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

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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.
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 ml 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 (>10^5 CFU ml^-1) (Gupta et al., 2003). 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 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 cephalxin 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%).

| 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)         |

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

| Isolate          | Activity of cephalxin |
|------------------|-----------------------|
| E. coli          | 49 (52.7%)            |
| Klebsiella spp   | 15 (75%)              |
| Proteus spp      | 1 (8.3%)              |
| Total            | 75 (53.6%)            |

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

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%).

DISCUSSION

In an attempt to evaluate the effect of cephalxin 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).

| 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 1: Bacteriological examination growth on blood and CLED agar

Table 2: Clinical species isolated from urine samples

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

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

Table 5: Activity of cephalxin according to gender
Table 6: Distribution of the isolates according to gender

| Isolat     | Male (%) | Female (%) | Total (%) |
|------------|----------|------------|-----------|
| E. coli    | 32 (56.1)| 61 (73.5)  | 93 (66.4) |
| Klebsiella | 10 (17.5)| 10 (12.0)  | 20 (14.3) |
| Proteus    | 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 spp 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 Klebsiella spp and 6 (10.5%) for Proteus spp. In females the percentage was 61(73.5%) for E. coli, 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.

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