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RESEARCH ARTICLE
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STUDY OF CARBAPENEM RESISTANCE IN E. COLI ISOLATES

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Abstract

Background: Enterobacteriaceae, such as *Escherichia coli*, *Klebsiella pneumoniae*, *Citrobacter freundii* and *Enterobacter cloacae*, are the most common pathogenic bacteria for nosocomial infection. Enterobacteriaceae accounted for 60–70% of all Gram-negative bacteria. Among them E. coli are very common bacteria in the gastrointestinal tract, and part of the normal bacterial flora in humans but are also a common cause of severe infections. It is one of the major etiologic agents for urinary tract infection, sepsis, and meningitis. The carbapenems (imipenem, meropenem, and ertapenem) are sometimes the only effective agents for treatment of severe infection.

Materials and Methods: This prospective compareative study was carried from OPD out Patient of Department of Microbiology at Muzaffarnagar Medical College,Muzaffareanagar UP. Study design is Hospital based observational study and Study place was in Department of Microbiology, Muzaffarnagar Medical College And Hospital. Study population would include samples of enterobacteriacae collected in patients OPD

Study duration around 15 days and Study size was 30 samples Sampling technique are Purposive sampling Inclusion Criterion carried of Patients having Carbapenem Resistance in E.coli isolates and Exclusion Criterion are Patients having other antimicrobial resistance in E.coli Isolates such as:Ampicillin ,Tetracycline, Cefotaxime resistance

Results: Out of 30 E. coli (Gram-negative bacteria) isolated from diferent clinical samples, 17 (16.8%) were carbapenemase producers. The isolates found were from diferent age group patients ranging from 8 to 80 years old. Isolates from males 63.3% (19/30) were more in number as compared to isolate from female 36.6% (11/30). Carbapenemase-producing isolates were found in the following clinical specimens: Urine: 66.6%,High vaginal swab: 57.1%,Pus: 40%,Sputum: 50%,Blood: 0%. Urine samples had the highest number of carbapenem-resistant isolates

Conclusion: The emergence and spread of carbapenem-resistant bacteria are a global health issue. Even though carbapenems are used in human medicine, several studies showed that carbapenem-resistant bacteria are found in humans, food-producing animals, foods, water sources, etc., due to the rapid dissemination in the complex web, affecting the health of people

Key Word: carbapenamse, imipenem resistance , amikacin

1.Introduction

Enterobacteriaceae,such as *Escherichia coli*, *Klebsiella pneumoniae*, *Citrobacter freundii* and *Enterobacter cloacae,* are the most common pathogenic bacteria for nosocomial infection. Enterobacteriaceae accounted for 60–70% of all Gram-negative bacteria. Among them E. coli are very common bacteria in the gastrointestinal tract, and part of the normal bacterial flora in humans but are also a common cause of severe infections. [1]It is one of the major etiologic agents for urinary tract infection, sepsis, and meningitis. The carbapenems (imipenem, meropenem, and ertapenem) are sometimes the only effective agents for treatment of severe infection. [2][3]

Carbapenem-hydrolyzing enzymes are β-lactamases that significantly hydrolyze imipenem, meropenem, and ertapenem and, usually, a wide range of other β-lactam antibiotics. Carbapenem resistance has been rarely reported in E. coli (2). The occurrence of an outer-membrane porin deficiency and the expression of a plasmid-mediated class C β-lactamase were reported to be responsible for carbapenem resistance in E. coli. [4]

As they are highly effective against many bacterial species and less vulnerable to most beta-lactam resistance determinants, carbapenems are considered to be the most reliable last-resort treatment for bacterial infections.For these reasons, the emergence and rapid spread through all continents of carbapenem resistance, mainly among Gram-negative bacteria, constitutes a global public-healthcare problem of major importance.However, carbapenem-resistant Enterobacteriaceae (CRE) are emerging as carbapenems have been widely used in clinical practice. Carbapenemases are β-lactamases using carbapenems as hydrolysis substrates, including Ambler classes A, B and C enzymes. [5]Here, we will describe the results of a survey to ascertain and confirm the occurrence of carbapenem-resistant E. coli in healthy and diarrhoeal patients.

2. Materials and methods

This prospective compareative study was carried from OPD out Patient of Department of Microbiology at Muzaffarnagar Medical College,Muzaffareanagar UP.

1. **Study design:** Hospital based observational study
2. **Study place :**Department of Microbiology, Muzaffarnagar Medical College And Hospital
3. **Study population :** The study would include samples of enterobacteriacae collected in patients OPD
4. **Study duration :**15 days
5. **Study size :**30 samples
6. **Sampling technique :**Purposive sampling
7. **Inclusion Criterion :**Patients having Carbapenem Resistance in E.coli isolates

Exclusion Criterion : Patients having other antimicrobial resistance in E.coli Isolates such as:

1. Ampicillin resistance
2. Tetracycline resistance
3. Cefotaxime resistance

8. **Study Procedure :**

- Identification of E. coli bacteria :

The different samples (sputum, urine, faeces, etc) of the patients will be checked for the presence of E. Coli under a microscope after gram staining. The gram negative bacilli will be identified. Then in MacConkey agar, if dry colonies will be found then E. Coli species are confirmed.

Then we will take the sample for antimicrobial susceptibility testing and will look for any carbapenem resistance in the species of E.coli

- Experimental and quality control strains :

A total of 30 Enterobacteriaceae strains clinically isolated from in our hospital were selected, from which the strains that resisted any carbapenem were screened. All strains were identified by API or ATB (BioMérieux, Craponne, France). *E. coli* ATCC 25922 was used as the quality control strain for the drug susceptibility test, and clinically isolated *C. freundii* known to produce IMP-8 metalloenzyme was utilized as the positive quality control strain in modified Hodge test.

3.Results

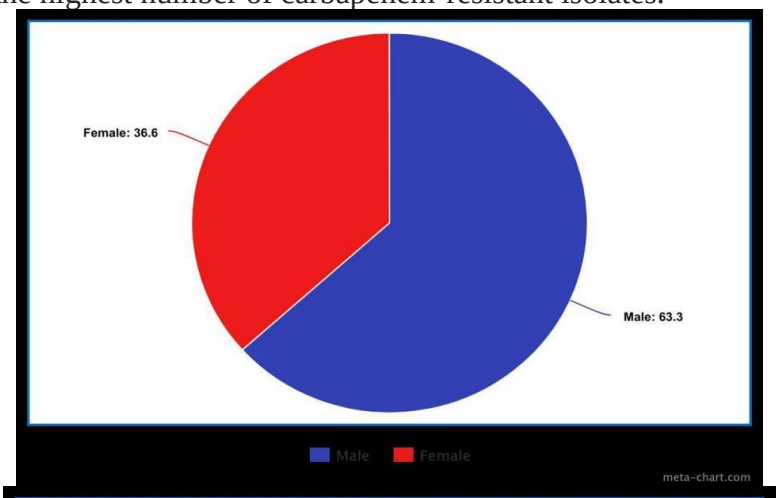
Out of 30 E. coli (Gram-negative bacteria) isolated from diferent clinical samples, 17 (16.8%) were carbapenemase producers. The specimen wise distribution is shown in the **table 1** given below.

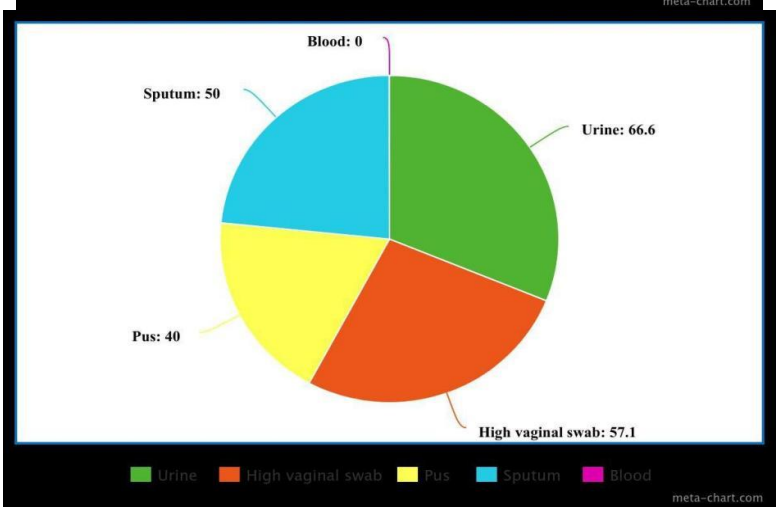
Specimen	No of isolates	Carbapenemresistance	Percentage
Urine	15	10	66.6%
High Vaginal Swab (Hvs)	7	4	57.1%
Pus	5	2	40%
Sputum	2	1	50%
Blood	1	0	0%

Demographicdistribution: The isolates found were from diferent age group patients ranging from 8 to 80 years old. Isolates from males 63.3% (19/30) were more in number as compared to isolate from female 36.6% (11/30). Carbapenemase-producing isolates were found in the following clinical specimens:

1. Urine: 66.6%
2. High vaginal swab: 57.1%
3. Pus: 40%
4. Sputum: 50%
5. Blood: 0%

Urine samples had the highest number of carbapenem-resistant isolates.





4.Discussion

Gram-negative bacterial (GNB) infections that produce carbapenemase are on the rise worldwide, including in India. As of today, carbapenems are the preferred medicine for treating serious hospital-acquired infections. Recent studies have shown a very high carbapenem resistance in India and the Indian subcontinent, which necessitates the use of alternative treatments. It would be interesting to precisely identify carbapenemase producing bacteria, and this would require genotypic and phenotypic studies. It would be interesting to precisely identify carbapenemase-producing microbes, and this would require phenotypic and genotypic studies to identify all carbapenemase-producing genes.

The prolonged hospital stay may have been contributed to the high prevalence of carbapenem-resistant in admitted patients. Carbapenemase activity has been known in β-lactamases classes namely A, B, and D21–24. The prevalence of CR-E. coli in the current study was 16.8%. Similarly, Wattal et al[6]. found a prevalence rate of 13 to 51.0% in a tertiary care hospital in Delhi. Nair et al[7]. found it to be around 12.3% in a study in Mumbai.

Gupta et al. found it to be between 17.0 and 22.0% in a study in Northern India. The prevalence of CR-E. colk observed in our study is consistent with the findings from other parts of India.

E. coli from healthy food animals can be key repositories of beta-lactamase genes and may contribute to the spread and transmission of these beta-lactamase genes, and lateral transfer of resistance genes between animals and humans. This creates a new challenge for the treatment of infections caused by carbapenem-resistant strains because carbapenem-resistant genes could co-exist with beta-lactamases and other resistant genes. In addition to this, co-existence to carbapenem retains genes that make them resistant to other antimicrobials, which threatens global antibiotic chemotherapy, patients recovery, and the economy. The carbapenem resistance can be caused by the presence of various genes. This is particularly problematic in India, where beta-lactamase/carbapenemase prevalence is relatively high. In our study, more than half of the isolates showed multidrug resistance (MDR) to the most common antimicrobials. Poor infection management in the country might be thereason for the high incidence of MDR, necessitating immediate action to combat the burgeoning carbapenem resistance.

5 .Conclusion

The emergence and spread of carbapenem-resistant bacteria are a global health issue. Even though carbapenems are used in human medicine, several studies showed that carbapenem-resistant bacteria are found in humans, food-producing animals, foods, water sources, etc., due to the rapid dissemination in the complex web, affecting the health of people. There have been continuing efforts to develop rapid and cost-effective detection methods to prevent and control their spread in the community. Current rapid phenotypic methods often require pure culture, costly and complex equipment, and skilled personnel. Immunological and conventional biosensor assays offer rapid and cost-effective detection, but they still require complex techniques for signal measurements and analysis. Recently, plasmonic biosensors have shown promise as a cost-effective, rapid, and simple detection technique by eliminating complex and costly equipment. The biosensors need further attention for their increased applicability and accessibility, especially in low-resource settings.

For rapid and cost-effective detection, simple and rapid bacterial separation plays a major role. The current separation techniques on bacteria need further investigation on their effectiveness for resistant bacteria. In addition, cell surface characteristics affect their separation and cell attachment properties. Overall, further studies are needed to enlighten their cell surface characteristics, bacterial attachment, and separation techniques to develop rapid and cost-effective detection assays. These assays can assist as screening or diagnostic tests in low-resource settings.

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