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Serum sodium and potassium changes during transurethral resection of prostate gland in patients under subarachnoid block

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Abstract
Background: Electrolyte disturbances often occur during TURP procedure. These disturbances should be fully corrected because it leads to increased morbidity and mortality rate.
Aims: To study changes occurring in serum sodium and potassium levels during TURP under SA block and to study other factors like volume of irrigation fluid absorbed, resection time, amount of the gland resected and concurrent hemodynamic changes occurring during procedure.
Methodology: 75 patients of ASA I, II, and III class in age group of 41 to 80 years with benign prostatic hyperplasia planned for elective transurethral resection of prostate gland under subarachnoid block were selected for the study and assigned into two groups: Group 1:- Resection time less than 45 minutes Group 2:- Resection time more than 45 minutes and Intraoperative blood sample was taken at 40 minutes and another sample taken 30 minutes after end of procedure.
Results: In intraoperative period the mean sodium was 138.46±2.94 and 138.68±2.34 (statistically insignificant; P-value 0.733) and mean serum potassium was 4.05±0.34 and 4.09±0.28 (statistically insignificant; P-value 0.5450. In post-operative period mean serum sodium in two group was 137.93±3.16 and 136.97±2.17 (statistically insignificant; P-value=0.137) and mean serum potassium in two group was 4.12±0.30 and 4.47±0.31 (statistically significant; P-value <0.001).
Conclusions: In TURP surgries there occur increase in serum potassium levels which shows statistically significant difference when surgery duration exceeds 45 minutes; in both intraoperative and post-operative periods.

Keywords: TURP, hyponatremia, hyperkalemia, glycine, spinal anaesthesia

Introduction
For surgical management of BPH transurethral resection of the prostate (TURP) remains the gold standard [1]. Electrolyte disturbances like hyponatremia is one of the most worrisome complications during TURP because of risk TURP syndrome; similarly, Hyperkalemia can also occur after TURP [2]. Significant hyponatremia is reported after TURP in 11-41% of patients [3].
Hence, we conducted this study to study the changes occurring in serum sodium and potassium levels and other factors like volume of irrigation fluid absorbed, resection time, amount of the gland resected and concurrent hemodynamic changes occurring during transurethral resection of prostate glands under subarachnoid block.

Materials and Methods
Inclusion criteria
Seventy five patients with benign prostatic hyperplasia planned for elective transurethral resection of prostate gland under subarachnoid block belonging to American society of anaesthesia (ASA) I, II, and III with age group of 41 to 80 years were selected for the study.

Exclusion criteria
Patients below 40 and above 80 years of age, Patients with American society of anaesthesia score of IV, Patients undergoing transurethral resection of prostate gland under general anaesthesia, Patients on diuretic therapy, Patients with electrolyte imbalance, Patients with pre-existing advanced cardiac, pulmonary and renal diseases, Patients with metastasis in the lumbar spine and spinal deformity.

Anaesthetic technique

Patients selected for the study were admitted at least 24 hours prior to the surgery and were subjected to pre-anaesthetic assessment. And a thorough history and physical examination was done and routine investigations were checked. Informed consent was taken from the patient to participate in the study.

Patients were assigned into two groups depending upon the duration of resection of prostate gland. Group 1:- Resection time less than 45 minutes, Group 2:- Resection time more than 45 minutes.

On arrival to the operating room all patients were connected to the multichannel monitor and baseline vitals was recorded. After Peripheral intravenous access was established the patient was preloaded with10ml/kg ringer lactate solution and Premedication with injection pantoprazole 40 mg and injection ondensetron 0.15mg/kg was given. After that Subarachnoid block was performed at L3-L4/L4-L5 space and 3 to 3.5 ml of hyperbaric 0.5% bupivacaine was injected. In case of elderly patients, they were administered supplemental oxygen (O2) by ventimask @ 4 liters/minute. Vitals (heart rate, blood pressure, oxygen saturation were checked every 5 minutes. The main variables to be assessed were serum electrolytes (serum sodium and potassium). Other variables were Resection time, weight of the prostate gland resected, total volume of irrigation fluid used, volume of irrigation fluid absorbed was calculated by using formula:

Fluid absorbed = (Preoperative serum sodium – ECF) / (postoperative sodium x ECF)

In our study, glycine 1.5% was used as irrigation fluid, using a cylindrical glass vessel at a height of 60 cms, measured from the pubic symphysis of the patient on the operating table. Intraoperative blood sample was taken at 40 minutes from start of resection of prostate gland and postoperative blood sample was taken 30 minutes after the end of the procedure. Patients were monitored in the post anaesthesia care unit (PACU) for postoperative vitals and any adverse effect of spinal anaesthesia like hypotension and vomiting for at least 2 hours after the end of the surgery and managed accordingly.

Statistical analysis

The data was compiled and entered in a spreadsheet (Microsoft Excel) and Continuous variables were expressed as Mean ± SD and categorical variables were summarized as frequencies and percentages. In order to compare continous variables we used Student's independent t-test. And for comparing categorical variables we used Chi-square test or Fisher's exact test. A P value of <0.05 was considered to be statistically significant.

Results

There were two groups in the study, Group 1 –surgery duration <45 minutes and Group 2 – surgery duration>45 minutes. The demographic characteristics including age, weight, smoking in both the groups in our study were comparable (Table 1). There was no statistically significant difference on comparing ASA status and co-morbidities in two groups (Table 1). Common co-morbidities were hypertension, COPD and diabetes (Table 1). There was no statistically significant difference on comparing the baseline preoperative haemodynamics and postoperative haemodynamics like heart rate, systolic and diastolic blood pressure and spo2 in 2 groups. Duration of TURP in group 1 was 40.3 min and in group 2 it was 57.2 minutes with statistically significant difference (Table 1). Mean amount of gland resected in group 1 was 28.93 grams while in group 2 it was 46.12 grams with statistically significant difference (Table 1). Mean volume of irrigation fluid used was 10.76 litre in group 1 and 16.31 litre in group 2 with statistically significant difference (Table 1). Mean volume of irrigation fluid absorbed was 68.09 ml in group 1 and 67.97 ml in group 2 with no statistically significant difference (Table 1). There was observed to be a decrease in serum sodium levels in both groups in intraoperative and postoperative period with no statistically significant difference on comparing serum sodium levels in two groups in intraoperative and in postoperative periods with serum sodium in group 1 & group 2 in preoperative period being 139.12 mEq/L and 139.21 mEq/L respectively; in intraoperative period being 138.46 mEq/L and 138.68 mEq/L respectively and in postoperative period values being 137.93 mEq/L and 136.97 mEq/L respectively (Table 2). However none of the patient in our study developed TURP syndrome. Serum potassium values increased in intraoperative and postoperative period compared to preoperative values with >45 min surgery group showing statistically significant difference compared to group with <45 min surgery duration. Values of serum potassium in group 1 and group 2 in preoperative period being 3.87 mEq/L and 3.84 mEq/L, respectively; in intraoperative period values being 4.05 mEq/L and 4.09 mEq/L, respectively and in postoperative period values being 4.12 mEq/L and 4.47 mEq/L (Table 3).

Discussion

In the study it was observed that in Group 1 having mean volume of irrigation fluid used was 10.76±2.23 litres with range of irrigation fluid used was 7-16 litres, whereas, in group 2 mean volume of irrigation fluid used was 16.21±2.66 litres with range of volume of irrigation fluid was 12-21 litres (statistically significant difference with P-value<0.001). This showed that as the duration of TURP procedure increased beyond 45 min, the volume of irrigation fluid used increased significantly. In group 1 where duration of surgery was upto 45 min, in that mean volume of irrigation fluid used was 10.76±2.23 litres but when the surgical duration increased beyond 45 min that is, in group 2 mean volume of irrigation fluid used increased to 16.21±2.66 litres with a difference of almost 5.45 litres between two groups.

In our study we observed serum sodium levels in preoperative, intraoperative and in postoperative period and compared the changes in two groups. Mean preoperative value of serum sodium in group 1 and group 2 were 139.12±3.15 mEq/L and 139.21±2.13 mEq/L, respectively (P-value of 0.895). In intraoperative period the mean serum sodium levels were 138.46±2.94 mEq/L and 138.68±2.34 mEq/L (P-value of 0.733). In postoperative period the mean serum sodium in two group were 137.93±3.16 mEq/L and 136.97±2.17 mEq/L, respectively (P-value=0.137). However none of the patient in our study developed TURP syndrome. Our results were consistent with Gupta K *et al*. (2010) [4] who also observed statistically significant reduction of serum sodium levels (hyponatremia) post-operatively, which was directly proportional to volume of irrigating fluid used, duration of procedure and volume of

prostate gland resected. In their study as the duration of study increased, hyponatremia was increased and similar was the trend in our study also. Our study also showed that as the duration of surgery increased, amount of gland resected and volume of irrigation fluid absorbed also increased and proportionately hyponatremia also increased. Similar finding were supported by study of Gupta K *et al.* (2010) [4]. Our results were also consistent with study by Moorthy K *et al*. (2002) [5] who also observed that there was a statistically significant reduction in the mean sodium levels post operatively when 1.5% glycine was used as irrigating fluid during TURP procedure. They further analyzed the correlation values and found that the height of fluid column and the volume of irrigating fluid used had better correlation with the changes in sodium levels compared to the duration of procedures and the weight of gland resected. Although no such correlation was noted in our study we observed that as the duration of surgery increases, volume of fluid absorbed and amount of gland resected also gets increased and so is the level of hyponatremia however the individual correlations were not studied. In their study the irrigating fluid was kept at 50, 60 and 70 cm height, measured from the level of pubic symphysis of the patient on the operating table while in our study height of irrigation fluid was kept constant in all the cases. Our results were also consistent with study of Pasha MT *et al*. (2005) [6] who observed that post-operative dilutional hyponatremia occurred in 15.3% patients in glycine group and in 11.8% patients in sterile water group however the difference was statistically not significant. Our results were also consistent with another study by Patel SN *et al*. (2014) [7] who observed that none of the patients in either of the groups developed TURP syndrome. The serum Na+ levels did not changed significantly in either of the groups (30 min surgery duration groups). Although they observed that intraoperative and postoperative serum sodium levels slightly increased as against our study which could be explained by the irrigation fluid used. This study used boiled cooled water and our study used 1.5% glycine as irrigation fluid. Our results were also consistent with study of Petrusheva AP *et al*. (2015) [8] who found statistically significant reduction of serum sodium in serum observed postoperatively and was directly proportional to the volume of the irrigation fluid used, duration of the procedure and volume of the resected prostate. Similar to our study clinical manifestation of fully developed TURP syndrome did not occur in any patient in their study also.

In our study Mean pre-operative value of serum potassium in group 1 and group 2 was 3.87±0.33 mEq/L and 3.84±0.26 mEq/L, respectively (statistically insignificant, P-value 0.572). In intraoperative period, the mean serum potassium was 4.05±0.34 mEq/L and 4.09±0.28 mEq/L (statistically insignificant, P-value 0.545). In postoperative period the mean serum potassium in two group was 4.12±0.30 mEq/L and 4.47± 0.31 mEq/L, respectively (statistically significant, P-value<0.001). It was observed that serum potassium level in both group increased in intraoperative and postoperative period compared to their preoperative levels, however in intraoperative period there was no statistically significant difference while in postoperative period group 2 had higher level of serum potassium values compared to group 1, and the difference in results were statistically significant in postoperative period. Our results were consistent with Gupta K *et al*. (2010) [4] who also observed that statistically significant elevation of serum potassium levels (hyperkalemia) post-operatively, which was directly proportional to volume of irrigating fluid used, duration of procedure and volume of prostate gland resected. In our study as the duration of surgery increased beyond 45 min, amount of irrigation fluid absorbed, amount of gland resected also increased and there was statistically significant increase in level in serum potassium compared to group in which surgery lasted for <45 min. Our results were also consistent with study of Moorthy HK *et al.* (2012) [5] who observed statistically significant increase in the mean levels of potassium when 1.5% glycine was used as irrigating fluid during TURP procedure. Similarly, Patel SN *et al*. (2014) [7] also observed significant rise in serum K+ level in post operative period in group II(surgery duration >30 min) as compared to preoperative level. They further observed that changes in serum K+ were related to duration of resection. Our study also had similar finding of statistically significant higher level of post operative serum potassium levels in group with >45 min surgery duration compared to the group with surgery duration <45 min. Our results were also consistent with Petrusheva AP *et al*. (2015)[8] who observed that there was statistically significant elevation of the serum potassium level in patients in postoperative period and it was directly proportional to the volume of the used irrigation fluid, the duration of the procedure and volume of the resected prostate. They also observed that in between the duration of operation and level of serum potassium there is a strong positive correlation (r = 0.80). The longer the intervention, the more it increases the level of serum potassium. Similar findings were also observed in our study.

Table 1: Demographic data, operative data in studied groups (Mean ± SD)

Variable		Group P (n=41)	Group L (n=34)	P-value
Age (years)		62.6±5.412	60.8±6.676	0.205
Weight (kg)		67.1± 4.445	68.1 ±6.100	0.445
ASA I		24.4%	23.5%	0.408
ASA II		65.9%	55.9%	
ASA III		9.8	20.6	
Comorbidities	Smoking status	46.3%	41.2%	0.654
	Diabetic Miletus	19.5%	20.6%	0.908
	Hypertension	26.8%	23.5%	0.743
	COPD	17.1%	20.6%	0.697
Procedure duration (min)		40.3±4.74	57.2±6.65	<0.001
Amount of gland resected (grams)		28.93±6.06	46.12±8.30	<0.001
Irrigation fluid used (litres)		10.76±2.23	16.21±2.66	<0.001
Irrigation fluid absorbed (ml)		68.09±5.17	67.97±7.14	0.932
Abbreviation: kg- kilogram, min- minute, mg- Milligram, %-percentage, ml-millilitre				

Table 2: Serum sodium changes at various intervals of time

Time interval	Group 1		Group 2		P-value
	Mean	SD	Mean	SD	
Pre-operative	139.12	3.15	139.21	2.13	0.895
Intra-operative	138.46	2.94	138.68	2.34	0.733
Post-operative	137.93	3.16	136.97	2.17	0.137

Table 3: Serum potassium changes in at various intervals of time

Time	Group 1		Group 2		P-value
	Mean	SD	Mean	SD	
Pre-operative	3.87	0.338	3.84	0.261	0.572
Intra-operative	4.05	0.343	4.09	0.280	0.545
Post-operative	4.12	0.305	4.47	0.312	<0.001*

Conclusion

In this prospective observational study it was concluded that there occurs a decrease in serum sodium levels and increase in serum potassium levels irrespective of duration of surgery in both intraoperative and post-operative periods in TURP surgeries, although the degree of fall of serum sodium levels is slightly more when duration of surgery is >45 minutes with no statistically significant difference in the two groups in both intra-operative and in post-operative periods while, increase in serum potassium levels shows statistically significant difference when surgery duration exceeds 45 minutes in both intraoperative and post-operative periods. It was also concluded that when duration of surgery exceeds 45 minutes there is increase in the mean amount of gland resected and the mean volume of irrigation fluid used with statistically significant difference and although the mean volume of irrigation fluid absorbed also increases but it does so with no statistically significant difference. Also the hemodynamic parameters do not show any statistically significant difference with change in duration of TURP surgery.

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Conflict of Interest

Not available

Financial Support

Not available

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