]. Also in our trial, the B-TUVP had significant lesser mean hemoglobin drop than B-TURP (0.58 vs. 1.52 g/dL) due to superior hemostasis and coagulation.

As regardthe mean **postoperative hospitalization and catheterization periods**, The published experiences reported (1.4-2.08) and (2.2-3.54) days for B-TUVP [14,6,16,17]. In Geavlete et al. randomized comparison, they reported 23.5 hours and 1.9 days in the B-TUVP (the shortest), 46.3 hours and 3.1 days in the B- -TURP, 72.8 hours and 4.2 days in the M-TURP (the longest) and these differences were significant ( $P = 0.0001$ ) [15]. Also we reported significant shorter postoperative hospitalization (1.75 vs. 2.15 days) and catheterization (4.25 vs. 4.78 days) in comparison with B-TURP in our results.

**The operation time** had the means of 61 and 63 minutes for B-TUVP in the published experiences [14,6,17]. Ahyai et al. reported the shortest mean operation time (36 minutes) for B-TUVP among minimally invasive surgical therapies [5]. Also in Geavlete et al. comparison, the mean operation time in the B-TUVP (39.7 minutes) was significantly ( $P = 0.0001$ ) shorter than B-TURP (52.1 minutes) and M-TURP (55.6 minutes) [15]. In our trial, B-TUVP had shorter mean operative

time (26.83 vs. 31.45 minutes) compared with B-TURP. This result can be explained by easy performance, good hemostasis and coagulation, better sighting due to decreased hemorrhage, the lack of vacating resected samples and possible proper vaporization of prostatic tissue during moving of the electrode in the B-TUVP.

The mean values of **pre- and postoperative serum sodium** were 141.3 and 140.6mmol/L and no serum electrolyte abnormality occurred in Reich et al. experience in B-TUVP [14]. In Otsuki et al. report the irrigation fluid volume was 22.9 liters and the B-TUVP had similar pre- and postoperative serum sodium level [6]. In our study, the mean values of irrigation fluid volume (10.38 vs. 13.80 liter) and serum sodium (1.68 vs. 2.29 meq/l) changes in the B-TUVP were lower than B-TURP. Reduced hemorrhage, superior sight and performing the operation without resection and sampling, decrease irrigation fluid volume, subsequent fluid absorption and serum electrolytes changes in the B-TUVP compared with B-TURP.

As regard **perioperative complications**, In the meta-analysis from Ahyai et al., the B-TUVP had higher rate of acute urinary retention and re-catheterization (8.2% vs. 3.6%, 4.5%), transient dysuria (2.9% vs. 0%, 0.8%) and re-intervention (2.4% vs. 0.2%, 0.5%) and lower rates of hematuria (0.0% vs. 1.0%, 3.5%) and transfusion (0.5% vs. 1.9%, 2.0%) compared with B-TURP and TURP.

The urgency (2.2% vs. 0%, 0.2%), bladder neck stenosis (2% vs. 0.5%, 0.5%) and urethral stricture (4.1% vs. 1.9%, 2.4%) in the TURP were higher than B-TUVP and B-TURP [5].

In Geavlete et al. randomized comparison, the B-TUVP had significantly lower rates of intraoperative bleeding (1.8% vs. 8.2%, 13.5%), capsular perforation (1.2% vs. 7.1%, 9.4%), re-catheterization (1.8% vs. 5.9%, 7.1%), re-treatment (3.5% vs. 9.4%, 8.8%) and bladder neck sclerosis (0.6% vs. 3.5%, 4.1%) compared with B-TURP and M-TURP.

Also postoperative hematuria (2.9%, 4.7% vs. 15.3%), transfusion (1.2%, 1.8% vs. 6.5%), clot retention (0.6%, 1.2% vs. 4.1%), TUR syndrome (0%, 0% vs. 1.8%) and re-hospitalization following hemorrhage (0.6%, 1.2% vs. 3.5%) in the B-TUVP and B-TURP were significantly lower than M-TURP. But the three groups had similar results regarding early irritative symptoms, urethral stricture and urinary incontinence [15].

During our follow-up, no significant differences were seen between B-TUVP and B-TURP regarding overall complications. Although postoperative hematuria, clot retention and transfusion occurred only in the B-TURP group and urinary retention and re-catheterization occurred only in the B-TUVP group, these differences were non-significant probably due to the small sample size.

The published studies have reported significant **improvement in IPSS and Qmax** with different follow-up durations for B-TUVP in the case series [14,6,16,17] or in comparison with monopolar or bipolar TURP[18,15,19,20,21,22] and our results are similar to those.

In the meta-analysis studies, the B-TUVP and B-TURP had similar results with M-TURP regarding IPSS and Qmax especially in the short-term follow-up [23,5,24, 25].

Also in our trial, the B-TUVP had significantly higher improvement in postoperative IPSS (3.13 vs. 5.23) and Qmax (22.24 vs. 20.28mL/s) compared with B-TURP. Proper visibility due to lesser bleeding and formation of suitable cavity with good margins and surface in the operated area can explain this result with B-TUVP.

## Conclusion

Bipolar TUVP is considered a high effective, safe and low cost procedure in the era of minimally invasive surgeries in management of BPH. In a comparison to B-TURP, B-TUVP had similar complication rate but give better perioperative and postoperative outcomes (significant short operative time, lower irrigation fluid volume,

serum sodium and potassium changes and post-operative hospitalization and catheterization period), superior hemostasis and higher efficacy (superior improvement in IPSS Qmax postoperatively).

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