American Journal of Infection Control 42 (2014) 38-42

Contents lists available at ScienceDirect

American Journal of Infection Control

journal homepage: www.ajicjournal.org

Major article

Risk factors for hospital-acquired pneumonia outside the intensive care unit: A case-control study

Nieves Sopena MD [a,*], Eva Heras BM [a], Irma Casas MD [b], Jordi Bechini BM [c], Ignasi Guasch BM [c], Maria Luisa Pedro-Botet MD [a], Silvia Roure BM [a], Miquel Sabrià MD [a]

[a] Infectious Diseases Unit, Internal Medicine Department, Germans Trias i Pujol University Hospital, Autonomous University of Barcelona, Badalona, Spain
[b] Preventive Medicine Department, Germans Trias i Pujol University Hospital, Autonomous University of Barcelona, Badalona, Spain
[c] Radiology Department, Germans Trias i Pujol University Hospital, Autonomous University of Barcelona, Badalona, Spain

Key Words:
Nosocomial pneumonia
Outcome

Background: Hospital-acquired pneumonia (HAP) is one of the leading nosocomial infections and is associated with high morbidity and mortality. Numerous studies on HAP have been performed in intensive care units (ICUs), whereas very few have focused on patients in general wards. This study examined the incidence of, risk factors for, and outcomes of HAP outside the ICU.
Methods: An incident case-control study was conducted in a 600-bed hospital between January 2006 and April 2008. Each case of HAP was randomly matched with 2 paired controls. Data on risk factors, patient characteristics, and outcomes were collected.
Results: The study group comprised 119 patients with HAP and 238 controls. The incidence of HAP outside the ICU was 2.45 cases per 1,000 discharges. Multivariate analysis identified malnutrition, chronic renal failure, anemia, depression of consciousness, Charlson comorbidity index $\geq$3, previous hospitalization, and thoracic surgery as significant risk factors for HAP. Complications occurred in 57.1% patients. The mortality attributed to HAP was 27.7%.
Conclusions: HAP outside the ICU prevailed in patients with malnutrition, chronic renal failure, anemia, depression of consciousness, comorbidity, recent hospitalization, and thoracic surgery. HAP in general wards carries an elevated morbidity and mortality and is associated with increased length of hospital stay and increased rate of discharge to a skilled nursing facility.

Hospital-acquired pneumonia (HAP) is one of the leading nosocomial infections worldwide and is associated with an elevated morbidity and mortality and increased hospital costs.[1] Most of the previous epidemiologic and etiologic studies of nosocomial pneumonia were performed in critically ill patients, most of whom were receiving mechanical ventilation.[2] There have been few studies of HAP outside the intensive care unit (ICU), likely owing to the dispersion of cases throughout hospital wards and the difficulty of performing invasive techniques to achieve an etiologic diagnosis.[3-5] Previous studies have identified HAP in general wards as a relatively frequent problem, with an incidence ranging from 1.6 to 3.67 cases per 1,000 admissions[4-7]; however, few studies have reported the risk factors for HAP outside the ICU. We conducted an incident case-control study to determine the incidence of, risk factors for, and outcomes of HAP in general hospital wards.

METHODS

Study design, patients, and setting

This prospective study was performed at Germans Trias i Pujol University Hospital, a 600-bed tertiary hospital with 20,000 annual

* Address correspondence to Nieves Sopena, MD, Hospital Germans Trias i Pujol, Carretera del Canyet s/n, 08916 Badalona, Spain.
E-mail address: nsopena.germanstrias@gencat.cat (N. Sopena).

The results of this article were presented in part in the 48th Annual Interscience Conference on Antimicrobial Agents and Chemotherapy/46th Infectious Diseases Society of America Annual Meeting, Washington DC, October 25, 2008, and at the 49th Annual Interscience Conference on Antimicrobial Agents and Chemotherapy, San Francisco, September 12, 2009.

This study was supported by research grant FIS PI051492 from the Ministerio de Sanidad, Instituto de Salud Carlos III, Spain, 2005-2007.

Conflict of interest: None to report.

Author contributions: Study supervision: N.S., E.H., I.C., and M.S.; study conception and design: N.S. and M.S.; data collection: N.S., E.H., S.R., M.L.P.-B., J.B., and I.G.; analysis and interpretation of data, N.S., E.H., I.C., and M.S.; statistical analysis: N.S. and I.C.; drafting of the manuscript: N.S., E.H., and M.S.; critical revision of the manuscript: N.S., E.H., I.C., S.R., M.L.P.-B., J.B., I.G., and M.S.

0196-6553/$36.00 - Copyright © 2014 by the Association for Professionals in Infection Control and Epidemiology, Inc. Published by Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.ajic.2013.06.021

admissions, between January 2006 and April 2008. Adult patients (age ≥18 years) diagnosed with HAP and hospitalized in conventional medical, surgical, and trauma wards were prospectively identified through a passive and active surveillance system based on daily review of chest radiology reports. Patients with chest radiography demonstrating new infiltrates were evaluated for possible inclusion in the study. Those included were followed up until hospital discharge or death. Patients acquiring pneumonia in the ICU (stay during previous 10 days) or who were diagnosed outside the surveillance period were excluded.

For each case, 2 controls admitted at least 72 hours earlier without suspected HAP were selected at random. Controls were matched for age (within 5 years), sex, admission date (within 7 days), and hospital ward (medical or surgical). The exclusion criteria for controls were the same as those for cases.

The following data were recorded for all patients on clinical chart review: age, sex, hospital ward, and intrinsic and extrinsic risk factors, including active cigarette smoking, alcohol abuse, underlying disease and severity, Charlson comorbidity index, malnutrition, anemia, history of nosocomial infection during the same admission, pharmacologic immunosuppression (corticosteroids and chemotherapy), previous antibiotic therapy, antacid use (anti-H_2 and proton pump inhibitor), nebulization, invasive techniques (endotracheal intubation, tracheotomy, nasogastric tube), surgery, hospital admission in the previous month, previous ICU admission, and interval from admission to presentation of pneumonia. The extent of chest radiograph abnormalities according to the interpretation of the investigators, the microbiological diagnosis, and the antibiotic treatment were recorded as well. The main outcome measures were complications, crude and attributable mortality, length of stay, and place of discharge. This observational study was approved by the hospital's Institutional Review Board.

Definitions

HAP was defined as the presence of a new infiltrate on a chest radiograph after 72 hours of hospital admission or within 10 days after previous discharge, along with at least 2 of the following criteria: fever (temperature >38.0°C), dyspnea, cough and purulent expectoration, altered respiratory auscultation, and leukocytes >14,000/μL or leukopenia <3,000/μL.

Underlying diseases were considered as the presence of a comorbid illness. Malnutrition was defined as a serum albumin value <30 g/L. Depressed consciousness was defined as any degree of altered level of consciousness observed at the time of presentation of pneumonia or in the previous 72 hours. The severity of the underlying disease was categorized according to the criteria of McCabe and Jackson[8] as rapidly fatal (<1 year), ultimately fatal (1-5 years), or not fatal (>5 years). Anemia was defined as a hemoglobin value <10 g/dL.

Extrinsic risk factors, such as nebulization, previous endotracheal intubation, tracheotomy, nasogastric tube, surgery, previous ICU admission, antibiotic therapy, and use of antacid medication, were considered if they were present or performed within 15 days before the diagnosis of pneumonia. Previous antimicrobial or antacid therapy was recorded if the patient had taken an antimicrobial drug for at least 48 hours or an antacid for at least 7 days. Corticotherapy was defined as treatment with prednisone >60 mg/day over >2 weeks in the previous month or 5-60 mg/day for >3 weeks. Chemotherapy referred to treatment with cytotoxic drugs, not including steroid therapy. Antibiotic treatment was defined as adequate if the empirical drugs chosen were administered according to hospital guidelines and were changed according to the microbiological diagnosis, when available.[2]

Complications were defined as any untoward clinical circumstances occurring during hospitalization. Deaths were considered attributable to pneumonia if the episode of HAP was the primary cause of death and no other potential cause of death was identified. Length of stay was defined as the time in days from hospital admission to discharge. Place of discharge was either the patient's home or a skilled nursing facility.

Microbiological methods

The microbiological methods used according to the protocol for HAP in our hospital included serial blood cultures, sputum or tracheal aspirate cultures, and urinary antigen detection of *Streptococcus pneumoniae* by immunochromatographic assay and *Legionella pneumophila* serogroup 1 by enzymoimmunoassay. Invasive techniques, such as fiberoptic bronchoscopy with protected brush culture, were performed only when requested by the attending physician.

The etiologic diagnostic criteria were defined as either definitive, with isolation of a microorganism in blood cultures, pleural fluid, respiratory sample representative of the lower respiratory tract (protected brush culture); isolation of a primary pathogen in sputum; or a positive urinary antigen test for *L pneumophila* or *S pneumoniae,* or possible, with isolation of a pathogen in adequate sputum samples in pure or predominant culture that was correlated with the predominant morphology detected on Gram stain. Only sputum samples of Murray-Washington classification degree IV or V were processed (degree IV, 10-25 epithelial cells and >25 leukocytes per field; degree V, <10 epithelial cells and >25 leucokytes per field using a low-magnification lens [100×]).

Statistical analysis

The incidence of HAP in general wards was calculated by dividing the number of new cases of HAP in the hospital and in the different departments by the number of patients hospitalized during this period. Incidence rates were calculated with 95% confidence intervals (CIs).

Data were analyzed using SPSS version 15 (SPSS, Chicago, IL). Statistically significant differences in risk factors between cases and matched controls were analyzed using conditional logistic regression modeling, with variables with a P value <.10 on univariate analysis included in the models. Statistical significance was established at $P \leq .05$. Odds ratios (ORs), 95% CIs, and P values were reported for all univariate and multivariate models.

The difference in length of stay between cases and controls was calculated by multiple linear regression adjusted for severity of the underlying disease and Charlson comorbidity index. Cases acquiring HAP within 10 days after previous discharge were excluded from this calculation.

RESULTS

Incidence and place of acquisition of HAP

The study group comprised 119 cases with HAP and 238 controls. The incidence rate of HAP in the general hospitalization wards was 2.45 cases/1,000 hospital admissions (95% CI, 2.04-2.92). The wards in which the cases were detected and the incidence of HAP are shown in Table 1.

Risk factors for HAP

The HAP cases had a mean age of 70 ± 14.46 years, and 72.3% were males. Length of previous hospital stay was >5 days in 87 of