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Demineralized Water Irrigation and Serum Electrolyte Stability in TURP for BPH

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ABSTRACT

Introduction: *Transurethral resection of the prostate (TURP) is a common procedure for benign prostatic hyperplasia (BPH). Demineralized drinking water is a potential bladder irrigant, yet data on its effect on serum electrolytes and TURP syndrome risk are limited. This study examined the effect of demineralized drinking water used as bladder irrigation during TURP on serum electrolyte levels.* ***Methods:*** *A pre-experimental one-group pretest–posttest design was applied to 15 purposively selected BPH patients undergoing TURP. Serum sodium, potassium, and chloride were measured before and after surgery and compared using the Wilcoxon signed-rank test.* ***Results:*** *Most patients received 20 L of irrigation for about 60 minutes with minimal bleeding. No significant changes occurred in sodium (p = 1.000), potassium (p = 0.655), or chloride (p = 0.655).* ***Conclusions:*** *Demineralized drinking water did not alter serum electrolytes and may be considered a safe option for bladder irrigation during TURP in routine clinical practice locally.*

Introduction

Transurethral Resection of the Prostate (TURP) is a minimally invasive surgical procedure commonly performed to treat benign prostatic enlargement that causes lower urinary tract problems in men (Putri Agustin, 2020). During TURP, a special instrument is inserted through the urethra to resect part of the enlarged prostate tissue and improve urinary flow (Novelty, Rofinda, and Myh 2019). The procedure reduces lower urinary tract symptoms (LUTS) such as difficulty urinating, urinary frequency, and urinary retention. The main advantages of TURP include the absence of large incisions, a reduced risk of infection, and a faster recovery time compared with open surgery (Putri, 2017). One important complication associated with this procedure is TURP syndrome.

According to WHO (2022), approximately 1,276,106 new cases of TURP syndrome were reported worldwide, with a higher prevalence in developed countries (Moramarco et al., 2023). In Indonesia, TURP syndrome occurred in 1.6% of 62 patients undergoing TURP at Sardjito General Hospital during 2010–2012, and an incidence of 4.7% was reported among 168 TURP procedures at Muhammadiyah Hospital, Yogyakarta, in 2013 (Subrata et al., 2018). Effective nursing care during TURP is essential to ensure patient safety and optimal clinical outcomes, and the success of the procedure is influenced by factors such as the knowledge, methods, and readiness of nurses involved in perioperative care (Rasyid et al., 2020). In clinical practice, TURP is associated with several complications that require careful monitoring, including excessive bleeding, urinary tract infection, hypothermia, and TURP syndrome (Zuhirman et al., 2017). Findings by Lumintang (2000) showed that among 25 patients who underwent post-TURP irrigation, 23 (93%) experienced hypothermia (Kusnanto et al., 2007), and hypothermia during TURP may affect multiple organ systems (Rehatta et al., 2007). The irrigation method used during TURP represents one of the main factors influencing both safety and procedural success.

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TURP offers additional advantages in terms of lower trauma rates and shorter recovery periods for patients (Yang et al., 2023). Irrigation fluid is required during the procedure to maintain a clear operative field so that the resection area remains visible and is not obscured by blood. The irrigation solution is generally non-ionic, meaning that it does not conduct electricity, and is selected to prevent electrical conduction during electrosurgical resection. In bipolar TURP, 0.9% sodium chloride (NaCl) is widely used as the irrigation fluid (Rajab et al., 2020), whereas sterile water (aquadest) and glycine are commonly used in monopolar TURP. Normal saline 0.9% is a sterile, non-pyrogenic isotonic solution that is considered suitable for various irrigation procedures. Sterile water fulfils several criteria of an ideal irrigation fluid, but its hypotonic nature presents a limitation. Demineralized or pure water shares this hypotonic characteristic, which allows the irrigant to enter the systemic circulation through open prostatic veins during surgery. Excessive absorption of hypotonic irrigation fluid can lead to relative hyponatremia or water intoxication, known clinically as TURP syndrome, and this syndrome remains one of the most common and feared complications because of its potentially fatal consequences (Meena et al., 2020).

Irrigation within a closed body cavity can trigger perioperative shifts in fluid and electrolytes. During TURP, the large venous sinus plexus surrounding the prostate is frequently opened, and absorption of irrigation fluid can result in a constellation of symptoms and signs collectively referred to as TURP syndrome. Absorption of 2,000 ml or more of irrigation fluid has been associated with headache, anxiety, confusion, dyspnea, arrhythmias, hypotension, and seizures, with the potential for fatal outcomes if not treated promptly. These manifestations are largely attributed to an excessive intravascular fluid load. Clinical presentation varies according to the solute content of the irrigation solution. Absorption of highly hypotonic irrigation fluids can cause dilutional hyponatremia and hypo-osmolality, leading to severe neurologic symptoms. Symptoms of hyponatremia usually appear when serum sodium levels fall below 120 mmol/L, and very hypotonic plasma ($Na^+ < 100$ mmol/L) may result in acute intravascular hemolysis. The incidence of TURP syndrome has been reported to increase by up to 20%, accompanied by a notable mortality risk, with one study reporting an overall mortality rate of 0.99%. Evidence from studies conducted over the past 20 years indicates that the incidence of mild to moderate TURP syndrome ranges from 0.5% to 8%, with reported mortality between 0.2% and 0.8%, while severe TURP syndrome, although rare, may present a mortality rate as high as 25%. Several studies have reported the absence of TURP syndrome with certain irrigation fluids. No ideal irrigation solution and no clear consensus on the optimal irrigation fluid for TURP have been established (Meena et al., 2020; Amu et al., 2023). Alternative irrigation fluids continue to be developed and implemented, taking into account both clinical effectiveness and cost. Demineralized water or pure water has been recommended as a candidate fluid that may meet standards for irrigation in TURP patients.

Demineralized water undergoes a purification process that includes distillation, deionization, and reverse osmosis (RO). Groundwater used for demineralized water production passes through filtration and demineralization stages to reduce mineral content, followed by disinfection using ultraviolet (UV) light to eliminate pathogens and microbes, producing packaged drinking water ready for consumption. Consumption of non-mineral water is considered not to have adverse health effects and may confer additional benefits, as it does not increase the levels of inorganic minerals that accumulate in body tissues over time and may help remove existing inorganic mineral deposits. These characteristics suggest that demineralized water is a potential alternative bladder irrigation fluid in TURP procedures. The limited number of studies exploring the use of demineralized drinking water for bladder irrigation in TURP highlights an important knowledge gap, and the present study aims to analyze the effects of

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demineralized drinking water as a bladder irrigation fluid during TURP on serum electrolyte levels in patients with benign prostatic hyperplasia (BPH).

Methods

This study employed a pre-experimental one-group pretest–posttest design. The study population consisted of patients scheduled to undergo TURP surgery in June–July 2024, with a total of 20 individuals. A sample of 15 respondents was obtained using a purposive sampling technique. Inclusion criteria were willingness to participate as a respondent and age not exceeding 85 years. Exclusion criteria were the presence of chronic comorbid diseases. The study was conducted at the Central Surgery Installation of Jombang Regency Hospital during June–July 2024. Data were collected using an observation sheet. Univariate analysis was performed by calculating the mean, median, and mode, and by constructing frequency distributions for each variable category. Bivariate analysis was conducted using the Wilcoxon signed-rank test to compare pretest and posttest measurements.

Results

Univariate Analysis

The results of the study are summarized in Table 1, which presents the general characteristics of respondents including age, irrigation fluid volume, duration of irrigation, and amount of bleeding.

Table 1. General characteristics of respondents

General Characteristic	n	%
Age (years)		
45- 59	0	0
60-74	9	60
75-90	6	40
> 90	0	0
Irrigation volume (liter)		
20	14	93,3
25	1	6,7
Duration (minutes)		
55	1	6,7
60	11	73,3
75	2	13,3
80	1	6,7
Amount of bleeding (cc)		
<50	14	93,3
51-75	1	6,7
Total	**15**	**100**

Primary data sources, 2024

Based on Table 1, most respondents were 60–74 years of age (60%), corresponding to the elderly age group. Almost all respondents received 20 liters of irrigation fluid (93.3%). Most respondents underwent bladder irrigation for 60 minutes (73.3%). Regarding intraoperative bleeding, almost all respondents had bleeding volumes of <50 cc (93.3%).

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Bivariate Analysis

The results of the study can be presented in the following table:

Table 2. Differences in Serum Electrolytes Before and After Irrigation with Demineralized Water

Ranks

		N	Mean Rank	Sum of Ranks
Na post - Na pre	Negative Ranks	0[a]	.00	.00
	Positive Ranks	0[b]	.00	.00
	Ties	15[c]		
	Total	15		
K post - K pre	Negative Ranks	3[d]	3.00	9.00
	Positive Ranks	2[e]	3.00	6.00
	Ties	10[f]		
	Total	15		
Cl post - Cl pre	Negative Ranks	3[g]	3.00	9.00
	Positive Ranks	2[h]	3.00	6.00
	Ties	10[i]		
	Total	15		

a. Na post < Na pre
b. Na post > Na pre
c. Na post = Na pre
d. K post < K pre
e. K post > K pre
f. K post = K pre
g. Cl post < Cl pre
h. Cl post > Cl pre
i. Cl post = Cl pre

Test Statistics[a]

	Na post - Na pre	K post - K pre	Cl post - Cl pre
Z	.000[b]	-.447[c]	-.447[c]
Asymp. Sig. (2-tailed)	1.000	.655	.655

a. Wilcoxon Signed Ranks Test
b. The sum of negative ranks equals the sum of positive ranks.
c. Based on positive ranks.

Primary data sources, 2024

Based on Table 2, all respondents had identical pretest and posttest serum sodium levels (15 ties), and the majority also showed no change in serum potassium and chloride levels. The Asymp. Sig. (two-tailed) values for serum sodium (1.000), potassium (0.655), and chloride (0.655) were all greater than 0.05, indicating no statistically significant differences in serum electrolyte levels before and after irrigation. These findings indicate that bladder irrigation using demineralized drinking water during TURP does not alter serum electrolyte levels in BPH patients and can be considered safe with respect to the risk of TURP syndrome.

Discussion

This study provides insights into the use of demineralized water as an irrigation fluid in Transurethral Resection of the Prostate (TURP) procedures. The majority of respondents were in the elderly age group (60–74 years), which reflects a population that frequently experiences prostate problems. This pattern is consistent with the findings of Susanto et al. (2014), who reported an association between increasing age and a higher risk of TURP syndrome, related to declining physiological and organ function (Susanto et al., 2014).

The irrigation procedure applied in this study demonstrated a relatively consistent pattern. Almost all respondents received approximately 20 liters of irrigation fluid per procedure, and most procedures lasted around 60 minutes, a duration that is considered low risk for TURP

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syndrome and remains within the recommended surgical time frame (Novelty et al., 2019). Postoperative bleeding was minimal, with almost all respondents experiencing bleeding volumes of less than 50 cc. This finding contrasts with concerns that monopolar TURP is associated with a high risk of bleeding (Yang et al., 2023). The amount of intraoperative bleeding is generally influenced by prostate size, resected tissue weight, and operative duration, and the relatively consistent operative time in this study suggests that the procedure was effective in minimizing complications.

The key finding of this study lies in the absence of significant differences in serum electrolyte levels, which serve as important indicators of TURP syndrome (Subrata, 2015), before and after bladder irrigation. Mean serum levels of sodium (Na), potassium (K), and chloride (Cl) did not differ significantly between pretest and posttest measurements, indicating that irrigation using demineralized water did not affect serum electrolyte profiles. The stability of these parameters provides evidence that demineralized drinking water as an irrigation fluid does not cause clinically relevant electrolyte disturbances and can therefore be considered safe for use in TURP procedures, particularly with respect to the risk of hyponatremia and hyperkalemia. The absence of electrolyte changes consistent with TURP syndrome, which is typically characterized by serious electrolyte imbalance, further reinforces the safety profile of this method.

Clinical implications derived from these findings are meaningful for perioperative practice. The use of demineralized water as an irrigation fluid emerges as a safe and potentially effective option in the management of TURP procedures. Demineralized drinking water undergoes multiple physical, chemical, and microbiological processes and quality tests, indicating that it is safe for human consumption (Ridlo et al., 2019). The same characteristics support its potential use as an irrigation fluid. Demineralized water is widely available and relatively low in cost, which is advantageous when considering both clinical effectiveness and economic efficiency. The perception that TURP invariably incurs high costs becomes less accurate when more affordable yet safe irrigation options are available (Hughes et al., 2023). Bladder irrigation using demineralized drinking water in this study was associated with the prevention of complications related to electrolyte imbalance and did not indicate an increased risk of TURP syndrome. The relatively small sample size represents a limitation and suggests the need for further research with larger populations. Despite this limitation, the results of the present study provide a basis for considering demineralized drinking water as a viable option for bladder irrigation in TURP procedures and support its integration into clinical practice under appropriate monitoring.

Conclusion

This study provides supporting evidence for the safety, potential effectiveness, and efficient use of resources associated with demineralized drinking water as a bladder irrigation fluid in TURP procedures. No significant differences were found in mean serum electrolyte levels of sodium (Na), potassium (K), and chloride (Cl) between pretest and posttest measurements, indicating that bladder irrigation using demineralized drinking water did not alter serum electrolyte levels in patients with BPH undergoing TURP. Based on these findings, demineralized drinking water can be considered a promising option for bladder irrigation in TURP, particularly in settings where cost and availability are important considerations. The stability of serum electrolyte levels suggests that this irrigation strategy does not appear to increase the risk of electrolyte disturbances commonly associated with TURP syndrome. Further studies are required to confirm these results and to evaluate broader clinical outcomes.

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Ethics approval and consent to participate

This study was conducted in accordance with ethical principles, including confidentiality and beneficence. All respondents provided informed consent prior to participation. Ethical approval was obtained from the Health Research Ethics Committee of Jombang Regency General Hospital (Number 53/KEPK/VI/2024).

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Recommendation

Further research on the use of demineralized drinking water as a bladder irrigation fluid in TURP procedures is recommended, particularly with a larger sample size, to enable broader generalization of these findings. Future studies need to include clinical indicators of TURP syndrome and additional variables such as infection markers to ensure that demineralized drinking water does not increase the risk of infection and remains safe as a bladder irrigation fluid for BPH patients undergoing TURP.

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