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RESEARCH ARTICLE

COMPARATIVE STUDY OF MONOPOLAR TURP VERSUS BIPOLAR TURP

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Abstract

AIM OF STUDY: The aim of this study was to compare the efficacy and safety of this newer bipolar TURP using the Gyrus™ bipolar diathermy (Gyrus plasma kinetic tissue management system,Gyrus Medical Ltd.) with conventional TURP using monopolar diathermy over a follow-up period of 12 months. **MATERIALS AND METHODS:** This study included a total of 40 patients with BPH who underwent TURP using the Gyrus™ PlasmaKinetic Tissue Management System (Gyrus Medical Ltd., Bucks, UK) or conventional monopolar resectoscope between march2008 and june 2009. 20 consecutive patients underwent bipolar TURP using the Gyrus™ system and 20 consecutive patients underwent monopolar TURP using the conventional monopolar resectoscope. **RESULTS:** The safety end points studied were the occurrence of complications and the changes in the preoperative and immediate postoperative serum sodium (Na^+) and hemoglobin (Hb) levels. The efficacy end points that we studied were resection time, weight of resected prostate tissue, and improvement in the International prostate Symptoms Score (IPSS) and maximum flow rate (Q_{max}) in patients' uroflow over 12 months. **CONCLUSIONS:** In conclusion, the bipolar transurethral prostatectomy (TURP) is as effective as conventional monopolar TURP in the relief of bladder outlet obstruction due to BPH.It has the further advantage of better hemostasis as proven by less blood loss, no significant reduction of serum sodium, less catheterization time and a shorter hospital stay. These in turn lead to decreased clot retention, less requirement for post TURP blood transfusion requirement , rarity of TUR SYNDROME.

KEY WORDS: LUTS,BENIGN PROSTATIC HYPERPLASIA (BPH),MONPOLAR TURP, BIPOLAR TURP, TUR SYNDROME, INTERNATIONAL PROSTATE SYMPTOMS SCORE (IPSS) AND MAXIMUM FLOW RATE (Q_{MAX}).

INTRODUCTION

LUTS are a common problem affecting older men and the prevalence of LUTS related to BPH increases with age, approaching 50% by age 60 years and 90% by age 85 years [1,2]

There are numerous treatment alternatives available for patients with bladder outlet obstruction (BOO) secondary to benign prostatic hyperplasia (BPH), including watchful waiting,

pharmacological therapy, minimally invasive therapy, transurethral resection (TURP), and open prostatectomy.

Despite the widespread use of medical treatment, a significant proportion of patients require surgical intervention.[1] TURP remains the most frequently performed operation for men with BPH,[2] despite the availability of numerous minimally invasive alternatives, because these fail to equal TURP and require costly instruments, a steep learning curve, and long-term follow-up to establish their efficacy and safety .

Transurethral resection of prostate (TURP) is currently the gold standard for surgical treatment of benign prostatic hyperplasia (BPH) as this procedure results in the best improvement in symptoms and urine flow rate. [1] However, this procedure is not free of complications. Mebust et al reported an 18% morbidity rate after TURP and a metanalysis by the BPH Guideline Panel showed that the morbidity rate associated with TURP ranges from 7% to 43%. [2]

TURP often requires extended Foley catheterization and hospital stays, and is associated with various complications, including bleeding, TUR syndrome, incontinence, impotence, and urethral stricture. In conventional TURP, most morbidities are related to the use of nonelectrolyte irrigation fluid like glycine, monopolar current, poor visibility due to bleeding, and mechanical factors.

The absorption of glycine and irrigation fluid from extended resection leads to glycine toxicity and hyponatremia, which are responsible for the symptomatology [4].

Recently, transurethral resection with bipolar energy was introduced to overcome some of these complications. Bipolar TURP results in less thermal damage and better visibility, and most importantly, the ability to use physiologic saline for irrigation

Bipolar technologies such as Gyrus system [5], Vista Coblation® system [6], and transurethral resection in saline (TURIS) system ,storz bipolar system allow the electric current to complete the circuit without passing through the patient. This allows saline solution to be used for irrigation during resection. Thus, it may potentially reduce the risk of TUR syndrome during TURP.

The Gyrus plasmakinetic (PK) system is a bipolar coaxial system with the active and return electrodes located in the same axis, separated by a ceramic insulator [7].

In our present study we attempted to compare the post-operative outcomes of patients undergoing TURP,by conventional monopolar TURP and newer bipolar PK TURP in terms of relief of bladder outlet obstruction,operative time , catheterization time,hospital stay, complications both immediate post TURP and in the follow up period of 12 months.

AIM OF STUDY:

The aim of this study was to compare the efficacy and safety of this newer bipolar TURP using the Gyrus™ bipolar diathermy (Gyrus plasma kinetic tissue management system,Gyrus Medical Ltd.) with conventional TURP using monopolar diathermy over a follow-up period of 12 months.

MATERIALS AND METHODS:

This study included a total of 40 patients with BPH who underwent TURP using the Gyrus™ PlasmaKinetic Tissue Management System (Gyrus Medical Ltd., Bucks, UK) or conventional monopolar resectoscope between march2008 and june 2009. 20 consecutive patients underwent bipolar TURP using the Gyrus™ system and 20 consecutive patients underwent monopolar TURP using the conventional monopolar resectoscope.

The safety end points studied were the occurrence of complications and the changes in the preoperative and immediate postoperative serum sodium (Na^+) and hemoglobin (Hb) levels. The efficacy end points that we studied were resection time, weight of resected prostate tissue, and improvement in the International prostate Symptoms Score (IPSS) and maximum flow rate (Q_{max}) in patients' uroflow over 12 months.

The **inclusion criteria** were patients aged older than 50 yr and fit for anesthesia. The indications for TURP included patients who had failed medical therapy, patients with acute urinary retention (AUR) and a failed trial of voiding without urinary catheter,recurrent urinary tract infection and recurrent hematuriawere also included.

Exclusion criteria were patients with documented or suspected prostate cancer, bladder calculus, neurogenic bladder, previous prostate surgery, renal impairment, associated hydronephrosis, and urethral stricture.

Patients included in the study were randomized in a 1:1 ratio into two groups: PK (bipolar TURP) and TURP (monopolar TURP). Before surgery, all patients were evaluated in detail by medical history ,physical examination with DRE.Their voiding symptoms were evaluated with IPSS, Quality of Life score, and Q_{max} with postvoid residual urine (RU). Baseline blood investigations include serum prostate-specific antigen (PSA), Na^+, creatinine, and Hb.

All surgeries performed under spinal anaesthesia .There were no difference in the bipolar TURP and monopolar TURP surgical technique . Bipolar TURP was performed with a 26 Fr. Karl Storz® (Tuttlingen, Germany) continuous flow rotatable resectoscope using normal saline irrigation and the Gyrus™ PlasmaKinetic Tissue Management System(Gyrus super pulse generator, Gyrus medical Ltd, buck, UK) with power setting at 200 for cutting and 100 for coagulation. The PlasmaKinetic device had a maximum power of 200 W and delivered a radio frequency wavelength of 320-450 kHz and a voltage range of 254-350 V. The TUR loop consisted of an 80/20 platinum/iridium alloy electrode with the active and return electrode on the same axis (axipolar) separated by a ceramic insulator. In bipolar PKRP, electrical energy is delivered via a bipolar generator. An ionized plasma pocket is created that allows resection and vaporization of the tissue along with haemostasis. Both the active and return electrode are contained within the instrument. Saline solution is used as an electrolytic medium to conduct the electrical energy from the active to the return electrode.

Conventional monopolar TURP was performed with 26 Fr. Karl Storz® (Tuttlingen, Germany) continuous flow rotatable resectoscope using KLS martin maxium diathermy with the power setting at 120 for cutting and 80 for coagulation utilizing 1.5% glycine as irrigation solution. Conventional TURP is performed using monopolar electric current from the electrosurgical unit which flows from the active electrode (the wire loop), through the patient, to an electrosurgical unit grounding pad. Glycine, which is a non-conducting fluid, is used for irrigation.

At the end of the procedure, a 20 Fr. 3-way Foley catheter was inserted. Saline irrigation was continued at a rate sufficient to maintain a clear returning fluid and the catheter was removed if the urine was clear in the absence of irrigation. The patient was subsequently given a voiding trial and discharged from the hospital if voiding spontaneously.

Serum electrolytes and hemoglobin were measured after TURP. Resection time, weight of resected tissue, duration of catheter use and hospital stay, and presence of any complications were documented in detail. Patients were observed at 1, 6 and 12 months after TURP to allow for the detection of early and late complications, International Prostate Symptom Score (IPSS) assessment, and uroflowmetry.

Statistical analysis was carried out using Student's t-test, Mann-Whitney test and Chi-square test. A *p*-value < 0.05 was considered to be statistically significant. Statistical data are presented as mean ± SD.

RESULTS:

Table 1 shows the charecteristics of all the 40 patients selected for both bipolar PK TURP and monopolar TURP. All the charecteristics are comparable in both the groups with p value insignificant (>0.05).

Table 2 shows the peri-operative data analysed after TURP in both the groups the mean operative time was 72.2+or - 32.8 in the bipolar group and 76.2 +- 28.6 in the monopolar group (p=0.351).

With bipolar resection 14.3+-6.7 of prostate tissue was resected versus 13.9+-8.6 in the monopolar group (p=0.513) post operatively there was statistically significant difference in the mean decline in serum sodium (1.47+-3.24 in bipolar group versus 2.23+- 3.63 ,p=0.051) as well as in fall in hemoglobin (0.67+-0.62 in bipolar group versus 1.1+- 0.78 in monopolar group p= 0.029) but there was no statistical difference in serum potassium levels (p=0.317).

Mean duration of catheter stay after TURP was less in bipolar group (2.27+-1.36)when compared to monopolar group (3.12+-0.69).This was possible due to early stoppage of post operative irrigation in bipolar TURP group.

Furthermore mean hospital stay was also low in bipolar group (3.62+-1.56) when compared to monopolar group (4.43+-1.69) (p=0.034)

IPSS and peak flow rate (Qmax) improvements at 1, 6 and 12 months were almost equal and comparable in the two groups (Table 3)

In the early post operative period complications were noted in 3 cases(%) in bipolar group and in in 5 cases (%)in monopolar group(table 4)

TABLE 1: PATIENT CHARECTERISTICS:

	Bipolar group	Monopolar group	P value
Number of patients	20	20	
Age(years)	68.4 ± 7.8	69.6 ± 7.6	0.864
Prostate volume(ml)	49.1 ± 20.5	47.3 ± 16.9	0.335
PSA(ng/ml)	2.89 ± 1.34	2.72 ± 0.91	0.273
pre-op Hb(g/dL)	12.6 ± 1.9	12.9 ± 2.1	0.635
Pre-op Na(mEq/L)	138.9±3.4	139.1 ± 3.8	0.450
IPSS	18.7 ± 4.5	19.9 ± 4.8	0.673
QoL	4.1 ± 1.0	4.5 ± 1.2	0.765
Qmax(ml/sec)	8.7 ± 2.7	8.4 ± 2.0	0.866

Values are presented as mean ± SD.
IPSS, international prostate symptom score; QoL, quality of life; Qmax, peak flow rate

TABLE 2; PERIOPERATIVE DATA

	Bipolar group Mean values	Monopolar group Mean values	P value
Wt of resected tissue(g)	14.1+6.9	13.7+8.7	0.514
Operative time(min)	72.2+-32.8	76.2+-28.6	0.351
Decline in sr. Na(mEq/L)	1.42+3.24	2.27+3.63	0.050
Decline in sr. K(mEq/L)	0.15+1.48	0.09+1.23	0.326
Fall in Hb%(g/dL)	0.67+0.62	1.1+0.78	0.029
Duration of catheter(days)	2.27+1.36	3.12+0.69	0.012
Hospital stay(days)	3.62+2.56	4.43+1.69	0.034

TABLE 3. PREOPERATIVE AND POSTOPERATIVE IMPROVEMENT IN IPSS AND QMAX AT 1, 6, 12 MONTHS

	Bipolar group		Monopolar group	
	IPSS	Qmax(ml/sec)	IPSS	Qmax(ml/sec)
Pre-operative	18.7+4.5	8.7+2.7	19.9+4.8	8.4+2.0
1 month	6.6+4.9	17.4+3.8	8.1+4.3	16.9+3.7
Improvement	12.1+4.6	8.7+4.5	11.8+3.4	8.5+3.9
6 months	6.5+4.0	18.9+3.1	7-7+4.9	18.5+4.3
Improvement	12.2+4.1	10.2+4.8	12.2+5.5	10.2+5.2
12 months	7.0+4.6	18.8+4.2	7.8+4.4	18.6+2.9
Improvement	11.7_3.5	10.1+5.1	12.1+5.1	10.2+3.5

Values are presented as mean + SD
IPSS international prostate symptom score ;Qmax , peak flow rate

TABLE 4; COMPLICATIONS IN BIPOLAR AND MONOPOLAR TURP GROUPS

complication	**Bipolar group**	**Monopolar group**
Early post-op complications		
Fall in Hb% requiring blood transfusion	0	2(10%)
Clot retention	1(5%)	2(10%)
TUR syndrome	0	1(5%)
Post-operative dysuria	3(15%)	2(10%)
UTI	1(5%)	1((5%)
Late post-op complications		
Urethral stricture	1(5%)	2(5%)
Urge incontinence	2(10%)	1(5%)
Recurrent obstructive symptoms	2(10%)	1(5%)

Values are presented as number(%)

Two patient required blood transfusion due to severe reduction in Hb(%) in the monopolar group where as no blood transfusion was given in the post op period of bipolar TURP patients.
Two patients in monopolar groupand one patient in bipolar group had clot retention which required evacuvation and recatheterisation .
Two patients in monopolar group had significant (<125meq/l)fall in serum sodium levels 124 and 120 respectively among one patient developed features of TUR syndrome such as bradycardia hypertension ,blurring of vision nausea, confusion and restlessness which was

managed successfully by giving intravenous lassix, Normal saline hydration and continous monitoring of patient in surgical intensive care unit

Two patients in monopolar group and one patient in bipolar group had postoperative dysuria which was treated by reassurance and bladder antispasmodics

One patient in each group developed culture positive UTI which was treated successfully with appropriate antibiotics

In all , 7 patients in monopolar group and 5 patients in bipolar group developed complications in the immediate post operative period

In the follow up at 1 , 6, 12 months after TURP both groups of patients were evaluated with IPSS, Qmax and for evidence for complications like urethral stricture,bladder neck stenosis, incontinence etc

Two patients in monopolar group and one patient in bipolar developed urethral strictures that were managed by visual internal urethrotomy in one patient and simple dilatation in two other patients.two patients in bipolar group and one patient in monopolar group required medical therapy to control recurrent obstructive symptoms

Two patients in bipolar group and one patient in monopolar group developed urgency and urge incontinence which were treated medically

Overall 4 patients in monopolar group and 5 patients in bipolar group developed late complications.

DISCUSSION:

Conventional monopolar TURP is considered safe with a low associated mortality rate. High perioperative morbidity rates largely due to intraoperative and postoperative hemorrhage or perforation, however, have been reported. Moreover, TUR syndrome, caused by absorption of irrigation fluid, has been known to occur.[6-8] Traditional monopolar TURP uses an active electrode loop to transmit energy into tissue and a return electrode at the skin to complete the circuit. The energy must travel through the body to the ground to complete the circuit. The electrical resistance creates temperature as high as 400*C which causes high thermal damage to the surrounding tissues especially urethra .To avoid conduction of this electrical energy to surrounding tissues, a nonconductive irrigating solution is used which, when absorbed in excess, may cause TUR syndrome. The reported rates range from 0.18% to 10.9%, with Mebust and his colleagues reporting an incidence of 2% in conventional monopolar TURP.[9-11] The risk of TUR syndrome increases with a larger prostate (> 45 g) or longer resection time (> 90 min).

Recently, transurethral resection and vaporization with bipolar energy has been introduced as a technical modification of TURP.[12-14]

Bipolar technology allows high initializing voltage to establish a voltage gradient in the gap between two electrodes in essence the active and return poles are incorporated into the electrode design this energy converts the conducting medium (saline) into a plasma field of highly ionized particles. This field disrupts the molecular bonds between the tissues. This allows the high temperature loop to provide rapid evaporation and desiccation of prostate tissue and result in “cut and seal effect” since these charge ions have only a short penetration of 50 to 100 micrometers, there should be less collateral thermal damage to the surrounding tissue and less tissue char.

The biggest advantage of bipolar current in TURP is the use of saline for irrigation, which may reduce the morbidity associated with the absorption of fluid. Performing TURP with saline eliminates the risk of TUR syndrome, thereby enabling the removal of a large bulk of prostate tissue by resection or vaporization.

In our results, the change in serum sodium concentration was significantly greater in the monopolar resection group when compared to the bipolar group (p = 0.051). In bipolar TURP, the mean change in serum sodium was 1.47 mEq/L, whereas in the monopolar group, the mean change was 2.23 mEq/L. Two patients of the monopolar groups were found to have serum sodium levels of less than 135 mEq/L (123 mEq/L and 126 mEq/L respectively), out of which one patient developed symptoms of TUR syndrome which was managed successfully.

In conventional monopolar TURP, radiofrequency energy is directed into the tissue where electrical resistance creates temperatures as high as 400℃. In bipolar TURP, however, radiofrequency energy converts a conductive medium (saline irrigant) into a plasma field of highly ionized particles that disrupt the organic molecular bonds between the tissues. By directing the radiofrequency current from an active electrode to an adjacent return electrode, tissue temperature is reduced to 40-70℃. The low temperatures of bipolar TURP allow for minimal tissue damage.[15]

The absence of a return current in bipolar surgery also removes the risks of burns and cardiac pacemaker problems.

Moreover, bipolar electrocautery seems to be more efficient for removing tissue and simultaneously controlling bleeding when compared to the monopolar procedure. Coagulation is also accurate and effective, which decreases the time for control of bleeding and improves intraoperative vision. Wendt-Nordahl and co-workers reported that bleeding rate was significantly reduced using the bipolar resectoscope in their *ex-vivo* experiments, compared to the monopolar resection device.[14]

In our study there was less intra-operative and post operative bleeding in bipolar group which has resulted in statistically significant difference in fall in post operative hemoglobin(p value 0.029) between two groups.

Also in 2 cases of monopolar TURP required blood transfusion in the immediate post op period where as blood was not transfused in any of the case of bipolar TURP.

In addition to the aforementioned advantages, bipolar TURP allows more rapid catheter removal and a shorter hospital stay. Botto and co-workers[12] reported a mean hospital stay of only 2.2 days, and all patients were discharged without a catheter, while Eaton and Francis[13] reported that 85% of patients were able to return home on the day of surgery and have their catheters removed at 48 hours in the bipolar TURP group. In another study by Starkmann and Santucci, the patients treated by Gyrus TURP had their catheter removed a mean of 1.4 days earlier than the standard group, improving patient comfort, length of hospital stay, and costs.[16]

Our results also show that both duration of catheter use and hospital stay were significantly shorter in the bipolar group (p = 0.012 and p = 0.034, respectively).

Other studies with bipolar TURP have reported high rates of recatheterization and that irritative symptoms were more common in the bipolar group, probably as a result of edema secondary to higher current with lower frequency exerted on the tissue.[17] Urethral stricture formation was also more commonly observed in the bipolar group. Several risk factors, such as the use of higher

ablative energy or larger resectoscope diameter, may account for increased urethral stricture formation. Higher recatheterization rates with the bipolar device were also described in a randomized study by Dunsmuir and collegues.[15] Singh and his collegues,[18] however, reported that postoperative dysuria was less with bipolar TURP than with monopolar TURP. This difference could be attributed to the greater thermal damage and formation of granulation tissue with monopolar current. In our results, there was no significant difference in the incidence of recatheterisation, irritative voiding symptoms urinary UTIs, or postoperative dysuria between the two groups.

In the follow up period of 12 months our results show that bipolar TURP was equivalent to conventional monopolar TURP in improvement of IPSS and urinary flow rates(Qmax) at 1, 6 and 12 months of follow-up.

The bipolar TURP allows for longer resection times without the risk of hyponatremia and transurethral resection syndrome . the slower pace of resection combined with good visibility due to better bleeding control is also more comfortable for the residents in training and will enhance resident training in future.

The advantages of bipolar TURP has also allowed safe resection of very large glands without the risk of dilutional hyponatremia and copious bleeding .Finley and colleagues reported on the safe resection of three patients with preoperative gland size over 160 ml.the mean resection was 163 minutes and average resection was 80.8gm.the mean change in hemoglobin was 2.1g/dL and mean serum sodium change was 3.3mEq/L [(5,4)]

Other advantages proposed for bipolar technology are lower risk of capsular perforation due to decreased stimulation of pelvic floor,less conductive trauma resulting in lower rate of bladder neck stenosis and urethral structure, self cleaning of loop by high energy level of plasma ignition.

Our study also showed no post operative urethral strictures in bipolar group whereas 2 patients in monopolar group had strictures which needed intervention

Some of the disadvantages described for bipolar TURP.

It does not entirely prevent fluid absorption and will not be able to prevent sever and/or pulmonary failure in cases of large volume uptake

Risk of recurrent bleeding due to smaller coagulation zone

Mamoulakis et al [4] reported on B-TURP versus M-TURP in a systematic review and meta-analysis of randomized controlled trials. An extensive literature search was performed to detect all published trials that compare the 2 techniques. The authors were able to include 16 randomized controlled trials with 1406 patients in their analysis. They concluded that no clinically relevant differences in short-term efficacy exist between the two techniques, but B-TURP is preferable due to a more favorable safety profile (lower TUR
syndrome and clot retention rates) and shorter irrigation and catheterization duration.

A major limitation of our study is the small number of patients recruited .this limitation greatly implicates the interpretation of our complications findings .

Accrual of larger pool of patients with a longer follow up period is required

CONCLUSIONS:

In conclusion, the bipolar transurethral prostatectomy (TURP) is as effective as conventional monopolar TURP in the relief of bladder outlet obstruction due to BPH.

It has the further advantage of better hemostasis as proven by less blood loss, no significant reduction of serum sodium, less catheterization time and a shorter hospital stay. These in turn lead to decreased clot retention ,less requirement for post TURP blood transfusion requirement , rarity of TUR SYNDROME

It may also enable prostate resection as a day case in selected cases.

These data are promising, but a longer follow up and larger series are needed to compare the late complications such as urethral stricture, bladder neck stenosis and retrograde ejaculation, before the bipolar TURP method becomes universally accepted for managing BPH.

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