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Electrolyte Changes in Monopolar and Bipolar Transurethral Resection of Prostate (TURP) – A Prospective Randomized Study

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Abstract

Prostatectomy and Transurethral resection of prostate (TURP) have been the surgical options for men with obstructive symptoms due to benign prostatic hyperplasia. Various clinical manifestations, produced due to the absorption of large volumes of irrigating fluid during TURP, are referred to as TURP syndrome. In this study, we have analyzed the changes in serum electrolytes while using irrigating fluids such as 1.5% glycine and Normal saline while performing TURP using Monopolar and Bipolar procedures respectively. A prospective, randomized study was conducted on 88 male patients belonging to the age group of 50 to 86 years over a period of 19 months. 1.5% glycine was used in 46 cases and Normal saline in 42 cases for irrigation. The weight of the prostate gland ranged from 25 gms to 90 gms. The duration of the TURP surgery ranged from 10 min to 90 min. The volume of 1.5% glycine used, ranged from 5l (litres) to 21 l and the volume of normal saline ranged from 5l to 36l. The changes in serum electrolytes that occurred during the procedure were correlated with duration of the procedure, volume of 1.5% glycine and Normal saline used and weight of prostate gland resected. The electrolyte changes during Monopolar and Bipolar TURP were same. Use of Normal Saline did not have any advantages over glycine in patients undergoing TURP.

Keywords: Glycine, Normal Saline, Prostate Gland, Serum Potassium, Serum Sodium, TURP Syndrome

Introduction

Transurethral resection of prostate (TURP) requires the use of irrigating fluid to gently dilate the mucosal spaces, remove blood, cut tissues, remove debris from the operating field and to enable better vision. Various types of irrigating fluids have been used during TURP procedure[1]. The potential complication of such a procedure is a systemic absorption of hypotonic irrigating fluid.

Early signs of TURP syndrome are dizziness, headache, nausea, dyspnea, arrhythmias, hypertension and bradycardia, followed by restlessness and confusion. If they are not treated promptly, the patient becomes cyanotic, hypotensive and ultimately there can be cardiac arrest. Rarely, it may exhibit neurological abnormalities[2]. These symptoms primarily are manifestations of circulatory fluid overload, water intoxication and occasionally toxicity of the solute in the irrigating fluid. Despite improvements in the current surgical and anesthetic management, 2.5-20% of patients undergoing TURP show one or more manifestations of TURP syndrome and 0.5-5% patients die perioperatively. A study was undertaken to identify and compare the electrolyte disturbances in both monopolar and bipolar TURP.

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Subjects and Methods

This prospective linear randomized study was conducted on 88 adult male patients in the age group of 50 to 86 years who gave consent. They underwent elective TURP under spinal anaesthesia, over a period of 19 months. 1.5% glycine was used as irrigating fluid in 46 cases who underwent monopolar TURP and Normal saline in 42 cases who underwent Bipolar TURP. Cases were operated by two surgeons with experience of performing TURP using Nesbit technique over a period of 19 years and 12 years respectively.

Clearance from Ethical Committee of Shri B. M. Patil Medical College, Hospital and Research Centre, Vijayapur, Karnataka was obtained. The baseline characteristics of the patients in both groups were documented [Table 1]. All patients were subjected to pre-anesthetic assessment prior to TURP surgery. They were assessed with routine investigations including hematocrit, ECG, Doppler echocardiography, preoperative estimation of serum sodium, potassium and calcium levels (in mEq/L). Those diagnosed with prostate cancer, neurogenic bladder as revealed in the urodynamic studies, urinary tract infection, urethral stricture, chronic renal failure, previous prostate surgery, receiving anticoagulant therapy, unable or unwilling to comply with follow-up schedule were excluded from the study.

Standard monitors for heart rate, systemic blood pressure, ECG, SpO_2 were attached to all patients. Spinal anaesthesia was given aseptically at L2-3 or L3-4 intervertebral disc spaces in sitting/lateral posture. There was no difficulty in producing satisfactory analgesia to a dermatome level up to T10. Patients were positioned in lithotomy posture and the TURP surgery was started with 1.5% glycine irrigation fluid in Monopolar TURP and Saline irrigation in Bipolar TURP, keeping the irrigation fluid column at a height of 60 cm, measured from the level of pubic symphysis of the patient on the operating table. The duration of the procedure in minutes, weight of prostate gland resected, and the volume of 1.5% glycine or saline used during the procedure were recorded. All patients were carefully observed for the early symptoms of TURP syndrome perioperatively. The procedure was terminated if early signs of restlessness, bradycardia, yawning, etc. were noted. Adequate therapeutic measures were taken to prevent further complications.

The serum levels of sodium, potassium, and calcium were measured immediately in the recovery room postoperatively. The changes in the plasma electrolytes levels were also correlated with the volume of irrigating fluid used, duration of the procedure, and the weight of prostate gland resected.

Statistical Analysis Used

The values of pre- and post-operative serum sodium, potassium and calcium levels were compared and statistical significance of the difference in values was assessed using Paired t test.

Results

All 88 patients underwent TURP surgery. 1.5% glycine was used as irrigating fluid in 46 cases and Normal saline in 42 cases. The weight of the prostate gland resected ranged from 10 gms to 50 gms. The duration of TURP surgery ranged from 10 min to 90 min, the volume of the 1.5% glycine used, ranged from 5L to 21L and the volume of normal saline used ranged from 5L to 36L.

Table 1. Baseline characteristics of the patients in both groups

Characteristics	Bipolar (N=42)		Monopolar (N=46)		Mean Difference	t	p value
	Mean	Std. Deviation +/-	Mean	Std. Deviation +/-			
Age (Yrs)	65.1	10.0	68.9	9.6	-3.7	-1.797	0.076
Pre-operative Prostate weight (gms)	55.1	23.8	51.2	23.3	3.9	0.782	0.437
Pre-operative PCV (%)	35.6	5.5	35.6	6.6	0.0	0.015	0.988
Pre-operative Na^+	136.7	3.5	136.3	4.4	0.3	0.373	0.710
Pre-operative Qmax (ml/sec)	3.6	3.7	3.4	3.2	0.2	0.303	0.762

In our study, clinical manifestation of TURP syndrome was not seen. One patient (5.3%) in Monopolar TURP and one patient in Bipolar TURP (11.1%) showed restlessness and bradycardia [Table 2]. The duration of TURP did not have any correlation with decreasing serum sodium and increasing serum potassium levels estimated intraoperatively with venous blood samples.

Table 2. Complication rate at least short term follow-up (30 days)

Sl. No.	Complications	Monopolar	Bipolar
1	Fall in Hb% requiring Blood Transfusion	1	0
2	Haematuria	0	1
3	Clot retention	2	0
4	TUR syndrome	0	0
5	Temporary Post-op dysuria	3	2
6	Stricture urethra	2	1
7	Transient Incontinence	1	2
8	Intraop Bradycardia	1	1
	Total	**10/46**	**7/42**

The mean levels of serum sodium, potassium, calcium pre- and post-operatively in patients undergoing both the TURP surgeries are given in Tables 3.

The mean level of serum sodium did not show statistically significant reduction post-operatively in both surgical procedures. There was no statistically significant increase in the mean level of serum potassium post-operatively in both procedures. There was no significant change in mean levels of serum calcium post-operatively. The percentage change noted in sodium levels in Monopolar and Bipolar TURP was 0.56% and 0.17% respectively. The percentage change in potassium levels in Monopolar and Bipolar TURP was 0.72% and 0.94% respectively.

The changes of serum sodium and potassium levels were not proportionate with volume of 1.5% glycine and saline used for irrigation, duration of TURP and the weight of prostate gland resected [Table 4, 5].

Discussion

TURP is considered a simpler and safer procedure than open prostatectomy. Patients who have undergone TURP are often elderly and suffer from co-morbid conditions such as cardiac, pulmonary, renal and endocrine disorders. Occasionally, these patients are dehydrated and depleted of essential electrolytes such as sodium, calcium and potassium because of long-term use of diuretics along with restricted fluid intake. Endourological surgery is associated with intraoperative complications of bleeding and deleterious systemic effects due to intravesical absorption of irrigating fluid.

Water intoxication with hyponatremia has been postulated by Hahn *et al* in 1990 as the primary cause for the genesis of TURP syndrome[3]. TURP syndrome is characterized by intravascular volume shifts and plasma-solute (osmolarity) effects. Patients often complain of dizziness, headaches, nausea, dyspnea, etc. However, other adverse effects due to greater amounts of fluid absorption soon become apparent. Hyponatraemia may cause weakness, muscular twitches and epileptic seizures.

Serum potassium often increases transiently by 15-25% in response to absorption of 1.5% glycine irrigation fluid, and that is probably related to intracellular uptake of the irrigant solute. Clinical manifestations of hyperkalemia occur when the plasma levels of potassium rise above 6 mEq/L. There will be ECG changes showing tall, peaked T waves, prolonged PR interval, QRS widening and

Table 3. Comparison of pre- and post-operative Sodium, potassium, calcium levels in both the study groups

Parameters Mean (Meq/l)		Pre operative		Post operative		Mean difference	t value	p value
		SD	Mean (Meq/l)	SD	Mean (Meq/l)			
Sodium	Monopolar(n=46)	136.35	4.45	135.59	4.60	0.76	1.54	0.130
	Bipolar(n=42)	136.67	3.45	136.90	3.94	-0.24	-0.31	0.756
Potassium	Monopolar(n=46)	4.16	0.59	4.19	0.63	-0.03	-0.43	0.671
	Bipolar(n=42)	4.25	0.81	4.21	0.86	0.04	0.71	0.482
Calcium	Monopolar(n=46)	9.04	0.49	8.97	0.48	0.08	1.46	0.152
	Bipolar(n=42)	8.75	0.63	8.65	0.64	0.11	1.34	0.187

Table 4. Changes in Serum sodium, serum potassium and serum calcium levels in Monopolar TURP with reference to duration of resection, volume of irrigation used, wt. of the resected gland

Duration of resection	< 30 min		30 – 60 min		60 min	
Volume of 1.5% Glycine used (ml)	9573.33		13265.22		15742.86	
Weight of prostate gland resected (gms)	19.07		21.54		20.86	
S. Sodium (Meq/L)	Preop	Postop	Preop	Postop	Preop	Postop
Mean	137.27	137.47	135.88	135.17	136.00	133.00
% change	0.15		0.52		2.21	
p-value	0.883		0.589		0.351	
	NS		NS		NS	
S. Potassium (Meq/L)	Preop	Postop	Preop	Postop	Preop	Postop
Mean	4.11	4.19	4.16	4.07	4.26	4.44
% change	2.11		2.23		4.36	
p-value	0.732		0.572		0.611	
	NS		NS		NS	
S. Calcium (Meq/L)	Preop	Postop	Preop	Postop	Preop	Postop
Mean	9.05	8.90	9.04	8.99	9.04	9.01
% change	1.62		0.56		0.32	
p-value	0.340		0.725		0.941	
	NS		NS		NS	

Table 5. Changes in Serum sodium, serum potassium and serum calcium levels in Bipolar TURP with reference to duration of resection, volume of irrigation used, wt. of the resected gland

Duration of resection	< 30 min		30 – 60 min		60 min	
Volume of Normal saline used (ml)	14500		13516.67		17159.09	
weight of prostate gland resected (gms)	15		19		22.86	
S. Sodium (Meq/L)	Preop	Postop	Preop	Postop	Preop	Postop
Mean	138.5	134	136.22	136.56	136.86	137.45
% change	3.25		0.24		0.43	
p-value	0.441		0.778		0.614	
	NS		NS		NS	
S. Potassium (Meq/L)	Preop	Postop	Preop	Postop	Preop	Postop
Mean	3.95	3.35	4.23	4.24	4.30	4.26
% change	15.19		0.13		0.74	
p-value	0.164		0.968		0.923	
	NS		NS		NS	
S. Calcium (Meq/L)	Preop	Postop	Preop	Postop	Preop	Postop
Mean	8.55	8.15	8.82	8.76	8.72	8.60
% change	4.68		0.69		1.36	
p-value	0.240		0.755		0.577	
	NS		NS		NS	

arrhythmias. Hyperkalemic cardiotoxicity is increased by hyponatremia and acidosis[4]. These cardiotoxic effects of hyperkalemia, occuring during TURP surgery, will be less marked if serum calcium levels are within normal limits of 8.5-10.5 mg/dL (2.1-2.6 mmol/L).

In our study, there was no statistically significant changes in the levels of serum sodium, potassium and calcium, with the use of either 1.5% glycine or normal saline, duration of procedure and with weight of prostate gland resected. We had fixed the irrigation fluid column height at 60 cm, so that other determinants can be assessed for changes in serum electrolytes during TURP surgery.

Our study showed that significant hyperkalemia did not occur during both TURP surgeries. Hahn *et al.* found significant elevation of serum potassium during absorption of 1.5% glycine solution into circulation intra-operatively.[3] The cause of hyperkalemia was inability of 1.5% glycine to maintain the isotonicity of plasma.[5,6]

There was a fall in haemoglobin averaging about 0.98 + 1.04 gms and 0.55 + 2.74 gms in Monopolar and Bipolar TURP respectively.

Monitoring the extent of fluid absorption during surgery allows control of the fluid balance in every patient. The most viable methods to monitor fluid absorption are ethanol monitoring and gravimetric weighing[7]. Newer techniques, such as bipolar resectoscopes and vaporizing the tissue instead of resecting tissue, would reduce the fluid absorption and its consequences[8]. Reuter *et al.* demonstrated in 1978 that low pressure irrigation during TURP would limit the risk of intravascular absorption[9]. The surgeon should be notified whenever resection time exceeds 90 min. This allows steps to be taken to prevent excessive absorption. Supportive care remains the most important therapeutic approach for management of complications. Treatment for dilution hyponatremia should be based on administration of hypertonic saline rather than on diuretics. Administration of calcium, alkalinisation and even hemodialysis in severe cases can counter the potassium toxicity[10].

Bipolar and Monopolar procedures have the same clinical out-come and complication rates. Both the procedures can be used for the treatment equally[11]. The Risk of developing TURP syndrome (p=0.32) and bleeding tendency (p=0.52) did not differ significantly between Monopolar and Bipolar groups. Since no major differences in the efficacy and safety were seen between the surgical groups the authors felt that the Monopolar technique still has a valuable place in TURP[12].

Conclusions

The electrolyte changes during monopolar and bipolar TURP are same. There is no additional advantage of using normal saline over glycine in patients undergoing TURP. The Monopolar Turp is less time consuming and cost of the monopolar resectoscope is less compared to Bipolar resectoscope.

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