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Detection of Antibiotic Resistance Pattern of Isolated Bacteria from a Hospital

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Background & Aims of the Study: Antibiotic resistance is an important problem in health care. The aim of this study was the survey of prevalence of bacteria isolated in a university affiliated hospital (Kerman, Iran) and detection of antibiotic resistance among major pathogens.

Materials & Methods: In this cross-sectional study, during a 3-year period (from June 2006 to June 2009) 14699 samples such as urine, blood, sputum, and cerebrospinal fluid obtained from patients hospitalized in a university affiliated hospital (Kerman, Iran). After isolation and identification of bacteria using standard microbiologic methods, antibiotic resistance testing was performed with the diffusion-disk method for several antibiotics.

Results: A total of 1910 (12.15%) specimens were positive for bacterial contamination. The cultures most positive cases were from urine specimen (67.75%). The majority of frequent microorganisms isolated were *E. coli* (41.52%), *Staphylococcus aureus* (17.96%), *Klebsiella pneumoniae* (9.48%), *Staphylococcus coagulase-negative* (8.27%), *and Pseudomonas aeruginosa* (7.49%), respectively. The high rate of resistance of *E. coli* was related to amoxicillin (70.36%), *Staphylococcus aureus* to oxacillin (66.76%), *Klebsiella pneumoniae* to amoxicillin (62.76%), *Staphylococcus coagulase-negative* to penicillin (74.68%) and *Pseudomonas aeruginosa* to cefotaxime (71.32%).

Conclusions: We found that antimicrobial resistance is a problem of our hospital. The high consumption of antibiotic in the community can be a cause of a major problem in treatment.

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Background

Antibiotic resistance of bacteria has been discussed as a particular concern for hospital-acquired (nosocomial) infections that is the major factor in increasing rates of bacterial resistance worldwide (1,2).

Increasing appearance and distribution of drug-resistant bacteria has become a growing problem in hospitals. However, it should be noted that diseases caused by resistant bacteria are associated with higher rates of morbidity and mortality (3). In addition, it is demonstrated that the widespread of resistance can be reduced with the correct use of antibiotics. However, various studies indicated that increasing resistance of bacteria is different worldwide (4).

Although the new antimicrobial drugs as an important emerging group are used to treat patients, but resistance to them is increasing.

Existence of β-lactamases (*i.e.*, extended-spectrum β-lactamases [ESBL] and Metallo-β-lactamase [MBL]) among bacteria is a major problem that can be transferred to others by plasmid (5).

Aims of the study: Therefore, the aim of this study was the survey of prevalence of bacteria isolated in a university affiliated hospital (Kerman, Iran) and detection of antibiotic resistance among major pathogens.

Materials & Methods

Bacterial isolates: In this cross-sectional study, during a 3-year period (from June 2006 to June 2009) a total of 14699 samples including faeces, wound, sputum, urine, cerebrospinal fluid (CSF), tracheal, blood, and gastric aspirate obtained from patients hospitalized in a university affiliated hospital (Kerman, Iran) and sent to microbiology laboratory.

The identification of the bacteria isolated was confirmed by biochemical tests.

Antimicrobial resistance testing: For the resistance survey, different antibiotics (Himedia Laboratories, India) were used (table 1). Antimicrobial resistance was determined by disc-diffusion method according to the Clinical and Laboratory Standards Institute (CLSI).

Data analysis: All information including percentage of prevalence and antibiotic resistance results were calculated using SPSS software version 17.

Results

From 14699 collected specimens, 1910 (12.15%) cultured were positive for bacterial contamination.

The most positive cases recorded were as follows:

Urine specimens 67.75% (1297 cases), followed by blood specimens 21.41% (409 cases) and other specimens 10.84% (204 cases).

The most isolated bacteria were *E. coli* 41.52% (n=793), *Staphylococcus aureus* 17.96% (n=343), *Klebsiella pneumoniae* 9.48% (n=188), *Staphylococcus coagulase-negative* 8.27% (n=158), *Pseudomonas aeruginosa* 7.49% (n=143), *Streptococci spp*. 6.65% (n=127), respectively.

Other bacteria isolated with low prevalence were *Proteus spp.* 2.72% (n=52*), Acinetobacter spp*. 1.78% (n=34), *citrobacter spp*. 1.52% (n=29), *Enterococci spp*. 0.58% (n=11), *Salmonella spp.* 0.37% (n=7), *Neisseria meningitides* 0.37% (n=7), *Haemophilus influenzae* 0.37% (n=7), *Serratia spp*. 0.31% (n=6*), Shigella spp*. 0.21% (n=4) and *Morganella spp*. 0.05% (n=1), respectively.

The recorded high-level resistances to antimicrobial agents are shown in table 1.

Table 1) The most antibiotic resistant percentage in isolated bacteria

Antibiotic	Bacteria	Resistance (%)
Amikacin	*Acinetobacter spp.*	37
	E. coli	3.8
	Staphylococcus aureus	7.66
	Staphylococcus coagulase-negative	2.3
Amoxicillin	*E. coli*	70.36
	Klebsiella pneumoniae	62.76
	Proteus spp.	36.53
	Staphylococcus aureus	53.85
	Staphylococcus coagulase-negative	51.25
Ampicillin	*E. coli*	69.05
	Staphylococcus coagulase-negative	60.12
	Staphylococcus aureus	49.85
	Acinetobacter spp.	67.64
	Pseudomonas aeruginosa	46.58
Cefalotin	*Streptococci spp.*	40.38
	Staphylococcus coagulase-negative	10.75
	Staphylococcus aureus	9.03
Cloxacillin	*Pneumococci*	45.65
	Streptococci spp.	23.58
	Staphylococcus aureus	28.48
	Staphylococcus coagulase-negative	18.82
Co-trimoxazole	*Pseudomonas aeruginosa*	66.43
	pneumococci	60.86
	E. coli	59.89
	Klebsiella pneumoniae	46.27
	Proteus spp.	36.53
Erythromycin	*Staphylococcus aureus*	47.23
	Staphylococcus coagulase-negative	36.70
	pneumococci	30.00
	Streptococci spp.	10.87
Gentamycin	*Klebsiella pneumoniae*	34.38
	Pseudomonas aeruginosa	33.56
	E. coli	25.79
	Staphylococcus aureus	22.20

Antibiotic	Bacteria	Resistance (%)
Cefotaxime	*Acinetobacter spp.*	76.47
	Pseudomonas aeruginosa	71.32
	Klebsiella pneumoniae.	46.68
	E. coli	30.39
	Streptococci spp.	18.58
Ceftizoxime	*Acinetobacter spp.*	60.88
	Pseudomonas aeruginosa	37.76
	Klebsiella spp.	30.25
	Proteus spp.	9.56
	Streptococci spp.	8.93
Ceftriaxone	*Acinetobacter spp.*	64.70
	Pseudomonas aeruginosa	57.34
	Klebsiella pneumoniae	38.29
	Staphylococcus coagulase-negative	35.44
	E. coli	30.21
	Staphylococcus aureus	20.24
Ciprofloxacin	*Klebsiella pneumoniae*	19.68
	Staphylococcus coagulase-negative	18.37
	Pseudomonas aeruginosa	15.28
	E. coli	15.25
	Staphylococcus aureus	9.32
	Staphylococcus coagulase-negative	18.95
Nalidixic acid	*Streptococci spp.*	60.49
	Staphylococcus coagulase-negative	43.67
	E. coli	33.16
	Proteus spp.	30.00
Oxacillin	*Staphylococcus coagulase-negative*	72.15
	Staphylococcus aureus	66.76
	Pneumococci	56.52
Penicillin	*Staphylococcus coagulase-negative*	74.68
	Staphylococcus aureus	62.68
Tetracycline	*E. coli*	46.65
	Streptococci spp.	41.97
	Klebsiella pneumoniae	32.44
	Proteus spp.	38.22
	Staphylococcus coagulase-negative	20.88
	Staphylococcus aureus	16.30

Discussion

Resistance is a major problem in hospital-acquired (nosocomial) infections. Frequently, the bacteria causing hospital-acquired infections are part of the normal flora of human that becomes causes of disease when they multiply in usually sterile sites. Thus, it seems that nosocomial infections are usually transmittable from patients with asymptomatically or symptomatically bacterial infection to other patients (6).

Bacterial pathogen causes of nosocomial infections are becoming resistant to many antibiotics. Thus this is important to identify and control the spread of antibiotic resistance in hospitals. Studies indicate that antibacterial drugs consumption control may decline bacterial resistance and nosocomial infections (7). On the other hand, indiscriminate and uncontrolled use of antibiotic therapy can lead to resistance increase in country. Therefore, recognition of resistance patterns in bacteria isolated from hospitals is a necessity for appropriate treatment of patients.

In this study, the most isolated bacteria were from urine specimens (67.75%), while the study of Al-Lawati showed that the most common site of bacterial isolation was the respiratory tract (65% of cases) (8).

Also in our study a high percentage of isolates was *E. coli* that shown the highest resistance to amoxicillin (70.36%). It is likely that this increase of resistance is due to the production of TEM-1 enzymes. In Cameroon, from the 522 isolated bacteria, 80.3% were *Enterobacteriaceae* (*E. coli* was the predominant bacteria isolated). The percentage of resistance to amoxicillin, piperacillin, trimethoprim/sulfamethoxazole was 85%, 75% and 71%, respectively (9).

In France, on 700 *Enterobacteriaceae* isolated from community-acquired infection, one-thirds of *E. coli* were resistant to amoxicillin (10). In the Netherlands also resistance to amoxicillin for *E.coli* was 56% in 2005. Reduced susceptibility to amoxicillin in *E. coli* may be the result of inappropriate use of antibiotics in community (11).

Coagulase-negative staphylococci (CoNS) are normal flora of human skin and mucous membranes. This bacteria is a cause of bacteremia, CSF shunts infection, endocarditis, *etc.* (12). A high percentage (72.15%) of oxacillin-resistant, *coagulase negative Staphylococci* isolates was found in our study. In Europe, the percentage of methicillin-resistant CoNS varies from country to country.

In Netherlands, prevalence of resistance in CoNS isolated was 21%. In addition, resistance rate to methicillin in a hospital in India was 66% (13). It seems that high resistance in these bacteria is due to *mec-A* gene. The percentage of methicillin-resistant strains containing *mecA* proved to be very high (59.5%) (14).

Klebsiella pneumoniae frequently causes hospital-acquired infections such as urinary tract infections, pneumonia, septicemias, and soft tissue infections. In a hospital, reservoirs and transmission of disease are hands and gastrointestinal tract of personnel. Therefore bacteria have the ability to spread rapidly in the environment (15).

Klebsiella pneumoniae causing infections are usually resistant to most antibiotics. In this study the higher percentage of resistance to amoxicillin was 62.76%. Increasing multidrug resistance of strains is due to production of extended-spectrum beta-lactamases (ESBLs), enzymes that cause resistance to penicillins, such as ampicillin or amoxicillin (16,17). In a study in Singapore hospitals, resistance to amoxicillin in *K. pneumonia* was 36.0%.

Since the first report about methicillin-resistant *Staphylococcus aureus* (MRSA), this bacterium has become a significant nosocomial microorganism throughout the world. The frequency of resistance to antibiotic among *S. aureus* varied in different regions and hospitals (18). Results of our study shown that most of strains of *S. aureus* were resistance to oxacillin (66.76%) which is in agreement with the previous studies (19).

Results of other studies showed that bacteria isolates have significant resistance to methicillin (20).

In a study in Denmark, also approximately 80% of *Staphylococcus aureus* isolated from two hospitals were resistant to antibiotic. In the United States, they recognized that methicillin-resistant *S. aureus* in Intensive Care Unit (ICU) in 2004 increased in comparison with 1998 to 2002 (21,22).

Pseudomonas aeruginosa is one of the pathogen causes of infection in hospitalized patients. In recent years, nosocomial infections increased and resistant strains to available antibiotics have been reported (23).

In our study the highest resistance of *Pseudomonas aeruginosa* was to cefotaxime (71.32%) that is in agreement with Tian's study (24).

In France, 16.8% of *P .aeruginosa* were resistant to ceftazidime. In the United States during 1997 and 2000, multidrug resistant *Pseudomonas aeruginosa* were resistant to ceftazidime, piperacillin, imipenem, ciprofloxacin (25).

In summary, we found that antimicrobial resistance is a problem of our hospital. The high consumption of antibiotic in the community can be a cause of a major problem in treatment. Infections with multidrug-resistant bacteria lead to high costs for the patients. Because of the decrease of susceptibility of pathogens to antibiotic new strategies should be recommended such as guide for patients in exact consumption of antibiotic, restriction of access to antibiotic in community, *etc.* to prevent the spread of resistant bacteria.

Footnotes

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Conflict of Interest:

The authors declare no conflict of interest.

References

1. Anderson DJ, Kaye KS. Controlling Antimicrobial Resistance in the Hospital. Infect Dis Clin North Am 2009;23(4):847-64.

2. Kolar M, Pantucek R, Bardon J, Vagnerova I, Typovska H, Valka I, et al. Occurrence of antibiotic resistant bacterial strains isolated in poultry. Vet Med 2002;47(2-3):52–9.

3. Mastertona R, Drusano G, Paterson DL, Park G. Appropriate antimicrobial treatment in nosocomial infections—the clinical challenges. J Hosp Infect 2003;55(Suppl 1):1–12.

4. Gould IM. The epidemiology of antibiotic resistance. Int J Antimicrob Agents 2008;32(Suppl 1):2–9.

5. Sader HS, Hsiung A, Fritsche TR, Jones RN. Comparative activities of cefepime and piperacillin/tazobactam tested against a global collection of *Escherichia coli* and *Klebsiella spp*. with an ESBL phenotype. Diagn Microbiol Infect Dis 2007;57(3):341–4.

6. Lipsitch M, Bergstrom CT, Levin BR. The epidemiology of antibiotic resistance in hospitals:paradoxes and prescriptions. Proc Natl Acad Sci USA 2000;97(4):1938-43.

7. Bantar C, Famiglietti A, Goldberg M. Three-Year Surveillance Study of Nosocomial Bacterial Resistance in Argentina. Int J Infect Dis 2004;4(2):85-90.

8. Al-Lawati AM, Crouch ND, Elhag KM. Antibiotic consumption and development of resistance among gram negative bacilli in intensive care units in Oman. Ann Saudi Med 2000;20(3-4):324-7.

9. Piéboji JG, Koulla-Shiro S, Ngassam P, Adiogo D, Njine T, Ndumbe P. Antimicrobial resistance of Gram-negative bacilli isolates from inpatients and outpatients at Yaounde Central Hospital, Cameroon. Int J Infect Dis 2004;8(3):147-54.

10. Chomarat M. Resistance of bacteria in urinary tract infections. Int J Antimicrob Agents 2000;16(4):483–7.

11. Oudhuis GJ, Verbon A, Hoogkamp-Korstanje JA, Stobberingh EE. Antimicrobial resistance in *Escherichia coli* and *Pseudomonas aeruginosa* from Intensive Care Units in The Netherlands, 1998–2005. Int J Antimicrob Agents 2008;31(1):58–63.

12. Piette A, Verschraegen G. Role of coagulase-negative *staphylococci* in human disease. Vet Microbiol 2009;134(1-2):45–54.

13. Jain A, Agarwal J, Bansal S. Prevalence of methicillin-resistant, coagulase negative *staphylococci* in neonatal intensive care units:findings from a tertiary care hospital in India. J Med Microbiol 2004;53(9):941–4.

14. Petinaki E, Kontos F, Miriagou V, Maniati M, Hatzi F, Maniatis AN. Survey of methicillin-resistant coagulase-negative *staphylococci* in the hospitals of central Greece. Int J Antimicrob Agents 2001;18(6):563–6.

15. Podschun R, Ullmann U. *Klebsiella* spp. as Nosocomial Pathogens: Epidemiology, Taxonomy, Typing Methods, and Pathogenicity Factors. Clin Microbiol Rev 1998;11(4):589-603.

16. Brisse S, Duijkeren EV. Identification and antimicrobial susceptibility of 100 *Klebsiella* animal clinical isolates. Vet Microbiol 2005;105(3-4):307–12.

17. Hsu LY, Tan TY, Jureen R, Koh TH, Krishnan P, Tzer-Pin Lin R, et al. Antimicrobial Drug Resistance in Singapore Hospitals. Emerg Infect Dis 2007;13(12):1944-7.

18. Chang SC, Sun CC, Yang LS, Luh KT, Hsieh WC. Increasing nosocomial infections of methicillin-resistant *Staphylococcus aureus* at a teaching hospital in Taiwan. Int J Antimicrob Agents 1997;8(2):109-14.

19. Leahy TR, Yau YC, Atenafu E, Corey M, Ratjen F, Waters V. Epidemiology of borderline oxacillin-resistant *Staphylococcus aureus* in Pediatric Cystic Fibrosis. Pediatr Pulmonol 2011;46(5):489-96.

20. Huang YC, Chou YH, Su LH, Lien RI, Lin TY. Methicillin-Resistant *Staphylococcus aureus* Colonization and Its Association With Infection Among Infants Hospitalized in Neonatal Intensive Care Units. Pediatrics 2006;118(2):469-74.

21. Jensen TG, Kolmos HJ, Siboni K. Resistance problems in two university hospitals in Denmark. Int J Antimicrob Agents 1999;12(1):71–3.

22. Rice LB. Antimicrobial Resistance in Gram-Positive Bacteria. Am J Med 2006;119(6Suppl 1):11-9.

23. Cholley P, Gbaguidi-Haore H, Bertrand X, Thouverez M, Plésiat P, Hocquet D, et al. Molecular epidemiology of multidrug-resistant *Pseudomonas aeruginosa* in a French university hospital. J Hosp Infect 2010;76(4):1-4.

24. Tian GB, Adams-Haduch JM, Bogdanovich T, Wang HN, Doi Y. PME-1, an Extended-Spectrum β-Lactamase Identified in *Pseudomonas aeruginosa*. Antimicrob Agents Chemother 2011;55 (6):2710-3.

25. Defez C, Fabbro-Peray P, Bouziges N, Gouby A, Mahamat A, Daurès JP, et al. Risk factors for multidrug-resistant *Pseudomonas aeruginosa* nosocomial infection. J Hosp Infect 2004;57(3):209–16.