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ORIGINAL ARTICLE

Effect of Early Rehabilitation by Physical Therapists on In-hospital Mortality After Aspiration Pneumonia in the Elderly

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Abstract

Objective: To clarify the effect of early rehabilitation by physical therapists on in-hospital mortality among elderly patients with aspiration pneumonia.

Design: A retrospective cohort study.

Setting: A total of 1161 acute-care hospitals across Japan.

Participants: Consecutive patients (age, 70−100y) (N=68,584) from July 2010 to March 2012 in the Japanese Diagnosis Procedure Combination inpatient database with aspiration pneumonia on admission who underwent early physical therapist−guided rehabilitation (n=16,835) and who did not undergo rehabilitation administered by physical therapists (n=51,749).

Interventions: Early rehabilitation was defined as physical rehabilitation administered by a physical therapist, initiated within 3 days of admission, and undertaken for at least 7 days.

Main Outcome Measure: Thirty-day in-hospital mortality.

Results: The 30-day in-hospital mortality rates were 5.1% and 7.1% in the early rehabilitation group and the control group, respectively. The multivariable logistic regression model showed that the early rehabilitation group had a significantly lower in-hospital mortality rate (odds ratio, .71; 95% confidence interval [CI], .64−.79; $P<.001$). Among patients without severe pneumonia, we found no significant difference in mortality rates between patients who underwent early rehabilitation and those who did not undergo rehabilitation by physical therapists. The instrumental variable analysis confirmed that early rehabilitation was associated with a reduced risk for in-hospital mortality (risk difference, −1.9%; 95% CI, −2.3% to −1.5%; $P<.001$; number needed to treat, 53 [95% CI, 43−67]).

Conclusions: The data suggest that early rehabilitation by physical therapists was associated with a reduction in 30-day in-hospital mortality rates in elderly patients with severe aspiration pneumonia.

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Aspiration pneumonia (AP) is a common but potentially serious disease that frequently affects elderly patients.[1] Elderly patients with AP often develop posthospital syndrome[2] and hospitalization-associated disability[3]; AP is frequently fatal in such patients.

Early rehabilitation administered by physical therapists potentially prevents hospitalization-associated disability for elderly inpatients.[3] Generally, rehabilitation for elderly inpatients includes encouraging early ambulation, strength exercise, and endurance training. These exercises are designed to enhance self-care ability and prevent a decline in physical performance. One meta-analysis has shown that inpatient rehabilitation specifically designed for elderly patients has the potential to improve outcomes related to physical function and mortality.[4] However, to

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our knowledge, no report has been published in English on the effectiveness of early rehabilitation by physical therapists for reducing mortality after AP. The purpose of the present retrospective observational study was to examine the effects of early rehabilitation by physical therapists on 30-day in-hospital mortality among elderly patients with AP, using a national inpatient database in Japan.

Methods

Data source

The Diagnosis Procedure Combination (DPC) database has been described in detail elsewhere.[5] In brief, all 82 university hospitals in Japan are obliged to participate in the database, but participation by other hospitals (including satellite hospitals of university hospitals and community hospitals) is voluntary. Specialized rehabilitation hospitals are not included in this data system. Administrative claims data and some detailed clinical data are collected for all inpatients discharged from the participating hospitals. The database includes a hospital's unique identifier and the following patient data: age and sex; diagnoses and comorbidities recorded with text data in Japanese and the *International Statistical Classification of Diseases, 10th Revision* codes; drugs used; length of stay; date of starting and ending treatment; and discharge status. All the diagnoses and comorbidities are recorded by the attending physicians. The database also includes details of pneumonia severity defined using the A-DROP scoring system[6] (parameters defined below) proposed by the Japanese Respiratory Society; this is a modified version of the British Thoracic Society's CURB-65.[6] A-DROP score on admission is recorded by an attending physician. In 2012, the number of patients included in the DPC was approximately 7 million, which represented approximately 50% of all inpatient admissions to acute-care hospitals in Japan. Because of the anonymous nature of the data, the requirement for informed consent was waived. The Institutional Review Board at The University of Tokyo approved this study.

Study population

We identified patients who were admitted to the participating hospitals with a diagnosis of AP (*International Statistical Classification of Diseases, 10th Revision,* code J69) and were discharged between July 2010 and March 2012. We included patients aged 70 to 100 years. We excluded those who died within 10 days of admission.

Early rehabilitation

Following the criteria used in several previous reports,[7-9] we defined the early rehabilitation group as those who underwent any type and intensity of physical rehabilitation administered by physical therapists, started within 3 days of admission and undertaken for at least 7 days. The control group was defined as those without rehabilitation by physical therapists. In Japan, rehabilitation by physical therapists is reimbursed by public health insurance when each patient receives a daily session of physical rehabilitation lasting over 20 minutes. Early rehabilitation for elderly patients generally consists of physical therapy, with the main focus on improving physical function; it helps people to stand, balance, and walk better by providing early ambulation and adaptive or assistive exercises.[10]

List of abbreviations:

AP **aspiration pneumonia**
CI **confidence interval**
DPC **Diagnosis Procedure Combination**

Pneumonia severity

Pneumonia severity was evaluated by tracheal intubation or vasopressor use on admission as well as the parameters used for calculating the A-DROP scores. A-DROP scores consist of the following: **a**ge (men, ≥70y; women, ≥75y); **d**ehydration (blood urea nitrogen, ≥21mg/mL); **r**espiratory failure (pulse oximetry saturation, $Spo_2 \leq 90\%$); **o**rientation disturbance; and low blood **p**ressure (systolic blood pressure ≤90mmHg).[6] We categorized patients with A-DROP scores of 0, 1 to 2, and 3 to 5 as having mild, moderate, and severe AP, respectively.

Outcome measure

The primary clinical outcome was in-hospital mortality within 30 days of admission.

Statistical analysis

We compared patients who underwent physical therapists–guided early rehabilitation and those who did not undergo rehabilitation. In univariate comparisons, we used a *t* test and a chi-square test. To assess the association between mortality and early rehabilitation, we conducted multivariable binary logistic regression analysis. We then performed subgroup analyses using separate multivariable logistic regressions for in-hospital mortality for the severe and mild-to-moderate pneumonia groups. We assumed that our data were structured hierarchically in 2 levels of patients and hospitals, and we accounted for the clustering of patients within hospitals by means of a generalized estimation equation.[11]

Instrumental variable analysis

Conventional approaches, such as multivariable logistic regression analyses, cannot remove hidden biases caused by unmeasured confounding variables.[12] Therefore, we conducted an instrumental variable analysis as a confirmatory analysis. Instrumental variable methods are quasi-experimental methods used to estimate the effects of a treatment or policy when an experimental design is infeasible. The instrumental variable is an observable factor that meets the following conditions: (1) is randomly present without association with patient background, (2) is associated with the likelihood of treatment selection, and (3) has no direct association with the targeted outcomes.[13]

For example, in a previous study, Bateman et al[14] adopted the proportion of specific drug use at individual hospitals as an instrumental variable.

In this study, the indications for rehabilitation by physical therapists in patients with acute-phase AP largely depended on the attending physician's policy and the availability of therapists at each hospital. When hospitals show consistency in whether or not they provide rehabilitation for patients with acute-phase AP, this decision may be assumed to be made largely independent of individual patients' characteristics (ie, patients' receipt of rehabilitation by physical therapists is more strongly determined by the facility in which they are treated than by their individual factors). Under these circumstances, the hospital's preference can act as an instrumental variable, setting the stage for a "natural experiment" that allows for an unbiased estimate of in-hospital death risk even