Evaluation of Antimicrobial Resistance Pattern of Nosocomial and Community Bacterial Pathogens at a Teaching hospital in Tehran, Iran

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Abstract-Antimicrobial resistance in pathogens not only in hospitals but also in the community has become an important public health problem. The aim of this study was to determine the antimicrobial resistance patterns of predominant pathogens from hospitalized and outpatients in a university hospital in Tehran, Iran. A total of 820 samples of common Gram-negative and Gram-positive bacteria were collected from a major referral and teaching hospital affiliated to Tehran University of Medical Sciences in Iran during April 2010 to February 2011. The pattern of antibiotic resistance was determined by disk diffusion test as recommended by the Clinical Laboratory and Standards Institute (CLSI). Gram-negative bacilli were the most isolated pathogens. *Acinetobacter spp*. and *Pseudomonas aeruginosa (P. aeruginosa*) was the most antibiotic-resistant pathogens. Imipenem and piperacillin/tazobactam were the most active antimicrobials against gram-negative bacilli whereas vancomycin was the antimicrobial agent most consistently active against the Gram-positive *cocci.* Community-acquired organisms were more susceptible to antimicrobial drugs tested than nosocomial isolates. The rates of antibiotic resistance among isolated pathogens in this study were approximately similar to other studies. However, high rates of antibiotic resistance among *Acinetobacter spp* and *P. aeruginosa*, the most isolated pathogens, indicating that antibiotic policy is urgently needed to prevent the resistance development ago.

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Keywords: Antimicrobial resistance; Bacterial Pathogen; Nosocomial; Community

Introduction

The patient in the hospital has a higher risk of nosocomial infection compared with the other patient. This is a result of impaired defense mechanism, applying invasive methods, exposure to broad-spectrum antibiotics, and the colonization of resistant microorganisms (1, 2).

Antimicrobial resistance in bacteria not only in hospitals but also in the community has become an important public health problem (3-6). In response to these concerns, improving antibiotic prescribing, dose and duration of treatment and as well as monitoring antimicrobial resistance is part of the strategy to reduce antibiotic resistance (7, 9). These strategies in most developing countries have not been implemented and favoring the emergence of resistant bacteria. In Iran, antimicrobial therapy constitutes a major form of infections treatment. Despite surveillance system to monitoring antimicrobial resistance has been established in Iran, limited published data is available on antimicrobial resistance patterns of bacteria originated from hospital and community. Having an awareness of antimicrobial resistance patterns, particularly in hospital, is crucial for choosing an appropriate antimicrobial treatment and consequently minimizing the hospitalization period, morbidity, and mortality.

This study presents data on antimicrobial resistance patterns of predominant pathogens from hospitalized and from outpatients in one of the referral university hospitals of Tehran, Iran.

Materials and Methods

A cross sectional study was carried out in a university

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hospital in Tehran, Iran during 5 March 2011 to 25 February 2012. This is a public general reference hospital with 350 beds with different wards. Clinical specimens, including blood, urine, wound/tissue, cerebrospinal fluid and respiratory specimens were collected from patients in different wards of the hospital. According to the Centers for Disease Control and Prevention (CDC) definitions, all isolates from patients with ≤ 48 hours of hospitalization (community-acquired) and those with >48 hours of hospitalization (nosocomially-acquired) were included in the study (10). Only 1 isolate per patient was included. Bacterial identification was performed by standard microbiologic methods. In vitro activities of amikacin, ceftriaxone, ciprofloxacin, Ampicillin/sulbactam, co-trimoxazole, erythromycin, rifampin, chloramphenicol, oxacillin, gentamicin, imipenem, piperacillin-tazobactam and vancomycin were determined by disk diffusion method in accordance with the Clinical and Laboratory Standards Institute (CLSI) guidelines (11).

Antimicrobial susceptibility testing

The isolated bacteria were inoculated on Mueller Hinton agar (Mast group Ltd, Merseyside, UK) and antimicrobial susceptibility testing was performed using disk diffusion method (as recommended by CLSI No: M2-A9). The antibiotic disks were provided from Mast diagnostic group Ltd. The antibiotic panels for each group of isolates were selected according to CLSI guidelines (as described by Clinical and Laboratory Standard Institute (CLSI) No: M100-S16).

The inhibition zone diameter was measured using a scaled ruler (antibiotic zone scale) and reported as resistant, intermediate and susceptible. E. coli ATCC 25922, *Pseudomonas aeruginosa* (*P. aeruginosa*} ATCC 27853 and Staphylococcus aureus ATCC 25923 were used as control strains and the test results were only accepted when the inhibition zone diameters of the above mentioned control strains were within performance ranges (as described by CLSI No:M100-S16). In case of mixed bacteria, only the major and predominant pathogens were tested. The antibiotics used for susceptibility testing were norfloxacin 10 µg, ofloxacin 5 µg, Ciprofloxacin 5 µg, nitrofurantoin 300 µg, co-trimoxazole (SXT), carbenicillin 100 µg, and ampicillin 10 µg, cephalothin 30 µg, gentamicin 10 µg, amikacin 30 µg, nalidixic acid 30 µg, cefotaxime 30 µg, imipenem 10 µg, tetracycline 30 µg, penicillin 10 IU, oxacillin 1 µg, vancomycin 30 µg, ceftriaxone 30 µg, and ticarcillin 75 µg.

Statistical analysis was carried out using SPSS version 11.5 and resembled with Chi-square test. All tests were two-tailed with $P<0.05$ considered significant. This study accepted by Ethical Committee of Tehran University of Medical Sciences.

Results

A total of 820 samples were obtained. Among these, 312 (38 %) were community-acquired. The most common sources for specimen were blood followed by urine, cerebrospinal fluid, respiratory tract and wound/tissue. The most common gram-positive *cocci* included S. aureus, coagulase-negative *staphylococci*, *Staphylococcus epidermidis*, *Enterococcus spp.*, *Streptococcus pyogenes* and *Streptococcus agalactiae*, which together represented 44.3% of all isolates. The most common gram-negative bacilli included *Acinetobacter spp*., *Escherichia coli*, *P. aeruginosa*, Klebsiella pneumoniae, *Enterobacter spp*., *Proteus mirabilis*, *Citrobacter freundii* and *Serratia marcescens*, which together made up 55.7% of all organisms. Antimicrobial results of the predominant pathogen of community- and nosocomial origin are shown in table 1 and table 2. The vancomycin was the antimicrobial agent most consistently active in vitro against the Gram-positive *cocci*, whereas imipenem and piperacillin/tazobactam were the most active antimicrobials against gram-negative bacilli.

Table 1. Resistance rates (%) for the most common gram-positive cocci

Organism	No. isolates	CIP*	ERT	OXA	GEN	COT	CHL	VAN	RIF
S. aureus									
(≤48 h)	53	35	61	46	31	17	22	0	22
(>48 h)	31	40	56	56	30	37	43	17	45
S. epidermidis									
(≤48 h)	35	26	32	51	38	71	0	0	10
(>48 h)	19	28	54	73	41	50	10	0	0
***Enterococcus* spp**									
(≤48 h)	38	26	85	53	10	79	54	38	14
(>48 h)	14	37	83	66	0	66	47	22	0

*Ciprofloxacin, Erythromycin, Oxacillin, Gentamicin, Co-trimoxazole, Chloramphenicol, Vancomycin, Rifampin

Table 2. Resistance rates (%) for the most common gram-negative bacilli

Organism	No. isolates	IPM*	CIP	CAZ	CEF	COT	TZP	A/S	AMK	GEN
E. coli										
(≤48 h)	58	1	53	43	65	61	3	51	9	12
(>48 h)	47	0	38	50	73	76	4	57	13	25
P. aeruginosa										
(≤48 h)	44	5	39	41	57	60	12	92	24	15
(>48 h)	32	20	52	50	81	85	27	87	23	28
K. pneumonia										
(≤48 h)	33	3	29	16	41	43	5	39	31	30
(>48 h)	21	0	23	0	45	65	0	63	7	16
Enterobacter spp										
(≤48 h)	36	0	13	15	51	30	3	36	14	13
(>48 h)	20	0	21	0	81	24	30	78	10	0
Acinetobacter spp										
(≤48 h)	60	5	76	28	65	73	13	10	16	79
(>48 h)	49	12	68	15	89	80	24	14	20	70

*Imipenem, Ciprofloxacin, Ceftazidime, Ceftriaxon, Co-trimoxazole, Piperacillin/Tazobactam Ampicillin/Sulbactam, Amikacin, Gentamicin

The high susceptibility of S. aureus to Vancomycin (100%), Co-trimoxazole (83%), Chloramphenicol (78%) and Rifampin (78%) were documented. For S. epidermidis no resistance to vancomycin was observed

Among the gram negative bacteria P. aeruginosa and Acinetobacter spp were most resistance pathogens. Resistance rates for P. aeruginosa were as follows: Ampicillin/sulbactam, 92% and Co-trimoxazole, 60. Imipenem was the most effective antibiotic against Acinetobacter spp followed by Ampicillin/Sulbactam and piperacillin/tazobactam.

Community-acquired organisms were more susceptible to antimicrobial drugs tested than nosocomial isolates.

Discussion

Antimicrobial resistance is an increasingly emerging problem worldwide especially in developing country. Identifying the resistance pattern of microorganisms in every hospital is necessary to select appropriate antibiotics for treatment of infections. According to this study, Gram-negative bacilli were the most isolated pathogens from all clinical specimens in different part of hospital. This observation was approximately similar to that seen in other studies (12-14). During the last decade, the emergence of resistance among Gram-negative bacilli have become a growing concern (15). In the current study, Acinetobacter spp. was the most antibiotic-resistant Gram-negative bacilli. This is in agreement with that reported in studies from Iran, Spain and United States (12,16,17). As reported by other studies, Imipenem was the most effective antibiotic against Acinetobacter spp in our study (18-21). Some other surveys have reported P. aeruginosa as the most resistant organism (18, 19). This is consistent with this study that showed this pathogen as the second most resistant isolate. In the present study, the most effective antibiotic against this pathogen was Imipenem, while in the other study that conducted in Iran the most effective antibiotic was ciprofloxacin (12,20).

Resistance to Ceftriaxon in Klebsiella spp. and E. coli was higher to that of other studies (22,23). Although the antibiotic use contributes to the emergence of antimicrobial resistance in gram negative bacteria, it also causes resistance in gram positive (23,24).

Resistant to oxacillin among S. epidermidis and S. aureus in this study is high and comparable to what has been reported in other countries (25-27). This highlights the need for strategies to prevent misuse of Antibiotics.

All S. epidermidis isolated in this study were susceptible to vancomycin. Similar findings have been reported in other survey (28).

Until recent years, the majority of the infections caused by resistance pathogens were described as nosocomial (29). However, recent data suggest that infections caused by resistance microorganisms are an emerging problem in community patients (30-33). However, in this study, community-acquired organisms were more susceptible to antimicrobial drugs tested than nosocomial isolates. This was similar to other studies (21,30). Nosocomially-acquired E. coli were significantly more resistant to beta-lactams that

community isolates, and nosocomially-acquired P. aeruginosa were significantly more resistant to all antimicrobial drugs evaluated. These results are consistent with the concept that isolates acquired in the hospital are usually more resistant than those acquired in the community (21).

In this study the most isolated organisms among clinical specimens were belonging to the gram-negative bacteria. The rates of antibiotic resistance among clinical isolates achieved in our study were approximately similar with previous studies performed elsewhere in Iran and international studies. However, high rates of antibiotic resistance among Acinetobacter spp and P. aeruginosa, the most isolated pathogens, indicating that antibiotic policy is urgently needed to prevent the resistance development. Regions surveillance studies in the Iran will be most useful to deciding out the correct empirical treatment and will help to control and prevent infections caused by resistant pathogens. Furthermore, our data suggest that the most effective antibiotics for gram-negative bacilli in our region are imipenem followed by piperacillin/ tazobactam and for gram-positive organisms is vancomycin.

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