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Extremely Poor Post-discharge Prognosis in Aspiration Pneumonia and Its Prognostic Factors: A Retrospective Cohort Study.

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Extremely poor post-discharge prognosis in aspiration pneumonia and its prognostic factors: a retrospective cohort study

ABSTRACT

Aim

There is little evidence regarding the long-term prognosis of patients with aspiration pneumonia. This study aimed to investigate post-discharge survival time and prognostic factors in older patients hospitalized for aspiration pneumonia.

Methods

This retrospective cohort study included patients aged ≥65 years hospitalized for aspiration pneumonia and discharged alive from a tertiary care hospital in Japan between April 2009 and September 2014. Candidate prognostic factors were patient's age, sex, body mass index (BMI), performance status, chronic conditions, CURB-65 score, serum albumin level, hematocrit concentration, nutritional pathway at discharge, and discharge location. Kaplan–Meier curves were determined, and multivariable survival analysis using Cox regression model was performed to analyze the effect of each factor on mortality.

Results

In total, 209 patients were included in this study. The median age was 85 years, 58% of the patients were males, 33% had a performance status of 4, and 34% were discharged home. Among the patients, 65% received oral intake, 23% received tube feeding, and 21% received parenteral nutrition at discharge. During the follow-up period, 77% of the patients died, and the median post-discharge survival time was 369 days. Besides male sex and low BMI, tube feeding (adjusted hazard ratio [aHR] = 1.70, 95% confidence interval [CI]:1.11–2.59) and parenteral nutrition (aHR= 4.42, 95% CI:2.57–7.60) were strongly associated with mortality.

Conclusions

Long-term prognosis of patients hospitalized for aspiration pneumonia was extremely poor. The nutritional pathway at discharge was a major prognostic factor. These results may be useful for future care and research.

Keywords: aspiration pneumonia; pneumonia; dysphagia; alternative nutrition; terminal care

INTRODUCTION

Aspiration pneumonia results from the inhalation of oropharyngeal contents into the lower respiratory tract, leading to chemical pneumonitis, lung injury, and resulting bacterial infection [1]. Most older patients with aspiration pneumonia have underlying dysphagia [2,3]. Aspiration pneumonia is a common cause of hospitalization [4–6] and a significant cause of death in older individuals [7]. In Japan, pneumonia and aspiration pneumonia are the fifth (4.7%) and sixth (3.6%) leading causes of death, respectively [8]. Aspiration pneumonia is estimated to be an even greater cause of death because most pneumonia cases in older people are aspiration pneumonia [9,10]; therefore, aspiration pneumonia is expected to account for a large proportion of deaths due to pneumonia.

After hospitalization for aspiration pneumonia, a subset of patients is unable to consume food orally due to dysphagia or other causes and opt for alternative nutritional pathways, resulting in a limited number of patients being discharged home [11]. The choice of an alternative nutritional pathway is, in principle, based on whether the patient's digestive system is functional [12]. In Japan, however, the view that percutaneous endoscopic gastrostomy (PEG) represents an unnecessary life-prolonging treatment has become widespread, and PEG is declining as a long-term alternative nutritional pathway for older patients, while parenteral nutrition is increasing, although both are similar on the point of being life-prolonging treatments [13]. On the other hand, parenteral nutrition is more complex and expensive than tube feeding, especially in home care and some care facilities, reducing its feasibility [12]. In this context, the choice of alternative nutritional pathways for older patients often relies on factors such as patient and family values and care complexity and cost, rather than solely on the patient's digestive system functioning in Japan. Therefore, sharing information about the prognosis with patients and their caregivers is crucial for decision-making processes such as choosing alternative nutritional pathways and determining the care location.

Although the prognostic factors for short-term mortality in aspiration pneumonia have already been reported [14–16], there is little evidence regarding the long-term prognosis of patients who are discharged alive after hospitalization for aspiration pneumonia. In a single Korean tertiary center, the proportion of 1-year death of older patients hospitalized for aspiration pneumonia was 49%, and the prognostic factors were mechanical ventilation, male sex, low body mass index (BMI), hypoalbuminemia, and anemia [17]. However, as this proportion of death included 17% of in-hospital deaths, the results were affected by short-term mortality from severe pneumonia, and the prognosis and prognostic factors for patients discharged alive, which is important for decision-making regarding post-discharge long-term care, remain unclear.

This study aimed to investigate post-discharge survival time and prognostic factors in older patients hospitalized for aspiration pneumonia.

METHODS

Study design and settings

This retrospective cohort study used data from a tertiary care hospital in Japan with 750 beds and approximately 240,000 inpatients annually. We enrolled patients who were hospitalized between April 1, 2009 and September 30, 2014 and followed them through September 30, 2021. This study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement.

Study participants

Aspiration pneumonia results from the inhalation of oropharyngeal contents into the lower respiratory tract [1]. However, because of the difficulty in establishing a clear causal relationship between aspiration and pneumonia, previous studies have defined aspiration pneumonia as pneumonia in patients with a history of or risk factors for aspiration [18,19]. There is no consensus on the definition of aspiration risk, and previous studies have included various combinations of witnessed aspiration, episodes of coughing on food or liquids, relevant underlying conditions, abnormalities on videofluoroscopy or water swallow test, and gravity-dependent distribution of shadows on chest imaging [18].

In this study, we defined aspiration pneumonia as pneumonia in patients with aspiration risk. Pneumonia was defined based on the combination of clinical features and chest imaging findings consistent with pneumonia at admission according to community-acquired pneumonia guidelines [20]. The presence or absence of aspiration risk was defined based on the name of the main disease and the diet type. Patients with aspiration risk were included by using “aspiration pneumonia” (International Classification of Diseases, 10th edition [ICD-10] code, J690) as the name of the main disease and not using other disease names of pneumonia such as “pneumonia” (ICD-10 code, J18.9). In addition, patients who were taking a non-dysphagia diet at discharge were excluded because they were not considered to be at aspiration risk.

Specifically, first, we identified patients with “aspiration pneumonia” (ICD-10 code, J690) based on the name of the main disease identified in the discharge summary. If the same patient was hospitalized for aspiration pneumonia more than once during the enrollment period, only the first hospitalization was considered. Patients were excluded from the study if they were aged <65 years, had not been diagnosed with aspiration pneumonia at admission, or died during hospitalization. We also excluded patients without clinical features (cough, fever, sputum production, and pleuritic chest pain) and/or imaging findings on chest radiography and/or computed tomography consistent with pneumonia at admission. In addition, patients who were taking a non-dysphagia diet, level seven in the International Dysphagia Diet Standardization Initiative framework [21], at discharge were excluded because they were not considered to be at aspiration risk. The study hospital uses a “dysphagia manual,” which recommends that patients with suspected dysphagia be screened with a water swallow test early in hospitalization, followed by a detailed assessment of swallowing, including videofluoroscopy and videoendoscopy if necessary. Then, if patients can consume a dysphagia diet without aspiration, the diet type is stepped up to a non-dysphagia diet. Such practices can determine the appropriate diet type and eating conditions to prevent aspiration for each patient. It is unknown if all study patients were covered, but since patients hospitalized for aspiration pneumonia are usually covered by this manual, it is assumed that most study patients who were on a dysphagia diet or using alternative nutrition at discharge were assessed as having eating or swallowing problems. This means that patients without aspiration risk were unlikely to be included in this study.

Data collection

Patient data were retrospectively extracted from the electronic medical records. We obtained data on demographic characteristics, chronic conditions, symptoms, vital signs, laboratory and imaging findings, clinical course, nutritional pathway and diet classification, and the date of last confirmed survival or death for each patient. In addition, for patients discharged to other hospitals or care facilities whose date of death was unknown, we inquired about the date of the last confirmed survival or death via mail to the institutions.

Candidate prognostic factors

The predictors were chosen based on prior knowledge [17,22–25], including the patient’s age, sex, BMI <18.5 kg/m^2, Eastern Cooperative Oncology Group Performance Status (PS) 4 (completely disabled) [26] before admission, chronic conditions with a prevalence >10% among the included patients (hypertension, stroke, dementia, diabetes, chronic heart failure, and ischemic heart disease), CURB-65 (confusion, uremia, respiratory rate, blood pressure, and age ≥65 years) score >2, severity rating scale for community-acquired pneumonia [27], serum albumin <3.0 g/dL at admission, hematocrit <33.0% at admission, nutritional pathway at discharge (oral intake, tube feeding, or parenteral nutrition), and discharge location (home or not). For discharge location, the combination of residence before admission (home or care facility) and discharge location (home or institution, including care facility or hospital) was also considered.

Outcome

The outcome was the post-discharge survival time. The survival time of patients with an unknown date of death was censored at the date of last confirmed survival.

Statistical analysis

Patient characteristics were described using median and interquartile range for continuous variables, and number and percentage for categorical variables. Kaplan–Meier curves for post-discharge survival time were drawn. The log-rank test was used to compare multiple curves. We fitted the Cox proportional hazard regression model to investigate the predictors of post-discharge mortality. After adjusting for covariates, the adjusted hazard ratios (aHR) and 95% confidence intervals (CI) were calculated for each prognostic factor. In Model 1, age and sex were adjusted as covariates; in Model 2, all candidate prognostic factors were adjusted as covariates. We also performed another analysis using a combination of residence before admission and discharge location instead of solely discharge location as a candidate prognostic factor to assess the association between changes in type of residence and post-discharge survival time. Patients who were lost to follow-up on the day of discharge were excluded from the Cox regression analysis.

A two-sided P <0.05 was considered statistically significant. All analyses were performed using IBM SPSS Statistics 28.0 (IBM Japan, Tokyo, Japan).

Ethics

Information about the study was displayed on the institution's website, and refusal to participate in the study was received. Data were anonymized and stored on a computer with no connection to an external network. The Ethics Committees of the institutions approved the study protocol (research approval no. 3529 and 20-311) and waived the requirement for informed consent because of the retrospective nature of the study.

RESULTS

Figure 1 shows the inclusion and exclusion flowchart for the study participants. In total, 355 patients with the name of the main disease aspiration pneumonia were hospitalized between April 1, 2009 and September 30, 2014. After excluding 60 patients who died in the hospital (22% of patients hospitalized for aspiration pneumonia), 209 patients with aspiration pneumonia who were discharged alive were included in the study.

Table 1 presents the patient characteristics. At discharge, regarding the nutritional pathway, 136 patients (65%) were on oral intake, 48 patients (23%) were on tube feeding (34 nasogastric tubes and 14 PEG or enterostomy tubes), and 25 patients (12%) received parenteral nutrition (three via central vein and 22 via peripheral vein). The response proportion from hospitals and care facilities regarding the date of last confirmed survival or death of patients was 84%. In total, 160 deaths (77%) occurred during the follow-up period.

Figure 2 shows the Kaplan–Meier curve for the post-discharge survival time of all patients. The median post-discharge follow-up period was 227 days, and the median post-discharge survival time was 369 days. Post-discharge survival proportions at 1 and 5 years were 50% and 13%, respectively, and the post-discharge mortality rate was 498 per 1000 persons in one year. Figure 3 shows the Kaplan–Meier curve for post-discharge survival time according to the nutritional pathway at discharge. The median post-discharge survival times of the patients on oral intake, tube feeding, and parenteral nutrition were 620, 264, and 34 days, respectively.

Table 2 presents the association between each factor and post-discharge mortality analyzed using a multivariable Cox proportional hazard regression model. After excluding patients who were lost to follow-up on the day of discharge, 193 patients were analyzed (Figure 1). After adjusting all candidate prognostic factors, factors significantly associated with post-discharge mortality were age (aHR = 1.05, 95% CI: 1.03–1.08), male sex (aHR = 2.43, 95% CI: 1.62–3.64), BMI <18.5 kg/m^2 (aHR = 2.21, 95% CI: 1.38–3.56), hematocrit <33.0% (aHR = 1.63, 95% CI: 1.12–2.37), tube feeding at discharge (aHR = 1.70, 95% CI: 1.11–2.59), parenteral nutrition at discharge (aHR = 4.42, 95% CI: 2.57–7.60), and discharge to a care facility or a subacute or long-term care hospital (aHR = 1.69, 95% CI: 1.13–2.54). However, the CURB-65 score was not associated with increased post-discharge mortality. In the analysis using a combination of residence before admission and discharge location instead of discharge location as a candidate prognostic factor, there was no marked difference in the association with post-discharge mortality between "admitted from home and discharged to an institution" and "admitted from a care facility and discharged to an institution" (Supplementary Table).

DISCUSSION

In this retrospective cohort study conducted in a single tertiary care hospital in Japan, we found that the long-term prognosis of patients hospitalized for aspiration pneumonia was extremely poor. The median age of the patients was 85 years, and the median post-discharge survival time was approximately 1 year, despite a life expectancy of approximately 6 years for males and 8 years for females in the 85-year-old population based on the 2010 Japanese census [28]. Major prognostic factors included male sex, low BMI, tube feeding, and parenteral nutrition.

A study in a single Korean tertiary center reported that the 1-year and 5-year survival proportion of patients hospitalized for aspiration pneumonia were 49% and 23% after hospitalization, respectively [17]. Although our study excluded in-hospital death cases, the 1-year survival proportion after discharge was 50%, similar to that in the previous study, and the 5-year survival proportion after discharge was 13%, lower than that in the previous study [17]. Although mechanical ventilation use, which is an indicator of pneumonia severity, was the greatest prognostic factor in the previous study [17], the CURB-65 score, a severity scale for pneumonia, was not associated with long-term prognosis in our study. This may indicate that the severity of aspiration pneumonia at the time of admission is associated with short-term but not long-term prognosis. Other prognostic factors were similar in both studies. Another previous study of older patients with dysphagia in a single long-term care hospital in Japan reported median survival times of 317 and 195 days for patients who received nutrition via PEG and total parenteral nutrition, respectively [29]. In contrast, our study reported the median post-discharge survival times of patients on tube feeding and parenteral nutrition as 264 and 34 days, respectively. We considered patient characteristics to be the reason for the poor prognosis in our study. Patients in our study were older, more likely to have dementia, be bedridden, and be on parenteral nutrition at discharge, and had lower BMI than those in the Korean study [17]. Although all patients in our study had aspiration pneumonia, the proportion of patients with aspiration pneumonia was approximately 37% in a study in a Japanese long-term care hospital [29]. Patients affected by aspiration pneumonia are considered to have poorer prognoses than patients with dysphagia but without aspiration pneumonia. Hematocrit <33% was a significant prognostic factor, and this is consistent with previous reports in patients with pneumonia [17,30]. Anemia is recognized as a mortality indicator in older adults and is considered to reflect underlying conditions such as nutritional disorders, chronic kidney disease, and chronic inflammation [31]. Anemia may be a useful prognostic factor also in patients with aspiration pneumonia. Factors including BMI <18.5 kg/m^2, PS 4, serum albumin <3.0 g/dL, nutritional pathway at discharge, and discharge to a care facility or a subacute or long-term care hospital showed lower aHRs in the multivariable Cox proportional hazard regression analysis using Model 2 than in the analysis using Model 1. This may imply that other factors have confounding or mediating effects on the association between the aforementioned factors and post-discharge survival time.

We considered two possible mechanisms for the poor prognosis of patients hospitalized for aspiration pneumonia. First, patients with poor prognostic factors are more likely to be susceptible to aspiration pneumonia. Patients in our study had a low BMI, were likely to have many chronic conditions, have poor physical function, and require the support of caregivers at discharge. Studies have shown that older populations with dysphagia have poor nutritional status and are more likely to have frailty and sarcopenia [32,33]. Second, wasting due to pneumonia and hospitalization may contribute to the worsening of physical function, leading to a poor prognosis. In our study, 69% of the patients were admitted from home, but only 34% were discharged home. This is speculated to be the result of increased patient dependence due, at least in part, to wasting from aspiration pneumonia and hospitalization. Frailty in older patients is reportedly exacerbated by hospitalization for pneumonia [34]. We also considered the mechanisms underlying the poor prognosis in patients receiving tube feeding and parenteral nutrition. In these patients, especially those receiving parenteral nutrition, the caloric intake should be lower. In addition, because parenteral nutrition tends to be chosen for patients with poor general conditions [29], their prognosis may be poor.

To our knowledge, this is the first study to report the long-term prognosis of patients hospitalized for aspiration pneumonia, who were discharged alive. Informing patients and their caregivers of poor prognosis is extremely important in decision-making for the rest of their lives, such as care location and alternative nutritional pathways. It is particularly important to note that the prognosis was predicted to be very poor when oral intake was not possible, and the prognosis may vary depending on the choice of alternative nutritional pathway. Those involved in the care of patients with aspiration pneumonia, not only in acute care hospitals but also in long-term care settings, can use the results of this study to care for patients and caregivers and support their decision-making. Further research is warranted to investigate whether providing prognostic information changes the decision-making of patients with aspiration pneumonia, caregivers, and healthcare professionals.

Our study has several limitations. First, when interpreting the results, a potential selection bias must be considered because this study was conducted at a single tertiary care hospital in Japan. However, the participant characteristics in our study such as age, sex, BMI, pre-hospitalization activities of daily living, length of hospitalization, discharge location, and short-term reestablishment of oral intake were quite similar to those in a study of hospitalized older patients with aspiration pneumonia that used nationwide representative administrative data from acute care hospitals in Japan [11]. The participant characteristics were also relatively similar to those in the study of a single Korean tertiary center [17]. Therefore, we believe that the results of our study can be well extrapolated to older patients in other Japanese acute care hospitals and some patients in other countries. In our study, the proportions of those who required tube feeding and parenteral nutrition at discharge were 23% and 12%, respectively. The use of alternative nutritional pathways for people who are unable to consume food orally is more common in Japan than in Western countries [35,36] because Japanese people tend to "abhor" death by starvation due to withholding alternative nutritional pathways [37], and they are less likely to refuse tube feeding for their family members [38]. Such differences should be considered when extrapolating the results of our study to patients in other countries. Second, because the definition of aspiration pneumonia has not yet been established, we need to carefully compare our results with those of other studies or apply them to clinical practice. In our study, we enrolled patients who were at risk of aspiration based on the name of the main disease and excluded those who were not at risk of aspiration based on the diet type at discharge. Although most patients' diet type at discharge should have been determined using the "dysphagia manual" of the study hospital, patients without aspiration risk who were not covered by the manual-based practice may have been included in this study. Third, a certain proportion of early censoring due to loss to follow-up may have affected the results. However, we believe that the impact was not so large because most prognostic factors and discharge locations were not significantly different between patients who were lost to follow-up early and the other patients. Finally, there might have been unmeasured prognostic factors. We did not collect direct data on dysphagia in each patient, which could be a potential prognostic factor. However, as noted in the Methods section, patients without aspiration risk, including dysphagia, were unlikely to be included in our study through the enrolment process and clinical practice in the study hospital. In addition, although discharge to a care facility or a subacute or long-term care hospital was a significant prognostic factor, it was impossible to identify whether the change in level of care between the facility each patient was before admission and the institution to which the patient was discharged was a prognostic factor. Patients discharged to care facilities should include those who return to their original facilities, but this does not seem to be a prognostic factor.

In conclusion, the long-term prognosis of patients hospitalized for aspiration pneumonia in a Japanese tertiary care hospital was extremely poor. Alternative nutritional pathways at discharge were one of the major prognostic factors. Sharing information about the poor prognosis and prognostic factors with patients and their caregivers may be useful for decision-making, including choices about alternative nutritional pathways and care locations. Further research should focus on care and shared decision-making for patients with aspiration pneumonia considering their poor prognosis.

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Data availability statement: The datasets generated during and/or analyzed during the current study are not publicly available because they contain information that could compromise the privacy of research participants, but are available from the corresponding author on reasonable request.

TABLES

Table 1. Patient characteristics (N = 209)

Characteristics	
Age (year), median (IQR)	85 (80–90)
Male, n (%)	122 (58)
Body mass index (kg/m²), median (IQR)	16.0 (14.6–17.8)
Body mass index <18.5 (kg/m²), n (%)	166 (79)
PS, n (%)	
0 (fully active)	20 (10)
1 (capable of light work)	27 (13)
2 (capable of all self-care)	26 (12)
3 (capable of only limited self-care)	68 (33)
4 (completely disabled)	68 (33)
Residence before admission, n (%)	
Home	145 (69)
Care facility	64 (31)
Chronic conditions, n (%)	
Hypertension	101 (48)
Stroke	69 (33)
Dementia	61 (29)
Diabetes	30 (14)
Chronic heart failure	28 (13)
Ischemic heart disease	27 (13)
Dyslipidemia	21 (10)
Fragility fracture	20 (10)
Chronic kidney disease	13 (6)
Parkinson's disease	13 (6)
Active malignancy	7 (3)
Hepatic disease	7 (3)
CURB-65, n (%)	
1	45 (22)
2	85 (41)
3	61 (29)
4	17 (8)
5	1 (1)
Serum albumin (g/dL), median (IQR)	2.8 (2.5–3.1)
Serum albumin <3.0 (g/dL), n (%)	126 (60)
Hematocrit (%), median (IQR)	33.6 (30.4–37.3)
Hematocrit <33.0 (%), n (%)	96 (46)

Nutritional pathway at discharge, n (%)	
Oral intake	136 (65)
Tube feeding	48 (23)
Parenteral nutrition	25 (12)
Discharge location, n (%)	
Home	72 (34)
Care facility	41 (20)
Subacute or long-term care hospital	96 (46)
Hospitalization period (day), median (IQR)	37 (20–53.5)
Death, n (%)	160 (77)

IQR, interquartile range; PS, Eastern Cooperative Oncology Group Performance Status; CURB-65, confusion, uremia, respiratory rate, blood pressure, and age ≥65 years

Each characteristic is at the time of admission, except for nutritional pathway at discharge, discharge location, hospitalization period, and death.

Table 2. Associations between candidate prognostic factors and post-discharge mortality
Multivariable Cox proportional hazard regression analysis (N = 193)

	Post-discharge mortality			
	Model 1[a], aHR (95% CI)	**P value**	**Model 2[b], aHR (95% CI)**	**P value**
Age (year)	**1.03 (1.01–1.05)**[c]	0.014	**1.05 (1.03–1.08)**	<0.001
Male	**1.54 (1.10–2.14)**[c]	0.012	**2.43 (1.62–3.64)**	<0.001
Body mass index <18.5 (kg/m^2)	**3.56 (2.31–5.49)**	<0.001	**2.21 (1.38–3.56)**	0.001
PS 4 (completely disabled)	**2.19 (1.53–3.14)**	<0.001	1.50 (1.00–2.25)	0.051
Hypertension	1.04 (0.76–1.44)	0.81	0.79 (0.55–1.14)	0.22
Stroke	1.13 (0.80–1.60)	0.48	1.02 (0.69–1.51)	0.91
Dementia	1.07 (0.75–1.53)	0.70	1.22 (0.84–1.79)	0.30
Diabetes	1.23 (0.78–1.94)	0.37	1.29 (0.77–2.18)	0.33
Chronic heart failure	0.98 (0.63–1.53)	0.93	0.94 (0.58–1.50)	0.78
Ischemic heart disease	1.27 (0.79–2.04)	0.32	0.93 (0.55–1.59)	0.80
CURB-65 >2	0.97 (0.70–1.35)	0.86	1.02 (0.72–1.43)	0.93
Serum albumin <3.0 (g/dL)	**1.96 (1.40–2.74)**	<0.001	1.36 (0.93–1.98)	0.11
Hematocrit <33.0 (%)	**1.63 (1.19–2.23)**	0.003	**1.63 (1.12–2.37)**	0.010
Nutritional pathway at discharge				
Oral intake	ref		ref	
Tube feeding	**2.16 (1.47–3.18)**	<0.001	**1.70 (1.11–2.59)**	0.015
Parenteral nutrition	**7.39 (4.43–12.33)**	<0.001	**4.42 (2.57–7.60)**	<0.001
Discharge to a care facility or a subacute or long-term care hospital	**2.19 (1.54–3.13)**	<0.001	**1.69 (1.13–2.54)**	0.011

PS, Eastern Cooperative Oncology Group Performance Status; aHR, adjusted hazard ratio; CI, confidence interval; CURB-65, confusion, uremia, respiratory rate, blood pressure, and age ≥65 years

[a] Adjusted for age and sex.

[b] Adjusted for all candidate prognostic factors including age, sex, body mass index (<18.5 kg/m^2 or not), PS (4 or not), chronic conditions (hypertension, stroke, dementia, diabetes, chronic heart failure, and ischemic heart disease), CURB-65 score (1–2 or 3–5), serum albumin (<3.0 g/dL or not), hematocrit (<33.0% or not), nutritional pathway at discharge (oral intake, tube feeding, or parenteral nutrition), and discharge location (home or not).

[c] Adjusted only by age or sex.

aHR (95% CI) is bolded if the P value is <0.05.

Each characteristic is at the time of admission, except for nutritional pathway at discharge, discharge location, hospitalization period, and death.

Supplementary Table. Associations between candidate prognostic factors and post-discharge mortality using a combination of residence before admission and discharge location instead of solely discharge location

Multivariable Cox proportional hazard regression analysis (N = 193)

	Post-discharge mortality	
	aHR (95% CI)	**P value**
Age (year)	**1.05 (1.03–1.08)**	<0.001
Male	**2.46 (1.64–3.70)**	<0.001
Body mass index <18.5 (kg/m^2)	**2.17 (1.34–3.50)**	0.002
PS 4 (completely disabled)	1.41 (0.92–2.18)	0.12
Hypertension	0.79 (0.55–1.14)	0.21
Stroke	1.00 (0.67–1.49)	1.00
Dementia	1.19 (0.80–1.77)	0.40
Diabetes	1.28 (0.76–2.17)	0.35
Chronic heart failure	0.94 (0.58–1.51)	0.80
Ischemic heart disease	0.98 (0.57–1.67)	0.93
CURB-65 >2	1.00 (0.71–1.41)	1.00
Serum albumin <3.0 (g/dL)	1.34 (0.92–1.95)	0.13
Hematocrit <33.0 (%)	**1.63 (1.12–2.37)**	0.011
Nutritional pathway at discharge		
Oral intake	ref	
Tube feeding	**1.74 (1.12–2.72)**	0.014
Parenteral nutrition	**4.49 (2.59–7.77)**	<0.001
Combination of residence before admission and discharge location		
Admitted from home and discharged to home	ref	
Admitted from home and discharged to an institution	**1.68 (1.08–2.61)**	0.020
Admitted from a care facility and discharged to an institution	**1.98 (1.17–3.33)**	0.011
Admitted from a care facility and discharged to home	2.59 (0.57–11.73)	0.22

PS, Eastern Cooperative Oncology Group Performance Status; aHR, adjusted hazard ratio; CI, confidence interval; CURB-65, confusion, uremia, respiratory rate, blood pressure, and age ≥65 years

Adjusted for all candidate prognostic factors including age, sex, body mass index (<18.5 kg/m^2 or not), PS (4 or not), chronic conditions (hypertension, stroke, dementia, diabetes, chronic heart failure, and ischemic heart disease), CURB-65 score (1–2 or 3–5), serum albumin (<3.0 g/dL or not), hematocrit (<33.0% or not), nutritional pathway at discharge (oral intake, tube feeding, or parenteral nutrition), and combination of residence before admission and discharge location (admitted from home and discharged to home, admitted from home and discharged to an institution, admitted from a care facility and discharged to an institution, and admitted from a care facility and discharged to home).

aHR (95% CI) is bolded if the P value is <0.05.

Each characteristic is at the time of admission, except for nutritional pathway at discharge, discharge location, hospitalization period, and death.

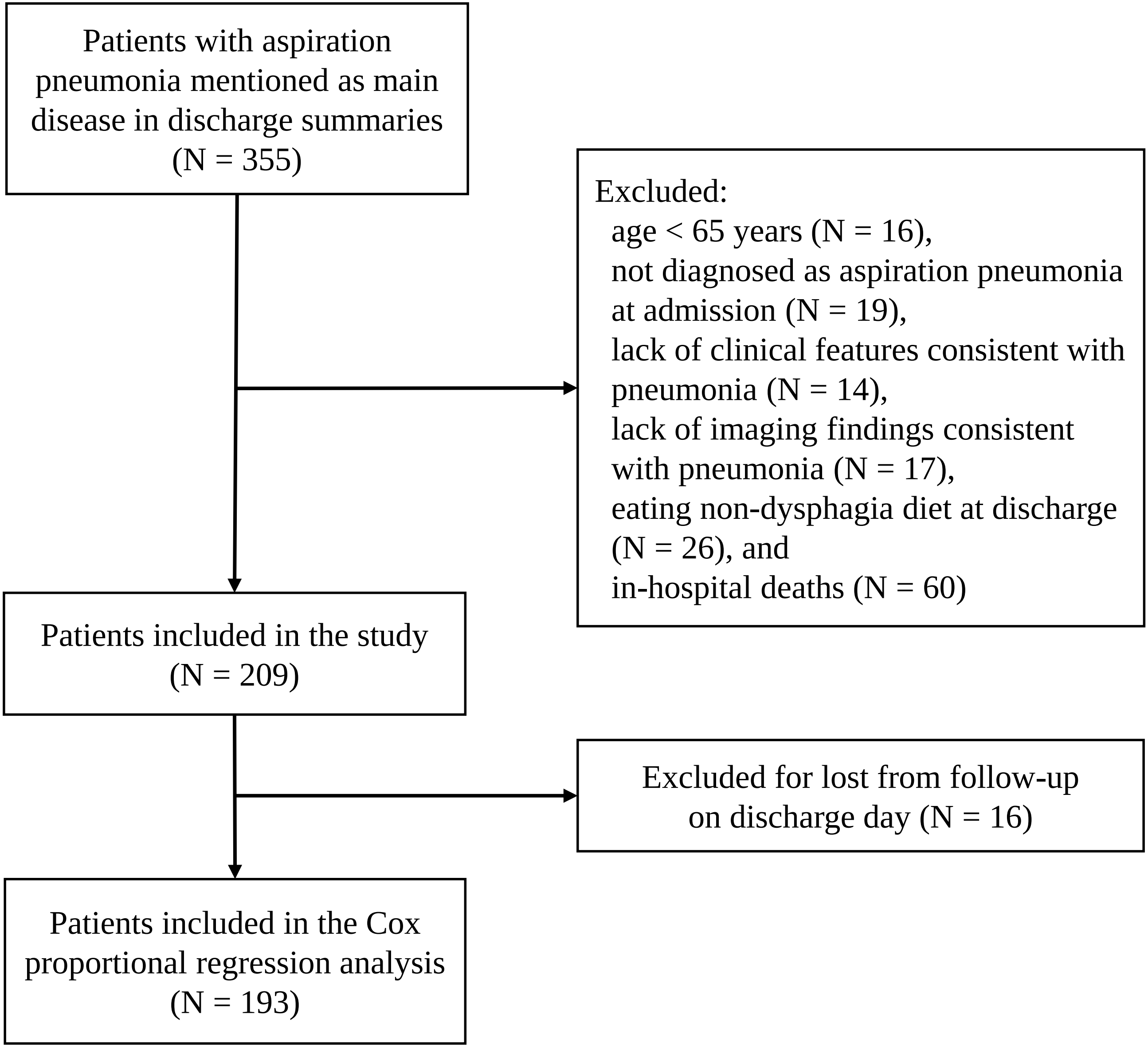

Fig 1 Flow chart of the selection of study participants

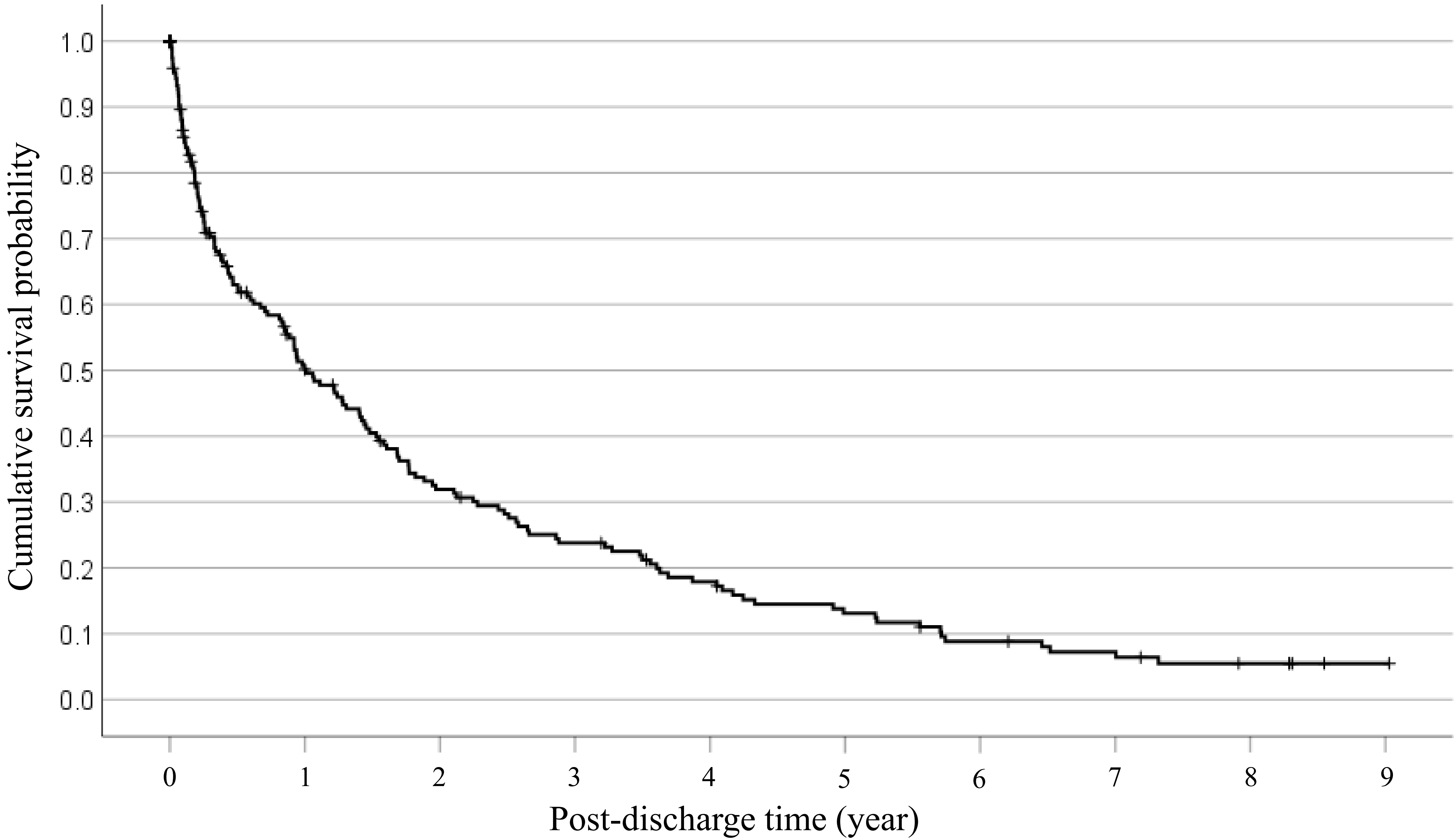

Fig 2 Kaplan–Meier curve for post-discharge survival time of patients with aspiration pneumonia (N = 209)

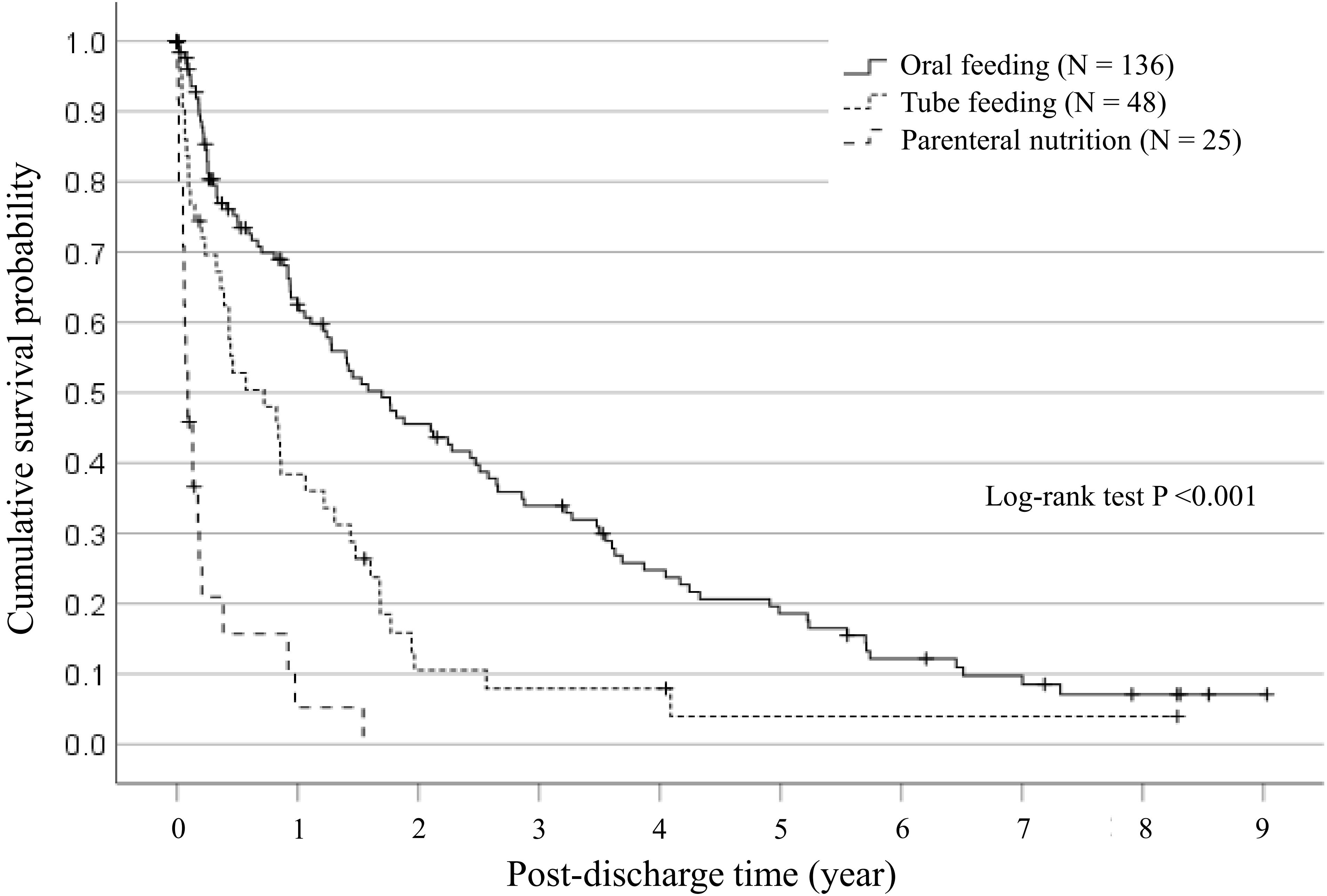

Fig 3 Kaplan–Meier curve for post-discharge survival time of patients with aspiration pneumonia according to the nutritional pathway at discharge