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NOSOCOMNIAL PNEUMONIA

Summary: Nosocomnial (hospital) pneumonias (hospital-acquired pneumonia - HAP) are defined as pneumonias in hospitalized patients that occur within 48 hours after admission to the hospital or later. These types of lung parenchymal infections are caused by pathogens that are present in the hospital environment. The incubation period is no longer than two days. Nosocomial pneumonias are the second most common of all hospital infections and the highest prevalence is recorded in intensive care units (ICU) (internal medicine and surgery). They represent a great burden on the health system everywhere in the world, because it is estimated that as many as 25% of infections in the ICU are hospital-acquired, and that 50% of all antibiotics are used precisely for their treatment.

Recognizing the causative agent can be challenging, primarily due to the difficulty of adequate sputum sampling, but also due to the lack of understanding of the epidemiological situation in a particular health facility.

Introduction

The definition of nosocomial pneumonia has changed in the last few decades. The American Thoracic Society (ATS) first published recommendations for the diagnosis and treatment of hospital-acquired pneumonia in 1996[1]. By 1998, Trouillet and colleagues recommended classifying patients with VAP (ventilator-associated pneumonia) based on risk factors to optimize initial antibiotic therapy.

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Epidemiology

In a significant international study (EPIC II), it was proven that 51% of patients in intensive care units have an infection[2]. The incidence and prevalence of hospital infections vary between centers and even within intensive care units in the same institution. On average, the incidence is 9-27%, equivalent to 1.2 to 8.5 cases per 1000 days of mechanical ventilation. Patient age significantly influences the incidence, with younger than 35 years at 5 per 1000 hospitalizations and those over 65 years at 15 per 1000 hospitalizations[3-5].

The risk of VAP occurrence increases by 1% per day on average during mechanical ventilation, peaking at around 3% in the first 5 days. It then decreases to 2% per day from days 5-10 and 1% after the tenth day.

Classification

Pneumonias can be primarily endogenous (pathogen isolated on admission), secondarily endogenous (colonization of oropharyngeal and gastrointestinal pathogens during hospitalization leading to translocation to lower respiratory tract), and exogenous (colonization due to mechanical ventilation, e.g., tubes, humidifiers, bronchoscopy, and the pathogen is not primarily isolated on patient admission)[6].

Ventilator-associated pneumonia (VAP) is a type of hospital pneumonia that can occur 48 hours after intubating a patient. They occur in intensive care units and are characterized by the presence of new or progressive infiltrates on chest X-ray, signs of systemic infection, changes in sputum characteristics, and the detection of pathogens. VAP is the most common hospital infection in the ICU[7].

VAP is divided into early and late depending on the time from the start of mechanical ventilation. This division is significant because causative agents and initial empirical treatment vary, affecting outcomes. Early VAP occurs within the first 4 days, while late VAP occurs after that period. However, studies comparing different time periods for early and late VAP found no significant differences in isolated pathogens, the occurrence of multidrug-resistant bacteria, or clinical significance[8-10].

Healthcare-associated pneumonia (HCAP) is defined as pneumonia in a person who has been hospitalized for at least two days in the past 90 days, resides in nursing facilities, or has received home-based therapy. It also includes those undergoing chronic dialysis in the last 30 days or living in households where a member is infected and/or colonized by multidrug-resistant bacteria. HCAP encompasses pneumonia occurring three days after using a specific antibiotic in a healthcare facility, chemotherapy, or any wound care[11].

In recent years, changes in the healthcare system have led to a significant number of patients, especially chronic patients, being cared for outside institutions (e.g., at

home). This blurs the distinction between community and hospital infections, leading to higher mortality in HCAP due to inadequate initial antibiotic therapy in the presence of multidrug-resistant strains.

Diagnosis

There is no universally accepted gold standard for diagnosing VAP as no clinical method has shown significant sensitivity and specificity[12]. The only reliable method for early diagnosis is daily clinical assessment with radiographic monitoring. This involves a new, persistent infiltrate on a chest X-ray 48 hours after admission, accompanied by one systemic and two pulmonary (respiratory) criteria. Systemic criteria include a temperature >38°C, leukocytosis (>12,000/mm³) or leukopenia (<4,000 mm³), and altered mental status in those over 70 years without another apparent cause. Pulmonary criteria include the appearance of purulent sputum, worsening gas analysis, cough, dyspnea, or tachypnea, and abnormal lung auscultation[13-16].

However, clinical assessment alone does not diagnose a third of VAP cases, as shown in autopsies, and can be incorrect in over 50% of cases. Clinical criteria have only 69% sensitivity and 75% specificity. The CDC definition of VAP is subject to variability among interpreting physicians and subjectivity. Therefore, a simplified version of patient surveillance for pneumonia has been attempted, primarily focusing on oxygenation parameters[17,18]. Deterioration in oxygenation parameters was defined as a period of increased PEEP for more than two days after two days of stable values or an increase in FiO2 for at least 0.15 bar for two days after a period of normal FiO2 values. VAP was diagnosed significantly faster (3.5 vs. 39 minutes per patient), although there was no difference in mortality, ICU stay, and mechanical ventilation[19].

The validity of clinical assessment for diagnosis and the duration of antibiotic therapy was recently examined in a study by Kalanuria et al. in neurosurgical intensive care units. They found significant variation in VAP therapy duration and excessive antibiotic use among clinicians. Only 31.3% of treated patients met CDC criteria. There was also a significantly longer antibiotic treatment duration based solely on clinical assessment, although there was no difference in mortality between the groups[20-25].

Radiological Diagnosis

Chest X-rays are not always reliable, as many other conditions can produce similar findings: pneumonitis, congestive changes, atelectasis, effusion, hemorrhage, contusion, and even acute respiratory distress syndrome. There is a poor correlation between radiological findings and histopathological diagnosis of pneumonia. Interpretation of radiological findings is sometimes challenging in intubated, critically ill

patients. Studies have demonstrated that a chest X-ray may be normal, while infiltrates are visible on a CT scan, especially in patients with COPD. No radiological sign for pneumonia in intubated patients has a diagnostic accuracy greater than 68%. However, a meta-analysis by Kolmpas et al. showed that the absence of clinical parameters such as fever, leukocytosis, and purulent secretion does not exclude the diagnosis of VAP, while the absence of a positive radiological sign significantly reduces the likelihood of pneumonia[26].

Sputum Sampling and Analysis

Sampling can be done invasively or non-invasively, with bronchoscopic or non-bronchoscopic methods. Invasive methods include bronchoalveolar lavage (BAL) and protected specimen brush (PSB), while endotracheal aspiration and mini-BAL are non-bronchoscopic methods.

Bronchoalveolar lavage involves placing a bronchoscope to the level of subsegmental bronchi and injecting 20-50 ml of sterile saline. About 5 ml of the obtained sample is sufficient for microbiological analysis[27]. Mini-BAL involves passing an aspiration catheter through the endotracheal tube until resistance is encountered, injecting saline, aspirating the content, and sending it for analysis.

PSB is a technique that reaches the most distal point with a special brush, providing more precise sampling. The sample is diluted with 1 ml of Ringer's solution. The threshold for quantitative diagnosis in this case is 10^3 cfu/ml[28].

Endotracheal aspiration is undoubtedly the fastest, easiest, and cheapest sampling method. Although the result has high sensitivity, specificity is extremely low (14-47%), so such a sample is quantitatively analyzed. Endotracheal aspiration involves passing the aspiration catheter through the endotracheal tube until resistance is encountered, then aspirating the content sent for microbiological analysis[29-35].

Therefore, sample analysis can be quantitative or qualitative. Although quantitative analysis has higher specificity in diagnosing VAP, false-negative results can be obtained in patients with early VAP with inadequate antibiotic therapy or false positives in colonization during mechanical ventilation. Bronchoscopic methods have a lower threshold for diagnosing VAP (10^4 cfu/ml for BAL and 10^3 cfu/ml for PSB), while the threshold for samples obtained by endotracheal aspiration is 10^6 cfu/ml.

Therapy

The therapy for hospital pneumonias is based on understanding the epidemiological situation in a particular hospital or intensive care unit. A successful treatment approach always involves a multidisciplinary approach, with the participation of

infectious disease specialists, epidemiologists, microbiologists, as well as anesthesiologists or intensivists[36].

Conclusion

Hospital pneumonias pose challenges both in terms of diagnosis and treatment, considering the increasing resistance of pathogens to antibiotics and the emergence of new forms of adaptation leading to greater resistance. Understanding the pharmacodynamics and pharmacokinetics of antibiotics is crucial, especially in empirical treatment. Currently, the involvement of multiple physicians from different specialties remains crucial in deciding which antibiotics to include as a measure to prevent inadequate treatment and increased resistance.

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