Prevalence of 'Superbugs', the Carbapenem Resistant Gram Negative Organisms in a Tertiary Care Hospital

Gurpreet Banga[1], Kanwardeep Singh[2], Loveena Oberoi[3]

ABSTRACT

Introduction: Bacterial resistance to antibiotics has been a recognized reality almost since the dawn of the antibiotic era, but only within the past twenty years has the emergence of dangerous, resistant strains occurred with a disturbing regularity. Objective: Prevalence of carbapenem resistant Gram negative organisms in a tertiary care hospital of North India.

Material and methods: Various clinical specimens collected from indoor and OPD were processed. Identification of the Gram negative organisms and carbapenem resistance was done by standard bacteriological techniques. All isolates were detected for carbapenemase production by Carba NP test.

Results: Out of 1670 samples, 935 (55.99%) were found to be culture positive of which 485 (51.87%) were Gram negative bacteria. The prevalence of carbapenemase producing Gram negative bacteria was 58 (11.96%).

Conclusion: Determing carbapenem resistance pattern and confirmation of carbapenemase production can improvise upon the usage of antimicrobials which will further help in reducing the burden of antimicrobial resistance.

Keywords: Antimicrobial Resistance, Carba NP Test.

INTRODUCTION

Bacterial resistance to antibiotics has been a recognized reality almost since the dawn of the antibiotic era, but only within the past twenty years has the emergence of dangerous, resistant strains occurred with a disturbing regularity.[1] Multidrug-resistant Gram-negative bacteria are a major public health threat. However, intense efforts to limit their spread has been taken, the number of multidrug resistant Gram-negative bacteria continues to increase globally.[2] CDC estimates that in the United States, more than two million people are sickened every year with antibiotic-resistant infections, with at least 23,000 dying as a result of these infections.[3] Clinically important Gram-negative bacilli that can cause infection includes *Pseudomonas, Escherichia, Klebsiella, Acinetobacter, Enterobacter, Proteus, Providencia* and *Morganella.* There are many complications that can occur after wound infection which includes death of surrounding tissue and septicemia. Septicemia following wound infection may lead to septic shock, a critical illness involving the whole body, which may require intensive care and life support and can lead to multiple organ failure or death.[2] Global Data epidemiologists analyzed sepsis epidemiology trends and found that Gram-negative bacteria cause more sepsis case.[4] Carbapenems are the most broad-spectrum β-lactam antibiotics active against Gram-negative organisms, are very slowly hydrolyzed by most beta-lactamases. Because of their broad-spectrum activity, carbapenems have served as the last lines of defense against multidrug-resistant Gram-negative organisms since their introduction in the early 1980s.[5] Present study was conducted to determine the prevalence of superbugs, carbapenem resistant Gram negative organisms in tertiary care hospital.

MATERIAL AND METHODS

A prospective study was conducted in the department of Microbiology, Government Medical College and hospital, Amritsar. Various clinical specimens (blood, pus, urine, sputum and ET secretions) were collected from the OPD and indoor patients in various departments of Guru Nanak Dev Hospital, Amritsar during January 2017 to June 2018 were included in the study.

All the samples were cultured on Blood Agar and Mac Conkey Agar and incubated for 24 hours aerobically at 37°C. Identification of the organisms was made based on the colony characters, motility and Gram staining. Final identification was made on the basis of biochemical reactions. Gram negative isolates were identified.

All the isolates were tested for carbapenemase production by Carba NP test, as per CLSI guidelines.[6]

RESULT

A total of 1670 clinical samples were collected. Out of them, 935 (55.99%) were found to be culture positive and 485 (51.87%) were Gram negative bacteria (table-1). The maximum number of Gram negative isolates were from adult age group 288 (59.38%) and in females 267 (55.14%). Among clinical samples urine 113 (23.30%) was the most common sample followed by tracheal secretions 105 (21.65%) and sputum 99 (20.41%).

E.coli was the most common Gram negative isolate 56 (37.84%) followed by *Klebsiella* spp. which were 37

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Organisms	Samples								
	Urine	Tracheal secretions	Sputum	Blood	Wound Swab	ET secretion	Pus	BAL	Bile Fluid
E.coli (n=148)	56 (37.84%)	23 (15.54%)	03 (2.03%)	18 (12.16%)	14 (9.46%)	15 (10.14%)	12 (8.11%)	05 (3.38%)	02 (1.35%)
Klebsiella spp. (n=123)	37 (30.08%)	24 (19.51%)	61 (49.59%)	01 (0.81%)	00 (0%)	00 (0%)	00 (0%)	00 (0%)	00 (0%)
Pseudomonas spp. (n=117)	16 (13.68%)	28 (23.93%)	12 (10.26%)	45 (38.46%)	07 (5.98%)	02 (1.70%)	05 (4.27%)	02 (1.71%)	00 (0%)
Acinetobacter spp. (n=53)	00 (0%)	12 (22.64%)	09 (16.98%)	28 (52.83%)	00 (0%)	02 (3.77%)	00 (0%)	02 (3.77%)	00 (0%)
Enterobacter spp. (n=40)	04 (10.00%)	16 (40%)	12 (30%)	03 (7.5%)	04 (10.00)	00 (0%)	00 (0%)	00 (0%)	01 (2.5%)
S. marcescens (n=4)	00 (0%)	02 (50%)	02 (50%)	00 (0%)	00 (0%)	00 (0%)	00 (0%)	00 (0%)	00 (0%)

Table-1 Prevalence of gram negative isolates in different samples

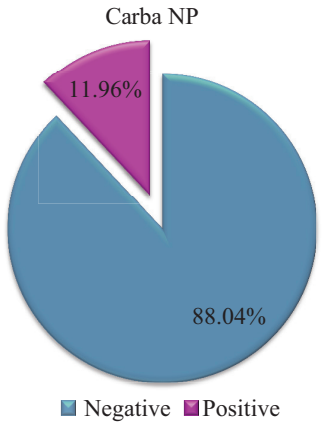

Figure-1: Percentage of carna np test positivity among isolated organisms

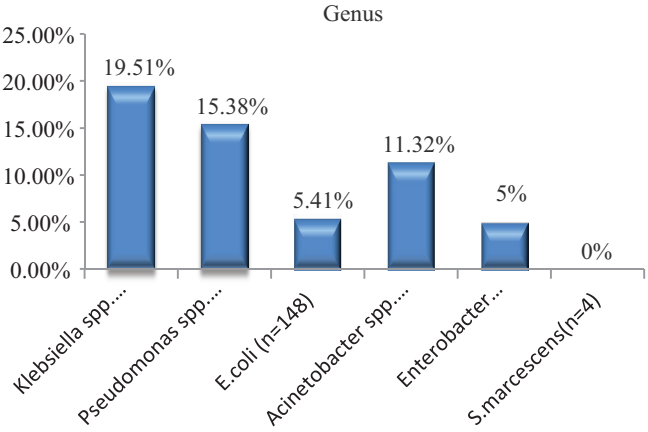

Figure-2: Carba NP positive gram negative bacterial isolates

(30.08%) in urine samples. Fig-1,2 shows Carba NP test was positive in 58 (11.96%) and negative in 427 (88.04%) of the total 485 gram negative isolates.

E.coli was the most common Gram negative isolate 56 (37.84%) followed by *Klebsiella* spp. which were 37 (30.08%) in urine samples. Fig-1,2 shows Carba NP test was positive in 58 (11.96%) and negative in 427 (88.04%) of the total 485 gram negative isolates.

DISCUSSION

Multidrug resistance is now emerging at an alarming rate among a variety of bacterial species, causing both nosocomial and community-acquired infections.[7] Carbapenems are active members of the β-lactam class of antibiotics and can resist hydrolysis by β-lactamases.[8] Resistance to carbapenems can be brought about by various mechanisms, the most common being the production of carbapenemases, a class of enzymes capable of hydrolyzing carbapenems and other β-lactams.[9] Resistance to carbapenems can also be due to the poor binding of carbapenems to penicillin-binding proteins present in the bacteria, the over-expression of multidrug efflux pumps by the bacteria or lack of porins present in the bacterial cell membrane.[8] However, for significant resistance to emerge, it is thought that a combination of resistance mechanisms is required.[1]

Increasing resistance to carbapenems, which are most often the last line of therapy, is now frequently being observed in many hospital-acquired and several community-acquired Gram-negatives rods. Carbapenem-resistant *Enterobacteriaceae* have now been reported worldwide.[8]

As per CLSI guidelines[6], Carba NP test can be used for detection of carbapenemase detection directly from bacterial culture. Other confirmatory tests (molecular methods) for carbapenemase detection require additional time and expertise. The Carba NP test is based on the principle of hydrolysis of the β-lactam ring of a carbapenem which turn the medium acidic which is detected by pH indicator (phenol red) from red to yellow. It is a biochemical test for rapid detection (≥2 h) of carbapenemase production on Gram-negative bacilli. This test is highly sensitive and specific is adaptable to any laboratory in the world.[7]

In present study 485 Gram negative bacilli were isolated from various clinical samples. The prevalence of CNP positive Gram negative organisms was 11.96% (58/485). This was in concordance with the study done by Nair PK et al[10] which showed prevalence rate of 12.26% of carbapenem resistance. The distribution of Gram negative organisms in adult age group was more than paediatric age group 59.38% (288/485) and 40.62% (197/485) respectively. This was in concordance with study done by Jan R et al.[11]

E.coli was the most common isolate 37.84% (58/148) from urine 113 (23.30%) followed by *Klebsiella spp* 30.08%

(37/123). In our study most common carba NP positive isolate was *Klebsiella* 19.51% (24/123) followed by *Pseudomonas* spp 15.38% and *Acinetobacter* spp. 11.32%. Similar results have been reported by Datta S et al[12] showed 26.1% positivity of carba NP in Klebsiella.

CONCLUSION

Detection of carbapenemase producing bacteria has great impact on hospital infection control strategy and for epidemiological purpose for preventing further transmission of resistance.

Lack of knowledge, poor infection control strategies, irrational use of antibiotics without prescription and their incomplete course might have led to high incidence of carbapenem resistance in gram negative bacteria. Screening procedures should be implemented worldwide for 'at-risk' patients. Therefore, less time consuming, rapid and high sensitivity and specificity tests like carba NP should be introduced in bacteriology laboratories worldwide.

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