

# Oropharyngeal Dysphagia is a Risk Factor for Readmission for Pneumonia in the Very Elderly Persons: Observational Prospective Study

Mateu Cabré,<sup>1</sup> Mateu Serra-Prat,<sup>2,3</sup> Ll Forcé,<sup>1</sup> Jordi Almirall,<sup>4,5</sup> Elisabet Palomera,<sup>2</sup> and Pere Clavé<sup>6,3</sup>

<sup>1</sup>Servei de Medicina Interna, Hospital de Mataró, Barcelona, Spain.

<sup>2</sup>Research Unit, Consorci Sanitari del Maresme, Mataró, Barcelona, Spain.

<sup>3</sup>Centro de investigación biomédica en red de enfermedades hepáticas y digestivas, Instituto de Salud Carlos III, Mataró, Barcelona, Spain.

<sup>4</sup>Unitat de Cures Intensives, Hospital de Mataró, Barcelona, Spain.

<sup>5</sup>Centro de investigación biomédica en red de enfermedades respiratorias, Instituto de Salud Carlos III, Mataró, Barcelona, Spain.

<sup>6</sup>Unitat d'exploracions funcionals digestives, Hospital de Mataró, Barcelona, Spain.

Address correspondence to Mateu Serra-Prat, PhD, Research Unit, Consorci Sanitari del Maresme, Hospital de Mataró, Carretera de Cirera s/n, 08304, Mataró, Barcelona, Spain. Email: [mserra@c sdm.cat](mailto:mserra@c sdm.cat)

**Background.** To determine whether oropharyngeal dysphagia is a risk factor for readmission for pneumonia in elderly persons discharged from an acute geriatric unit.

**Methods.** Observational prospective cohort study with data collection based on clinical databases and electronic clinical notes. All elderly individuals discharged from an acute geriatric unit from June 2002 to December 2009 were recruited and followed until death or December 31, 2010. All individuals were initially classified according to the presence of oropharyngeal dysphagia assessed by bedside clinical examination. Main outcome measure was readmission for pneumonia. Clinical notes were reviewed by an expert clinician to verify diagnosis and classify pneumonia as aspiration or nonaspiration pneumonia.

**Results.** A total of 2,359 patients (61.9% women, mean age 84.9 y) were recruited and followed for a mean of 24 months. Dysphagia was diagnosed in 47.5% of cases. Overall, 7.9% of individuals were readmitted for pneumonia during follow-up, 24.2% of these had aspiration pneumonia. The incidence rate of hospital readmission for pneumonia was 3.67 readmissions per 100 person-years (95% CI 3.0–4.4) in individuals without dysphagia and 6.7 (5.5–7.8) in those with dysphagia, with an attributable risk of 3.02 readmissions per 100 person-years (1.66–4.38) and a rate ratio of 1.82 (1.41–2.36). Multivariate Cox regression showed an independent effect of oropharyngeal dysphagia, with a hazard ratio of 1.6 (1.15–2.2) for hospitalization for pneumonia, 4.48 (2.01–10.0) for aspiration pneumonia, and 1.44 (1.02–2.03) for nonaspiration pneumonia.

**Conclusion.** Oropharyngeal dysphagia is a very prevalent and relevant risk factor associated with hospital readmission for both aspiration and nonaspiration pneumonia in the very elderly persons.

**Key Words:** Deglutition disorders—Dysphagia—Elderly—Patient readmission—Pneumonia—Aspiration pneumonia.

Received April 3, 2013; Accepted May 14, 2013

Decision Editor: James Goodwin, PhD

PNEUMONIA is an important cause of morbidity and mortality in the elderly persons (1,2). Incidence increases with age (3) and people aged 75 and older have a sixfold higher risk of pneumonia than those aged 60 and younger (4). The increased incidence of pneumonia in elderly people has been linked to the higher prevalence of comorbidity and concomitant chronic disease in this population (5), and it also appears to be linked to aspiration pneumonia. In a study of 273,141 hospitalizations due to pneumonia, admission for aspiration pneumonia was found to increase with age, and the authors described a 93.5% increase between 1991 and 1998 (6). Admissions for other types of pneumonia, by contrast, decreased in the same period.

The prevalence of swallowing disorders also increases with age. Our group reported a 23% prevalence of oropharyngeal dysphagia in independently living individuals aged 70 or older (7). Higher rates have been reported in elderly people in long-term care facilities (50%) (8), stroke patients (30%) (9,10), and patients with neurodegenerative disorders (60%–80%) (11). Furthermore, a high prevalence of dysphagia has been reported in elderly patients hospitalized for pneumonia, ranging from 55% to 86% (12–14). This prevalence, however, is inconsistent with reports showing that aspiration pneumonia accounts for only 6%–10% of all cases of pneumonia requiring hospitalization (15,16). These conflicting data suggest that aspiration pneumonia is underdiagnosed or

that dysphagia may be associated with a large proportion of pneumonias not considered to be caused by aspiration. It is well established and accepted that oropharyngeal dysphagia is an independent risk factor for aspiration pneumonia in the elderly persons, especially in those in long-term care facilities (17–22). The role of dysphagia in nonaspiration pneumonia, however, is less clear. In this study, we investigated whether oropharyngeal dysphagia might be associated with an increased risk of hospital readmission for aspiration and nonaspiration pneumonia in elderly patients discharged from an acute geriatric unit.

## MATERIAL AND METHODS

We designed a prospective observational study of all patients aged 70 or older discharged from the acute geriatric unit at *Hospital de Mataró* in Barcelona, Spain between June 2002 and December 2009. All the patients were followed up until death or December 31, 2010. *Hospital de Mataró* is the only hospital in the area and provides for a catchment population of 250,000 inhabitants.

On the first day of admission, a complete geriatric assessment was performed with evaluation of (a) age, sex, and point of origin; (b) comorbid disease, Charlson comorbidity index, and presence of geriatric syndromes; (c) functional status 2 weeks before admission and on admission using the Barthel Index (BI); (d) cognitive status using the Short Portable Mental Status Questionnaire; and (e) nutritional status using the Mini-Nutritional Assessment administered by an experienced nutritionist. Reasons for admission and primary and secondary diagnoses according to the International Classification of Diseases, 9th Revision were also recorded. Functional status was reevaluated at discharge, as was dominant hand grip strength using a JAMAR hand dynamometer. An experienced nurse assessed oropharyngeal dysphagia within the first 2 days of admission or as soon as the patient was capable of collaborating. From June 2002 to December 2004, this assessment was made using a validated adaptation of the water swallow test (23), in which the patient is given 10, 20, and 30 mL of water. Coughing, wet-hoarse voice quality, or a decrease in oxygen saturation of greater than or equal to 3% measured using a pulse oximeter (Nellcor OxiMax, Philips Medical Systems, Eindhoven, Netherlands) were considered clinical signs of oropharyngeal dysphagia (23). From January 2005 to the end of the study, oropharyngeal dysphagia was assessed using the volume–viscosity swallow test (24). This test is designed to evaluate the safety and efficacy of swallow using boluses of increasing volumes (5, 10, and 20 mL) and different viscosities: liquid (20 mPa/s), nectar (270 mPa/s), and pudding (3900 mPa/s). Clinical signs of impaired swallow safety were cough, decreased oxygen saturation of greater than or equal to 3%, and changes in voice quality. Signs of impaired swallow efficacy were poor labial seal, multiple swallows per bolus, and oropharyngeal residue.

The primary outcome measure was readmission due to pneumonia. All hospital readmissions and their causes

among patients in the study cohort were registered until December 31, 2010. The information was obtained from the national hospital discharge database, which is integrated with the hospital's information system and includes International Classification of Diseases, 9th Revision codes for primary and secondary diagnoses. Hospital admission for pneumonia or bronchoaspiration was initially evaluated using the following International Classification of Diseases, 9th Revision diagnostic codes: 481, 482.1, 482.2, 482.39, 482.41, 482.82, 482.84, 482.89, 485, 486, and 507.0. To confirm the diagnoses, an experienced physician reviewed the clinical records, radiographs, and additional tests of all patients readmitted with the aforementioned codes. Pneumonia was considered according to compatible clinical criteria and a new infiltrate on the chest radiograph (25). Aspiration pneumonia was defined as a pneumonic episode involving loss of consciousness or a witnessed aspiration and radiographic evidence of an infiltrate in the posterior segments of the upper lobe or the apical or basal segments of the lower lobes (12,17). All pneumonia episodes that did not fulfill the criteria established for aspiration pneumonia were considered nonaspiration pneumonia. Bronchoaspiration was defined as an episode involving loss of consciousness or a witnessed aspiration with no radiographic evidence of pneumonia and at least one of the following respiratory symptoms: cough with or without sputum production, fever/hypothermia, and crackles on lung auscultation. To identify patients who died during follow-up and determine their date of death, we checked the hospital's records to identify use of hospital services after December 31, 2010 and death during any hospitalization; consulted the list of obituaries issued by the funeral homes in the area every 3 months; and telephoned the patients or their next of kin 1 year after discharge from the acute geriatric unit. Survival status for all patients for whom information was missing despite these strategies was determined by telephone contact with the patients or their next of kin. The study protocol was approved by the institutional ethical committee.

## STATISTICAL ANALYSIS

We estimated the risk of readmission using incidence density (ID, number of readmissions/100 person-years) and the corresponding 95% confidence interval (95% CI). We calculated the attributable risk ( $ID_{exp} - ID_{nonexp}$ ) and the etiologic fraction ( $[ID_{exp} - ID_{nonexp}] \cdot 100 / ID_{exp}$ ) as a measure of the impact of oropharyngeal dysphagia on the risk of readmission, and the rate ratio ( $ID_{exp} / ID_{nonexp}$ ) as a measure of its effect along with its 95% CI. Stratified analysis was used to assess effect modification by age ( $\leq 85$  vs  $> 85$  y), malnutrition (Mini-Nutritional Assessment  $\leq 17$  vs  $> 17$ ), and chronic pneumopathy (yes or no). Four multivariate Cox regression models were used to adjust for the effect of dysphagia on the risk of readmission due to pneumonia (general, aspiration, or nonaspiration) or bronchoaspiration. These models

included all variables statistically associated with both dysphagia and readmission in the bivariate/crude analysis. Finally, Kaplan–Meier survival curves were used to determine the rate of survival free of readmission due to pneumonia or bronchoaspiration; these curves were then compared between patients with and without dysphagia using the log rank test. Statistical significance was set at  $p < .05$  for all tests. Statistical analysis was performed with the statistical package SPSS 15.0.

## RESULTS

Of the patients discharged from the acute geriatric unit, 2,359 met the inclusion criteria. The mean age of the cohort

at the time of inclusion was 84.9 ( $SD$  6.2) years, and 61.9% were women. The prevalence of oropharyngeal dysphagia was 47.5%. Table 1 shows the main characteristics of the study population according to the presence or absence of this disorder. Notably, those with dysphagia were older, lived more often in a nursing home, had worse functional status, had a weaker hand grip, and had a higher prevalence of geriatric syndromes. They also had more comorbid conditions; took more sedatives, neuroleptics, and antidepressants; and had worse nutritional status. In total, 10.1% of the cohort was admitted with a primary diagnosis of pneumonia, which was coded as aspiration pneumonia in 17.1% of cases. All of the patients with aspiration pneumonia, 94.3% of those with bronchoaspiration, 48.7%

Table 1. Baseline Characteristics of Patients Discharged From an Acute Geriatric Unit, According to Oropharyngeal Dysphagia Status

Characteristic	With Dysphagia ( $n = 1121$ )	Without Dysphagia ( $n = 1238$ )	$p$ Value
Mean ( $SD$ ), age (y)	85.7 (6.3)	84.0 (6.1)	<.001
Female sex	62.9	61.1	.362
Point of origin			
Home	41.6	58.4	<.001
Nursing home	65.4	34.6	
Other	52.9	47.1	
Mean ( $SD$ ) BI score 2 weeks preadmission	52.9 (33.2)	77.5 (23.5)	<.001
Mean ( $SD$ ) BI score on admission	29.4 (27.4)	54.8 (27.0)	<.001
Mean ( $SD$ ) BI score on discharge	38.4 (30.7)	67.6 (25.8)	<.001
Urinary incontinence	60.9	39.1	<.001
Fecal incontinence	73.9	26.1	<.001
Pressure ulcers	11.4	3.3	<.001
Immobility	71.6	28.4	<.001
Previous falls	53.7	46.3	.001
Delirium	59.4	40.6	<.001
Depressive syndrome	47.8	52.2	.845
Chronic pneumopathy	47.0	53.0	.732
Cardiac heart failure	47.5	52.5	.978
Ischemic heart disease	39.5	60.5	<.001
Diabetes mellitus	47.5	52.5	.964
Chronic liver disease	38.2	61.8	.054
Cancer	42.4	57.6	.079
Dementia	73.8	26.2	<.001
Cerebrovascular disease	62.9	37.1	<.001
Chronic renal dis (creatinine >1.5 mg/dL)	53.6	46.4	<.001
Mean ( $SD$ ) Charlson Comorbidity Index	2.4 (1.6)	1.9 (1.6)	<.001
Mean ( $SD$ ) no. of drugs	7.1 (3.7)	7.1 (3.8)	.707
Benzodiazepines	51.6	48.4	.003
Antipsychotic drugs	69.5	30.5	<.001
Antidepressants drugs	54.5	45.5	<.001
Mean ( $SD$ ) BMI	25.5 (5.3)	27.0 (5.1)	<.001
MNA ( $n = 1887$ )			
Malnutrition (<17)	41.4	18.1	<.001
Risk of malnutrition (17–23.5)	51.4	58.8	
Well nourished (>24)	7.2	23.0	
Hand grip (kg)			
Men	13.7 (9.0)	19.6 (8.5)	<.001
Women	7.2 (6.3)	9.8 (5.4)	<.001
Albumin (mg/dL)	32.6 (4.9)	34.9 (4.7)	<.001
Creatinine ( $\mu$ mol/L)	1.3 (1.0)	1.2 (0.8)	.555
Lymphocytes ( $\mu$ L)	1660 (4541)	1489 (1472)	.060
Cholesterol (mg/dL)	153.1 (39)	157.0 (40.1)	.011

Notes: BI = Barthel Index; BMI = body mass index; MNA = Mini Nutritional Assessment. Values are percentage of patients unless otherwise specified.

of those with nonaspiration pneumonia, and 44.3% of those hospitalized for other reasons had oropharyngeal dysphagia.

The mean follow-up time was 24.6 months (24.2). During this period, there were 4,423 readmissions for any cause and 232 readmissions for pneumonia (5.2% of all readmissions); 56 (24.1%) of these last readmissions were due to aspiration pneumonia. Overall, 186 patients (7.9% of the sample) were readmitted due to pneumonia; 45 (24.2%) of these patients had aspiration pneumonia. There were 123 readmissions for bronchoaspiration in 101 patients. Of the 186 patients readmitted with pneumonia, 52.7% had oropharyngeal dysphagia. The proportions by subgroup were 47.3% for nonaspiration pneumonia, 75.6% for aspiration pneumonia, and 72.3% for bronchoaspiration. **Table 2** shows the incidence rate of readmission according to the presence or absence of oropharyngeal dysphagia, as well as attributable risks and rate ratios (with their 95% CI) of dysphagia for readmission. Oropharyngeal dysphagia had a significant effect on the risk of readmission due to pneumonia, nonaspiration pneumonia, aspiration pneumonia, and bronchoaspiration. Stratified analysis showed that age, nutritional status, and chronic pneumopathy did not modify the effect of dysphagia on the risk of readmission due to pneumonia, nonaspiration pneumonia, or aspiration pneumonia.

In the multivariate Cox analysis, oropharyngeal dysphagia was found to be an independent predictor of readmission due to pneumonia, nonaspiration pneumonia, aspiration pneumonia, and bronchoaspiration (**Table 3**). **Figure 1** shows the curves for survival free of readmission for pneumonia, nonaspiration pneumonia, aspiration pneumonia, and bronchoaspiration, according to the presence or absence of oropharyngeal dysphagia. This analysis also showed that dysphagia had a significant effect on readmission due to pneumonia, aspiration pneumonia, and bronchoaspiration, but it did not reach the statistical significance

in the case of nonaspiration pneumonia ( $p = .073$ ). **Figure 2** shows the overall adjusted survival of patients with and without dysphagia with significant differences between them ( $p < .001$ ).

## DISCUSSION

This prospective observational study shows a high prevalence (47%) of oropharyngeal dysphagia in elderly patients hospitalized in an acute geriatric unit. It also proves dysphagia to be an independent risk factor for readmission due to pneumonia. The effect was particularly evident for aspiration pneumonia but was also observed for nonaspiration pneumonia. We also noted that one in four elderly patients readmitted with pneumonia had aspiration pneumonia, which is higher than generally reported (15). Our results suggest that swallowing disorders play an important role in the pathogenesis of pneumonia in the very old or frail elderly persons. Moreover, in elderly participants with dysphagia, nearly 5% of all hospital readmissions, 27% of hospital readmissions for nonaspiration pneumonia, and 80% of hospital readmissions for aspiration pneumonia were attributable to dysphagia, indicating the relevance of this clinical condition in terms of health resource consumption.

The high prevalence of oropharyngeal dysphagia in our cohort is consistent with those previously reported in various populations (7,9,26,27). Using the definition of aspiration pneumonia as pneumonia occurring in patients with dysphagia and/or a swallowing disorder, the Japanese Study Group on Aspiration Pulmonary Disease reported that admissions due to aspiration pneumonia as a proportion of all admissions due to pneumonia increase progressively with age, with rates ranging from 0% in those aged 50 or younger to as high as 90% in those aged 90 or older (13). This observation indirectly supports an association between dysphagia and increasing age. In this study, by defining

Table 2. Measures of Effect and Impact Based on Incidence Rates of Hospital Readmission, According to Oropharyngeal Dysphagia Status

	Incidence Rate: Readmissions/ 100 Person-years (95% CI)	Attributable Risk: Readmissions/ 100 Person-years (95% CI)	Etiologic Fraction (%)	Incidence Rate Ratio (95% CI)
All readmissions				
No dysphagia	90.7 (87.3–94.2)	4.75 (–0.87–10.36)	4.97	1.05 (0.99–1.12)
Dysphagia	95.5 (91.1–99.9)			
Readmissions for pneumonia				
No dysphagia	3.7 (3.0–4.4)	3.02 (1.66–4.38)	45.21	1.82 (1.41–2.36)
Dysphagia	6.7 (5.5–7.8)			
Readmissions for nonaspiration pneumonia				
No dysphagia	3.2 (2.6–3.9)	1.19 (0.03–2.34)	27.04	1.37 (1.02–1.84)
Dysphagia	4.4 (3.5–5.3)			
Readmissions for aspiration pneumonia				
No dysphagia	0.45 (0.21–0.69)	1.83 (1.11–2.56)	80.26%	5.07 (2.73–9.43)
Dysphagia	2.3 (1.6–3.0)			
Readmissions for bronchoaspiration				
No dysphagia	1.1 (0.7–1.5)	3.72 (2.66–4.78)	77.02	4.36 (2.91–6.52)
Dysphagia	4.8 (3.8–5.8)			

Table 3. Multivariate Cox Analysis: Variables Associated With Readmissions for Pneumonia, Nonaspiration Pneumonia, Aspiration Pneumonia, and Bronchoaspiration and Associated With Death in 2359 Elderly Patients

	Hazard Ratio	95% CI	<i>p</i> Value
Model 1: Readmissions for pneumonia			
Dysphagia	1.60	1.15–2.20	.005
Barthel index ≤40	1.07	0.67–1.71	.778
Dementia	0.82	0.51–1.33	.432
Chronic pneumopathy	2.33	1.70–3.20	<.001
MNA <17 (malnourished)	1.73	1.20–2.54	.004
Age >85 y	1.24	0.90–1.70	.186
Cerebrovascular disorders	1.36	0.94–1.70	.105
Antipsychotics	0.77	0.42–1.43	.410
Model 2: Readmissions for nonaspiration pneumonia			
Dysphagia	1.44	1.02–2.03	.037
Barthel index ≤40	1.13	0.69–1.85	.626
Dementia	0.73	0.44–1.25	.260
Chronic pneumopathy	2.32	1.66–3.23	<.001
MNA <17 (malnourished)	2.01	1.20–3.06	.001
Age >85 y	1.19	0.85–1.65	.307
Antipsychotics	0.65	0.31–1.34	.247
Model 3: Readmissions for aspiration pneumonia			
Dysphagia	4.48	2.01–10.0	<.001
Barthel index ≤40	1.68	0.78–3.62	.181
Age >85 y	2.85	1.44–5.64	.003
Model 4: Readmissions for bronchoaspiration			
Dysphagia	3.02	1.73–5.27	<.001
Barthel index ≤40	2.45	1.37–4.40	.003
Dementia	1.20	0.68–2.12	.519
Chronic pneumopathy	2.16	1.33–3.51	.002
MNA <17 (malnourished)	1.55	0.90–2.70	.122
Age >85 y	0.88	0.54–1.44	.619
Antidepressives	1.97	1.20–3.24	.008
Model 5: Mortality			
Dysphagia	1.82	1.62–2.04	<.001
Age >85 y	1.58	1.42–1.76	<.001
Barthel index ≤40	1.40	1.23–1.61	<.001
Dementia	1.25	1.10–1.43	.001
Chronic pneumopathy	1.19	1.06–1.33	.003
Stroke	1.08	0.95–1.23	.213

Note: MNA = Mini-Nutritional Assessment.

aspiration pneumonia according to loss of consciousness, a witnessed aspiration, and radiographic criteria rather than simply the presence of dysphagia, we were able to investigate the association between aspiration pneumonia and dysphagia and the role of the latter in the pathogenesis of pneumonia.

There is evidence that oropharyngeal dysphagia has an effect on the risk of pneumonia, with several studies showing swallowing disorders to be a risk factor for aspiration pneumonia (23) in elderly people in long-term care facilities (14,18,28,29). The Centers for Disease Control and Prevention have acknowledged oropharyngeal dysphagia as a risk factor for pneumonia in geriatric nursing homes and health facilities (30). Similarly, swallowing disorders have been identified as a risk factor for aspiration pneumonia in patients with certain diseases such as stroke (9) and dementia (31). Although the association between dysphagia and

aspiration pneumonia appears to be well established and accepted, this is not the case with nonaspiration pneumonia. To the best of our knowledge, very few original studies have analyzed swallowing disorders as a risk factor for pneumonia (32,33). One of these, a case-control study, reported a higher prevalence of aspiration in hospitalized patients aged 65 or older with community-acquired pneumonia compared with controls (32), with an independent effect after adjustment with an odds ratio of 2.2. The authors, however, did not distinguish between aspiration and nonaspiration pneumonia, and the presence of dysphagia was determined from medical records, with a lack of clear, explicit criteria or specific tests. In another study with a similar design and population, dysphagia was also found to be an independent risk factor (odds ratio = 3.8) for community-acquired pneumonia (33). The authors of that study also did not make a distinction between aspiration and nonaspiration

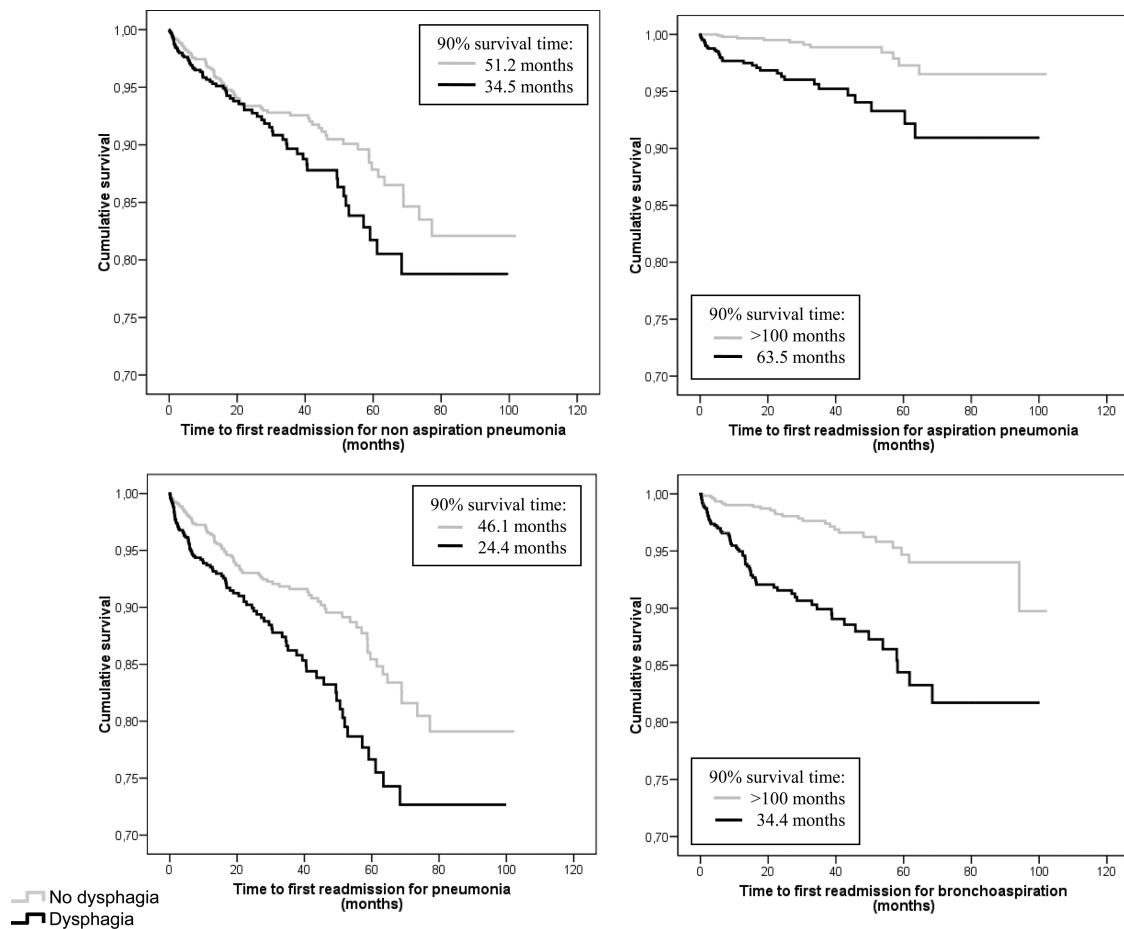


Figure 1. Curves for survival free of readmission due to nonaspiration pneumonia, aspiration pneumonia, pneumonia in general, and bronchoaspiration according to oropharyngeal status. Log rank test  $p = .073$  for nonaspiration pneumonia and  $p < .001$  for aspiration pneumonia, pneumonia in general, and bronchoaspiration.

pneumonia, but they did conclude that the effect observed was consistent with the rising incidence of aspiration pneumonia observed in the elderly persons in recent decades (6). We are unaware of any prospective studies other than ours that have evaluated dysphagia as a risk factor for aspiration pneumonia and pneumonia in general. The results of the three analytical approaches in our study (estimation of rate ratios and their 95% CI, multivariate Cox regression, and survival analysis) coincide in showing a significant effect of dysphagia on the risk of readmission for pneumonia. The increase in pneumonia with age (1,4) has been attributed to the parallel increase in comorbid diagnoses (5). Although many comorbid conditions, such as stroke or neurodegenerative disorders, may be related to swallowing disorders, our results indicate that oropharyngeal dysphagia itself is an independent risk factor for pneumonia in very old or frail elderly patients. All these evidences strongly suggest that dysphagia play a major role in the pathogenesis of pneumonia in the elderly persons and that, independently of the definition of aspiration pneumonia, dysphagia-related pneumonia may play a role in the increasing incidence of pneumonia with age (6,13). In our cohort, approximately

a quarter of all patients with pneumonia were considered to have an aspiration pneumonia, whereas more than half of this patients with pneumonia had dysphagia. These data indicate that half of the pneumonic episodes in elderly patients with dysphagia are not considered aspiration pneumonia according to the “traditional” definition established in our study.

Previous studies have shown oropharyngeal dysphagia to be closely associated with frailty, poor functional status, and the presence of geriatric syndromes (34,35). We have now shown that it is also associated with shorter survival. Approximately 5% of the patients discharged from the acute geriatric unit at our hospital had a hospital readmission attributable to dysphagia within 12 months. An increased risk of readmission in elderly patients with dysphagia has been previously reported (36), suggesting that oropharyngeal dysphagia is an indicator of frailty and poor health outcomes. Considering the high prevalence of dysphagia in frail elderly populations and in elderly patients with pneumonia, it would be of great interest to screen for dysphagia in these populations. Effective treatments exist for swallowing disorders (37,38), and timely diagnosis

## Survival Functions

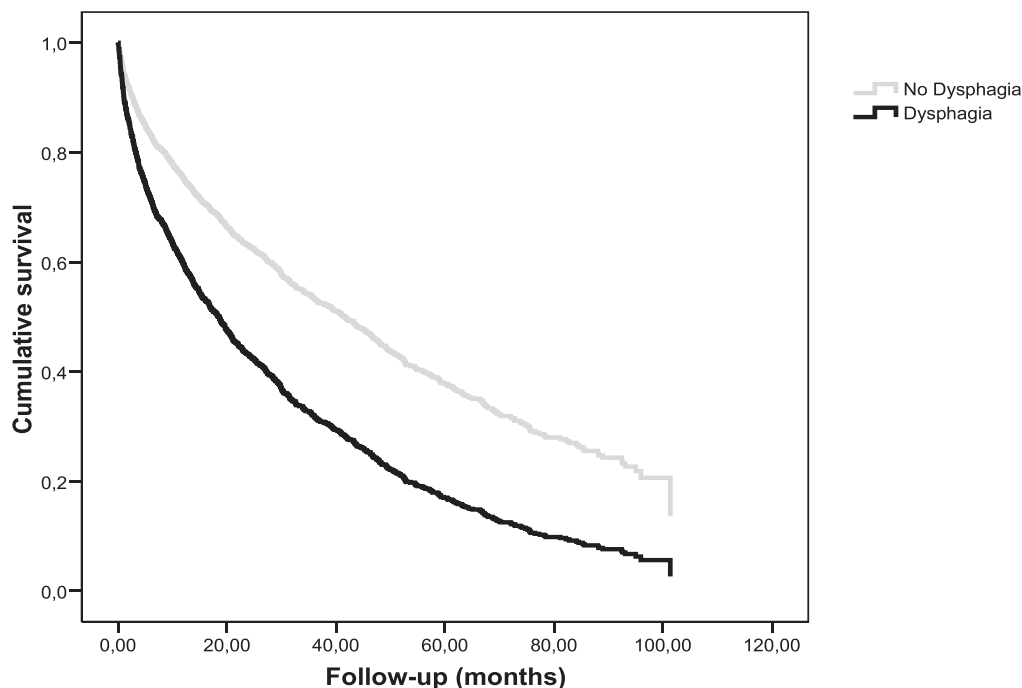


Figure 2. Cumulative survival by dysphagia (adjusted for age, functionality, and comorbidities). Survival curves are adjusted for age, Barthel score, dementia, stroke, and chronic pneumopathy.

would contribute to reducing the frequency and impact of aspiration and consequently the risk of pneumonia and hospitalization.

One of the limitations of this study is that our results cannot be extrapolated to the general elderly population as we studied very old patients hospitalized in an acute geriatric unit. Furthermore, the clinical diagnosis of aspiration pneumonia can be both difficult and uncertain, particularly in elderly patients (6,39). This fact is probably related to the lack of a standardized working definition of this form of pneumonia. However, in this study, we used explicit criteria for the diagnosis of aspiration pneumonia (12,17). It should also be noted that the use of an administrative database to identify readmissions due to pneumonia may have resulted in codification errors. Although an experienced physician reviewed the clinical notes of all patients admitted with the International Classification of Diseases, 9th Revision diagnostic codes listed in the Methods section, the cases of patients without these codes (potential false negatives) were not reviewed. Nevertheless, considering the wide range of codes used and the experience and expertise of the coders, we believe that the risk of misclassification was very low and would have had only a minimum influence on the results presented. Finally, the use of two methods to assess dysphagia could be considered as a limitation. Although the volume–viscosity swallow test showed better diagnostic accuracy than the water swallow test, both are validated and accepted screening tests. A possible misclassification in

the diagnosis of dysphagia could have diluted the observed effect (acting against our hypothesis) but does not introduce any bias. We believe that the use of two methods to assess dysphagia has minimum (if any) influence on the observed results.

In conclusion, very elderly patients hospitalized in an acute geriatric unit have approximately an 80% increased risk of being readmitted for pneumonia, a 40% increased risk of being readmitted for nonaspiration pneumonia and a 400% increased risk of being readmitted for aspiration pneumonia or bronchoaspiration when they have oropharyngeal dysphagia. This swallowing disorder thus appears to play an important role in the pathogenesis of both aspiration and nonaspiration pneumonia and should be systematically evaluated in all elderly patients with pneumonia.

## ACKNOWLEDGMENTS

The authors would like to thank Ms. R. Monteis and V. Arreola for their help in assessing oropharyngeal dysphagia, Dr. MD. Soler for providing technical assistance, and Ms. A. Murray for translating the original manuscript into English.

## REFERENCES

1. Almirall J, Bolibar I, Vidal J, et al. Epidemiology of community-acquired pneumonia in adults: a population-based study. *Eur Respir J*. 2000;15:757–763.
2. Vila-Corcoles A, Ochoa-Gondar O, Rodriguez-Blanco T, Raga-Luria X, Gomez-Bertomeu F; EPIVAC Study Group. Epidemiology of community-acquired pneumonia in older adults: a population-based study. *Respir Med*. 2009;103:309–316.

3. Jokinen C, Heiskanen L, Juvonen H, et al. Incidence of community-acquired pneumonia in the population of four municipalities in eastern Finland. *Am J Epidemiol*. 1993;137:977–988.
4. Koivula I, Sten M, Mäkelä PH. Risk factors for pneumonia in the elderly. *Am J Med*. 1994;96:313–320.
5. Fry AM, Shay DK, Holman RC, Curns AT, Anderson LJ. Trends in hospitalizations for pneumonia among persons aged 65 years or older in the United States, 1988–2002. *JAMA*. 2005;294:2712–2719.
6. Baine WB, Yu W, Summe JP. Epidemiologic trends in the hospitalization of elderly Medicare patients for pneumonia, 1991–1998. *Am J Public Health*. 2001;91:1121–1123.
7. Serra-Prat M, Hinojosa G, López D, et al. Prevalence of oropharyngeal dysphagia and impaired safety and efficacy of swallow in independently living older persons. *J Am Geriatr Soc*. 2011;59:186–187.
8. Lin LC, Wu SC, Chen HS, Wang TG, Chen MY. Prevalence of impaired swallowing in institutionalized older people in taiwan. *J Am Geriatr Soc*. 2002;50:1118–1123.
9. Sellars C, Bowie L, Bagg J, et al. Risk factors for chest infection in acute stroke: a prospective cohort study. *Stroke*. 2007;38:2284–2291.
10. Gordon C, Hewer RL, Wade DT. Dysphagia in acute stroke. *Br Med J*. 1987;295:411–414.
11. Miller N, Allcock L, Hildreth AJ, Jones D, Noble E, Burn DJ. Swallowing problems in Parkinson disease: frequency and clinical correlates. *J Neurol Neurosurg Psychiatry*. 2009;80:1047–1049.
12. Cabre M, Serra-Prat M, Palomera E, Almirall J, Pallares R, Clavé P. Prevalence and prognostic implications of dysphagia in elderly patients with pneumonia. *Age Ageing*. 2010;39:39–45.
13. Teramoto S, Fukuchi Y, Sasaki H, Sato K, Sekizawa K, Matsuse T; Japanese Study Group on Aspiration Pulmonary Disease. High incidence of aspiration pneumonia in community- and hospital-acquired pneumonia in hospitalized patients: a multicenter, prospective study in Japan. *J Am Geriatr Soc*. 2008;56:577–579.
14. Almirall J, Rofes L, Serra-Prat M, et al. Oropharyngeal dysphagia is a risk factor for community-acquired pneumonia in the elderly. *Eur Respir J*. 2013;41:923–928.
15. Fernández-Sabé N, Carratalà J, Rosón B, et al. Community-acquired pneumonia in very elderly patients: causative organisms, clinical characteristics, and outcomes. *Medicine (Baltimore)*. 2003;82:159–169.
16. Reza Shariatzadeh M, Huang JQ, Marrie TJ. Differences in the features of aspiration pneumonia according to site of acquisition: community or continuing care facility. *J Am Geriatr Soc*. 2006;54:296–302.
17. Marik PE. Aspiration pneumonitis and aspiration pneumonia. *N Engl J Med*. 2001;344:665–671.
18. Vergis EN, Brennen C, Wagener M, Muder RR. Pneumonia in long-term care: a prospective case-control study of risk factors and impact on survival. *Arch Intern Med*. 2001;161:2378–2381.
19. Magaziner J, Tenney JH, DeForge B, Hebel JR, Muncie HL Jr, Warren JW. Prevalence and characteristics of nursing home-acquired infections in the aged. *J Am Geriatr Soc*. 1991;39:1071–1078.
20. Setia U, Serventi I, Lorenz P. Nosocomial infections among patients in a long-term care facility: spectrum, prevalence, and risk factors. *Am J Infect Control*. 1985;13:57–62.
21. Alvarez S, Shell CG, Woolley TW, Berk SL, Smith JK. Nosocomial infections in long-term facilities. *J Gerontol*. 1988;43:M9–17.
22. van der Maarel-Wierink CD, Vanobbergen JN, Bronkhorst EM, Schols JM, de Baat C. Risk factors for aspiration pneumonia in frail older people: a systematic literature review. *J Am Med Dir Assoc*. 2011;12:344–354.
23. DePippo KL, Holas MA, Reding MJ. The Burke dysphagia screening test: validation of its use in patients with stroke. *Arch Phys Med Rehabil*. 1994;75:1284–1286.
24. Clavé P, Arreola V, Romea M, Medina L, Palomera E, Serra-Prat M. Accuracy of the volume-viscosity swallow test for clinical screening of oropharyngeal dysphagia and aspiration. *Clin Nutr*. 2008;27:806–815.
25. Woodhead M, Blasi F, Ewig S, et al.; European Respiratory Society; European Society of Clinical Microbiology and Infectious Diseases. Guidelines for the management of adult lower respiratory tract infections. *Eur Respir J*. 2005;26:1138–1180.
26. Perez-Lloret S, Nègre-Pagès L, Ojero-Senard A, et al.; COPARK Study Group. Oro-buccal symptoms (dysphagia, dysarthria, and sialorrhoea) in patients with Parkinson's disease: preliminary analysis from the French COPARK cohort. *Eur J Neurol*. 2012;19:28–37.
27. Walker RW, Dunn JR, Gray WK. Self-reported dysphagia and its correlates within a prevalent population of people with Parkinson's disease. *Dysphagia*. 2011;26:92–96.
28. Langmore SE, Skarupski KA, Park PS, Fries BE. Predictors of aspiration pneumonia in nursing home residents. *Dysphagia*. 2002;17:298–307.
29. Quagliarello V, Ginter S, Han L, Van Ness P, Allore H, Tinetti M. Modifiable risk factors for nursing home-acquired pneumonia. *Clin Infect Dis*. 2005;40:1–6.
30. Tablan OC, Anderson LJ, Besser R, Bridges C, Hajjeh R; CDC; Healthcare Infection Control Practices Advisory Committee. Guidelines for preventing health-care-associated pneumonia, 2003: recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee. *MMWR*. 2004;53:1–36.
31. Chouinard J. Dysphagia in Alzheimer disease: a review. *J Nutr Health Aging*. 2000;4:214–217.
32. Skull SA, Andrews RM, Byrnes GB, et al. Hospitalized community-acquired pneumonia in the elderly: an Australian case-cohort study. *Epidemiol Infect*. 2009;137:194–202.
33. Loeb M, Neupane B, Walter SD, et al. Environmental risk factors for community-acquired pneumonia hospitalization in older adults. *J Am Geriatr Soc*. 2009;57:1036–1040.
34. Cabré M, Serra-Prat M, Force L, Palomera E, Pallarés R. Functional status as a risk factor for mortality in very elderly patients with pneumonia. *Med Clin (Barc)*. 2008;131:167–170.
35. Serra-Prat M, Palomera M, Gomez C, et al. Oropharyngeal dysphagia as a risk factor for malnutrition and lower respiratory tract infection in independently living older persons: a population-based prospective study. *Age Ageing*. 2012;41:376–381.
36. Chu LW, Pei CK. Risk factors for early emergency hospital readmission in elderly medical patients. *Gerontology*. 1999;45:220–226.
37. Rofes L, Arreola V, Almirall J, et al. Diagnosis and management of oropharyngeal Dysphagia and its nutritional and respiratory complications in the elderly. *Gastroenterol Res Pract*. 2011;2011:818–979.
38. Rofes L, Arreola V, Clavé P. The volume-viscosity swallow test for clinical screening of dysphagia and aspiration. *Nestle Nutr Inst Workshop Ser*. 2012;72:33–42.
39. Marik PE, Kaplan D. Aspiration pneumonia and dysphagia in the elderly. *Chest*. 2003;124:328–336.