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Age and other risk factors of pneumonia among residents of Polish long-term care facilities

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SUMMARY

Background: Pneumonia is one of the leading causes of morbidity and mortality in the elderly population. Nursing home-acquired pneumonia (NHAP) is probably the largest health problem in long-term care facilities (LTCFs). It is the second most common infection in LTCFs and frequently requires hospitalization. The aim of this study was to investigate the incidence rate of NHAP among LTCF residents, its microbial etiology, and the frequency of multidrug-resistant microorganisms. Risk factors for NHAP were analyzed.

Methods: This was a prospective study conducted on a group of 217 elderly subjects aged ≥65 years, recruited from the inhabitants of LTCFs, with disabled elderly individuals living in the community serving as controls. Continuous surveillance was carried out from December 1, 2009 to November 30, 2010.

Results: The incidence rate of NHAP in the observed population of Polish residents was 0.6/1000 resident-days. Vulnerability to NHAP was due to the poor general condition of residents, expressed by low Barthel index values (relative risk (RR) 1.6), the activities of daily living (ADL) score (RR 1.7), the Katz scale (RR 1.2), and limited physical activity (RR 1.6). Also significant were malnutrition (RR 2.3), the use of a bladder catheter (RR 1.3), dysphagia (RR 1.7), tracheotomy tube (RR 3.1), and gastric feeding tube (RR 3.5). *Enterobacteriaceae* were the predominant etiological agents of NHAP (56.3%).

Conclusions: The significance of risk factors for NHAP among residents in LTCFs was confirmed. Unfortunately, we also found that a lack of proper supervision with regard to the microbiology of infections is characteristic of Polish health care and LTCFs. There is an opportunity to improve the medical care of patients with severe disabilities, limit the rise in antimicrobial resistance and the need for hospitalization, and improve the prognosis.

1. Introduction

Pneumonia is one of the leading causes of morbidity and mortality in the elderly population worldwide.[1,2] The classification of pneumonia is becoming increasingly complex as the patient population becomes more diverse.[3] Patients exposed to a non-hospital risk have been categorized as having community-acquired pneumonia (CAP). However, even the outpatient population is nowadays subjected to many procedures and therapies, such as hemodialysis, wound care, infusion therapy, and therapy causing immunosuppression. Pneumonia in such a population is now referred to as health care-associated pneumonia (HCAP) and is frequently caused by multidrug-resistant bacteria.[3] Patients residing in non-hospital health care facilities, such as nursing homes, form a specific subpopulation themselves. Pneumonia in this group of patients has been classified as nursing home-acquired pneumonia (NHAP). Although NHAP is currently treated with the same protocols as CAP, it differs from CAP with respect to pathogens and the prognosis, and more closely resembles hospital-acquired pneumonia (HAP).[2,3]

NHAP is probably the largest health problem in long-term care facilities (LTCFs). It is the second most common infection in LTCFs and the leading cause of mortality and hospitalization.[4,5] NHAP frequently requires hospitalization and worsens the prognosis.[4,5] A number of factors may increase the risk of pneumonia among LTCF residents. Individual factors include malnutrition, long-term

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diseases, functional impairment, invasive devices, and prolonged antimicrobial exposure.[6] Institutional factors include larger facilities, low immunization rates, excessive antimicrobial use, and the widespread colonization of residents with antimicrobial-resistant organisms.[7] Other important aspects include many age-related changes with non-adaptive immunity, a decline in the cough reflex, diminished immunoglobin A secretion, loss of elastic tissue, decreased mucociliary transport, increased Gram-negative colonization of oropharynx, etc.[8,9]

There are also problems connected with the proper diagnosis and treatment of NHAP. Pneumonia among older residents of LTCFs does not manifest itself with typical symptoms. A third may not present fever and many do not have a cough or dyspnea either.[5] Patients frequently receive empirical antibiotic treatment before specimens are obtained for diagnostic testing.[4,5] Moreover, the etiology of most cases of NHAP is underdetermined.[10] *Streptococcus pneumoniae* is the most common causative agent. However, *Staphylococcus aureus* and Gram-negative organisms may be more common in severe cases of NHAP.[10] Accurate data on the etiologic agents and the epidemiology of severe NHAP have been limited by low bacteriology yields, the poor quality of respiratory specimens, and potential contamination of the upper respiratory tract.[10] Knowledge of the determinant factors responsible for NHAP is crucial for optimal management of this frail population and for improvement of the prognosis.

The aim of this study was to investigate the incidence rate of NHAP among residents of two different types of LTCF, with a comparison to a control group consisting of patients treated by the same family doctor in their homes, and to determine the microbial etiology and frequency of multidrug-resistant microorganisms. Secondly, we aimed to determine possible risk factors for NHAP and the possibility of improving microbiological surveillance. The former included demographic and clinical characteristics analyzed with respect to the severity scores.

2. Methods

Prospective continuous surveillance was carried out from December 2009 to November 2010 among elderly subjects aged ≥65 years, recruited from the inhabitants of LTCFs; disabled elderly individuals living in the community served as controls. The selected LTCFs – one nursing home and two residential homes – represent the essential forms of institutional care in Poland. A nursing home is an institution that provides skilled nursing care and rehabilitation services to people with illnesses, injuries, or functional disabilities and where care is provided by professionals, including medical doctors, nurses, and physical therapists. A residential home is a type of care home suitable for elderly people who are unable to live alone, do not require 24-h medical care, and where non-skilled nursing care is provided. The sample of 193 subjects who agreed to participate in the study, recruited from the residents of these three LTCFs, corresponded to 2.6% of the total LTCF population in Malopolska in 2010.[11]

Elderly individuals living in the community constituted the control group. These patients were treated by the same family doctor and their home care was provided by family members. Recruitment into the control group was carried out in collaboration with the family doctor. Twenty-four persons agreed to participate in the study.

The study protocol was approved by the local ethics committee at the Jagiellonian University and conforms to the guidelines set forth by the Declaration of Helsinki. The study protocol was carefully explained to the participants, who then gave their written informed consent prior to inclusion.

The medical documentation of all the residents was analyzed for the presence of chronic diseases and medical problems. In addition, the activities of daily living score (ADL; scores range from 0 to 6), the Katz scale (scores range from 0 to 6), and the Barthel index (scores range from 0 to 100) were obtained for all participants studied. The abbreviated mental test score (AMTS; scores range from 0 to 10) was obtained for the LTCF residents studied. Physical dependence was also classified according to a five-point scale: 1, independent; 2, independent with falls; 3, limitations in movement; 4, bedridden, mobile; 5, bedridden, dependent.

Continuous prospective infection surveillance was carried out between December 1, 2009 and November 30, 2010. In this study we used the incidence rate, which expresses the risk of disease and case-fatality rate: a ratio of the number of deaths from a specific disease divided by the number of cases of disease. Cases of NHAP were detected and recorded using the standard McGeer definition, i.e., both of the following criteria had to be met: (1) interpretation of a chest radiograph as demonstrating pneumonia, probable pneumonia, or the presence of an infiltrate; (2) the resident had to have at least two of the following signs and symptoms: chills, new headache or eye pain, myalgia, malaise or loss of appetite, sore throat, and new or increased dry cough,[12] observed by trained nurses in collaboration with a physician. Expectorated sputum or tracheal aspirate specimens were taken for the microbiological confirmation of NHAP, depending on the clinical status of the resident. The specimens were cultured on MacConkey agar, horse blood agar (at 37 °C, each for 24 h), and Sabourand agar (at 37 °C for 48 h). Identification with API tests (bioMérieux) was then performed. Antimicrobial susceptibility testing was performed using the disk diffusion antimicrobial susceptibility method on Mueller–Hinton agar plates, in accordance with the current European Committee on Antimicrobial Susceptibility Testing (EUCAST) guidelines.[13] The microbiological diagnosis was carried out at outside facilities, at the Department of Microbiology, Jagiellonian University Medical College (at a distance of not more than 5 km).

Data consisted of descriptive statistics based on the frequencies of nominal/categorical variables, and the parameters of distribution (mean and standard deviation (SD)) for continuous/quantitative data. Comparisons were made between LTCF residents (nursing home + residential home) and home care patients. In addition, the influence of selected risk factors for NHAP was also studied. The analysis of relationships between qualitative/categorical data was based on contingency table tests (Chi-square). If the classical analysis of variance (ANOVA) test could not be used due to non-homogeneous variances, the Welsh ANOVA test was used. The common influence of several factors on the probability of NHAP was analyzed using multivariate nominal logistic regression. All analyses were done with SAS JMP 7.01 package (JMP Software).[14]

For the continuous data usually presented as categories (age, Barthel index) and for variables with Poisson distribution and a limited number of given values (physical dependence scale), the analyses were supplemented by tests of frequencies in particular categories. For the analysis of the common influences of risk factors, multivariable analysis was done using general linear model (GLM) techniques. The model based on binominal distribution of the explanatory variable and logit link function was used.[15]

3. Results

Of the original number of 217 enrolled patients, one patient was discharged, one was transferred to another facility, and 31 patients died before the study was completed. Eighty-six (39.6%) of the subjects lived in residential homes, 107 in nursing homes (49.3%), and 24 were in home care (11.1%). The mortality rate in home care was 12.5% (three persons).