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Antimicrobial Resistance Profile of Urinary Isolates from Patients with Indwelling Urinary Catheter Diagnosed of Benign Prostate Hyperplasia in Bida, Niger State, 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 wrote the first draft of the manuscript. Authors HEI, EGE, SOO and EOU performed the analysis of the samples and proof reading. Authors ECA, ROA, EFE, OVN and YAA managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Antimicrobial resistance is increasing daily and a cause of major challenges in many countries. Indiscriminate antibiotic prescription is associated to a higher prevalence of antibiotic resistant bacteria. The incidence of antimicrobial resistance among urinary pathogens is also increasing and its treatment has become more complicated due to increasing resistance.
Aims: The present study investigated the pattern of uropathogens and their antimicrobial resistance pattern among the clinical isolates to commercially available antibiotics that are often prescribed

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in UTI treatment.
Materials and Methods: The research was a retrospective study carried out on January 2009 through November 2013 and was exempted from ethical approval. Three hundred and thirty one (331) bacterial pathogens were selected for this study as isolated at the Medical Microbiology Laboratory, Federal Medical Centre, Bida, Niger State.
Data was coded, computed and analyzed using SPSS version 16.0.
Results: Out of (331) isolates, the most prevalent isolate is *Escherichia coli* 247(74.6%) followed by *Staphylococcus aureus* 34(10.3%), *Pseudomonas aeruginosa* 29(8.8%), *Klebsiella* species 10(3.0%), *Proteus* species 10(3.0%) and least uropathogen *Staphylococcus albus* 1(0.3%). Mean resistance of isolated uropathogen to Augmentin (94.0%), followed by Ampicillin (93.4%), Gentamycin (90.0%), while least resistance are Nitrofurantoin (36.3%) and Levofloxacin (56.2%).
Conclusion: It is quite alarming to note that almost all of the isolates included in this study were found resistant to multiple drugs (four or more antibiotics).

Keywords: Benign prostrate hyperplasia; urinary tract infection and antimicrobial.

1. INTRODUCTION

Antimicrobial resistance is increasing daily and a cause of major challenges in many countries [1]. Indiscriminate antibiotics prescription is related to a higher prevalence of antibiotic resistant bacteria [2-3]. The elderly are prescribed antibiotics more frequently than younger adults [4]. Increasing antimicrobial resistance in bacterial pathogens is a worldwide concern. The prevalence of antimicrobial resistance among urinary tract infections (UTI) agents is also increasing [5] and its treatment has become more complicated due to increasing resistance and empirical therapy leading to treatment failures mostly associated with gram-negative bacteria [6].

In the UK, nitrofurantoin is always recommended for treatment of uncomplicated cystitis in the community [7], and parenteral cephalosporins and aminoglycosides are reserved for complicated infections or pyelonephritis. The emergence of extended spectrum β-lactamases (ESBLs) producing strains, and others exhibiting quinolone resistance threatens the use of both cephalosporins and ciprofloxacin seriously limiting treatment regimens [8].

Fluoroquinolones such as ciprofloxacin are used increasingly [9], but resistance to ciprofloxacin is also increasing [10]. The resistance rate to ciprofloxacin (6.8%) is alarming, as ciprofloxacin is now the most commonly prescribed therapy for UTIs [11]. Resistance rates to antibiotics vary geographically, [12]; In British Columbia, there is a well-documented trend of increasing ciprofloxacin resistance in uropathogens, with the rate of resistance increasing from 2.5% in 1998 to over 20% in 2007; this correlates with the increased use of fluoroquinolone antibiotics [13]. Treatment of a UTI with an antibiotic to which the organism is resistant results in high rates of microbiology and clinical failure which leads to additional morbidity and costs [14]. These studies investigated the pattern of urinary pathogens and their antimicrobial resistance pattern among the urinary isolates to commercially available antibiotics that usually prescribed in UTIs treatment.

2. MATERIALS AND METHODS

2.1 Study Population

The research was a retrospective study carried out in January 2009 through November 2013 and was exempted from ethical approval.

2.2 Selection of Isolates

Three hundred and thirty one (331) bacterial pathogens were selected for this study as isolated at the Medical Microbiology Department of Federal Medical Centre, Bida, Niger State.

The agar diffusion method as described by Baur et al. [15] was used. Discrete colonies was inoculated into 5 ml of sterile nutrient broth and incubated at 37℃ over night. The broth culture was then diluted 1:10 with a freshly prepared nutrient broth to give a count of approximately 10^4 colonies per millimetre. A sterile cotton wool was allowed to soak in the broth culture, squeezed by the side of the bottle before streaking over the sensitivity plates and incubated at 37℃ for 18 -24 hrs. Interpretation of results was done using the zone of inhibition sizes. Zones of inhibition of > 13 mm were considered sensitive and < 13 mm resistant [15].

Nitrofurantoin (50 mcg), Nalidixic acid (300 mcg), Ampicillin (10 mcg), Augmentin (30 mcg), Gentamycin (10 mcg), Ciprofloxacin (5 mcg), Ofloxacin (5 mcg), Cefuroxime (30 mcg), Levofloxacin (5 mcg), Ceftriazone (30 mcg) and Ceftazidime (30 mcg) antimicrobial discs were used.

SPSS version 16.0 was used for statistical analysis.

3. RESULTS

In Table 1, out of (331) isolates, the most prevalent isolate is *Escherichia coli* 247(74.6%) followed by *Staphylococcus aureus* 34(10.3%), *Pseudomonas aeruginosa* 29(8.8%), *Klebsiella* species 10(3.0%), *Proteus* species 10(3.0%) and least isolated uropathogen *Staphylococcus albus* 1(0.3%).

Table 1. Frequency of uropathogens isolated from patient with indwelling urinary catheter and diagnose of benign prostate hyperplasia

Isolated organism	No of occurence (%)
Escherichia coli	247(74.6)
Staphylococcus aureus	34(10.3)
Klebsiella species	10(3.0)
Pseudomonas aeruginosa.	29(8.8)
Proteus species	10(3.0)
Staphylococcus albus	1(0.3)
Total	331 (100)

Table 2, showed the antimicrobial resistance pattern of isolated organisms. Results showed mean resistance of isolated uropathogen to Augmentin (94.0%), followed by Ampicillin (93.4%), Gentamycin (90.0%) while the antibiotics of low mean resistance are Levofloxacin (56.2%) and Nitrofurantoin (36.3%).

Escherichia coli the most prevalent uropathogen was resistant to Ampicillin (99.6%) followed by Augmentin (92.3%), Cefuroxime (92.7%), Gentamycin (87.9%) and least resistance to Levofloxacin (55.9%) and Nitrofurantoin (38.1%).

The second uropathogen, *Staphylococcus aureus* was resistant to Cefuroxime (100%), followed by Ampicillin (97.1%), Nalidixic acid (94.1%), Gentamycin (91.2%), and least resistance to Nitrofurantoin (44.1%) and Ofloxacin (41.2%). *Klebsiella* species was resistant to Ampicillin, Augmentin, Cefuroxime, and Nalidixic acid all by (100%) while resistance to Ofloxacin and Nitrofurantoin both by (50%).

Pseudomonas aeruginosa was resistant to Augmentin (93.1%), Cefuroxime (93.1%), Gentamycin and Ofloxacin both by (89.7%) while least resistance to Ceftriazone (62.1%).

Proteus species was resistant to Ampicillin (100%), Augmentin (90%), Gentamycin and Nalidixic acid both by (80%) but least resistance to Levofloxacin (30%) and Ceftazidime (40%).

Staphylococcus albus was resistant to Ampicillin, Augmentin, Gentamycin, Cefuroxime, Nalidixic acid, Ceftriazone and Ceftazidime all by (100%).

4. DISCUSSION

Antibiotic resistance is a serious clinical problem in treating infections caused by microorganisms. The resistance rate to common antimicrobial agents has increased over the years [16]. Resistance rates to antimicrobial agents vary geographically, [12]; Overall, clinical isolates from Latin American countries show high resistance rates to all antimicrobial agents followed by Asian-Pacific isolates and strains from European countries; while the strains from Canada exhibit the least resistance pattern [16].

Our research showed overall resistance pattern of uropathogens to Ampicilin (93.4%), Augmentin (94.0%) and the lowest resistance Nitrofurantoin (36.3%). This report is lower than Taiwo and Aderounmu, [17] who reported resistance to Ampicilin (100%). However, our report is higher than Olaboopo et al. [18], who reported resistance to Ampicilin (84.2%) and Bean et al, [19] reported resistance to Ampicilin (63.6%) and Augmentin (20.8%) among men with antimicrobial resistant *Escherichia coli* in community and nosocomial urinary tract infection in London. Also, our report on Nitrofurantoin is lower than Taiwo and Aderounmu, [17] and Olaboopo et al. [18] both reported resistance rate of Nitrofurantoin (67.3%) and (84.2%) respectively, while our report is higher than Bean et al. [19] who reported resistance rate of Nitrofurantoin (8.6%). It is a fact that antibiotics are inappropriately used in Africa resulting to antibiotic resistance. This situation impinges on the quality of patient care through its associated morbidity, mortality and significant economy burdens on our patients [20]. The emergence of antimicrobial resistance is primarily due to excessive and often unnecessary use of antibiotics in humans [21].

Table 2. Antimicrobial resistance pattern of isolated organism from benign prostate hyperplasia frequency (%)

Antibiotics	***E. coli*** **(N=247)**	***Staph. aureus*** **(N=34)**	***Kleb.*** **specie (N=10)**	***Pseudo. aeruginosa*****. (N=29)**	***Proteus*** **specie (N=10)**	***Staph. albus*** **(N=1)**	**Mean resistance**
Ampicillin	246(99.6)	33(97.1)	10(100)	NA	10(100)	1(100)	309(93.4)
Augmentin	228(92.3)	27(79.4)	10(100)	27(93.1)	9(90.0)	1(100)	311(94.0)
Gentamycin	214(87.9)	31(91.2)	9(90.0)	26(89.7)	8(80.0)	1(100)	298(90.0)
Ciprofloxacin	191(77.3)	23(67.6)	7(70.0)	24(82.8)	6(60.0)	0(0)	251(75.8)
Ofloxacin	189(76.5)	14(41.2)	5(50.0)	26(89.7)	7(70.0)	0(0)	241(72.8)
Cefuroxime	229(92.7)	10(100)	10(100)	27(93.1)	9(90.0)	1(100)	286(86.4)
Levofloxacin	138(55.9)	16(47.1)	6(60.0)	23(79.3)	3(30.0)	0(0)	186(56.2)
Nitrofurantoin	94(38.1)	15(44.1)	5(50.0)	NA	6(60.0)	0(0)	120(36.3)
Nalidixic acid	217(87.9)	32(94.1)	10(100)	NA	8(80.0)	1(100)	268(81.0)
Ceftriazone	173(70.0)	22(64.7)	8(80.0)	18(62.1)	5(50.0)	1(100)	227(68.6)
Ceftazidime	186(75.3)	28(82.4)	9(90.0)	23(79.3)	4(40.0)	1(100)	251(75.8)

Mean Resistance = Sum of resistance of individual organisms/total no of organisms.
NA = Not applicable
E .coli = Escherichia coli
Staph. aureus = Staphylococcus aureus
Kleb. species = Klebsiella species
Pseudo. aeruginosa- Pseudomonas aeruginosa
Staph. albus = Staphylococcus albus.

Our research showed that *Escherichia coli* the highest uropathogen exhibited resistance rate of Ampicilin (99.6%) followed by Augmentin (92.3%) and least resistance to Nitrofurantoin (38.1%). Our report is lower than Taiwo and Aderounmu [17] who reported resistance rate of Nitrofurantoin (61.5%) among catheter associated urinary tract infections, Olaboopo et al. [18] reported resistance rate of Nitrofurantoin (80%), Oshodi et al. [22] reported resistance rate of Nitrofurantoin (80.6%) among patient with benign prostate hyperplasia. However, our report is higher than Sundvall et al. [23] who reported resistance rate of Ampicilin (46%) and Nitrofurantoin (0%) among *Escherichia coli* isolated from urinary catheter and Erique et al. [24] reported resistance to Augmentin (16.5%). Taiwo and Aderounmu [17] reported resistance rate of Ampicilin (100%) and Olaboopo et al. [18] reported resistance to Ampicilin (97.1%) among patient with indwelling urinary catheter at Abeokuta, south west, Nigeria both of which are similar to our report.

The second uropathogen *Staphylococcus aureus* showed high resistance to cephalosporin such as Cefuroxime (100%), Ceftazidime (82.4%) and Ceftriazone (64.7%), and fluoroquinolone such as Nalidixic acid (94.1%), Ciprofloxacin (67.6%), Levofloxacin (47.1%), Ofloxacin (41.2%). Also, resistance to aminoglycoside; Gentamycin (91.2%), and Nitrofurantoin (44.1%), Penicillin such as Ampicilin (97.1%) and Augmentin (79.4%). This report is similar to Taiwo and Aderounmu [17] who reported resistance rate of *Staphylococcus aureus* to Penicillin (100%), Getenet and Wondewosen [25] reported Ampicilin (100%) and Nalidixic acid (100%). Also, Al-Jebouri et al. [26] reported Ampicilin (100%) and Nalidixic acid (100%), Devanand et al. [27] reported Nalidixic acid (100%). However our report is higher than Taiwo and Aderounmu [17] who reported Cefuroxime (66.7%), Al-Jebouri et al. [26] reported Gentamycin and Levofloxacin both (10%), Ciprofloxacin (40%). Devanand et al. [27] reported Ofloxacin (13.3%), Levofloxacin (26.7%), Nitrofurantoin (6.7%). Contrarily, our report is lower than Al-Jebouri et al. [26] who reported resistance to Nitrofurantoin (55%).

Also, *Klebsiella* species showed high resistance to Ampicilin, Augmentin, Cefuroxime, Nalidixic acid all by (100%) and least resistance to Ofloxacin and Nitrofurantoin by (50%). Our report is similar to Oni et al. [28], Olaboopo et al. [18], Rahman et al. [29] all reported resistance to Ampicilin (100%), and Kazi et al. [30] reported Ampicilin and Cefuroxime (100%). Contrarily, our report is higher than Taiwo and Aderounmu [17], who reported Nalidixic acid (78.3%) and Cefuroxime (69.6%).

Oni et al. [28], reported Nitrofurantoin (33.3%), Ofloxacin (0%) and Nalidixic acid (46%), Rahman et al. [29], reported Cefuroxime (53.9%) and Nalidixic acid (61.5%), and Getenet et al. [25] reported Augmentin (15.1%), Cefuroxime (12.5%) and Nalidixic acid (25.1%).

Pseudomonas aeruginosa showed resistance to Augmentin and Cefuroxime both by (93.1%), Gentamycin and Ofloxacin (89.7%), and least resistance Ceftriazone (62.1%). This report is higher than Oni et al. [28] who reported Gentamycin (66.7%) and Ofloxacin (0%), Devanand et al. [27] reported Ofloxacin (15%), Gentamycin (10%), Rahman et al. [29] reported Gentamycin (48.7%), Cefuroxime (69.3%) and Ceftriazone (48.7%). However, our report is similar to Kazi et al. [30] who reported Cefuroxime (100%), Taiwo and Aderounmu [17] reported Gentamycin (94.1%) and Cefuroxime (94.1%) and Olaboopo et al. [18] reported Gentamycin (95%). Nevertheless, our report is lower than Devanand et al. [27] who reported resistance rate of Ceftriazone (95%) and Oni et al. [28] also reported Ceftriazone (75%) resistance.

In this research, Proteus species showed resistance rate of Ampicilin (100%), Augmentin and Cefuroxime both (90%) while Ceftriazone (50%), Ceftazidime (40%) and least resistance Levofloxacin (30%). This report is similar to Oni et al. [28], Olaboopo et al. [18] and Getenet et al. [25] all reported resistance rate of Ampicilin (100%).

However, our report is higher than Oni et al. [29] who reported Ceftazidime (11%), Rahman et al. [29] reported Ceftazidime (27.5%), Ceftriazone (10.8%), and Ampicilin (84.2%). Our report is lower than Al-Jebouri et al. [26] who reported Levofloxacin (50%) and Oni et al. [28] reported Ceftriazone (66.7%) resistance rate to Proteus species.

Staphylococcus albus showed high resistance to Ampicillin, Augmentin, Gentamycin, Cefuroxime, Nalidixic acid, Ceftriazone and Ceftazidime all by (100%). Our report is similar to Olaboopo et al. [18] who reported resistance of *Staphylococcus epidermidis* to Gentamycin (100%), Al-Jebouri

et al. [26] reported resistance of *Staphylococcus saprophyticus* against Ampicilin and Nalidixic acid both (100%). Contrarily, our report is higher than Getenet et al. [25] who reported resistance to *Staphylococcus saprophyticus* against Ampicilin (66.7%). Al-Jebouri et al. [26] reported resistance to *Staphylococcus saprophyticus* against Gentamycin (5%) and Nitrofurantoin (56%). We observed in our research that isolated uropathogens are resistance to three to four classes of antimicrobial agents such as Nitrofurantoin, Cephalosporin, Fluoroquinolones, Aminoglycoside and Penicillin group.

The high incidence of multi drug resistance to uropathogen in these studies might be as a result of extended spectrum beta lactamase (ESBLs) but there was no proven research work to this in our locality. According to Patel et al. [31] who stated that the increase resistance of uropathogens to conventional antibiotics can however largely be attributed to plasmid mediated by lactamase producing bacteria. Also, Kazi et al. [30] stated that increase in the antibiotic resistance amongst the uropathogens indicates that they are hospital acquired and thus difficult to treat. This will be more dangerous if infection prevention practices are not followed during care of the catheterized patients. The chances of transmission of these multi drug resistant are high if health care workers do not follow preventive practices meticulously.

5. CONCLUSION

It is alarming to observe that almost all of the isolates included in this study were resistance to multiple drugs. Antibiotic resistance has emerged as a major clinical problem in the management of hospitalized patients as well as those with chronic conditions, and adds considerably to health care cost in developing countries such as Nigeria. It is considered a threat to public health problem worldwide. This important issue need to be addressed urgently by policy makers to formulate a strict antibiotics prescription policy in our country, which will bring awareness to all stakeholders and care giver to make a judicious use of antibiotics.

CONSENT

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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