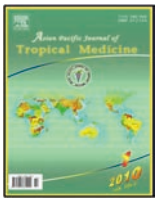
Contents lists available at ScienceDirect

Asian Pacific Journal of Tropical Medicine

journal homepage:www.elsevier.com/locate/apjtm



Document heading

Pattern and antibiogram of urinary tract infection at the University of Port Harcourt Teaching Hospital

Wariso KT[1], Siminialayi IM[2*], Odigie JO[2]

[1]*Department of Medical Microbiology and Parasitology, College of Health Sciences, University of Port Harcourt, Nigeria*

[2]*Department of Pharmacology and Toxicology, College of Health Sciences, University of Port Harcourt, Nigeria*

ARTICLE INFO

Article history:
Received 10 July 2009
Received in revised form 7 August 2009
Accepted 10 October 2009
Available online 20 January 2010

Keywords:
Urinary tract infection
Bacterial susceptibility
Antibiotic resistance
Port Harcourt

ABSTRACT

Objective: To explore the prevalence, pathogenicity, and antibiotic susceptibility patterns of urinary tract infections at the University of Port Harcourt Teaching Hospital. **Methods**: Samples from 400 patients with a presumptive diagnosis of urinary tract infection including 250 non pregnant females and 150 males were used for this study. They were distributed into two groups: children aged 2 to 17 (Group A) and adults aged 18 to 75 (Group B).The standard wire loop and agar diffusion technique were employed for culture and susceptibility testing, respectively. Data obtained were analysed using SPSS, version 14. **Results**: 30.0% of Group A and 41.0% of Group B had significant bacteriuria with 66.7% and 79.3% as females, respectively. The commonest isolates cultured were *Escherichia coli* (32.8%), *Staphylococcus aureus* (17.2%), and *Klebsiella spp.* (16.4%). About 76.6% of isolates were sensitive to the fluorinated quinolones, 31.2% to the aminoglycosides, and 22.7% to the urinary antiseptic, nitrofurantoin. The isolates were non-sensitive to tetracycline (93.8%), cotrimoxazole (92.2%), and nalidixic acid (86.7%). Most isolates showed non-uniform sensitivity patterns to the cephaloporins (cefuroxime and ceftazidime). *Pseudomonas spp.* isolates were generally resistant to the fluorinated quinolones. **Conclusion**: Though the fluorinated quinolones are still largely effective for empirical therapy in urinary tract infections, the importance of prior sensitivity testing in checking the emergence of bacterial antibiotic resistance can not be overemphasized.

1. Introduction

Clinically, acute infections of the urinary tract are divided into lower tract infections (urethritis and cystitis) and upper tract infections (acute pyelonephritis, prostatitis and intrarenal and perinephric abcesses). Infection at these various sites may either be asymptomatic or symptomatic[1]. Microbiologically, urinary tract infection (UTI) exists when pathogenic microorganisms are detected in the urine, urethra, bladder, kidney or prostate. In most cases, growth of greater than 10^5 organisms/mL of a properly collected midstream "clean catch" urine sample indicates infection[1,2]. Occasionally, however, colony counts of greater than 10^5/mL of midstream urine may be due to specimen contamination, especially when multiple bacterial species are found. In symptomatic patients, a smaller number of bacteria (10^2 to 10^4/mL) may signify infection[1].

UTI can occur in both male and female patients of any age with bacteria counts as low as 100 colony forming units (CFU) per milliliter of urine[1]. This is common in patients with symptoms of acute urethral syndrome, males with chronic prostatitis and patients with in-dwelling catheters[2]. Females are however believed to be more affected than males except at the extremes of life[3]. This is as a result of shorter and wider urethra[4]. Up to fifty percent of patients consulting with urinary tract symptoms may not have a clinically important infection on culture[5].

Most acute lower urinary tract infections termed acute bacterial cystitis are uncomplicated since they are not associated with signs or symptoms of upper urinary tract infection (fever, chills, or flank pain). The most important risk factors for acute cystitis in young women are a history of previous episodes of cystitis and frequent or recent sexual activity[6]. The relative odds of acute cystitis during the 48 hours after sexual intercourse increase by a factor as great as 60[7,8]. Sexual activity and contraception methods have been found to be important risk factors for such infections and their recurrences[9,10].

*Corresponding author: Dr. Siminialayi IM, Department of Pharmacology and Toxicology, College of Health Sciences, University of Port Harcourt, Nigeria.
Tel: 2348035310680
E-mail: imsiminialayi@aol.com

About 5% of patients will have recurrent urinary tract infections-that is, symptomatic infections that follow the clinical resolution of a previous episode, generally but not necessarily after treatment[11]. This has largely been attributed to bacterial antibiotic resistance. One of the factors responsible for bacterial resistance is increasing age[12].

The purpose of this study is to determine the actual prevalence and the pathogens responsible for urinary tract infection amongst patients at the University of Port Harcourt Teaching Hospital, and evaluate the pathogenetic susceptibility/resistance to common antibiotics.

2. Materials and methods

2.1. Study population

A total of 400 patients (sample size obtained using Kish formula[13]), including 250 non pregnant females and 150 males, with a presumptive diagnosis of urinary tract infection at UPTH were involved in this study. They were distributed in two equal groups: children aged 2 to 17 (Group A) and adults aged 18 to 75 (Group B) with each group consisting of equal number of inpatients and outpatients.

2.2. Collection of sample

Mid stream, clean catch urine samples were collected and analysed for bacteriuria. The patients were instructed on how to collect the samples into sterile universal bottles containing 1% boric acid to stem overt multiplication of bacterial cells.

2.3. Culture and identification of isolates

A modified semi-quantitative technique was employed (standard wire loop method). A standard bacteriological loopful of urine was spread over the surface of Cystine Lactose Electrolyte Deficient (CLED) agar plate. The loop used can transfer 0.002 mL of urine. After inoculation, the plates were left on the bench for 10 to 20 minutes to allow the urine to be absorbed into the agar medium. The plates were then inverted and incubated at 37 ℃ for 18-24 hours. Using morphological and cultural features, the number of bacterial colony forming units was counted on each CLED agar medium. Plates containing 200 colony forming units (CFU´s) or more were considered to be significant bacteriuria because 200 CFU´s in 1/500 mL of urine is proportional to 10^5 organisms per mL of urine, as described by Cheesbrough[14]. Pure isolates of resulting growth were identified using biochemical method as described by Holt *et al*[15].

2.4. Antibiotic susceptibility testing

The agar diffusion technique as described by Bauer *et al*[16]. was used. Five colonies of the test organisms were streaked on agar plates using sterile inoculating wire loop. The appropriate multi-disc depending on whether the test organism plated was a gram negative or gram-positive organism was then placed firmly onto the surface of the dried plates, using sterile forceps. The plates were left at room temperature for one hour to allow diffusion of the different antibiotics from the disc into the medium. The plates were then incubated at 37 ℃ for 18-24 hours. Interpretation of results was done using the zone sizes. Zones of inhibition greater than 10 mm were considered sensitive, 5-10 mm moderate sensitive and no zone of inhibition resistant.

2.5. Statistical analysis

The data obtained were analysed using SPSS, version 14. Chi-square test using the method of Snedecor and Cochran[17] was used to determine significance. Significance was accepted at $P<0.05$.

3. Results

Of the 200 urine samples in Group A, 60 (30.0%) had significant bacteriuria; while 41 (20.5%) had insignificant bacteriuria, 15 (7.5%) had doubtful significant mixed growth, and 77 (38.5%) had no bacterial growth. 40 (66.7%) cases of significant bacteriuria were females. Of the 200 urine samples in Group B, 82 (41.0%) had significant bacteriuria, while 34 (17%) had insignificant bacteriuria, 22 (11.0%) had doubtful significant mixed growth, and 54 (27%) had no bacterial growth. 65 (79.3%) cases of significant bacteriuria were females (Table 1).

Table 1
Distribution of significant bacteriuria and bacterial isolates in in-patients and out-patients.

Finding/ Group	Out-patient (A)	In-patient (A)	Out-patient (B)	In-patient (B)
Significant bacteriuria	34	26	51	31
Escherichia coli	10	6	18	8
Staphylococcus aureus	6	2	10	4
Klebsiella spp.	5	3	8	5
Proteus spp.	2	2	4	3
Pseudomonas spp.	1	4	2	3

42 cases had *Escherichia coli* (32.8%), 22 had *Staphylococcus aureus* (17.2%), 21 had *Klebsiella spp.* (16.4%), 11 had *Proteus spp.* (8.6%), 10 had *Pseudomonas spp.* (7.8%), 10 had coliform organisms (7.8%), 6 had *Enterococus faecalis* (4.7%), and 6 had *Enterobacter aerogenes* (2.7%) (Table 1). The antibiotic sensitivity pattern revealed that 98 isolates (76.6%) were sensitive to the fluorinated quinolones: ciprofloxacin and ofloxaxin. Sensitivity to aminoglycosides (gentamycin, streptomycin), and the urinary antiseptic, nitrofurantoin was 31.2% and 22.7% respectively (Table 2).

The isolates were generally non-sensitive to tetracycline (93.8%), cotrimoxazole (92.2%), and nalidixic acid (86.7%). All isolates were also mostly non-sensitive (51.6%) to the cephalosporins (cefuroxime and ceftazidime), with each isolate showing an erratic sensitivity pattern to individual cephalosporins. The isolates of *Pseudomonas spp.* also showed an atypical sensitivity pattern, being non sensitive to the fluorinated quinolones (70.0%), cephalosporins (95.0%), and completely resistant to tetracycline, cotrimoxazole, nitrofurantoin, and nalidixic acid.

Table 2
Distribution of sensitivity patterns to the different antibiotics (%).

Bacteria	CPL	OFL	GEN	STR	CEF	CZM	NIT	NAL	COT	TCN
Escherichia coli	75.8	76.2	35.7	38.1	54.8	35.7	26.2	28.6	7.1	4.8
Staphylococcus aureus	86.4	77.3	18.2	13.6	36.4	50.0	41.0	4.5	9.1	13.6
Klebsiella spp.	85.7	66.7	19.1	14.1	47.6	52.4	14.3	0.0	4.8	0.0
Proteus spp.	91.0	91.0	36.4	45.5	63.6	45.5	18.2	18.2	0.0	9.1
Pseudomonas spp.	20.0	50.0	30.0	60.0	10.0	10.0	0.0	0.0	0.0	0.0

CPL: ciprofloxacin, OFL: ofloxacin, GEN: gentamycin, STR: streptomycin, CEF: cefuroxime, CZM: ceftazidime, NIT: nitrofurantoin, NAL: nalidixic acid, COT: cotrimoxazole, TCN: tetracycline.

4. Discussion

Of the 400 urine samples analysed for bacteriuria in this study, 60 (30.0%) in Group A and 82 (41.0%) in group B had significant bacteriuria, with 40 (66.7%) and 65 (79.3%) cases were females, respectively. The most common isolates observed in cases of significant bacteriuria in both groups were *Escherichia coli* 42 (32.8%), *Staphylococcus aureus* 22 (17.2%), *Klebsiella spp.* 21 (16.4%), *Proteus spp.* 11 (8.6%), and *Pseudomonas spp.* 10 (7.8%). Sensitivity to the fluorinated quinolones, the aminoglycosides, nitrofurantoin were 76.6%, 31.2% and 22.7%, respectively.

Our findings agree with other reports[18-25] which indicated that gram negative bacteria are the commonest pathogens isolated in patients with urinary tract infections. This preponderance of *Escherichia coli* isolates can be attributed to its population of the large bowel and its possession of fimbriae (adhesions) used for adherence to the mucosal surface of the urinary tract[19]. Some have shown, however, that the percentage of *Escherichia coli* is slowly declining, being replaced by other members of the Enterobacteriaceae and enterococci[26].

UTI was more prevalent in adults aged 18 to 75 than in children aged 2 to 17 and more prevalent in females than males, reflecting other reports, which showed that UTI´s are more frequent in females than males during adolescence and adulthood[21,27]. *Escherichia coli* and *Staphylococcus aureus* accounted relatively, for more cases of community-acquired significant bacteriuria cases (out-patients) while *Klebsiella spp.*, *Proteus spp.*, *Pseudomonas spp.* accounted relatively, for more cases of hospital-acquired (nosocomial) significant bacteriuria cases (in-patients).

The most useful antibiotics in this study were the fluorinated quinolones, the aminoglycosides, and the urinary antiseptic Nitrofurantoin, agreeing with other reports[20,21,28-32]. This may be because the parent drugs are completely excreted in urine unchangingly, thus concentrating the drug and enhancing their effects.

Patients presenting with urinary frequency and dysuria would usually receive empirical antibiotic before the results of any bacteriological investigation are available, if any investigations are undertaken at all[33]. The reason for the absence of the bacterial growth recorded in 131 samples may be due to the fact that patients were already undergoing antibiotic therapy[34].The antibiotic chosen usually reflects the fact that the organism is most likely to be *Escherichia coli*[23,35,36]. There has been an increasing problem with antibiotic resistance to common organisms[36-38]. Since antibiotic resistance is a common cause of treatment failure[39], emphasis is being placed on the treatment most likely to cure a patient with these symptoms and reduce the need for a further course or different course of antibiotics, which would seem a more objective measure of treatment failure. The choice of antibiotic will be influenced by knowledge of the resistance patterns of urinary pathogens locally, although the correlation between in vitro resistance and clinical outcome is far from absolute[37].

However, antibiotic resistance observed may be because these antibiotics have been employed for the treatment of urinary tract infections for a long time, explaining their frequent abuse and subsequent development of resistance[22]. In fact, increasing flouroquinolone resistance in community acquired infections has raised concerns about this potent, frequently prescribed antibiotic[40].

The study has showed that susceptibility pattern is necessary to obtain sensitivity reports before start of antibiotic treatment in case of suspected urinary tract infection. This will help check emergence of resistance strains and prevent treatment failure. The fluorinated quinolones should be employed if indications for empirical therapy are absolute.

References

[1] Akinyemi KO, Alabi SA, Taiwo NA, Omonighehin EA. Antimicrobial susceptibility pattern and plasmid profile of pathogenic bacteria isolated from subjects with urinary tract infections in Lagos, Nigeria. *Nig Qt J Hosp Med* 1997; (1): 7-11.
[2] Karen C, Deron CH, Donal HV, Clenn CR, Leslie TH, John MM. Laboratory evaluation of urinary tract infection in an ambulatory clinic. *Am Clin Path* 1994; **101**: 100-3.
[3] Akinkugbe FM, Familusi FB, Akinkugbe O. Urinary tract infection in infancy and early childhood. *East Afri Med* 1973; **50**(9): 514-52.
[4] Duerden BI, Reid TMS, Jewsbury JM, Turk DC. *A new short book of medical parasitic infection.* ELBS Publishers; 1990, p. 576-81.
[5] Mond NC, Percival A, Williams JD, Brumfitt W. Presentation, diagnosis and treatment of urinary tract infections in general practice. *Lancet* II 1965; **1**(7384)514-6.
[6] Scholes D, Hooton TM, Roberts PL, Stapleton AE, Gupta K, Stamm WE. Risk factors for recurrent urinary tract infection in young women. *J Infect Dis* 2000; **182**: 1177-82.
[7] Kunin CM. Sexual intercourse and urinary infections. *N Engl J Med* 1978; **298**: 336-7.
[8] Nicolle LE, Harding GKM, Preiksaitis J, Ronald AR. The association of urinary tract infection with sexual intercourse. *J Infect Dis* 1982; **146**: 574-83.
[9] Ik ä heimo R, Siitonen A, Heiskanen T, Karkkainen U, Kuosmanen P, Lipponen P, et al. Recurrence of urinary tract infection in a primary care setting: analysis of a 1-year follow-up of 179 women. *Clin Infect Dis* 1996; **22**: 91-9.
[10] Foxman B, Gillespie B, Koopman J, Zhang L, Palin K, Tallman P, et al. Risk factors for second urinary tract infection among college women. *Am J Epidemiol* 2000; **151**: 1194-205.
[11] Hooton TM. Recurrent urinary tract infection in women. *Int J Antimicrob Agents* 2001; **17**: 259-68.
[12] Steinke DT, Seaton RA, Phillips G, MacDonald TM, Davey PG. Factors associated with trimethoprim-resistant bacteria isolated from urine samples. *J Antimicrobial Chemotherapy* 1999; **43**: 841-3.

[13] Nyengidiki KT, Enyindah CE. Contraceptive prevalence amongst women attending the infant welfare clinic at the University of Port Harcourt Teaching Hospital. *Port Harcourt Med J* 2008; **3**: 42–8.
[14] Cheosbrough M. D*istrict laboratory practice in tropical countries (Part 2)*. Cambridge University Press; 2005, p. 107–15.
[15] Holt JG, Krieg NR, Sneath PHA, Stanley JT, Williams ST. *Bergey's manual of systematic bacteriology*. 9th edition.Maryland: Williams and Wilkins Company Baltimore; 1994, p. 786.
[16] Bauer AW, Kirby WM, Sherris JC, Jurck M. Antibiotic susceptibility testing by a standard single disc method. *Am J Clin Path* 1996; **451**: 493–6.
[17] Snedecor GW, Cochran WG. *A statistical method*. Arnes Iowa USA: Ames IOWA State University Press; 1967.
[18] Baron EJ, Peterrson LR, Finegold SM. *Bailey and Scott's Diagnostic microbiology*. 9th ed. St Louis: The CV Mosby Co; 1994, p. 249–57.
[19] Nester EW, Roberts CE, Pearsall NN, Anderson DG, Nester MT. *Microbiology: A human perspective*. New York: McGraw-Hill; 1995, p. 600–3.
[20] Ebie M, Kandakai-Olukemi YT, Ayanbadejo J, Tanyigna KB. Urinary tract infection in a Nigeria Military Hospital. *Nig J Microbiol* 2001; **15**(1): 31–7.
[21] Burbige KA, Retik AB, Colony A, Bauer SB, Lebowitz R. Urinary tract infection in boys. *J Urol* 1984; **132**: 541–2.
[22] Tice AD. Short course therapy of acute cystitis: a brief review of therapeutic strategies. *J Antimicrobial Chemotherapy* 1999; **43**: 85–93.
[23] Ferry S, Burman LG, Holm SE. Clinical and bacteriological effects of therapy of urinary tract infection in primary health care: relation to *in vitro* sensitivity testing. *Scandinavian J Inf Dis* 1988; **20**: 535–44.
[24] Stamm WE, Hooton TM. Management of urinary tract infections in adults. *New Engl J Med* 1993; **329**: 1328–34.
[25] Henry D, Ellison W, Sullivan J, Mansfield DL, Magner DJ, Dorr MB, et al. Treatment of community acquired acute uncomplicated urinary tract infection with sparfloxacin versus ofloxacin. The Sparfloxacin Multi-Center UUTI Study Group. *Antimicrobial Agents & Chemotherapy* 1998; **42**: 2262–6.
[26] Gruneberg RN. Changes in urinary pathogens and their antibiotic sensitivities 1971–1992. *J Antimicrobial Chemotherapy* 1994; **33**(Suppl. A): 1–8.
[27] Ibeawuchi R, Mbata TI. Rational and irrational use of antibiotics. *Afri Health* 2002; **24** (2): 16–8.
[28] Huang ES, Stafford RS. National patterns in the treatment of urinary tract infections in women by ambulatory care physicians. *Arch Intern Med* 2002; **162**: 41–7.
[29] Steinman MA, Gonzales R, Linder JA, Landefeld CS. Changing use of antibiotics in community-based outpatient practice, 1991–1999. *Ann Intern Med* 2003; **138**: 525–33.
[30] Warren JW, Abrutyn E, Hebel JR, Johnson JR, Schaeffer AJ, Stamm WE. Guidelines for antimicrobial treatment of uncomplicated acute bacterial cystitis and acute pyelonephritis in women. *Clin Infect Dis* 1999; **29:** 745–58.
[31] Hooton TM. The current management strategies for community-acquired urinary tract infection. *Infect Dis Clin North Am* 2003; **17**: 303–32.
[32] Hooton TM, Scholes D, Gupta K, Stapleton AE, Roberts PL, Stamm WE. Amoxicillin-clavulanic acid vs Ciprofloxacin for treatment of uncomplicated cystitis in women. *JAMA* 2005; **293**: 949–55.
[33] Brooks D. The management of suspected urinary tract infection in general practice. *British J General Pract* 1990; **40**: 399–401.
[34] Okonofua EE, Okonofua BN. Incidence and pattern of asymptomatic bacteriuria of pregnancy in Nigeria woman. *Nig Med Pract* 1989; **17**: 354–8.
[35] Bailey RR. Management of lower urinary tract infections. *Drugs* 1993; **45**(Suppl. 3): 139–44.
[36] Gupta K, Scholes D, Stamm WE. Increasing prevalence of antimicrobial resistance among uropathogens causing acute uncomplicated cystitis in women. *J American Med Association* 1999; **281**: 736–8.
[37] Davey P, Steinke D, MacDonald T, Phillips G, Sullivan F. Not so simple cystitis: how should prescribers be supported to make informed decisions about the increasing prevalence of infections caused by drug-resistant bacteria? *British J General Practe* 2000; **50**: 143–6.
[38] Magee JT, Pritchard EL, Fitzgerald KA, Dunstan FD, Howard AJ. Antibiotic prescribing and antibiotic resistance in community practice: retrospective study 1996–1998. *Brit Med J* 1999; **319**: 1239–40.
[39] Lawrenson RA, Logie JW. Antibiotic failure in the treatment of UTI in young women. *J Antimicrobial Chemotherapy* 2001; **48**: 895–901.
[40] Scheld WM. Maintaining fluoroquinolone class efficacy: review of influencing factors. *Emerg Infect Dis* 2003; **9**: 1–9.

Executive Editor: Beijia Tan