Afr. J. Med. med. Sci. (2011) 40, 235-238

Antibiotic resistance pattern of uropathogenic *Escherichia coli* in South West Nigeria.

AO Okesola and TI Aroundegbe

Department of Medical Microbiology and Parasitology, College of Medicine, University of Ibadan, University College Hospital, Ibadan, Nigeria

Summary

Background: Various studies have indicated *Escherichia coli* to be the most prevalent pathogen isolated in urine specimens.

Objectives: This study was therefore conducted to find out whether the same holds in this environment. The study will also determine the resistance pattern of uropathogenic *Escherichia coli* isolates to available antibiotics.

Methods: Two hundred consecutive urine samples collected from patients with clinical diagnosis of urinary tract infections (UTI) and which have significant bacteriuria were included in this study. These were analysed using standard bacteriological techniques. *Escherichia coli* isolated from the urine specimens were subjected to antibiotic susceptibility testing because many cases of resistance to commonly available antibiotics here have been encountered in the course of management of patients with UTI.

Results: Klebsiella species (40%) were found to be the most prevalent uropathogen in this environment, followed by *E.coli* (25%),*Staphylococcus aureus* (25%), Proteus species (4%), *Pseudomonas aeruginosa* (2.5%),and *Enterococcus faecalis* (3.5%). Resistance of *E.coli* to antibiotics commonly used in our environment for UTI, namely, amoxicillin/ clavulanate, cotrimoxazole and amoxicillin were 100% each. Resistance rates to other antibiotics such as ofloxacin, gentamycin, nalidixic acid and tetracycline were 70%, 92%, 96% and 88% respectively.

Conclusion: The high antibiotic resistance rates recorded in this study therefore calls for urgent review of existing and implementation of effective antibiotic policy in this community.

Keywords: *Escherichia coli, uropathogenic, antibiotic, resistance*

Résumé

Des études ont indiquées les *Escherichia coli étant les plus prévalent* pathogènes isolés des échantillons des urines. Cette étude était ainsi conduit pour découvrir si ces résultats sont les mêmes dans cet environnement. L'étude permettra de déterminer la fréquence de résistance des isolats uropathogenique. *Escherichia coli* aux antibiotiques disponibles. Deux cent échantillons d'urine consécutive collectés des patients avec un diagnostic Clinique des infections des voies urinaires (IVU) et avec une bactériurie significative étaient inclus dans cette étude. Ces échantillons étaient analyses en utilisant la technique standard bactériologique. Les *Escherichia coli* isolés des échantillons d'urine étaient soumisse au test de susceptibilité d'antibiotiques parce que plusieurs cas de résistance aux antibiotiques disponibles ont été documentés au cours des soins des patients ayant des infections des voies urinaires. Les espèces Klebsielle (40%) étaient observés étant le plus prévalent uropathogene dans cet environnement, suivi des *E. coli* (25%), *Staphylocoque aureus* (25%), espèces Proteus (4%), *Pseudomone aeruginose* (2.5%) et *Entérocoque fécales* (3.5%). La résistance des *E. coli* aux antibiotiques couramment utilisés dans notre environnement contre les infections urinaires notamment, amoxicilline/acide clavulanique, cotrimoxazole et amoxicilline étaient de 100% chacun. Les taux de résistance a d'autres antibiotiques tels que l' ofloxacine, la gentamycine, l'acide nalidixique et la tétracycline étaient 70%, 92%, 96% et 88% respectivement. Les taux élevés de résistance enregistrés dans cette étude nécessite un urgent revu des antibiotiques existant et de la politique des antibiotiques effective dans cette communauté.

Introduction

Various studies have shown *Escherichia coli* to be the most frequently isolated urinary pathogen accounting for most community (up to 95%) and hospital-acquired (50%) infections[1-4]. However, routine testing by medical microbiology laboratories have indicated growing resistance to several antibiotics by *E.coli* from urinary tract[5]. Moreover, uropathogens generally have shown a slow but steady increase in resistance to several antibiotics. Over the last decades, *E.coli* and other Enterobacteriaceae have become less susceptible to commonly used antibiotics such as ampicillin, amoxicillin, co-amoxiclavulanate, sulphonamides, trimethoprim, co-trimoxazoles and in some geographic areas, fluoroquinolones [6,7].

In the United States, there has been a notable increase in the isolation of uropathogenic *E.coli*

Correspondence: Dr. A.O. Okesola, Department of Medical Microbiology and Parasitology, College of Medicine, University of Ibadan, University College Hospital, Ibadan, Nigeria. E-mail: abiolaokesola@yahoo.com

strains resistant to trimethoprim-sulphamethoxazole (TMP–SMZ) [8]. This finding is of particular interest since resistance to this drug is generally associated with resistance to additional antiobiotics [9]. The increasing occurrence of TMP–SMZ resistant uropathogenic *E.coli* emphasized the need to determine resistance prevalence levels within a community [8]. This study was therefore carried out to determine the most prevalent uropathogen in this environment as well as the susceptibility pattern of *E.coli* isolates from urine specimens in the same environment.

Materials and methods

This study was conducted between June and September 2009 in the Medical Microbiology Department of University College Hospital, Ibadan, Nigeria. Two hundred consecutive urine samples with significant bacteriuria, which were from patients with clinical diagnosis of urinary tract infection in 3 hospitals in Osun State, Nigeria were included in this study. These hospitals are Osun State General Hospital, Asubiaro, Osogbo, Obafemi Awolowo University Teaching Hospital, Ile-Ife and Ladoke Akintola University of Technology Teaching Hospital, Osogbo.

These urine samples were analyzed using standard bacteriological techniques. Various pathogens were isolated and identified from these urine specimens but only *E.coli* isolates were subjected to susceptibility testing according to the recommendation of Clinical and Laboratory Standard Institute (CLSI) for disc diffusion susceptibility test [10].The following antibiotics were tested against the *E.coli* isolates: amoxicillin/clavulanate (30ug), ofloxacin (30ug), gentamycin (10ug), nalidixic acid (30ug) ,amoxicillin (25ug), nitrofurantoin (30ug), co-trimoxazole (25ug) and tetracycline (30ug).

The susceptibility pattern of *E.coli* to these antibiotics were reported as sensitive and resistant, using the interpretive chart. Selected demographic characteristics, such as the age and sex of the study patients were also obtained.

Results

Various bacterial pathogens were recovered from the 200 urine samples collected. A breakdown of the frequency of isolation of these pathogens showed that Klebsiella species 80(40%) was the most frequently isolated, followed by *Escherichia coli* 50 (25%), *Staphylococcus aureus* 50(25%), Proteus species 8(4%), *Enterococcus faecalis* 7(3.5%) and *Pseudomonas aeruginosa* 5(2.5%) (Table 1).

Table 1: Distribution of uropathogens in urine specimens

Isolates	Number	Percentage (%)
Klebsiella species	80	40
Escherichia coli	50	25
Proteus species	8	4.0
Pseudomonas aeruginosa	5	2.5
Staphylococcus aureus	50	25
Enterococcus faecalis	7	3.5
Total	200	100.0

Gram-negative bacilli accounted for 143 (71.5%) of the pathogens isolated while 57(28.5%) were Gram-positive cocci (Table 2). The Gram-positive cocci identified in this study were *S.aureus* and *E.faecalis* . *Escherichia coli* and Klebsiella species accounted for 130 (90.9%) of the Gram-negative bacilli while Proteus species and *Pseudomonas aeruginosa* made up the remaining 13 (9.1%). The Gram-positive cocci were predominantly *S.aureus* 50 (87.7%).

Table 2: Distribution of Gram-negative and Gram-positive uropathogens.

Isolates	Number	Percentage (%)
Gram-negative	143	71.5
Gram-positive cocci	57	28.5
Total	200	100.0

Table 3: Distribution of urinary tract infection by age and sex

Age group (years)	Male	Female	Total (%)
05 -15	2	10	12(6.0)
16-25	10	50	60(30.0)
26-35	13	44	57(28.5)
36-45	19	15	25(12.5)
46-55	8	12	20(10.0)
56-65	6	20	26(13.0)
Total	67	133	200(100)

The age and sex distribution of study patients are demonstrated in Table 3. The activities of eight different antibiotics against the *E.coli* isolates are illustrated in Table 4. All the *E.coli* isolates were resistant to amoxicillin/clavulanate, co-trimoxazole and amoxicillin. The highest susceptibility was demonstrated towards nitrofurantoin 33(66%). Susceptibilities to ofloxacin, gentamycin, nalidixic

acid and tetracycline were, however, rather poor and these were 30%, 8%, 4% and 12% respectively.

Table 4: Antibiotic resistance pattern of *E. coli* in urine specimens.

Antibiotics	Antibiotics resistance pattern (N=50) No of resistant isolates	Percentage (%)
Amoxicillin/clavulanate	50	100.0
Ofloxacin	35	70.0
Gentamycin	46	92.0
Nalidixic acid	48	96.0
Nitrofurantoin	17	34.0
Cotrimoxazole	50	100.0
Amoxicillin	50	100.0
Tetracycline	44	88.0

Discussion

Our study has shown that the most frequently isolated pathogen from urine in this environment is Klebsiella species (40%), as against *E.coli* (25%). This is contrary to the results from other studies where *E.coli* was found to be the most prevalent of the uropathogens [11,12]. Gram-negative bacilli (71.5%) were more prevalent as uropathogens in this study than Gram-positive cocci (28.5%). Other studies have also demonstrated this fact [13].

Furthermore, in this study, urinary tract infections were more predominant in females (66.5%) than in males (33.5%). This has been shown to be due to the shorter urethra in females, which allow bacteria to reach the bladder more easily [14]. The prostatic fluids in male also play a role in their resistance to UTI [15].

Urinary tract infection was more prevalent among females in the age range 05- 15years than males. Similar result was recorded in a study by Riccaboni in 2003 where UTI decreased in boys and increased in girls by school age [16]. In the age range 16-25 years also, there was preponderance of incidence of UTI in females than in males. This could be attributed to early exposure or active participation in sex in this age group. A study conducted in 2006 by Olaitan supported this fact and stated that there is increased sexual activities among university female students which also fall into this age group[17]. Among the male subjects included in the study, UTI was most prevalent in the age range 36-45 years. This may be due to prostate gland hypertrophy or prostatic cancer which affects the production of prostatic fluids that offers protection against UTI in males.

Escherichia coli isolates are becoming increasingly resistant to commonly used antibiotics. In this study, all the *E.coli* isolates were resistant to amoxicillin/clavulanate, co-trimoxazole and amoxicillin which are antibiotics that are commonly used for UTI in our environment because they are readily available.

Decrease in susceptibility to antibiotics such as nalidixic acid (4%) , ofloxacin(30%) and nitrofurantoin (66%) is rather worrisome because these have been proven to be effective in both hospitalized and non-hospitalized patients [18].

The high resistance rates to antibiotics reported in another study [19], and in our environment may be connected with indiscriminate use and abuse of these drugs, and, in support of this fact, studies have shown causal relationship between antibiotic exposure and resistance [20,21].

Conclusion

High resistance rates to antibiotics demonstrated by *E.coli* isolates in this study call for strict control of antibiotic use in this environment. Further studies also need to be done to determine the molecular basis of resistance in these isolates in order to find a lasting solution to the problem.

Acknowledgements

The authors appreciate Mrs Popoola for her secretarial assistance.

References

1. Steadman R andTopley N. The virulence of *Escherichia coli* in urinary tract. In: Brufitt W, Jeremy MT, Hamilton Miler, Eds. Urinary Tract Infection. First edition. Chapman Hall, 1998; 37-41.
2. Foxman B and Brow P. Epidemiology of urinary tract infections: transmission and risk factors, incidence and costs. Infect Dis Clin North Am 2003; 17: 227-241.
3. Kucheria R, Dasgupta P, Sacks SH, Khan MS and Shearlin NS. Urinary tract infections: new insights into a common problem. Postgrad Med J 2005; 81: 83-86.
4. Jacobsen SM, Stickler DJ, Mobley HL and Shertiff M. Complicated catheter-associated urinary tract infections due to *Escherichia coli* and *Proteus mirabilis*. Clin Microbiol Rev 2008; 21: 26-59.
5. Geottseh WG, Goosen H, De Neeling AJ and Springer MJ. Infections and bacterial resistance in the community. Nederland T,

dschritt Voor Genees kunte 1999;143: 1296-1299.

6. Anon.The Copenhagen recommendation report from the invitational EU conference in the microbial threat, Copenhagen,Denmark. Ministry of Health, Ministry of food, Agriculture and Fisheries, Denmark. 1998.
7. Winstenley TG, Limb DI, Egginton R and Hancock F. A 10-year survey of the antimicrobial susceptibility of urinary tract isolates in the United Kingdom: the Microbe Base Project. J Antimicrob Chemother 1997; 40: 591–594.
8. Karlowsky JAS, Kelly LJ, Thornsberry C, Jones ME and Salon DF. Trends in antimicrobial resistance among urinary tract infection isolates of *Esherichia coli* from female out-patients in the United States. Antimicrob Agents Chemother 2002;46: 2540-2545.
9. Brown PD, Freeman A and Foxman B. Prevalence and predictors of trimethoprim-sulfamethoxazole resistance among uropathogenic *Escherichia coli* isolates in Michigan. Clin Infect Dis 2002;34:1061-1066.
10. Clinical and Laboratory Standard Institute M100-S16. Performance standards for antimicrobial susceptibility testing, sixteenth informational supplement.CLSI, Wayne,2006 PA, USA.
11. Gupta K. Emerging antibiotic resistance in urinary tract pathogens. Infect Dis Clin N Am 2003; 17: 243-259.
12. Grzesik A, Polytylo A and Wolskon A. Etiological agents of urinary tract infections in children treated at the Institute of Mother and Child. Med Wieku Rozwo 2008; 12(3): 789–794.
13. Brumfit W and Hamilton-Miler JM. A new look at the aetiology of urinary infection. Infection 1981; 5: 214.
14. Muhkdorfer I, Ziebur W and Hacker J. *Escherichia coli* in urinary tract infections. London: Academic Press, 2001;1739–1748.
15. Nicolle LE, Muir P, Jardin GK and Marries M. Localization of urinary tract infection in elderly institutionalized women. Asympt Bact J Infect 1988;157: 65 –70
16. Riccaboni M. Urinary tract infections in children. J Curr Opinion In Urology, 2003; 13: 59-62.
17. Olaitan JO. Asymptomatic bacteriuria in female students population of Nigerian university. The Int J Microbiol 2006 : 2.
18. Karl D and Muhammad M. Fluoroquinolones; action and resistance. Curr Top Med Chem 2003 ; 3: 249-282.
19. Aiyegoro OA, Igbinosa OO, Ogunwonyi IN, Odejare EE, Igebinosa OE and Okoh AI. Incidence of urinary tract infections (UTI) among children and adolescents in Ile-Ife, Nigeria. Afr J Microbiol Res 2007 : 014 – 019.
20. Goosens H, Ferech M,Vander SR and Elseviers M. Outpatient antibiotic use in Europe and association with resistance; a cross national data base study. Lancet 2005; 356: 579-587.
21. Hiller S, Roberts Z, Dunsten F, Butler C, Howard A and Palmer S. Prior antibiotics and risk of antibiotic–resistant community–acquired urinary tract infection; a case–control study. J Antimicrob Chemother 2007; 60:92-99.

Received: 18/10/10
Accepted: 06/06/11