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Prevalence of Klebsiella pneumoniae ESBLs Producer Strains in Hospitalized and Community Acquired Urinary Tract Infections

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Abstract

***Background*:** Klebsiella pneumoniae is considered of the bacteria causing urinary tract infection and one of the opportunistic pathogens and cause of nosocomial infections. Outbreak of ESBL (broad-spectrum β-Lactamase) in the bacteria leads to the improvement of antibiotic resistance and mortality in patients.

***Materials and Methods*:** This descriptive study in 2010 took 22 months. Bacteria were identified according to the microbiological methods and production of broad-spectrum β-Lactamase through screening and confirmatory tests.

***Results*:** Based on the results, the frequency of *Klebsiella pneumoniae* in samples of inpatients and outpatients has been respectively 15% and 14%, and the frequency of broad-spectrum β-Lactamase in *Klebsiella pneumoniae* bacteria in samples of inpatients and outpatients has been respectively 64% and 22%.

***Conclusion*:** The results indicated the prevalence of broad-spectrum β-Lactamase in isolated strains from comparison between inpatients and outpatients.

Introduction

Nosocomial infection is acquisitive infection in hospital by patient who has been hospitalized for a reason other than infection problem. According to the reviews of World Health Organization, the frequency of nosocomial infections among inpatients is reported averagely 8.7% [1, 2]. Nosocomial infections are of major factors of mortality of patients in medical centers which impose considerable costs on patients and health system [1].

Urinary tract infection is the second infection in human. Urinary infections cause fewer complications than nosocomial infections, but they occasionally can cause bacteremia and death. Urinary tract infection is usually characterized with microbiological properties that are positive culture more than 10 microorganisms per milliliter of urine associated with a maximum of two bacterial species [3]. Urinary infections are mainly caused by bacteria that are colonic flora, including gram-negative organisms causing UTI, including *E. coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa* and *Proteus spp* [3].

The most important method of resistance of bacteria against antibiotics of β-Laktam family is production of β-Lactamase [1, 2]. Broad-spectrum β-Lactamases are β-Lactamases that hydrolyze the broad spectrum cephalosporins, including cefotaxim, ceftriaxone and ceftazidime. These enzymes lack the ability to hydrolyze cephamycins and carbapenems [1, 4].

Broad-spectrum β-Lactamases are found in some family members of Enterobacteriaceae and *Pseudomonas aeruginosa*. The major bacteria producing broad-spectrum β-Lactamases are *Escherichia coli* and *Klebsiella pneumonia* [1, 2]. Generators of Broad-spectrum β-Lactamases strains are identified through various methods including microbus sensitivity testing, MIC, E-test, Molecular tests, including LCR, PCR and sequencing genes broad-spectrum β-Lactamases [5, 6]. The specialized method proposed by CLSI to identify the bacteria causing broad-spectrum β-Lactamases are divided into two categories: screening tests and confirmatory tests [5, 6].

According to the prevalence of broad-spectrum β-Lactamase-producing *Klebsiella pneumoniae* bacteria in urinary tract infections and the importance of identification and frequency of the mentioned strains and given the spread of drug-resistant nosocomial infections, this study was conducted to review and compare relative frequency of broad-spectrum β-Lactamase-producing *Klebsiella pneumoniae* bacteria in urinary tract infections in inpatients and outpatients.

Materials and Methods

This research was a descriptive study which was conducted from 6 June 2009 to 6 March 2011 in Shariati and Kashani hospitals for 22 months. In this study, 60 *Klebsiella pneumoniae* bacteria isolated from non-nosocomial urinary tract infections and 72 *Klebsiella pneumoniae* bacteria isolated from urinary tract infections were investigated. For this purpose, first, middle urine samples were taken for culture. Then, it was cultured on

conventional microbiological medium including eosin methylene blue and blood agar and incubated at temperature 35 C for 18 to 24 hours. *Klebsiella pneumoniae* and other factors causing urinary tract infection were identified based on microbiologic methods including Gram staining, biochemical tests, and the use of differential and specialized mediums [1, 2, 7].

To confirm *Klebsiella pneumoniae* bacteria producing broad-spectrum β-Lactamase, combination of screening and confirmatory tests were used based on the Kirby-Bauer method using 30 µg ceftazidime disc and 30/10 µg ceftazidime-clavulanic acid and 30 µg cefotaxime and 30/10 µg cefotaxime-clavulanic acid manufactured by Mast Company of England. For all isolated bacteria, antibiotic sensitivity was conducted according to Kirby-Bauer method and ATCC 700603 *Klebsiella pneumoniae* bacteria was used for quality control of this stage [8].

Sampling method in the research was simple sampling and this continued until achieving the desired sample size. The necessary sample size for this study was calculated using sample size estimation formula for the prevalence studies mentioned below and considering 95% confidence level, the error rate of 10% and prevalence of broad-spectrum β-Lactamases obtained from 5% to 35% (average 20%) in the reviews performed in other studies, as at least 62 samples of *Klebsiella pneumoniae* and finally, 132 samples of *Klebsiella pneumoniae* bacteria, 60 bacteria samples in non-nosocomial group and ultimately, 72 bacteria in nosocomial group were investigated.

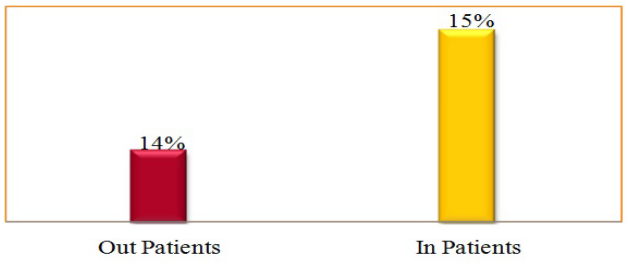

Figure 1. Relative frequency of Klebsiella pneumoniae strains in urinary tract infections isolated from inpatients and outpatients

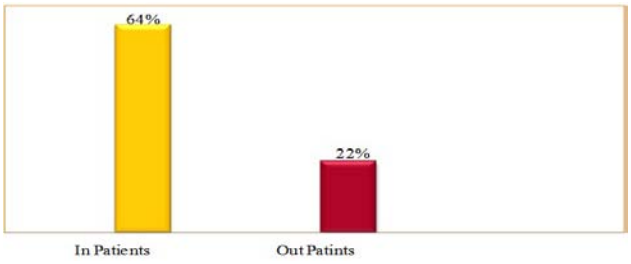

Figure 2. Relative frequency of ESBL in Klebsiella pneumoniae strains isolated from inpatients and outpatients

Results

In non-nosocomial group, 60 *Klebsiella pneumoniae* bacteria were studied. Relative frequency of *Klebsiella pneumoniae* bacterium among factors causing non-nosocomial urinary tract infection in selected centers was 14%. In the nosocomial group, 72 *Klebsiella pneumoniae* bacteria were studied. Relative frequency of *Klebsiella pneumoniae* bacterium among factors causing nosocomial urinary tract infection in selected centers was 15% (Fig. 1). The relative frequency of broad-spectrum β-Lactamase in *Klebsiella pneumoniae* bacteria isolated from non-nosocomial urinary tract infections was determined 22% and of broad-spectrum β-Lactamase in *Klebsiella pneumoniae* bacteria isolated from nosocomial urinary tract infections was determined 64% (Fig. 2). The highest relative frequency of broad-spectrum β-Lactamase-producing *Klebsiella pneumoniae* in nosocomial urinary tract infections in selected centers was reported 74% and the highest relative frequency of broad-spectrum β-Lactamase-producing *Klebsiella pneumonia* bacterium in non-nosocomial urinary tract infections in selected centers was reported 28/6%.

Discussion

The results of the present study indicate respectively 64% and 22% prevalence of broad-spectrum β-Lactamase in *Klebsiella pneumoniae* strains isolated from urinary tract infections in nosocomial and non-nosocomial patients increasing prevalence of antibiotic. Resistant microorganisms such as broad-spectrum β-Lactamase producing gram negative bacteria among sensitive patients have led to the spread of dangerous infections. Resistance and transmission of resistant bacteria occurs by the pressure resulting from the misuse of selected antibiotics. Resistant bacteria are transmitted among patients with a high prevalence and the most important causes of this phenomenon may be excessive prescription of medication, prescription of inadequate doses, inappropriate treatment and wrong diagnosis of bacteria causing the infection by laboratory and subsequently, selection of inappropriate antibiotic to treat or perform Antibiogram.

In the present study, the relative frequency of broad spectrum β-Lactamase in *Klebsiella pneumoniae* bacteria isolated from nosocomial urinary tract infections in selected medical centers was 64% which was significantly (p<0.001) greater than frequency of *Klebsiella pneumoniae* bacteria isolated from non-nosocomial urinary tract infections 22%. The results of the study of Mirsalehian et al. in 2006 in Iran showed that 76.74% of Klebsiella species isolated from intensive care unit have been generating broad-spectrum β-Lactamases [9]. In 2000, according to the report published by SENTRY Antimicrobial Surveillance, prevalence of broad-spectrum β-Lactamases in Klebsiella species has been reported 19% [10].

In a review by Yun-Kyung Kim et al. in 1993-1998 in hospitals of Seoul, frequency of ESBL in *Klebsiella pneumoniae* isolated from blood cultures of children was 52/9% [5]. In recent years, the prevalence of ESBL in America, Canada, China and Italy have been significantly increased [11-14].

According to the studies of Winokur in 2001, the highest prevalence of ESBL has been reported with a prevalence

of 45% in *Klebsiella pneumoniae* strains isolated from Latin America and the lowest rate with prevalence of 5% in Canada [15].

The results of this study and other studies in this regard indicate the greater frequency of ESBL in *Klebsiella pneumoniae* strains isolated from nosocomial samples compared with non-nosocomial samples that on the one hand indicates a higher risk for inpatients to acquire ESBL productive strains are community, and on the other hand, it indicates the prevalence of ESBL productive strains in the hospital environment which can indicate lack of compliance with standards of personal hygiene of personnel and public health in hospitals.

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Authors' Contributions

All authors had equal role in design, work, statistical analysis and manuscript writing.

Conflict of Interest

The authors declare no conflict of interest.

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