ISSN- O: 2458 - 868X, ISSN–P: 2458 – 8687
National Library of Medicine - ID: 101731606

International Journal of Medical Science and Innovative Research (IJMSIR)
IJMSIR : A Medical Publication Hub
Available Online at: www.ijmsir.com
Volume – 8, Issue – 2, April – 2023 , Page No. : 173 – 178

Prevalence of Carbapenem resistant Escherichia coli from various clinical samples at a Tertiary Care Hospital in Rural Uttar Pradesh

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Citation this Article: Atosh Kumar Tripathi, Dr. Rohit Kumar, Dr. M S Chandel, "Prevalence of Carbapenem resistant Escherichia coli from various clinical samples at a Tertiary Care Hospital in Rural Uttar Pradesh", IJMSIR- April - 2023, Vol – 8, Issue - 2, P. No. 173 – 178.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Introduction: In recent years increased incidences of carbapenem resistance among Escherichia coli have been reported worldwide. Due to higher prevalence and wide range of clinical infections Escherichia coli are considered great risk for public health. Furthermore, carbapenem resistance limits the treat ment options in individuals infected with Escherichia coli. Thus, rapid detection of carbapenem resistance is essential to initiate appropriate treatment, effective management and prevent further dissemination. In the present study we aimed to explore the prevalence of carbapenem resistance Escherichia coli at a tertiary care hospital in rural Uttar Pradesh.

Material and Methods: A cross sectional study was performed at Dept. of Microbiology, Government Medical College, Azamgarh in collaboration with Dept. of Microbiology, Index Medical College, Indore. A total of3180 clinical specimens comprising of urine, pus, wound swabs, sputum, throat swabs and other samples were collected following the standard guidelines and were processed for culture by standard bacteriological methods. After obtaining the growth gram staining and standard biochemical reactions were performed for identification of Escherichia coli. All these isolates were subjected to antibiotic sensitivity testing for carbapenem by Kirby Bauer disc diffusion method.

Results: Out of the3180 specimens 53.11% showed growth of various organisms. Of these 58.44%isolate showed the growth of Entero bacteriaceae, of which 25.94% were car bapenem resistant Escherichia coli.

Conclusion: A high prevalence of 25.94% car bapenem resistance was observed among Escherichia coli isolates. Early detection, isolation and contact precaution of CRE patients will help to prevent rapid dissemination of Carbapenem resistant Escherichia coli infection.

Keywords: Antimicrobial Resistance, CRE, Carbapenem resistant Escherichia coli

Introduction

Antimicrobial resistance has been observed towards most of the antibiotics which has become the major issue in combating against clinical pathogens. Overuse of anti biotics, inappropriate processing and lack of regulatory barriers are the major causes for antibiotic resistance. [1]

There have been growing epidemics of infections due to gram negative bacteria especially from Entero bacter iaceae family, which are resistant to many classes of antibiotics.[2] In the past carbapenems have been reserved for most difficult infections. They have an exceptionally broad spectrum of activity and are used exclusively in intensive care unit and critically ill patients. [3] Due to extended spectrum beta-lactamase (ESBL) and AmpC enzyme producing Enterobacteriaceae, carbapenems are used as a last option against many multi drug resistant, gram-negative bacteria. [4] However, there is alarming increase in carbapenem resistance Entero bacteriaceae related to high mortality and the trend is increasing around the World.[5]

Carbapenem Resistant Entero bacteriaceaec an be defined as – Entero bacteriaceae that are resistant to one or all the following carba penems Ertapenem, Mero penem, Imipenem. [6] Escherichia coli are the most common agents of community and hospital-acquired infections among the Entero bacteriaceae family. The main reason for the resistance to carbapenems is production of carbapenemase that hydrolyze carbapenem and other beta lactam drugs.[1] Besides production of carbapenemase enzyme the other mechanism of resistance includes over-expression of efflux pumps by the bacteria, lack of porins present in the bacterial cell membrane and poor binding of carbapenems to penicillin-binding protein.[7] The inter and intra species spread of carbapenemase encoding genes responsible for resistance via horizontal plasmid mediated transmission is also common among carbapenem resistant Entero bacter iaceae (CRE). [8]

Rapid detection of carbapenem resistance is necessary to initiate effective infection control measures to prevent their dissemination and to start appropriate treatment for the patient suffering from carbapenem resistant strain of Escherichia coli infection as they have limited treatment options.

Also, epidemiology and bacteriology of carbapenem resistant strains of Escherichia coli are essential for formulating guidelines for rational therapy and isolation and contact precautions of such infectious patient preventing further spread at health care settings.

Data regarding carbapenem resistance among clinical isolates of Escherichia coli prevalent in rural Uttar Pradesh is limited. Thus, in present study we aimed to explore the prevalence of carbapenem resistance Escherichia coli at a tertiary care hospital in rural Uttar Pradesh.

Material and Methods

Study Design and Settings: A Cross sectional study was performed at Dept. of Microbiology, Government Medical College, Azamgarh in collaboration with Dept. of Microbiology, Index Medical College, Indore.

Inclusion Criteria

Escherichia coli isolated from various clinical samples showing resistance to at least one car bapenem (Imipenem, Meropenem, Etrapenem) is included in this study.

Exclusion Criteria

Escherichia coli isolated from various clinical samples not showing resistance to any carbapenems is not included in this study.

Sample Collection and Processing

A total of 3180various clinical specimens comprising Urine, pus, wound swab, sputum, throat swab and other samples were collected following the standard guidelines and were processed for culture by the standard bacterio logical methods in Department of Microbiology. All the samples were processed and cultured on appropriate culture media depending upon the type of samples and were incubated at 37^0C for 24-48 hrs. After incubation

the culture plates were observed for bacterial growth and colony characteristics, gram staining of the bacteria was performed and gram-negative bacilli were confirmed using standard biochemical tests.

All clinical isolates of Escherichia coli were further processed for antibiotic sensitivity testing for carba penem using Imipenem (10µg), Meropenem (10µg) and Ertapenem (10µg) by Kirby Bauer disc diffusion method. After performing the Kirby Bauer disc diffusion test for carbapenems zone of inhibition around the antibiotic disc for the test strains was measured with the help of scale and the result were interpreted following CLSI guidelines 2021. [6]

Statistical Analysis

Data entry was done in Excel format and analysed in the form of Tables, Figures and Charts.

Results

Out of the 3180 specimens 1689 (53.11%) showed the growth of various organisms. A total of 987 iso lates showed growth of Entero bacteriaceae, of which 256 of them were car bapenem resistance Escherichia coli. Prevalence of Carbapenem Resistant Escherichia coli in present study is 25.94%.

Among 256 carbapenem resistant isolates of Escherichia coli,171(67%) isolates were from female patients while 85 (33%) isolates were from male patients. Gender wise distribution of Carbapenem Resistant Escherichia coli is shown in Figure 1.

Maximum number of carbapenem resistant strains were obtained from urine samples (58%), followed by pus/ wounds wab (23%) sputum/ throat swab (14%) and other samples (05%).

Distribution of carbapenem resistant Escher ichia coli among different clinical samples in the present study is shown in Figure 2.65% of the total carbapenem resistant isolates of Escher ichia coli were isolated from various inpatients departments that included Medicine, Surgery, Obstetrics and Gynaecology, Paediatric and Ortho paedics. 35% were isolated from Outpatient depart ments.16 Out of 256 CR E. coli showed resistance to Imipenem, 04 Out of 256 CR E. coli showed resistance to Mero penem, 33 CR E. coli showed resistance to Imipenem & Mero penem, 05 CR E. coli showed resistance to Imipenem & Ertapenem & 198 CR E. coli showed resistance to Imipenem, Meropenem & Ertape nem all three.

Drugs	**Escherichia coli**
Imipenem alone	16
Meropenem alone	04
Imipenem & Meropenem	33
Imipenem & Ertapenem	05
Imipenem, Meropenem & Ertapenem	198
Total	**256**

Figure 1: Gender wise distribution of Carbapenem Resistant Escherichia coli**.**

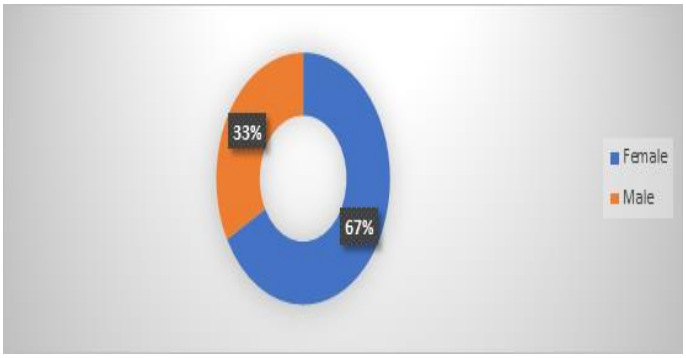
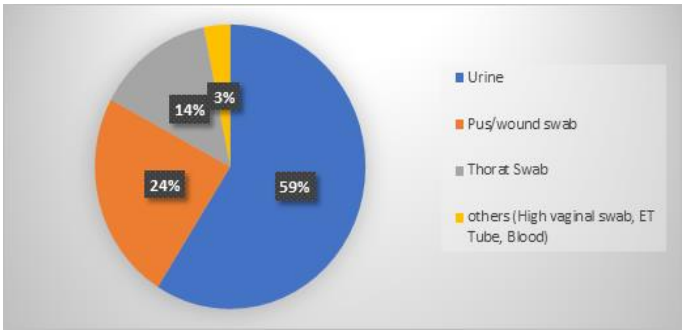


Figure 2: Distribution of Carbapenem Resistant Escheri chia coli among Different Clinical Samples



Discussion

Enterobacteriaceae are often associated with a wide range of severe infections including blood stream infections, ventilator - associated pneumonia community-acquired pneumonia, hospital- acquired pneumonia, complicated urinary tract infections, and complicated intra-abdominal infections. Emergence of extended-spectrum β-lactamase (ESBL) - producing Entero bacteriaceae has led to extensive use of carbapenem as a first-line empirical treatment. The increasing use of carbapenem for possible ESBL infections has led to a more serious problem of the emergence of carbapenemase producing Entero bacteria ceae. [9]

Carbapenemase-producing Enterobacteriaceae pose an exponentially increasing threat for the public health worldwide. Carbapenemases are β-lactamases with the ability to hydro Lys penicillin's, cephalo sporins, mono bactams and carbapenems.[10]

Carbapenems are considered as last-resort antibiotics for the treatment of infections caused by multidrug-resistant Gram-negative bacteria. In the last decade prevalence of car bapenem-resistant Entero bacteriaceaehas increased rapidly.[11] Early and accurate detection of carbapenem resistance isolates is important for appropriate treatment of patient and reduce the further escalation of resistance in the community.

Distribution of carbapenem resistant isolates among different clinical samples showed that majority (56.86%) of isolates were from urine samples which was in concordance with the findings by Nair et al [12] (42%), Singh et al [13] (39.4%) and Satyajeet K Pawar et al [4] (31.76%) who also reported majority of carbapenem resistant isolates from urine in their studies. Car bapenem mase producing Entero bacteriaceae spread rapidly because of horizontal transmission of plasmid encoding genes responsible for carbapenemase production. This occurs mainly by faeco-oral route in community-acquired infections as well as in hospitalized patients.[14] Because of this proximity urine specimens might show more car bapenem resistant Entero bacteriaceae (CRE) prevalence. 65% of the total carbapenem resistant isolates of Escherichia coli were isolated from various inpatients depart ments that included Medicine, Surgery, Obstetrics and Gynaecology, Paediatric and Orthopaedics. 35% were isolated from Outpatient departments. Our study findings co-relate well with studies, which have also shown the same pattern. (08), (15)

Admission to a hospital setting predisposes the patients to colonisation followed by infection with Carbapenem resistant isolates, which is the reason for increased isolation of Carbapenem resistant isolates from inpatient departments. (6) Also, in the present study maximum number of isolates were recovered from the wards, which could be due to cross-transmission from one patient to another. The reason attributed to this could be use of increased usage of Carbapenem for treating invasive infections. This points out towards improving the need for implementation of various precautionary measure essential to prevent the spread of such resistant isolates. (16)

Since treatment options available for carbapenem resistant isolates are very few which include tigecycline, colistin or combination therapy increasing resistance to Carbapenem is of rising concern.

Absence of proper antimicrobial policy could have resulted in indiscriminate use of carbapenem. It has resulted in overall increase in these group of drugs. Introduction of appropriate antimicrobial stewardship program may help curb the issue. Use of optimal dose for specified duration and use of combination antibiotics are some of the measures that may play an important role. (01) (16)

In current scenario there are very limited options available for treatment of multidrug resistant organisms. Thus, there is an urgent need to implement multi-disciplinary approach to limit the spread of these organisms. Strategies for prompt detection, appropriate treatment, anti-microbial stewardship and adequate infection control measures to stop the spread of car bapenem resistant organisms is the need of the hour to successfully tackle the global threat imposed by these organisms.

Conclusion

The emergence of CRE has become major public health issue. In this study the prevalence of carbapenem resistant E. coli is 25.94% which is higher than most of the previous studies. This further emphasizes role of early detection, isolation and contact precaution of CRE. coli patients to prevent rapid dissemination of carba penemase encoded genes present on the plasmids. There should be restricted use of Carbapenem antimicrobials to prevent further escalation of carbapenem–resistance, which underlines the importance of strict implementation of Antimicrobial Stewardship Programme.

References

1. Srivastava P, Bisht D, Kumar A, Tripathi A. Prevalance of Carbapenem- resitant Escherial coli and Klebsiella pneumoniae in rural Uttar Pradesh. J Datta Meghe Inst Med Sci Univ2022; 17:584-8

2. Peleg AY, Hooper DC. Hospital-acquired infections due to gram- negative bacteria. N Engl J Med 2010; 362: 1804-13.

3. Jaggi N, Chatterjee N, Singh V, Giri SK, Dwivedi P, Panwar R, et al. Carbapenem resistance in Escherichia coli and Klebsiella pneumonia among Indian and international patients in North India. Acta Micro biol Immunol Hung 2019;66:367-76.

4. Pawar SK, Mohite ST, Shinde RV, Patil SR, Karande GS. Carbapenem – Resistant Entero bacteria ceae: Prevalence and bacteriological profile in a tertiary teaching hospital from rural western India. Ind J Micro biol Res 2018;5:342-7.

5. Nasiri MJ, Mirsaeidi M, Mousavi SM, Arshadi M, Fardsanei F, Dei him B, et al. Prevalence and mechani SMS of carbapenem resistance in Klebsiella pneumoniae and Escherichia coli: A systematic review and meta - analysis of cross-sectional studies from Iran. Microb Drug Resist2020;26:1491-502.

6. Clinical Laboratory Standard Institute (CLSI). Performance Standards for Anti-microbial Susceptibility Testing; 29th Informational Supplement. M-100-S27. Wayne, Pennsylvania, USA: CLSI; 2019.

7. Datta P, Gupta V, Garg S, Chander J. Phenotypic method for differentiation of carbapenemases in Entero bacteriaceae: Study from north India. Indian J Pathol Micro biol 2012;55:357-60.

8. Diene SM, Ro lain JM. Carbapenemase genes and genetic platforms in Gram-negative bacilli: Entero bacteriaceae, Pseudomonas and Acine to bacter species. Clin Microbiol Infect 2014;20:831-8.

9. Sheu CC, Chang YT, Lin SY, Chen YH, Hsueh PR. Infections caused by carbapenem - resistant Entero bacteria ceae: An update on therapeutic options. Front Micro biol 2019;10:80.

10. Cui X, Zhang H, Du H. Carbapenemases in Entero bacteriaceae: Detection and Antimicrobial Therapy. Front Microbiol 2019;10:1823.

11. Veera Raghavan B, Shankar C, Karunasree S, Kumari S, Ravi R, Ralph R. Carbapenem resistant Klebsiella pneumoniae isolated from blood stream infection: Indian experience. Pathog Glob Health 2017; 111: 240-6.

12. Nair PK, Vaz MS. Prevalence of carbapenem resistant Entero bacteriaceae from a tertiary care hospital in Mumbai. India J Microbiol Infect Dis2013;3:207-10.

13. Singh S, Samant SA, Bansal M, Talukdar A, Arif D. Phenotypic detection of carbapenemase producing gram negative bacteria by modified Hodge test. Int J Curr Micro biol App Sci 2016;5:315-20.

14. Niranjan BP, Shetye S, Manjusha A, Mihir V, Zaheer V, Parijat G, et al. Prevalence and susceptibility analysis of gram-negative pathogens in tertiary care transplant Hospital, Mumbai. Asian J Res Med Pharm Sci 2018;4:1-8.

15. Mate PH, Devi KS, Devi KM, et al. Prevalence of carbapenem resistance among gram-negative bacteria in a tertiary care hospital in north-east India. IOSR J of Dental & Med Sci (IOSR-JDMS) 2014;13(12):56-60.

16. Verma S, Thorat SS, Bisure K, Prevalence of Carbapenem resistant Enterobacteriaceae- A study in a tertiary care hospital in Mumbai J. Evolution Med. Dent. Sci 2018;7(45):4909-12.