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Original article

Changes in physical function after hospitalization in patients with nursing and healthcare-associated pneumonia

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ABSTRACT

To clarify the functional changes after hospitalization due to pneumonia in elderly Japanese patients, we investigated the changes in physical functioning, nutritional routes, and diet that occurred after hospitalization in patients with nursing and healthcare-associated pneumonia (NHCAP). We analyzed 405 patients with NHCAP and compared findings with 448 patients with community-acquired pneumonia (CAP). Among the NHCAP patients, 140 (34%) patients showed a decline in activities of daily living function between baseline and discharge. After hospital discharge, 149 (37%) NHCAP patients did not return to the same residence location compared with where they were living prior to hospital admission. The frequency of this outcome was significantly higher in NHCAP patients than in CAP patients ($p < 0.0001$). After 6 months' follow-up, of the patients who transferred to different hospitals, 41 (73%) patients with CAP had returned to their own home, but only 16 (20%) patients with NHCAP could return home ($p < 0.0001$). Rates of alteration of nutritional route and type of diet from oral nutrition were significantly higher in NHCAP patients compared with CAP patients (22% vs 4%, $p < 0.0001$). Our results demonstrated that approximately one-third of hospitalized patients with NHCAP showed a decline in physical function. In addition, approximately one-fifth of NHCAP patients had changed their route of nutrition and type of diet. Our results indicated that physicians should attach greater importance to preventative measures against NHCAP rather than relying on antibiotic therapy post-infection in the management of pneumonia in elderly patients in order to extend their healthy life expectancy.

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1. Introduction

Pneumonia remains a significant cause of morbidity and death worldwide despite the availability of potent antibiotic therapies. In Japan, pneumonia is the third leading cause of mortality, and 97% of these deaths occur in elderly patients who are ≥65 years old. Thus, the Japan Respiratory Society (JRS) has issued guidelines for the management of pneumonia in elderly or disabled persons who are diagnosed with nursing and healthcare-associated pneumonia (NHCAP) [1]. NHCAP overlaps for the most part with nursing home-acquired pneumonia (NHPA) and healthcare-associated pneumonia (HCAP). These categories are distinct from community-acquired pneumonia (CAP) [2–10], and NHCAP is relevant to the Japanese population, the Japanese healthcare insurance system, including the nursing-care insurance system, and the pattern of drug-resistant pathogens [1].

Because Japan is facing an unprecedented situation of being a super-aging society, the Ministry of Health, Labor and Welfare has chosen to promote "Society with Extended Healthy Life Expectancy" initiatives as part of national strategies such as the Japan Revival Plan and the Health and Medical Care Plan [11]. By promoting specific approaches related to prevention and health management, it is aimed to achieve sustained well-being and healthy aging. Pneumococcal vaccination to help prevent pneumonia in the elderly in one such initiative, and it was incorporated into the National Immunization Program in 2014. However, the vaccination rate for adult pneumococcal vaccine is still low, given

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the fact that there is a lack of understanding of the serious health consequences of pneumonia. To increase vaccination rates, it is necessary to clarify to what degree pneumonia could affect healthy life expectancy.

Although many studies on NHCAP, NHAP, and HCAP have investigated patient background, clinical characteristics, disease severity, distribution and frequency of pathogens, and clinical outcome, there are no available data focused on functional changes after hospitalization due to pneumonia in elderly Japanese persons [2–10]. The purpose of the present study was to clarify physical outcomes after hospital discharge in patients with NHCAP. We investigated the changes in physical functioning, nutritional routes, and diet occurring after hospitalization and compared the findings with those of CAP patients.

2. Patients and methods

2.1. Study populations

All adult patients with pneumonia who were admitted to the Kawasaki Medical School Kawasaki Hospital from January 2012 to June 2015 were enrolled in this study. The diagnosis was based on clinical signs and symptoms (cough, fever, productive sputum, dyspnea, chest pain, mental changes, appetite loss, hypoxemia, or abnormal breath sounds) and radiographic pulmonary abnormalities that were at least segmental and were as a result of pre-existing or other known causes. Informed consent was obtained from all patients, and the study protocol was approved by the Ethics Committee at Kawasaki Medical School (approval number 2352).

2.2. Definitions

Pneumonia was classified as NHCAP or CAP according to the JRS guidelines [1,12]. NHCAP was defined as pneumonia acquired in the community with one or more of the following risk factors: Group A) pneumonia diagnosed in a resident of an extended care facility or nursing home; Group B) pneumonia diagnosed in a person who had been discharged from a hospital within the preceding 90 days; Group C) pneumonia diagnosed in an elderly or disabled person who is receiving nursing care with a performance status (PS) of 3 or 4; Group D) pneumonia diagnosed in a person who is receiving regular endovascular treatment as an outpatient (dialysis, antibiotic therapy, chemotherapy, or immunosuppressant therapy). All cases of pneumonia occurring more than 3 days after hospitalization were considered nosocomial.

Patients with poor functional status were defined according to their PS using the European Cooperative Oncology Group (ECOG) score [13]. Aspiration pneumonia was defined according to the Japanese Study Group on Aspiration Pulmonary Disease definition as pneumonia in a patient with a predisposition to aspiration because of dysphagia or swallowing disorders. Swallowing function was assessed using the water swallowing test, repetitive saliva swallowing test, simple-swallowing provocation test, and video fluorography [1,14]. When swallowing function was not assessed using these examinations, the presence of overt symptoms of dysphagia or a medical history of aspiration was determined as a swallowing disorder in the patient.

The severity of pneumonia was evaluated using predictive rules according to the respective 5-point scoring systems for CAP in Japan proposed by the JRS: A-DROP (age, dehydration, respiratory failure, orientation disturbance, and low blood pressure) [12].

2.3. Evaluation of hospital discharge outcome

We investigated the following conditions: activities of daily living (ADL) function at discharge, the location of residence after hospital discharge, the reason if the patient was transferred to other hospital, the route of nutrition, and the type of diet. The ADL assessment for calculating the Barthel Index consisted of the following 10 indices: feeding; bathing; grooming; dressing; bowels; bladder; toilet use; transfers; morbidity; and stairs [15]. In the present study, we calculated the difference in ADL scores between baseline (2 weeks before admission) and at discharge. The difference was categorized into two groups: declined ($\geq$1) and not declined (0). In addition, we followed up patients who transferred to a different hospital for 6 months after discharge from our hospital.

2.4. Statistical analysis

Statistical analysis was performed using Stat View version 5.0. (SAS Institute Inc, Cary, NC, USA). The incidence of clinical findings was analyzed using Fisher's Exact test. Continuous variables were compared using Student's t test when variables were normally distributed and the Mann–Whitney U test when variables were non-normally distributed. Risks of decline in ADL function between baseline and discharge were analyzed using logistic regression using Excel Toukei 2012 (SSRI, Tokyo, Japan). The contribution of each potential risk factor was denoted by an odds ratio (OR) and associated 95% confidence interval (CI).

3. Results

3.1. Patient characteristics

During the study period, we enrolled 968 pneumonia cases. Of these, 520 and 448 cases were classified as NHCAP and CAP, respectively. Of the NHCAP cases, we excluded 115 bedridden cases because these patients were not able to change their ADL score or their method of dietary intake between before and after admission to hospital. Finally, we compared the findings between 405 NHCAP and 448 CAP patients. Among the NHCAP criteria, group C was the most common in our study with 229 patients (56%), next was group A with 178 patients (44%), group B with 154 patients (38%), and finally 33 patients in group D (8%). One hundred sixty-five patients (40%) had overlapping NHCAP criteria.

The characteristics of NHCAP and CAP patients are shown in Table 1. Patients with NHCAP were significantly older than those with CAP ($p < 0.0001$), but the male/female ratio did not differ between the two groups. The incidences of some co-morbid illnesses were significantly higher in patients with NHCAP compared with those with CAP (cerebrovascular disease $p < 0.0001$, chronic renal disease $p = 0.0049$, and neoplastic disease $p = 0.0350$). Among general conditions, patients with dementia, aspiration, and PS $\geq$ 3 were significantly more frequent among patients with NHCAP than with CAP (Table 1, $p < 0.0001$).

3.2. Outcomes after hospital discharge

Among NHCAP patients, 140 patients declined in ADL function between baseline and discharge (Table 1). Functional decline rate was significantly higher in NHCAP patients than CAP patients (34% vs 17%, $p < 0.0001$). Of these, the average Barthel Index score reduced from 54 points to 22 points in NHCAP patients and from 89 points to 52 points in CAP patients between baseline and discharge. Among the patients with functional decline, 58 patients with NHCAP and 12 patients with CAP became bedridden. The severity of

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