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PATTERNS OF ANTIMICROBIAL RESISTANCE AMONG PATIENTS IN THE INTENSIVE CARE UNIT

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Abstract:

Given the importance of nosocomial infections (HAI), it is essential to conduct follow-up studies to obtain the required data on local microorganisms and their susceptibility to antibiotics. This study investigated the pattern of antimicrobial resistance among patients in intensive care unit (ICU).

Study Design: *A cross-sectional study.*

Place and Duration: *In the Medicine Unit-II of Jinnah Hospital Lahore for one-year duration from April 2019 to April 2020.*

Methods: *100 samples were collected from patients admitted to the ICU with symptoms or symptoms of nosocomial infection. Blood, urine, tracheal aspirate, sputum, wound swab, pus, and tracheal tubes were sampled from each patient, cultured, and analyzed by antibiogram.*

Results: *The most common primary diagnosis was aspiration pneumonia (49%) and UTI (20%), respectively. The most common sites of infection were tracheal aspirates (54%). The most common sample-derived Gram-negative microorganisms were Acinetobacter spp (29%), Klebsiella spp (26%) and Pseudomonas spp (18%). Klebsiella spp., Acinetobacter spp. And Pseudomonas spp. They were the most common resistant organisms of all. Klebsiella spp were resistant to ceftriaxone (84.6%), ceftazidime (82.6%), amikacin (46.1%), gentamicin (66.6%) and quinolones (65-66.6%), respectively. Acinetobacter spp were resistant to ceftriaxone (85%), ceftazidime (88.8%), cefotaxime (85.7%), meropenem (79.3%), amikacin (86.2%), gentamicin (84.5%) and quinolones (86.2-89.2%). Pseudomonas spp were resistant to ceftriaxone (70.5%), ceftazidime (66.6%), amikacin (68.7%), gentamicin (58.8%), meropenem (52.9%) and quinolones (81 2-86.6%). Meropenem was the most sensitive antibiotic to Klebsiella spp (84.6%), and co-trimoxazole in Acinetobacter spp (60%), respectively. Escherichia coli were mostly isolated from urine, which was sensitive to amikacin (73.3%) and meropenem (86.6%), respectively.*

Conclusion: *Gram-negative pathogens obtained from ICU patients in our facilities show high resistance to antibiotics. Regular monitoring of resistance patterns of common pathogens in intensive care units is essential for the current application of sound antibiotic ceilings.*

Key words: *antibiotic, microbes, nosocomial infections, healthcare associated infections, antimicrobial resistance.*

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INTRODUCTION:

Infectious diseases are the main health problems in Pakistan, requiring frequent use of antimicrobials. Antibiotic-resistant bacteria are a major threat among critically ill patients. Infections in critically ill patients result in high rates of morbidity and mortality[1-2]. Due to significant disease processes and disturbed physiological condition, critically ill patients are more susceptible to various infections and the adverse effects of infection[3-4]. Many infectious diseases do not respond to conventional antimicrobials. Standard guidelines for treating a variety of microbes are not sufficient for this purpose. Healthcare-associated infections (HAIs) are especially important in intensive care units (ICUs), where the incidence is five times higher than that of the general inpatient population[5-6]. This is due to the increased use of invasive medical instruments such as mechanical ventilators, monitoring devices, blood and urine catheters, which in turn is a result of the overt use of broad-spectrum antibiotics. These patterns of antimicrobial resistance always change with time[7]. Due to the importance of HAI infections, it is extremely important to conduct follow-up studies to obtain the required data on local microorganisms and their susceptibility to antibiotics[8-9]. This study is designed to provide such information to our clinicians.

MATERIAL AND METHODS:

This cross-sectional study was held in the Medicine Unit-II of Jinnah Hospital Lahore for one-year duration from April 2019 to April 2020. 100 samples from patients with HAI infection criteria admitted to the intensive care unit. A structured case record form was completed for each patient. Clinical specimens included blood, urine, pus and secretions from the tracheal tube and swabs from postoperative wounds, collected and cultured in Eosin Methylene Blue (EMB), blood agar, chocolate agar, thioglycolate, and tryptic broth (TSB) and incubated at 37 ° C for 24 - 48 hours. The thioglycolate cultures and TSB flasks were re-incubated for at least 7 days and, if necessary, subcultures were grown on EMB agar plates with blood or chocolate agar. Blood, urine, tracheal aspirate, sputum, wound smear, pus, and tracheal tube samples were collected from each patient, cultured and analyzed by antibiogram. The study protocol was approved by the Institute's ethics committee, and each patient's family gave written informed consent prior to study entry. Data was analyzed using the Chicago Illinois version 16 Social Science Statistical Package (SPSS).

RESULTS:

Of the total of 100 samples obtained, 67% were male and 33% female. 30% of patients were aged 61-70 years, respectively, and 18% aged> 80 years.

Table-I

Frequency of different microorganisms from various samples (n=100).

Microorganism	Blood	Urine	Tracheal Aspirate	Sputum	Wound Swab	Pus Endotrachial	Tube	Total (%)
Acinetobacter spp	3(10.3)	1 (3.4)	20 (68.9)	2 (6.8)	2 (6.8)	0	1 (3.4)	29(29)
Klebsiella spp	3 (11.5)	3(11.5)	16 (61.5)	2 (7.6)	0	2(7.6)	0	26(26)
Pseudomonas spp	1 (5.5)	4(22.2)	9 (50)	3 (16.6)	0	0	1 (5.5)	18(18)
Escherichia coli	2(13.3)	7(46.6)	4 (26.6)	0	1 (6.6)	1 (6.6)	0	15(15)
Staphylococcus aureus	0	0	5 (83.3)	1 (16)	0	0	0	6(6)
Streptococcus	0	4 (100)	0	0	0	0	0	4(4)
Salmonella spp	1 (100)	0	0	0	0	0	0	1(1)
Morganella morganii	0	1 (100)	0	0	0	0	0	1(1)
Total	**10(10)**	**20(20)**	**54(54)**	**8(8)**	**3(3)**	**3(3)**	**2(2)**	**100(100)**

The most common primary diagnoses were aspiration pneumonia (49%) and UTI (20%), respectively [Table 2].

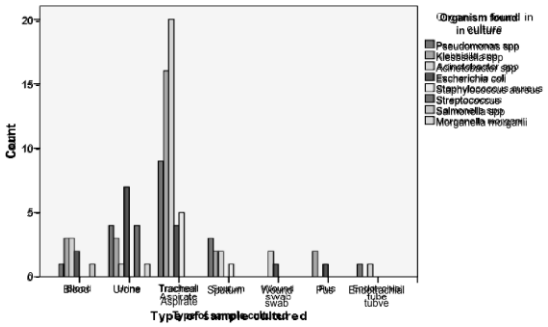

Fig.-2 : *Distribution of various microorganisms according to types of samples cultured.*

Table-II

Primary diagnosis of these ICU patients. (n=100)

Primary Diagnosis	Frequency	Percentage
Aspiration Pneumonia	49	49.0
UTI	20	20.0
Septicaemia	11	11.0
Pneumonia	10	10.0
COPD with respiratory failure	4	4.0
Surgical wond infection	3	3.0
Empyma thoracic	3	3.0
Total	100	100.0

The most common sites of infection were tracheal aspirate (54%), urine (20%), blood (10%), and sputum (8%) [Table 1]. The most common sample-derived microorganisms were Acinetobacter spp (29%), Klebsiella spp (26%) and Pseudomonas spp (18%), Escherichia coli (15%), Staphylococcus aureus (6), Streptococcus (4%), Salmonella spp (1%) and Morganella morganii (1%) respectively [Table II]. Acinetobacter spp, Klebsiella spp, and Pseudomonas spp were most commonly detected in samples from tracheal aspirates. However, Escherichia coli was mostly isolated from urine samples.

Table-III

Distribution of microorganisms according to susceptibility to penicillin and cephalosporins groups of antibiotics. (n=100)

Microorganism	Amoxicillin (%)		Piperacillin+ Tazobactum (%)		Ceftriaxone (%)		Ceftazidime (%)		Cefotaxime	
	S	R	S	R	S	R	S	R	S	R
Acinetobacter spp	0(0)	1 (100)	2 (66.6) 1 (33.3) 4 (14.8)		23 (85.1)	3 (11.1)	24 (88.8)	2 (14.2)	12 (85.7)	
Klebsiella spp	0(0)	2 (100)	1 (33.3) 2 (66.6) 4 (15.3)		22 (84.6)	4 (17.3)	19 (82.6)	2 (28.5)	5 (71.4)	
Pseudomonas spp	0(0)	3 (100)	1 (50) 1 (50) 5 (29.4)		12 (70.5)	6 (33.3)	12 (66.6)	5 (45.4)	6 (54.5)	
Escherichia coli	-	-	2 (66.6) 1 (33.3) 3 (20)		12 (80)	5 (35.7)	9 (64.2)	1 (50)	1 (50)	
Staphylococcus aureus	-	-	2 (100) 0 (0) 0 (0)		4 (100)	0 (0)	5 (100)	-	-	
Streptococcus	1 (50)	1 (50)	- - 1 (25)		3 (75)	1 (25)	3 (75)	-	-	
Salmonella spp	-	-	- - 1 (100)		0 (0)	1 (100)	0 (0)	-	-	
Morganella morganii	0(0)	1 (100)	- - 0 (0)		1 (100)	0 (0)	1 (100)	0 (0)	1 (100)	
Total	1 (11.1) 8 (88.8) 8 (61.5) 5 (38.4)18 (21.1)				77 (81)	20 (21.5)	73(78.4)	10 (28.5) 25 (71.4)		

Table III, IV, V explains the sensitivity of various microorganisms to common antibiotics. Klebsiella spp., Acinetobacter spp. They were the most common resistant organisms of all. In Table 3, of the 95 samples, 77% of the samples were resistant to ceftriaxone and 73% to ceftazidime, respectively. They were mainly Pseudomonas spp., Klebsiella spp., Acinetobacter spp. Klebsiella spp. They were resistant to ceftriaxone (84.6%), ceftazidime (82.6%), amikacin (46.1%), gentamicin (66.6%), respectively. %) and quinolones (65-66.6%) [Table III, IV, V].

Table-IV	
Distribution of microorganisms according to susceptibility to aminoglycosides	*Macrolides and lincosamides groups*
of antibiotics. (n=100)	

Acinetobacter spp	4(13.7)	25(86.2)	4(16.6)	20(84.4)	5(19.2)	21(80.7)	0	1(100)	1(50)	1(50)
Klebsiella spp	14(53.8)	12(46.1)	8(33.3)	16(66.6)	8(40)	12(60)	0	2(100)	0	2(100)
Pseudomonas spp	5 (31.2)	11(68.7)	7 (41.1)	10 (58.8)	8 (50)	8(50)	1(25)	3(75)	1(16.6)	5(84.4)
Escherichia coli	11(73.3)	4(26.6)	7(50)	7(50)	8(57.1)	6(42.8)	-	-	-	-
Staphylococcus aureus	1(20)	4(80)	1(16.6)	5(84.4)	0	4(100)	-	-	-	-
Streptococcus	0	3(100)	1(25)	3(75)	0	3(100)	0	1(100)	0	1(100)
Salmonella spp	-	-	1(100)	0	-	-	-	-	-	-
Morganella morganii	0	1(100)	0	1(100)	0	1(100)	0	1(100)	0	1(100)
Total	35(36.8)	60(63.1)	29(31.1)	64(68.8)	29(34.5)	55(65.4)	1(11.1)	8(88.8)	2(16.6)	10(84.4)

Acinetobacter spp were resistant to ceftriaxone (85%), ceftazidime (88.8%), cefotaxime (85.7%), meropenem (79.3%), amikacin (86.2%), gentamicin (84.5%),) and quinolones (86.2-89.2%) [Table III, IV, V].

Table-V

Distribution of microorganisms according to susceptibility to quinolones and other groups of antibiotics. (n=100)

Microorganism	Ciprofloxacin (%)		Levofloxacin (%)		Meropenem (%)		Colistin (%)		Cotrimoxazole (%)	
	S	R	S	R	S	R	S	R	S	R
Acinetobacter spp	3(10.7)	25(89.2)	4(13.7)	25(86.2)	6(20.6)	23(79.3)	2(40)	3(60)	12(60)	8(40)
Klebsiella spp	8(33.3)	16(66.6)	8(34.7)	15(65.2)	22(84.6)	4(15.3)	2(66.6)	1(33.3)	2(18.8)	9(81.8)
Pseudomonas spp	2(13.3)	13(86.6)	3(18.7)	13(81.2)	8(47)	9(52.9)	1(20)	4(80)	0	8(100)
Escherichia coli	2(14.2)	12(85.7)	2(14.2)	12(85.7)	13(86.6)	2(13.3)	1(100)	0	2(33.3)	4(66.6)
Staphylococcus aureus	0	4(100)	1(25)	3(75)	3(50)	3(50)	0	2(100)	1(25)	3(75)
Streptococcus	0	3(100)	0	3(100)	1(25)	3(75)	1(50)	1(50)	0	2(100)
Salmonella spp	0	1(100)	0	1(100)	1(100)	0	-	-	-	-
Morganella morganii	0	1(100)	0	1(100)	0	1(100)	0	1(100)	0	1(100)
Total	15(16.6)	75(83.3)	18(19.7)	73(80.2)	54(54.5)	45(45.4)	7(36.8)	12(63.1)	17(32.6)	35(67.3)

Pseudomonas spp were resistant to ceftriaxone (70.5%), ceftazidime (66.6%), amikacin (68.7%), gentamicin (58.8%), meropenem (52.9%) and quinolones (81 2-86.6%) [Table III, IV, V]. Meropenem was the most sensitive antibiotic to Klebsiella spp. (84.6%), but Acinetobacter spp. They were still resistant to Meropenem and Amikacin, but susceptible to Kotrimoxazole (60%) [Table V]. Table 4.5 showed that Escherichia coli were the most sensitive to amikacin (73.3%) and meropenem (86.6%), respectively. Gram-negative pathogens obtained from ICU patients in our facilities show high resistance to antibiotics.

DISCUSSION:

This study analyzes the epidemiology and microbiology of infections in ICU patients at tertiary care Hospital of Lahore city. Consistent with other studies, aspiration pneumonia (49%), pneumonia (10%), and UTI (20%) were the leading forms of infection in the subjects. The types of organisms that turned out to be the most problematic for ICU patients were Acinetobacter spp, Klebsiella spp, Pseudomonas spp, Escherichia coli[10-11]. In our study, the most common sample-derived microorganisms were Acinetobacter spp (29%), Klebsiella spp (26%) and Pseudomonas spp (18%), Escherichia coli (15%) respectively, which is consistent with the results of other studies. In recent years, Acinetobacter spp. Have proven to be important pathogens in intensive care units, most of them resistant to ampicillin, carbenicillin, cefotaxime, chloramphenicol and gentamicin. In our study, Acinetobacter spp was the major cause of pneumonia based on tracheal aspirate samples and is resistant to ceftriaxone (85.1%), ceftazidime (88.8%), amikacin (86.2%), gentamicin (84, 4%) and fluoroquinolones (86.2-89.2%) respectively. This is in line with the results of a similar study conducted in India. Another type of antimicrobial resistant pathogen commonly found in ICU patients is Klebsiella spp, which produces extended spectrum beta-lactamases (ESBL). Our Klebsiella spp isolates showed high resistance to broad-spectrum cephalosporins and gentamicin (82.6-84.6% and 66.6%, respectively). But they were very sensitive to meropenem (84.6%). Gram-negative bacilli are often associated with nosocomial infections in intensive care units. Data from a multicenter observational study in the intensive care unit (ISS) in the United States have shown that Pseudomonas spp are often isolated from ICU specimens and exhibit particular resistance to fluoroquinolones. Pseudomonas spp[12]. Isolates in this study accounted for 18%, mainly from tracheal and urine aspirates. In this study, Pseudomonas spp were resistant to ceftriaxone (70.5%), ceftazidime (66.6%), amikacin (68.7%), gentamicin (58.8%), meropenem (52.9%) and quinolones, respectively. (81.2-86.6%), which is strictly in line with other studies. In our study, E. coli was the most common pathogen obtained from patients with a urinary tract infection[13-14]. This is similar to the previous study. In this study, Escherichia coli species were fully susceptible to meropenem but resistant to ceftriaxone. In our study, similarly, Escherichia coli were mostly sensitive to meropenem (86.6%), amikacin (73.3%) and resistant to ceftriaxone (80%) and ceftazidime (64.2%), respectively. The multi-resistant species Klebsiellae, Pseudomonas and Acinetobacter added a new dimension to the problem of nosocomial infections[15]. The panic situation is infection with Acinetobacter spp, where no single antibiotic has shown effective susceptibility.

CONCLUSION:

Antibiotics and similar drugs, collectively called antimicrobials, have been used for many years, since the First World War, to treat patients with infectious diseases. Since the 1940s, these drugs have significantly reduced the number of cases and deaths caused by infectious diseases. The use of antibiotics is beneficial when they are prescribed and taken properly. Their value in patient care is enormous. Infections caused by resistant microorganisms often fail to respond to conventional treatment, resulting in protracted illness, prolonged hospital stay, and a greater risk of death. A number of factors contribute to the emergence of antimicrobial resistance in intensive care units, including the severity of the patient's disease, predisposition to nosocomial infections, cross-transmission of pathogens characteristic of intensive care areas in a hospital, impairment of membrane and skin barriers after the use of invasive devices, extension in hospital and the widespread use of prophylactic and therapeutic anti-infective agents. Antimicrobial resistance among Intensive Care Unit (ICU) pathogens is gradually increasing but varies by country, possibly due to individual patterns of antimicrobial use. We need institutional surveillance mechanisms in the health sectors to generate reliable and practical epidemiological information, including basic data and trends on antimicrobial resistance, antimicrobial use, and economic and health impacts through designated national and regional centers of reference.

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