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A STUDY ON THE EXTENT OF DERANGEMENT OF SERUM SODIUM LEVELS AFTER TRANSURETHRAL RESECTION OF PROSTATE - A CROSS-SECTIONAL STUDY

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ABSTRACT

Introduction: Transurethral resection of prostate (TURP) surgery is often done on men over the age of 40 who have benign prostatic hyperplasia (BPH). The fluid used to clean the area has 1.5% glycine in it. The potential complication of such procedure is systemic absorption of hypotonic irrigating fluid leading to fluid overload and resultant hyponatremia leading to manifestation of TUR syndrome. It should be treated promptly. Even though surgery and anaesthesia for TURP have improved a lot in recent years, 2.5–20% of patients who have TURP still, show one or more signs of TURP syndrome, and 0.5–5% die during surgery.

Objective : The objective of the study was to assess the extent of derangement of serum sodium levels following transurethral resection of prostate.

Methods: In this cross-sectional study, there were 40 participants, all of whom were men between the ages of 40 and 80 who met the criteria for participation. Patients who met the criteria were studied one after the other. A pre tested and validated proforma was used to collect data. The study subjects underwent routine preoperative anaesthesia checkup and optimisation prior to surgery. Preoperative S.Na+ and S.K+ were recorded. Standard monitors were attached and intravenous access was secured. Under strict asepsis after local infiltration with 2% lignocaine central neuraxial blockade was performed with 0.5% Bupivacaine (H) 2.2-2.5 mL. The level of the blockade was restricted to T10. Patients were placed in a lithotomy position and the surgery started using mono-polar cautery with 1.5% glycine irrigation fluid, keeping the irrigation fluid column at a height of 60 cm, from the patient. The resection time and irrigation time, the weight of the prostate gland resected, and the volume of 1.5% glycine used recorded during the procedure. The S.Na+ and S.K+ levels were done in patients at 1 hour and 3 hours after initiation of irrigation with 1.5 % glycine, using venous blood samples. Any value below 135 mEq/L was considered significant.

Results: The study showed that there is significant derangement of S.Na+ levels at 1Hr and 3Hr after initiation of irrigation with 1.5% glycine with a p value of 0.002 and <0.001 respectively.

Conclusion: Incidence of hyponatremia following TURP has not been decreased despite the advancement of management of BPH. The derangement of S.Na+ can become pronounced in the first three hours postoperatively.
Key words: BPH, hyponatremia, TURP, TURP syndrome,1.5% glycine, S. Sodium,

Introduction

Benign prostatic hyperplasia (BPH) is common in men over 40 years of age. The open prostatectomy and transurethral resection of prostate (TURP) have been the surgical options for men with obstructive symptoms. TURP is the second most common surgical procedure done in men. It requires an irrigating fluid to gently dilate the mucosal spaces, remove blood, cut tissue and debris from the operating field and enable better vision through the resectoscope (1). Various irrigating fluids have been used for TURP. The potential complication of such procedure is systemic absorption of hypotonic irrigating fluid leading to fluid overload and resultant hyponatremia. The various clinical manifestations, produced due to the absorption of large volume of irrigating fluid during transurethral resection of prostate, are together known as Transurethral Resection syndrome (TUR syndrome). Early signs of TUR syndrome are dizziness, headache, nausea, dyspnea, arrhythmias, hypertension and bradycardia, followed by restlessness and confusion. If not treated promptly, a patient becomes cyanotic, hypotensive and ultimately sustains cardiac arrest. Occasionally, it starts with neurological signs (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 anaesthetic management, 2.5-20% of patients undergoing TURP show one or more manifestations of TURP syndrome and 0.5-5% die perioperatively (3). The fluid absorption in TURP can be assessed by many methods of which one is an estimation of preoperative (preop) and postoperative (postop) serum sodium(S.Na+) levels. There have been considerable improvements in the current surgical and anaesthetic management of TURP, still 2.5-20% of patients undergoing TURP show one or more manifestations of TURP syndrome and 0.5-5% die perioperatively (4).

The Aim and objective of this study was to determine the extent of derangement of serum sodium level following transurethral resection of prostate.

Methodology: In this study, a total of 40 patients who underwent transurethral resection of the prostate under central neuraxial blockade in the Department of Anaesthesia, Gov. Medical College, Thiruvananthapuram, were included. All of the study participants were males between the ages of 40 and 80 who had TURP surgery. All study participants provided written informed consent. This study was conducted after obtaining the Institutional Ethics Committee clearance. A predefined proforma was used to record the results.

Inclusion Criteria: Inclusion criteria consists of the following

- Patients undergoing TURP surgery under central neuraxial blockade,
- ASA-PS 1-3
- Patients with an age group between 40years to 80 years
- Patients those who will give consent

Exclusion Criteria: Inclusion criteria consists of the following

- TURP under general anaesthesia
- ASA-PS 4,
- Patients with an age group above 80 years
- patients with already deranged electrolytes
- preexisting renal dysfunction,
- Metastasis in the lumbar spine,
- Patients those who are not willing to give consent.

Study Variables:

- Pre op S.Na+ and S.K+
- Post op S.Na+ and S.K+
- Volume of 1.5% glycine used
- Irrigation time
- Resection time
- Weight of resected tissue
- History of Hypertension
- History of Smoking.

All patients have been monitored perioperative with standard monitors for heart rate non-invasive blood pressure (NIBP), ECG and SpO2. An intravenous line was secured in the forearm with an 18 G (gauge) iv cannula, free flow of iv fluids was confirmed and the cannula was secured with adhesive tapes. Patients were given premedication with Inj. Midazolam 0.5 - 1 mg IV and Inj. Ondansetron 4 mg IV. The patient was placed in a lateral position and back of the patient was prepared, first with povidone iodine solution followed by chlorhexidine to achieve strict asepsis. Then draped with a sterile hole towel. The L3 - L4 interspace was palpated and local infiltration was given with 2% plain lignocaine 2 mL. Then a 23 G Quincke's spinal needle was introduced into the subarachnoid space, free flow of CSF was confirmed and 2.2 -2.5 mL 0.5% bupivacaine (H - heavy) central neuraxial block was performed. The patient was then turned to supine position. A satisfactory analgesia to a dermatome level up to T10 was achieved. Patients were then placed in lithotomy position and the TURP surgery started, using mono-polar cautery with 1.5% glycine as the irrigation fluid. The irrigation fluid column was kept at a constant height of 60 cm, measured from the level of pubic symphysis of the patients on the operating table. The duration of the procedure (in minutes), the weight of the prostate gland resected (in grams), and the volume of 1.5% glycine (litres) used during the procedure were recorded. The serum sodium and serum potassium estimation were done in patients undergoing the surgery at 60 min (1 Hr) and 180 minutes (3 Hr) after initiation of irrigation by using venous blood samples drawn from the other arm in which there were no iv lines. Hyponatremia is classified as mild - 130-134 mEq/L, moderate - 120-130 mEq/L, and severe - < 120 mEq/L. Derangement is defined as serum sodium levels of < 135 mEq/L and >145 mEq/L. Any value outside this range (135 - 145 mEq/L was considered significant. All patients were carefully observed for the early symptoms of TURP syndrome

perioperatively. Only patients who had preoperative serum sodium levels > 135 mEq/L were recruited for the study. The values of pre and postoperative serum sodium and potassium levels were compared and statistical significance of the difference in values was assessed using relevant statistical tests. The changes in the plasma electrolytes levels were correlated with the age of the patient, volume of irrigating fluid used, irrigating time, resection time and the weight of the prostate gland resected.

Statistical Analysis : Data was entered in Microsoft Excel data sheet and analysed using Statistical Package a for Social Sciences, version 20 (SPSS 20). Since the distribution of data was non-nor mal, non-parametric tests were used to assess the statistical significance - Wilcoxon Signed Ranks test and Spearman's Correlation test. In the results, quantitative variables ware expressed as mean and standard deviation (SD) and qualitative data as frequency and percent. A p-value of < 0.05 is considered statistically significant and $p < 0.001$ is highly significant. A $p > 0.05$ is considered not significant.

Results

The objective of the study was to assess the extent of derangement of serum sodium levels after transurethral resection of the prostate. The other study variables were serum potassium levels, the volume of 1.5 % glycine used, irrigation time, resection time, age of the patient, weight of the resected tissue, history of hypertension and history of smoking. The results are shown below.

Mean and standard deviation (in bracket) were as given: age - 65.73 (7.60) years, irrigation time - 38.88 (14.33) min., resection time - 33.20 (13.20) min., vol. of 1.5 % Glycine - 25.88 (11.24) L, weight of resected tissue - 27.5(15.56) g, size of the prostate by USG 60.16 (23.88) cc, Preop S. Na+ - 137.26(1.70) mEq/L, S.Na+ at 1 Hr. - 135.56 (4.08) mEq/L, S.Na+ at 3 Hr. - 134.86(3.30) mEq/L, Preop S. K+ - 4.26(0.46) mEq/L, S.K+ at 1 Hr. - 4.54(0.47) mEq/L, S.K+ at 3 Hr. - 4.37 (0.41) mEq/L.

The objective of this study was to assess the extent of derangement of S.Na+ following TURP at 1 Hr. and 3 Hr. after initiation of irrigation with 1.5% glycine. Derangement of S.Na+ is defined as any value 145 mEq/L. In this study, no postoperative S.Na+ value went above 145 mEq/L. In this study S.Na+ levels were estimated perioperatively, 1 Hr. and 3 Hr. after initiation of irrigation with 1.5% glycine. The mean preop S.Na+ is 137.26(1.72), mean S.Na+ at 1 Hr. is 135.56(4.08) and the mean S.Na+ at 3 Hr. is 134.87(3.30). The derangement of S.Na+ at 1 Hr. from the preoperative value is highly significant, $p = 0.002$. There is statistically highly altering vascular growth in the gland.

Table 1. Descriptive statistics of Age, Size of the prostate by USG, Irrigation time, Resection time, Vol.of 1.5%glycine used and wt. of resected tissue in patients for TURP

	Age (yrs)	Size of prostate gland by USG (cc)	Irrigation time (minute)	Resection time (minute)	Volume of 1.5% glycine used (L)	Weight of resected tissue (gms)
Mean	65.73	60.16	38.88	33.20	25.88	27.50
Standard	7.60	23.89	14.33	13.21	11.24	15.57

deviation						
Range	35	95.0	54	49	36	70
Minimum	45	20.0	16	11	9	5
Maximim	80	115.0	70	60	45	75

Table 2: Serum sodium values - Preoperative, 1 Hr. and 3 Hr. after initiation of irrigation with 1.5 % glycine in patients for TURP.

	Preoperative S.Na+	S.Na+ after 1 hr	S.Na + after 3 hrs
Mean	137.26	135.56	135.86
Standard deviation	1.72	4.09	3.30
Range	5.90	25.0	18.40
Minimum	135	116.00	124.60
Maximum	140.90	141.00	143.00

Table 3: Comparison of (Preoperative S. Na+ and S. Na+ at 1 Hr) and (s.Na+ at 1 hour and S. Na+ at 3 Hr) after initiation of irrigation with 1.5 % glycine in patients for TURP with Wilcoxon Signed Ranks Test.

Variable		N	Mean rank	Z-variance	Asymptomatic sig 2 tailed P value
Preop s.Na+- S.Na+ at 1hr	Negative Rank	30_a	21.30	-3.079	0.002
	Positive Rank	10□	18.10		
	Ties	0^c	0		
s.Na+ at 1 hr -S.Na+ at 3hr	Negative Rank	34_a	21.19	-4.175	< 0.002
	Positive Rank	6□	16.58		
	Ties	0^c	0		

Table 4: Correlation of Serum Sodium at (1 Hr and Serum Sodium at 3 Hr). after initiation of irrigation with 1.5 % glycine in TURP.

			Age(yrs)	Irrrigation time (Min)	Resection time(min)	Volume of 1.5% glycine (L)	Weight of resected tissue (Gms)	H/O smoking	H/o Hypertension
Spearman's rho	S.Na= at 1 hour	Correlation coefficient	-0.329	-0.027	-0.018	-0.070	-0.316	0.296	-0.116
		.Sig 2 tailed P value	0.038	0.868	0.910	0.668	0.047	0.064	0.475
	S.Na= at 3 hour	Correlation coefficient	-0.319	-0.104	-0.077	-0.112	-0.094	0.085	-0.050
		.Sig 2 tailed P value	0.045	0.522	0.638	0.491	0.566	0.601	0.759

There is significant negative correlation of age of the patient with S.Na+ level at 1 Hr. after the initiation of irrigation with 1.5 % Glycine (p = 0.038). Weight of resected tissue also shows a significant negative correlation between age of the patient and S.Na+ level at 1 Hr. after the initiation of irrigation with 1.5 % Glycine (p = 0.047 (Table 5).

There is a significant negative correlation of S. Na+ at 3 Hr. and age of the patient. But there is no significant correlation of S. Na+ at 3 Hr. with weight of resected tissue as seen with S. Na+ at 1 Hr.

Table 5: Serum potassium values - Preoperative,1 Hr. and 3 Hr. after initiation of irrigation with 1.5 % glycine in patients for TURP.

	Preop s.Na+	S.Na+ at 1 hr	S.Na= at 3 hr
Mean	4.26	4.54	4.37
Standard deviation	0.46	0.48	0.41
Range	2.40	1.90	2.11
Minimum	3.39	3.70	3.39
Maximum	5.79	5.60	5.50

Table 6: Hypothesis Test Summary of comparison between PreOP S.K+ - S.K+ at 1 Hr. and PreOP S.K+ - S.K+ at 3 Hr. after initiation of irrigation with 1.5% glycine in patients for TURP

Null hypothesis	Test	Asympt.sig	Desicion
Median differenec between preop S.Na= and S.Na= at 1 hout equals zero	Related - Samples Wilcoxon Signed Rank Test	0.001	Reject the Null Hypothesis
The Median of differences between Preop S. K+ and S. K+ at 3 Hr. equals 0	Related - Samples Wilcoxon Signed Rank Test	0.083	Retain the Null Hypothesis

Discussion

Endourologic procedures like transurethral resection of the prostate (TURP), transurethral resection of bladder tumours, hysteroscopic transcervical diagnostic and therapeutic procedures, percutaneous removal of kidney stones, and some other percutaneous and minimally invasive procedures use large amounts of irrigating fluids. Volumes of irrigation fluid absorbed can be difficult to predict, although the volume tends to be greater in extended and bloody operations (5). In the 1950s several studies were undertaken to determine the amount of fluid absorbed during TURP. Hagstrom (1955) weighed patients before and after TURP, and calculated that a 20 mL/min of fluid was absorbed by the patient. (6,18) However, there appeared to be a wide variation among patients. Oester and Madsen (7,19) in 1969 showed that the mean volume of fluid absorption was 1 L and that a third of the fluid was absorbed intravenously and stated that this occured when the prostatic venous sinuses were opened. Thus implying that most of the fluid was absorbed in the periprostatic area.(8,6). Various methods used to estimate the fluid absorption are:- a) weighing the patient before and after surgery (9,7) b) volumetric method (10,8) c) ethanol breath testing (5) d) nitrous oxide in expired air (11,12,9,10) e) radio-isotope method (6,3) gravimetric method e) fluorescein (13,11) f) serum acid phosphatase (14,12) g) preoperative and postoperative S.Na+ levels (15,13) h) serum glucose (8,6) .

The primary event that leads to TUR syndrome is fluid absorption, dilutional hyponatremia and hypo-osmolality. As we are using M-TURP with 1.5% glycine, measurement of S.Na+ is considered relevant in detecting significant fluid absorption in TURP. The incidence of full-blown TUR syndrome has decreased significantly due to better development in this field. Even then various studies showed significant hyponatremia in patients undergoing TURP and some of them develops few manifestations of TUR syndrome (15) was a retrospective study and used a database containing 1,160 patients between age 49 and 91 years (mean 71) undergoing transurethral prostatic resection. Absorption greater than 1,000 mL. occurred in 15.7% of the present smokers, 15.5% of the past and present smokers, and 8.8% of those who had never smoked. 1% ethanol was added as marker to assess fluid absorption. The researcher concluded that past and present habitual smoking of tobacco increases the risk of fluid absorption in excess of 1,000 mL (16,17). In this present study population, 63% were smokers. But according to the results in present study no

significant correlation could be seen between derangement of S.Na+ and smoking. The reason for this lack of significance may be that the sample size was calculated for the objective of this study. Further study may be done including the years of smoking, pack years, type of cigarette smoked, duration after quitting smoking etc. to draw a relevant conclusion. Studies have shown that as the age of the patient, duration of irrigation time, height of the irrigating column, resection time, weight of the resected tissue and volume of irrigation fluid increased, the incidence and extent of decrease in S.Na + also increased(.3,8,9). In this study, there is no significant correlation of S.Na+ at 1 Hr. and 3 Hr. with irrigation time, resection time, volume of 1.5% glycine used (table 7), history of smoking and hypertension. There is significant negative correlation of S.Na+ at 1 Hr. with weight of resected tissue; p = 0.047. But no such correlation was noted with 3 Hr. S.Na+ values. Most resections were done within 60 min., the mean resection time was 33.2(13.21) min. and mean irrigation time was 38.88(14.33) min. and excess time was taken to achieve hemostasis. This might be the reason why no correlation was seen with 3 Hr. S.Na+ values and weight of resected tissue. The height of the fluid column was maintained at 60 cm from the level of pubic symphsysis of patient so as to maintain a constant flow rate according to studies (3,17). The fluid overload and hyposmolality may lead to hemolysis and this can result in increased S. K+ levels in TURP. This can lead to hyperkalemia (S.K+ >6.5 mEq/L) and its manifestations (18). In this study the mean preop S.K+ value is 4.26(0.46) mEq/L, mean 1 Hr. S.K+ 4.54(0.48) mEq/L and mean 3 Hr. S.K+ value was 4.37(0.41) mEq/L (Table 6.11). Figure 6.19 shows dropline graph of change in S. K+ from preoperative value at 1 Hr. and 3 Hr. after initiation of irrigation. There is statistically significant difference in preop and 1 Hr. S.K+ values, p = 0.001 (Table 6.12). No statistically significant difference was there between preop and 3 Hr. S.K+ values, p = 0.08. The observations are in good agreement with the results obtained by H. Krishnamoorthy and Sobha Philip (17) in which they studied the change in S.Na+ and S.K+ in TURP and Percutaneous Nephrolithotomy (PCNL) using various irrigating fluids. The irrigating fluids used were 1.5% glycine, sterile water and normal saline. The mean preop S.K+ was 4.28(0.13) and mean postop S.K+ was 4.87(0.11) with a p = < 0.001, in the TURP group in which 1.5% glycine was used. From this study, it is found that there is statistically significant derangement of S.Na+ at 1 Hr. and 3 Hr. after initiation of irrigation with 1.5% glycine. This decrease in S. Na+ has a significant negative correlation with the age of the patient and weight of resected tissue.

Conclusion:

The incidence of hyponatremia following TURP has not decreased despite the advancements in management of BPH. The derangement of S.Na+ can become more pronounced during the first three hours in postoperative period. Therefore monitoring for fluid overload with serial estimation of of S.Na+ is still of value. It also enables early detection and treatment of hyponatremia and thereby prevents complications associated with it. By this study we would like to emphasise the need to assess both sodium and potassium levels in plasma during procedures involving the use of hypotonic irrigating solutions and to take corrective steps at the earliest to prevent serious and fatal complications. Preoperative levels of sodium and potassium should be estimated and necessary corrections made before taking up the patient for surgery. The optimisation of serum electrolytes

prior to surgery must be considered seriously to enhance the patient outcome by reducing the chances for complications.

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