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The Study of Prevalence and Antimicrobial Susceptibility of Tracheal Bacterial Strains Isolated from Pediatric Patients

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Abstract: The aim of this study was to investigate the prevalence and antimicrobial susceptibility of bacterial strains isolated from tracheal specimens obtained from pediatric patients admitted to a major children hospital in Tehran, in 2007. Tracheal specimens were cultured on the appropriate bacteriological media. Bacterial isolates were identified by standard biochemical and serological tests. Antimicrobial susceptibility testing was performed according to Clinical and Laboratory Standards Institute (CLSI) guidelines. *Pseudomonas* spp. was identified as the most prevalent bacterial isolate (32%) followed by *Staphylococcus aureus* (27.6%). Thirty strains (16%) were identified as *Klebsiella* spp., 18 (9.6%) as *Enterobacter* spp. and the rest belonged to coagolase negative *Staphylococci*, *Streptococcus viridans*, *Acinetobacter* spp., *Escherichia coli* and *Neisseria* spp. All *Pseudomonas* spp. were resistant to ampicllin, kanamycin and ceftizoxime. *Staphylococcus* and *Klebsiella* spp. showed high degree of resistance to 40% of examined antibiotics.

Key words: Gram negative bacteria, gram positive bacteria, tracheal infections, antimicrobial susceptibility

INTRODUCTION

Respiratory tract infection is one of the most important infectious diseases worldwide. This infection is the leading cause of morbidity and mortality in critically ill patients in developing countries (Navneeth *et al*., 2002; Pittet, 1994; Kumari *et al*., 2007). Respiratory infections in particular those occur in upper respiratory tract are seen with great frequency in both children and adults and have remarkable economic impact, related not only to lost output in the workplace but also to the frequent prescription by physicians of antibiotics, even when the causative agents of infection almost certainly are not bacteria (Carroll and Reimer, 1996). On the other side, respiratory tract infections are the most common reason for primary care consultations (Creer *et al*., 2006).

It is notable that they cause more disease and death than any other infection in the United States and there has been reported little change in mortality caused by respiratory tract infection for more than five decades (Mizgerd, 2008).

Eradication of the causative agents of respiratory tract infections is recognized as a requirement (Dagan *et al*., 2001), however during the last few years, the increase in the rates of antibiotic resistance amongst the major microbial causes of the respiratory infections in the community has compromised the selection of empirical treatment for some respiratory tract infections (Gonzalo de Liria, 2004). The consequences of increased drug resistance are far-reaching since bacterial infection of the lower respiratory tract is a major cause of death due to infectious disease (Kumari *et al*., 2007).

To our knowledge, there is limited information on the prevalence of various tracheal bacterial pathogens and their antibiotic resistance patterns in hospitalized pediatrics patients in Iran. Hence, the aim of this study was to determine the prevalence and antimicrobial susceptibility rates of bacterial strains isolated from tracheal specimens obtained from a major pediatric hospital in Tehran, Iran.

MATERIALS AND METHODS

Study design, specimen collection and bacterial identification: The study was conducted from Mar. 2007 to Feb. 2008. The study included all bacterial strains recovered from tracheal specimens obtained from pediatric patients admitted to a major children hospital in Tehran, Iran. The specimens were cultured on to various suitable bacteriological media then were incubated at 37°C for 16-24 h on the based of each organism. The isolated bacteria then further identified microbiologically according to standard laboratory methods (Pezzlo, 1992; Reisner *et al*., 1999).

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Antimicrobial susceptibility testing: Antimicrobial susceptibility testing was performed according to the standard CLSI guideline (Clinical and Laboratory Standard Institute, 2005) using following antibiotic disks (Padtan Teb): amikacin (AN, 30 μg), ampicillin (AM, 10 μg), cefazolin (CZ, 30 μg), cephalexin (CFX, 30 μg), cefixime (CFM, 5 μg), ceftazidime (CAZ, 30 μg), ceftizoxime (CT, 30 μg), ceftriaxon (CRO, 5 μg), cephalothin (CF, 30 μg), ciprofloxacin (CP, 5 μg), chloramphenicol (C, 30 μg), clindamycin (CD, 2 μg), cloxacillin (CX, 5 μg), erythromycin (E, 15 μg), gentamicin (GM, 10 μg), kanamycin (K, 30 μg), penicillin (P, 10 μg), piperacilline-tazobactam (PTZ, 85 μg), tobramycin (TOB, 10 μg), trimethoprim-sulfamethoxazole (SXT, 30 μg) and vancomycin (V, 30 μg).

RESULTS AND DISCUSSION

A total of 188 tracheal specimens had positive results for bacterial cultures. Sixty isolates (32%) were identified as *Pseudomonas* spp., 52 (27.6%) as *S. aureus*, 30 (16%) as *Klebsiella* spp., 18 (9.6%) as *Enterobacter* spp., 10 (5.3%) as coagolase negative *Staphylococci,* 6 (3.2) as *Acinetobacter* spp., 5 (2.6%) as *S. viridans*, 5 (2.6%) as *E. coli* and 2 (1.1%) as *Neisseria* spp. All *Pseudomonas* spp. strains were resistant to ampiclin, kanamycin and ceftizoxime. More than 60% of *S. aureus*, coagolase negative *Staphylococci* and *Enterococcus* spp. strains were resistant to the most commonly used antibiotics. Table 1 and 2 show the frequency of antibiotic susceptibility among gram negative and positive bacterial strains respectively.

Infectious diseases are an important cause of mortality and morbidity in children. The Children Medial Center is a major hospital for pediatric treatment in Tehran. Ranjbar *et al.* (2007a, b, 2008a, b) have recently investigated the prevalence of some pediatric infections such as shigellae in this hospital. The aim of current study was to investigate the prevalence and antimicrobial susceptibility of bacterial strains isolated from tracheal specimens obtained from pediatric patients admitted to this hospital in 2007. Respiratory tract infection is considered as one of the most important infectious diseases in developing countries. There are a few reports on the prevalence of tracheal bacterial pathogens and their antibiotic resistance patterns in hospitalized pediatric patients in Iran.

It is notable that around one third of all respiratory tract infections are lower respiratory tract infections with incidence rate of 44-50 per 1000 (Macfarlane *et al.*, 1993, 2001; Creer *et al.*, 2006). The main causal agents have been reported as *S. aureus* and resistant gram-negative bacteria which constitute a major problem in intensive respiratory care units (Kamat *et al.*, 1989; Kumari *et al.*, 2007).

In a study on the epidemiology of respiratory tract bacterial pathogens carried out by Varotto *et al.* (2001) *P. aeruginosa* has been reported as the most prevalent organism (24%) followed by *S. pyogenes* (18%), *S. aureus* (17%) and *K. pneumoniae* (8%) (Varotto *et al.*, 2001). In an Indian study carried out by Kumari *et al.* (2007) on bacterial isolates from respiratory tract of ICU patients, the percentage isolation rate for *P. aeruginosa*, *Klebsiella* spp., *Enterobacter* spp. have been reported 21.5, 19, 8 and 6.2%, respectively.

As shown in Table 1 and 2 the gram-negative bacterial isolates in order of the frequency in our study were *Pseudomonas* spp. (32%), *Klebsiella* spp. (16%) and *Enterobacter* spp. (9.6%) which is comparable, however the isolation rate of *S. aureus* in our study was higher than reported by two above mentioned studies. The highly resistant gram-negative bacilli continue to

Table 1: Prevalence and antimicrobial susceptibility (%) of gram negative bacterial strains recovered from tracheal samples

Bacterial strains	N (%)	*CP	CRO	TOB	CAZ	CFM	CT	AN	GM	PT	AM	SXT	CF	K	C
Pseudomonas spp.	60(32.0)	83.3	5.0	56.6	20.0	1.6	0	41.6	36.6	51.6	0.0	8.4	1.6	0	8.3
Klebsiella spp.	30(16.0)	70.0	3.3	20.0	0.0	0.0	0	3.3	6.6	40.0	3.3	43.3	0.0	0	46.6
Enterobacter spp.	18 (9.6)	93.4	22.0	56.7	16.6	11.0	0	22.0	56.7	83.2	5.5	66.0	5.5	0	72.2
E. coli	5(2.6)	20.0	20.0	20.0	20.0	20.0	20	40.0	60.0	60.0	20.0	20.0	20.0	40	100.0
Acintobacter spp.	6 (3.2)	33.3	0.0	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0	99.0

*CP: Ciprofloxacin, CRO: Ceftriaxon, TOB: Tobramycin, CAZ: Ceftazidime, CFM: Cefixime, CT: Ceftizoxime, AN: Amikacin, GM: Gentamicin, PT: Piperacilline-tazobactam, AM: Ampicillin, SXT: Trimethoprim-sulfamethoxazole, CF: Cephalothin, K: Kanamycin, C: Chloramphenicol

Table 2: Prevalence and antimicrobial susceptibility (%) of gram positive bacterial isolates recovered from tracheal samples

Bacterial strains	N (%)	*P	CP	CRO	V	CZ	CN	CD	E	AN	GM	CX	AM	SXT	CF	C
S. aureus	52(27.6)	0	40	27	98	33	38.4	46	22	31	31	0	2.8	29	33	98
Coagulase negative *Staphylococci*	10(5.3)	70	40	30	70	50	40.0	20	20	60	50	0	0.0	30	60	50
Streptococcus (viridans group)	5(2.6)	20	40	40	60	20	20.0	40	40	20	0	0	40.0	20	40	80

*P: Penicillin, CP: Ciprofloxacin, CRO: Ceftriaxon, V: Vancomycin, CZ: Cefazolin, CN: Cephalexin, CD: Clindamycin, E: Erythromycin, AN: Amikacin, GM: Gentamicin, CX: Cloxacillin, AM: Ampicillin, SXT: Trimethoprim-sulfamethoxazole, CF: Cephalothin, C: chloramphenicol

disseminate in hospitals causing therapy problems in many parts of the world, particularly in developing countries (Kumari *et al*., 2007). The increasing frequency of antibiotic resistance has been reported first in infections at sites where penetration of the antimicrobial agent is restricted and the level of therapeutic concentrations is consequently more difficult to be achieved. It could also hinder the eradication of infections in respiratory tract infections treated using standard antibiotic therapy regimens (Dagan *et al*., 2001). Accurate information on local epidemiology and antimicrobial resistance patterns of pathogens among the children is essential to select a clinically effective antibiotic therapy for the infections (Bassetti *et al*., 2000).

We observed a high level of resistance to the most antibiotics tested particularly among *Pseudomonas*, *Klebsiella* and *E. coli* isolates which is consistent with the results obtained from other countries (Kumari *et al*., 2007). In an Indian study on antibiotic resistance pattern of gram-negative bacterial isolates of lower respiratory tract secretions, the highest and lowest mean resistance among predominant gram negative bacteria in tracheal aspirate has been noted to ampicillin (96.6%) and amikacin (28%), respectively (Navaneeth *et al*., 2002). Compared to previous report from Iran, an increased rate of antibiotic resistance was observed in *Acinetobacter* spp. (Ranjbar *et al*., 2007b) and *P. aeruginosa* against some tested antibiotics (Shirazi *et al*., 2005, 2007).

We concluded the most the isolates had a high level of resistance to examined antibiotics. There are many possible reasons for this alarming phenomenon, including inappropriate and incorrect administration of antimicrobial agents in empiric therapies and lack of appropriate infection control strategies. This problem indicates importance of performing antibiotic susceptibility testing before empirical therapy.

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