## Prevalence, Antibiotic Susceptibility Pattern and Production of Extended-Spectrum $\beta$ -Lactamases Amongst Clinical Isolates of *Klebsiella pneumoniae* at Armed Forces Hospital in Saudi Arabia

Shamweel Ahmad<sup>1</sup>, Nami Fawazan Al-Juaid<sup>2</sup>, Faris Q. Alenzi<sup>3</sup>, Essam H. Mattar<sup>4</sup> and Osama El-Sayed Bakheet<sup>1</sup>

## ABSTRACT

The aim of this descriptive study was to determine the prevalence of *Klebsiella pneumoniae* from different clinical specimens, their antibiotic susceptibility pattern and the extended-spectrum  $\beta$ -lactamase (ESBL) production among such isolates at Armed Forces Hospital, Al-Kharaj, Saudi Arabia, from November, 2004 to October, 2007. A total of 328 isolates of *K. pneumoniae* recovered from 8152 different specimens were studied for ESBL production and antimicrobial susceptibility. The prevalence of *K. pneumoniae* was 4% (328/8152). We observed a high percentage of *K. pneumoniae* resistant to ampicillin (100%) and tetracycline (92%). The prevalence of ESBL-producing *K. pneumoniae* was found to be 10.4% (34/328). The ESBL-producing strains were mostly from aspirates (25%) followed by sputum (20%) and blood (18.2%). These ESBL-producing isolates were highly resistant to gentamicin and ciprofloxacin. All isolates were susceptible to imipenem. Our findings demonstrate a high percentage of ESBL-producers among clinical isolates of *K. pneumoniae* and a high rate of multidrug resistance. Continued infection control measures and prudent use of antimicrobial agents are essential in reducing the spread of multi-resistant ESBL-producing *K. pneumoniae*.

Key words: Antibiotic susceptibility.  $\beta$ -Lactamase. Klebsiella pneumoniae. Aspirate. Sputum.

*K. pneumoniae* is an important pathogen frequently responsible for nosocomial infections, strains producing ESBL are more prevalent and difficult to eradicate because they develop resistance to multiple antibiotics.<sup>1</sup> The emergence of extended-spectrum  $\beta$ -lactamase production (ESBL) among *K. pneumoniae* and its dissemination greatly complicates therapeutic options for infections due to this organism. These ESBL-producing isolates are resistant not only to the extended-spectrum cephalosporins, but also to the aminopenicillins, ureidopenicillin, narrow-spectrum cephalosporins and aztreonam.<sup>1</sup>

Reports of treatment failure of nosocomial infections due to ESBL-producing organism are emerging. The ESBL-producing organisms are often multidrug resistant, as the plasmids-producing ESBLs can carry resistance to other antibiotics.<sup>1</sup> Most ESBLs were mutant forms of TEM-1, TEM-2 and SHV-1 enzymes coded by genes located on transferable plasmids that can be easily spread from one organism to another.<sup>2</sup>

<sup>1</sup> Department of Clinical Microbiology/Immunology<sup>3</sup>/College of Medical Sciences<sup>4</sup>, King Saud University, Kingdom of Saudi Arabia.

<sup>2</sup> Department of General Surgery, Armed Forces Hospital, Kingdom of Saudi Arabia.

**Correspondence:** Dr. Shamweel Ahmad, Al-Aziziyah, Al-Kharaj, Kingdom of Saudi Arabia. E-mail: drshamweel@hotmail.com

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These enzymes, which are most commonly produced by *Escherichia coli* and *K. pneumoniae*, are capable of inactivating a variety of  $\beta$ -lactam drugs, including third-generation cephalos-porins, extended-spectrum penicillins and mono-bactams. The therapeutic choices in infections caused by ESBL-producing organisms are limited because of cross-resistance. The carbapenemes are the most active antibiotics against these organisms.<sup>3</sup>

The objective of this study was to assess the prevalence of *K*. *pneumoniae* from different clinical specimens, their antibiotic susceptibility pattern and the extendedspectrum  $\beta$ -lactamase (ESBL) production among such isolates.

It was a descriptive study, conducted between November, 2004 to October, 2007 at the Armed Forces Hospital, Al-Kharaj, Saudi Arabia. A total of 328 isolates of *K. pneumoniae* were recovered from 8152 different clinical specimens. All these isolates were subjected to antibiotic susceptibility testing and studied for extendedspectrum  $\beta$ -lactamase production according to the National Committee for Clinical Laboratory Standards.<sup>4</sup>

The prevalence rate of *K. pneumoniae* was found to be 4% (Table I). There was a high percentage of *K. pneumoniae* resistant to ampicillin (100%) and tetracycline (92%), which is in agreement with others.<sup>5</sup> Although most of the *Klebsiella* were naturally resistant to ampicillin and carbenicillin, but resistance to tetracycline is plasmid mediated. Ciprofloxacin, norfloxacin, nalidixic acid, aztreonam, amikacin and tobramycin showed the

Table I:	Total	number	of	different	specimens	and	number
	(perce	entage) of I	Klebsi	ella pneumon	<i>iiae</i> and numb	er (pei	rcentage)
	of ESI	BL-produci	ing K	. pneumonia	e.		

Specimen	Total number	Number (%) of	Number (%) of					
	received	K. pneumoniae	ESBL-producing					
		isolates	K. pneumoniae					
Urine	7429	272 (3.7)	25 (9.2)					
Wound swabs	305	36 (11.8)	05 (13.9)					
Blood	300	11 (3.7)	02 (18.2)					
Sputum	65	05 (7.7)	01 (20.0)					
Aspirates	53	04 (7.5)	01 (25.0)					
Total number	8152	328 (4.0)	34 (10.4)					

 Table II: Antibiotic resistance pattern of Klebsiella pneumoniae isolates.

Antimicrobial agent	K. pneumoniae (n=328) isolates from:						
	Urine	Wound	Blood	Sputum	Aspirates		
		swabs					
Ampicillin	100%	100%	100%	100%	100%		
Naldixic Acid	16.1%	NT	NT	NT	NT		
Norfloxacin	12.7%	NT	NT	NT	NT		
Ciprofloxacin	23.9%	18.3%	10.1%	17.9%	11.8%		
Imipenem	0%	0%	0%	0%	0%		
Tetracycline	92.2%	89.8%	93.0%	88.6%	95.4%		
Amoxicillin-							
Clavulanic acid	29.0%	22.7%	26.7%	44.1%	33.3%		
Cefuroxime	NT	NT	NT	27.7%	20.1%		
Cefotaxime	26.9%	24.1%	25.3%	13.3%	18.0%		
Cefoxitin	37.1%	19.1%	18.0%	21.1%	23.4%		
Ceftazidime	28.6%	19.2%	18.4%	21.1%	26.2%		
Ceftriaxone	23.2%	31.0%	22.5%	10.4%	24.3%		
Trimethoprim-							
sulphamethoxazole	35.0%	22.8%	25.4%	22.1%	30.2%		
Gentamicin	23.4%	19.9%	39.3%	13.9%	32.4%		
Amikacin	17.0%	18.1%	19.9%	10.9%	17.2%		
Tobramycin	15.2%	16.3%	10.1%	11.1%	24.4%		
Aztreonam	23.4%	14.2%	11.4%	15.0%	15.8%		

NT=Not Tested, n=Total Number

greatest efficacy, showing more than 83% sensitivity. Imipenem was the only antibiotic with 100% activity against different strains of *K. pneumoniae* isolated from various sources (Table II).

The prevalence of ESBL-producing *K. pneumoniae* was found to be 10.4 % (Table I).  $\beta$ -lactamase producing strains of *K. pneumoniae* were recovered from different patients with urinary tract infections, septicemia and respiratory tract infections. These ESBL-producing

isolates were highly resistant to gentamicin and ciprofloxacin. The increased resistance to ciprofloxacin indicates that resistance to ciprofloxacin is strongly associated with ESBL production. Similar findings have been reported by others earlier.<sup>6</sup> This association greatly limits the role of ciprofloxacin against ESBL-producing *K. pneumoniae*. Of all the antimicrobial agents tested, imipenem had the highest activity against the ESBL-producing *K. pneumoniae*, similar to other studies.<sup>6</sup>

The findings demonstrate a high percentage of ESBLproducers among clinical isolates of *K. pneumoniae* and a high rate of multidrug resistance. Imipenem was the only antimicrobial agent which showed 100% sensitivity even with multidrug resistance. However, regular monitoring of imipenem sensitivity and routine testing of newer carbapenems like meropenem and ertapenem should be carried out further. A regular surveillance of hospital associated infections including monitoring antibiotic sensitivity pattern of *K. pneumoniae* and ESBL production is mandatory to control the spread of multidrug resistant and ESBL-producing *K. pneumoniae* in the hospital.

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