

RESEARCH ARTICLE

Comparative Study of Monopolar and Bipolar Transurethral Resection in Patients with Benign Prostatic Adenoma

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ABSTRACT

A prospective controlled study at Al-Diwaniya Urological center was compared two procedures (M-TURP and B-TURP-PLASMA EDGE). A total of 120 men were included in our study for 2 years. In 60 men with M-TURP, their age ranged from 49-89 years, size of prostate /mL ranged from 35 to 90, IPSS ranged from 8 to 34, and their SPSA ranged from 0.1–3.4 ng/mL. In the other 60 men with B-TURP (plasma edge), their ages ranged from 47 to 89 years, the size of prostate/ml ranged from 36 to 90, IPSS ranged from 9 to 34, and their S.PSA were ranged from 0.1 to 3.8 ng/mL. There was no significant difference in mean age, mean prostate size, mean IPSS, mean serum PSA, mean maximum flow rate (Q max), mean residual volume, mean hemoglobin (Hb), mean serum sodium, mean serum potassium, mean serum chloride and, mean serum creatinine ($p > 0.05$). There was a significant difference in the mean duration of operation between the monopolar group and plasma edge group ($p = 0.019$), in such a way that the duration is less in the plasma edge group, 56.75 ± 9.02 minutes versus 53.10 ± 7.73 minutes. The intra-operative level of Hb was significantly higher in a monopolar group than in the plasma edge group, 13.87 ± 1.87 g/dL versus 15.06 ± 1.28 g/dL, respectively ($p < 0.001$). There was no significant difference in intra-operative mean serum sodium, potassium, chloride, and creatinine between both groups ($p > 0.05$). The mean duration of hospital admission was more in the monopolar group compared with the plasma edge group, 1.57 ± 0.83 days versus 1.03 ± 0.18 days, respectively, in a highly significant manner ($p < 0.001$). Mean Hb level was significantly lower in the monopolar group compared to the plasma edge group, 14.00 ± 1.64 g/dL versus 15.03 ± 1.26 g/dL, respectively ($p < 0.001$). Mean IPSS was significantly lower in the monopolar group compared to the plasma edge group, 26.18 ± 4.12 versus 28.05 ± 4.09 , respectively ($p = 0.014$). Maximum flow rate (Q max) was significantly more in the monopolar group in comparison to the plasma edge group, 16.62 ± 1.89 versus 15.03 ± 2.20 , respectively ($p < 0.001$). There was no significant difference in the rate of urethral stricture between the monopolar group and plasma edge group, 1 (1.7%) versus 1 (1.7%), respectively ($p = 1.000$). In addition, there was no significant difference in the rate of repetition of TURP between the monopolar group and plasma edge group, 1 (1.7%) versus 1 (1.7%), respectively ($p = 1.000$). Our study showed that there was a shorter duration of the procedure, less bleeding, shorter duration of admission, and improvement in IPSS and Qmax.

Keywords: BPO, B-TURP-plasma-edge, M-TURP.

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INTRODUCTION

Benign prostatic enlargement is a common disease in older men—histological prevalence of 50% in the 6th decade of life.^{1,2}

The patient's symptoms are either voiding (frequency, urgency, urge incontinence, and nocturia) and/or storage (retention, hesitancy, poor stream urine), and these are collectively called lower urinary tract symptoms (LUTS) and haematuria.

Up to 35% of men above the age of 50 years complain of LUTS.^{3,4} The diagnosis depends on clinical history and examination, DRE, laboratory tests (PSA, creatinine), PV

residual urine volume, flow rate measurement, pressure flow studies, and renal ultrasound.⁵

Many treatment options range from conservative medications, minimally invasive therapy, TURP, TUV, laser prostatectomy, and simple open prostatectomy.

Surgical treatment is indicated when the patient is unresponsive to medical treatment or the patient complaints from moderate-severe symptoms and if their complications (recurrent AUR, renal impairment, recurrent hematuria, or vesical stones).^{2,6,7}

TURP is the gold standard treatment for surgically indicated patients.⁸

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Despite the fact that monopolar TURP (M-TURP) has the advantage of excellent resection, it is usually done using hypotonic solutions like Glycine, Mannitol which have a risk of TUR-syndrome (dilutional hyponatremia), in addition to massive blood loss, prolong catheterization, UTI, erectile dysfunction, voiding symptoms and bladder neck contracture.⁹⁻¹¹

Bipolar TURP (B-TURP) is an alternative surgical procedure to M-TURP by using normal saline as a physiological fluid to decrease the risk of TUR syndrome, in addition to shorter catheterization, reduced hospital stay, and small coagulation depth (less bleeding), B-TURP displays thinner coagulation zone than M-TURP.¹²⁻¹⁶

As a result, IPSS, Q_{max} , and more tissue removal (more than 60 mL) improved.¹⁷

In contrast to M-TURP, its energy does not travel through the body to reach a skin pad; bipolar circuitry is completed locally. The energy is confined between an active (resection loop) and passive pole situated on the resectoscope tip (true bipolar system) or the sheath (quasi bipolar).^{18,19} The aim of the study is to use a new concept, plasma edge (bipolar), to decrease complications of M-TURP.

METHODS

A total of 120 men were included in our prospective clinical study for 2 years, from August 2017 to August 2019 (patient consent was taken). A total of 60 men with M-TURP, their age were ranged 49 to 89 years, size of prostate/mL were ranged 35 to 90, IPSS were ranged between 8 to 34, their S.PSA were ranged from 0.1 to 3.4 ng/mL, digital rectal examination (DRE) for all patients was revealed features of benign prostatic enlargement, under spinal anaesthesia preceded by prophylactic ceftriaxone antibiotic at Al-Diwaniyah teaching Hospital-Urology center.

In the other 60 men with B-TURP (plasma edge), their ages ranged from 47 to 89 years, the size of prostate/mL ranged between 36 to 90, IPSS were ranged between 9 to 34, and their S.PSA were ranged from 0.1 to 3.8 ng/mL. Digital rectal examination (DRE) for all patients revealed features of benign prostatic enlargement under spinal anesthesia preceded by prophylactic ceftriaxone antibiotic at Al-Diwaniyah private hospital.

Inclusion criteria were: benign prostatic enlargement with or without retention, haematuria recurrent UTI. Exclusion criteria were; patients with renal failure, neuropathic bladder, and prostate cancer.

Surgical Procedure

The MCB plasma edge system (Lamidey Noury, Paris, France) was used for treating patients in the B-TURP group (140 W for cutting and 100-120W for coagulation; 0.9% NaCl as irrigation fluid) and an M-TURP system (Storz, Germany) was used for treating patients in the M-TURP group (200 W for cutting and 150 W for coagulation; Glycine as irrigation fluid). All the patients were placed in the lithotomy position and were given spinal anesthesia. Bladder irrigation was initiated immediately after the patient was transferred to a ward.

RESULTS

The current study included 120 patients with BPH who were randomly allocated into two groups, the first one were involved in M-TURP, and the second group was enrolled in Plasma edge TURP, the preoperative characteristics of whom are shown in Table 1. There was no significant difference in mean age, mean prostate size, mean IPSS, mean serum PSA, mean maximum flow rate (Q_{max}), mean residual volume, mean hemoglobin (Hb), mean serum sodium, mean serum potassium, mean serum chloride and, mean serum creatinine ($p > 0.05$), as shown in Table 1.

Table 1: Characteristics of patients according to group (monopolar versus plasma edge) preoperatively

Characteristic	Monopolar <i>n</i> = 60	Plasma Edge <i>n</i> = 60	<i>p</i>
<i>Age (years)</i>			
Mean ± SD	66.80 ± 8.52	66.90 ± 8.42	0.949 †
Range	49 - 89	47 - 89	NS
<i>Size (ml)</i>			
Mean ± SD	60.40 ± 13.07	59.83 ± 12.90	0.812 †
Range	35 -90	36 -90	NS
<i>IPSS</i>			
Mean ± SD	22.18 ± 6.27	22.33 ± 6.11	0.895 †
Range	8 -34	9 -34	NS
<i>PSA (ng/ml)</i>			
Mean ± SD	1.32 ± 0.83	1.34 ± 0.79	0.919 †
Range	0.1 -3.4	0.1 -3.8	NS
<i>Qmax (ml/sec)</i>			
Mean ± SD	9.27 ± 2.24	9.17 ± 2.15	0.803 †
Range	5 -14	5 -14	NS
<i>Residual volume (ml)</i>			
Mean ± SD	194.38 ± 59.82	201.65 ± 54.43	0.488 †
Range	78 -310	95 -312	NS
<i>Hb (g/dl)</i>			
Mean ± SD	15.08 ± 1.37	15.13 ± 1.28	0.837 †
Range	11.9 -17.2	11.9 -17.2	NS
<i>Serum sodium (meq/l)</i>			
Mean ± SD	137.79 ± 2.72	138.04 ± 2.82	0.629 †
Range	125.3 -144.4	125.3 -145.4	NS
<i>Serum potassium (meq/l)</i>			
Mean ± SD	4.48 ± 0.36	4.52 ± 0.33	0.463 †
Range	3.7 -5.1	3.9 -5.1	NS
<i>Serum chloride (meq/l)</i>			
Mean ± SD	101.31 ± 2.60	101.40 ± 2.51	0.844 †
Range	96 -106.1	96.8 -106	NS
<i>Serum creatinine mg/dl</i>			
Mean ± SD	0.86 ± 0.22	0.90 ± 0.22	0.321 †
Range	0.5 -1.3	0.5 -1.3	NS

n: number of cases; *SD*: standard deviation; *IPSS*: international prostate symptom score; *PSA*: prostatic specific antigen; *Q max*: maximum flow rate; †: independent samples t-test; *NS*: not significant at $P > 0.05$

The intra-operative characteristics of patients with BPH enrolled in this study are shown in Table 2. There was a significant difference in the mean duration of operation between the monopolar group and plasma edge group ($p = 0.019$), in such a way that the duration is less in the plasma edge group, 56.75 ± 9.02 minutes versus 53.10 ± 7.73 minutes, respectively, Table 2. There was no significant difference in resection weight ($p > 0.05$). The intra-operative level of Hb was significantly higher in a monopolar group than in the plasma edge group, 13.87 ± 1.87 g/dL versus 15.06 ± 1.28 g/dL, respectively ($p < 0.001$). There was no significant difference in intra-operative mean serum sodium, potassium, chloride, and creatinine between both groups ($p > 0.05$), Table 2.

One-week postoperative characteristics are shown in Table 3. The mean duration of hospital admission was more in the monopolar group in comparison with the plasma edge group, 1.57 ± 0.83 days versus 1.03 ± 0.18 days, respectively, in a highly significant manner ($p < 0.001$). Mean Hb level was significantly lower in the monopolar group compared to the plasma edge group, 14.00 ± 1.64 g/dl versus 15.03 ± 1.26 g/dL, respectively ($p < 0.001$). Urinary tract infection was reported in

Table 2: Characteristics of patients according to group (monopolar versus plasma edge) intra-operatively

Characteristic	Monopolar <i>n</i> = 60	Plasma Edge <i>n</i> = 60	<i>P</i>
<i>Duration of operation (minute)</i>			
Mean ± SD	56.75 ± 9.02	53.10 ± 7.73	0.019 †
Range	36.00–74.00	36.00–74.00	S
<i>Resection weight (g)</i>			
Mean ± SD	35.17 ± 10.17	38.53 ± 10.93	0.083 †
Range	17.00–57.00	20.00–60.00	NS
<i>Hb (g/dl)</i>			
Mean ± SD	13.87 ± 1.87	15.06 ± 1.28	< 0.001 †
Range	9–17.1	11.9–17.2	HS
<i>Serum sodium (meq/l)</i>			
Mean ± SD	137.58 ± 3.27	137.94 ± 3.06	0.541 †
Range	125.4–144.5	125.3–144.4	NS
<i>Serum potassium (meq/l)</i>			
Mean ± SD	4.48 ± 0.33	4.52 ± 0.30	0.467 †
Range	3.6–5.1	3.9–5.1	NS
<i>Serum chloride (meq/l)</i>			
Mean ± SD	101.35 ± 2.45	101.37 ± 2.64	0.971 †
Range	96–105.5	96–106.1	NS
<i>Serum creatinine (mg/dl)</i>			
Mean ± SD	0.86 ± 0.20	0.90 ± 0.22	0.362 †
Range	0.5–1.23	0.5–1.3	NS
<i>Intra-operative obturator reflex</i>			
Yes	3 (5.0%)	0 (0.0%)	0.242 F
No	57 (95.0%)	60 (100.0%)	NS

n: number of cases; **SD**: standard deviation; †: independent samples t-test; **F**: Fischer exact test; **NS**: not significant at $P > 0.05$; **S**: Significant at $p \leq 0.05$; **HS**: Highly significant at $p \leq 0.01$

6 (10.0%) of the monopolar group and 1 (1.7%) of plasma edge group; however, the difference was statistically insignificant ($p = 0.119$), as shown in Table 3.

Six months' postoperative characteristics are shown in Table 4. Mean IPSS was significantly lower in the monopolar group compared to the plasma edge group, 26.18 ± 4.12 versus 28.05 ± 4.09 , respectively ($p = 0.014$). Maximum flow rate (*Q max*) was significantly more in the monopolar group in comparison to the plasma edge group, 16.62 ± 1.89 versus 15.03 ± 2.20 , respectively ($p < 0.001$). There was no significant difference in the rate of urethral stricture between the monopolar group and plasma edge group, 1 (1.7%) versus 1 (1.7%), respectively ($p = 1.000$). In addition, there was no significant difference in the rate of repetition of TURP between

Table 3: Characteristics of patients according to group (monopolar versus plasma edge) one week post-operatively

Characteristic	Monopolar <i>n</i> = 60	Plasma Edge <i>n</i> = 60	<i>P</i>
<i>Duration of admission (days)</i>			
Mean ± SD	1.57 ± 0.83	1.03 ± 0.18	< 0.001 †
Range	1–4	1–2	HS
<i>Hb (g/dl)</i>			
Mean ± SD	14.00 ± 1.64	15.03 ± 1.26	< 0.001 †
Range	11.1–17.1	11.9–17.2	HS
<i>Urinary tract infection</i>			
Yes	6 (10.0%)	1 (1.7%)	0.119 Y
No	54 (90.0%)	59 (98.3%)	NS

n: number of cases; **SD**: standard deviation; †: independent samples t-test; **Y**: Yates correction for continuity test; **NS**: not significant at $P > 0.05$; **HS**: Highly significant at $p \leq 0.01$

Table 4: Characteristics of patients according to group (monopolar versus plasma edge) six months post-operatively

Characteristic	Monopolar <i>n</i> = 60	Plasma Edge <i>n</i> = 60	<i>P</i>
<i>IPSS</i>			
Mean ± SD	26.18 ± 4.12	28.05 ± 4.09	0.014
Range	19–34	18–36	S
<i>Qmax (ml/sec)</i>			
Mean ± SD	16.62 ± 1.89	15.03 ± 2.20	< 0.001
Range	12–20	9–19	HS
<i>Residual volume (mL)</i>			
Mean ± SD	56.12 ± 25.78	48.35 ± 26.45	0.106
Range	13–135	15–120	NS
<i>Urethral stricture</i>			
Yes	1 (1.7%)	1 (1.7%)	1.000 Y
No	59 (98.3%)	59 (98.3%)	NS
<i>Repeat TURP</i>			
Yes	1 (1.7%)	1 (1.7%)	1.000 Y
No	59 (98.3%)	59 (98.3%)	NS

n: number of cases; **SD**: standard deviation; **IPSS**: international prostate symptom score; **Q max**: maximum flow rate; †: independent samples t-test; **Y**: Yates correction for continuity test; **S**: Significant at $p \leq 0.05$; **NS**: not significant at $p > 0.05$

the monopolar group and plasma edge group, 1 (1.7%) versus 1 (1.7%), respectively ($p = 1.000$), as shown in Table 4.

Figure 1 showed a comparison of changes in mean IPSS between both groups; the score was higher in the plasma edge group following 6 months in comparison with the monopolar group. Figure 2 showed a comparison of changes in mean Q max between both groups; the rate was lower in the plasma edge group following 6 months compared to the monopolar group. Figure 3 showed a comparison of changes in mean residual volume between both groups; the volume was comparable in both groups 6 months later. Figure 4 showed a comparison of

changes in mean Hb between both groups; the level was higher in the plasma edge group following 6 months in comparison with the monopolar group. Figure 5 showed a comparison of changes in mean serum electrolytes between both groups; the levels were comparable in both groups 6 months later. Figure 6 showed a comparison of changes in mean serum creatinine between both groups; the level was lower in the plasma edge group following 6 months compared to the monopolar group.

Statistical Analysis

Data were analyzed using statistical package for social science (SPSS) (IBM, Chicago, USA, version 23). Quantitative

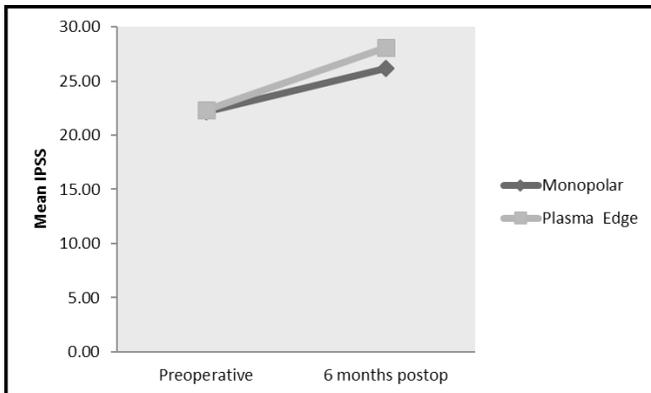


Figure 1: Mean IPSS in monopolar and plasma edge groups preoperatively and 6 months postoperatively

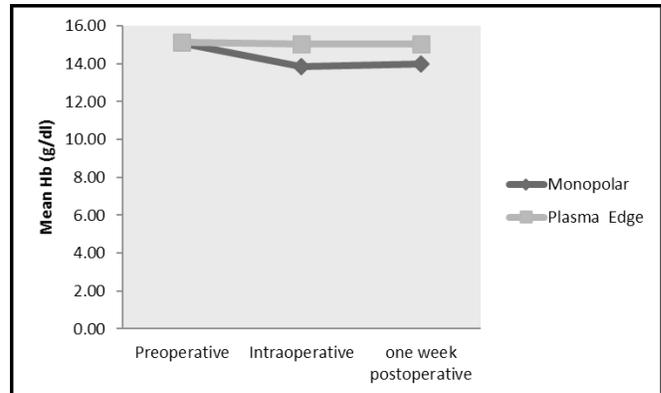


Figure 4: Mean Hb in monopolar and plasma edge groups preoperatively, intra-operatively and 6 months postoperatively

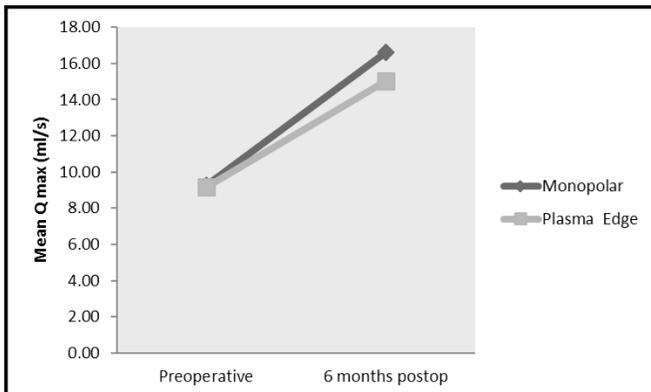


Figure 2: Mean Q max in monopolar and plasma edge groups preoperatively and 6 months postoperatively

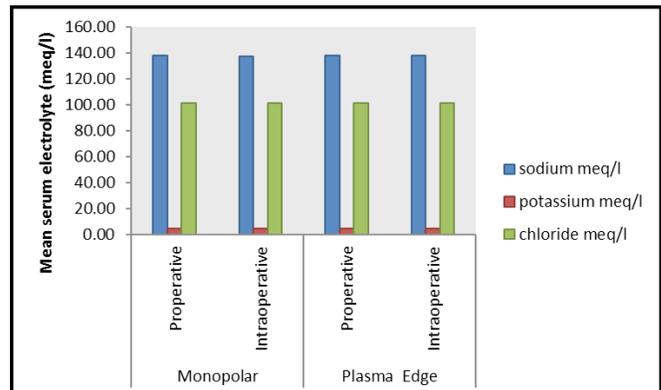


Figure 5: Mean serum electrolytes in monopolar and plasma edge groups preoperatively and intra-operatively

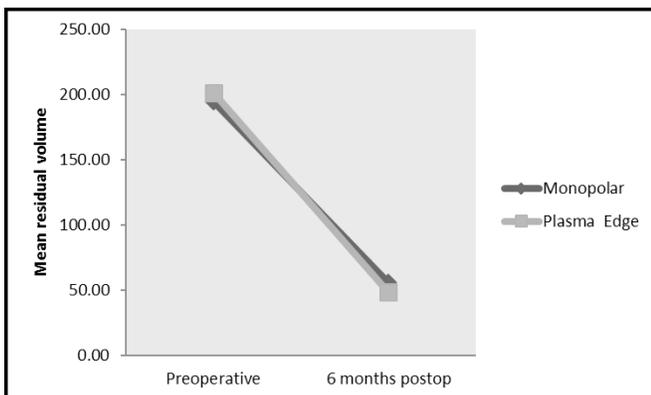


Figure 3: Mean residual volume in monopolar and plasma edge groups preoperatively and 6 months postoperatively

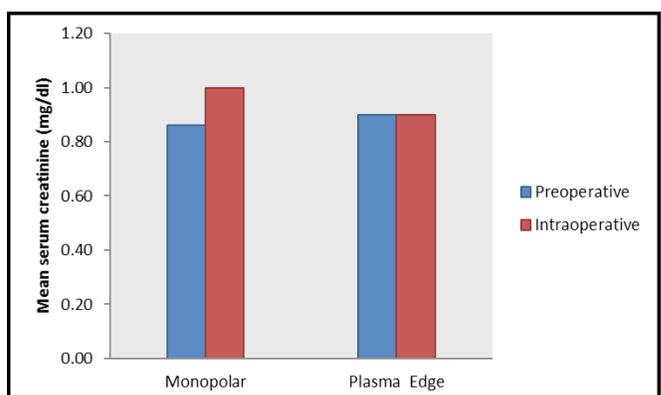


Figure 6: Mean serum creatinine in monopolar and plasma edge groups preoperatively and intra-operatively

variables were expressed as a mean, range, and standard deviation, whereas qualitative variables were expressed as numbers and percentages. Independent samples t-test was used to compare the mean between two groups. In contrast, Yates correction for continuity test and Fischer exact test were used to assess the difference in the frequency distribution of qualitative variables between groups. The significance level was set at $p \leq 0.05$, and the high significance level was set at $p \leq 0.01$.

DISCUSSION

Benign prostatic enlargement is an age-related disease. It affects about 70% of men older than 70 years.²⁰ Medications are used for mild-moderate symptoms without complications, while surgical intervention is used for severe symptoms and/or complicated adenoma.

M-TURP has been established as an excellent surgical option for adenoma smaller than 80 ml, sometimes more, despite its complications such as TUR syndrome, UTI, bleeding, and urethral stricture.^{8,19,21} New procedures are starting to decrease complications of M-TURP, such as B-TURP and laser technologies.²²

Our study was done to discuss our results when we did M-TURP for 60 patients and B-TURP (PLASMA EDGE) for 60 patients also.

Plasma edge is a new technology that used the bipolar principle of cauterization, made by a French company (Lamidey Noury).

The most common problems that the Urologist suffers from are bleeding during the procedure; studies written by some authors found that the drop in hemoglobin was higher in M-TURP than in B-TURP. Xing *et al.* were found 0.7 g/dL loss in B-TURP²³ while 1.1 g/dL loss in M-TURP. In addition to Patankar *et al.*, Starkman *et al.*, and Singh *et al.* found the transfusion rate in M-TURP (3.9, 11, and 3.3%), respectively, while no blood transfusion was needed for B-TURP.¹¹ Fagerström *et al.* found that the blood losses during TURP and in total were significantly smaller in B-TURP than in M-TURP ($p < 0.001$) In 185 patients.²⁴ Rassweiler J. *et al.* mention that more blood loss in M-TURP was due to preoperative UTI and urine retention¹⁹. Yoon CJ *et al.*, the mean fall in hemoglobin in the B-TURP group was 0.67 ± 0.62 g/dL, whereas, for the M-TURP group, it was 0.62 ± 0.78 g/dL was insignificant.²⁵

Engeler *et al.* found no difference between M-TURP and B-TURP regarding a drop in hemoglobin.²⁶

In the current study drop in hemoglobin in M-TURP was 1.21 intraoperatively and 1.08 (one week postoperative), in plasma edge 0.07 intraoperative and 0.1 (one week postoperative), which is highly significant in comparison with other studies. One important point toward the plasma edge might be due to the strong hemostatic effect.

Another problem is TUR syndrome. Chen Q *et al.* M-TURP (decrease in serum Na)³⁰ (3.2 vs. 10.7), Issa MM *et al.*¹⁸ (1.6 vs. 4.1), Singhania P *et al.*²⁹ (1.3 vs. 4.12) it might be due to smaller cutting loop and large bite.

DS Engeler *et al.*²⁶ and Mohamed N E *et al.* in B-TURP (1.63) vs M TURP (5.04) mmol/l loss.

Michielsen *et al.*²⁷ Na loss was (1.44vs 2.23)

In the current study was no change in electrolyte loss bet. B- and M- TURP.

Regarding the weight of resected prostatic tissue, in the current study (resected weight was the same between M- AND B-TURP), but the duration is shorter, so we can cut more. Resection weight had an insignificant difference ($35.17 \text{ g} \pm 10.17$) for M-TURP vs. ($38.53 \text{ g} \pm 10.93$) for plasma edge.^{30,31} 0.45 vs 0.56 g/min, more resection weight in B-TURP (0.74 vs 0.61) g/min.

Duration of procedure was ($56.75 \text{ min} \pm 9.02$) for M-TURP vs. ($53.10 \text{ min} \pm 7.73$) significantly. While Michielsen *et al.*²⁷ reported that B-TURP needs more time (56 vs. 44) minutes, Fagerstrom *et al.* reported that insignificant difference.²⁴

The current study reported that insignificant difference between B-TURP and M-TURP regarding Obturator reflex, UTI, post-void residual, and urethral stricture.

IPSS was significant, and Q_{\max} was highly significant in this review. This review also confirms that B-TURP remarkably increases Q_{\max} due to the shorter operative time, better surgeons' comfort as a result of lower complication rates, better coagulation, and better surgical experience. Similar results were reported by Otaola-Arca *et al.*, Seckiner in 2006¹⁷ while Nuhoglu *et al.*, Yoon *et al.* in 2006²⁵, no difference was observed in the improvement of IPSS, Q_{\max} over 12 months follow up. Bipolar Plasma EDGE (Lamidey Noury) benefits:

- Saline solution
- No superficial carbonizations and thermal damage
- Deep hemostasis for less post-op bleeding

The tissues remain white and the solution clear after the procedure, with Same capabilities of a laser with minimal learning curves and cost-efficiency

There are currently two main bipolar resection technologies that you may already be using.

The key difference in each system is how power returns to the unit. SYSTEM 1: Power returns through the Resoscope+

- Cost-effective solution
- Loop design similar to monopolar loop
- Risk of electricity leakage on the resectoscope sheath
- High power is necessary for activation
- Require a specific and complete resectoscope dedicated to bipolar resection

WHY: The power return is operated by all metallic parts in the instrument. In this case, the working element has two connection cables. One is for supplying power to the wire and another for power return.

The combination of a high power and power return through the total metallic instrument increases the risk of electricity leakage. SYSTEM 2: Power return on a top neutral electrode

- +
- Power return is integrated into the loop
- No electric power in contact with the sheaths
-
- Top neutral electrode potentially in contact with tissues
- Long distance between the wire and he neutral electrode, which could cause activation delay

- Low wire lifetime
- Cutting tissues could stick between the wire and the top neutral electrode

WHY: The power return is integrated into a transparent top electrode. Having a neutral electrode potentially in contact with tissues could increase the risk of thermal damage.

The distance between the wire and neutral electrode impacts the activation efficiency.

Plasma edge technology

By integrating completely, the electric current flow inside the electrode.

We can provide the EDGE of the bipolar resection technology with:

- low power requirement for plasma activation
- instant activation
- no electric power on the resectoscope
- loop design similar to monopolar loop

Why: Power return is integrated inside the electrode Plasma EDGE technology is simply the perfect answer to the two key features required by a surgeon:

Safety

Power return is directly integrated inside the electrode

Low power requirement

No apparent neutral electrode; therefore no thermal damage risk by tissue contact

Efficiency

Instant activation

Long-life time wire

The cable is completely integrated into the loop, so there is no short-cut risk at the cable connexion.

CONCLUSION

Despite the standardization of Monopolar TURP in adenoma smaller than 80 mL, the B-TURP has some advantages regarding TUR syndrome and bleeding, time of procedure and recovery of IPSS and Qmax.

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