Original Article

Effects of early physiotherapy with respect to severity of pneumonia of elderly patients admitted to an intensive care unit: a single center study in Japan

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Abstract. [Purpose] We performed early physiotherapy for elderly patients with pneumonia admitted to an intensive care unit (ICU), and examined the effects of this early physiotherapy on the severity of pneumonia. [Subjects and Methods] Patients for whom physiotherapy was started the day after admission to the ICU (acute phase) were assigned to the early intervention group and compared with patients in the standard intervention group. All patients were divided into three groups (Groups I, II, and III) based on the severity of pneumonia. We evaluated the ICU admission period, hospitalization period, and activities of daily living (ADL) before and after admission. [Results] With respect to the severity of pneumonia, Group II showed significant differences in the ICU admission period and rates of change in the operating range, cognitive domain, and Functional Independence Measure (FIM). Group III showed significant differences in the ICU admission period and rate of change in the cognitive domain (FIM item). The results were more favorable in the early intervention group than in the standard intervention group. [Conclusion] The ICU admission period was shorter and a reduction in the ADL level was prevented in Groups II, and III compared to Group I. This may have occurred because of the early rehabilitation.
Key words: Pneumonia, Early physiotherapy, Intensive care unit

INTRODUCTION

In Japan, ≥95% of persons who die of pneumonia are >65 years of age[1]. This raises the issue of pneumonia treatment in the acute phase with an emphasis on the importance of early intervention by physical therapists. Although early rehabilitation shows favorable effects on the respiratory, cardiovascular and locomotor systems and mental state of bedridden patients, excessive rest by elderly patients with pneumonia often leads to long-term recumbency and a reduction in activities of daily living (ADL)[2].

Positive physiotherapy is not associated with adverse events in the intensive care unit (ICU) and can be safely performed under risk management[3–5]. Many studies have investigated the effects of exercise therapy early after admission to the ICU on early rehabilitation[6, 7]. The presence of protracted functional or ADL disorders has been recognized in previous ICU treatment assessments[8, 9]. Early rehabilita-tion by physical therapists may prevent pneumonia-related disuse syndrome, and is potentially an important treatment, considering patient prognoses and times until discharge.

In this study, we performed early physiotherapy for elderly patients admitted to an ICU with pneumonia, and examined the influence of early physiotherapy on the ICU admission period, hospitalization period, and ADL upon discharge with respect to the severity of pneumonia.

SUBJECTS AND METHODS

One hundred ninety-two elderly patients admitted to an ICU with community-acquired pneumonia between January 2011 and November 2014 were included in this study. Criteria for ICU admission included the presence of pneumonia on chest X-rays, presence of clinical symptoms, and an appropriate revised American Thoracic Society score[10].

Early physiotherapy began the day after admission (acute phase) and was introduced in January 2013.

Thirty-eight patients treated after the introduction of early physiotherapy (January 2013 to November 2014) were assigned to the early intervention group. Thirty-three patients treated before the introduction of early physiotherapy (January 2011 to December 2012) were assigned to the standard intervention group. The severity of pneumonia on admission was evaluated using the Confusion, Urea, Respiratory rate,

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Blood pressure, and age >65 (CURB-65) score[11]. Patients scoring 3 points were assigned to Group I, those scoring 4 points were assigned to Group II, and those scoring 5 points were assigned to Group III (Fig. 1).

We excluded patients aged ≤64 years, those bedridden before the onset of pneumonia, those with serious complications such as severe heart failure, and those who were discharged due to death.

The study protocol was approved by the ethics review board of Kanetsu Central Hospital. Consent to participate in this study was obtained from the patients after sufficient explanation of the study content. The study was conducted in accordance with the ethical principles of the Helsinki Declaration and with the protection of all patients' information.

In the early intervention group, respiration training guidance, sputum elimination assistance[12], and range-of-motion exercises (ROM ex) of the upper and lower limbs were conducted on the day of admission or the day after. Early rehabilitation was performed when possible. Respiration training was carried out by performing 10 sessions of slow, deep breathing starting immediately after admission[13]. Furthermore, the patients were instructed to perform self-sputum elimination using the active cycle of breathing technique with assistance[14]. ROM ex of the upper limbs (scapula, shoulder, elbow, wrist, and fingers) and lower limbs (hip, knee, ankle, and toes) was conducted in all ranges and directions of motion. This was continued from the day of admission, even for unconscious patients. Passive exercise was started and switched to active exercise when instructions could be followed. Early rehabilitation was conducted from the day of admission when the body temperature was controlled at <38 °C. When fever (≥38 °C), orthostatic hypotension, vomiting, or dyspnea was observed, early rehabilitation was discontinued. Initially, the patients were instructed to sit in a wheelchair. Standing and gait training were introduced in accordance with the patient's condition.

In the standard intervention group, no intervention was performed by physical therapists immediately after admission. Sputum elimination and rehabilitation were conducted by ward nurses. After ≥1 week, when the pneumonia was expected to improve and the general condition had become stable, intervention by physical therapists was performed.

In each group, the intervention was performed for 40 minutes once a day.

The evaluation items comprised gender, age, body mass index, CURB-65 score on admission, ICU admission period, hospitalization period, and Functional Independence Measure (FIM) before admission and upon discharge.

The CURB-65 score[11] was used to evaluate the severity of pneumonia. In the CURB-65 scoring system, 4 laboratory data items are evaluated; age is also assessed. CURB-65 scores range from 0 to 5. A higher score indicates a more severe condition in which the grade of invasiveness is more advanced (Table 1).

For ADL assessment, the FIM was used[15]. We evaluated the FIM before admission and upon discharge. The FIM upon discharge was subtracted from that before admission to obtain the FIM change. The FIM before admission was evaluated based on information obtained through inquiry

with the patients and their families.

The results of the early and standard intervention groups were compared using the t-test. The results of the severity of pneumonia were compared between the two groups using the Mann-Whitney U-test. SPSS statistical software (version 17.0; SPSS, Inc., Chicago, IL, USA) was used for all statistical analyses. A p-value ≤ 0.05 was regarded as statistically significant.

RESULTS

The results of the standard and early intervention groups were compared. There were no significant differences in age, or body mass index. However, the ICU admission period was shorter and the rate of change in the FIM was smaller in the early intervention group than in the standard intervention group. Patients in the early intervention group also exhibited more favorable ADL upon discharge (Table 2). With respect
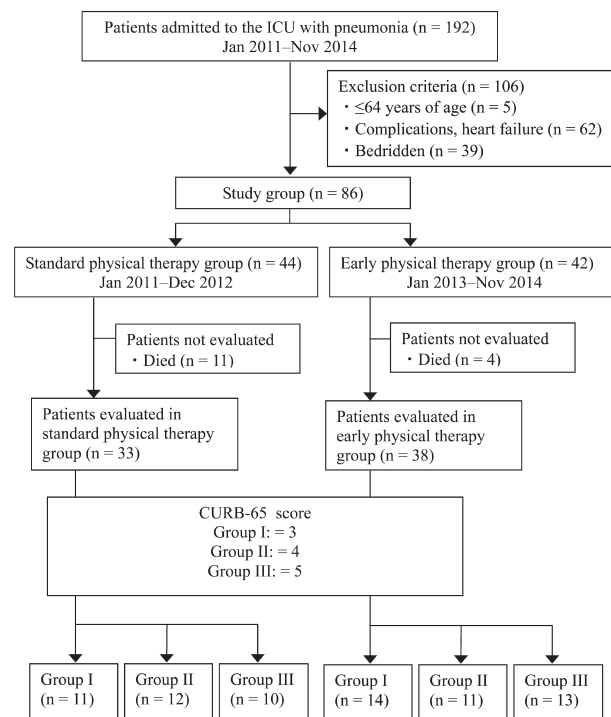

Fig. 1. Flow diagram of the patients

Table 1. CURB-65

CURB-65	
Symptom	Points
Confusion	1
BUN>19 mg/dl	1
Respiratory rate≥30	1
SBP<90mmHg, DBP≤60mmHg	1
Age≥65	1

CURB-65 is a clinical prediction rule that has been validated for predicting mortality in community-acquired pneumonia.

Table 2. Comparison between standard and early intervention groups

	Standard intervention group	Early intervention group
Patients, n (male/female)	33 (26/7)	38 (23/15)
Age, years	80.5 ± 6.1	82.2 ± 7.6
Body mass index	20.06 ± 1.8	20.1 ± 2.5
Interval until the start of physiotherapy, days	10.27 ± 3.03	1.63 ± 1.03
Admission period, days	37.7 ± 13.8	31.7 ± 16.7
ICU admission period, days	15.45 ± 3.76	12.03 ± 4.14 **
CURB-65 score / n	3 / 11	3 / 14
	4 / 12	4 / 11
	5 / 10	5 / 13
FIM before admission	81.9 ± 12.7	81.9 ± 7.04
Locomotory domain	56.8 ± 10.9	57.7 ± 5.8
Cognitive domain	25.3 ± 2.6	24.2 ± 2.5
FIM on dischargem	61.4 ± 16.7	67.6 ± 9.2
Locomotory domain	41.5 ± 12.6	46.9 ± 8.4 *
Cognitive domain	18.4 ± 4.5	19.5 ± 3.3
Rate of change in FIM	20.3 ± 7.6	14.3 ± 5.7 **
Locomotory domain	15.3 ± 7.1	10.8 ± 5.3 *
Cognitive domain	6.6 ± 2.8	4.7 ± 2.2 **

Data are presented as mean ± standard deviation unless otherwise indicated.
$*p < 0.05, **p < 0.01$
ICU: intensive care unit, CURB-65: The Confusion, Urea, Respiratory rate, Blood pressure, and age >65, FIM: Functional Independence Measure

to the severity of pneumonia, Group I exhibited no significant differences in the evaluation items. Group II showed significant differences in the ICU admission period, locomotory/cognitive domains and rate of change in the FIM. Group III showed significant differences in the ICU admission period and rate of change in the cognitive domain. The results were favorable in the early intervention group (Table 3).

DISCUSSION

We performed early physiotherapy for elderly patients with pneumonia admitted to an ICU and examined its influence on the severity of pneumonia. We compared the results of the standard and early intervention groups. In the early intervention group, the ICU admission period was significantly shorter and the rate of change in the FIM was smaller than in the standard intervention group. The FIM upon discharge of the early intervention group was better than that of the standard intervention group. Another study evaluated the effects of early physiotherapy on patients with pneumonia, including those with a severe clinical status, admitted to an ICU and reported improvement in ADL, reduction of delirium, shortening of the artificial respiration period, shortening of the ICU admission period, shortening of the hospitalization period, improvement in the 6-minute walking distance, improvement in health-related quality of life, and improvement in muscle strength[3]. The results of the present study also demonstrate the beneficial effects of early physiotherapy on ADL and the ICU admission period. This is important with respect to the patient's prognosis at home and reductions in health expenditures.

In terms of the severity of pneumonia, there were no ef-

Table 3. Background and effects of intervention with respect to severity of pneumonia

	Group I		Group II		Group III	
CURB-65 score	3		4		5	
	Standard	Early	Standard	Early	Standard	Early
Patients, n	11	14	12	11	10	13
Age, years	75.5 ± 6.4	78.1 ± 6.7	83.3 ± 4.2	87.7 ± 4.2	82.5 ± 4.5	82.0 ± 8.4
Body mass index	20.2 ± 1.6	20.4 ± 2.8	20.1 ± 1.9	20.9 ± 2.7	19.8 ± 2.1	19.6 ± 2.4
Admission period, days	29.7 ± 17.8	22.1 ± 14.9	30.5 ± 13.3	26.2 ± 17.7	46.1 ± 14.5	42.0 ± 11.6
ICU admission period, days	11.9 ± 2.9	9.8 ± 2.7	14.7 ± 3.9	10.7 ± 4.7 **	17.1 ± 3.6	13.5 ± 2.6 *
FIM before admission	87.1 ± 11.1	84.6 ± 6.8	76.2 ± 15.3	79.5 ± 2.9	77.0 ± 4.6	75.5 ± 5.1
Locomotory domain	60.4 ± 8.7	59.7 ± 5.2	53.4 ± 12.9	54.3 ± 3.7	53.4 ± 7.6	54.3 ± 7.2
Cognitive domain	26.6 ± 2.9	24.9 ± 2.6	24.6 ± 2.3	24.3 ± 1.0	23.6 ± 3.4	21.7 ± 2.6
FIM upon discharge	69.3 ± 14.3	70.1 ± 11.8	53.8 ± 14.3	64.3 ± 1.6	46.6 ± 8.6	52.5 ± 1.8
Locomotory domain	49.6 ± 9.3	49.3 ± 8.8	34.4 ± 8.1	43.2 ± 2.3*	28.6 ± 3.6	35.7 ± 4.5
Cognitive domain	19.8 ± 5.1	20.8 ± 5.4	18.2 ± 3.0	20.5 ± 1.6	13.4 ± 1.8	16.8 ± 2.9
Rate of change in FIM	13.4 ± 5.1	12.4 ± 4.5	23.4 ± 4.3	13.5 ± 2.3**	31.0 ± 7.2	23.8 ± 3.3
Locomotory domain	10.0 ± 5.2	9.4 ± 4.6	18.0 ± 5.6	4.6 ± 8.4*	24.9 ± 7.3	18.5 ± 2.4
Cognitive domain	5.6 ± 2.3	5.2 ± 2.5	6.6 ± 1.3	4.5 ± 7.4*	10.6 ± 3.2	5.3 ± 1.5**

Data are presented as mean ± standard deviation unless otherwise indicated.
$*p < 0.05, **p < 0.01$
ICU: intensive care unit, CURB-65: The Confusion, Urea, Respiratory rate, Blood pressure, and age >65, FIM: Functional Independence Measure
Group I comprised patients scoring 3 points on CURB-65 score, Group II comprised patients scoring 4 points, and Group III comprised patients scoring 5 points

fects of early intervention among the patients in Group I, who showed the mildest conditions. This was possibly because the severity of pneumonia was low, the ICU admission period was short, and the progression of disuse syndrome was slight in this group.

In Group II, comparison of the rate of change in the FIM locomotory and cognitive domains revealed better results in the early intervention group. In the locomotory domain, the prevention of ICU-acquired weakness (ICUAW) may have contributed to this result. Five factors, namely multiple organ failure, inactivity, hyperglycemia, steroids, and neuromuscular blockers, may be primarily involved in the development of ICUAW[3]. ICUAW influences artificial respiratory control, prolongs the ICU admission period, and delays ADL recovery[16]. Early intervention by physiotherapy may have reversed the patients' inactivity, preventing ICUAW. Another study reported that continuous passive exercise of the unilateral lower limb significantly ameliorated both muscular atrophy and decreases in the muscular protein level in patients with severe respiratory failure when the contralateral lower limb was regarded as the control[4]. In the early intervention group, passive ROM ex were conducted even for unconscious patients. This may have contributed to the favorable results in the locomotory domain through similar effects. Long-term inactivity of patients in an ICU affects the patients' ADL, and how best to promote physical activity in ICUs must be reviewed.

In Group III, comparison of the rate of change in the cognitive domain revealed the early intervention group had better results, as reported for Group II. Some studies have described the lack of an association of cognitive impairment after intensive care with the severity of the patient's condition and length of the ICU admission period[17]. However, in the present study, the ICU admission period was longer in patients with more severe pneumonia, and cognitive impairment was more marked. If early intervention by physiotherapy shortens the ICU admission period, cognitive impairment may be reduced. Delirium reduces the cognitive level of many patients in an ICU[18]. However, one study reported that physiotherapy during artificial respiration reduced delirium[19], and another study indicated that early physiotherapy decreased the incidence of delirium in patients with acute respiratory disorder[7]. Thus, physiotherapy is beneficial for patients' physical and mental states. This is consistent with the results of the present study. Early physiotherapy may help to prevent reductions in the cognitive level, regardless of severity.

Although the effects of early intervention by physiotherapy for elderly patients with pneumonia in an ICU depend on the severity of pneumonia, early physiotherapy may shorten the ICU admission period and prevent decline in ADL. Physiotherapy should be recognized as an effective treatment method that prevents complications and improves the prognosis associated with ADL, and not solely as a method to prevent disuse syndrome. Further research is needed in this field.

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