World Journal of Medical Sciences 11 (4): 439-444, 2014
ISSN 1817-3055

DOI: 10.5829/idosi.wjms.2014.11.4.8626

Bipolar Transurethral Resection of the Prostate: Perioperative Safety and Functional Outcome: Prospective Randomized Study

[1]Hani H. Nour, [2]Hani W. Elkady, [3]M. Hussein, [1]Ahmad M. Kamal, [1]Hossam M. Elganzoury and [1]Ahmad G. Elbaz

[1]Urology Department Theodor Bilharz Research Institute, Giza, Egypt
[2]Department of Anesthesia, Kasr Eleiny School Of Medicine, Cairo University, Cairo, Egypt
[3]Department of Anesthesia, Theodor Bilharz Research Institute, Giza, Egypt

Abstratc: TURP using saline is an alternative to standard monopolar resection reducing risk of bleeding and other complications caused by other hypotonic irrigants. In our study we evaluate intraoperative hemodynamic and electrolytes changes during TURP using either saline or glycine as irrigant together with complications and functional outcome at 12 months.104 included in this study divided randomly into two equal groups: Monopolar group underwent TURP using 1.5% glycine irrigation and Bipolar group underwent TURP using 0.9% normal saline irrigation. Preoperative data included prostate and residual urine volumes, estimation of the maximal flow rate (Qmax), International Prostate Symptom Score (IPSS) and quality of life (QOL) scoring. Intraoperative bleeding was evaluated using estimated blood loss (EBL) and frequencies of blood transfusion together with change in arterial blood pressure were recorded. Postoperative(PO) data included serum electrolytes, incidence of complications, duration of catheterization and hospital stay. Qmax, IPSS and QOL scores were evaluated at 1 and 12 months.Results thatEBL was significantly higher ($p<0.05$) in monopolar compared to bipolar group. PO serum sodium level was significantly lower in monopolar compared to bipolar group. No significant postoperative changes in systolic blood pressure between both groups. Post operative complications were significantly higher in monopolar compared to bipolar group. Functional results were significantly higher in both groups compared to preoperative estimates. Functional outcome was maintained for up to 12 months.inConclusion:TURP in saline is safe and effective with fewer incidences of complications and equal functional outcome to monopolar resection.

Key words: Turp · Bipolar · Saline · Bleeding · Hyponatremia

INTRODUCTION

Transurethral resection of the prostate (TURP) is the standard surgical treatment option for patients with lower urinary tract symptoms (LUTs) secondary to benign prostatic enlargement (BPE) up to 80cc. It's safe, effective with retreatment rate at 10 years comparable to open prostatectomy [1]. Larger glands are usually treated by conventional surgery with transurethral holmium laser enucleation of the prostate (HoLEP) being a new treatment options lacking long term results [2].

Several irrigant fluid can be used for resection, yet there is no ideal irrigation fluid, they all have to be electrically non-conductive (to prevent dispersion of the diathermy current), isotonic (if possible), non-toxic, non-haemolytic and provides adequate vision. Glycine 1.5% is the most common irrigant fluid used for monopolar TURP [3].

Although usually a safe procedure complications occurs in up to 18% [4]of patients undergoing TURP with size of the gland, time of resection, irrigant fluid used and surgeon experience being the most important determining factors. Perioperative hemorrhage needing transfusion was reported in up to 4%, clot retention in up to 5% and TUR syndrome in 2-3% [5].

TURP syndrome causing dilution hyponatremia is a unique complication of TURP reported in 2 to 3% of patients. It occurs when the irrigant solution used during

Corresponding Author: Hani H. NOUR, MD, FEBU, AFSA, Lecturer of Urology Urology Department, Theodor Bilharz Research Institute Kornishe El Nile, Elwarak Giza, Egypt.
Tel: +201111000191.

resection is absorbed into the blood stream. Symptoms and signs are varied and unpredictable and result from fluid overload and disturbed electrolyte balance and hyponatraemia. Although absorption of small amounts of fluid (1-2 liter) occurs in 5-10% of patients higher volume is needed to clinically detect TUR syndrome with mortality rates around 0.5% [6,7].

Bipolar TURP has emerged as an alternative to standard monopolar resection, it has the advantage of using normal saline (NaCl 0.9%) as an irrigant fluid thus avoiding the hypotonic effect of glycine, decrease hyponatremia so allowing more time for resection. The plasma kinetic effect allows also for prostatic vaporization [8,9].

In our work we studied the haemodynamic changes occurring during resection using monopolar and bipolar devices, perioperative electrolytes disturbances and complications. We aimed also to compare clinical outcome of bipolar versus monopolar TURP at one year.

MATERIALS AND METHODS

Prospective randomized study conducted between January 2011 and October 2013. The study followed the tenets of the declaration of Helsinki, informed consent was obtained from 104 patients with lower urinary tract symptoms (LUTs) secondary to benign prostatic obstruction (BOP) amenable to treatment with transurethral resection(TUR) were included in the study. Patients were randomly allocated into two equal arms (n=52): Monopolar arm included patients assigned for monopolar TURP performed with a 26 continuous flow Fr resectoscope using 1.5% glycine as irrigant fluid. Bipolar arm included patients assigned for bipolar TURP performed with a 27 Fr continuous flow resectoscope using 0.9% normal saline irrigation with the Plasma- Kinetic Tissue Management System.

All patients had spinal anesthesia, TURP either bipolar or monopolar was done in the standard technique.

Preoperative data included patients' demographic data, prostate volume, volume of residual urine, estimation of the maximal flow rate (Qmax) and functional data including determination of International Prostate Symptom Score (IPSS) and quality of life (QOL) scoring. Blood samples were collected for determination of hemoglobin concentration, hematocrite value and serum electrolytes level.

Intraoperative patients monitoring included blood pressure measures including systolic arterial blood pressure (SAP), diastolic arterial blood pressure (DAP) and mean arterial blood pressure (MAP). Estimated blood loss (EBL) was calculated according to the Gross formula [10]. The frequency of blood transfusion and the amount of transfused blood units were also determined.

Postoperative (PO) Patients Monitoring Included the Following:

- Immediate PO estimation of serum electrolytes and calculation of the deficit, if any and equals the difference between preoperative and immediate PO levels.
- Perioperative complications using the Clavien Grading system [11].
- Determination of duration of PO catheterization, PO hospital stay.
- Functional outcome at 1 and 12 months PO including residual urine, Qmax, IPSS and QOL in relation to preoperative measures.

Statistical Analysis: Statistical analysis was conducted using the SPSS (Version 15, 2006) for Windows statistical package. P value <0.05 was considered statistically significant.

RESULTS

Perioperative patients caracterestics are described in Table 1 with non-significant ($p>0.05$) difference in its parameters between studied groups.

Estimated blood loss was significantly ($p_1=0.005$) higher with significantly ($p_1=0.003$) higher Hct deficit in monopolar group compared to bipolar group, (Table 2). In parallel, both groups showed significantly ($p_2<0.001$) lower hemoglobin concentration compared to their preoperative concentration with non-significant ($p_1>0.05$) difference between studied groups, but in favor of bipolar group. However, the percentage of decrease of hemoglobin concentration was significantly ($p_1<0.001$) lower in bipolar group compared to monopolar group (Table2).

Systolic arterial blood pressure (SAP) estimated at the end of surgery was non-significantly ($p>0.05$) higher in monopolar group compared to bipolar group. On comparison to baseline measures, SAP estimated at end of surgery was significantly ($p<0.05$) higher in both groups. The extent of elevation of SAP was significantly higher ($p=0.024$) in monopolar versus bipolar group.

Postoperative serum electrolyte levels estimated in both groups were significantly lower compared to their respective preoperative rates. Postoperative serum sodium level in monopolar group was significantly

Table 1: Perioperative Data

	Monopolar group (52pt)	Bipolar group (52pt)	Statistical Analysis
Age	67.1±3.4	67.3±3.5	p>0.05
Prostate volume (ml)	61.6±5.2	63.1±4.2	p>0.05
BMI (kg/m2)	33.2±2.1	32.8±1.5	p>0.05
Operative time (min)	56.7±6.4	59.2±7.5	p>0.05
Resected weight (g)	38.6±3.1	39.5±4.7	p>0.05
Catheterization time (days)	2.1±0.8	2.3±1	p>0.05
Hospital stay (days)	4.3±1.3	4.6±1	p>0.05

Data are presented as mean±SD and numbers; p>0.05: non-significant difference

Table 2: Blood loss data

		Monopolar group (n=52)	Bipolar group (n=52)	Statistical Analysis
Blood loss data	Blood volume (ml)	6349±350.3	6300±247.1	p_1>0.05
	Hct(i)	39.2±2.7	38.7±1.9	p_1>0.05
	Hct(f)	35.8±2.6	36.1±1.8	p_1>0.05
	Hct(d)	3.4±0.8	2.6±0.8	p_1=0.003
	EBL (ml)	578.5±152.5	469.5±131.5	p_1=0.005
Hb concentration (gm%)	Preoperative	13.3±0.8	13.1±0.7	p_1>0.05
	Postoperative	11.9±0.6	12.1±0.7	p_1>0.05
	Statistical analysis	t=21.013, p_2<0.001	t=23.618, p_2<0.001	
	% of decrease	10.4±2.9	7.6±2	p_1<0.001

Data are presented as mean±SD; Hct (i): initial hematocrite value; Hct (f): final hematocrite value; Hct (d): deficit of hematocrite value; EBL: estimated blood loss; Hb: Hemoglobin; p<0.05: significant difference; p>0.05: non-significant difference

Table 3: Preoperative and postoperative serum electrolyte levels of studied patients

		Monopolar group (n=52)	Bipolar group (n=52)	Statistical Analysis
Sodium (mEq/l)	Preoperative	141.6±1.6	141.4±1.7	p_1>0.05
	Postoperative	138.3±1.7	139.3±1.6	p_1=0.001
	Statistical analysis	t=20.660, p_2<0.001	t=11.717, p_2<0.001	
	Extent of change	3.33±1.5	2.03±0.6	p_1<0.001
Potassium (mEq/l)	Preoperative	4.21±0.18	4.2±0.22	p_1>0.05
	Postoperative	4.09±0.19	4.1±0.21	p_1>0.05
	Statistical analysis	t=3.087, p_2=0.005	t=2.97, p_2=0.013	
	Extent of change	0.12±0.05	0.1±0.05	p_1>0.05

Data are presented as mean±SD; p<0.05: significant difference; p>0.05: non-significant difference

Table 4: Preoperative and postoperative functional results

		Monopolar group (n=40)	Bipolar group (n=40)	Statistical Analysis
Residual urine (ml)	Preoperative	88.4±23.3	88.9±24	p_1>0.05
	Postoperative	60.2±4.5	58.7±7.3	p_1>0.05
	Statistical analysis	t=6.702, p_2=0.001	t=7.353, p_2=0.001	
Qmax	Preoperative	6.3±2.3	6.5±3	p_1>0.05
	Postoperative	12.5±3.5	15.5±4.2	p_1=0.004
	Statistical analysis	t=10.613, p_2<0.001	t=11.250, p_2<0.001	
	% of change	118.4±75.8	189.3±126.6	p_1=0.005
IPSS	Preoperative	21.8±7.5	19.8±5.5	p_1>0.05
	Postoperative	11.8±4.4	10.3±3.7	p_1>0.05
	Statistical analysis	t=14.147, p_2<0.001	t=18.054, p_2<0.001	
	% of change	46±9.9	48.8±8.3	p_1>0.05
QOL	Preoperative	4.4±1.1	4.6±1.1	p_1>0.05
	Postoperative	2.4±0.5	2.1±0.8	p_1=0.040
	Statistical analysis	t=13.335, p_2<0.001	t=24.789, p_2<0.001	
	% of change	43.5±12.7	55.3±9.9	p_1<0.001

Data are presented as mean±SD; Qmax: maximal flow rate ; IPSS: International prostate symptom score; QOL: quality of life scoring; p<0.05: significant difference; p>0.05: non-significant difference

(p_1=0.001) lower compared level estimated in bipolar group. In parallel, the extent of decrease of serum sodium was significantly (p_1<0.001) higher in monopolar compared to bipolar group. On the other hand, changes of serum potassium and chloride showed non-significant (p>0.05) difference between both studied groups, irrespective being in favor of bipolar group, (Table 3).

Using the clavien grading system for surgical complications [11], The frequency of postoperative complications was significantly (X^2=3.147, p<0.05) higher in monopolar group compared to bipolar group. Four patients developed postoperative bleeding, three patients had clot retention and three patients required re-catheterization. The frequency of individual complication showed non-significant (X^2=2.109, p>0.05) difference between studied groups.

At one month post operative residual urine volume in both groups was significantly (p_2=0.001) lower compared to their respective preoperative volumes with non-significant (p>0.05) difference between both groups as regards either preoperative or postoperative volume of residual urine, (Table 4).

At one-month postoperative Qmax estimated in both groups were significantly (p_2<0.001) higher compared to their respective preoperative rates. Postoperative Qmax estimated in bipolar group was significantly (p_1=0.004) higher compared to rate estimated in monopolar group. In parallel, the percentage of change of Qmax was significantly (p_1=0.005) higher in bipolar compared to monopolar group, (Fig. 1).

The same was found for postoperative IPSS which was significantly (p_2<0.001) higher compared to their respective preoperative rates, with no difference between monopolar and bipolar groups.

At 12-months 98 patients were present for follow up, 20 patients showed regression of their functional data, while the remaining 78 patients maintained their functional results. The frequency of patients showed regressed functional scoring was significantly higher (X^2=11.446, p<0.05) among those of monopolar group compared to bipolar group. Patients who had bipolar TURP showed non-significantly (p>0.05) better IPSS and QOL scoring at 12-m post operative compared to those had monopolar TURP, despite the significant (p<0.05) difference of 12-m scores compared to 1-month score reported in both groups. On contrary, Qmax rate was significantly (p<0.05) higher at 12-m PO in patients had bipolar TURP and developed regression of post operative scoring compared to those had monopolar TURP despite of the significant (p<0.05) difference compared to 1-m PO, (Fig 2).

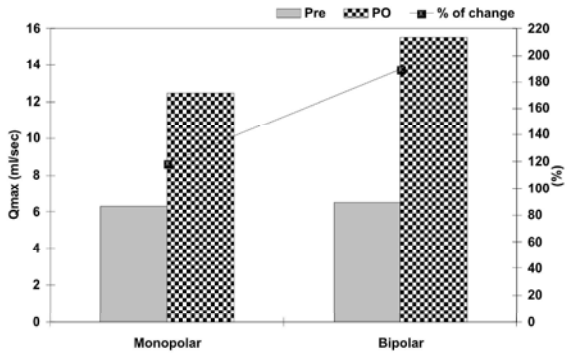

Fig. 1: Mean preoperative and postoperative maximal flow rate of urine estimated in both studied groups with reference to percentage of change:

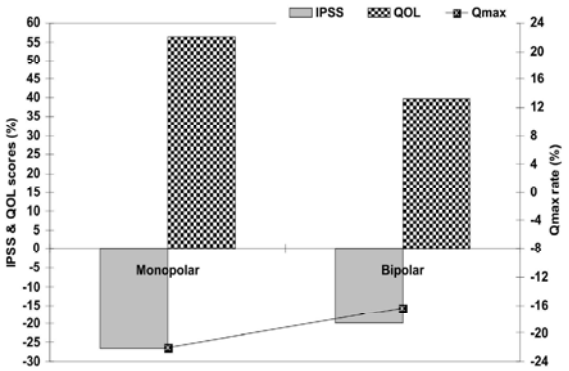

Fig. 2: Mean extent of change of Q max, IPSS, QOL at 12 month in relation to 1 month results

DISCUSSION

TURP with saline irrigation provided significant advantages over monopolar TURP manifested as significantly lower amount of estimated blood loss with significantly lower reduction of hemoglobin concentration. Functionally, bipolar TURP provided significant improvement of Qmax, IPSS and QOL scoring evaluated at 1 and 12 months post operatively. These advantages go in hand with Shum *et al.* [12] who found improvement in terms of IPSS, QOL scores, peak flow rate and post-void residual volume after bipolar TURP.

The advantageous outcome of bipolar versus monopolar TURP was superior to that previously reported in similar comparative studies wherein Mamoulakis *et al*. [13] documented that the midterm safety and efficacy of bipolar and monopolar TURP are comparable.

On the other side, Huang *et al*. [14] reported no statistically significant differences in operative time, resected tissue weight and capsular perforation rate between bipolar and monopolar TURP, while there was significantly more decline in hemoglobin with significantly higher rate of postoperative bleeding in monopolar TURP. Akman *et al*. [15] reported significantly improved IPSS values, maximum urinary flow rate values and PVR measurement in patients had bipolar compared to those had monopolar TURP.

The reported better control of bleeding and subsequently reduction of hemoglobin and hematocrite value deficit was experimentally attributed to depth of coagulation by Huang *et al*. [16,17], on his canine model on dog's prostate they proved that the bipolar TURP causes deeper coagulation of the tissues in comparison to monopolar TURP.

Concerning hyponatermia, bipolar TURP significantly reduced the extent of hyponatremia in relation to monopolar TURP. This finding goes in hand with Ho *et al*. [18] who reported a decline in the mean postoperative serum Na^+ for bipolar TURP and monopolar TURP respectively with significantly lower decline with bipolar TURP. Huang *et al*. [14] found that the decline in serum sodium was significant in monopolar compared to bipolar TURP. Akman *et al*. [15] reported that sodium levels are significantly lower in the monopolar group than in the bipolar group and that transuretheral resection syndrome developed in 1.4% of patients in the monopolar group. In support of the favorable effect of bipolar TURP on Post operative serum sodium level, recently, Ghozzi *et al*. [19], found declines in the mean postoperative serum Na+ for bipolar and monopolar TURP groups were 1.2 and 8.7mmol/L, respectively.

Postoperative SAP was significantly higher in both groups compared to baseline measures with non-significant difference between both groups; a finding indicating concomitant increased circulatory volume with TURP, irrespective of irrigant solution used.

The frequency of perioperative complications was significantly higher in monopolar group compared to bipolar group, however, the frequency of individual complication showed non-significant difference between studied groups. These data indicated safety of bipolar TURP and supported that previously reported by Michielsen *et al*.[20] who reported that bleeding did not significantly differ between monopolar and bipolar groups, the frequency of clot

retention was 5% versus 3%, in both groups respectively, while two repeat interventions were required in monopolar group.

This study showed several limitations, follow up was only for 12 months, longer period are needed

CONCLUSION

TURP in saline is a safe and effective technique; it carries lower risks of blood loss and electrolytes disturbance. Functional results are equal if not superior to conventional monopolar TURP, with results maintained in up to 12 months.

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