Egyptian Journal of Anaesthesia (2014) **30**, 47–52

Egyptian Society of Anesthesiologists

Egyptian Journal of Anaesthesia

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Research Article

Bipolar versus monopolar transurethral prostate resection: Comparison of hemodynamic and biochemical changes

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Received 30 July 2013; revised 23 September 2013; accepted 26 September 2013
Available online 5 November 2013

KEYWORDS

TURP;
Bipolar;
Monopolar;
Hemodynamics;
Anesthesia

Abstract *Background and aim:* Transurethral resection of the prostate (TURP) is the standard procedure for treatment of benign prostatic hyperplasia which is the most common non-malignant disorder of the prostate, affecting over 50% of the elderly male population. This randomized study was done to compare the effect of bipolar cautery using saline with monopolar cautery using glycine regarding hemodynamic and biochemical changes in TURP.

Methods: After approval from the ethical committee in Kasr Al Ainy university hospital, fifty consenting ASA II and III male patients scheduled for TURP were randomly allocated into two equal groups. Monopolar group had TURP performed with monopolar cautery using 1.5% glycine and bipolar group had it done using bipolar cautery with 0.9% saline. Spinal anesthesia was used. Hemodynamic data (mean arterial blood pressure (MAP), heart rate (HR), central venous pressure (CVP), and oxygen saturation (SPO_2)) were recorded preoperatively and postoperatively. Hemoglobin (Hb) and biochemical laboratory findings (Na^+, ABG) were recorded pre- and postoperatively. Volume of irrigant was recorded by the end of surgery.

Results: No significant difference in patients' age or size of the prostate was present. Duration of surgery in bipolar group was longer (p-value 0.003). Preoperatively there was no significant difference in the hemodynamic variables, SPO_2, CVP, biochemical markers and hemoglobin. Postoperatively, the mean HR was significantly higher in bipolar group, p-value 0.006. Also, MAP in bipolar

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Peer review under responsibility of Egyptian Society of Anesthesiologists.

ELSEVIER **Production and hosting by Elsevier**

http://dx.doi.org/10.1016/j.egja.2013.09.005

group was higher, and *p*-value was 0.001. Postoperatively, the mean serum Na^+ level and mean Hb were significantly lower in monopolar group, *p*-value 0.002 and 0.013 respectively. Although there was no significant difference in both SPO_2 and CVP of both groups postoperatively, the increase in CVP in monopolar group was significantly higher.

Conclusions: Bipolar TURP causes less drop in serum sodium and hemoglobin level and less fluid overload than monopolar TURP. However, it takes longer resection time.

1. Introduction

Benign prostatic hyperplasia is the most common non-malignant illness of the prostate, affecting more than 50% of the aged male population [1]. Despite the fact that medical therapy is the first line treatment for BPH, a significant percentage of patients with moderate to severe BPH will require surgical interference [2].

Transurethral resection of the prostate (TURP) is the standard procedure for treatment of this illness [3]. Problems with the monopolar system conventionally used for TURP include bleeding – with reported blood transfusion rates between 5% and 11% [4]; an incidence of TUR syndrome of 2%; [5,6] loss of potency; incontinence; stricture development; and infrequent impediments such as bladder perforation and diathermy burns from unwell placed return electrodes used to complete the circuit [7]. Failure of certain types of pacemakers during monopolar use has been reported [8].

Endoscopic surgical techniques necessitate the usage of an irrigating fluid. Such use of fluids may have consequences that are influenced by the rate, volume and nature of the fluid absorbed [9].

A possible impediment of such irrigation is systemic absorption of the fluid to the degree that evident symptoms are produced. In monopolar TURP, frequently used irrigation fluid is glycine 1.5%. Glycine is a popular irrigating fluid because of its good optical characteristics. Absorbed glycine may be toxic to the cardiovascular system and central nervous system if infused in large amounts (average 20 ml/min) [10]. Normal saline is a more physiological solution that can be given intravenous with negligible side effects. Studies comparing use of bipolar diathermy in normal saline with regular monopolar resection in glycine have shown benefits including fewer frequencies of bleeding and hyponatremia [11].

Most of the previous studies were concerned by comparing monopolar and bipolar resection of prostate regarding duration of surgery, bleeding, and sodium level [11–13]. Very few were concerned by changes in hemodynamics, central venous pressure and arterial blood gases [9,10,14].

2. Aim of work

This study was addressed to compare the usage of bipolar cautery using saline as an irrigant with conventional monopolar cautery using glycine as an irrigant regarding hemodynamic and biochemical changes in TURP surgery.

3. Patients and methods

After approval from Ethical Committee in Kasr Al Ainy University Hospital, an informed consent was taken from 50 patients, with a diagnosis of benign enlargement of the prostate undergoing TURP. Patients were randomly allocated to one of two groups using odd and even number. Group I (monopolar group) ($n = 25$) had TURP performed with monopolar cautery using 1.5% glycine as an irrigant. In Group II (bipolar group) ($n = 25$), bipolar cautery was used with 0.9% saline as irrigant.

Bipolar resection was performed using the Gyrus PK bipolar resection system while Monopolar resection was performed using Erbee resection system.

Any consenting male patient ASA II, or III undergoing TURP was included in the study. Exclusion criteria included ASA IV Patients, proven or suspected allergy to local anesthetics and Patient on Anti-platelets treatment or coagulopathies.

In the pre-anesthesia room I.V. line was inserted and intravenous preload was given by using isotonic saline solution (10 ml/kg). Premedication with midazolam 1–2 mg was given intravenous. Intra-arterial cannula 20G under lidocaine local anesthesia was inserted for arterial blood gases sampling, and Na level assessment.

In the operating theater basic monitoring was applied (ECG, Pulse oximetry and non-invasive blood pressure). The regional block was done in the sitting position. After sterilization of the patient's back using povidone iodine, and under complete aseptic precautions, 25G spinal needle (Uniever) was inserted by para-median approach followed by injection of hyperbaric bupivacaine 0.5% 2.5 ml with 25 μg fentanyl, i.e. the total volume is 2.5–3 ml. After 15 min from injection of local anesthetic the assessment of sensory block was done using pinprick test to be above T10 and motor assessment by using Bromage score [15]. Central venous line was inserted under local anesthesia for CVP monitoring (as a guide for intra vascular volume). All patients were operated upon by the same surgical team.

In all patients, hemodynamic data (mean arterial blood pressure (MAP), heart rate (HR), central venous pressure (CVP), and oxygen saturation (SPO_2)) were recorded preoperatively and postoperatively. Hemoglobin and biochemical laboratory findings (Na, ABG) were recorded pre- and postoperatively. Total volume of irrigant used by each group was recorded by the end of surgery.

3.1. Sample size

Sample size calculated was 50 research subjects, 25 subjects for each treatment arm. This was based on intention to detect 0.44 difference in mean change in serum Hb level among Monopolar TURP versus Bipolar TURP treatment arms, as well as 2.55 difference in mean change in serum Na level among treatment arms as per Huang et al. [16] findings. This also worked on findings of Yousef et al. [14] for Hemodynamic changes among the studied groups.

These calculations were based on study power of 95% and type I error probability of 0.05. The sample size was calculated using PS-Power and Sample size calculation Soft Ware version 3.0.43.

3.2. Statistical analysis

Results are expressed as mean ± SD. Comparison between the two groups as regards different variables or change occurred in each variable was performed using unpaired *t* test. Change occurred in each variable was calculated as follows: [Change = postoperative measurement-preoperative measurement]. The data were considered significant if *p*-value was ⩽0.05. Statistical analysis was performed with the aid of the SPSS computer program (version 12 windows).

4. Results

In both study groups there was no significant difference in age, and there was no significant difference in the size of the prostate between the two groups. However, there was a significant difference in the duration of surgery between both study groups, more in the bipolar group Table 1.

Preoperatively there was no significant difference in the hemodynamic variables (HR, MAP, CVP, and SPO_2) between the two study groups Table 2. There was also no significant difference in preoperative biochemical markers (Na, pH) and Hb level between bipolar and monopolar groups Table 3.

Postoperatively there was a significant difference between the mean heart rate in bipolar group and that in monopolar group Table 2.

Also, there was a significant difference between the mean arterial blood pressure in bipolar group and that in monopolar group Table 2. Throughout the study, SPO_2 slightly decreased in both groups, and CVP increased in both of them (more in the monopolar group) yet, there was no significant difference in both SPO_2 and CVP of the two studied groups postoperatively Table 2.

Comparison between the different biochemical markers and hemoglobin level of the two groups measured postoperatively shows significant difference in serum Na^+ between monopolar group and the bipolar group Table 3. There was a significant decrease in Na level in monopolar group by 9.53 ± 2.26, while it decreased by 3.53 ± 2.50 in the bipolar group Fig. 1. As regards hemoglobin level, there was a significant difference between hemoglobin level in the bipolar group and the monopolar group Table 3. The change in the hemoglobin level showed a significant decrease in the monopolar group (1.51 ± 0.70), while the decrease in the bipolar group was (0.65 ± 0.18) Fig. 1. There was no significant difference in pH value between the two studied groups.

The changes in postoperative hemodynamic variables in both groups were compared with the preoperative values. There was a significant increase in the mean heart rate in bipolar group by 3.67 ± 2.35 Fig. 2, while it decreased by 0.8 ± 2.27 in monopolar group, Fig. 2.

Concerning the changes in the mean blood pressure, there was a significant increase in the MAP in bipolar group by 6.93 ± 1.44 in comparison with the increase in the monopolar group which was 3.00 ± 1.31, Fig. 2.

There was no significant difference in change in SPO_2 between bipolar group and monopolar group, *p*-value 0.219. On the other hand, there was a significant increase in CVP in monopolar group (4.37 ± 1.06) more than in the bipolar group (3.63 ± 0.40), *p*-value 0.022 Fig. 2.

The total volume of glycine used in the monopolar group was 20.93 ± 3.01, while the total volume of saline used in the bipolar group was 21.47 ± 5.25, *p*-value 0.368.

There was one case of TURP syndrome in the monopolar group and no cases in the bipolar group; the difference between the two groups is not significant.

5. Discussion

In our study we compared two groups of patients undergoing TUR of the prostate. One group used bipolar resectoscope with saline as an irrigant, and the other group used monopolar resectoscope with glycine as an irrigant. The two groups had no statistically significant differences in baseline characteristics regarding patients' ages, ASA status and size of the prostate.

We found out that the heart rate increased in the bipolar group and decreased in the monopolar group. Mean blood pressure increased in both groups, and the increase was significantly higher in the bipolar group. CVP increased in both groups, slightly more in the monopolar group. We also found that serum sodium decreased more in the monopolar group.

In our study there was an increased time of resection in bipolar group (63.67 ± 7.90) more than that in monopolar group (54.67 ± 6.94) which was statistically significant. In line with our study Huang et al. [16], compared coagulation depth and bleeding between bipolar and monopolar transurethral prostatectomy in a randomized controlled study done on 136 patients. They found that the operative time for bipolar group was (75.77 min ± 22.63), and for monopolar group was (71.22 min ± 19.85). Also, Acuña-López et al. [12], analyzed intraoperative and postoperative results in bipolar versus monopolar transurethral prostatectomy in cross-sectional study done on 30 patients. The operative time for bipolar group was 64.3 min ± 19.4 and that for monopolar group was 61 min ± 13.5.

In contrast to our study Fagerstrom et al. [13] compared bleeding in monopolar versus bipolar transurethral prostatec-

Table 1 Patients' characteristics of studied groups.

	Monopolar (n = 25)	Bipolar (n = 25)	*P*-value
Age (yrs)	68.93 ± 3.10	69.73 ± 3.17	0.491
Duration of surgery (min)	54.67 ± 6.94	63.67 ± 7.90	0.003*
Size of prostate (cc)	51.2 ± 8.44	54.2 ± 9.47	0.464

Values are presented as mean ± SD.
* $p < 0.05$ Denotes Statistical significance.

Table 2 Comparison between the hemodynamic data of the two studied groups measured preoperatively and postoperatively.

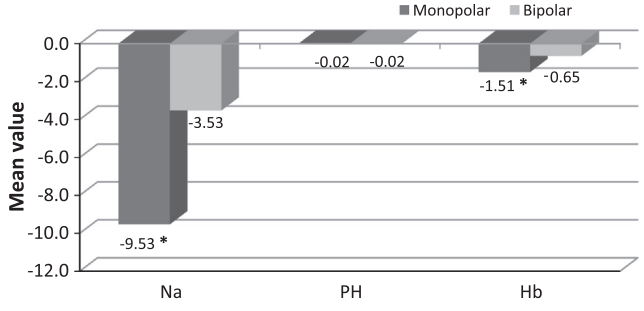
	Monopolar (n = 25) Preoperative	Bipolar (n = 25) Preoperative	Monopolar (n = 25) Postoperative	Bipolar (n = 25) Postoperative
HR	70.60 ± 4.84	73.40 ± 7.89	69.80 ± 5.06	77.07 ± 7.94*
Mean B.P.	99.27 ± 4.03	100.73 ± 3.35	102.27 ± 3.20	107.67 ± 2.64*
SPO_2%	97 ± 0.01	97 ± 0.01	96 ± 0.01	96 ± 0.01
CVP	5.53 ± 1.19	5.53 ± 1.30	9.90 ± 1.02	9.17 ± 1.10

Values are presented as mean ± SD.
* Statistical significance between both groups postoperatively $p < 0.05$.

Table 3 Comparison between the biochemical markers and hemoglobin level of the two studied groups measured preoperatively and postoperatively.

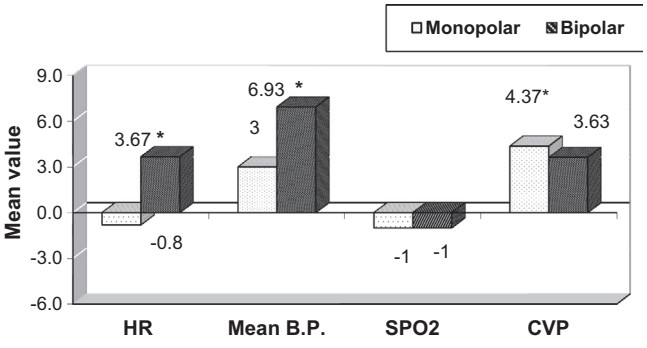
	Monopolar (n = 25) Preoperative	Bipolar (n = 25) Preoperative	Monopolar (n = 25) Postoperative	Bipolar (n = 25) Postoperative
Na (mEq/L)	138.07 ± 3.99	137.53 ± 3.44	128.53 ± 4.75	134.00 ± 3.70*
PH	7.37 ± 0.03	7.37 ± 0.03	7.36 ± 0.04	7.36 ± 0.03
PCO_2 (mmHg)	38.48 ± 3.35	38.75 ± 4.58	37.21 ± 3.83	39.24 ± 4.75
HCO_3	23.85 ± 2.70	24.02 ± 2.54	22.19 ± 2.56	23.12 ± 2.60
Hb (gm.%)	13.07 ± 1.18	13.31 ± 1.19	11.57 ± 1.08	12.67 ± 1.20*

Values are presented as mean ± SD.
* Statistical significance between both groups postoperatively $p < 0.05$.



* Statistically significant (*p value* < 0.05)

Figure 1 Comparison between the change biochemical markers (Na^+, and PH) and Hb level of the two studied groups.



* Statistically significant ($p < 0.05$)

Figure 2 Comparison between the changes in hemodynamic data of the two study groups.

tomy in a randomized controlled study done on 202 patients. They found that the operative time for bipolar group (62 min ± 23) was shorter than monopolar group (66 min ± 23). Also Singhania et al. [17], compared safety and efficacy of bipolar versus monopolar transurethral prostatectomy. They found that, the operative time for bipolar group was 55.1 min ± 13.3 and for monopolar group was 56.76 min ± 14.51. The difference in operative time is most probably operator dependent, related to orientation to the use of the bipolar resectoscope as most surgeons are well trained to the use of the monopolar resectoscope which is the gold standard in treatment of benign prostatic hypertrophy. Also, the size of the monopolar resectoscope loop is larger than that of the bipolar resectoscope.

Comparison between the hemodynamic data of the two studied groups measured postoperatively revealed a significant difference in HR, and MAP which were higher in the bipolar group. However there was no significant difference in both SPO_2, and CVP of the two groups measured postoperatively. In the current study comparison between the effect of bipolar versus monopolar on changes in hemodynamics of the two groups showed a significant increase in HR in bipolar group (3.67 ± 2.35) more than in monopolar group (−0.80 ± 2.27). Also there was a significant change in MAP in the bipolar group (6.93 ± 1.44) more than in the monopolar group (3.00 ± 1.31). Also, there was a significant increase in CVP in the monopolar group (4.37 ± 1.06) which was more than in the bipolar group (3.63 ± 0.40). These results are comparable to Yousef et al. [14] who compared peri-operative complications between three types of irrigating fluids during transurethral resection in benign prostatic hyperplasia in a randomized controlled study done on 360 patients. There was an increase in mean HR in bipolar group, while there was a decrease in mean HR in monopolar group, and there was an increase in MAP in bipolar group more than the increase in

mean MAP in monopolar group. Also there was an increase in the mean CVP in the monopolar group more than in the bipolar group. However, these differences were statistically insignificant.

In our study there was no significant difference regarding changes in pH. Comparison between the different biochemical markers and Hb level of the two studied groups measured postoperatively; there was a significant decrease in serum Na^+ in monopolar group than in bipolar group. However the Hb level was observed to be higher in bipolar group than monopolar group mostly due to better hemostasis.

The most important finding in our study was the significant decrease in Na^+ level in monopolar group (-9.53 ± 2.26) than in bipolar group (-3.53 ± 2.50). These results are in accordance with the previous works done to compare the change in serum sodium level between bipolar and monopolar TURP [16–19].

In consensus with this study Huang et al. [16] compared the decrease in serum sodium between bipolar and monopolar transurethral prostatectomy in a randomized controlled study done on 136 patients, they found that the decrease in serum Na^+ in bipolar group was (-2.02 ± 0.53 mmol/l) and in monopolar group was (-4.57 ± 0.71 mmol/l). Also, Singhania et al. [17] showed that the decrease in serum sodium in bipolar group was (-1.25 meq/l) and in monopolar group was (-4.12 mmol/l), Ho et al. [18] compared the decline in postoperative Na^+ and Hb between bipolar and monopolar TURP in a prospective randomized study on 100 patients. They found that decrease in serum Na^+ in bipolar group was (-3.2 mmol/l) and in monopolar group was (-10.7 mmol/l), which was highly significant. In another study by Michielsen et al. [19], the decrease in serum sodium in bipolar group was (-1.5 mmol/l) and monopolar group was (-2.5 mmol/l).

In our study the difference between the decrease in Hb level in bipolar group (-0.65 g/dl $\pm$ 0.18) and monopolar group (-1.51 g/dl $\pm$ 0.70) was highly significant. This result comes in harmony with that of Huang et al. [16], who found that the decrease in Hb level in bipolar group was (-0.71 g/dl) and in monopolar group was (-1.15 g/dl). Also, Singhania et al. [17], reported a decrease in Hb level in bipolar group (-0.55 gm%) and in monopolar group (-0.97 gm%). On the other hand; Fagerstrom et al. [13], compared the change in percentage Hb level between bipolar and monopolar TURP in randomized controlled study on 202 patients, They found that the percentage of decrease in Hb level in bipolar group was 5.5% and in monopolar group was 9.6% which was highly significant.

In contrary to this study Ho et al. [18] found that there was no significant decrease in Hb level between bipolar group and monopolar group. Also, Michielsen et al. [19] found that the decrease in Hb level in bipolar group was (-1.21 g/dl) and in monopolar group was (-1.3 gm/dl).

In our study the total volume of glycine used in the monopolar group was less than the total volume of saline used in the bipolar group, p-value 0.368. This was mostly due to the longer resection time in the bipolar group. This was in contrast to what Singhania et al. [17] found. Where they found that the mean volume of glycine used in the monopolar group was 19.8 ± 5.4 while the mean volume of saline used in the bipolar group was 18.76 ± 8.1, p-value was >0.05. Mostly due to longer resection time in the monopolar group.

Limitations to this study included our inability to fix the irrigant fluid in both groups, as the idea is to use normal saline for its great visibility with the bipolar resectoscope. Saline is impossible to be used with the monopolar resectoscope.

In this study there was only one case of TURP syndrome in monopolar group versus no cases in bipolar group. That was statistically insignificant. Manifestations in this case started 45 min after the beginning of surgery. The patient complained of blurred vision, dyspnea, palpitation and nausea. There were ventricular ectopic beats about 4/min without affection of MAP, and decline in SPO_2 from 97% to 93%. The surgeon was asked to do hemostasis and end the procedure. Active management included intravenous administration of furosemide 40 mg, sampling of serum Na^+ level, and symptomatic treatment in the form of IV metoclopramide 10 mg. Serum Na^+ in this case declined from 134 to 117 mEq/L. 300 ml hypertonic saline 2.7% was given over 3 h. Symptoms then disappeared; serum Na^+ was repeated and reached 124 mEq/L .The patient was discharged to the ward with repeated follow up of serum Na^+.

6. Conclusion

Our results demonstrate that bipolar transurethral resection of prostate causes less drop in sodium and hemoglobin level and less fluid overload than monopolar transurethral resection of prostate. However, it takes longer resection time.

Conflict of interest

None.

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