Original Research Article

Prevalence and Antimicrobial Susceptibility of Bacterial Isolates from Intensive Care Unit of a Tertiary Care Hospital of Bihar

Sagar Kumar[1], Kumar Amaresh[2*], Rakesh Kumar[3]

[1]Tutor, Department of Microbiology, JLNMCH, Bhagalpur, Bihar, India
[2]Assistant Professor, Department of Microbiology, JLNMCH, Bhagalpur, Bihar, India
[3]Assistant Professor, Department of Pediatrics, JLNMCH, Bhagalpur, Bihar, India

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Abstract

Introduction: Antimicrobial resistance is a modern warfare against trillions upon trillions of microorganisms which is constantly evolving. The intention of the study is to find out the prevalence of common infection and sensitivity pattern among bacterial pathogens in a tertiary care hospital of Bihar. **Methodology:** The current study was carried out in the Department of Microbiology, Jawaharlal Nehru Medical College and Hospital, Bhagalpur, Bihar, India over a period of 1 year from November 2020 to October 2021. The prior approval was obtained from the Institutional Ethics Committee. The data comprising a total of 615 samples collected over a period of one year. Isolates from clinical specimen such as urine, pus, blood, sputum, wound, ear, throat swabs, and peritoneal fluid sample were analyzed. The positive cultures and their antibiotic susceptibility testing were performed under the guidelines of Clinical and Laboratory Standard Institute (CLSI). **Results:** During the study period, total of 615 samples were received for culture and sensitivity test in the Department of Microbiology from the various intensive care units of the hospital. Out of 252 positive samples, based on microscopy and culture characters 179 (71.1%) were Gram Negative isolates and 73 (28.9%) were Gram positive isolates. The most predominant isolated organism in Gram Negative isolates are Klebsiella - 98 (54.7%), Pseudomonas – 38 (21.2%), Escherichia coli – 29 (16.2%) & Proteus vulgaris – 14 (7.8%). Similarly the most predominant Genus/Species in Gram Positive isolates is Staphylococcus – 71 (97.3%). **Conclusion:** Existing and future medical community, health care professionals, Government should address this emerging problem and curb this at its root or else a scenario of pre antibiotic era in near future is inevitable.

Key Words: Prevalence, Antimicrobial Susceptibility, Bacterial Isolates, Intensive Care Unit

Introduction

Antimicrobial resistance is a modern warfare against trillions upon trillions of microorganisms which is constantly evolving[1]. Antimicrobial drugs include all agents that work against a variety of microorganisms such as bacteria, viruses, fungi and parasites. Antimicrobial resistance is when bacteria or other microbes become resistant to the effects of a drug after being exposed to them[2]. Each antimicrobial agent is injurious only to a certain segment of the microbial world. So, for a given antibacterial agent there are some species of bacteria that are susceptible and others are not. Bacterial species insusceptible to a particular drug are naturally resistant. Species that were once sensitive but eventually become resistant to it are said to have acquired resistance. Acquired resistance affects a subset of strains in the entire species; this explains the different resistance pattern of the same species in different location[1]. Antibiotics were too widely, too cheaply and indiscriminately used worldwide[3]. In India, the main reason for development of antimicrobial resistance could be due to irrational use of antibiotics, over the counter availability of higher / broader antimicrobial agents, higher prevalence of infection and poor monitoring of antibiotic susceptibility surveillance in hospitals[4]. If resistant strains spreads widely, important group of drugs lose their efficacy and would render many infections untreatable[5]. Apart from medical consequences of antibiotic resistance, there is direct cost to society. Newer drugs are costlier and are difficult to manufacture. Hence prevention of resistance outbreaks makes the health care society a spendthrift[3], thus costing the nation a huge sum of money.

*Correspondence
Dr. Kumar Amaresh
Assistant Professor, Department of Microbiology, JLNMCH, Bhagalpur, Bihar, India
E-mail: drkamaresh@yahoo.co.in

The problem of resistance is global and need to be tackled on that scale[3]. The intention of the study is to find out the prevalence of common infection and sensitivity pattern among bacterial pathogens in a tertiary care hospital of Bihar.

Methodology

The current study was carried out in the Department of Microbiology, Jawaharlal Nehru Medical College and Hospital, Bhagalpur, Bihar, India over a period of 1 year from November 2020 to October 2021. The prior approval was obtained from the Institutional Ethics Committee. The data comprising a total of 615 samples collected over a period of one year. Isolates from clinical specimen such as urine, pus, blood, sputum, wound, ear / throat swabs, and peritoneal fluid sample were analyzed. The positive cultures and their antibiotic susceptibility testing were performed under the guidelines of Clinical and Laboratory Standard Institute (CLSI). The isolates were subjected to antibiotic susceptibility testing by disc diffusion technique after positive culture. The lab data were utilized and filled in a Performa and analyzed. The Antimicrobial agents used and their drug content in disc were: Clindamycin, CD (2 mcg), Ciprofloxacin, CIP (5 mcg), Ofloxacin, OF (5 mcg), Cefixime, CFM (5 mcg), Levofloxacin, LE (5 mcg), Rifampicin, R (5 mcg), Imipenam, IPM (10 mcg), Meropenam, MR (10 mcg), Norfloxacin, NX (10 mcg), Gentamycin, GEN (10 mcg), Ampicillin, AMP (10 mcg), Amikacin, AK (30 mcg), Ceftazidime, CF (30 mcg),Amoxycillin-clavulanic acid, AC (30 mcg), Cefepime, CPM (30 mcg), Cephoxitin, CN (30 mcg), Cefuroxime, CXM (30 mcg), Cefazolin, CZ (30 mcg), Cefotaxime, CTX (30 mcg), Ceftriaxone, CTR (30 mcg),Nalidixic acid, NA (30 mcg), Cephalothin, CEP (30 mcg), Vancomycin, VA (30 mcg), Teicoplanin, TEI (30 mcg), Linezolid, LZ (30 mcg), Nitrofurantoin, NIT (300 mcg).

Results

During the study period, total of 615 samples were received for culture and sensitivity test in the Department of Microbiology from the various intensive care units of the hospital. From the total specimen obtained, a little more than one-third (40.97%) were cultured positive. Among the patients with positive culture (n = 252), the male to female ratio was 1.42:1.

Out of 252 positive samples, based on microscopy and culture characters 179 (71.1%) were Gram Negative isolates and 73 (28.9%) were Gram positive isolates. The most predominant isolated organism in Gram Negative isolates are Klebsiella - 98 (54.7%), Pseudomonas – 38 (21.2%), Escherichia coli – 29 (16.2%) & Proteus vulgaris – 14 (7.8%). Similarly the most predominant Genus/Species in Gram Positive isolates is Staphylococcus – 71 (97.3%). Organisms isolated from various body fluids have shown in fig 1. It can be inferred from the figure that Klebsiella is the most common causative organism of urinary tract infection (UTIs) and Staphylococcus being the most common causative organism of pyogenic infections.

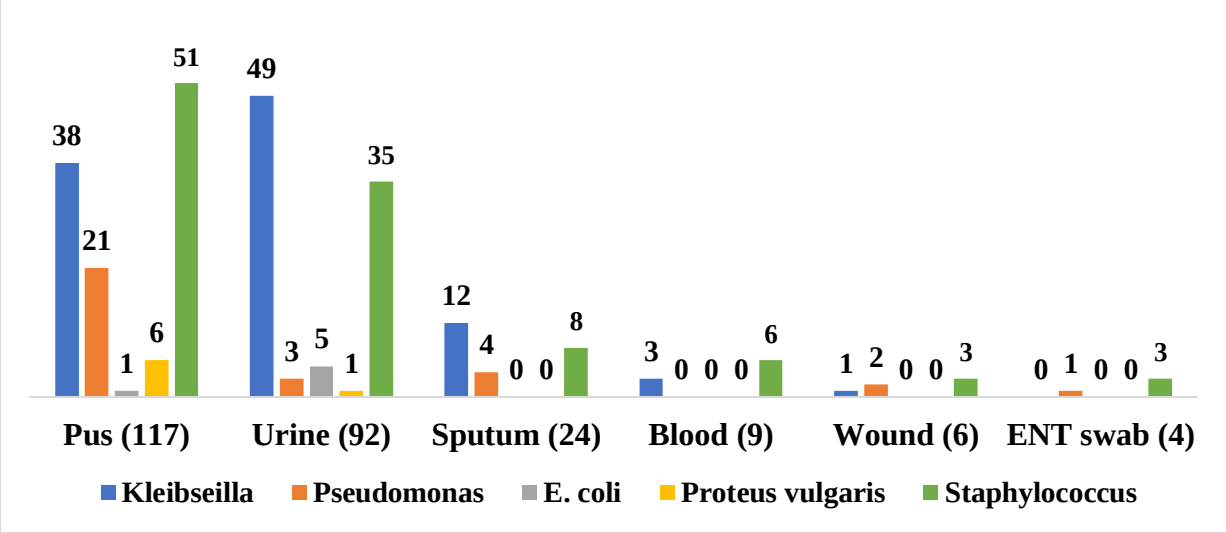

Figure 1: Distribution of organism isolated from various samples collected from patients of critical care units

Antibiotic resistance pattern revealed that the majority of bacterial isolates were resistant to multiple anti-bacterial agents. Widespread resistance to nalidixic acid, Ampicillin, Cefuroxime is seen in both Gram negative isolates and Gram positive isolates. Widespread resistance to Cefazolinand Norfloxacin was noted for Gram negative isolates and widespread resistance to Amoxicillin with clavulanic acid and Imipenemwas noted for Gram positive isolates. Antibiotic Sensitivity Antibiotic sensitivity pattern indicates the effective drugs to manage multidrug resistant bacterial infections in patients. Imipenem, Gentamycin, Amikacin were most sensitive for Gram Negative isolates, while Ceftriaxone, Cefotaxime, Nitrofurantoin and Linezolid were most sensitive for Gram positive isolates.

Table 1: Antibiogram showing percentage of sensitivity among isolated organism to various antibiotics

Antibiotic	Organism				
	Klebseilla	Pseudomonas	E.coli	Proteus vulgaris	Staphylococcus
AK	100	98.2	90.2	75	92.5
CF	75	100	0	-	80.9
AC	-	0	-	-	17.2
CIP	53.4	89.3	32.5	92.5	90.2
CPM	35.8	5.2	25	33.3	50
CN	1.25	-	-	66.6	-
CXM	25	11.2	25	-	33.3
CZ	25	5.2	25	25	56.8
IPM	100	100	100	100	41.2
MR	-	-	-	-	-
NX	41.4	25	0	33.3	75
NIT	91.7	50	100	50	98.7
OF	53.4	62.5	25	33.3	56.8
CTX	56.4	75	44.7	50	100
CFM	35.8	19.7	0	50	80.9
CTR	25	50	-	100	-
CD	-	100	-	-	72.5
GEN	91.7	89.3	100	89.3	92.5
LZ	100	100	-	-	92.5
TEI	-	50	-	-	75
VA	-	-	-	-	80.9
CEP	1.25	5.2	-	0	-
NA	35.8	0	-	0	0
LE	91.7	75	-	-	75

R	0	-	-	-	50
AMX	-	-	-	-	41.2
AMP	12.5	0	-	-	25
CTR	-	-	-	-	100

Discussion

In this study, appalling results were obtained about the resistance pattern of microbes to antibiotics. The number of positive isolates was 296 out of 788 samples with an infection rate of 37.56%. This is quite higher compared to some of the previous studies[6]. The age wise distribution of clinical isolates of positive cultures showed that most of the patients were of the 31-50 years of age[4, 7, 8]. By and large, the most common infected body fluid has been pus[7, 9].

On evaluating the common bacterial isolates, Klebsiella was found to be the commonest among urine isolates followed by Staphylococcus aureus, Escherichia coli and Pseudomonas. Among the wound/swab isolates also Klebsiella was the predominant gram negative bacteria followed by Pseudomonas and E. coli. The isolates from pus samples showed staphylococcus aureus was the commonest organism. Among sputum samples again Klebsiella is more common than Staphylococcus aureus and Pseudomonas. Among the blood samples isolated Staphylococcus aureus was the predominant followed by Klebsiella and E. coli. A few positive cultures with Proteus vulgaris were obtained in few pus /urine isolates. Similar organisms have been isolated from various body fluids of patients admitted in the ICU, across the country[3, 5, 10-19]. The microbes which were positively cultured in our study were Klebsiella, Staphylococcus aureus, Pseudomonas, Escherichia coli, Proteus vulgaris.

On observing the resistance pattern Klebsiella showed a high level of resistance to Cephalothin, Cefoxitin, Ceftriaxone, Cefuroxime, Cefazolin and Ampicillin. The resistance shown by Klebsiella was also observed in other studies Kaushal V Sheth et al[5], IffatJaveed et al[11], Li-Yang Hsu et al[20], Amin A et al[21]. Pseudomonas was resistant to Ampicillin, Nalidixic acid, Amoxycillin with Clavulanic acid, Cefoxitin, Cefazolin, Cefepime and Cephalothin. This is similar to IffatJaveed et al[11]. Resistance to Cefepime was also observed by Mohanasundaram KM et al[22] and BasantiPathi et al[23]. Escherichia coli was mostly resistant to Cefixime, Nalidixic acid, Ceftazidime, Cefipime, Cefuroxime, Cefazolin and Ofloxacin. This was also identical to Li Yang Hsu et al[20], Mangaiarkkarasi. A et al[24] and Oteo J et al[25]. Proteus was highly resistant to Cephalothin, Nalidixic acid, followed by Cefaolin, Cefipime, Norfloxacin, Ofloxacin. Most gram negative were resistant to first and second generation Cephalosporins and resistance to third generation Cephalosporins is now emerging which is due to Beta lactamase activity by the bacteria. This was similar to the study of MaksumRadji et al[26] and Vera Vlahović-Palčevski, [Croatia] et al[27]. Vera Vlahović-Palčevski et al[27] quotes that third or fourth generation Cephalosporins and Amoxiclav were most misused antibiotics. Gram negative isolates and their sensitivity pattern Antibiotics which retained their usefulness and showed less resistance to these gram negative isolates in our study were Imipenem, Amikacin and Gentamicin against Klebsiella, Pseudomonas and E. coli respectively. This is similar to Kaushal V Sheth et al[5], Balan K et al[7], IffatJaveed et al[11], Girish M. B et al[13], Amin A et al[21], R. Shyamala et al[28], Nathisuwan S et al[29] and Muhammad Naeem et al[30].According to a study conducted by Hasan AS et al[31], Amikacin and cefotaxime is still effective against Gram negative bacterial infections. In another study conducted bySaghir H et al[32], Imipenem was the most effective drug againstGram negative strains. This is also in line with Kaushal V Sheth et al[5], Mehta A et al[6], SumitaRajeevan et al[14], Sriram S et al[15] and Gaurav Dalela et al[33]. Specifically, Pseudomonas aeruginosa was sensitive to Aminoglycosides, Fluoroquinolones. This effectiveness is also reported by Kaushal V Sheth et al[5], BasantiPathi et al[23]. Similarly E. coli was highly sensitive to Gentamicin, Imipenem, Nitrofurantoin and Amikacin. Sensitivity of E. coli to Imipenem was also reported by Mangaiarkkarasi. A et al[24], Syed Mustaq Ahmed et al[34]. Similarly Sensitivity to Nitrofurantoin was also reported by Mangaiarkkarasi. A et al[24], Gaurav Dalela et al[33], Bonten M et al[35], and to Amikacin was also reported Mangaiarkkarasi. A et al[24], Mutate AJ[36].

Gram positive isolate and its resistance pattern Staphylococcus aureus shows maximum resistance to Amoxicillin with Clavulanic acid and Ampicillin followed by Imipenem. Resistance to Ampicillin was also noted by Shrestha S et al[18]. Few of Staphylococcus aureus isolates showed low resistance to Vancomycin similar to Vanitha Rani N et al [16], Li-Yang Hsu et al[20] and M. Mehdinejad et al[37].

Gram positive isolate and its sensitivity pattern Regarding effectiveness of antibiotics for Staphylococcus aureus Linezolid, Amikacin, Nitrofurantoin and Vancomycin were much effective. This sensitivity of Staphylococcus aureus to Linezolid was observed similarly by Sriram S et al[15] and Raval PN et al[19]. Sensitivity of Staphylococcus aureus to Vancomycin was observed similarly by Vanitha Rani N et al[16] and Raval PN et al[19]. Sensitivity to Amikacin was noted by Sriram S et al[15].

Conclusion

The results of the present study highlights the alarming development of resistance to almost all the drugs with a very few exception of drugs used in this study. Non empirical inappropriate antibiotic use contributes to the emergence of antimicrobial resistance in bacteria both Gram negative and Gram positive organisms. In developing countries, antibiotics are prescribed for 44-97% of patients in hospital, often inappropriately[19, 27, 38-41]. Shockingly, India has one of the highest rates of Gram negative bacillary resistance in the world[3, 42]. This is due to over reliance on broad spectrum antibiotics, which is because of diagnostic uncertainty among physicians and non-empirical or inappropriate use of antimicrobial agents. Optimal selection of antibacterial agents would decrease the emergence of resistance and would reduce the pharmacy expenditure. Existing and future medical community, health care professionals, Government should address this emerging problem and curb this at its root or else a scenario of pre antibiotic era in near future is inevitable.

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