ISSN: 0975-3583,0976-2833 VOL13, ISSUE 08, 2022

Determination of the prevalence of antimicrobial-resistant infection among patients attending a tertiary care in out patient setting.

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ABSTRACT

Background: It is becoming more frequent for organisms of different generations to acquire resistance to widely-used antibiotics. Due to a lack of monitoring of antimicrobial resistance (AMR), India remains in the dark about the true state of AMR throughout the country.

Aim: To determine the prevalence of antimicrobial-resistant infection among patients attending the tertiary care OPD.

Material and Methods: After obtaining approval from the relevant authorities, the research was conducted inside the internal medicine department. Included in the analysis were the antibiotic susceptibility test results of clinical specimens such as urine, blood, vaginal swabs, pus, samples from indwelling urinary catheters, pleural fluid, stool, wound swabs, abscess swabs, sputum, aspirates, and urethral swabs collected during the study period.

Results: One hundred patients were analyzed in this research. E. coli was the most common kind of bacterium. Microorganisms such as E. coli (20%), S. aureus (30%), K. pneumoniae (30%), S. pneumoniae (10%), and other bacteria (10%). The ampicillin (100%) and amoxicillin/clavulanate (83.33%) showed substantial resistance rates among E. coli isolates. There was a significant amount of resistance to the oral cephalosporins cefotaxime (70%) and cefoxitin (93.33%) among the isolates. There was also a significant proportion of resistance to various antibacterial drugs, including ciprofloxacin (50 percent), gentamicin (50 percent), trimethoprim-sulfamethoxazole (73.33 percent), and imipenem (13.3 percent). The resistance rates of Klebsiella pneumoniae isolates were greater than those of E. coli. Antibiotics against E. coli that have a high resistance rate include: amoxicillin/clavulanate (65%), cefotaxime (50%), cefoxitin (55%), ciprofloxacin (30%), gentamicin (75%), tetracycline (75%), and trimethoprim-sulfamethoxazole (75%). However, resistance to carbapenem was somewhat more in case of K. pneumonia than E.Coli

Conclusion: Considering the widespread antibiotic resistance shown in E. coli, we came to this conclusion. This could complicate treatment options for community-acquired infections.

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 08, 2022

Keywords: Antimicrobial resistance Antibiotics, Bacterial infections

Introduction

The first report of vancomycin-resistant Staphylococcus aureus (VRSA) in the United States in 2002, Brazil in 2005, Jordan and India in 2006, all show that AMR is a developing public health problem when the bacteria is able to survive exposure to antibiotic therapy. A similar case of resistance, this time to vancomycin, was documented with Enterococci in the late 1980s. Methicillin-resistant Staphylococcus aureus (MRSA), identified in 1990 soon after the introduction of pencillinase-resistant penicillins, originated as a single clonal mutation and resulted in community-acquired MRSA due to diversification of clones.[1] This makes infection control a difficult task in developing countries like India, where infectious diseases still hold high morbidity and mortality.[2]

Antibiotic resistance may arise for a variety of reasons, both internal and external to the organism, including but not limited to point mutation, gene amplification, and the horizontal transfer of resistant genes between bacteria within and between species through transposons, integrins, or plasmids. According to a study conducted in rural Tamil Nadu,[1,3] AMR has emerged due to the inappropriate and irrational use of antibiotics in humans and animals for therapeutic and non-therapeutic use (as growth promoters). These findings are supported by the isolation of multidrug-resistant (MDR) Escherichia coli in carriers and in water samples (WHO). Evidence of this included the existence of multidrug-resistant E. coli. E. coli in cow poop and drinking water in an Odisha study.[4,6]

Studies in North India found vibrio cholera to be resistant to furazolidone, co-trimoxazole, and nalidixic acid but sensitive to tetracycline around Delhi, but resistance against tetracycline was noted in Bangladesh1. This led to the development of the concept of extended spectrum-lactamase (ESBL), which was first proposed in 1987.[6] There are currently three clinically available -lactamase inhibitors that can be combined In a study on ventilator-associated pneumonia in French intensive care unit (ICU) patients who were started on antibiotics empirically, Didier Gruson et al.[7] found that following antibiotic policy and by antibiotic rotation increased susceptibility to antibiotics by previously resistant gram-negative organisms. The aim of this study to determine the prevalence of antimicrobial-resistant infection among patients attending the tertiary care.

Material and methods

After obtaining approval from the relevant authorities, the research was conducted inside the internal medicine department. Included in the analysis were the antibiotic susceptibility test results of clinical specimens such as urine, blood, vaginal swabs, pus, samples from indwelling urinary catheters, pleural fluid, stool, wound swabs, abscess swabs, sputum, aspirates, and urethral swabs collected during the study period. Only outdoor patients' culture specimens were sent to the labs.

Patient demographics and microbiological laboratory data, including culture (identification) and sensitivity findings, were recorded. A pre-made data abstraction tool based on Microsoft Excel 2010 was used for data collection. Data entry was double-checked for correctness, and a descriptive analysis of the resistance profiles of isolated organisms was carried out.

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Results

One hundred patients were analyzed in this study. Among the several types of samples analysed, urine samples accounted for 40%, blood for 30%, a high vaginal swab for 5%, pus for 10%, a catheter for 5%, pleural fluid for 5, wound swabs for 3%, an abscess for 1%, and sputum for 1%. K. pneumoniae was the most common kind of bacterium. Microorganisms such as E. coli (20%), S. aureus (30%), K. pneumoniae (30%), S. pneumoniae (10%), and other bacteria (10%). Specifically,(Tables1and 2). The ampicillin (100%) and amoxicillin/clavulanate (83.33%) showed substantial resistance rates among E. coli isolates. There was a significant amount of resistance to the oral cephalosporins cefotaxime (70%) and cefoxitin (93.33%) among the isolates. There was also a significant proportion of resistance to various antibacterial drugs, including ciprofloxacin (50 percent), gentamicin (50 percent), trimethoprim- sulfamethoxazole (73.33 percent), and imipenem (13.3 percent). The resistance rates of Klebsiella pneumoniae isolates were higher than those of E. coli. Antibiotics against E. coli that have a high success rate include: amoxicillin/clavulanate (65%), cefotaxime (50%), cefoxitin (55%), ciprofloxacin (30%), gentamicin (75%), tetracycline (75%), and trimethoprim-sulfamethoxazole (75%). However, resistance to carbapenem was somewhat greater in E.Coli than that of K. pneumoniae. Sulfa-based E.coli-imipenem resistance was seen in 10% and 13% for K.Pneumoniae (Table 3). Even Gram-positive bacteria have shown resistant to standard antibiotics. Amoxicillin/clavulanate (100%),
ampicillin (90%), cefotaxime (40%), cefoxitin (43.33%), ciprofloxacin (60%), and trimethoprim/sulfamethoxazole (90%) are all effective against Staphylococcus aureus. As a whole, twenty percent of the isolates showed resistance to vancomycin. High levels of resistance were also seen in Streptococcus pneumoniae, including to amoxicillin/clavulanate (100%) and cefotaxime (30%) and cefoxitin (40% and 40% respectively), ciprofloxacin (9%) and tetracycline (100%) and trimethoprim-sulfamethoxazole (90%) (Table 3).

Table 1. Types of sample

Type of sample	Number	Percentage
Urine	40	40
Blood	30	30
Pus	10	10
High vaginal swab	5	5
wound swabs	3	3
catheter	5	5
Pleural fluid	5	5
Sputum	1	1
abscess	1	1

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Table 2 Prevalence of clinical isolates

	Number	Percentage
Escherichia coli	30	30
Staphylococcus aureus	30	30
Klebsiella pneumoniae	20	20
Streptococcus pneumoniae	10	10
Streptobacillus Spp.	4	4
Klebsiella aerogenes	4	4
Proteus Spp.	1	1
Enterobacter Spp.	1	1

Table 3 Resistance profile of isolated microorganisms

Antibiotics	Escherichia coli=20	Klebsiella pneumoniae=30	Staphylococcus aureus=30	Streptococcus pneumoniae=10
	n (%)	n (%)	n (%)	n (%)
Amoxicillin/clavulanate	13 (65)	25(83.33)	15(50)	10 (100)
Ampicillin	-	30(100)	27 (90)	-
Cefotaxime	10 (50)	21(70)	12(40)	3 (30)
Cefoxitin	11 (55)	28(93.33)	13 (43.33)	4 (40)
Ciprofloxacin	6 (30)	15 (50)	18(60)	9(90)
Chloramphenicol	-	-	21(70)	3 (30)
Clindamycin	-	-	6 (20)	4 (40)
Gentamicin	15 (75)	15 (50)	25(83.33)	7 (70)
Imipenem	2 (10)	4 (13.33)	1 (3.33)	1 (10)
Ofloxacin	-	30 (100)	22 (73.33)	-
Penicillin	-	27 (90)	14 (46.67)	-
Piperacillin	14 (70)	7 (23.33)	11 (36.67)	3 (30)
Tetracycline	15 (75)	29(96.67)	25(83.33)	10 (100)

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Trimethoprim-sulfamethoxazole	15 (75)	22 (73.33)	27 (90)	9 (90)
Vancomycin	-	-	6 (20)	-

Discussion

Three out of ten cases with resistance to cefotaxime included Escherichia coli(50%), Klebsiella pneumonia(70%) and S. aureus (40%). The other most common bacteria were S. pneumoniae (30%), which showed high levels of resistance to cephalosporins (cefotaxime), penicillins (ampicillin), gentamicin, and co-trimox- azole, but lower levels of resistance to imipenem, vancomycin (for S. aureus), and piperacillin. Research in central Uganda also found alarmingly high E. coli resistance. Bacteria like E. coli and Klebsiella. One study found that 70% of S. pneumoniae isolates were resistant to trimethoprim/sulfamethoxazole, 36% were resistant to amoxicillin/clavulanate, 27% were resistant to piperacillin/tazobactam, 22% were resistant to cefoxitin, 15% to cefepime, 20% to chloramphenicol, 1% to gentamicin, and 1% were resistantto ciprofloxacin.[8]

Enterobacterales isolates revealed significant resistance rates to ciprofloxacin, cotrimoxazole, and tetracycline, in addition to resistance to numerous beta-lactam antibiotics. There may be environmental variables at play in the rise of antibiotic-resistant microorganisms; for instance, the preventive use of co-trimoxazole in HIV patients may have a role in the spread of resistanceto trimethoprim-sulfamethoxazole.[10]

As Heidary et al.[11] noted, drug-resistant K. ceftazidime and imipenem resistant K. pneumoniae strains, at 55.7% and 3.2%, respectively. There is a lot of resistance in K. resistance among S. pneumoniae isolates was seen against ampicillin (82.2%), aztreonam (55.4%), and nitrofurantoin (54.5%). Multiple studies have found alarmingly high rates of MDR strains across Africa and the world.[12–14] This rise in resistance has a significant effect on the economies of both developed and developing nations, as it is most likely to affect the labour force through mortality and morbidity.[15,16] We found a similarly high resistant rate of K. pneumoniae in our own research. resistance of S. pneumoniae to imipenem (10%). There have been a lot of reports of K. pneumoniae strains that are resistant to carbapenems. Numerous articles detailing the spread of carbapenem-resistant K. pneumoniae have been published in various parts of the globe.[17-19] The growing unrestricted use of carbapenem as a last option in the treatment of multidrug-resistant infections has been linked to the emergence of carbapenemases in S. pneumoniae.23 Several investigations have revealed methicillin-resistant S. aureus (MRSA) isolates. [20-22] 53.9% of all cases of aureus in 122 patients. Average antibiotic susceptibility profiles for the eight antibiotics examined were as follows: ampicillin 75.0 percent, chloramphenicol 34.4 percent, ciprofloxacin 1.6%, erythromycin 7.8 percent, gentamycin 0%, oxacillin 1.6%, tetracycline 45.3%, and co-trimoxazole 50%. Even Gram-positive bacteria have shown resistant to standard antibiotics. Ampicillin (90%), Cefotaxime (40%), Cefoxitin (43.33%), Cipro (60%) and Trimethoprim-Sulfamethoxazole (90%) are all effective against Staphylococcus aureus.[23,24] As a whole, forty percent of the isolates showed resistance to vancomycin. MRSA infections are related with greater mortality and increased treatment costs

ISSN: 0975-3583,0976-2833 VOL13, ISSUE 08, 2022

and may complicate clinical management of the infections due to a lack of effective therapeutic options.[25]

There is growing worry that pneumococcal bacteria are developing resistance to treatment with standard antimicrobials. Streptococcus pneumoniae revealed substantial rates of resistance, including to amoxicillin/clavulanate (100%) and cefotaxime (30%), cefoxitin (40%), ciprofloxacin (9%), tetracycline (100%) and trimethoprim-sulfamethoxazole (90%). The empirical treatment that includes these antibiotics has shown some success in the past in treating S. a pneumonia-related illness. Pneumococcal infections may be effectively treated with antibiotics, but an increasing number of bacteria are developing multi drug resistance in OPD patients to these drugs.[26]

Conclusion

Considering the widespread antibiotic resistance shown in E. coli, we came to this conclusion. This could complicate treatment options for community-acquired infections caused by the Enterobacteriaceae. As also reported by ICMR, the incidence of E.Coli resistance is increasing. Resistance to 1st generation cephalosporins, is almost 90% and 60% to 3rd generation among community acquired infections. Similar resistance pattern is also noted for gentamycin.

The strains of other bacteria detected from community acquired infections is also exhibiting high level of resistance. In our study also, MDR incidence has increased alarmingly. We recommend strong measures to be implemented at levels including education and training in regard to antimicrobial stewardship program. The humanity is in danger and we must put our best to curtail the menace of MDR.

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