

Trend of Antibiotic Resistance Among *Acinetobacter* spp. Strains Isolated From Wound Infections in Ghaem University Hospital in Northeast of Iran From 2005 to 2011

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Background: *Acinetobacter* has become an important cause of different infections such as wound infection, due to its great ability to survive and spread in hospital settings and to develop resistance against many antibiotics.

Objectives: The aim of this study was to investigate the antibiotic resistance among isolates of *Acinetobacter* from wound infections during a 7-year period, from 2005 to 2011, in Ghaem University Hospital, Mashhad.

Patients and Methods: During this period, patients with nosocomial wound infections were identified according to national nosocomial infections surveillance system (NNIS) and appropriate samples were taken from their wounds. Furthermore, microbiological procedures were performed to identify the bacterial strains causing the infection. Antibiotic susceptibility of *Acinetobacter* isolates was determined by disk diffusion method.

Results: Based on the guideline, 324 cases of infection were identified and 43 samples of *Acinetobacter* strains were isolated. During this 7-year period, the resistance to kanamycin and norfloxacin was increased among these 43 samples. However, the resistance against ampicillin, ciprofloxacin, cefixime, trimethoprim-sulfamethoxazole, cefotaxime, cefazolin, gentamicin, and ceftizoxime was not significantly increased. The overall bacterial resistance was high. The pick of *Acinetobacter* species was observed in 2006 and 2007.

Conclusions: Our results demonstrated a high antibiotic resistance among *Acinetobacter* species isolated from wound infections. The increased resistance to antibiotics such as kanamycin and norfloxacin was due to their vast application in treatments. Moreover, the decreased resistance to other noted antibiotics was probably due to their low application.

Keywords: *Acinetobacter*; Drug Resistance; Microbial; Wound Infection

1. Background

Pathogenic bacteria have become increasingly resistant to antimicrobial treatments. Recently, this resistance problem has been relatively much worsened among Gram-negative bacilli. Although, genus *Acinetobacter* was originally identified in the early 20th century, it was recognized as a ubiquitous pathogen only in the last decade (1). *Acinetobacter* spp. are aerobic, nonfermentative and saprophytic bacteria that are found most commonly in the environment including water, soil, and sewage; furthermore, they can be seen on both dry and damp surfaces in the nature and in hospitals (2).

Acinetobacter spp. have become a major concern due to their great ability to survive and spread in hospital settings and developing resistance against many antibiotics (3). They are responsible for many cases of pneumonia, bacteremia, meningitis, urinary tract infection, and wound infection in hospitals nowadays (2).

One of the significant features of bacteria of this genus is their rapid and progressive acquisition of resistance

against antibiotics. Thus, rapid identification of bacteria could be an important step in the treatment of the infection and consequently preventing the spread of resistant strains (4).

The attention of the scientific community with interest in this pathogen should therefore be directed to developing and introducing new antimicrobial agents that are effective against *Acinetobacter* spp., as well as to the implementation of infection control measures that may help control the increasing problem of *Acinetobacter* spp. infections which have taken epidemic dimensions in several parts of the world, especially in critical patients (5).

2. Objectives

The aim of this study was to investigate the resistance against antibiotics in isolates of *Acinetobacter* spp. from nosocomial wound infections during a 7-year period in Ghaem University Hospital, Mashhad.

3. Patients and Methodss

In this descriptive study, during 2005-2011 period, appropriate samples were taken from wound infections in hospitalized patients in different sections of Ghaem Hospital (including the internal, surgical, pediatric, emergency, thoracic, and ICU wards), in accordance with the national nosocomial infection surveillance (NNIS) guidelines. Furthermore, subsequent microbiological procedures were performed for the purpose of isolation and identification of bacteria causing the infection. Ghaem University Hospital is an 840 beds general hospital which provides educational, research and therapeutic services in northeast of Iran. Sampling procedures: After cleaning the lesion's surface and surrounding areas with normal saline solution, appropriate samples were taken from depth of wound.

Bacterial identification: Microscopic evaluations of direct smears were performed. Aerobic cultivation for bacteria was implemented by inoculation on sheep blood agar and MacConkey agar. The cultures were incubated at 36°C for 48 hours. Primary characterization of the isolates was based on the microscopic Gram stain examination, as well as on the morphological and cultural characteristics of colonies. Bacterial genus and species were identified by standard identification testing according to guidelines (6). The antibiotics susceptibility profile of isolates was detected according to CLSI guidelines (7).

All isolated *Acinetobacter* spp. were tested by the disk diffusion method on Mueller-Hinton agar. The disks that were used include: ampicillin (a beta-lactam antibiotic), ciprofloxacin and norfloxacin (fluroquinolone), cefexime, cefotaxime, ceftazolin and ceftizoxime (cephalosporin), kanamycin and gentamicin (aminoglycoside), and trimethoprim-sulfamethoxazole (anti-metabolite).

4. Results

Based on the NNIS guidelines, 324 cases of nosocomial wound infection were identified. *Acinetobacter* spp. were isolated from 43 samples (31 samples from men and 12 samples from women). 58.1% of the samples were isolated from surgical wards. Moreover, 20.9% and 9.3% of the samples were isolated from ICU and medical wards respectively.

The majority of the infection cases (25.5%) were observed during 2006 and 2007. Furthermore, 11.6% and 13.9% of the samples were isolated in 2008 and 2010 respectively. Kanamycin resistance was 33.3% and 28% in thoracic and surgical wards respectively and was observed in more cases of women than in men. Most of the kanamycin resistance strains were isolated during 2011 (75%) and 2008 (40%).

Norfloxacin resistance was 51.6% in men and the utmost resistance to this antibiotic was observed in surgical and internal wards. The maximum resistance to norfloxacin in this 7-year period was in 2010 (83.3%).

Cefexime resistance was 41.9% in men and the resistance was mostly observed in surgical and ICU wards (48% and 44.4% respectively). Furthermore, Most of resistance was in 2006 (72.7%). Ceftizoxime resistance was 74.1% in men

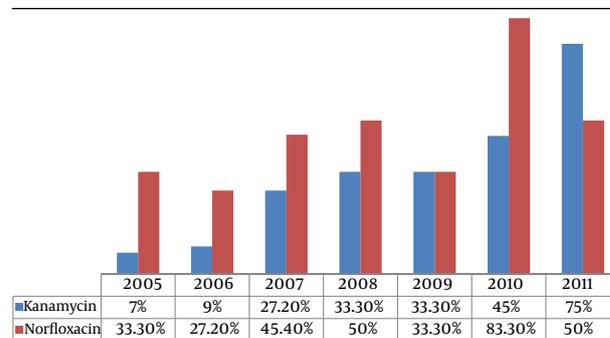


Figure 1. Trend of Resistance in Kanamycin and Norfloxacin During the 7-Year Period (2005-2011)

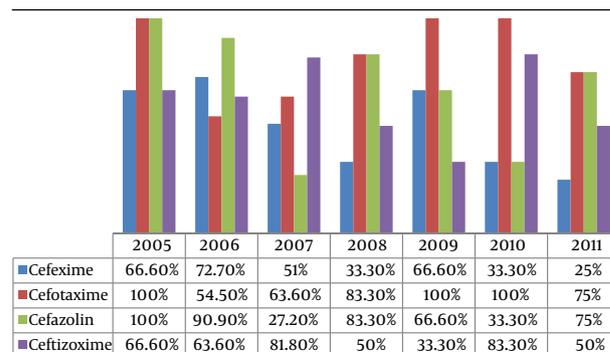


Figure 2. Trend of Resistance in Cefexime, Cefotaxime, Cefazolin, and Ceftizoxime During the 7-Year Period (2005-2011)

and 50% in women. The resistance was mostly observed in internal, ICU and surgical wards (75%, 66.6% and 64% respectively). The resistance to ceftizoxime was very high in 2010 (83.3%) and in 2007 (81.8%).

Cefazolin resistance was 67.7% in men and 50% in women. The resistance was mostly observed in ICU (88.8%), thoracic (66.6%), and surgical wards (60%). In addition, the pick of resistance was in 2008 (100%).

Cefotaxime resistance was 77.4% in men and 75% in women. The resistance was mostly observed in ICU, surgical, thoracic and internal wards (100%, 76%, 66.6% and 50% respectively). During 2008-2010 periods, resistance to cefotaxime was 100%.

Ampicillin resistance was 66.6% in women and 45.1% in men. The resistance was mostly observed in surgical ward (56%), ICU ward (44.4%), and internal ward (25%). In 2005 and 2009, ampicillin resistance was 100%. Gentamicin resistance was 66.6% in women, which was higher than in men and the resistance was mostly observed in surgical ward. In 2009 and 2010, the resistance to this antibiotic was 66.6%.

Ciprofloxacin resistance was 32.2% in men, which was higher than in women and the resistance was mostly observed in internal, ICU and surgical wards (50%, 44.4%, and 28% respectively). The pick of resistance was in 2008. Trimethoprim-sulfamethoxazole resistance was 66.6% in women and 48.3% in men and the resistance was mostly observed in surgical (60%) and ICU (55.5%) wards. In 2009, resistance to this antibiotic was 66.6%.

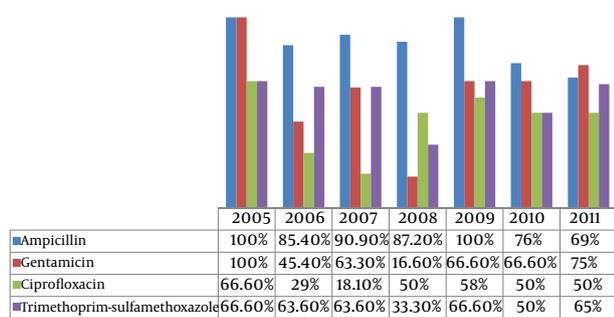


Figure 3. Trend of Resistance in Ampicillin, Gentamicin, Ciprofloxacin, and Trimethoprim-Sulfamethoxazole During the 7-Year Period (2005-2011)

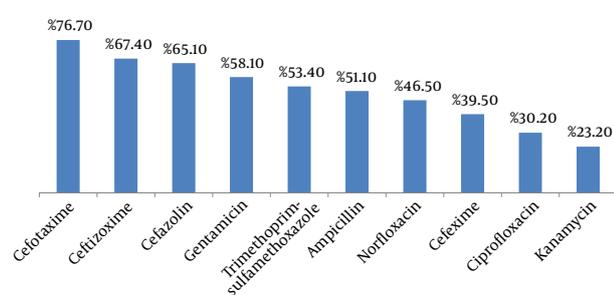


Figure 4. The Mean of Antibiotic Resistance in This Study for Each Individual Antibiotic During the 7-Year Period (2005-2011)

Among all these samples, resistance to kanamycin and norfloxacin was increased during the 7-year period and resistance against ampicillin, ciprofloxacin, cefexime, trimethoprim-sulfamethoxazole, cefotaxime, cefazolin, gentamicin, and ceftizoxime were not significantly increased. The overall bacterial resistance was high. The pick of *Acinetobacter* spp. was observed in 2006 and 2007.

5. Discussion

Emergence and spread of *Acinetobacter* spp, resistant to most of the antibiotics, is an area of great concern. In this study, trend of antibiotic resistance was studied among *Acinetobacter* spp. strains isolated from nosocomial wound infections in Northeast of Iran from 2005 to 2011. There are some other studies which considered the prevalence of multidrug resistant (MDR) *Acinetobacter* in different parts of the world (8, 9).

Karabay et al. reported the mortality rates of nosocomial *Acinetobacter* infections between 50-60%, depending on several factors (10). In his study, *Acinetobacter* infection was identified in 56 patients (29 females, 27 males; mean age: 63 years) that were all in the intensive care units during the study period. The total mortality rate was estimated as 77% (43/56) (10).

In another study, Lee showed that the overall 14-day mortality rate was 29.8%. The unadjusted mortality rate for an appropriate antimicrobial therapy was 13.2%. Appropriate antimicrobial therapy significantly reduced

14-day mortality for *Acinetobacter* bacteremia in severely ill patients (11). In Rahbar's study, *Acinetobacter* spp. were isolated from clinical specimens obtained from patients hospitalized in an Iranian 1000-bed tertiary care hospital in Tehran from July 2005 to November 2006 (12). He reported that the *Acinetobacter* spp. Isolates showed high rate of resistance to ciprofloxacin (90.9%) (12), which is higher than the rate we obtained in our study. In another study, Mohammadtaheri et al. (13) investigated the antimicrobial susceptibility patterns among common pathogens in the intensive care unit (ICU) of a university hospital in Iran from 2006 to 2009. He demonstrated that less than 7% of *Acinetobacter* spp. isolates were susceptible to aminoglycosides, cefotaxime, and ciprofloxacin (13).

In a similar study, the antimicrobial resistance of nosocomial strain of *Acinetobacter baumannii* in the Tehran Children's Medical Center was investigated. The susceptibility rates to ciprofloxacin, cephalosporins, ceftizoxime, and cefexime were 20.1%, 9.3%, 18% and 18% respectively. In addition, the susceptibility rates to kanamycin and gentamicin decreased gradually from 50% and 50% in 2002 to 15.6% and 28.1% in 2007 respectively (14). However, the resistance to kanamycin had an increasing progress in this study.

Vahdani et al. showed that in hospital-acquired antibiotic-resistant *Acinetobacter baumannii* infections in a 400-bed hospital in Tehran, the organism was resistant to ceftizoxime (95%), gentamicin (68%), and ciprofloxacin (85%). The susceptibility rates of *Acinetobacter* isolates to third-generation cephalosporins, fluoroquinolones, gentamicin, and trimethoprim/sulfamethoxazole (SXT) were very low (15).

Considering this study and above mentioned reports, there should be great concern about choosing therapeutic options, including combination therapies available. There is an urgent need to enforce infection control measures and antimicrobial stewardship programs to prevent the further spread of these resistant *Acinetobacter* species and to delay the emergence of increased resistance in the bacteria (16).

Our results showed a high resistance against antibiotics among *Acinetobacter* spp. isolated from nosocomial wound infections. The resistance to antibiotics such as kanamycin and norfloxacin was increased due to the high usage of these antibiotics in treatments. Furthermore, the resistance to other noted antibiotics was reduced, probably due to their decreased application in the course of the treatments.

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Authors' Contributions

Authors have contribution in concept, data gathering, analysis and writing

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