SAFETY AND EFFICACY OF BIPOLAR VS MONOPOLAR TRANSURETHRAL RESECTION OF BLADDER TUMOR-A RANDOMIZED CONTROLLED TRIAL

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ABSTRACT

Monopolar Transurethral resection of bladder tumor (TURBT) has been a gold standard for bladder tumor. Initial studies of bipolar TURBT were promising, however, no high level evidence exists and its exact role remains undefined. We compared the safety and efficacy of bipolar and monopolar TURBT. Primary objective was to compare the incidence of obturator jerk. The secondary objectives included the comparison of decrease in hemoglobin, recoagulation and transfusion requirements, bladder perforation, decrease in sodium, resection syndrome and resection time, hospital stay, detrusor muscle identification and severe cautery artifact in resected specimen in two groups. A randomized control trial was conducted for one year. All patients undergoing TURBT for suspected bladder tumors were eligible. Patient's refusal to participate, unfitness for spinal anesthesia and lack of tumor in lateral wall were excluded. Of the 118 TURBT done during study period, 48 were excluded and 70 patients, 36 in monopolar and 34 in bipolar arms, were analyzed. The incidence of obturator jerk was less in bipolar arm but not significantly different (26.4% vs. 47.2%, p=0.073). There was no significance difference in most of the secondary outcomes except lesser hemoglobin drop (0.49gm/dl vs. 0.98gm/dl, p=0.016) and lesser resection time in bipolar arm (33.0 mins vs. 46.8mins, p=0.008). Bipolar was not different to monopolar TURBT with respect obturator jerk and most of the secondary outcomes. However, with bipolar TURBT, there was significantly less resection time and although hemoglobin drop was less as well, it was not clinically significant.

KEYWORDS

TURBT, obturator jerk, cautery artifact

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INTRODUCTION

Transurethral resection of bladder tumor (TURBT) is a primary modality of treatment for superficial bladder cancer[1] and also helps in tissue diagnosis and then further management in muscle invasive bladder cancer.[2] Monopolar system (mTURBT) has been a gold-standard treatment for non-muscle invasive bladder cancer, however, many complications have been reported, such as electrolyte abnormalities and bladder perforation because of obturator jerk.[3] Tumor in difficult location and large size particularly prompted for the search for improved surgical methods.[4]

Bipolar system (bTURBT) uses plasma, a highly energized state of matter to cut the tissue, has already been proved to be safe and effective in transurethral resection of prostate (TURP).[5] However, there are very little high level evidence to prove its safety and efficacy in bladder tumor.

Earlier studies on bTURBT have indicated improved hemostasis, decreased obturator nerve stimulation rate, decreased bladder perforation, [4, 6] and good safety in patients with certain specific conditions such as anticoagulant therapy, cardiac pacemaker etc.[7] bTURBT has also been reported to result in lesser cautery artifact in resected specimen.[8]

Later studies have failed to prove the superiority of bTURBT over mTURBT as regards to obturator jerk, bladder perforation, electrolyte changes and TUR syndrome.[9] Only a few systemic review and meta- analysis are available but that too has a problem of including case-control and cohort studies and having only few RCT to draw the conclusion.[10]

MATERIALS AND METHODS

Study design: This was a single center, parallel arm, randomized, controlled trial done at Tribhuvan University Teaching Hospital, Institute of Medicine from May 2017 to April 2018. The allocation ratio was 1:1. Patients were allocated to two arms of TURBT using computer generated random number list. Approval of the institutional review board was obtained.

Inclusion and exclusion criteria:

Inclusion criteria: All patients undergoing TURBT for suspected bladder tumors.

Exclusion criteria: Consent withdrawal, bladder tumour other than in the lateral wall, unfit for spinal anesthesia and need of general anesthesia or obturator nerve block.

In this prospective, randomized, controlled trial we evaluated the safety and efficacy of bTURBT compared to mTURBT for bladder cancer in.

The Primary Objective was to compare the incidence of obturator jerk between the monopolar and bipolar TURBT. The Secondary Objectives were to compare the bladder perforation, resection time, decrease in hemoglobin and serum sodium, clot retention, need for blood transfusion, need for recoagulation, TUR syndrome and presence of deep muscle and the degree of severe cautery artifact in the resected sample. (Severe artifact was defined as more than 50% cautery artifact in most chips.)

All patients suspected to have bladder cancer were subjected to imaging or cystoscopy and with confirmation of the diagnosis; they were randomized into two arms of TURBT using computer generated random number list. Spinal anesthesia was used in all cases. To overcome the potential confounding effect on our primary end point, obturator jerk, nerve block was not used.

Cystoscopy was done first and the findings were noted before proceeding to TURBT. Monopolar resection was done using 1.5% Glycine solution at 110 watt cutting, and 70 watt coagulation power (Covidien Valleylab Force Fx ™) with Karl Storz 26f resectoscope and loop (8mm width and 5mm depth) with 30^0 telescope. Bipolar resection was done with 0.9% Normal Saline with digital impedance dependent cutting (power range 150-250 watt) and 80 watt coagulation power (Bowa Arc 400) with Karl Storz 26f resectoscope and loop (6mm width and 5mm depth) with 30^0 telescope.

Tumors were resected in block from periphery to center with the stalk resected last. An additional sample of deep muscle was obtained from the tumor base and sent for histopathological examination in different containers. All study variables were recorded in Performa during the operation and in post operative period. Hemoglobin and sodium level was determined in immediate post operative period.

Postoperative irrigation was done with normal saline in both the resection groups and continued till the urine was clear. The catheter was removed after 48 hours in uncomplicated cases and patients were discharged. Patients were followed up in OPD at 2 weeks with the histopathological report or when necessary.

Statistical Analysis: Sample size (n) was calculated using 80% power and a 95% significance level for obturator jerk, assuming

a 30% incidence for the monopolar system and a 5% incidence for the bipolar system. These values were arrived at after a comprehensive literature review. The sample size was determined with the formula (Fig 1):

A sample size of 33 in each arm was calculated using above formula. Estimating a drop out of 10%, we decided to include at least 37 patients in each arm. A computer generated random number was used to allocate eligible patients

The two study arms were well matched with respect to baseline patient variables and tumor morphology (Table. 1). The mean age of patients in monopolar arm was 60.02 years and in bipolar arm it was 61.76 (p=0.53). There were total of 60 male patients and 10 females in the study with 30 males in each arm and 6 females in monopolar where as four in bipolar arm (p=0.55). The tumor size was less than 3 cms in 21 monoplar and 17 in bipolar arm, whereas it
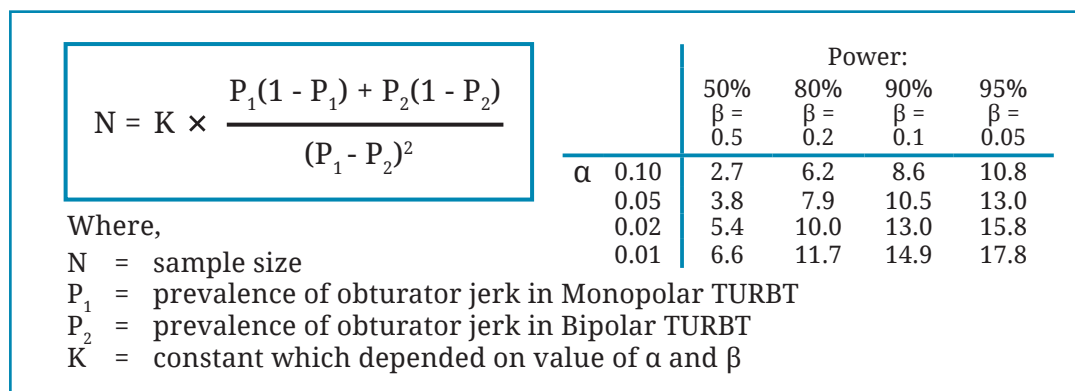
$$N = K \times \frac{P_1(1 - P_1) + P_2(1 - P_2)}{(P_1 - P_2)^2}$$

		Power:			
		50% $\beta = 0.5$	80% $\beta = 0.2$	90% $\beta = 0.1$	95% $\beta = 0.05$
α	0.10	2.7	6.2	8.6	10.8
	0.05	3.8	7.9	10.5	13.0
	0.02	5.4	10.0	13.0	15.8
	0.01	6.6	11.7	14.9	17.8

Where,

N = sample size
P_1 = prevalence of obturator jerk in Monopolar TURBT
P_2 = prevalence of obturator jerk in Bipolar TURBT
K = constant which depended on value of α and β

Fig. 1: Sample size formula

in to monopolar or bipolar resection arm. Data analysis was done using Statistical Package for Social Sciences (SPSS) version 21. Significance was determined using the independent sample t-test for quantitative variables and the chi-square test for qualitative data. *P* value of <0.05 was considered statistically significant.

RESULTS

A total of 118 patients underwent TURBT during the study period. Eighty-two patients were randomized into two arms after exclusion of 30 patients who had tumor location other than at lateral wall and six patients who were unfit for anesthesia. Out of 41 patients in each group, five in monopolar arm and seven in bipolar arm had protocol violation (need of general anesthesia) during the TURBT procedure hence 36 patients in monopolar arm and 34 patients in bipolar arm were analyzed. (Fig. 2)

was more than 3 cms in 15 monopolar and 17 bipolar arm (p=0.48).

The incidence of obturator jerk was 47.22% (17 of 36 patients) in the mTURBT and 26.47% (9 of 34 patients) in the bipolar arm (p=0.073). The bladder perforation occurred in three patients in mTURBT and in 1 patient in bTURBT. The change in sodium was not significantly different in two arms, two patients in mTURBT required blood transfusion in post operative period where as there was no requirement for transfusion in bTURBT, there were no TUR syndrome in any patients or clot retention or recoagulation requirement in any patient during the period of the study (Table 2).

The mean hospital stay in post operative period was 3.25+/- 1.22 days in mTURBT and 2,70+/- 1.05 days in bTURBT (p=0.52).

The detrussor muscle identification rate was 52.77% in monopolar and 58.82% in bipolar

Table 1: Baseline Demographic variables			
	Monopolar TURBT	**Bipolar TURBT**	**P Value**
Age (yrs)	60.02+/-2.15	61.76+/-1.71	0.53
Sex (M:F)	30/6	30/4	0.55
Tumor size (<3cm/ >3cms)	21/15	17/17	0.48
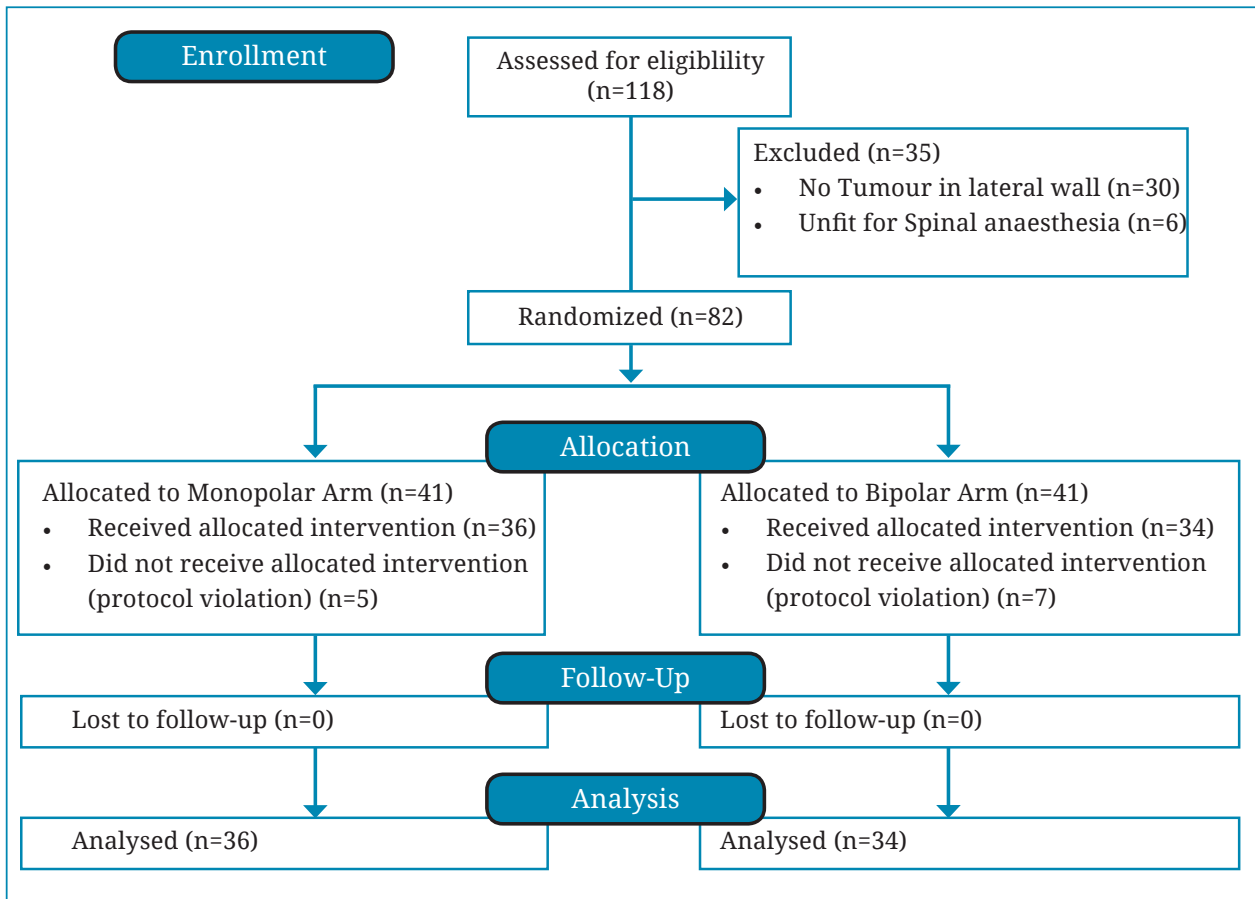
Fig. 2: CONSORT diagram

Table 2: Results			
	Monopolar TURBT	**Bipolar TURBT**	**P Value**
Obturator Jerk	17	9	0.073
Bladder Perforation	3	1	0.331
Resection Time (min)	46.83 ± 3.24	33.06 ± 3.91	0.008
Hemoglobin drop (gm/dl)	0.98 ± 0.79	0.49 ± 0.34	0.016
Sodium drop (mmol/l)	0.53 ± 0.16	0.68 ± 0.7	0.93
Transfusion requirement	2	0	0.163
Hospital stay (days)	3.25 ± 1.22	2.70 ± 1.05	0.52
Detrusor muscle identified	19	20	0.611
Severe artifact	5	3	0.506

arm (p=0.611), the severe artifact in the resected tissue was seen in five cases in mTURBT and three cases in bTURBT (p=0.506). The mean hemoglobin drops significantly less in bTURBT (0.49 ± 0.34 gm/dl) as compared to mTURBT (0.98 ± 0.79 gm/dl (p=0.016). The resection time was also significantly less in bTURBT (33.06 ±3.91 mins) as compared to mTURBT (46.83 ± 3.24 mins) (p=0.008).

DISCUSSION

Monopolar cautery has remained the gold standard for bladder tumor resection since its inception but complications can occur. (12) Initial studies of bipolar TURBT showed certain advantages but till date no high quality evidence exists to conclusively establish its role in TURBT. To our knowledge, this is the

first randomized, controlled trial in Nepal to compare bipolar and monopolar TURBT.

The primary end point of our study was the incidence of obturator jerk. The exact incidence of this event varies widely in the literature at an average of about 10% to 25% to even greater than 50% for monopolar resection.[8,13] The incidence of bipolar resection is 0% to 5%.[8,14,15] Tumor location and general anesthesia with muscle relaxation or obturator block, all influences the incidence of the obturator jerk.[7,16] Many studies have not reported the types of anesthesia used.[8] This makes it difficult to judge the true incidence of the obturator jerk. We eliminated this confusion by performing all resections with the patient under spinal anesthesia and only including tumors on the lateral wall in our study. We found no significant difference between monopolar and bipolar cautery with regard to obturator jerk (47.22% vs 26.47%, p= 0.073). But, there was a trend towards lesser obturator jerk in Bipolar arm. Possible mechanisms of obturator jerk in bipolar resection include current transmission secondary to the initial high voltage needed to generate the plasma vapor pocket and nerve stimulation in patients with a thin bladder wall.[15,17] Also, current mushrooming occurs around the electrodes and is transmitted a few mm deep in the body. The close proximity of the obturator nerve to the bladder wall means that even this limited transmission is enough to stimulate it. Unlike in our study, Geavlete *et al*[4] , had reported significantly less obturator jerk in bipolar bTURBT. Similar to our study, Venkatramani V *et al*[4] did not find bTURBT to cause significantly less obturator jerk. In contrary, Ozer K *et al*[9] found bTURBT to cause significantly more obturator jerk. Gupta *et al* eliminated nerve stimulation using settings of 50 W for cutting and 40 W for coagulation,[15] but we found these settings to be too low for satisfactory resection.

One of the most dreaded complications of TURBT is bladder perforation. We had perforation in 3 patients in monopolar group and one in bipolar group, which was not significantly different. All the cases had small extraperitoneal bladder perforation which was managed with catheter drainage only. Xishuang *et al*[6] and Geavlete *et al* both had reported lesser bladder perforation in bTURBT. However, Venkatramani V *et al* did not find significant diffrence in bladder perforation in bTURBT and Ozer K *et al* had reported more bladder perforation in bTURBT.

The mean resection time was significantly less in bTURBT(33.06 +/- 3.91 mins in bTURBT) compared to mTURBT(46.83 +/- 3.24 mins) (p=0.008). Unlike in our study, Venkatramani V *et al* and Xishuang *et al* did not find significant difference in resection time in their study.The effective cutting with plasma and coagulating ability of the bipolar system caused less sticking of the tissue on to the loop,[18] which lead to reduced resection time in our study as the requirement for repeated manual removal of tissue from the loop by disassembling the resectoscope was less.

There was less hemoglobin drop in bipolar arm (0.98 +/- 0.79 gm/d vs 0.49 +/- 0.34 gm/dl, p=0.016) which was statistically significant, but this was not clinically significant as there was no need of recoagulation or clot retention in either groups. Also only two patients in mTURBT required blood transfusion and none bTURBT (p=0.163). The reduced hemoglobin drop was again because of better cutting and coagulating ability of bipolar system. Venkatramani V *et al* did not find blood loss to be significantly different, however, Geavlete *et al* had reported less hemoglobin drop in bTURBT, but the requirement for blood transfusion was not significantly different in the two groups.

There was no TUR syndrome during the study period. The mean hospital stay, sodium drop, muscle identification and severe cautery artifact was not significantly different between the two groups. Venkatramani V *et al* also did not find any significant differences in these parameters but they found that severe cautery artifact was significantly less in bTURBT

Similar to our finding, a Systematic Review and Meta-Analysis by Yu Chu *et al*[10] have found bTURBT does not have significantly different obturator jerk, bladder perforation and transfusion requirement but, bTURBT was significantly better as regards to less hemoglobin drop and resection time.

Our study concluded that bipolar TURBT is as safe as, but not superior to monopolar TURBT with regards to bladder perforation, sodium changes, TUR syndrome, recoagulation and transfusion requirement. Although not statistically significant, there was trend towards fewer occurrence of obturator jerk in bipolar TURBT. It is safer than monopolar TURBT in terms of lesser hemoglobin drop but this was not clinically significant. It has same efficacy as monopolar TURBT with regards to hospital stay, detrussor muscle identification, and severe cautery artifact identification but has superior efficacy in terms of lesser operative time.

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