

Research Article

Bacteriological pattern of urinary tract infection in men with symptomatic benign prostatic hyperplasia at a tertiary hospital in Nigeria

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Abstract

Introduction/Background: Benign Prostatic Hyperplasia (BPH) is characterized by narrowing of the prostatic urethra with resultant difficulty in passing urine, stasis, and a predisposition to urinary tract infection. The objective of this study is to identify the prevalence of urinary tract infections, common organisms isolated, their antimicrobial sensitivity pattern, and the relationship of co-morbidities with urinary tract infection in this population.

Materials and methods: All patients who presented to our urology team with bladder outlet obstruction secondary to benign prostatic hyperplasia between January 2020 and January 2021 were included. Information on age, occupation, co-morbid conditions, urine microscopy, culture, and sensitivity patterns were obtained and analyzed using SPSS version 25. Midstream urine samples were collected from 172 BPH patients. Microscopy, culture, and antibiotic susceptibility tests were carried out.

Results: From our study, the prevalence of bacteriuria was 67.9% with the 65-74 and 45-54 age groups having the highest and the least prevalence of bacteriuria (88.9% and 33.3% respectively). The most common organisms cultured from their urine were Pseudomonas (17.9%), E. coli (14.3%), Coliforms (10.7%), and Klebsiella (10.7%). Sensitivity patterns of these microorganisms revealed the highest sensitivity to the fluoroquinolones (25.9%) followed by Nitrofurantoin (14.8%) and Ceftriaxone and Cefoxitin (7.4%). The least sensitivity was to Augmentin and Gentamycin.

Conclusion: Bacteriuria is common in patients with BPH. Pseudomonas spp was the commonest isolated organism in our study and most isolated organisms were susceptible to the fluoroquinolones.

Introduction

Benign prostatic hyperplasia (BPH) is characterized by progressive enlargement of the prostate [1]. It is a nonmalignant neoplastic process secondary to increased cellular growth and one of the most common causes of Lower Urinary Tract symptoms (LUTS) [2]. About half of the male population over the age of 50 can be diagnosed with histological BPH, and this prevalence increases with age to about 90% over the age of 80 [3].

As the lumen of the Prostatic urethra becomes compromised

by fibroadenomatous growth in the Periurethral region of the prostate, urine outflow is obstructed progressively resulting in incomplete bladder emptying causing stasis and may predispose patients to infection [4].

Bacterial presence in the Urine within its tract is known as bacteriuria and can result in a microbial invasion of the organs responsible for the manufacture (kidney), transport (ureters and urethra), and storage (bladder) of urine. Infection of the kidney is known as pyelonephritis.

Infection of the lower urinary tract that involves the bladder is called Cystitis while it is called urethritis when the urethra



is involved [4]. Urinary tract infection is one of the commonest infections encountered in our environment [5].

In a study done by Pourmand, et al. the incidence of bacteriuria following prostatectomy was 10.8% [6]. In a meta-analysis conducted by Qiang, et al, bacterial contamination was detected in 44% of the BPH prostatic specimens. They reported satisfactory results and reduced infection rate following preoperative antibiotic prophylaxis in TURP patients [7]. A Research done by Akobi, et al. showed a high incidence rate of 62.5% of UTIs among patients with an indwelling urinary catheter and diagnosed of benign prostate hyperplasia [8], while a study done by Agbugui, et al. noted bacteriuria in 44.7% of the patients [9].

UTIs occur when normal protective mechanisms fail. These mechanisms include: dislodging of bacteria during urination, high urea concentration in the urine, antibacterial secretions from the prostate, high urine osmolality and white blood cells [10].

According to Oni, et al. in their study on patients with the indwelling urinary catheter at Ibadan, Nigeria reported that the common agents of infections are Klebsiella species, Escherichia coli, Proteus species, and Staphylococcus aureus, in order of frequency [11]. Taiwo and Aderounmu reported that in Osogbo, Nigeria, Klebsiella specie is the commonest pathogen isolated with 46(36.6%), followed by Pseudomonas specie 34(27.8%), Escherichia coli 26(20.6%), Staphylococcus aureus 12(9.5%), Proteus mirabilis 4(3.2%), Candida albicans 4(3.2%) and coagulate negative staphylococcus 2(1.6%) [12]. Oshodi, et al reported that Proteus mirabilis is the leading cause of UTI among the subjects of the study closely followed by E. coli and Pseudomonas aeruginosa, while Akobi, et al demonstrated that Escherichia coli 247(67.7%) was the most prevalence uropathogen in North Central Nigeria [8].

The antimicrobial susceptibility pattern confirms that most of the urinary isolates in our environment are resistant to the commonly used antibiotics including cephalosporin and fluoroquinolones [12]. Akobi, et al observed that the most susceptible antimicrobial agent in their locality was Nitrofurantoin (61.9%) and Levofloxacin (44.1%). The bacterial agents of infection were noted to be resistant to ampicillin, cotrimoxazole, and nitrofurantoin commonly used for the patient with a urological problem, however, ceftazidime, ceftriazone, pefloxacin and ofloxacin showed good sensitivity against the bacteria [11].

Materials and methods

All patients who presented to our urology team with bladder outlet obstruction secondary to benign prostatic hyperplasia between January 2020 and January 2021 were included. Information on age, occupation, co-morbid conditions and urine microscopy, culture, and sensitivity patterns were obtained and analyzed using SPSS version 25. Midstream urine samples were collected from 172 BPH patients. Microscopy, culture and antibiotic susceptibility tests were carried out.

This study was carried out at the Federal Medical Center, Umuahia, Nigeria over a period of one year (January 2020 to Jan 2021). Approval was obtained from the ethical Review Committee of the Hospital. It was a single-center cross-sectional study. Patients who presented to our urology team with features suggestive of bladder outlet obstruction secondary to benign prostatic hyperplasia formed the study population.

- Inclusion criteriPatients presenting with lower urinary tract symptoms secondary to BPH.

Exclusion criteria

- Patients on steroid therapy
- Recent antibiotics use.

Methods

The minimum sample size was calculated using the Fisher's formula for a single sample prevalence cross-sectional study [13].

$$n = \frac{Z^2 p(1-p)}{e^2}, \text{ where: } n = \text{minimum sample size, } Z =$$

standard deviation at 99% confidence limit is equivalent to 2.576, P = Expected prevalence of UTI among BPH patients = 93% (estimated from the prevalence of UTI among BPH patients in Enugu) [14], e = level of precision desired = 0.05

$$n = \frac{Z^2 p(1-p)}{e^2} = (2.576)^2 \times 0.93(1-0.93)/0.05^2 = 172.8$$

Adjusting for a population size less than 10,000

Since the target population in this study is less than 10,000, we adjust the sample size

$$Nf = n / (1+n/N)$$

nf = desired sample size when population is less than 10,000;

n = the desired sample size when population is more than 10,000;

N = the estimate of the population size (300 BPH patients)

$$Nf = 173 / (1+100/300)$$

$$Nf = 173 / (1+0.333)$$

$$Nf = 173 / 1.333$$

$$Nf = 129.7 \text{ approximately } 130$$

To account for non-response (NR) of 20% due to the poor data quality of hospital-based record

$$N = \frac{n}{1-NR}$$

$$N = \frac{130}{0.8}$$

$$N = 162.5$$

Total minimum sample size of 163 participants.



Following informed consent, a proforma was opened for each patient, with information on occupation, co-morbid conditions, urine microscopy and culture and sensitivity patterns. Using purposive standard sampling technique, clean catch midstream urine samples were collected from non-catheterized patients and catheter specimens after clamping the catheter for 30 minutes from catheterized patients into a sterile universal container [15] and submitted for analysis within an hour of collection. The specimen were subjected to microscopy, culture and sensitivity. The centrifuged urine specimens were examined under a microscope for the presence of bacteria, white blood cells, red blood cells, casts, pus cells and crystals and recorded. The specimen using a standard wire loop of 4mm, on CLED, MacConkey and Blood agar and incubated at 37°C for 18 - 24 hours. Plates were examined for bacterial growth with growths of $\geq 10^5$ cfu/ml taken to be significant. The isolates were identified by colony morphology, Gram staining, motility testing and necessary biochemical tests [16]. Antibiotic susceptibility tests were carried out by adopting Kirby Bauer method and CLSI guidelines [17].

Data analysis

Data were presented in the form of tables, frequencies and percentages. Statistical analysis was done using SPSS version 25.

Results

From Table 1, the mean age of the 172 recruited BPH patients was 66.4 years (\pm 8.8) with 39.5% within the 65-74 year age category. Most were drivers or retired (21.4% each). Prevalence of bacteriuria was 67.9% with the 65-74 year and 45-54 year age group having the highest and the least prevalence of bacteriuria (88.9% and 33.3% respectively). 41.5% of patients had either suprapubic discomfort or pain on micturition Table 2.

Tables 3,4 shows that the most common organisms cultured from their urine were Pseudomonas (17.9%), E.coli (14.3%), Coliforms (10.7%) and Klebsiella (10.7%). Other organisms isolated include Staphylococcus aerus (7.1%), Proteus vulgaris (3.6%) and Actinobacter spp. (3.6%).

Table 1: Age and occupation of BPH patients.

	Variable	Frequency	Percent
Occupation	Driver	12	21.4
	Retired	12	21.4
	Civil Servant	8	14.3
	Clergy	8	14.3
	Farmer	4	7.1
	Legal Practitioner	4	7.1
	Police Officer	4	7.1
	Trader	4	7.1
	Total	56	100.0
	Age in Years	Mean	66.44
Median		68.00	
Mode		70	
Std. Deviation		8.795	
Minimum		48	
Maximum		83	

Table 2: Prevalence of bacteriuria.

Prevalence	Total	Age CAT			
		45 to 54 years	55 to 64 years	65 to 74 years	75 to 84 years
No Bacterial Growth	36 (32.1)	8 (66.7)	20 (55.6)	4 (11.1)	4 (14.3)
Bacteriuria prevalence	76 (67.9)	4 (33.3)	16 (44.4)	32 (88.9)	24 (85.7)
Total	112 (100.0)	12 (100.0)	36 (100.0)	36 (100.0)	28 (100.0)

Table 3: Urine Cultured Organisms by AGE.

		Age Category				Total
		45 TO 54 years	55 TO 64 years	65 TO 74 years	75 TO 84 years	
Urine Culture Organisms	No Bacterial Growth	8 (66.7)	20 (55.6)	4 (11.1)	4 (14.3)	36 (32.1)
	Pseudomonas sp	0 (0.0)	8 (22.2)	8 (22.2)	4 (14.3)	20 (17.9)
	E. coli	0 (0.0)	4 (11.1)	4 (11.1)	8 (28.6)	16 (14.3)
	Coliform	4 (33.3)	0 (0.0)	8 (22.2)	0 (0.0)	12 (10.7)
	Klebsiella sp	0 (0.0)	0 (0.0)	8 (22.2)	4 (14.3)	12 (10.7)
	Staph aerus	0 (0.0)	0 (0.0)	4 (11.1)	4 (14.3)	8 (7.1)
	Proteus vulgaris	0 (0.0)	4 (11.1)	0 (0.0)	0 (0.0)	4 (3.6)
	Actinobacter spp	0 (0.0)	0 (0.0)	0 (0.0)	4 (14.3)	4 (3.6)
Total		12 (100.0)	36 (100.0)	36 (100.0)	28 (100.0)	112 (100.0)

Table 4: Urine cultured organisms and their sensitivity pattern.

	Variables	Frequency	Percent
Urine Culture Organisms	No Bacterial Growth	36	32.1
	Pseudomonas sp	20	17.9
	E. coli	16	14.3
	Klebsiella sp	12	10.7
	Coliform	12	10.7
	Staph aerus	8	7.1
	Actinobacter spp	4	3.6
	Proteus vulgaris	4	3.6
	Total	112	100.0
	Urine Culture Sensitivity	Nil	40
Nitrofurantoin		16	14.8
Ofloxacin		12	11.1
Ciproflox		12	11.1
Ceftriaxone		8	7.4
Cefoxitin		8	7.4
Gentamycin		4	3.7
Augmentin		4	3.7
Levoflox		4	3.7
Total		108	100.0

Figure 1 shows that the patients at the lowest age group (45-54) had the least incidence of UTI followed by those in the 55 to 64 age group. Sensitivity patterns of these microorganisms revealed the highest sensitivity to the fluoroquinolones (25.9%) followed by Nitrofurantoin (14.8%), Ceftriaxone and Cefoxitin (7.4%). The least sensitivity was to Augmentin, Gentamycin. From Table 5,6, 20.9% (36 patients) had co-morbidities with p-value less than 0.05 which is statistically significant Tables 1-6, Figures 1-3.

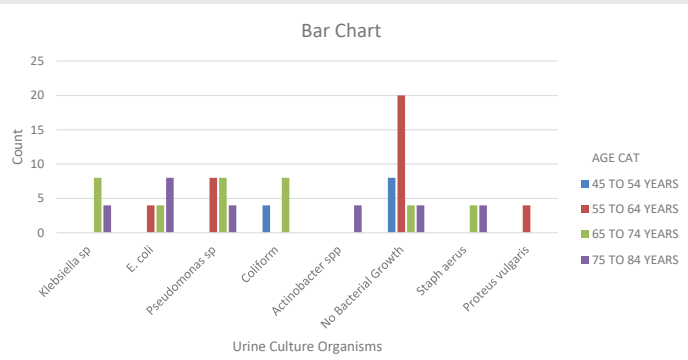


Figure 1: Distribution of Urinary Tract Infections by Age.

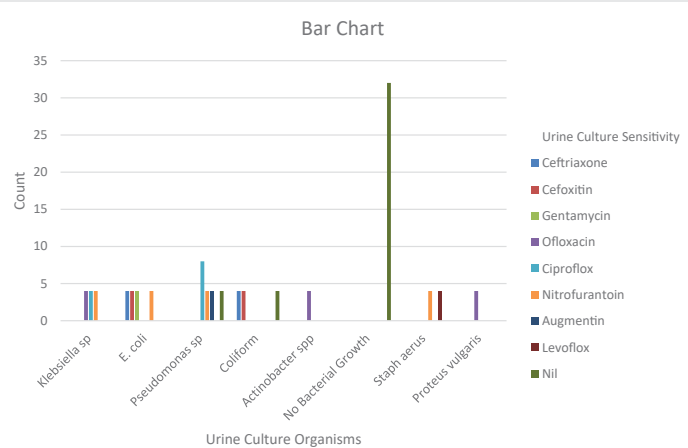


Figure 2: Relationship between the Cultured Organisms and the Different Antibiotics.

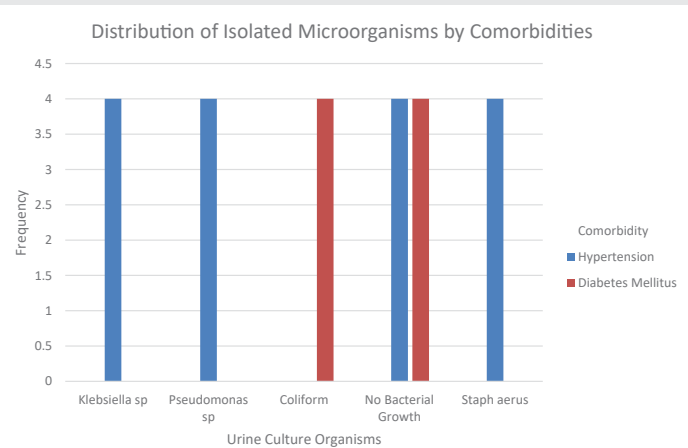


Figure 3: Distribution of Isolated Microorganisms by Comorbidities.

Discussion

Our study sought to define the urine bacteriology of patients with symptomatic BPH in our area. Bladder outlet obstruction due to BPH is a major cause of bacteriuria in aging males. This is as a result of increased bacterial colonization of the urinary tract due to stasis and incomplete bladder emptying as well as urethral catheterization in these category of patients.

The prevalence of bacteraemia was 67.9% in this study which is similar to a value of 62.8% in a study by Mishra PP, et al. [15] and 62.5% by Akobi OA, et al. [8].

Among the pathogens isolated, Pseudomonas (17.9%) had the highest percentage of occurrence, this was followed by E.coli (14.3%), Coliforms (10.7%) and Klebsiella (10.7%). Proteus Spp and actinobacter Spp with a percentage of 3.6%. In the studies by Mishra PP, et al. and Akobi, et al. the most common organism isolated was E. coli with a percentage of 31.81% and 67.7% respectively.

The incidence of UTI seems to be higher in the elderly (65 years and above) as seen in Table 2 probably as a result of worsening stasis in the elderly group. This is in agreement with a study done by Oshodi AJ, et al. and Mishra, et al. which showed a steady rise in the prevalence of UTI among BPH patients [4,15].

The most common organism cultured in our study is Pseudomonas (17.9%) and this is followed by E. coli (14.3%). In a study by Oni, et al. Klebsiella Spp (36%) was the most common organism isolated followed by Pseudomonas aeruginosa at 15.1%. A study by Oshodi, et al. put Pseudomonas Spp and E.coli as the second and 3rd predominant causes of UTI while a study by Agbugui e al had E.coli (47.6%) as the most common organism isolated [4,9,11].

Sensitivity patterns of these microorganisms revealed the highest sensitivity to the fluoroquinolones (25.9%) followed by Nitrofurantoin (14.8%). A study done by Agbugui, et al. [9] revealed a highest sensitivity to the Carbapenems followed by Nitrofurantoin while in the study done by Chedi, et al. [5] the pathogens showed highest sensitivity to the fluoroquinolones followed by cephalosporins.

Regarding co-morbidities, a significant number of patients in this study had co-morbidities. A number of previous studies

Table 5: Urine Cultured Organisms and their relationship in terms of sensitivity to the different antibiotics.

Urine Culture Organisms	Urine Culture Sensitivity									Total
	Ceftriaxone	Cefoxitin	Gentamycin	Ofloxacin	Ciproflox	Nitrofurantoin	Augmentin	Levoflox	Nil	
Proteus vulgaris	0 (0.0)	0 (0.0)	0	4 (100.0)	0	0	0	0	0	4 (100.0)
Staph aerus	0	0	0	0	0	4 (50.0)	0	4 (50.0)	0	8 (100.0)
Actinobacter spp	0	0	0	4 (100.0)	0	0	0	0	0	4 (100.0)
Coliform	4 (33.3)	4 (33.3)	0	0	0	0	0	0	4 (33.3)	12 (100.0)
Pseudomonas sp	0	0	0	0	8 (40.0)	4 (20.0)	4 (20.0)	0	4 (20.0)	20 (100.0)
E. coli	4 (25.0)	4 (25.0)	4 (25.0)	0	0	4 (25.0)	0	0	0	16 (100.0)
Klebsiella sp	0	0	0	4 (33.3)	4 (33.3)	4 (33.3)	0	0	0	12 (100.0)
Total	8 (7.4)	8 (7.4)	4 (3.7)	12 (11.1)	12 (11.1)	16 (14.8)	4 (3.7)	4 (3.7)	40 (37.0)	108 (100.0)

**Table 6:** Frequency of comorbidities.

	Variable	Frequency	Percent
Comorbidity	Hypertension	24	66.7
	Diabetes Mellitus	8	22.2
	Diabetes Mellitus + Hypertension	4	11.1
	Total	36	100.0

have demonstrated the association of lower urinary tract infections with co-morbidities [18,19].

Fluoroquinolones should therefore be a major consideration when thinking of the class of antibiotic to be used before culture result is out in our region. Broader studies are however needed to strengthen this submission.

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