Serum Sodium and Potassium Concentration Imbalance in Patients with Benign Prostatic Hyperplasia following Transurethral Resection of the Prostate (TURP)

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Abstract

Objective: The aim of the present study was to calculate the mean differences in serum sodium and potassium concentration levels in patients with Benign Prostatic Hyperplasia undergoing TURP pre and post-operation.
Methods: A cross-sectional and observational study was conducted at the Department of Urology, Liaquat National Medical College and Hospital, Karachi, Pakistan. Purposive, convenience sampling technique was used. A total of 75 male patients undergoing transurethral resection of the prostate were included in the study. Data was analysed using SPSS version 20.0. A p-value of less than 0.05 was considered to be significant.
Results: Out of a total of seventy-five patients, the mean age was 59.59 ± 7.02 years. After surgery, 1.3% (1) patient had hyponatremia (<135 mmol/L), 97.3% (73) patients had normal sodium level (135-145 mmol/L) and 1.3% (1) patient had hypernatremia (>145 mmol/L). In contrast, only 1 (1.3%) patient had hypokalaemia, 66.7% (50) patients had normal potassium levels and 32% (24) patients had hyperkalaemia (p-value 0.001).
Conclusion: We reported a significant increase in serum levels of potassium in post-surgery evaluation. Therefore, the monitoring of serum electrolyte concentration following transurethral resection of the prostate (TURP) is highly recommended.
Keywords: Transurethral resection of the prostate, prostatic hyperplasia, hyperkalaemia, hyponatremia, serum, potassium, sodium.
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Introduction

Benign prostatic hyperplasia (BPH) is the most frequently occurring disease in elderly men usually 40 to 60 years of age. It is presented with urinary frequency, urgency, hesitancy, or a weak urine flow and intermittency[1]. However, there is limited or no consensus on the prevalence as well as the incidence rates of benign prostatic hyperplasia (BPH) as in different regions, the definition, evaluation method, criteria of the disease, and cut-off values for disease progression are different. A normal-sized prostate weighs approximately 20 grams while BPH is considered when the prostate becomes heavier than 20 grams with associated genito urinary obstructive symptoms as listed above. Benign prostatic hyperplasia (BPH) is the most frequently occurring disease in the elderly male population, with more than half of the patients of 60 years or more suffering from moderate to severe prostatic hyperplasia. The exact mechanism for the development of hyperplasia is still unknown. However, some believe that the long-term synthesis

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of testosterone may have a role in it, while some authors believe that this may be a hereditary disease[2]. Another hypothesis is that the presence of on-going inflammatory process can contribute to the progress and development of the disease. Increased levels of C-reactive protein have been associated with lower genitourinary tract obstructive symptoms. Due to the emergence of these nascent theories, there is a surge of explorative studies comparing the surgical treatment procedures to medical therapy options[3]. Two such popular medical therapies targeting BPH and Lower Urinary Tract Symptoms (LUTS) are alpha-adrenergic blocking agents and 5 alpha-reductase inhibitors and in many cases, they have proven to be effective. This means that many cases of benign prostatic hyperplasia with mild to moderate symptoms and without complications such as infection, bleeding, or chronic retention can be dealt with in primary care setting[4]. When a patient is presented with lower genitourinary tract symptoms such as voiding, storage, or post-urinating symptoms, detailed history of onset, severity, and medication history precedes the clinical exam of the prostate. The goal of the prostate clinical exam is to evaluate the disease and its probable aetiology. LUTS are often accompanied by sexual dysfunction; hence, it is important to assess the reproductive history of the patient. For the severity assessment of the presenting complaint in these patients, AUA-SI (American Urological Association - Symptoms Index) and IPSS (International Prostate Symptom Score) are both occasionally used. They both assess the severity of voiding (hesitancy, intermittency, dysuria, etc.) and storage (urinary frequency, urgency, nocturia, etc.) symptoms. The latter also contains evaluation of quality of life, which is useful in deducing the most optimum therapy plan for the patients[2-4].

In spite of these advances in medical care, the transurethral resection of the prostate (TURP) remains the most effective treatment offered in patients with BPH, which leads to urinary obstruction with frequent complaints of urinary tract infections[5]. For this procedure, a working sheath is placed in the urethra via which an electrified loop with a working element is positioned to remove the diseased prostatic tissue while cauterizing to prevent bleeding. The surgery can be performed using either spinal or general anaesthesia without any preference. Preoperative morbidity for TURP ranges between 18% to 26% and the mortality rate is reported to be 1%[6].

Recent reports have shown that in 11-41% of patients, significant hyponatremia occurs during the procedure. The incidence of hyponatremia with a sodium concentration level of less than 125 mEq measured postoperatively is 15% with a mortality rate of 40%[7]. During the surgical procedure, it is very common for about 20 ml/min to several litres irrigation fluid to be absorbed through the prostatic venous sinuses. Absorption of at least one-litre irrigation fluid for a period of 1-hour coincides with an acute hyponatremia condition with a serum sodium concentration of 5-8 mmol/L. Hence, suggesting a risk of symptoms associated with absorption[8]. Acute hyponatremia with serum concentration of sodium (115-120 mEq/L) is a potentially serious condition[9]. Hyponatremia and plasma hypo-osmolarity, may result in intravascular haemolysis leading to increase in serum potassium[10].

BPH is the most prevalent disease in men over the age of fifty years. It places a significant amount of burden on the health-care communities. The disease has substantial influence over several health outcomes resulting in an overall negative impact on patient's quality of life. The TURP provides the best prognosis for these patients with moderate to severe disease. However, regular monitoring and assessment of plasma electrolytes post-TURP can save patients from many life-threatening complications. The present study was designed with an aim to evaluate the changes in plasma concentration of both sodium and potassium before and after TURP.

Subjects and Methods

A prospective, cross-sectional study was carried out at the Department of Urology, Liaquat National Medical College and Hospital from January 2017 to July 2017. Non-probability, non-randomized,

convenience sampling technique was used. The sample size was calculated using Select Statistical Services Software[11].

Due to non-availability and non-cooperation of patients, time and space restrictions, a sample size of 75 was obtained. Ethical approval from the Ethical Review Committee of the Institution was obtained prior to the conception of the study. All enrolled participants were initially subjected to pre-anaesthetic evaluation before the surgery. All routine investigations for anaesthesia, including FBC, LFTs, spirometric studies, electrocardiography, doppler studies, pre and postoperative plasma concentration of sodium, potassium and calcium levels (in mEq/L) and fundus examination were completed. If patients did not meet the criteria, they were excluded from the study.

All patients presenting with suspected of having benign prostate enlargement with LUTS were diagnosed on the basis of patient's urine flow study, prostate-specific antigen (PSA) blood test, ultrasound of prostate MRI, digital rectal exam, cystoscopy[4-6].

The participants were counselled about the surgical procedure, its complications, and prognosis. After availing the informed consent from the male participants; undergoing transurethral resection of the prostate (TURP), the required measurements and concentrations were collected on a proforma. Patients with known comorbidities such as hypertension, diabetes, or chronic renal disease, previous unsuccessful surgery or recurrent strictures, abnormal findings of digital rectal examination or ultrasonography, history of prostate cancer, neurogenic bladder, bladder calculi, and patients on anticoagulant therapy were barred from the study.

All study patients underwent TURP under spinal anaesthesia. Spinal anaesthesia was administered using aseptic technique at intervertebral disk space (L2-3 or L3-4) while the patient was in a sitting position, resulting in a sufficient analgesia up to T10. The patients undergoing the surgery, were settled in a lithotomy position for maximum visibility and ease of access[12]. The surgery was initiated with lukewarm 1.5% glycine irrigation fluid. The irrigation fluid column level was kept at a height of 60 centimetre, and was gauged to the extent of pubic symphysis of the patient, who was lying in a lithotomy position during operation. The total duration of the entire surgery was recorded (in minutes). The mass of resected prostate gland (in grams) and the irrigation fluid volume utilized in the procedure were also recorded. During the operation, the plasma concentration of sodium and potassium levels were assessed by blood gas analyser. Blood sampling from veins was used for this assessment. All patients were kept under observation for over 48 hours perioperatively. Blood samples of all the patients were obtained before and 24 hours after the surgery for determination of serum sodium and potassium levels. Reports were assessed and mean changes in serum sodium and potassium were noted.

Data was entered and analysed using the Statistical Package for Social Sciences (IBM SPSS version 20). For quantitative variables, mean ± standard deviation was calculated such as age, BMI, duration of BPH, weight of resected tissue, baseline, postoperative and change in serum sodium and potassium levels whereas frequencies and percentages were generated for levels of sodium and potassium i.e. reduced, normal or greater than normal.

Paired sample t-test was used in order to contrast between the mean change in serum concentration of both sodium and potassium before and after the surgery. Whereas, the Chi-square test was applied to determine the correlation between the time of sampling and levels of sodium and potassium. P-value of <0.05 was considered as statistically significant.

Results

A total of seventy-five participants were enrolled in this study. The mean age ± SD of the patients was recorded to be 59.59 ± 7.02 years, having a mean BMI ± SD of 22.05 ± 4.54 kg/m2. Mean duration of symptoms were 6.95 ± 1.18 days. The mean weight of prostate resected was 44.27 ± 8.01 grams.

Mean change in Sodium was reported to be 1.22 ± 2.05 meq/L and that of potassium it was 0.36 ± 0.21 meq/L (Table 1).

Plasma concentration of sodium and potassium were observed before and 24 hours after TURP surgical procedure. The mean plasma concentration of sodium before TURP was 141.61 ± 2.02 meq/L and after 24 hours of TURP it was 140.39 ± 2.71 meq/L (p-value 0.24).

The mean plasma concentration of potassium before TURP was 4.30 meq/L. The mean level of sodium before TURP was 0.52 meq/L and 24 hours after TURP 4.67 meq/L with a significant p-value of 0.02 (Table 2).

In preoperative evaluation, 92% (69) patients had normal sodium levels while 8% (6) had hypernatremia. Whereas, in postoperative evaluation, 1.3% (1) patient had hyponatremia (<135 mmol/L), 97.3% (73) patients had normal sodium level (135-145 mmol/L) and 1.3% (1) patient had hypernatremia (>145 mmol/L) (p-value 0.92) (Table 3).

Similarly, on preoperative evaluation, 4% (3) patients had hypokalaemia (<3.5 mmol/L) while 89.35% (67) had normal potassium levels (3.5-5.5 mmol/L) and 6.75% (5) patients had hyperkalaemia (>5.5 mmol/L). After surgery, 1.3% (1) patient had hypokalaemia, 66.7% (50) patients had normal potassium levels and 32% (24) patients had hyperkalaemia with a significant p-value of 0.001 (Table 3).

Table 1. Baseline descriptive statistics of patients undergoing surgery

n=75	Mean	Standard Deviation
Age (years)	59.59	7.02
Body Mass Index (kg/m2)	22.05	4.54
Duration of symptoms (days)	6.95	1.18
Weight resected (grams)	44.27	8.01
Change in Na (mmol/L)	1.22	2.05
Change in K (mmol/L)	0.36	0.21

Table 2. Mean difference of the electrolytes before and after the surgery

n=75	Before		After 24 hours		
	Mean	Standard Deviation	Mean	Standard Deviation	p-value
Sodium (mmol/L)	141.61	2.02	140.39	2.71	0.24
Potassium (mmol/L)	4.30	0.52	4.67	0.61	0.02

Paired t- test was applied to assess the mean difference

Table 3. Association of electrolyte imbalance before and after the surgery

Variables (n=75)		Reduced n(%)	Normal n(%)	Increased n(%)	P-value
Sodium(mmol/L)	Before	0(0%)	69(92%)	6(8%)	0.915
	After	1(1.3%)	73(97.3%)	1(1.3)	
Potassium(mmol/L)	Before	3(4%)	67(89.3%)	5(6.7%)	<0.001
	After	1(1.3%)	50(66.7%)	24(32%)	

Chi-square test was used to assess the association

Discussion

Early complications of electrolyte imbalance in postoperative evaluation of patients most frequently includes, genitourinary diseases, postoperative haemorrhage, perforation, or urinary incontinence. Other complications may include moderate to severe electrolyte imbalance causing a hypervolemic state called the TURP syndrome resulting from absorption of large volumes of the irrigating fluid and subsequently causing a hyponatremic state. The patient may present with symptoms of hypovolemia including general weakness, irritability, nausea, vomiting, head tenderness, myalgia, shortness of breath, increased respiratory and heart rate, disorientation, hypertension, fits, or coma[13].

A number of mechanisms have been hypothesized in the development of this disease. With ageing being the key mechanism implicated, recent studies have reported that hormone imbalance, metabolic syndrome and inflammatory response might also be the key players when it comes to BPH[14-16].

The present study reported that in 75 patients undergoing TURP significant change in serum plasma levels of potassium before and after twenty-four hours of the procedure with a p-value of 0.02

whereas, the sodium concentration levels before and after 24 hours of TURP did not show considerable significant change. Significant changes in potassium concentration were recorded after the surgery in which 24 (32%) of patients developed hyperkalaemia while pre-operatively only 5 (6.7%) patients had hyperkalaemia.

In a study by Altaf J et al. in which out of a one-hundred and fifty patients who underwent TURP, 57 (38%) had electrolyte imbalance while, 93 (62%) had no electrolyte disturbance. Out of the 57 patients, significant mean preoperative and postoperative hyponatremia was found (129.29 ± 1.94) mmol/L and (132.05 ± 2.41) mmol/L (p-value 0.001) and significant mean preoperative and postoperative hypernatremia was found (149.8 ± 0.3) mmol/L and (147.2 ± 1.1) mmol/L (p-value 0.02). Significant mean pre and postoperative hypokalaemia was recorded (2.82 ± 0.5) mmol/L and (3.8 ± 1.6) mmol/L (p-value 0.03)[17].

In another study by Khan et al, 93 patients were enrolled for TURP surgery with a mean age ± SD of participants to be 65.16 years ± 5.49. They correlated the presence of preoperative comorbidities with postoperative electrolyte imbalance. In their sample, comorbidities were present in 31 (33.3%) participants. Hypertension was the most frequent comorbidity present in the patients. They deduced that preoperative evaluation of comorbidities, preoperative serum electrolytes and intraoperative procedure time and the total volume of irrigating fluids were highly predictive of postoperative electrolyte imbalance[18].

Ahmed et al, compared the two irrigation fluids i.e. normal saline (0.9% sodium chloride) and Ringer's acetate (RA) in patients undergoing TURP surgical procedure, with regards to complications following the surgery. Twenty diagnosed cases of benign prostatic hyperplasia (BPH) were enrolled in the study. The irrigation fluid bags contained either normal saline (0.9% sodium chloride) or RA and were administered in a randomized method. Their study yielded insignificant results when the two irrigation fluids were compared. It was found that there is no substantial difference (p>0.05) between the two fluids[19]. Another study by Aziz W et al. reported significant change in their electrolyte levels (p-value 0.001 for sodium and 0.002 for potassium) among their 66 (23.5%) out of total of 280 TURP patients[20]. In view of the above studies, our study demonstrated that preoperative levels of sodium of 141.61 ± 2.02 and postoperative levels of sodium of 140.39 ± 2.71 were not significant (p-value 0.24). Preoperative serum concentration levels of potassium were found to be 4.30 ± 0.52 mmol/L and postoperative serum concentration levels of potassium were recorded as 4.67 ± 0.61 mmol/L with a significant p-value of 0.02.

In another study by Desai A et al. non-significant levels of sodium and potassium, pre and postoperative were found (p-value 0.38 and 0.58) respectively[21]. Water intoxication with hyponatremia has been assumed as the main cause for the beginning of TURP syndrome. In a study by Karadeniz et al. fifty-two subjects underwent TURP, and were categorized into two groups. In the first group, 5 % mannitol was used for irrigation and in the second group 0.9 % sodium chloride was used for irrigation purposes during the surgical procedure. The subjects were administered spinal anaesthesia. The methodology applied in this study is different from our study, as they grouped their participants and compared the serum electrolyte imbalance in patients who were administered mannitol and those who were administered sodium chloride. Preoperative and postoperative serum electrolyte concentration in blood samples were recorded. Out of the fifty-two patients, the change in sodium concentration were significantly different (p-value 0.001) in those who underwent the monophasic TURP while, no such change was seen in patients who underwent biphasic TURP procedure. Both monophasic and biphasic TURP patients did not have significant change in potassium concentration[22].

TURP syndrome is a result of absorption of huge amounts of irrigation fluid via the venous sinuses present in the prostate. This can result in serum electrolyte imbalance causing hypovolemic

state in the body. In case, the irrigation fluid column is maintained at a constant height, a persistent volume of fluid is attained per minute during the procedure[23]. The amount of absorbed irrigation fluid is depending upon three key factors i.e. on the period of exposure of the irrigating fluid, the number of open prostatic venous channels, and the hydrostatic pressure at the prostatic bed. Several approaches have been proposed by authors to decrease fluid absorption during the surgery, however, no tactic is able to eradicate this complication. It is recommended to keep the duration of the procedure less than 60 minutes to minimize fluid absorption; TURP syndrome has been reported after a resection time of only 15 minutes[24]. The amount of fluid absorption during surgery, if monitored has been suggested to control the TURP syndrome to some extent. Novel techniques, such as bipolar resectoscopes and vaporizing the diseased tissue have decreased fluid absorption hence, electrolyte disturbance, therefore, the routine checking of fluid absorption has been abandoned in many settings. However, there is no mutual agreement on repetitive monitoring of postoperative serum electrolytes. With improved technology and use of isotonic, non-hemolytic solutions electrolyte derangement has significantly reduced. Principally, use of isotonic saline and bipolar resection TURP syndrome rarely occurs[25]. Electrolytes should be monitored in patients having a risk for increased fluid absorption.

The approach of the present study has ascertained the diverse range of patients undergoing transurethral resection have been enrolled. However, the study may have observer bias. It is further acknowledged that a larger sample size would have resulted in better estimates of the actual differences between the pre and postoperative mean values of the study outcomes. Bearing in mind, the findings of the present study and to what extent these observations are in accordance with the hemodynamic parameters of the patient would help to determine more actualities about the electrolyte imbalance in these patients. Moreover, the study findings are recommended to be more rigorously evaluated before such results are considered to be incorporated into management guidelines of such patients.

Conclusion

The present study reports a significant increase in the mean serum potassium after 24 hours of surgery. However, there was no significant difference in the serum sodium concentration before and after the surgical procedure. We recommend, pre and postoperative evaluation should be considered in patients with BPH undergoing TURP.

Conflict of Interest

Authors have no conflict of interest and nograntfunding from any organisation

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