American Journal of Infectious Diseases 6 (4): 89-92, 2010
ISSN 1553-6203

In Vitro Activity of Cephalexin against Community-Acquired Urinary *Escherichia coli*, *Klebsiella* and *Proteus* species Isolates

[1]Humodi A. Saeed and [2]Amira Saad Eldin Mohammed
[1]Department of Microbiology, College of Medical Laboratory Science,
Sudan University of Science and Technology, Arbab El Agaid Street, Khartoum, Sudan,
[2]Department of Microbiology Laboratory, Khartoum North Teaching Hospital,
El Mouna Street, Khartoum North, Sudan

Abstract: Problem statement: Resistance among urinary tract pathogens to conventional antibiotics has been considered a health problem worldwide. The aim of this study was to evaluate the *in vitro* activity of cephalexin on urinary enterobacterial isolates. **Approach:** Patients with community-acquired urinary tract infections were microbiologically investigated. Urine specimens were collected from each patient. The specimens were cultured on bacteriological media. The isolated urinary pathogens were subjected to antibiotic sensitivity test using modified Kirby-Bauer Disc diffusion method. The method was judged by the National Committee for Clinical Laboratories Standards (NCCLS). **Results:** A total of 140 enterobacterial urinary isolates were recovered. Of these 93 (66.4%) were identified as *E. coli*, 20 (14.3%) as *Klebsiella* spp. and 12 (8.6%) as *Proteus* spp. The results showed that urinary enterobacterial pathogens had a high rate of resistance to cephalexin amounting to 75 (53.6%), whereas susceptible and intermediate rates were 34 (24.3%) and 31 (22.1%) respectively. **Conclusion:** It was concluded that *E. coli* are the predominant organisms isolated from subjects sampled. High resistance to cephalexin activity was noticed with *Klebsiella* spp isolates.

Key words: *E. coli*, *Klebsiella*, *Proteus*, urinary tract, Community-acquired, cephalexin, enterobacteria, susceptibility test, intermediate susceptible, antimicrobial susceptibility, antibiotics, pathogens

INTRODUCTION

Urinary Tract Infection (UTI) is one of the most common diseases encountered in medical practice. It is the second leading cause for the use of antibiotics in the community (Kunin, 1994; Hooton and Stamm, 1997; Raz *et al.*, 2000; Kamatchi *et al*., 2009).

Worldwide data show that there is increasing resistance among urinary tract pathogens to conventional drugs (Katarzyna *et al*., 2001). The judicious use of antibiotics requires accurate data on antimicrobial susceptibility which may vary in time and place (Keah *et al*., 2007). Raz and his colleagues, reported 38.8% resistance in *E. coli* to cephalexin (Raz *et al*. (2000). In patients with suspected UTI, antibiotic treatment is usually started immediately. To ensure appropriate treatment, knowledge of the organisms that cause UTI and their antibiotic susceptibility is considered mandatory to eliminate the symptoms, eradicate the infection and prevent urosepsis as well as to reduce the likelihood of renal damage (Gaspari *et al*., 2006; Younis *et al*., 2009). The microorganisms usually responsible for catheter-associated UTIs are derived from the fecal flora native to the patient or originate in the hospital environment. They include *E. coli*, *Enterococcus* species, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae, Proteus mirabilis* and *Candida albicans* (Taher and Golestanpour, 2009).

In the Sudan, bacterial infections of the urinary tract are common and represent a common cause of morbidity in outpatients as well as a frequent cause of nosocomial infections in many hospitals. Most infections are treated on an empirical basis. Clinical experience has indicated the presence of numerous cases resistant to conventional chemotherapy. Microbial resistance rates to commonly prescribed antibiotics have increased recently. Updated knowledge of the prevailing causative bacteria and their susceptibility patterns is important for the proper selection and use of antimicrobial drugs as well as for the development of an appropriate prescription policy (Ahmed *et al*., 2000).

The purpose of this study was to evaluate the *in vitro* activity of cephalexin on urinary enterobacterial isolates.

Corresponding Author: Humodi A. Saeed, Department of Microbiology, College of Medical Laboratory Science, Sudan University of Science and Technology, Khartoum, Sudan

MATERIALS AND METHODS

Patients with urinary tract infection visiting National Health Laboratory, Military Hospital and Ibn Sina Hospital were investigated. Urine specimens were collected from males and females with symptoms of urinary tract infection. Individual patients were provided with a wide mouth container and advised to collect about 20 m1s of mid-stream urine in accordance with standard methods. All samples were cultured on blood agar and Cystine Lysine Electrolytes Deficient (CLED) agar plates. The plates were examined for significant bacterial growth (>10^5CFU mL^{-1}) (Gupta *et al*., 3003). The causative agents were then identified according to (Barrow and Feltham, 2003).

Antimicrobial susceptibility testing of isolates was done by the reference agar diffusion method, as described by the National Committee for Clinical Laboratory Standards (2003) and Murray *et al*. (2002).

RESULTS

Samples were collected from two hundred patients attending the Military Hospital, Ibn Sina Hospital and the National Health Laboratory. Samples were collected from 123 (61.5%) females and 77 (38.5%) males. Bacteriological examination of growth on blood and CLED agar showed that 140 (70%) of the samples were found positive for bacterial growth (≥10^5 colony-forming units/ml) were considered significant and the rest of the samples 60 (30%) were insignificant (growths <10^5 colony-forming units/ml) (Table 1).

The result of culture morphology, Gram stains and biochemical tests showed that the causative agents were *E. coli* 93 (66.4%), *Klebsiella* spp, 20(14.3%), *Proteus* spp 12(8.6%), *Pseudomonas* spp 10 (7.1%), *Staph. aureus* 3(2.1%) and *Strepto. faecalis* 2 (1.4%) (Table 2). The results of the *In vitro* activity of cephalexin against the total number of isolates (140), showed that 75 (53.6%) were resistant, 34(24.3%) were susceptible and 31(22.1%) were intermediate (Table 3). On the other hand, the results indicated that the resistant *E. coli* strains were 49(52.7%), susceptible strains were 22(23.7%) and intermediate strains were 22(23.6%). For *Klebsiella* spp the resistant strains were 15(75%), susceptible strains were 4(20%) and only 1 strain was intermediate (5%). On the other hand, *Proteus* spp isolates showed that only 1(8.3%) strain was resistant, 3 (25%) were susceptible and 8 (66.7%) were intermediate (Table 4).

The results of susceptibility testing for both sexes showed that in males the resistant strains were 34 (59.6%) susceptible strains were 13 (22.8%) and intermediate susceptible strains were 10 (17.5%). For females resistant strains were 14 (49.4%), susceptible 21(25.3%) and intermediate 21 (25.3%) (Table 5).

In males the percentage of isolated strains of *E. coli* was 32 (56.1%), *Klebsiella* spp 10 (17.5%), *Proteus* spp 6 (10.5%), *Pseudomonas* spp 5 (8.8%), *Staph. aureus* 3 (5.3%) and *Strepto. faecalis* 1 (1.8%). In females the percentage of isolated strains *E. coli* was 61 (73.5%), *Klebsiella* spp 10 (12%) and *Proteus* spp. 6 (7.2%).

Table 1: Bacteriological examination growth on blood and CLED agar

		Growth rate on blood and CLED agar	
Specimen source	No. of specimens (%)	Significant (%)	Insignificant (%)
Male	77 (38.5)	42(30)	35(58.3)
Female	123 (61.5)	98(70)	25(41.7)
Total	200 (100)	140 (100)	60 (100)

Table 2: Clinical species isolated from urine samples

Isolate	Frequency	(%)
E. coli	93	66.4
Klebsiella spp	20	14.3
Proteus spp	12	8.6
Total	140	100.0

Table 3: Percentage susceptibility and resistance of isolated organisms to cephalexin

Activity of cephalexin	Frequency	(%)
Resistant	75	53.6
Susceptible	34	24.3
Intermedial susceptible	31	22.1
Total	140	100.0

Table 4: Activity of cephalexin against *E. coli*, *Klebsiella* spp and *Proteus* spp

	Activity of cephalexin			
Isolate	Resistant	Susceptible	Intermediate	Total
E. coli	49 (52.7%)	22 (23.7%)	22 (23.6%)	93 (66.4%)
Klebsiella spp	15 (75%)	4 (20%)	1 (5%)	20 (14.3%)
Proteus spp	1 (8.3%)	3 (25%)	8 (66.7%)	12 (8.6%)

Table 5: Activity of cephalexin according to gender

	Activity of cephalexin			
Sex	Resistant (%)	Susceptible (%)	Intermediate (%)	Total (%)
Male	34 (59.6)	13 (22.8)	10 (17.5)	57 (100)
Female	41 (49.4)	21 (25.3)	21 (25.3)	83 (100)
Total	75 (100)	34 (100)	31 (100)	140 (100)

Chi-square = 1.668; d = 2; P = 0.434

DISCUSSION

In an attempt to evaluate the effect of cephalexin on urinary isolates, a total of 200 urinary samples were randomly collected. Of these 140 were recovered and the remainder were excluded due to insignificant growth (Table 6).

Table 6: Distribution of the isolates according to gender

	Gender		
Isolat	Male (%)	Female (%)	Total (%)
E. coli	32 (56.1)	61 (73.5)	93 (66.4)
Klebsiella spp	10 (17.5)	10 (12.0)	20 (14.3)
Proteus spp	6 (10.5)	6 (7.2)	12 (8.6)
Total	57 (100)	83 (100)	140 (100)

Chi-square = 7.472; df = 5;P.= 0.188

NCCLs modified Kirby-Bauer Disc Diffusion Technique was used for performance of susceptibility testing.

The percentages of isolates in males and females were 57 (40.7%) and 83 (59.3%), respectively. This result differs from that reported by Raz *et al*. (2000). who found that the percentage of isolates from females was 83.7 and 14.3% from males.

The most common urinary isolates identified were *E. coli* 93 (66.4%), *Klebsiella* spp 20 (14.3%) and *Proteus* sp 12 (8.6 (Table 4). This finding differs from that reported by Prais *et al*. (2003), who found that the percentages of isolates were *E. coli* (86%), *Klebsiella* (6%), others (8%) and in (1999) *E. coli* (82%), *Klebsiella* (13%) and other (5%). The percentage of *Klebsiella* sp in (1999) was close to this study.

The study revealed that 75 (53.6%) of isolates were resistant to cephalexin, while 34 (24.3%) were susceptible to cephalexin and 22.1% were found to be intermediate. This finding differs from the results obtained by Oren *et al*. (1991) who found that the percentage of susceptibility rate to cephalexin was 60% and 77% in two community laboratories in northern Israel. In another study (Iqbal *et al*., 1997) in Bangladesh reported a higher susceptibility rate of 54% isolates to cephalexin. However, Kapoor *et al*. (1997) reported a comparable rate (48%) of resistance to cephalexin.

In determining the activity of cephalexin on urinary isolates the resistance of *E. coli* was 49 (52.7%) while 22 (23.7%) were susceptible and 22 (23.6%) were intermediate susceptible. Resistant *Klebsiella* spp were 15 (75%), susceptible 4 (25%) and the remaining were intermediate susceptible 1 (5%). *Proteus* spp 1 (8.3%) was resistant to cephalexin, 3 (25%) were susceptible and 8 (66.7%) intermediate susceptible.

According to Raz *et al.* (2000) the most common pathogen in UTIs was *E. coli* with a comparable rate of resistant 38.8% to cephalexin.

The activity of cephalexin in males and females was found to be insignificance (P = 0.434) and had a similar effect on both gender. For males 34(59.6%) were found to be resistant, 13 (22.8%) susceptible and 10 (17.5%) intermediate susceptible. For females 41 (49.4%) were found to be resistant, 21 (25.3%) susceptible and 21 (25.3%) intermedial susceptible.

The relation between the urinary isolates and sex had no statistical significance (P = 0.188) and all isolates can affect both males and females. The occurrence of infection in males was 32 (56.1%) for *E. coli*, 10 (17.5%) for *Klebsiells* spp and 6 (10.5%) for *Proteus* spp.

In females the percentage was 61(73.5%) for *E. col*, 10 (12.0%) for *Klebsiella* spp, 6 (7.2%) and for *Proteus* spp, 5(6%). A comparable result (females was 74.7% and males was 5.5%) *E. coli* was reported by Raz *et al*. (2000).

CONCLUSION

It is concluded that the *E. coli* is predominant organism isolated from subjects sampled. Intermediate activity of cephalexin was noticed on *Proteus* spp isolates. High resistance to cephalexin activity was noticed on *Klebsiella* spp isolates.

ACKNOWLEDGEMENT

The researchers thank Professor Mubarak Eisa for critical reading of the manuscript.

REFERENCES

Ahmed, A.A., H. Osman, M.A.M. Mansour, H.A. Musa and B. Abdalla *et al*., Ahmed, 2000. Antimicrobial agent resistance in bacterial isolates from patients with diarrhea and urinary tract infection in the sudan. Am. J. Trop. Med. Hyg., 63: 259-263. URL: http://www.ajtmh.org/cgi/reprint/63/5/259

Barrow, G.I. and R.K.A. Feltham, 2003. Characters of Gram-negative Bacteria. In: Cowans and Steels Manual for Identification of Medical Bacteria. 3rd Edn., Cambridge, UK.; Ch. 6, pp: 130-131. ISBN: 9780521543286

Gaspari, R.J., E. Dickson, J. Karlowsky and G. Doern, 2006. Multidrug resistance in pediatric urinary tract infections. Microbol. Drug Resist, 12: 126-129. PMID: 16922629

Gupta, V., A. Yadav and R.M. Joshi, 2003. Antibiotics resistance pattern in uropathogen. Indian J. Med. Microbiol. 20: 96-98. ISSN: 0255-0857

Hooton, T.M. and W.E. Stamm, 1997. Diagnosis and treatment of uncomplicated urinary tract infection. Infect. Dis. Clin. North Am., 11: 551-581. PMID: 9378923

Iqbal, J., M. Rahman, M.S. Kabir and M. Rahman, 1997. Increasing ciprofloxacin resistance among prevalent urinary tract bacterial isolates in Bangladesh. J. Pn. J. Med. Sci. Biol. Dec., 50: 241-50. PMID: 9789787

Kapoor, H. and P. Aggarwal, 1997. Resistance to quinolones in pathogens causing urinary tract infection. J. Commun. Dis., 29: 263-7. PMID: 9465532

Katarzyna, H., S. Katarzyna, S. Agnieszka, J. Krzysztof and B. Katarzyna *et al*., 2001. Antibiotic susceptibility of bacterial strains isolated from urinary tract infections in Poland. J. Antimicrobial Chemother, 47: 773-780. DOI: 10.1093/jac/47.6.773

Keah, S.H., E.C. Wee, K.S. Chng and K.C. Keah, 2007. Antimicrobial susceptibility of community-acquired uropathogens in general practice. Malaysian Family Physician, 2: 64-69. URL: http://www.ejournal.afpm.org.my/

Kunin, C.M., 1994. Urinary tract infections in females. Clin. Infect. Dis., 18: 1-12. ISSN: 1058-4838

Kamatchi, C., H. Magesh, U. Sekhar and R. Vaidyanathan, 2009. Identification of clonal clusters of *Klebsiella pneumoniae* isolates from Chennai by extended spectrum beta lactamase genotyping and antibiotic resistance phenotyping analysis. Am. J. Infect. Dis., 5: 74-82. DOI: 10.3844/ajidsp.2009.74.82

Murray, P., K. Rosenthal, G. Robagashi and M. Pfaller, 2002. Medical Microbiology. 4th Edn., USA, Mosby, Ch. 20, pp: 185-193.

National Committee for Clinical Laboratory Standards. 2003. Performance standards for antimicrobial disk susceptibility tests: Approved Standard. NCCLS Document M2-A8. 8th Edn., Wayne, Pa, USA., pp: 379-380.

Oren, B., R. Raz, H. Helter, Y. Kennes and I. Potasman, 1991. Antimicrobial susceptibility of organisms infecting the urinary tract in Northern Israel. Harefuah Jan, 15: 120: 60-2. http://www.ncbi.nlm.nih.gov/pubmed/2007488

Prais, D., R. Straussberg, Y. Avitzur, M. Nussinovitch and I. Harel *et al*., 2003. Bacteiral susceptibility acquired urinary tract infection. Arch Dis. Child., 88: 215-8. http://www.ncbi.nlm.nih.gov/pubmed/12598381

Raz, R., N. Okev, Y. Kennes, A. Gilboa and I. Lavi *et al*., 2000. Demographic characteristic of patients with community-acquired becteriuria and susceptibility of urinary pathogens to antimicrobials in Northern Israel. Isr. Med. Associ. J., 2: 426-429. http://www.ncbi.nlm.nih.gov/pubmed/10897231

Taher, M.T. and A. Golestanpour, 2009. Symptomatic nosocomial urinary tract infection in ICU patients: Identification of antimicrobial resistance pattern. Iranian J. Clin. Infect. Dis., 4: 25-29. http://www.sid.ir/en/VEWSSID/J_pdf/122020090106.pdf

Younis, N., K. Quol, T. Al-Momani, F. Al-Awaisheh and D. Al-Kayed, 2009. Antibiotic resistance in children with recurrent or complicated urinary tract infection. J. Nepal Med. Assoc., 48: 14-9. http://www.jnma.com.np/files/pdf/vol/48/no/1/issue/173/year/2009/month/jan-ar/original_article/14-9.pdf