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ORIGINAL ARTICLE

Hospital-acquired pneumonia in Japan may have a better mortality profile than HAP in the United States: a retrospective study

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Abstract The characteristics of hospital-acquired pneumonia (HAP) are not well documented. In the present study we investigated the severity and mortality, microbiological profile, and the value of Gram staining in culture-confirmed HAP in a Japanese hospital by retrospective review conducted at a Japanese university hospital. Only culture-confirmed cases with good specimen quality were included in the analysis. The clinical characteristics of HAP, as well as the causative organisms, were investigated. Furthermore, the prognostic ability of existing prediction rules were evaluated for prediction of overall mortality. Forty-two cases were enrolled in this analysis. The majority of patients were admitted to the ICU (61.9 %), and 40.5 % had ventilator-associated pneumonia (VAP). The 30-day mortality was 23.8 %, which is less than that reported in the United States. Factors commonly known to be associated with worse outcome in the USA did not appear to influence the mortality from HAP in Japan. The most frequent causative organisms were methicillin-resistant *Staphylococcus aureus* (MRSA), followed by *Pseudomonas* spp. Sensitivity and negative predictive value of Gram staining were 89.4 and 85.7 %, respectively. SMART-COP predicted 30-day mortality with an area under the ROC curve (AUC) >0.7. The characteristics of HAP in Japan differ from HAP reported in the USA. In addition to lower mortality, we found both fewer ICU cases and VAP. Gram staining of good-quality specimens demonstrated promising sensitivity to predict the causative organisms. SMART-COP predicted mortality with appropriate ROC curve (AUC).

Keywords Hospital-acquired pneumonia · Gram staining · Prediction rule

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Introduction

Hospital-acquired pneumonia (HAP) is defined as pneumonia that develops 48 h or more after admission to a hospital and did not appear to be incubating at the time of admission [1–3]. It is commonly seen and associated with high morbidity and mortality [2, 3]. However, in comparison to more restricted types of pneumonia such as ventilator-associated pneumonia (VAP), fewer studies have been conducted on HAP because of the inherent complexity of its diagnosis and because its causative organisms are difficult to ascertain.

The Infectious Disease Society of America (IDSA) and the American Thoracic Society (ATS) jointly developed a guideline for the management of HAP, ventilator-associated

pneumonia (VAP), and healthcare-associated pneumonia (HCAP) [3]. However, because the characteristics of HAP in Japan appear to differ from those in the United States (USA), it remains unclear whether the contents of this guideline can be directly applicable to patients in Japanese hospitals. For example, the length of hospital stays in the USA is generally shorter than that in Japan, and US hospitals have a tendency to accumulate patients who are in more severe condition. Furthermore, most cases of nosocomial pneumonia that are seen in the USA are VAP, whereas VAP is relatively uncommon in Japan.

To clarify the characteristics of HAP in Japan, we conducted a retrospective study on HAP, which was confirmed by bacteriological studies carried out on respiratory specimens (culture-confirmed HAP). The objective of this study is to delineate the characteristics of culture-confirmed HAP at a university hospital in Japan in terms of both severity and causative organisms. We also evaluated whether existing severity prediction criteria in both community-acquired pneumonia and HAP are applicable in this setting.

Patients and methods

Setting and case definition

This is a retrospective observational study carried out at Kobe University Hospital, Kobe, Japan. Kobe University Hospital is a tertiary care hospital, located on the west side of the main island of Japan, with 15,000 hospitalizations and 430,000 outpatient visits per year. The data analyzed were collected over the period 1 April 2008 to 15 May 2009.

The culture database at the Department of Microbiology was used to collect cases. Only cultures obtained from the lower respiratory tract (i.e., expectorated sputum, aspirate through intratracheal tube, and bronchoalveolar lavage) were used for analysis. For expectorated sputum, only high-quality specimens, determined as a 4 or 5 by microscopic appearance under the Geckler classification [4], were included in the analysis. Because our hospital does not conduct quantitative culture of respiratory specimens routinely, results of nonquantitative cultures were used for the analyses. HAP was defined as pneumonia that occurs 48 h or more after hospital admission. Diagnosis of pneumonia was based on clinical signs and symptoms, such as fever, cough, and new infiltrates on chest X-ray. VAP was also included in this analysis. HAP occurring within 4 days of hospitalization was defined as early-onset HAP, and those occurring thereafter were defined as late-onset HAP [3]. Diagnoses were determined independently by two investigators (W.I. and M.H.) and in duplicate. Causative organisms were defined as pathogens that grew from high-quality specimens from patients who were diagnosed to have HAP by these investigators. Cases resulting in disagreement between the investigators concerning inclusion or exclusion were resolved by the principal investigator acting as a third reviewer (K.I.). Specimens taken from a patient before or within 48 h after admission, specimens taken after antibiotic therapy was started, and cases involving patients under 20 years of age were excluded from this study. The clinical characteristics of HAP, as well as the characteristics of its causative organisms, were investigated. Underlying conditions of patients were determined according to Charlson et al. [5] and evaluated using the Charlson co-morbidity index. Mortality was measured 7 and 30 days after the initial diagnosis of HAP, and 30-day mortality was used for various analyses (vide infra).

This study has been approved by the Institutional Review Board at Kobe University School of Medicine (No. 896).

Evaluation of Gram staining

Results of Gram staining conducted by microbiology technicians at Kobe University Hospital upon specimen submission were evaluated. The results were categorized as GPC (gram-positive cocci), GPR (gram-positive rods), GNC (gram-negative cocci), and GNR (gram-negative rods). The agreement of Gram staining category between initial staining and resultant organism grown was evaluated.

Validation of existing classifications

Prediction rules often used in community-acquired pneumonia (CAP), such as the pneumonia severity index (PSI) [6], CURB-65 [7], and SMART-COP [8, 9], were evaluated in this analysis. Recently, the Japanese Respiratory Society (JRS) proposed a prediction rule for HAP in its revised guideline. It proposed the use of (1) the presence of malignancy or immunodeficiency, (2) need of FiO_2 >35 % to keep SpO_2 >90 %, (3) altered mental status, (4) age over 70 for men and 75 for women, and (5) oliguria or dehydration as factors to predict poor outcome. If three of five of these criteria are met, a patient is classified as having "severe" pneumonia. If two or fewer criteria are met, secondary factors such as (6) serum C-reactive protein level ≥20 mg/dl and (7) involvement of infiltrates on lung parenchyma covering more than two thirds on chest radiography are evaluated. If either criterion is present, the pneumonia is classified as "moderate," and if not, the pneumonia is classified as "mild" [10]. For the present study, we also included JRS criteria for analysis.