ORIGINAL RESEARCH

Incidence and Risk Factors of Postoperative Bacteriuria after Transurethral Resection of the Prostate using Distilled Water as Irrigating Fluid: A Retrospective Cohort Study

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Objective: To establish the incidence of postoperative bacteriuria (PBU) in patients after undergoing transurethral resection of the prostate (TURP) using sterile distilled water as irrigating fluid, and determine the possible risk factors for its development.
Methods: A retrospective cohort study of patients who underwent TURP using distilled water as irrigating fluid from 2014-2018 at a tertiary government hospital was performed. Included were patients who had urine culture results upon admission, treated with antibiotics or received antibiotic prophylaxis within 24 hours prior to operation, as appropriate, and had a repeat culture prior to discharge. PBU was defined as the presence of significant (≥ 105 CFU/mL) bacteriuria upon catheter removal in patients with either no growth on preoperative urine culture or growth of a different organism from that of the preoperative culture. Chi-square and Student's T-test were used to compare those with and without PBU and attributable risk (AR) values were determined for identified risk factors.
Results: Eighty-four patients with a mean age of 65 (± 6.32) years were included. Sixteen (19%) patients developed PBU. Preoperative catheterization and resection time of more than 30 minutes were found to be associated with the development of PBU (p=0.020 and 0.047, respectively), with AR of 24.24% (95% CI [13.90,34.58]) and 22.86% (95% CI [13.02,32.69]). Age, resected prostate weight, and diabetes mellitus were not found to be associated with PBU.
Conclusion: Postoperative bacteriuria rate of 19% was noted with the use of distilled water as irrigant during TURP. Significant risk factors for its development included preoperative catheterization and prolonged resection times.

Keywords: prostate, transurethral resection of the prostate, infection

Introduction

Transurethral resection of the prostate (TURP) remains to be the cornerstone in the surgical management of benign prostatic obstruction in cases of failure of medication and disease progression.[1] Despite advancements in technology such as bipolar TURP and laser enucleation of the prostate, monopolar TURP (MTURP) is still the standard method for resection.[2] While MTURP typically requires a non-ionic irrigating fluid such as glycine or sorbitol to allow for electroresection, distilled water as a cost-effective alternative irrigating solution is widely used in many developing countries.[3] Several studies have shown that distilled water can be a safe alternative irrigating fluid in terms of systemic

fluid absorption, hemolysis, and the development of TURP syndrome.[4-6]

Postoperative infection is the most common complication of TURP and can lead to significant morbidity and mortality.[7,8] To date, there have been no published studies on the possible development of postoperative bacteriuria (PBU) after using distilled water as irrigating fluid for TURP. Recognition and prevention of PBU even in the absence of occult infection is important as the rate of PBU correlates well with the overall rate of the development of symptomatic UTI and postoperative complications[9-10], as well as the length and cost of hospitalization.[11-12] This study aimed to establish the incidence of PBU in patients undergoing TURP using sterile distilled water as irrigating fluid, and to determine the risk factors for its development.

Methods

This is a retrospective cohort study of adult male patients who underwent TURP using distilled water as irrigating fluid from 2014-2018 at a tertiary government hospital. Included were patients who had samples collected for urine culture upon admission, treated with culture- or antibiogram- based antibiotics or received antibiotic prophylaxis within 24 hours prior to the operation, and had a repeat urine culture done postoperatively upon removal of the urethral catheter prior to discharge. Those with incomplete information on the clinical parameters and outcome in question have been excluded from the study. Also excluded were patients who developed PBU but had mixed culture results on their preoperative urine, and patients who underwent another lower urinary tract operation concurrent with TURP, such as open bladder surgery or intracorporeal lithotripsy.

Information on the following clinical and surgical parameters were retrieved from the patients' medical records: patient demographics, presence of indwelling catheter on admission, preoperative urine culture, postoperative urine cultures, total resection time (from first application of the electrode to cut the prostate until the insertion of the catheter, including time spent for hemostasis and evacuation of prostate chips), weight in grams of the resected prostate chips, and a known diagnosis of diabetes mellitus. Prolonged resection time was defined as resection time of more than 30 minutes.

The development of PBU was defined as the presence of significant bacteriuria (≥ 105 cfu/mL) on an aseptically-collected urine specimen upon removal of the urethral catheter of patients with either no growth on preoperative urine culture or those with a postoperative growth of a different organism from that of the preoperative culture. The incidence of PBU was determined from the study population, and the different clinical and surgical parameters (age, diabetes mellitus, preoperative catheterization, resected prostate weight and resection time) between those who developed and did not develop were compared, using the Student's T-test for continuous variables and the Chi-Square test for categorical variables. A statistically significant difference was considered if the p-value was less than 0.05. The attributable risk (AR) values were determined for identified risk factors. Statistical analysis was performed using SPSS version 10.0 (Chicago, IL).

The study protocol was reviewed and approved by the University of the Philippines Manila - Research Ethics Board, and the study was conducted in accordance with ICH-GCP principles, the provisions of the National Ethical Guidelines for Health and Health-related Research of 2017, and the Data Privacy Act of 2012 (RA 10173).

Results

Patient Selection

Among the patients who underwent TURP from 2014-2018, 135 patients had urine samples taken for culture upon admission and postoperatively upon catheter removal. Among these patients, 51 were subsequently excluded due to the following: 14 due to incomplete information on clinical data, 13 due to unavailability of culture results, 2 due to mixed culture results on postoperative urine, 3 due to a positive postoperative culture result but a mixed culture on preoperative urine, and 19 due to a concurrent lower urinary tract operation with TURP.

Patient Characteristics and Uculture Results

The mean age of the study population was 65.5 years (± 6.32), with a range of 53-83 years. Majority

(74 %) were above 60 years old and 34 patients (40%) were above 65 years. Sixty-six patients (78.57%) had an indwelling urethral catheter in place at the time of admission. Seven patients (8.33%) had a known diagnosis of diabetes. Resection times ranged from 13-65 minutes with an average of 39.69 minutes (S.D.= 12.83). Seventy (83%) patients had resection times more than 30 minutes. The resected prostate weights ranged from 9g-47g, with an average of 24.55g (S.D.= 9.33).

Preoperatively, 42 (50%) of the included patients had sterile urine on admission, 11 (13.1%) had a mixed culture, and 31 (36.9%) had a documented growth of bacteria. After the operation, 16 (21.4%) patients developed PBU: 5 (6%) from an initially sterile preoperative urine, and 11 (13%) patients had preoperative bacteriuria but had growth of a different organism, postoperatively. Patient demographics, surgical data, and urine culture results are summarized in Table 1.

Risk Factor Analysis

All patients who developed PBU had an indwelling catheter preoperatively, compared to only 74% of those without (p=0.020, AR = 24.24% with 95%CI [13.90, 34.58]). Likewise, all patients who developed PBU were noted to have a prolonged resection time, compared to only 79% of those with shorter resection times (p=0.047, AR = 22.86% with 95%CI [13.02-32.69]). No significant associations were noted between the development of PBU and patient age (66.13 ± 4.01 vs. 65.18 ± 6.71 years, p=0.239), resected prostate weight (23.38 ± 7.18 vs. 24.82 ± 9.75, p= 0.258) and a known history of diabetes (6% vs 9%, p=0.738). Risk factor analysis is summarized in Table 2.

Table 1. Patient characteristics and urine culture results of patients who underwent TURP from 2015-2018.

Demographics and surgical data	
Age (years)	65.5 ± 6.32
Above 60 years	62 (74)
Above 65 years	34 (40)
With preoperative catheter	66 (79)
Resection time (minutes)	39.7 ± 12.8
Prolonged resection time (>30 min)	70 (83)
Resected prostate weight (g)	24.5 ± 9.3
With known history of diabetes	7 (8)
Preoperative urine culture	
No growth	42 (50)
Positive	42 (50)
Bacteria identified	31 (37)
Mixed culture	11 (13)
Development of postoperative bacteriuria	
(+) PBU, total	16 (21)
From preoperatively sterile urine	5 (6)
With different growth from preop culture	11 (13)
(-) PBU	68 (79)

Values are presented as mean ± standard deviation, or number (%).
PBU- postoperative bacteriuria

Table 2. Risk factor analysis for the development of postoperative bacteriuria.

	(+) PBU N = 16	(-) PBU N = 58	p-value	AR
Age (years)	66.13 ± 4.01	65.18 ± 6.71	0.239*	
With preoperative catheter	16 (100)	50 (74)	0.020**	24.24 [13.90, 34.58]
Prolonged resection time (>30 min)	16 (100)	54 (79)	0.047**	22.86 [13.02-32.69]
Resected weight (g)	23.38 ± 7.18	24.82 ± 9.75	0.258*	
With known history of diabetes	1 (6)	6 (9)	0.738**	

Values are presented as mean ± standard deviation, or number (%).
AR (Attributable risk) is expressed as percentages and 95% confidence intervals
* T-test for difference in means ** Chi-square test

Discussion

About one-fifth of patients who underwent TURP using distilled water as irrigating fluid at our institution developed postoperative bacteriuria. This is comparable to incidences of PBU after TURP in conventional irrigating fluids with reported rates of 26-35%.[13-14] Even in Bipolar TURP, which uses plain normal saline solution (PNSS) as the irrigating fluid, the reported PBU incidence of 18.2% in a study by Huang and colleagues[15] is still comparable to the incidence reported in our study. This suggests that in terms of possible infectious postoperative events, distilled water can be used safely as an alternative irrigating solution for TURP.

Still, a 20% incidence of PBU is noteworthy, and should be recognized and controlled perioperatively because it can possibly lead to serious consequences such as bacteremia and sepsis.[16] A prospective multicentric study (Wagenlehner, 2005) has shown that PBU correlates well with the overall rate of complications after TURP.[9] Another prospective, randomized study by Raz 1994, has shown that PBU after TURP can prolong hospital stay by as much as 5 days[11], which is consistent with earlier findings of Rutledge, 1985[12], which showed that postoperative bacteriuria is not just associated with prolonged hospital stay, but also with increased treatment costs.

The National Antibiotic Guidelines on Surgical Prophylaxis of the Department of Health recommends antimicrobial prophylaxis for all TURP based on local sensitivity patterns.[17] However, even after antibiotic prophylaxis and a documented sterile urine prior to manipulation of the urinary tract, Alsaywid, 2013 demonstrated that there is still the risk of the development of postoperative bacteriuria after TURP[18], as also shown by the results of this study.

The risk factors found to be associated with the development of PBU are consistent with previous reports. Two multicenter prospective cohort studies have established prolonged duration of operation as a risk factor for the development of bacteriuria after TURP in conventional irrigating solutions.[13,15] In particular, a prospective cohort study (Colau, 2001), showed that operative times lasting for more than 30 minutes is significantly associated with a higher risk for postoperative bacteriuria, compared to those with shorter resection times.[13] This is consistent with the association found in our study. Another prospective cohort study by Robinson and coworkers found out that the organisms found in the urine of patients after TURP mainly comes from the prostate itself, and thus prolonged manipulation of the prostate increases the risk of PBU.[19] This should be taken into account when performing transurethral prostate surgeries.

Aside from intraprostatic sources, studies have also shown that ascending infections from the penile meatus and urethra also contribute to postoperative bacteriuria.[19,20] This can explain why preoperative catheterization has also been found to be associated with the development of PBU, similar to findings of a study by Taylor, et al.[21] Therefore, in this particular group of patients who have an indwelling catheter in place upon admission for TURP, it might be necessary to make adjustments or continue antibiotic prophylaxis postoperatively to minimize the risk of PBU.

The relatively low number of patients included after the removal of a high number of those who did not fit the inclusion criteria is a major limitation of this study. This could then affect the generalizability of the results. Furthermore, the small sample size limits conclusions on the presence or absence of an association between PBU and the other variables such as the resected prostate weight and diabetes mellitus, which have been found to be significant risk factors as well by other studies.[13,14]

Conclusion

Distilled water can be used as a safe alternative irrigating fluid for TURP, with a comparable incidence of development of postoperative bacteriuria to other irrigants. For patients with a prolonged resection time or a presence of a catheter preoperatively, the chance of developing bacteriuria after the operation is higher even after the administration of prophylactic antibiotics, and this should be considered when deciding upon a perioperative antibiotic regimen. Data obtained from this study can guide practitioners in minimizing postoperative infectious complications after TURP while using a cost-effective alternative irrigating fluid. Further studies involving more patients, with a more extensive analysis relating the incidence of PBU with other risk factors, as well as signs and symptoms of urinary tract infection are recommended.

References

1. Reich O, Gratzke C, Stief CG. Techniques and long-term results of surgical procedures for BPH. Eur Urol 2006; 49: 970–8.
2. Hueber P, Al-Asker A, Zorn K. Monopolar vs. bipolar TURP: assessing their clinical advantages. Can Urol Assoc J 2011; 5(6): 390–1.
3. Memon A, Buchholz NP, Salahuddin S. Water as an irrigant in transurethral resection of the prostate: a cost-effective alternative. Arch Ital Urol Androl 1999; 71(3): 131-4.
4. Moskovitz B, Ross M, Bolkier M, Rosenberg B, Levin DR. The use of distilled water as an irrigating fluid in patients undergoing transurethral resection of the prostate. Eur Urol 1989; 16(4): 267-70.
5. Norlén H, Allgén LG, Vinnars E, Wiklund A. Plasma haemoglobin concentrations and other influx variables in blood in connection with transurethral resection of the prostate using distilled water as an irrigating fluid. Scand J Urol Nephrol 1987; 21(3): 161-8.
6. Beal JL, Freysz M, Berthelon G, D'Athis P, Briet S, Wilkening M. Consequences of fluid absorption during transurethral resection of the prostate using distilled water or glycine 1.5 per cent. Can J Anaesth 1989; 36(3 Pt 1): 278-82.
7. Li YH, Li GQ, Guo SM, Che YN, Wang X, Cheng FT. Clinical analysis of urinary tract infection in patients undergoing transurethral resection of the prostate. Eur Rev Med Pharmacol Sci 2017; 21(20): 4487-92.
8. Osman T, ElSaeed KO, Youssef HA, Shabayek M, Emam A, Hussein MS. Evaluation of the risk factors associated with the development of post-transurethral resection of the prostate persistent bacteriuria. Arab J Urol 2017; 15(3): 260-6. Published 2017 Jul 12. doi:10.1016/j.aju.2017.05.004
9. Wagenlehner FM, Wagenlehner C, Schinzel S, Naber KG. Prospective, randomized, multicentric, open, comparative study on the efficacy of a prophylactic single dose of 500 mg levofloxacin versus 1920 mg trimethoprim/sulfamethoxazole versus a control group in patients undergoing TUR of the prostate. Eur Urol 2005; 47(4): 549-56. Epub 2005 Jan 18.
10. Köves B, Cai T, Veeratterapillay R, Pickard R, Seisen T, Lam TB, et al. Benefits and harms of treatment of asymptomatic bacteriuria: A systematic review and meta-analysis by the European Association of Urology Urological Infection Guidelines Panel. Eur Urol 2017; 72(6): 865-8. doi: 10.1016
11. Raz R, Almog D, Elhanan G, Shental J: The use of ceftriaxone in the prevention of urinary tract infection in patients undergoing transurethral resection of the prostate. Infection 1994; 22: 347–9.
12. Rutledge KA, McDonald HD Jr: Cost of treating simple nosocomial urinary tract infection. Urology 1985; 26(suppl 1): 24.
13. Colau A, Lucet JC, Rufat P, Botto H, Benoit G, Jardin A. Incidence and risk factors of bacteriuria after transurethral resection of the prostate. Eur Urol 2001; 39: 272–6.
14. Hwang EC, Jung SI, Kwon DD, Lee G, Bae JH, Na YG. A prospective Korean multicenter study for infectious complications in patients undergoing prostate surgery: risk factors and efficacy of antibiotic prophylaxis. J Korean Med Sci 2014; 29: 1271–7.
15. Huang X, Shi HB, Wang XH, Zhang XJ, Chen B, Men XW. Bacteriuria after bipolar transurethral resection of the prostate: risk factors and correlation with leukocyturia. Urology 2011; 77: 1183–7.
16. Rassweiler J, Teber D, Kuntz R, Hofmann R. Complications of transurethral resection of the prostate (TURP) incidence, management, and prevention. Eur Urol 2006; 50: 969–79.
17. National Antibiotic Guidelines on Surgical Prophylaxis of the Department of Health, Republic of the Philippines. 2017
18. Alsaywid BS, Smith GHH. Antibiotic prophylaxis for transurethral urological surgeries: Systematic review. Urol Ann 2013; 5(2): 61-74. doi:10.4103/0974-7796.109993.
19. Robinson MRG, Arudppragasam ST, Sahgal SM, et al. Bacteraemia resulting from prostatic surgery: The source of bacteria. Br J Urol 1982; 54: 542– 6.
20. Ibrahim AI, Bilal NE, Shetty SD, Patil KP, Gommaa H. The source of organisms in the post-prostatectomy bacteriuria of patients with pre-operative sterile urine. Br J Urol 1993; 72(5 Pt 2): 770-4.
21. Taylor EW, Lindsay G. Antibiotic prophylaxis in transurethral resection of the prostate with reference to the influence of preoperative catheterization. J Hosp Infect 1988; 12(2): 75-83.