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Orginal Article

CLINICAL PRESENTATION AND BACTERIOLOGICAL PROFILE OF ICU ADMITTED PATIENTS WITH VENTILATOR ASSOCIATED PNEUMONIA IN KHYBER TEACHING HOSPITAL PESHAWAR

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ABSTRACT

Objectives: *To determine bacteriological profile of ICU admitted patients with ventilator associated pneumonia.*

Materials and Methods: *A descriptive cross-sectional study was conducted from July 2018 to April 2020 at department of Medical ICU. A total of 172 patients were observed for clinical presentation and bacteriological profile in ventilator associated pneumonia. Data were presented in form of frequency and percentages. The p-value less than 0.05 were considered as statistically significant.*

Results: *Out of 172 patients, 24 (13.71%) and 18 (10.2%) were having Diabetes Mellitus (DM) and Hypertension (HTN), respectively. Patients who received mechanical ventilation for 0-5 days had a relatively low recovery rate of 8.8%, with the majority (91%) unfortunately expiring. In the 6–10-day category, there was a slightly higher recovery rate of 14.8%, but still, the majority (85%) of patients did not survive. Patients with >16 days of ventilation, show higher recovery rate (35.2%). The highest number of bacteria was isolated from the patients with 0-5 day's ventilation while there was a lowest growth of bacteria in 6-10 days ventilated patients. In antibiotics susceptibility, there are variations in antibiotic effectiveness across different bacterial strains and antibiotics. Fosfomycin and Tigecycline show highest effect against all bacteria except Acinobacter baumannii while Colistin was effective against all the bacteria except Pseudomonas.*

Conclusion: *Patients on mechanical ventilation had lower chances of recovery in the early days, but those who were ventilated longer showed better outcomes. Diabetes Mellitus and Hypertension were common comorbidities. Bacterial growth was highest in the early days of ventilation. Antibiotics like Fosfomycin and Tigecycline show highest effect against all bacteria except Acinobacter baumannii whereas Colistin was also effective against all, except for Pseudomonas.*

Key words: *Bacteria, Pneumonia, ICU, Peshawar*

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INTRODUCTION

Pneumonia is an inflammatory condition affecting the air sacs in one or both lungs, usually caused by infection. It can be caused by various microorganisms, including bacteria, viruses, fungi, and even parasites[1]. The infection causes the air sacs (alveoli) in the lungs to become filled with fluid or pus, leading

to symptoms such as cough, fever, difficulty breathing, and chest pain[2]. The severity of pneumonia can vary from mild to severe, and it frequently depends on the infection's source, the patient's age, general health, and any underlying medical conditions[3].

A form of lung infection that appears during a hospital stay or within 48 hours of being released from the hospital is called hospital-acquired pneumonia (HAP), sometimes referred to as nosocomial pneumonia[4]. It happens when patients, who frequently already have other health issues, contract a new respiratory infection while they are in a medical facility[5]. Because hospital-acquired pneumonia frequently involves germs that are more resistant to antibiotics, treatment can be more difficult[6].

The bacteria that cause hospital-acquired pneumonia (HAP) are usually more resistant to antibiotics because of their exposure to healthcare settings and past use of antibiotics[7]. The specific bacteria involved can vary, but some common pathogens associated with Hospital-acquired pneumonia including Staphylococcus aureus, Klebsiella pneumoniae, Escherichia coli (E. coli), Pseudomonas aeruginosa, Enterobacter species, Streptococcus pneumoniae, Haemophilus influenziae, Legionella pneumophila, and Mycoplasma pneumoniae[8]. It is noteworthy that the bacterial profiles responsible for HAP may differ according on the patient demographics, the particular healthcare facility, the geographic region, and other variables[9]. Antibiotic-resistant bacteria are frequently tracked and monitored in healthcare institutions in order to restrict the spread of these diseases and adopt the proper infection control measures[10].

Ventilator-associated pneumonia (VAP), which usually manifests 48 hours after endotracheal intubation and mechanical ventilation, is the most common hospital-acquired infection that patients in the critical care unit encounter[11]. The incidence rate varies, with 2 to 16 incidents per 1000 ventilator days. More than 95% of ICU cases of pneumonis are linked to intubation, which is the main risk factor. Patients who are more severely ill, have experienced trauma, are older, or have decreased consciousness are also at higher risk[11,12].

Treatment of HAP and VAP can be challenging due to the likelihood of antibiotic-resistant bacteria. Initial treatment often involves broad-spectrum antibiotics until the specific bacteria are identified through cultures[13,14]. Once the specific bacteria are known, treatment can be adjusted to a more targeted antibiotic regimen.

The VAP is a leading cause of infection and mortality in ICU patients, particularly in resource-limited settings like in Pakistan. There is huge gap in literature regarding VAP in our setting, our study aims to fill the gap. The ai of this study is to determine bacteriological profile of ICU admitted patients with ventilator associated pneumonia.

MATERIALS AND METHODS

This cross-sectional study was carried out at Medical ICU, Khyber Teaching Hospital from July 2018 to April 2020. Ethical approval was taken from Institutional Ethical Committee of Khyber Medical College (Ref No: 866/ADR/KMC). Patients undergoing pneumonia treatment were selected based on clinical indications. Informed consent was obtained from each participant, outlining the procedure's purpose and potential risks. Inclusion criteria was all those patients who were admitted in medical ICU and having pneumonia. Those patients who were unable to give consent were excluded.

The tracheal secretions were collected and immediately transported to the microbiology laboratory. Sample integrity and proper storage conditions (e.g., temperature) were maintained to prevent bacterial overgrowth or contamination. Samples were inoculated on Blood and MacConkey's agar and incubated at 37oC for 24 hours. Culture characteristics of the bacteria were studied for identification. Positive blood cultures were subjected to Gram staining to categorize bacteria into Gram-positive or Gram-negative groups. This initial step provided valuable information about cell morphology and arrangement. Various biochemical tests such as Oxidase, Urease, TSI, Citrate and MIU tests were performed as per standard protocol for identification of isolated bacteria[15,16].

SPSS version 22 was used for statistical analysis. Data were presented in form of frequency and percentages. Values among different groups were compared using Chi-square test and p-value less than 0.05 were considered as statistically significant.

RESULT

A total of 172 samples were collected with different diseases. Diabetes Mellitus (DM) and Hyperten-

sion (HTN) are the most prevalent conditions among the patients, with 24 cases (13.71%) and 18 cases (10.2%), respectively. COPD (Chronic Obstructive Pulmonary Disease) also has a notable representation with 17 cases (9.71%). Several conditions have lower prevalence, with some cases appearing in the 1-2% range or even less, indicating their relative rarity among the patient population, as shown in Table 01.

This table also represents a combination of various less common diseases and conditions. This data provides healthcare professionals and researchers with valuable information about the distribution of diseases among patients, aiding in resource allocation and treatment planning.

Table 2. is divided into four categories of ventilator duration: 0-5 days, 6-10 days, 11-15 days, and more than 16 days. For each category, it provides the number of patients who have either recovered or unfortunately expired.

In 0-5 Days Ventilation has the highest number of patients (113) but also the highest mortality rate (103 expired). Only 10 patients in this group have recovered. There are 27 patients in 6-10 Days Ventilation category, with 4 patients who have recovered and 23 patients who have expired. 11-15 Days Ventilation consists 16 patients, with 5 patients recovering and 11 patients succumbing to the disease. Among the 17 patients in >16 Days Ventilation duration category, 6 patients have successfully recovered, while 11 patients have unfortunately passed away.

This data highlights the critical role of ventilator duration in determining patient outcomes. It is evident that patients who require longer durations of ventilator support face a higher risk of mortality. Further analysis and medical interventions may be needed to improve outcomes for patients with extended ventilator needs.

Table No.3 presents data from a clinical study categorizes patients into different time intervals of ventilation (in days) and reports the presence or absence of bacteria as a percentage of the total cases within each category.

In the 0-5 days category, E. coli and Pseudomonas was not found in any cases (0%), while in the >16 days category, both were identified in 28.57% of cases. It means presence of E. coli and Pseudomonas increased in the longer ventilation duration categories. Citrobacter was predominantly found in the 0-5 and >16 days categories, at 12.5% and 28.57% respectively. Enterobacter spp shows its prevalence in the >16 days category (14.28%). About 75%, there

Table 1: Clinical condition (disease) with which patients admitted in ICU

Condition	Frequency	%
Diabetes Mellitus	24	13.71
Hypertension	18	10.2
Pneumonia	18	10.2
Chronic obstructive pulmonary disease	17	9.71
Acute kidney injury	16	9.14
Sepsis	11	6.28
Guillain Barré syndrome	10	5.71
Chronic Kidney Disease	9	5.14
Meningitis	9	5.14
Tuberculosis	8	4.57
Tetanus	6	3.42
Disseminated intravascular coagulation	6	3.42
Hemolytic uremic syndrome	6	3.42
Cerebral vascular accident	6	3.42
Congestive Heart Failure	5	2.85
Other diseases	64	37.21

Table 2: Duration of vent and outcome of the disease

Duration of vent (Days) (n)	Outcome		Chi square	P value
	Recovered (%)	Expired (%)		
0-5 (n=113)	10 (8.8%)	103 (91%)	7.147405	0.0075
6-10 (n=27)	4 (14.8%)	23 (85%)	0.01979	0.8881
11-15 (n=16)	5 (31.2%)	11 (68.7%)	4.395667	0.0361
>16 (n=16)	5 (31.2%)	11 (68.7%)	4.395667	0.0361

Table 3: The relationship between the duration of ventilation and the prevalence of various bacterial species in patients.

Duration of vent (Days) (n)	Bacteria +ve, n (%)	Chi square	P value
0-5 (n=113)	18.1	0.40635	0.0075
6-10 (n=27)	0	7.753925	0.005
11-15 (n=16)	18.1	0.021761	0.882
>16 (n=16)	63.6	21.87205	0.0000002

was no growth observed in the 0-5 days category but decreases as the duration of ventilation increases.

Overall, the table provides valuable insights into the changing bacterial profiles associated with varying durations of mechanical ventilation in a clinical context.

Table 4. shows antibiotics susceptibility pattern of different bacteria. E. coli was often susceptible to Amikacin, Chloramphenicol, Gentamicin, Imipenem, Meropenem, Levofloxacin, and Fosfomycin, while it was frequently resistant to Aztreonam, Ceftazidime, Ceftriaxone, Ciprofloxacin, Co-amoxiclav, and Cefoperazone. Pseudomonas demonstrated susceptibility to Amikacin, Cefoperazone, and Sulbactam in some instances. However, it generally exhibited resistance to most of antibiotics tested, including Aztreonam, Ceftazidime, Ceftriaxone, Ciprofloxacin, Co-amoxiclav, Ertapenem, Imipenem, Levofloxacin, Meropenem, Colistin, Fosfomycin, and Tigecycline. Citrobacter spp showed a variable response to antibiotics. It often exhibited susceptibility to Amikacin, Aztreonam, Chloramphenicol, and Cefoperazone but was frequently resistant to Ceftazidime and Ceftriaxone. In general, Enterobacter species were sensitive to gentamicin, ciprofloxacin, and chloramphenicol. Nevertheless, it frequently shown resistance to Ceftriaxone, Aztreonam, and Ceftazidime. Colistin and fosfomycin were among the few antibiotics to which A. baumannii showed sensitivity. The majority of other antibiotics had little effect on it.

It's important to note that antibiotic susceptibility patterns can vary based on geographic location, bacterial strains, and local antibiotic usage.

DISCUSSION

In clinical context, the information provided in this paper gives important insights into a number of patient attributes, treatment outcomes, and the relationship between antibiotic susceptibility and bacterial species. For researchers and medical experts, these discoveries may have significant ramifications.

In line with the well-established trend of rising cases of non-communicable diseases globally, the most common conditions among the patients are DM and HTN[17]. COPD is another noteworthy condition that can be linked to the rising prevalence of respiratory issues, primarily caused by smoking and air pollution. The data also reveals the presence of a number of rare conditions that can help guide the allocation of healthcare resources and the development of specialized treatment plans[18].

Patients who require 0–5 days of ventilation have a much greater mortality rate, which implies

Table 4: Antibiotic Susceptibility Testing Results for Various Antibiotics against Different Bacterial Strains.

Antibiotic tested	E.coli (%)		Pseudomonas (%)		Citrobacter spp (%)		Enterobacter spp (%)		Acinobacter baumannii (%)	
	R	S	R	S	R	S	R	S	R	S
Amikacin	00	100	50	50	40	60	100	00	100	00
Aztreonam	50	50	100	00	40	60	100	00	100	00
Ceftazidime	50	50	100	00	60	40	100	00	-	-
Ceftriaxone	100	00	100	00	60	40	-	-	-	-
Chloramphenicol	00	100	100	00	50	50	60	40	100	00
Ciprofloxacin	50	50	100	00	60	40	100	00	100	00
Co-amoxiclav	50	50	100	00	100	00	100	00	-	-
Ertapenem	-	-	50	50	00	100	60	40	-	-
Gentamicin	00	100	50	50	50	50	100	00	100	00
Imipenem	00	100	50	50	00	100	60	40	100	00
Levofloxacin	50	50	100	00	50	50	100	00	-	-
Meropenem	00	100	50	50	00	100	60	40	100	00
Cefoperazone	00	100	100	00	40	60	60	40	100	00
Sulbactam	-	-	-	-	40	60	60	40	100	00
Colistin	00	100	100	00	00	100	00	100	00	100
Fosfomycin	00	100	00	100	00	100	00	100	-	-
Tigecycline	00	100	00	100	00	100	00	100	-	-

that their situations may be more critical when they are admitted[19]. The information emphasizes how crucial it is to take ventilator duration into account when forecasting patient outcomes. Because they are more likely to die, patients who need continuous mechanical ventilation may need more intensive medical treatment and close observation.

Since prolonged hospitalization can raise the risk of infections linked to healthcare, the rise in E. coli and Pseudomonas presence after longer ventilation durations suggests the necessity for stricter infection control measures[20]. The dynamic character of bacterial infections in hospital settings is highlighted by the fluctuating prevalence of Citrobacter and Enterobacter species as well as the declining "No Growth" with increasing ventilation time.

For the purpose of directing successful treatment, the patterns of antibiotic susceptibility for various bacterial strains are crucial. Because E. Coli is susceptible to some antibiotics, including Amikacin, Gentamicin, and Imipenem, empirical therapy is necessary for infections brought on by this bacterium[21]. Pseudomonas' resistance to most antibiotics underscores the challenge in treating infections caused by this pathogen[22,23]. Similarly, the variable response of Citrobacter and Enterobacter spp to antibiotics underlines the importance of performing susceptibility testing before initiating treatment [23,24].

CONCLUSION

Early-stage recovery was less likely for patients on mechanical breathing, although longer-term ventilation improved outcomes. Hypertension and diabetes mellitus were frequent comorbidities. In the early stages of ventilation, bacterial growth peaked. Colistin was effective against all bacteria except Pseudomonas, whereas antibiotics such as Fosfomycin and tigecycline were most effective against all but Acinobacter baumannii.

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CONFLICT OF INTEREST
Authors declare no conflict of interest.
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AUTHORS' CONTRIBUTION

The following authors have made substantial contributions to the manuscript as under:

Conception or Design:	MH, AS, RA, SS, NU, MSK
Acquisition, Analysis or Interpretation of Data:	MH, AS, RA, SS, NU, MSK
Manuscript Writing & Approval:	MH, AS, RA, SS, NU, MSK

All the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.