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Prevalence and antibiogram of extended spectrum β-lactamase producing *Klebsiella pneumoniae* in a tertiary care hospita

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Abstract

Resistant Extended spectrum β lactamases (ESBL) bacteria are emerging worldwide as a threat to favorable outcome in the treatment of common infections in community and hospital settings. They are mainly found in *Escherichia coli*, *Klebsiella* species and *Proteus* species. Extensive and often indiscriminate use of the extended-spectrum cephalosporins in particular, Ceftazidime, Cefotaxime and Ceftriaxone, is associated with the emergence and spread of multi drug resistant *K. pneumoniae*. Prevalence of ESBLs varies from institute to institute. Hence the present study was done to know the prevalence and antibiogram of ESBL producing *K. pneumoniae*. This was a prospective study conducted in a tertiary care hospital in South India from April 2011 to May 2012. Consecutive non-repeat culture isolates of were obtained from different clinical specimens such as urine, pus, blood etc. Antimicrobial susceptibility was determined by Kirby-Bauer disk diffusion method as per CLSI recommendations. Higher resistance among ESBL producers than among non-ESBL producers. Highest resistance was seen with beta lactam antibiotics, Gentamicin and Ciprofloxacin. Resistance to Aztreonam was zero percent and one isolate was resistant to Imipenem. During the past decade, ESBL producing Gram-negative bacilli especially *Escherichia coli* and *K. pneumoniae* have emerged as serious pathogens both in hospital and community acquired infections worldwide. An important step in rationalizing the use of antibiotics is the formulation of hospital infection control committee. Antibiotic policy should be prepared in consultation with various clinical and surgical clinical departments. Routine detection of ESBL-producing microorganisms should be done by each laboratory, which helps physicians in choosing an appropriate empirical therapy and conserve powerful antibiotics for life threatening infections.

Keywords: Extended spectrum β lactamases (ESBL), *K. pneumoniae*, Antibiogram, Resistance.

Introduction

Resistant Extended spectrum β lactamases (ESBL) bacteria are emerging worldwide as a threat to favorable outcome in the treatment of common infections in community and hospital settings.[1] They are mainly found in *Escherichia coli, Klebsiella* species and *Proteus* species but can also occur in other members of Enterobacteriaceae family.[2] *Klebsiella pneumoniae* (*K. pneumoniae*) causes infections such as pneumonia, urinary tract infections, wound infection, cholecystitis and bacteriuria.

There is no consensus on the precise definition of ESBLs. A commonly used working definition is that the ESBLs are β-lactamases capable of conferring bacterial resistance

to the penicillins; first-, second- and third-generation cephalosporins; and aztreonam (but not the cephamycins and carbapenems) by hydrolysis of these antibiotics and which are inhibited by β-lactamase inhibitors such as clavulanic acid.[2] Outbreaks of infection caused by ESBL producing Klebsiella spp have been widely reported.[3-6] In India, prevalence of ESBL producing Klebsiella spp. is reported varying from 6% to 87.%.[7,8].

Extensive and often indiscriminate use of the extended-spectrum cephalosporins in particular, Ceftazidime, Cefotaxime and Ceftriaxone, is associated with the emergence and spread of multi drug resistant *K. pneumonia*.[9] Bacteria producing ESBLs exhibit additional resistances to other drug groups such as the quinolones, tetracyclines and aminoglycosides which further limits therapeutic options.[10-12] Prevalence of ESBLs varies from institute to institute. Hence the present study was done to know the prevalence and antibiogram of ESBL producing *K. pneumoniae*.

Material and Methods

This was a prospective study conducted in a tertiary care hospital in South India from April 2011 to May 2012. Consecutive non-repeat culture isolates of were obtained from different clinical specimens such as urine, pus, blood etc. The specimens received were inoculated on blood and MacConkey agar plates. Then all plates were incubated at 37°C for 24 hours. *K. pneumoniae* isolates were identified using standard techniques.[13]

Antimicrobial susceptibility test and detection of ESBL production

Antimicrobial susceptibility was determined by Kirby-Bauer disk diffusion method as per CLSI recommendations.[14] Antimicrobial disks used were Ampicillin (10 µg), Amoxycillin-clavulanic acid (20/10 µg), Piperacillin (100 µg), Piperacillin-tazobactam (100/10 µg), Cefuroxime (30 µg), Ceftriaxone (30 µg), Ceftazidime (30 µg), Gentamicin (10 µg), Amikacin (30 µg), Tobramycin (30 µg), Ciprofloxacin (5µg), Ofloxacin (5 µg), Co-trimoxazole (1.25/23.75 µg), Aztreonam (30 µg) and Imipenem (10 µg). (Hi media, Mumbai). Phenotypic evidence of ESBL production was tested by the combination disk method MIC reduction test as per guidelines of CLSI. *K. pneumoniae* ATCC 700603 was used as control. Prevalence of ESBL producing *K. pneumoniae* was 22.5%.

The data obtained was analyzed using Microsoft excel (2010 version). The results are explained in frequency and percentage

Results

Out of 1680 samples collected, 120 *K. pneumoniae* were isolated, prevalence of 7.1%. The age and sex distribution of the cases is shown in table 1.

Maximum number of cases were from age group of 40-60 years and maximum patients were male.

Out of 120 *K. pneumoniae*, 27(22.5%) were ESBL producers. The distribution of ESBL and non-ESBL producers in clinical samples is shown in table 2. Most ESBL producers were from urine and least from swabs.

The antibiogram of ESBL and non-ESBL producers is shown in table 3.

Table 1: Age and sex distribution of the patients

Age group (years)	Male	Female	Total
0-10	3	3	6
10-20	15	11	26
20-40	12	6	18
40-60	32	28	60
>60	6	4	10
Total	**68**	**53**	**120**

Table 2: Distribution of ESBL and non-ESBL producers in samples (n=120)

Samples	ESBL producers	Non ESBL producer	Total
Urine	12	33	45
Pus	5	21	26
Blood	3	15	18
CSF	2	6	8
Sputum	4	14	18
Swabs	1	4	5
Total	**27**	**93**	**120**

Table 3: Antibiogram of *K. pneumoniae* (Resistance pattern).

Antibiotic (n=93)	ESBL producers (n=27)	Non ESBL producers
Ampicillin	27 (100)	77 (82.7)
AM-CV	26 (96.2)	59 (63.4)
Piperacillin	26 (96.2)	52 (55.9)
PP-TZ	15 (55.5)	29 (31.1)
Cefuroxime	22 (81.4)	56 (60.2)
Ceftriaxone	21 (77.7)	42 (45.1)
Ceftazidime	19 (70.3)	38 (40.8)
Gentamicin	22 (81.4)	52 (55.9)
Amikacin	15 (15.5)	12 (12.9)
Tobramycin	16 (59.2)	26 (27.9)
Ciprofloxacin	24 (88.8)	64 (68.8)
Ofloxacin	21 (77.7)	47 (50.5)
Co-trimoxazole	15 (55.5)	31 (33.3)
Aztreonam	0	0
Imipenem	1 (3.7)	0

AM-CV = Amoxycillin-clavulanic acidPP-, TZ = Piperacillin-tazobactam

Discussion

In the present study, prevalence of ESBL producing *K. pneumoniae* was 22.5%. In India, prevalence of ESBL producing Klebsiella spp. is reported varying from 6% to 87.%.[7,8] This variation might be due to different demographics of the patients, local antibiotic prescribing pattern and hospital conditions. The occurrence of ESBL among clinical isolates vary greatly worldwide and geographically and are rapidly changing over time.[1] During the past decade, ESBL producing Gram-negative bacilli especially *Escherichia coli* and *K. pneumoniae* have emerged as serious pathogens both in hospital and community acquired infections worldwide.

The present study shows higher antimicrobial resistance among ESBL producers than among non-ESBL producers (table 3). Highest resistance was seen with beta lactam antibiotics, Gentamicin and Ciprofloxacin. Resistance to Aztreonam was zero percent and one isolate was resistant to Imipenem. This is an alarming sign, as ESBL producers are resistant to most commonly used antibiotics. Overuse of antibiotics, especially of cephopsorins may be one of the reason for development of resistance and this may be associated with development of resistance to β-lactam antibiotics as reported earlier.[15]

There are very limited treatment options available for ESBL producing *K. pneumoniae*. So early detection and prevention plays a significant role in controlling the development and spread of ESBL producing *K. pneumoniae*. The increase in antibiotic resistance is due to several factors but the major cause appears to be excessive use of antibiotics.[16] Hence, an important step would be to

restrict the use of third-generation cephalosporins and rational use of empiric therapy based on local susceptibility pattern will help in significantly decrease the resistance of ESBL-producing bacteria.

One of the most important risk factors of multidrug (including carbapenems) resistant ESBL producing Klebsiella is the high prevalence rate of ESBL producing Klebsiella spp. in hospital flora.[17] An important step in rationalizing the use of antibiotics is the formulation of hospital infection control committee. Antibiotic policy should be prepared in consultation with various clinical and surgical clinical departments. This is more so important in view of emerging resistance, the recent example being the Metallo-betalactamase-1 (NDM-1).[18]

Conclusion

The prevalence of ESBL producing *K. pneumoniae* at our institute was 22.5%. ESBL producing *K. pneumoniae* was resistant to most commonly used antibiotics. Routine detection of ESBL-producing microorganisms should be done by each laboratory, which helps physicians in choosing an appropriate empirical therapy and conserve powerful antibiotics for life threatening infections.

Conflict of interest

None.

References

1. Chaudhary U, Aggarwal R. Extended spectrum β lactamases (ESBL): An emerging threat to clinical therapeutics. Indian J Med Microbiol 2004; 22:75-80.

2. Paterson DL, Bonomo RA. Extended- Spectrum β-Lactamases: a Clinical Update. Clin Microbiol Rev 2005; 18(4):657-686.

3. Hanberger H, Garcia Rodriguez JA, Gobernado M, Goosens H, Nilsson LE, Strulens MJ. Antibiotic susceptibility among aerobic gram-negative bacilli in intensive care units in 5 european countries, French and Portuguese ICU study groups. JAMA 1999; 281:67-71.

4. Albertini MT, Benoit C, Berardi L, Berrouane Y, Boisivon A, Cahen P, et al. Surveillance of methicillin resistant *Staphylococcus aureus* (MRSA) and enterobacteriaceae producing extended spectrum beta-lactamase (ESBLE) in Northern France: a five years multicentre incidence study. J Hosp Infect 2002; 52:107-113.

5. Desimoni MC, Esquivel GP, Merino LA. Fecal colonization by extended spectrum beta-lactamase producing *Klebsiella pneumoniae* in a neonatal intensive care unit. Enferm Infecc Microbiol Clin 2004; 22:507-511.

6. Duman M, Abacioglu H, Karaman M, Duman N, Ozkan H. Beta-lactam antibiotic resistance in aerobic commensal fecal flora of newborns. Pediatr Int 2005; 47:267-73.

7. Hansotia JB, Agarwal V, Pathak AA, Saoji AM. Extended spectrum beta-lactamase mediate resistance to third generation cephalosporins in *Klebsiella pneumoniae* in Nagpur, central India. Indian J Med Res 1997; 105:160-165.

8. Manchanda V, Singh NP, Goyal R, Kumar A, Thukral SS. Phenotypic characteristics of clinical isolates of *Klebsiella pneumoniae* and evaluation of available techniques for detection of extended spectrum beta-lactamases. Indian J Med Res 2005; 122:330-337.

9. Meyer KS, Urban C, Eagan JA, Berger BJ, Rahal JJ. Nosocomial outbreak of Klebsiella infection resistant to late-generation cephalosporins. Ann Intern Med 1993; 119:353-358.

10. Morosini MI, Garcia-Castillo M, Coque TM, Valverde A, Novais A, Loza E, et al. Antibiotic co-resistance in extended-spectrumbeta- lactamase-producing Enterobacteriaceae and in vitro activity of tigecycline. Antimicrob Agents Chemother 2006; 50:2695-2699.

11. Pitout JD and Laupland KB: Extended-spectrum beta-lactamaseproducing Enterobacteriaceae: an emerging public-health concern. Lancet Infect Dis 2008; 8:159-166.

12. Talbot GH: What is in the pipeline for Gram-negative pathogens? Expert Rev Anti Infect Ther 2008; 6:39-49.

13. Cowan SF, Steel KJ. Manual for identification of medical bacteria. 3rd ed. Cambridge: Cambridge University Press;1993. pp.140-143.

14. Clinical and Laboratory Standards Institute. Performance Standards for Antimicrobial Susceptibility Testing: Twentieth Informational Supplement M100-S20-U. Wayne, PA: CLSI; 2010.

15. Jarlier V, Nicolas MH, Fournier G, Philippon A. Extended broad-spectrum beta-lactamases conferring transferable resistance to newer beta-lactam agents in Enterobacteriaceae: hospital prevalence and susceptibility patterns. Rev Infect Dis1988; 10:867-878.

16. Kotwani A, Holloway K, Chaudhury RR. Methodology for surveillance of antimicrobials use among out-patients in Delhi. Indian J Med Res 2009;129:555-560.

17. Mena A, Plasencia V, Garcia L, Hidalgo O, Ayestaran JI, Alberti S, et al. Characterization of a large outbreak by CTXM-1-producing *Klebsiella pneumoniae* and mechanisms leading to

in vivo carbapenem resistance development. J Clin Microbiol 2006; 44:2831-2837.

18. Yong D1, Toleman MA, Giske CG, Cho HS, Sundman K, Lee K, et al. Characterization of a new metallo-beta-lactamase gene, bla(NDM-1), and a novel erythromycin esterase gene carried on a unique genetic structure in *Klebsiella pneumoniae* sequence type 14 from India. Antimicrob Agents Chemother 2009; 53(12):5046-5054.