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Original Research Article

Analysis of Bacteriological Profiles and Clinical Features of Hospital Acquired Pneumonia

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Abstract

Introduction: Nosocomial pneumonia (NP), also known as hospital-acquired pneumonia (HAP), is pneumonia that develops 48 hours or more after being admitted to the hospital; it doesn't develop just at the moment after admission. There are several causal agents which can cause HAP and there are similar clinical features between HAP and CAP.

Aims and Objectives: To analyze the bacteriological and clinical aspects of HAP.

Methods: This is a prospective study where samples from the lower respiratory tract of LRTI patients are collected. Samples which are contaminated when in contact with the secretions of the upper respiratory tract are not accepted. Microscopic preparations and culture examination was carried out for identification of microorganisms. Identification and characterization of the micro-organisms were carried out by employing various biochemical tests. Finally, these findings were evaluated.

Results: Females are seen higher in 0-20 and 21-40 years 4 and 23, males are seen high in 41-60 and 61-80 years 40 and 18 respectively. The highest co-morbidities are septicaemia, acute bronchitis, consolidation, and cystic fibrosis each with more than 8% of patients, and the least is seen with acute renal failure, mitral regurgitation, and alcoholic liver disease.

Conclusion: The study has concluded that most of the patients of HAP are mid-aged to elder and also concluded that *Pseudomonas*, *Streptococcus* species and Klebsiella spp. have been the most common cause of HAP in this sample.

Keywords: Nosocomial, Infection, Pneumonia, Hospital-Acquired.

Introduction:

Nosocomial pneumonia (NP), also known as hospital-acquired pneumonia (HAP), is pneumonia that develops 48 hours or more after being admitted to the hospital; it doesn't develop just at the moment after admission[1]. Ventilator-associated pneumonia (VAP), which is believed to impact 10.5% to 20.7% of people in intensive care units, using mechanical

ventilation for more than 48 hours is a sizable subset of HAP (ICUs). It is defined as pneumonia which occurs in people who have undergone mechanical ventilation for longer than 48 hours and require respiratory support [2,3].

Gram-positive cocci and aerobic gram-negative bacilli, including *Klebsiella pneumoniae*, *Escherichia coli, Pseudomonas aeruginosa, Enterobacter* spp., are common causes of HAP and VAP. Gram-positive cocci includes *Staphylococcus aureus* & *Streptococcus* spp., which also includes methicillin-resistant *S. aureus (MRSA).* Variations in the host factors as well as the hospital flora of organization affect the pattern of causative infections [4-6].

It is the most frequent illness in hospitals, followed by ventilator-associated pneumonia in intensive care units (ICUs) because there is an increase in the usage of antibiotics, duration of ICU stays, and duration of hospital stays. Nosocomial pneumonia has a considerable effect on mortality, morbidity, and rising medical expenses [7,8]. Whether in intubated or freely breathing patients, aspiration and upper respiratory tract colonisation are believed to be key pathogenetic factors and pathways that underlie the growth of NP. The timing of NP's beginning affects its microbiology. The pathogens in charge of early-onset NP are typically endogenous infections acquired in the population. Potentially multi-drug resistance nosocomial organisms found in the oropharynx or stomach contents are among the microorganisms responsible for late-onset NP [9,10].

In Europe and the US, hospital-acquired infections are thought to be most frequently caused by HAP, occurring at a rate ranging from five to ten per 1000 hospitalizations. Upwards of 90% of pneumonia bouts in hospitals with intensive care units occur in patients who were recently intubated and are receiving mechanical ventilation [11,12] Cough, an increase in temperature, expectoration, chest pain, or dyspnea are just a few symptoms that can occur. Fever, consolidations, tachypnea, or crackles are other signs and symptoms [13].

For patients with VAP, the lower airways can be sampled to acquire quantitative cultures using blind tracheobronchial aspiration (TBAS), a non-invasive method that includes inserting a flexible catheter into the distal trachea through the use of the endotracheal tube. Yet, since lung segment direct collection with infiltrates on the radiograph is not possible with this blind technique, the rate of false-negative results may rise [14,15]

The false-negative rate can be reduced by sampling the lung segments thought to be damaged by pneumonia during bronchoscopy with bronchoalveolar lavage (BAL) [16]. Because it is not advanced until it is in the distal airway, the protected specimen brush (PSB), which can be advanced through a bronchoscope, has the benefit of avoiding contamination with upper airway secretions [17].

Non-invasive techniques for sample collection in the lower airways in HAP (non-VAP) individuals include nasotracheal suctioning in cases where the patient is unwilling or unable to cooperate in producing a sputum sample and spontaneous expectoration [18].

Coma, long-term use of antibiotics, supine positioning, and repeated intubations, including prolonged mechanical ventilation are significant variables that increase the likelihood of NP. The most important preventive steps involve regular hand cleansing and avoiding certain situations, such as supine positions, incorrect antibiotic use, and excessive H_2-antagonist use for stressed ulcer prophylaxis [19,20]. As NP diagnosis is challenging and contentious, quantitative invasive culture techniques should be used instead of tracheal aspirates. The use of

empiric antibiotics should be quick, initiated based on clinical suspicion, and based on the local epidemiology of ICU pathogens, antibiotic resistance trends, and a de-escalating antibiotic strategy. Consideration should be given to novel antibiotic approaches, such as giving antibiotics on rotation, to help stop the development of infections that are multi-drug resistant and increase life expectancy [21].

Materials and Methods

This is a prospective study which was conducted from Dec 2015 to Nov 2016. All the samples collected from the lower respiratory tract of LRTI patients are processed.Those samples, which are contaminated when in contact with the secretions of the upper respiratory tract are not accepted. Chocolate agar, Sheep Blood agar and MacConkey's agar, THIO (thioglycollate) and BH (brain heart infusion broth) are utilized for processing aspirates and biopsy specimens. Precautions have to be taken and the samples are to be processed only in the biological safety cabinet. All specimens of bronchoscopy are cultured and gram stained is done. Trans tracheal aspirate, bronchial brushes, and bronchial biopsy are also processed for the anaerobic cultures.

Counting of the colony: Number of colonies in a palate x100 (dilution factor).

All the bronchoscopy specimens are then centrifuged and the supernatant is discarded, sediment is vortexed and then plating is done. Then the following steps are followed.

Smear preparation: the purulent portion of the sputum is smeared on glass slide and then examined under 10x microscopy for detecting bacterial and fungal structures.

Microscopic examination

The quality of the sputum is examined. The slide is assessed under 10X microscopy for detecting the polymorphonuclear neutrophils (PMNS), and squamous epithelial cells (SEC), nearly 20-40 fields are examined.

Interpretation of gram stain:

1. The slide that is to be examined should be under oil immersion
2. The WBCS and PMNS should be reported semi-quantitatively.
3. The main organism in the inflammatory area should be examined as:

- If some other type of pathogen is detected then it is called a mixed bacterial morphotype.
- If no bacteria is seen then it is no organisms seen
- Yeast and fungi are reported semi-quantitatively.

Probable pathogens- These are reported as micro-organisms that are in association with LRTI which are the members of Enterobacteriaceae. *P. aeruginosa* family. Other gram-negative bacilli and fungi and *H. influenza*, and *S. pneumonia* (non-hospital acquired).

Table 1: Microorganism identification from the respiratory tract

Organism	Gram stain	Rapid test	Alternative test
Enterococcus spp.	Gram-positive cocci (pairs)	PYR: +ve	Bile esculin: +ve
Coagulase-negative staphylococci	Gram-positive cocci (clusters)	Slide coagulase: -ve	Tube coagulase: -ve
H. influenza	Small, gram-negative bacilli	PPT: +ve	X and V dependent
S. aureus	Gram-positive cocci (clusters)	Slide coagulase: +ve	Tube coagulase: +ve

Moraxella catarrhalis	Gra -ve diplococci	Oxidase +ve	Glucose acid, maltose acid, lactose alkaline, sucrose alkaline
S. pneumoniae *S. pyogenes* *Viridans streptococcal* group	Gram +ve cocci	Bile solubility +ve, PYR: +ve, Bile solubility: -ve	Optochin-sensitive, streptococcus typing
C. neoformans	Yeast cells	Urea: +ve	
Mycobacteria spp.	Gram +ve rods (beaded)	Acid-fast stain +Ve	
C. albicans	Germ tube +ve		

Inclusion and exclusion criteria

The specimens that are included in the study are bronchial brushings, sputum, tracheal and trans-tracheal aspirates, bronchial biopsy, lung biopsy, BAL, and lung aspirate.

Swabs sample that is collected 2 hours before the processing and saliva that is used as sputum are not included in the study.

Statistical Analysis

The study conducted data analysis using MS Excel. The study has shown the frequencies of the discrete data and the continuous data was expressed as mean± standard deviation. The discrete data were also expressed as a percentage to evaluate each variable in this study sample.

Ethical approval

The patients were given a thorough explanation of the study by the authors. The patients' permissions have been gotten. The concerned hospital's ethical committee has accepted the study's methodology.

Results

Table 2 shows the distribution of patients based on age. There are 8 patients in the 0-20 years age group, the highest number of patients (50) among the 41-60 years age, 39 patients among 21-40, and 36 among 61-80 years age.

Table 2: Age-wise distribution of patients

Age	Number of patients
0-20 years	8
21-40 years	39
41-60 years	50
61-80 years	36

Table 3 shows the distribution of patients based on gender. Females are seen higher in 0-20 and 21-40 years 4 and 23, males are seen high in 41-60 and 61-80 years 40 and 18, respectively.

Table 3: Sex-wise distribution of patients

Age	Males	Females
0-20 years	3	4
21-40 years	10	23
41-60 years	40	25
61-80 years	18	7

Table 4 shows the co-morbidities among patients of in-patient. The highest co-morbidities are septicemia, Ac. bronchitis, consolidation, and cystic fibrosis each with 10, and the least is seen with acute renal failure, mitral regurgitation, alcoholic liver disease, and empyema each with 1.

Table 4: Showing various co-morbidities among IPD patients

Co-morbidities	Number of patients	Percentage
Pleural effusion	6	5.30%
septicemia	10	8.80%
COPD	8	7.07%
Acute bronchitis	10	8.80%
Asthma	8	7.07%
Consolidation	10	8.80%
Diabetes	2	1.75%
Hypertension	3	2.65%
Hypoxic ischemic encephalopathy	2	1.76%
Acute renal failure	1	0.88%
Bacterial endocarditis	8	7.07%
Ischemic heart disease	7	6.19%
Tracheostomy	8	7.07%
Alcoholic liver disease	1	0.88%
Smoking	8	7.07%
Mitral regurgitation	1	0.88%
Ecthyma gangrenosum	2	1.76%
Cystic fibrosis	10	8.80%
Empyema	1	0.88%
Cerebral infarction	5	4.40%
Fracture	2	1.76%

Table 5 shows the distribution of organisms. *Pseudomonas aeruginosa* is the most common organism seen with 29.3%, then *Streptococcus* spp (28%), *Klebsiella* (22%), *Actinobacter* (13.5%), and the least seen is serratia (0.75%).

Table 5: Shows the percentage-wise distribution of organisms

Organism	No. of patients	Percentage
Klebsiella spp.	30	22%
Actinotobacter	18	13.50%
Pseudomonas aeruginosa	39	29.30%
Staphylococcus aureus	3	2.25%
Streptococcus spp.	37	28%
E. coli	3	2.25%
Enterococcus faecalis	2	1.50%
Serratia	1	0.75%

Discussion

Very few investigators have investigated the prevalence and risk factors for inpatients with psychiatric problems in general hospitals who develop hospital-acquired pneumonia (HAP). In hospitalized patients with mental illnesses, HAP was widespread. Hypoproteinemia, hospitalization within the last 180 days, chronic liver disease, a BMI under 18.9 kg/m^2, as well as using cholinesterase inhibitors, clozapine, or mood stabilizers are risk factors for HAP in individuals with mental illnesses [22].

According to earlier observational research, a study was done to identify, measure, and summarise the predicted indicators for NVHAP in adult patients hospitalized in non-intensive care units. Although there isn't enough high-quality research to identify predictor variables for NVHAP, the study's findings revealed 24 characteristics that may contribute to the emergence of this infectious condition. The determination of individuals specially to experience NVHAP were made possible by understanding the important predictive factors for it [23].

About 1 in 100 hospitalized patients develop non-ventilator-associated hospital-acquired pneumonia (NV-HAP), although the risk-adjusted consequences of this condition are unknown. Up to 1 year, after an episode, NV-HAP has been linked to significantly worse patient results and greater healthcare expenses. The entire population of hospitalized Veterans should be the focus of preventative efforts since population risk segmentation is not practical [24].

The article details the frequency of hospital-acquired pneumonia (HAP) over 4 years in Portuguese (2014–2017). Gender, chronic comorbidities, age, hospital duration of stay, and mortality were among the information gathered from the diagnostic discharge database of 100 Portuguese hospitals for elderly patients. Patients with HAP experienced a protracted stay in the hospital and a high rate of death. Patients under 66 years old and men accounted for the majority of occurrences. 17.9% of patients required mechanical ventilation [25].

Despite advancements in their care, ventilator-associated pneumonia (VAP) and hospital-acquired pneumonia (HAP) jointly account for a significant portion of morbidity and death. Its prevalence is still high all over the world, and along with the rising spread of MDR bacteria, they are now a challenge for doctors and an issue for global public health. Our awareness of the pathophysiology of pneumonia has altered as a result of recent findings that have been published and the development of new technologies. This information can be used to create novel therapies and avoid HAP/VAP [26].

Non-ventilator-associated hospital-acquired pneumonia (NV-HAP) rates among U.S. Veterans in hospitals dropped between 2015 and 2020 before rising after the appearance of COVID-19. This rise in NV-HAP rates may be caused by a combination of factors including increased COVID-19 risk among Veterans, a reduction in prevention methods during extremely high COVID-19-related scheme stress, and a raise in patient care among Veterans hospitalized during the initial year of the pandemic. The study concludes that population surveillance and basic nurse protective measures that seem to be resilient to system stress are required to quickly recognize changes in NV-HAP risk [27,28].

Conclusion

The study has concluded that most of the patients of HAP are mid-aged to elder and also concluded that Pseudomonas, *Streptococcus* species and Klensiella spp. have been the most common cause of HAP in this sample. The study also concluded that HAP is associated with co-morbidities like septicemia, acute bronchitis, pulmonary consolidation, and cystic fibrosis.

This is a single-centre study due to which the sample is not varied. Similar studies should be conducted for evaluating the same parameters over varied populations.

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