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Lower Urinary Tract Infections among Patients Diagnosed of Benign Prostate Hyperplasia in Federal Medical Centre, Bida, North Central, Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author OAA designed the study, wrote the protocol and the first draft of the manuscript. Authors HEI, EGE, SOO, EOU, ROA and EFE managed the experimental process. Authors ECA and OVN, managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Objective: This study was aimed to identify the aetiology of bacteria associated with Benign Prostate Hyperplasia (BPH) and to determine the antimicrobial susceptibility pattern of the isolated organisms in the community.
Study Design: Data were obtained from Medical Microbiology Department register from February 2009 through December 2013, and was exempted from ethical approval. Urine samples were collected from a total of 536 patients with indwelling urinary catheter on hospital admissions that were clinically diagnosed of BPH. Subjects were between the ages of 41 and 100 years. Data was coded, computed and analyzed using SPSS version 16.0 and p values ≤0.05 was considered to be statistically significant.

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Results: Our research showed that the incidence of urinary tract infections in this study population was (62.5%), and statistically not significant (p- value = 0.296, mean age=5.13, mode=4.00 and S.D ±2.03). *Escherichia coli* 247(67.7%) was the most prevalent uropathogen followed by *Staphylococcus aureus* 34(9.3%), *Pseudomonas* species 29(7.9%), *Klebsiella* species 10(2.7%), *Proteus* species 10(2.7%), *Candida albicans* 4(1.1%) and *Staphylococcus albus* 1(0.3%) being the least isolates. The highest uropathogen was susceptible to Nitrofurantoin (61.9%) followed by Levofloxacin (44.1%) and least susceptible to Gentamycin (12.1%), Nalidixic acid (12.1%), Augmentin (7.7%) and Ampicillin (0.4%).

Conclusion: Our research showed high incidence rate of 62.5% of UTIs among patients with indwelling urinary catheter and diagnosed of benign prostate hyperplasia in our community. This is of serious concern to all stake holders in health industry.

Keywords: Benign prostate hyperplasia; susceptibility; lower urinary tract infection and uropathogen.

1. INTRODUCTION

Benign Prostatic Hyperplasia, a histologic diagnosis, is a condition that occurs with aging; the prevalence increases from 25% among men between 40 to 49 years of age to more than 80% among men 70 to 79 years of age [1]. More than 50% of men in their 60s to as many as 90% of octogenarians present with lower urinary tract symptoms [2]. Urinary Tract Infection (UTI) is an infection caused by the presence and growth of microorganisms anywhere in the urinary tract. It is perhaps the single most common bacterial infection of mankind [3]. Long term urethral catheterisation is a risk factor for urinary tract infections [4]. Urinary tract infection is a risk factor for subsequent development of prostatectomy surgical site infection [5]. The enlarged gland has been proposed to contribute to the lower urinary tract symptoms (LUTS) complex via at least two routes: (1) direct bladder outlet obstruction (BOO) from enlarged tissue (static component) and (2) from increased smooth muscle tone and resistance within the enlarged gland (dynamic component) [6]. The prevalence and the severity of LUTS in the aging male can be progressive, and is an important diagnosis in the healthcare of our patients and the welfare of society [7]. Many different pathogenic organisms have been observed to infect and induce an inflammatory response in the prostate. This include sexually transmitted organisms, such as *Neisseria gonorrhoeae* [8], *Chlamydia trachomatis* [9], *Trichomonas vaginalis* [10] and *Treponema pallidum* [11], and non-sexually transmitted bacteria such as *Propionibacterium acnes* [12] and those known to cause acute and chronic bacterial prostatitis, primarily Gram negative organisms such as *Escherichia coli.* [13] According to Oni et al. [14] in their study on patients with indwelling urinary catheter at Ibadan, Nigeria, reported that the common agents of infections are *Klebsiella* specie, *Escherichia coli*, *Proteus* specie *and Staphylococcus aureus*, in order of frequency.

Taiwo and Aderounmu [15] 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%).

This study was aimed to identify the aetiology of bacteria associated with benign prostate hyperplasia and to determine the antimicrobial susceptibility pattern of the isolated organisms in the community.

2. MATERIALS AND METHODS

2.1 Study Population

This research was a retrospective study carried out on February 2009 through December 2013 and was exempted from ethical approval. Urine samples were collected from a total of 536 patients with indwelling urinary catheter on hospital admissions that were clinically diagnosed of BPH at Federal Medical Centre, Bida, Niger State, Nigeria. Subjects were between the ages of 41 and 100 years. Inclusion criteria were patients clinically diagnosed of benign prostate hyperplasia.

2.2 Sample Collection

Five hundred and thirty six (536) mid-stream urine samples were collected from the patients into disposable sterile universal containers in the process of changing catheters. The samples

were transported to Medical Microbiology Laboratory of the hospital for analysis within 30 minute to 1 hour of sample collection.

2.3 Microscopy

The urine samples were mixed and aliquots centrifuged at 5000 rpm for 5 min. The deposits were examined using both x10 and x40 objectives. Samples with ≥10 white blood cells/mm3 were regarded as pyuria [16].

A volume of the urine samples were applied to a glass microscope slide, allowed to air dry, stained with gram stain, and examined microscopically [17].

2.4 Analysis, Characterization and Identification of Bacteria from Urine Samples

Urine specimen were cultured on Cystine Lactose Electrolyte Deficient (CLED) agar and Blood agar as described by Cheesbrough [18], specimen that yielded pure isolates of bacterial pathogens were included in this study. Presence of $>10^4$ colonies of a single pathogen per millilitre of urine is considered to be bacteriuria [18,19]. Isolated bacterial species were characterized by Gram stain followed by microscopy examination, motility test and biochemical tests, and identified according to standard bacteriological methods as highlighted by Omer and Fadil [20] and Cheesbrough [21]. Antimicrobial susceptibility test by disc diffusion methods according to clinical laboratory standard guidelines [21]. Susceptibility to antibiotics was measured by the method of Baker and Breach [22]. When the antibiotic agent was 16 mm or higher, it was recorded susceptible and resistance when less than 16 mm. The susceptibility plates were incubated aerobically for 18-24 hrs and zone of inhibition was recorded.

Data was coded, computed and analysed using SPSS version 16.0 and p values ≤0.05 was considered to be statistically significant.

3. RESULTS

Five hundred and thirty six (536) urine samples were examined in this research; microscopically there was presence of significant pus cells 326(57.6%), red blood cells 172(30.4%), *schistosoma haematobium* 1(0.2%), and yeast cell 12(2.1%) (Table 1).

Table 1. Microscopy examination of urine

Isolates	Number of positive samples (%)
Pus cells	326(57.6%)
Red blood cell	172(30.4%)
S. haematobium	1(0.2%)
Yeast cell	12(2.1%)
Bacteria cell	311(54.9%)

Table 2 showed incidence of urinary tract infections in relation to age distribution of subjects; out of (536) subjects examined 335(62.5%) had significant uropathogen and 201(37.5%) yielded no growth of organism.

Also, a higher percentage of uropathogen in this research was found within the age groups 90-100 years with 1(100%), followed by 81-85 years, 46-50 years, and 71-75 years with 10(76.9%), 30(76.9%) and 35(76.1%) respectively.

Table 3 showed occurrence of bacteria isolated in urinary tract infections among subjects and prevalence of the uropathogen in relation to age distribution. *Escherichia coli* 247(67.7%) was the most prevalence uropathogen followed by *Staphylococcus aureus* 34(9.3%), *Pseudomonas* species 29(7.9%), *Klebsiella* species 10(2.7%), *Proteus* species 10(2.7%), *Candida albicans* 4(1.1%) and *Staphylococcus albus* 1(0.3%) being the least isolates.

Furthermore, the highest uropathogen was found within the age groups of 56-60 years 75(22.4%) followed by 66-70 years 61(18.2%) and 61-65 years 60(17.9%) while 91-100 years 1(0.3%) had the least uropathogen.

Table 4 showed the antibiotics susceptibility pattern of the isolates. *Escherichia coli,* the highest uropathogen was susceptible to Nitrofurantoin (61.9%) followed by Levofloxacin (44.1%) and least susceptible to Gentamycin (12.1%), Nalidixic acid (12.1%), Augmentin (7.7%) and Ampicillin (0.4%).

Staphylococcus aureus second uropathogen was susceptible to Ofloxacin (58.8%), Nitrofurantoin (55.9%) and Levofloxacin (52.9%) but least susceptible to Gentamycin (8.8%), Nalidixic acid (5.9%) and Ampicillin (2.9%).

Klesiella species was susceptible to Ofloxacin and Nitrofurantoin both by (50%) while resistance to Ampicillin, Augmentin and Cefuroxime by

Table 2. Frequency of urinary tract infections in relation to age distribution of patients with benign prostate hyperplasia

Age interval	Number tested	% Positive	% Negative
41-45	21	11 (52.4)	10(47.6)
46-50	39	30(76.9)	9(23.1)
51-55	38	16(42.1)	22(57.9)
56-60	117	75(64.1)	42(35.9)
61-65	98	60(61.2)	38(38.8)
66-70	103	61(59.2)	42(40.8)
71-75	46	35(76.1)	11(23.9)
76-80	47	29(61.7)	18(38.3)
81- 85	13	10(76.9)	3(23.1)
86-90	13	7(53.8)	6(46.2)
91-100	1	1 (100)	0(0.0)
Total	**536**	**335(62.5)**	**201(37.5)**

(100%) respectively. *Pseudomonas* species was susceptible to Ceftriazone (37.9%), Levofloxacin and Ceftazidime both by (20.7%) but least susceptible to Ciprofloxacin (13.8%), Gentamycin (10.3%), Cefuroxime (7.0%) and Augmentin (6.9%).

Proteus species was susceptible to Levofloxacin (70%), Ceftazidime (60%) and Ceftriazone (50%) while least susceptible to Nalidixic acid and Gentamycin both (20%), Cefuroxime and Augmentin both by (10%). The least isolate *Staphylococcus albus* was susceptible to Ciprofloxacin, Ofloxacin, Levofloxacin and Nitrofurantoin all by (100%).

4. DISCUSSION

Out of 536 men clinically diagnosed of benign prostate hyperplasia with indwelling urinary catheter on admission within the age bracket of 41 and 100 years. Our research showed that the incidence of urinary tract infections in this study population was (62.5%), and statistically not significant (p- value = 0.296, mean age = 5.13, mode = 4.00 and S.D ±2.03). Our findings is lower than Gyasi-Sarpong et al. [23], who reported (76.6%) in Kumasi, Ghana, and Paryani et al. [24], reported (73.14%), among patients admitted in urology ward in Jamshoro, Pakistan with indwelling urinary catheter. Contrarily, our report is higher than Arul Prakasam et al. [25], who reported incidence of (17.1%) in Kerala, Indian, among catheterized patients, and Oshodi et al. [26], reported (33%) in Kwara State, Nigeria, among patients diagnosed of benign prostate hyperplasia. Griebling [27], stated that there is unique risk factors for the development of urinary tract infections among men, which include urinary stasis from bladder outlet obstruction (BOO) due to benign prostatic hyperplasia, instrumentation and catheterization.

In this research, microscopic examination of urine samples revealed presence of significant pus cell 326(57.6%), RBC 172(30.4%), *Schistosoma haematobium* 1(0.2%), Yeast cell 12(2.1%) and Bacteriuria 311(54.9%). This findings is in agreement with Fujita et al. [28], who reported white blood cell count and neutrophil count as positively associated with prostate enlargement and benign prostate hyperplasia (BPH). Also, Fujita et al. [29], stated that neutrophils are often found in glandular and periglandular areas, and also, Kramer et al. [30] said T-lymphoctes, B-lymphocyte, macrophages and mast cells are seen in stroma areas. Okani et al. [31], reported presence of schistosoma haematobium (3.8%) at autopsy in university college hospital Ibadan, Nigeria and Hennenfet et al. [32], reported presence of urinary yeast cell [23.3%]. Also, Taiwo and Aderounmu [15], reported presence of significant bacteriuria (88.5%) at Osogbo, Nigeria. Schaeffer et al. [33], said UTI is an inflammatory response of the urothelium to bacterial invasion that is usually associated with bacteriuria and pyuria.

Our study showed higher incidence of urinary tract infections (UTIs) between age groups of 56-60 years (22.4%), Followed by 66-70 years (18.2%) and 61-65 years (17.9%) while age groups 91-100 years (0.3%) and 86-90 years (2.1%) both had the least uropathogen. However, our report is higher than Oshodi et al. [26] who reported among age groups 50-59 yrs (11.8%) but similar to age groups 60-69 yrs (24.1%). The variation in age groups prevalence in these studies may be geographical factor and, or number of patients enrolled.

Table 3. Overall incidence of uropathogens against age distribution of patient with benign prostate hyperplasia

		Frequency (%)										
Isolates	**Number**	**41-45**	**46-50**	**51-55**	**56-60**	**61-65**	**66-70**	**71-75**	**76-80**	**81-85**	**86-90**	**91-100**
E. coli	247(67.7)	11(4.5)	22(8.9)	12(4.9)	57(23.1)	46(18.6)	36(14.6)	27(10.9)	21(8.5)	8(3.2)	6(2.4)	1(0.4)
Staph. aureus	34(9.3)	0(0)	2(5.9)	3(8.8)	12(35.3)	5(14.7)	4(11.8)	2(5.9)	5(14.7)	0(0)	1(2.9)	0(0)
Kleb. species	10(2.7)	0(0)	2(20.0)	0(0)	1(10.0)	3(30.0)	3(30.0)	0(0)	0(0)	1(10.0)	0(0)	0(0)
Pseudo. specie	29(7.9)	0(0)	3(10.3)	0(0)	2(6.9)	4(13.8)	12(41.4)	5(17.2)	2(6.9)	1(3.4)	0(0)	0(0)
Proteus species	10(2.7)	0(0)	1(10.0)	0(0)	2(20.0)	2(20.0)	4(40.0)	0(0)	1(10.0)	0(0)	0(0)	0(0)
Staph. albus	1(0.3)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1(100)	0(0)	0(0)	0(0)	0(0)
C. albicans	4(1.1)	0(0)	0(0)	1(25.0)	1(25.0)	0(0)	2(50.0)	0(0)	0(0)	0(0)	0(0)	0(0)
Total	335(100)	11(3.3)	30(9.0)	16(4.8)	75(22.4)	60(17.9)	61(18.2)	35(10.4)	29(8.7)	10(3.0)	7(2.1)	1(0.3)

P-Value = 0.296 (Not significant); E. coli = Escherichia coli; Staph. aureus = Staphylococcus aureus Kleb. species = Klebsiella species; Pseudo. species = Pseudomonas species, Staphylococcus albus; C. albicans = Candida albicans

Table 4. Antimicrobial susceptibility pattern of isolated organism from benign prostate hyperplasia

	Frequency (%)					
Antibiotics	***E. coli* (N=247)**	***Staph. aureus* (N=34)**	***Kleb.* specie (N=10)**	***Pseudo.* specie (N=29)**	***Proteus* specie (N=10)**	***Staph. albus* (N=1)**
AMPICILLIN	1(0.4)	1(2.9)	0(0)	NA	0(0)	0(0)
AUGMENTIN	19(7.7)	7(21.0)	0(0)	2(6.9)	1(10.0)	0(0)
GENTAMYCIN	30(12.1)	3(8.8)	1(10.0)	3(10.3)	2(20.0)	0(0)
CIPROFLOXACIN	56(22.7)	11(32.4)	3(30.0)	5(13.8)	4(40.0)	1(100)
OFLOXACIN	58(23.5)	20(58.8)	5(50.0)	3(10.3)	3(30.0)	1(100)
CEFUROXIME	18(7.3)	0(0)	0(0)	2(7.0)	1(10.0)	0(0)
LEVOFLOXACIN	109(44.1)	18(52.9)	4(40.0)	6(20.7)	7(70.0)	1(100)
NITROFURANTOIN	153(61.9)	19(55.9)	5(50.0)	NA	4(40.0)	1(100)
NALIDIXIC ACID	30(12.1)	2(5.9)	0(0)	NA	2(20.0)	0(0)
CEFTRIAZONE	74(30.0)	12(35.3)	2(20.0)	11(37.9)	5(50.0)	0(0)
CEFTAZIDIME	61(24.7)	6(17.6)	1(10.0)	6(20.7)	6(60.0)	0(0)

NA = Not applicable; E .coli = Escherichia coli; Staph. aureus = Staphylococcus aureus; Kleb. species = Klebsiella species; Pseudo. species = Pseudomonas species; Staph. albus = Staphylococcus albus

According to Hidron et al. [34], stated that even distribution of organisms among various age groups and occupations suggest that age and occupation were not predetermining factor for UTIs especially in patient with lower urinary tract obstruction (LUTO).

The highest uropathogen isolates in this study population was *Escherichia coli* (67.7%). Our report is in agreement with other studies where *Escherichia coli* was reported as major uropathogen in BPH [23,25,35]. However, our report contradict Taiwo and Aderounmu [15], and Adegoke et al. [36] who reported *Klebsiella* species as the major uropathogen. Other isolated pathogens are as follows; *Staphylococcus aureus* 34(9.3%), *Pseudomonas* species 29(7.9%), *Klebsiella* species 10(2.7%), *Proteus* species 10(2.7%), *Candida albicans* 4(1.1%) and *Staphylococcus albus* 1(0.3%).

Pelouze [8], stated that many different pathogenic organisms have been observed to infect and induce an inflammatory response in the prostrate. This include sexually transmitted organisms, such as *Neisseria gonorrhoeae* [7], *Chlamydia trachomatis* [8], *Trichomonas vaginalis* [9] and *Treponema pallidum* [10], and non-sexually transmitted bacteria such as *Propionibacterium acnes* [11] and those known to cause acute and chronic bacterial prostatitis, primarily Gram negative organisms such as *Escherichia coli* [12].

The antimicrobial susceptibility showed that *Escherichia coli* was susceptible to Nitrofurantoin (61.9%) and Levofloxacin (44.1%). In contrast *Escherichia coli* showed resistance to Ciprofloxacin (77.3%) and Ofloxacin (76.5%), however, least susceptible to Gentamycin and Nalidixic acid by (12.1%), and Augmentin (7.7%).

Also, it was observed that Nitrofurantoin and Levofloxacin were both susceptible to most of the uropathogen isolated in this research. This is in agreement with Sundvall et al. [37], who reported Nitrofurantoin (100%) susceptible against *Escherichia coli* isolated from patient with indwelling urinary catheter in nursing home resident in Sweden. Also, Bean et al. [38], reported Nitrofurantoin (94%) susceptible among clinical isolates from patients with community and nosocomial infection in London. However, Oshodi et al. [26], reported Nitrofurantoin (19.4%) susceptible among patient diagnosed of benign prostrate hyperplasia and Olaboopo et al. [39], reported susceptibility rate of Nitrofurantoin (20%) to *Escherichia coli* isolated from patient with indwelling urinary catheter at Abeokuta, Nigeria., and Taiwo and Aderounmu [15], reported Nitrofurantoin (38.5%) susceptible to *Escherichia coli* isolated from catheter associated urinary tract infection at Osogbo, Nigeria. Gupta et al. [40], stated that Nitrofurantoin is currently recommended as a frontline agent for the treatment of community acquired cystitis. Also, Schito et al. [41] and Zhanel et al. [42], says according to the findings of NAUTICA and ARESC studies of community acquired UTIs, found only 1.1% and 1.6% of urinary pathogenic *Escherichia coli* isolates resistance to Nitrofurantoin respectively.

Furthermore, Gupta et al. [40] and Hooton et al. [43], stated that fluoroquinolones such as Ciprofloxacin and Levofloxacin target bacterial DNA replication. Therefore, they are currently recommended for use as a frontline therapy for nosocomial UTIs.

5. CONCLUSION

Our research showed high incidence rate of 62.5% of UTIs among patients with indwelling urinary catheter diagnosed of benign prostate hyperplasia in our community. This is of serious concern to all stake holders in health industry. Also, we observed age groups 56-60 years with the highest uropathogen 75(22.4%) and *Escherichia coli* 247(67.7%) as the most prevalence uropathogen in this locality.

We observed that the most susceptible antimicrobial agent in this locality is Nitrofurantoin (61.9%) and Levofloxacin (44.1%).

6. RECOMMENDATION

Authors therefore, recommend educating our patients on importance of prompt report to the hospital in cases of signs of infection and proper hygiene to reduce community acquired nosocomial infection.

Also, health providers should reduce the cost of health services to encourage patient patronage.

CONSENT

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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