Biomedical & Pharmacology Journal, March 2024. Vol. **17**(1), p. 163-170

Uropathogenic Infection Associated with Prostate Hypertrophy and Transurethral Resection of Prostate

Maysaa K. Al-Malkey[1]*, Noor K. Habash[2] and Mustafa A. Salman[3]

[1]Tropical Biological Research Unit, College of Science, University of Baghdad, Baghdad, Iraq.
[2]Iraqi Center for Cancer and Medical Genetics Research, Mustansiriyah University, Baghdad, Iraq.
[3]Nu'man Teaching Hospital, Baghdad, Iraq.
*Corresponding Author E-mail:maysakadhim@uobaghdad.edu.iq

https://dx.doi.org/10.13005/bpj/2844

(Received: 05 February 2024; accepted: 04 March 2024)

Benign prostatic hyperplasia (BPH) is a prevalent condition among elderly and middle-aged men characterized by symptoms such as dysuria, urinary incontinence, and frequent micturition. The gold standard procedure for relieving BPH symptoms is transurethral resection of the prostate (TURP). However, some patients undergoing TURP are at risk of developing urinary tract infections (UTIs) due to uropathogenic bacteria. This prospective study aimed to investigate post TURP bacteruria alongside with multifactoria risk factors that implicated postoperatively compared to preoperative and intraoperative periods. Ninety patients undergoing TURP and 30 control subjects were included in the study. Urine specimen for urine analysis from patients were conducted on three occasions: (60 mid-stream urine and 30 catheterized urine samples) were taken preoperatively, (90 samples via cystoscopy) were taken intraopertively, and (90 mid-stream urine samples after catheter removal) were taken at the third day post-TURP procedure. The study findings were analyzed in correlation with various pre-, intra-, and postoperative potential risk factors to underscores the vulnerability of BPH patients to UTIs, particularly during the postoperative recovery phase. The Escherichia coli was the most commonly isolated uropathogen preoperatively, while Pseudomonas aeruginosa emerged as the primary pathogen intra- and post-operatively. Several risk factors were identified as significantly associated with post-TURP bacteriuria. These include preoperatively, positive pre-operative culture analysis, diabetic patients, and preoperative catheterization. Additionally, intraoperative factors such as prolonged operation duration were also implicated. Postoperatively, persistent bacteriuria was significantly linked with the duration of catheterization. In conclusion, the findings highlight the complex interplay of factors contributing to post-TURP UTIs and stresses the significance of thorough risk evaluation and customized preventative measures to reduce infection risks among BPH patients undergoing TURP.

Keywords: Benign prostatic hyperplasia; Risk factors; TURP; Uropathogens.

Benign prostatic hyperplasia (BPH) is a common male disease in the Urology clinics and occurs more frequently in the middle-aged and elderly men[1]. The prevalence of BPH was estimated to be 26% in men aged 40 to 49 years and 41% in men aged 60 to 69 years[2]. Urine retention resulting in dysuria, incomplete voiding, and urinary incontinence is the primary prognosis of the disease[3]. The Transurethral Resection of Prostate (TURP) procedure had a satisfying sequel, nevertheless few patients are exposed to uropathogenic bacteria beyond the procedure due to age advancement, chronic diseases, and previous catheter insertion[4]. Postoperative sequels, such

as urinary tract infection (UTI), bacteremia and prostatitis are known complications after TURP; their incidence is 6–64%, depending on the type of urethral instrumentation used and the use of prophylactic antibiotics[5,6]. UTIs are common with a prevalence of 0.7% in terms of community-acquired infection[7,8]. Studies have reported rates of postoperative morbidity greater than 10% as complication for BPH, the UTI was included[9–12]. The focus of this study was to analyze urinary tract infection (UTI) defined as bacteriuria and identify potential risk factors in patients with BPH during the three stages preoperative, intraoperative and postoperative associated with TURP procedure.

MATERIALS AND METHODS

General information

A prospective clinical study involving 90 patients suffering from BPH who were scheduled for a TURP procedure at the Urology clinic, Al-Yarmouk Teaching Hospital, Baghdad from January to August 2019 was designed. The range of their ages was 35 to 87 years, with an average age of 59.64 ± 9.35 years. This study also included 30 subjects as controls selected from matched age range (55 - 70 years), with no previous hospital admission for any urological procedures, neither previous history of UTIs, nor diabetes mellitus (DM). Written consent for participation was taken from the patients. The hospital Ethics Committee and the University of Baghdad, College of Science approved the study. Inclusion criteria included patients with main symptoms of BPH, then they were confirmed by color Doppler ultrasound, cystoscopy, and Prostate serum Antigen (PSA) positive tests. Concomitant bladder pathology, including stones, prostate cancer, diseases like urinary system deformity, obstruction, bladder calculi, or previous urethral surgery were considered an exclusion criteria.

Surgical procedure

The surgical procedure (TURP) was performed by surgeons who had more than 15 years of experience. For all operations, distilled water was the suggested fluid for irrigation fluid. After that, a continuous irrigation system was applied to insert a three-way urethral Foley catheter. A three-day course of intravenous third-generation cephalosporin was part of the postoperative care unless the preoperative urine antibiotic sensitivity indicated otherwise. After three days, the catheter was taken out.

Study design

Clinical data of all patients were collected including age, disease course, Body Mass Index (BMI), prostate volume, and International Prostate Symptom Score (IPSS). The time of indwelling catheter after the procedure; and prophylactic application of antibiotics before surgery were recorded. Urine and culture analysis were taken on three times for all patients: before 24 hours of the procedure (60 mid-stream urine (MSU) and 30 catheterized urine), immediately after the procedure ends (90 per cystoscopy), and (90 MSU) after the catheter removal at 3rd day post TURP procedure. For bacterial growth assessment the guidelines of European Association of Urology were applied. The urine was sterilely collected and incubated at 37°C for 24 hours on blood and MacConkey agar. A minimum of $1x10^5$ colony forming units (CFU)/ml was defined as significant bacterial growth. Less bacterial growth was defined as bacteriuria. Biochemical analysis to identify the isolates and the antimicrobial susceptibility test were performed (Figure 1). Any potential risk factor—preoperative, intraoperative, and postoperative—was investigated associated with post-TURP-UTIs (Table 1).

Statistical analysis

For data processing, SPSS software (version 22.0) was applied. The experimental data's continuous variables were presented as mean standard deviation (x±SD), and the independent t-test was employed for univariate analysis to determine statistical significance for both continuous and categorical variables. Both descriptive analysis and classified variable data were expressed as (%) and adopted X2 test. A multivariate logistic regression model was performed to assess the independent factors affecting UTI. The significant difference was considered when $P < 0.05$.

RESULTS

Incidence of urinary tract infection

A total of 90 patients with BPH were enrolled in this study. There were a total 180 positive cultures of pathogenic bacteria in 270

specimens, divided into three occasions as follows: there were 61 positive cultures with UTIs after operation, accounting for (67.7%) comparing to 40 (44.4%) cases with UTIs pre-operatively, there were 79 cases reported (87.7%) as UTIs during the procedure. The most common isolated uropathogen was *Escherichia coli* (37.5%) pre-operatively, the scenario was changed in intra- and post-operatively in term that *Pseudomonas aeruginosa* was the master of the scene by (44%) and (36%) respectively (Table 2). From presumably health subjects, 30 MSU were taken. They attended the clinic as relatives of the patients having the TURP, there were five bacterial isolates form 14 subjects represented (46.6%), *E. coli* was the most prevalent recorded (35.7%) (Table 2).

Univariate Analysis

There was no statistically significant difference in the patient's associations between pre-operative risk variables and post-TURP bacteriuria with age older than 65 years old, BMI, prostate size, PSA level, and prophylactic use of antibiotics before operation ($p > 0.05$). However, the differences were statistically significant ($p < 0.05$) with pre-operative positive urine and culture analysis, history of DM, and preoperative catheterization (Table 3).

Regarding the association of post-TURP bacteriuria to intraoperative risk factors, the post-TURP bacteriuria indicated significant results were

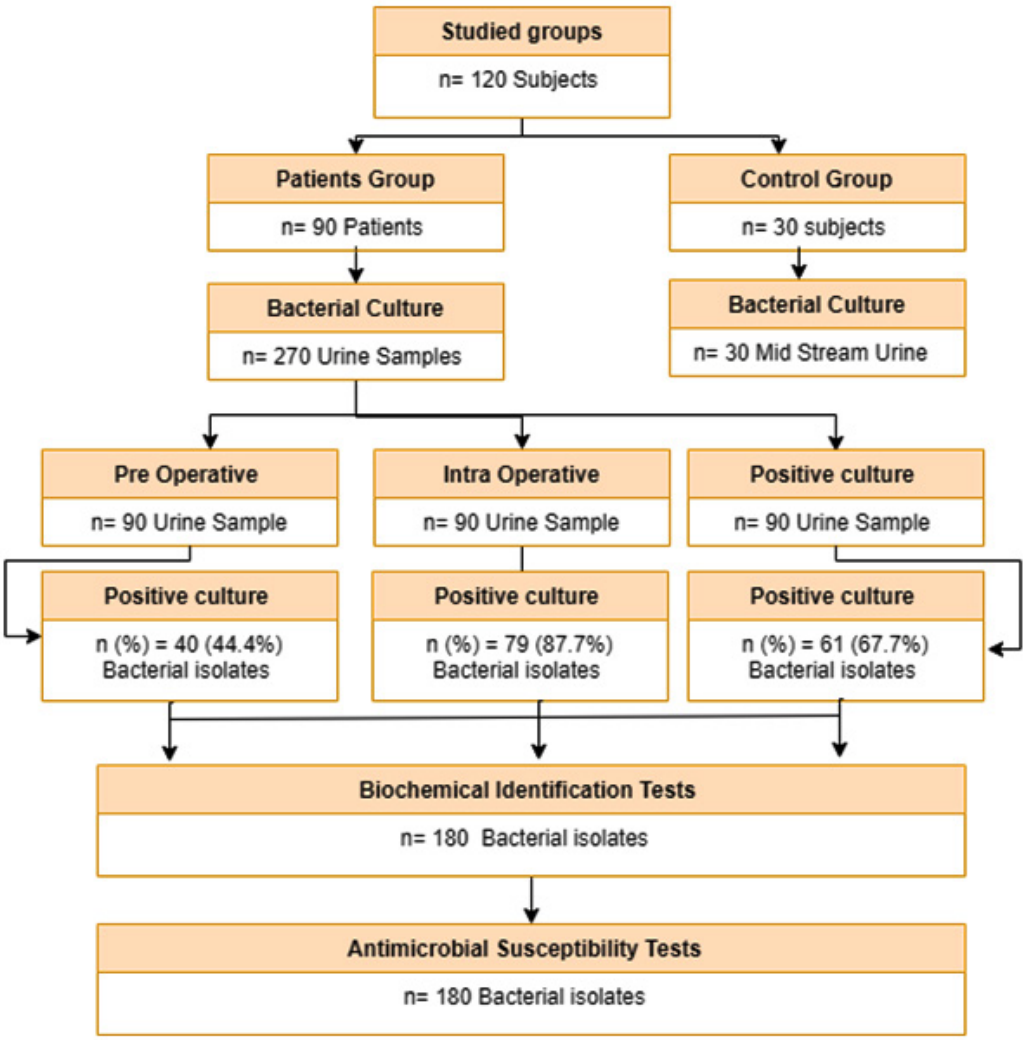

Fig. 1. Urine samples for bacterial analysis of studied groups

only related to the duration of the operation and pre-operative positive urine and culture analysis (Table 3).

Concerning the association between post-TURP bacteriuria and post-operative risk factors, persistent post-TURP bacteriuria was found to be significantly linked with both urine analysis and culture with the third postoperative catheterization (Table 3).

Multivariate Analysis

The results of multivariate logistic regression analysis showed a statistically significant correlation between the following risk factors and post-TURP bacteriuria: prostatic size, older age of patients, positive pre-operative urine analysis, use of pre-operative catheters, prophylactic use of antibiotics, history of DM, and longer operation duration.

DISCUSSION

Studies on the post-TURP bacteriuria risk factors have been conducted on numerous occasions[13–16]. Therefore, the purpose of the current investigation was to determine the possible risk factors—particularly UTIs and bacteriuria—that could raise the incidence of post-TURP infection. Our findings revealed UTIs incidence accounted for (67.7%) compared to (44.4%) of cases with UTIs pre-operatively (87.7%) of UTIs during the procedure as well as there were 14 subjects represented (46.6%) of presumably healthy males had bacteriuria (Figure 1) which comes in line with Zhu et al., (2021)[17] who reported an incidence of UTIs reached 60.40% but contradicted with Xu et al., (2024)[18] in which showed that the

Table 1. Potential risk factors associated with TURP-UTI (preoperatively, intra-operatively, and post operatively)

Preoperative	Intraoperative	Post-operative
Age	Duration of the operation (minutes)	Catheter duration (Days)
Presentation	Irrigation fluid (distilled water)	Urine analysis/culture (3rd day)
BMI	Sterilization solution (CIDEX®)	Antibiotic duration (days)
Prostate size	Urine analysis/culture	
PSA level		
Urine analysis/culture		
Diabetes mellitus		
Catheter duration (days)		
Antibiotic prophylactic use		

Table 2. Pathogens distribution associated with TURP-UTI (pre, intra, and post-operative)

UTI Pathogen	Transurethral resection of prostate			
	Pre-Op No. (%)	Intra-Op No. (%)	Post-Op No. (%)	Control No. (%)
Escherichia coli	15 (37.5%)	18 (23%)	12 (20%)	5 (35.7%)
Pseudomonas aeruginosa	3 (7.5%)	35 (44%)	22 (36%)	0
Klebsiella pneumoniae	2 (5%)	5 (6%)	4 (6.5%)	3 (21.4%)
Proteus mirabilis	2 (5%)	0	0	0
Serratia marcescens	1 (2.5%)	3 (4%)	5 (8%)	2 (14.2%)
Staphylococcus aureus	6 (15%)	9 (11%)	4 (6.5%)	3 (21.4%)
Staphylococcus epidermidis	4 (10%)	0	2 (3%)	1 (7.3%)
Enterococcus faecalis	2 (5%)	3 (4%)	9 (15%)	0
Mixed	5 (12.5)	6 (8%)	3 (5%)	0
Total positive culture	40 (100%)	79 (100%)	61 (100%)	14 (100%)

Table 3. Univariate analysis of bacteriuria associated with transurethral resection of prostate

Risk factor	Pre-TURP patients (n = 90)		Chi-squared test	
	Negative n = 50 (%)	Positive n = 40 (%)	χ^2	*P* value
Age, years				
< 65 y	20 (83%)	4 (17%)	8.93	0.005
≥ 65 y	36 (55%)	30 (45%)		
BMI				
< 24 kg/m^2	9 (22.5%)	31 (77.5%)	3.107	0.076
≥ 24 kg/m^2	12 (24%)	38 (76%)		
Prostate size, g				
< 60 g	26 (65%)	14 (35%)	4.54	0.019 S
≥ 60 g	27 (54%)	23 (46%)		
PSA level, ng/mL				
Mean (SD)	3.78 (2.25)	3.8 (1.85)	1.68	0.102
Range	0-5.9	0-6.8		
Urine analysis/culture				
No Bacteriuria	46 (78%)	13 (22%)	21.75	0.001 HS
Bacteriuria	10 (32%)	21 (68%)		
Diabetes mellitus				
No	50 (72%)	19 (28%)	4.66	0.025 S
Yes	10 (48%)	11 (52%)		
Cather insertion				
No	54 (73%)	20 (27%)	16.55	0.001 HS
Yes	4 (25%)	12 (75%)		
Antibiotic				
No	52 (68%)	24 (32%)	3.17	0.077
Yes	6 (43%)	8 (57%)		
Risk factor	Intra-TURP patients (n = 90)		Chi-squared test	
	Negative (n = 29)	Positive (n = 61)	χ^2	*P* value
Duration of procedure, min				
< 60 min	18 (78%)	5 (22%)	9.78	0.003 HS
≥60 min	39 (58%)	28 (42%)		
Irrigation fluid (distilled water), L				
Mean (SD)	16.66 (2.62)	19.89 (3.75)	1.4	0.199
Range	11–26	12–24		
Sterilization solution (CIDEX®), days				
Mean (SD)	6.12 (3.15)	5.72 (3.15)	–1.06	0.518
Range	1–14	1–12		
Urine analysis/culture				
No Bacteriuria	18 (90%)	2 (10%)	7.35	0.006 HS
Bacteriuria	40 (57%)	30 (43%)		
Risk factor	Post-TURP patients (n = 90)		Chi-squared test	
	Negative (n = 11)	Positive (n = 79)	χ^2	*P* value
Cather duration (days)				
No	35 (73%)	12 (26%)	5.7	0.019 S
Yes	23 (53%)	20 (47%)		
Urine analysis/culture (3$^{rd\ day}$)				
No Bacteriuria				
Bacteriuria	54 (73%)	20 (27%)	6.75	0.015 S
	7 (44%)	9 (56%)		

S, significant; HS, highly significant

Table 4. Multivariate analysis of bacteriuria associated with transurethral resection of prostate

Variable	Coefficient	Std. error	*P* value	Odd ratio	95% CI
Age	1.55	0.57	0.007 S	4.82	1.53 – 15.28
Prostate size	1.23	0.56	0.24 S	3.50	1.20 – 10.19
Preoperative urine culture	2.16	0.48	0.001 HS	8.47	3.26 – 21.95
Preoperative catheter	1.23	0.44	0.006 S	3.46	1.38 – 8.59
Prophylactic antibiotic	1.44	0.46	0.002 S	4.24	1.65 – 11.10
Diabetes mellitus	1.03	0.48	0.028 S	2.74	1.12 – 6.89
Duration of operation	2.06	0.79	0.007 S	7.71	1.67 – 35.38

S, significant; HS, highly significant

infection rate in 92 patients with BPH was 43.48%. These findings emphasize nosocomial acquired UTIs, these infections are not already present or incubating at the time of admission but are acquired during hospital stay[19–21]. Truzzi, et al.[22] observed a positive urine culture in 53 of 196 asymptomatic patients. The most common isolated uropathogenic was *Escherichia coli* (37.5%) pre-operatively and *Pseudomonas aeruginosa* for intra- and post-operatively by (44%) and (36%) respectively (Table 2), these results in consistent with Li et al., (2017)[14].

For the effect of preoperative risk factors on post-operative UTIs, our findings revealed no significant association with risk factors including age older than 65 years old, BMI, prostate size, PSA level, and prophylactic use of antibiotics before operation (Table 3). The age > 60 years was not a risk factor according to Bouassida et al., (2016)[19]. A study by Stangl-Kremser et al., (2019).[11] stated that BMI and preoperative PSA level are not predictive factors for the risk of developing UTIs. A study Edmond et al., (2023).[21] reported that the occurrence of complications, including bacteriuria, was not significantly related to prostate volume. Nevertheless, our findings come opposite to what was reported by Xu et al.[18] in regards to "age, volume of prostate, concomitant DM, preoperative prophylactic application of antibiotics, insertion catheterization preoperatively, operation duration, and indwelling catheter postoperative duration were the single factors affecting postoperative urine-derived pathogenic bacteria infection in BPH patients".

After assessing the possible intraoperative risk variables, we observed a statistically significant association between a lengthy surgical recovery and post-TURP bacteriuria (Table 3). Both the majority of research and the current investigation agree that a longer surgery (more than 60 minutes) is a significant risk factor for post-operative UTIs[13,18,21,25]. However, this has also been denied in another study Diagana et al., (2021).[23]. There was no significant association between post-TURP bacteriuria related to both irrigation duration and sterilization solution (Table 3), longer irrigation times have been linked to the development of bacteriuria, according to Pourmand et al., (2010)[24] report, which runs counter to our current findings. Osman et al.[13] correspond with our findings regarding the irrigation duration and the sterilization solution considering them as a non-risk factor for post-TURP bacteriuria. Regarding urine analysis, our results come in line with several studies (Stangl-Kremser et al., 2019; Osman et al., 2017; Bouassida et al., 2016; Al-Fatlawi and Jasim, 2022)[11,13, 19, 26].

Regarding post-operative catheter insertion with postoperative bacteriuria, this study finds a highly significant statistical association which concurs with (Zhu et al., 2021; Xu et al., 2024; Edmond et al., 2023)[17,18,21]. Meanwhile Osman et al., (2017).[13] contradicted this finding in that interval of the catheter post-operatively more than 3 days. The study's limitations include the need for a larger cohort study due to the numerous risk factors involved: the short patient follow-up period, the failure to evaluate persistent bacteriuria lasting longer than three weeks, the failure to assess the correlation between bacteriuria, symptoms, complications, and the lack of investigation into previous sexual activity or the family history of UTIs. In summary, pre-operative catheter use, history of DM, and pre-operative positive urine

analysis were independent risk factors for post-TURP UTI in this investigation, for the intra-operatively were: a long duration of operation and persistent bacteriuria, meanwhile, post-operative catheter insertion and post-operative persistent bacteriuria were the post-TURP UTI risk factors.

CONCLUSION

The study underscores the multifactorial nature of post-TURP UTIs and emphasizes the importance of comprehensive risk assessment and tailored preventive strategies to mitigate the risk of infection in BPH patients undergoing TURP particularly during the postoperative recovery phase. The shifting of microbial landscape underscores the importance of tailored antimicrobial strategies based on the procedural phase. These findings provide valuable insights for optimizing patient care and enhancing surgical outcomes in the urology clinic setting.

ACKNOWLEDGMENT

The authors would like to thank all the medical staff in Urology clinic, Al-Yarmouk Teaching Hospital, Baghdad for their cooperation, thanks are extended to all patients who agree to share their affliction through that difficult period.

Conflict of interest

The authors declare that they have no conflict of interests

Funding Sources

Self-funding

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