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ORIGINAL ARTICLE

Microbial Etiology of Pneumonia: Epidemiology, Diagnosis and Resistance Pattern

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ABSTRACT

Background: In general, pneumonia is defined as the presence of a recent pulmonary infiltrate and signs that the infiltrate was brought on by an infectious agent, such as bacteria, viruses, fungi, or parasites. The fifth most common cause of mortality globally is bacterial pneumonia, causing nearly 2.56 million mortalities each and every year across all age groups, with Sub-Saharan Africa, South Asia, and Southeast Asia having the highest fatality rates.

Objective: The most prevalent etiological bacteria, its sensitivity to medications, and the most prevalent associated conditions were examined in this research of pneumonia patients

Methods: The medical records of pneumonia patients treated at National Institute of Health, Pakistan from January, 2022 to August, 2022 served as the data source for this cross-sectional study.

Result: Among the 121 pneumonia patients, the majority (n=54; 44.62%) were older than 64. Majority (n= 109; 90.09%) of the sample used for the culture examination was sputum. The third-generation empirical antibiotic therapies that were most frequently prescribed were ceftriaxone (n=59; 48.78%) and viccillin SX (n=21; 17.35%). Antibiotics Imipenem (100%), meropenem (96%), and Gentamycin (92%) were all very effective against Klebsiella pneumonia.

Conclusion: The most frequent bacteria identified in sputum cultures were Klebsiella pneumoniae and Acinetobacter sp. Antibiotics Imipenem, meropenem, and gentamycin have demonstrated encouraging outcomes, however Klebsiella pneumonia, Acinetobacter sp., and Pseudomonas sp. have demonstrated resistance to Isolate, Tetramycin, Ciprofloxacin and Ceftazidime when compared to other antibiotics.

Keywords: pneumonia, Klebsiella pneumoniae, Pseudomonas, epidemiology, diagnosis, resistance pattern

INTRODUCTION

In general, pneumonia is the presence of a recent lung infiltrate together with indicators that the infiltrate was caused by an infectious agent, such as or bacteria, viruses, fungi, or parasites [1]. Bacterial pneumonia is an infection of one or more lung lobes brought on by bacteria [2]. Community-acquired pneumonia (CAP) and hospital-acquired pneumonia (HAP) are two categories of pneumonia that can be categorized according to how the infection is acquired [3]. Lower respiratory tract infections (LRTIs), including bacterial pneumonia, account for over 2.56 million deaths worldwide each year among all age groups, making them the fifth greatest cause of mortality, with Sub-Saharan Africa, South Asia, and Southeast Asia having the highest fatality rates [4]. Pathogenic bacteria can spread through the circulation, aspiration, or inhalation to cause bacterial pneumonia [5].When the immune system fails to remove a pathogen from the lower airways and alveoli, an infection results in pneumonia [6].

After urinary tract infections, HAP is the second-most typical nosocomial disease. HAP is a common issue in general wards, with a frequency of 5 to 15 cases per 1000 hospital admissions (1.6 to 3.67 cases per 1000 admissions, on average) [7]. HAP can occur in up to 20% of patients who are hospitalized to an intensive care unit (ICU), with 60 to 70 percent of incidents taking place during mechanical ventilation [8]. Six pathogens (Staphylococcus Aureus, Escherichia Coli, Klebsiella species, Pseudomonas Aeruginosa, Acinetobacter species, andEnterobacter species) are thought to be responsible for around 80% of HAP cases [9].

Community-acquired pneumonia (CAP) is a lung parenchyma infection that is not contracted from a hospital or other healthcare institution [10]. The overall yearly incidence of CAP in adults in Europe varies between 1.09 and 1.24 per 1000 person-years and 1.53 and 1.72 per 1000 population, and it rises with age (15 per 1000 person-years in individuals aged 65 years). Men (in comparison to women) and patients around 65 years old were shown to have a higher chance of developing CAP, according to a research by Torres et al [11]. Mycoplasma pneumoniae, Chlamydophilapneumoniae, and Legionella pneumophila are the most often reported to cause CAP. Up to 37% of CAP in patients receiving outpatient treatment is caused by M. pneumoniae, and 10% of cases needed hospitalization [12]. L. pneumophila pneumonia causes nearly 2 to 6% of CAP in immunocompetent patients, while C. pneumoniae causes 5 to 15% of CAP cases [13]. Bacterial resistance is brought on by patients and healthcare professionals and improper use of therapeutic drugs. The efficiency of treatment is reduced as pneumonia-causing bacteria become more resistant to some antibiotics, which increases morbidity and death [14].

The most prevalent etiological bacteria, its sensitivity to medications, and the most prevalent associated conditions will all be examined in this research of pneumonia patients at National Institute of Health, Pakistan from January, 2022 to August, 2022

MATERIALS AND METHODS

Data collected from participants' medical records that had pneumonia were gathered for these cross-sectional research that were treated at National Institute of Health, Pakistan from January, 2022 to August, 2022. This research gathered information depending on the outcomes of tests to determine how sensitive bacteria are to different antibiotics, culture analysis, and medication therapy use in pneumonia patients undergoing treatment. The entire population for this research was identified using the inclusion criteria: (1) Pneumonia patients above the age of 18 who were hospitalized between January, 2022 to August, 2022, (2) got antibiotics or empirical treatment and (3) had a complete medical record that included the patient's age, gender, and treatments they'd received, as well as the medical record number. Patients without a sputum culture examination and those with incomplete medical records were not included in this study.

The presence of a cough, purulent sputum abnormalities, a temperature (or a history of a fever higher than 38°C), chest discomfort, crackles, leukopenia (less than 4500/l), or leukocytosis (greater than 10,000/l), as well as air bronchograms evident on a chest X-ray in the posteroanterior view, were used to make the diagnosis of pneumonia. Gram staining tests and culture investigations are other tests that can be used to detect pneumonia.

ETA (endotracheal aspirate) and sputum samples were obtained, and they were transferred to the Clinical Microbiological Laboratory (CML) to be examined under a microscope for suitability. Utilizing blood agar and MacConkey agar for plating, together with biochemical reactions, culture and identification were

carried out in accordance with normal CML procedure. Mueller-Hinton agar was used for the antimicrobial susceptibility testing, and standard disc diffusion techniques were used. The WHO-NET Version 5.6 tool was used to process and evaluate the data regarding antibiotic susceptibility.

RESULTS

On the basis of the patients' medical records, this investigation was conducted. Only 121 of the 189 pneumonia patients who complied with the study's inclusion and exclusion criteria were chosen. The majorities (n=54; 44.62%) of the 121 pneumonia patients were above the age of 64 (Table 1). Male patients (n=73) made up 60.33% of the total population (Figure 1**).** High school graduates (n=81; 66.94%) predominated among the patients (Table 2). Housewives made up one-third of the patient population (n=38; 31.4%), followed by private sector workers (n=32; 26.44%) (Figure 2).

Table 1: Age of Hospitalized Patients with Pneumonia

Age (Years)	Patients	
	N	Percentage
18–24	4	3.3
25-34	9	7.43
35-44	13	10.75
45-54	17	14.05
55-64	24	19.85
>64	54	44.62

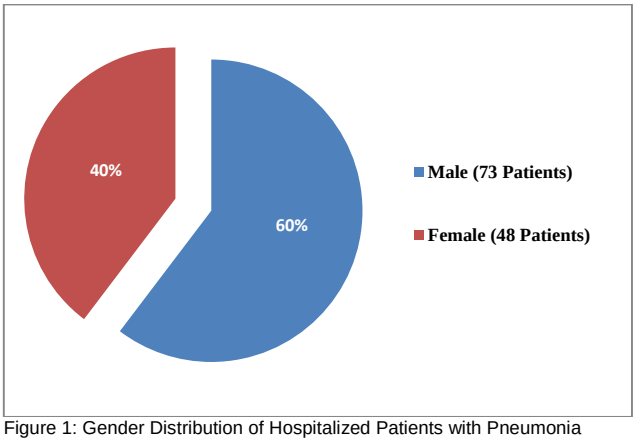

Figure 1: Gender Distribution of Hospitalized Patients with Pneumonia

Table 2: Educational Status of Pneumonia Patients in Hospital

Educational Status	Patients	
	N	Percentage
Elementary school graduate	13	10.74
Junior high school graduate	15	12.39
Senior high school graduate	81	66.94
University graduate	7	5.79
Unknown	5	4.14

Sputum made up the majority of the sample (n= 109; 90.09%) used for the culture examination (Table 3). A total of five harmful bacteria and fungus were discovered throughout the culture investigations. In terms of frequency, fungi (n=61) accounted for 50.43% of all microbiological agents. Enterobacter sp. (n= 6; 4.95%), Escherichia coli. (n=7; 5.79%), Pseudomonas sp. (n=11; 9.09%), Acinetobacter sp. (n=14; 11.57%), were the next most common bacteria after Klebsiella pneumonia (n=17; 14.04%).In contrast, the culture test revealed no bacteria in five samples (Figure 3).

Treatment with empirical antibiotics for patients at this hospital varied substantially. However, ceftriaxone (n=59; 48.78%) and viccillin SX (n=21; 17.35%) were the most often prescribed third-generation empirical antibiotic treatments (Figure 4). Antibiotic sensitivity values for bacteria are displayed (Table 4). Antibiotics Imipenem (100%), meropenem (96%), and Gentamycin (92%) were all very effective against Klebsiella pneumonia. however, Klebsiella pneumonia, Acinetobacter sp., and Pseudomonas sp. have demonstrated resistance to Isolate, Tetramycin, Ciprofloxacin and Ceftazidime when compared to other antibiotics.

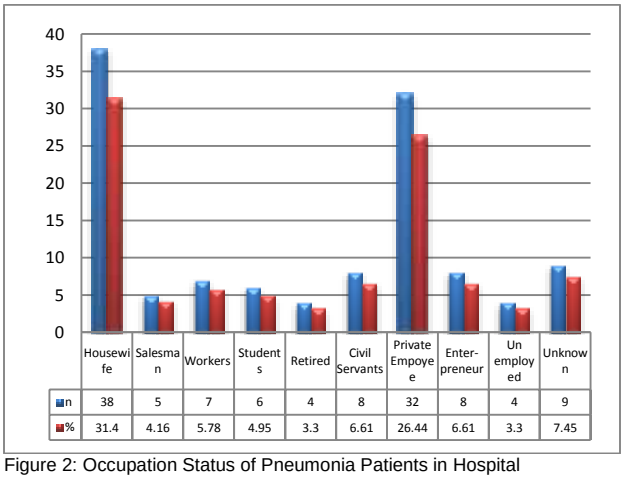

Figure 2: Occupation Status of Pneumonia Patients in Hospital

Table 3: Material Use for Culture Examination

Material	N	Percentage
Endotracheal tube (ETT)	12	9.91
Sputum	109	90.09%

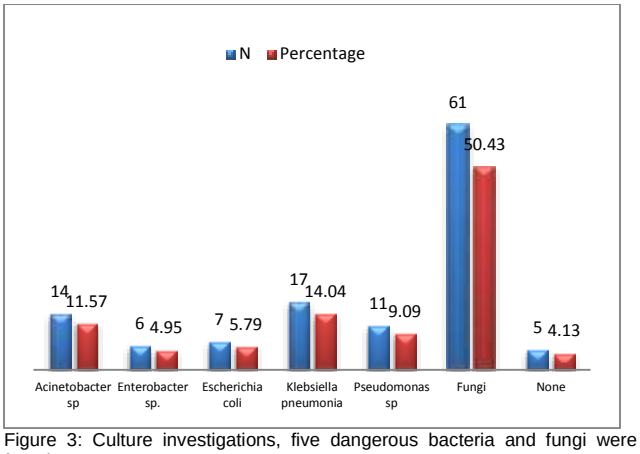

Figure 3: Culture investigations, five dangerous bacteria and fungi were found.

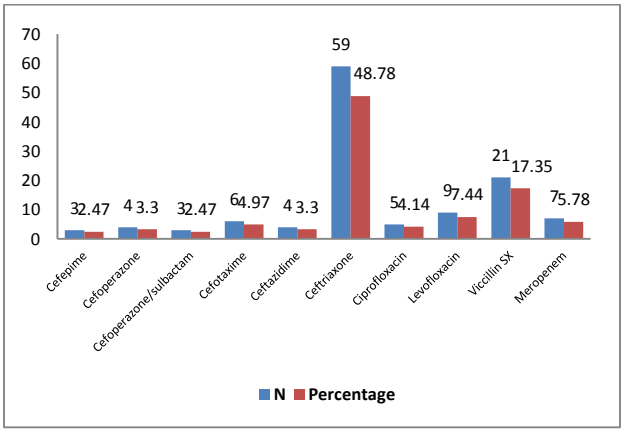

Figure 4: Treating Pneumonia Patients with Antibiotics

Table 4: Antibiotic sensitivity in Pneumonia Patients

Antibiotics	Klebsiellapneumoniae	Acinetobacter sp	Pseudomonas sp.
Isolate	14	14	8
Amikacin	74	78	39
Ciprofloxacin	12	16	09
Gentamycin	92	95	93
Imipenem	100	96	91
Kanamycin	66	58	38
Sulfa	56	50	
Tetramycin	15	20	11
Levofloxacin	74	82	56
Meropenem	96	92	94
Ceftazidime	08	05	18

From 121 hospitalized pneumonia cases, the patients had a variety of comorbidities, the most common of which was pulmonary tuberculosis (n=31; 25.61%), followed by heart failure (n=23; 19.1%), HIV/AIDS (n=18; 14.87%), and COPD (n=18; 14.87%).

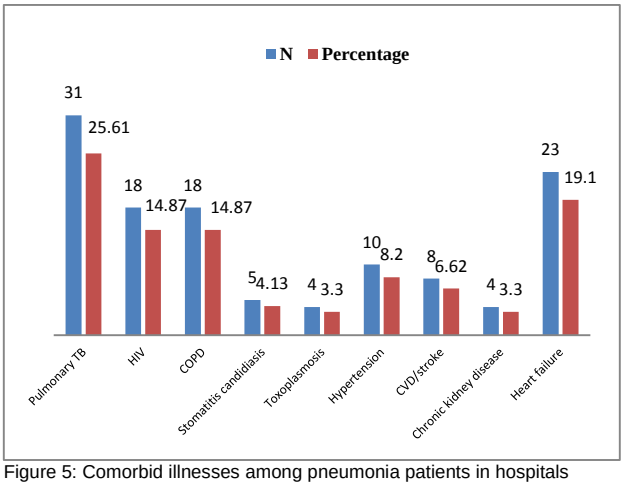

Figure 5: Comorbid illnesses among pneumonia patients in hospitals

DISCUSSION

According to research by Kosar et al. (2017) in Turkey, COPD, hypertension, and diabetes mellitus were the most common concomitant conditions among 208 patients having pneumonia [15]. COPD and diabetes mellitus made up the majority of the concomitant conditions in hospitalized pneumonia patients, according to research conducted in Argentina by Luna et al. (2016) [16]. In contrast to two earlier investigations, this one discovered that TB was the most common co-morbid condition among pneumonia patients who were hospitalized.This could be as a result of the fact that Pakistan is the fifth-ranked nation in the world for having the most TB cases.

According to Luna et al., (2016) Streptococcus pneumonia, Staphylococcus sp., atypical microorganisms, anaerobic Gram-negative bacteria, and Pseudomonas aeruginosa were the microbes most often identified in patients having pneumonia. [16]. Additionally, this research discovered that Klebsiella pneumonia was frequently discovered in sputum examination (n=17; 14.04%).

According to studies conducted in Cambodia by Rammaert et al., (2012) patients with pneumonia who both had diabetes mellitus and female were more likely to get Klebsiella pneumonia. One of the elements that contributed to the bronchiectasis colonization of Klebsiella pneumonia in Cambodia was the high frequency of TB sequelae there [17]. A productive chronic cough and, occasionally, hemoptysis were detected in instances of chronic Klebsiella pneumonia, according to Boonsarngsuk et al. (2015) [18]. Two chronic Klebsiella pneumonia cases that mimicked pulmonary tuberculosis were identified from the investigation. In many situations of Klebsiella pneumonia, pulmonary tuberculosis was incorrectly diagnosed, thus doctors need to be aware of this similar clinical disease.

In these tertiary hospitals, medicines Ipenem (100%), meropenem (96%), and Gentamycin (92%) were most effective against Klebsiella pneumonia. The main causes of this were the greater rates of Gram-negative pneumonia and the improper use of medicines in the former medical institutions, which resulted in antibiotic resistance [19]. By using antibiotics in accordance with the sensitivity pattern at an earlier phase of the illness, disease and death would be reduced.

CONCLUSION

In Pakistan, tuberculosis was the most common comorbidity among hospitalised pneumonia patients, who tended to be male and older than 64. The most frequent bacteria in sputum cultures were Klebsiella pneumoniae, and medicine Imipenem (100%), meropenem (96%), and gentamycin (92%) were the most effective antibiotics for treating it. When compared to other antibiotics, Klebsiella pneumonia, Acinetobacter sp., and Pseudomonas sp. have shown resistance to drugs Isolate, Tetramycin, Ciprofloxacin, and Ceftazidime.

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