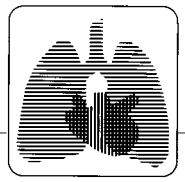

reviews

Aspiration Pneumonia and Dysphagia in the Elderly*

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Community-acquired pneumonia (CAP) is a major cause of morbidity and mortality in the elderly, and the leading cause of death among residents of nursing homes. Oropharyngeal aspiration is an important etiologic factor leading to pneumonia in the elderly. The incidence of cerebrovascular and degenerative neurologic diseases increase with aging, and these disorders are associated with dysphagia and an impaired cough reflex with the increased likelihood of oropharyngeal aspiration. Elderly patients with clinical signs suggestive of dysphagia and/or who have CAP should be referred for a swallow evaluation. Patients with dysphagia require a multidisciplinary approach to swallowing management. This may include swallow therapy, dietary modification, aggressive oral care, and consideration for treatment with an angiotensin-converting enzyme inhibitor. ***(CHEST 2003; 124:328–336)***

Key words: aspiration; community-acquired pneumonia; cough; dysphagia; elderly

Abbreviations: ACE = angiotensin-converting enzyme; CAP = community-acquired pneumonia; CI = confidence interval; VFSS = videofluoroscopic swallow assessment

Pneumonia - "Captain of the Men of Death"

William Osler[1]

Community-acquired pneumonia (CAP) is a major cause of morbidity and mortality in the elderly, with an estimated annual health-care cost in the United States of $4.4 billion.[2,3] Epidemiologic studies have demonstrated that the incidence of pneumonia increases with aging, with the risk being almost six times higher in those ≥ 75 years old, compared to those < 60 years of age.[3–6] Furthermore, the mortality from pneumonia increases strikingly with aging.[2–9] The attack rate for pneumonia is highest among those in nursing homes.[6] Marrie[10] found that 33 of 1,000 nursing home residents per year required hospitalization for treatment of pneumonia, compared with 1.14 of 1000 elderly adults living in the community. The "greying" of the population will have a major impact on the incidence, morbidity, mortality, and health-care costs associated with CAP.[11]

COPD, heart disease, malignancy, malnutrition, congestive heart failure, and diabetes mellitus have been implicated as risk factors leading to CAP in the elderly.[9,12–15] Dysphagia, with oropharyngeal aspiration, is usually not considered an etiologic factor in elderly patients who acquire CAP. In this article, we provide evidence to support the concept that oropharyngeal aspiration, due to abnormalities in swallowing and of the upper airway protective reflexes, is an important pathogenetic mechanism leading to CAP in the elderly. In addition, we review the diagnostic approach to dysphagia and the prevention of aspiration pneumonia in this population of patients.

Dysphagia and the Cough Reflex in Elderly Patients With Pneumonia

Aspiration is defined as the misdirection of oropharyngeal or gastric contents into the larynx and lower respiratory tract.[16] Aspiration pneumonia de-

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velops after the aspiration of colonized oropharyngeal contents.[16] Aspiration of pathogens from a previously colonized oropharynx is the primary pathway by which bacteria gain entrance to the lungs. Indeed, *Haemophilus influenzae* and *Streptococcus pneumoniae* first colonize the naso/oropharynx before being aspirated and causing CAP.[17] However, when the term *aspiration pneumonia* is used, it refers to the development of a pneumonia in the setting of patients with risk factors for increased oropharyngeal aspiration.[16]

Preserved swallow function and the cough reflex are important defenses against oropharyngeal aspiration, with abnormalities of both increasing the risk of aspiration pneumonia. Approximately half of all healthy adults aspirate small amounts of oropharyngeal secretions during sleep.[18,19] Presumably, the low virulent bacterial burden of normal pharyngeal secretions, together with forceful coughing, active ciliary transport, and normal humoral and cellular immune mechanisms result in clearance of the innoculum, without sequelae. However, if the mechanical, humoral, or cellular mechanism are impaired, or if the aspirated innoculum is large enough, pneumonia may follow. While the etiology of aspiration pneumonia is multifactorial, there is a strong association between dysphagia and the development of aspiration pneumonia.

Loeb and colleagues[6] investigated the risk factors for pneumonia in elderly residents of long-term care facilities. In this study, multivariate analysis revealed that difficulty swallowing food (odds ratio, 2.0; 95% confidence interval [CI], 1.2 to 3.3) and medication (odds ratio, 8.3; 95% CI, 1.4 to 50) were the most important risk factors leading to pneumonia. Similarly, Vergis and coworkers[20] identified witnessed aspiration and sedative medications (which impair the cough reflex and swallowing) as the most important risk factors for pneumonia in a long-term care facility. Kikuchi and colleagues[21] evaluated the occurrence of silent aspiration in otherwise "healthy elderly patients" with CAP and age-matched control subjects using ^{111}indium chloride scanning. Silent aspiration was demonstrated in 71% of patients with CAP compared to 10% in control subjects.

An intact cough reflex is an important respiratory defense mechanism. Sekizawa and coworkers[22] demonstrated a marked depression of the cough reflex in elderly patients with pneumonia. Nakajoh and colleagues[23] demonstrated that the greater the derangement of the cough reflex, the greater the risk of pneumonia. Nakazawa and colleagues[24] assessed the swallow and the cough reflex in elderly control subjects, patients with dementia but with no history of aspiration pneumonia, and elderly patients with aspiration pneumonia. The initiation of the swallow was determined by measuring the latency period following the injection of 1 mL of distilled water into the pharynx through a nasal catheter. The cough threshold was determined using various concentrations of inhaled citric acid. The latent (mean ± SD) time of swallowing was 1.2 ± 0.1 s in the control subjects, 5.2 ± 0.6 s in the patients with dementia, and 12.5 ± 3.0 s in the patients with aspiration pneumonia. The threshold concentration for citric acid was 2.6 ± 4.0 mg/mL in the control subjects, 37.1 ± 16.7 mg/mL in the patients with dementia, and > 360 mg/mL in the patients with aspiration pneumonia.

It has been suggested that the increased incidence of pneumonia with aging may be a consequence of impairment of swallowing and the cough reflex with senescence.[25] Investigators have studied the effects of aging on swallowing.[26–30] The major finding of these studies is that older people swallow more slowly. In older adults, the initiation of the laryngeal and pharyngeal events, including laryngeal vestibule closure, maximal hyolaryngeal excursion, and upper esophageal sphincter opening, has been found to be significantly delayed with longer oral bolus transport time. Although the elderly swallow more slowly than younger people, it appears as though the safety of oropharyngeal swallowing is not compromised. No significant increases have been observed in the frequency of aspiration in the radiographic studies that compare older to younger adults.[26–30] However, it is likely that the older person is rendered more susceptible to dysphagia and is more likely to aspirate with neurologic or upper aerodigestive tract diseases than younger patients. While aging effects swallowing, the cough reflex does not appear to be affected with age. Katsumata and co-workers[31] measured the cough threshold to citric acid in 110 healthy subjects 20 to 78 years in age. These authors demonstrated that the cough reflex did not decrease with advancing age. These studies suggest that aging *per se* does not increase the risk of aspiration; however, the incidence of cerebrovascular and degenerative neurologic disease increase with aging and these disorders are strongly associated with impaired swallow and cough reflex and the increased risk of aspiration (see below).

Risk Factor for Dysphagia in the Elderly

Dysphagia occurs commonly following a stroke. In patients with an acute stroke, the incidence of dysphagia ranges from 40 to 70%, with neurologic dysphagia developing in approximately 500,000 patients per year in the United States.[32–37] Aspiration occurs in approximately 40 to 50% of stroke patients

with dysphagia. Dysphagic patients who aspirate are at an increased risk of acquiring pneumonia.[37,38] Specifically, the development of pneumonia is seven times greater in stroke patients who aspirate, as compared to those who do not.[32,39] Although dysphagia improves in most patients following a stroke, in many the swallowing difficulties follow a fluctuating course, with 10 to 30% continuing to have dysphagia with aspiration.[34,35] Nakagawa and colleagues[41] evaluated the cough reflex and swallowing in 143 stroke patients whom they followed up for 1 year. Forty-three patients had a normal cough reflex and swallow; pneumonia developed in none of these patients. However, pneumonia developed in 24 of the 100 patients with abnormal cough reflex and swallow function. Elderly patients are at risk of silent cerebral infarction. Nakagawa et al[41] demonstrated that elderly patients with silent cerebral infarction have a fivefold higher risk of developing pneumonia than elderly patients with normal head CT scans.

Dysphagia develops in almost all patients with degenerative diseases of the CNS.[42–48] In patients with Alzheimer disease, amyotrophic lateral sclerosis, and Parkinson disease, dysphagia usually occurs early in the course of the disease, and the severity of dysphagia does not necessarily relate to the overall severity of the neurologic disease. Considering the high incidence of cerebrovascular and degenerative neurologic diseases in nursing home residents, it is not surprising that the reported incidence of dysphagia in this population is between 50 to 75% and explains the extremely high attack rate of pneumonia in these patients.[10,49–51]

Factors That Increase the Risk of Pneumonia in Patients Who Aspirate

While the presence of dysphagia and the volume of the aspirate are key factors that predispose elderly patients to aspiration pneumonia, a number of other factors play an important role.[52] Colonization of the oropharynx is an important step in the pathogenesis of aspiration pneumonia. The elderly have increased oropharyngeal colonization with pathogens such as *Staphylococcus aureus* and aerobic Gram-negative bacilli (*eg*, *Klebsiella pneumoniae* and *Escherichia coli*).[53–55] Although this increased colonization may be transient, lasting < 3 weeks, it underlies the increased risk in the elderly of pneumonia with these pathogens (see below). The defects in host defenses that predispose to enhanced colonization with these organisms are uncertain; however, dysphagia with a decrease in salivary clearance and poor oral hygiene may be major risk factors.[53] Terpenning and colleagues[56] demonstrated that edentulous patient had a lower risk of aspiration pneumonia than dentate patients.

Decreased immunity and changes in lung function may underlie the predisposition of the elderly to aspiration pneumonia. Reduction in mucociliary transport, reduced pulmonary elasticity, decreased respiratory muscle strength, and a reduction in functional residual capacity have been described with aging.[57] Furthermore, a progressive decline in the integrity of the immune system occurs with aging.[58–61] The age-related changes are most evident in the peripheral T-cell pool, which show signs of decreased activation to challenge with antigens.[60–62] Trebilcock and Ponnappan[63] have provided evidence of an age-associated decline in the induction of nuclear factor-κB in activated T cells, which could explain the decreased production of both interleukin-2 and its receptor with aging. Patients with dysphagia are likely to have poor nutritional status. Nutrition has a profound effect on the immune system. Riquelme and colleagues[64] demonstrated that oropharyngeal aspiration and a low serum albumin (as a marker of malnutrition) were independent risk factors for CAP in the elderly.

Bacteriology of CAP in the Elderly and Its Relationship to Dysphagia

Despite extensive investigations, the diagnosis of the bacterial cause of CAP is made in $\leq 50\%$ of patients overall; this is particularly so in the elderly, who may not be able to produce adequate sputum specimens for evaluation.[15,65] Ruiz and coworkers[66] reported that age > 60 years was not associated with any discernable difference in microbial causes of CAP; however, numerous other studies have reported a higher incidence of Gram-negative pathogens and *S aureus* in elderly patients with CAP.[9,12–14,67–73] While the prevalence of *H influenzae*, Gram-negative bacilli, and *S aureus* appears to be increased in elderly patients with CAP, *S pneumoniae* remains the single most common implicated pathogen.[9,12–14,67–73] Oropharyngeal colonization with Gram-negative pathogens and *S aureus* with subsequent aspiration presumably accounts for the greater prevalence of these pathogens in elderly patients with CAP. It is unclear, however, if patients with dysphagia are at risk of acquiring pneumococcal pneumonia, as no study to date has specifically reported the microbiology of CAP in patients with oropharyngeal dysphagia and aspiration. However, Kikuchi and colleagues[21] reported a high incidence of silent aspiration in otherwise healthy elderly ambulatory patients with no specific risk factors for Gram-negative or *S aureus* oropharyngeal colonization who acquired CAP. Unfortunately, in this study the microbial causes of CAP were

not reported. While elderly patients with pneumococcal pneumonia may be at a lower risk of having oropharyngeal dysphagia, based on the current available evidence, we suggest that all elderly patients with CAP be screened for dysphagia.

Assessment of Dysphagia

Swallowing is a complex and coordinated neuromuscular process, which consists of both volitional and involuntary activity. It is described as involving three anatomically and temporally distinct phases: the oral, the pharyngeal, and the esophageal.[74,75] Elderly patients with signs and symptoms of oropharyngeal swallowing difficulties (Table 1), particularly with a history of pneumonia, should be referred for a comprehensive swallow evaluation and for the development and implementation of a management program.[37,76] A screening may be performed to identify a swallowing disorder. Historically, the gag reflex has been used by many physicians as an indicator of swallowing function; however, some patients with an absent gag reflex have normal swallowing, and many patients with dysphagia have a normal gag reflex.[77,78] The gag reflex is therefore a poor indicator of swallow function and should not be used as a screening tool for dysphagia.

Clinical Assessment

A clinical assessment evaluates the structure and function of the swallow impairment of the oral stage. It enables the prediction of the impairment of the pharyngeal, laryngeal, and esophageal swallow physiology. The findings from the clinical evaluation will determine appropriate management, specific treatment strategies, and the need for appropriate instrumental testing.

The clinical assessment includes a comprehensive medical and swallowing history, an oral motor and sensory evaluation, and the patient swallowing food and liquid of varying consistencies and at various calibrated volumes. Oral control, lingual activity, oral residue, initiation of laryngeal elevation, laryngeal excursion, voice quality, and cough after swallow are some of the key clinical parameters observed during the clinical assessment. The swallow assessment may be performed with or without the use of cervical auscultation, pulse oximetry, or use of food coloring with tracheostomized patients. Therapeutic strategies such as altering food textures, head postures, and specific maneuvers may be also be tested. Education and recommendations regarding management is provided, and the need for further testing is determined.[37,76,79–82]

Available evidence, although limited, suggests that a full clinical assessment may have approximately 80% sensitivity and 70% specificity for detecting aspiration in elderly adults. It has been predicted that clinical testing will reduce the number of elderly patients inappropriately referred for instrumental testing, which would then reduce unnecessary assessments costs.[37,82,83]

Table 1—*Clinical Signs Suggesting the Presence of Dysphagia*

Difficulty managing secretions
Drooling of secretions or food from the mouth
Delay in triggering the swallow
Coughing or choking before, during, or after the swallow
Wet, gurgly voice quality after the swallow
Reduced or absent thyroid/laryngeal elevation during swallow attempts
Multiple swallows per mouthful
Food or liquid leaking from the nose
Pocketing of food in the oral cavity
Slow rate or very rapid rate of oral intake
Prolonged oral preparation with food
Significantly increased time to complete a meal
Unusual head or neck posturing while swallowing
Pain with swallowing
Decreased oral/pharyngeal sensation

Instrumental Assessment

The instrumental evaluation supplements the clinical assessment.[37,76,82–84] It enables the clinician to further evaluate the structure and function of the oral, pharyngeal, laryngeal, and upper esophageal swallow physiology, as well as assess the benefit of compensatory and treatment strategies. The videofluoroscopic swallow assessment (VFSS) is the most commonly utilized instrumental assessment tool in the clinical setting to determine the nature and extent of the swallow disorder.[82,85] Fiberoptic endoscopy is increasingly being used to assess swallow physiology and the risk of aspiration. Other less common instrumentation techniques include scintigraphy, ultrasonography, electromyography, and manometry.[82,86]

The VFSS is a videotaped or digitized fluoroscopic image, focusing on the oral, pharyngeal, laryngeal, and upper esophageal anatomy and swallow physiology.[76,81–83] The patient is seated as upright as possible and should be viewed in the lateral and anteroposterior plane during the study. Radiopaque material, usually barium, is administered to the patient, with incremental increases in bolus volume as tolerated. The barium is usually mixed with liquid

and food of varying consistencies in the process of a single study. Radiographic images are observed on a monitor during the procedure, and should be simultaneously videorecorded or digitally recorded for further analysis. The VFSS should be jointly carried out by a radiologist and speech and language pathologist or other trained health-care professional.

The VFSS demonstrates anatomic structures and swallow physiology of the oral cavity, pharynx, larynx, and upper esophagus during deglutition. It identifies the disorders in movement patterns of the oropharyngeal, laryngeal, and esophageal structures, which may result in aspiration or inefficient swallowing. Compensatory and treatment strategies including head positioning and swallow maneuvers are tested during the VFSS to determine whether swallow efficiency is increased and/or if aspiration is reduced or eliminated.[82,87]

Fiberoptic endoscopic evaluation of swallowing is an adjunct to clinical assessment and provides detailed information about the anatomy and physiology of the pharynx and larynx, with the assessment of the pharyngeal phase of swallowing. It requires the transnasal passage of a flexible laryngoscope into the hypopharynx. Food and liquid are presented in the same manner as during the clinical examination. Fiberoptic endoscopic evaluation of swallowing is an assessment tool that can be administered at the bedside and is suitable for serial testing.[76,82,84,88]

Management of Dysphagia in the Elderly and the Prevention of Pneumonia

The management of elderly patients with dysphagia requires the coordinated expertise of a number of health-care professionals, including the patients' primary care physician, pulmonologist, speech and language pathologist, clinical dietician, occupational therapist, physiotherapist, nurse, oral hygienist, dentist, as well as the primary caregivers. The goal is to optimize the safety, efficiency, and effectiveness of the oropharyngeal swallow, to maintain adequate nutrition and hydration, and to improve oral hygiene. Enhanced quality of life, wherever possible, should direct management. This would be to maximize oral vs nonoral nutritional intake and hydration.

The management plan is developed according to the clinical and instrumental assessment results. Compensatory strategies for increasing eating and swallowing efficiency, and for reducing the risk of aspiration, may involve modifying food and liquid consistencies and volumes, as well as altering the bolus presentation. Dietary modification is a common management approach. Patients vary in their ability to swallow thin and thick liquids, semi-solids, and solids. The consistency of the patients food should be individualized according to the findings from clinical testing. Dehydration in the elderly is one of the leading problems in nursing homes and long-term care facilities.[89] Caution should therefore be taken with regard to the modification of fluids, as compliance with thickened liquids is often reduced. Small sips of cold water in patients with good oral hygiene may bring relief to thirsty patients and may reduce the resultant dehydration.[76]

Treatment techniques include compensatory strategies (postural maneuvers) and indirect therapy (exercises to strengthen swallowing musculature). These techniques alter the physiology of the swallow to achieve improved efficiency or a safer swallow. There are specific strategies for improving airway protection, pharyngeal, and laryngeal and upper esophageal sphincter function. Swallow maneuvers place aspects of the pharyngeal swallow under voluntary control. For example, the Mendlesohn maneuver is designed to increase the extent and duration of laryngeal elevation in patients with reduced laryngeal movement. This in turn increases the duration and width of cricopharyngeal opening.[90] Another maneuver is the "super-supraglottic swallow," which is designed to close the airway entrance before and during swallowing.[91] It is used with patients who have reduced airway entrance closure, and are able to follow instructions. The findings from the clinical and instrumental examination will direct which strategies and exercises are most beneficial for a specific patient. Environmental strategies are often key in managing the dysphagia of the elderly. These changes, which may include modifying the feeding environment or altering the feeding schedule, frequently improve nutritional intake. Education, training, and counseling of the patient and/or their caregiver is essential.[82]

Tube Feeding

Nutritional supplementation, as determined by the clinical dietitian, may be required. Tube feeding is not essential in all patients who aspirate. As clinicians treating patients with dysphagia, we make every attempt to encourage oral intake, considering the safety as well as the efficiency to sustain our patients. The practice of tube feeding in the end stages of degenerative illnesses in the elderly should be carefully reconsidered. Finucane et al[92] found no data to suggest that tube feeding of patients with advanced dementia prevented aspiration pneumonia, prolonged survival, reduced the risk of pressure sores or infections, improved function, or provided palliation.

Short-term tube feeding, however, may be indicated in elderly patients with severe dysphagia and aspiration in whom improvement of swallowing is likely to occur. Nakajoh and colleagues[23] demonstrated that the incidence of pneumonia was significantly higher in stroke patients with dysphagia who were fed orally compared to those who received tube feeding (54.3% vs 13.2%, $p < 0.001$), despite the fact that the orally fed patients had a higher functional status (higher Barthel index).

Colonized oral secretions are a serious threat to dysphagic patients, and feeding tubes offer no clear protection. There are no data to suggest that patients fed with gastrostomy tubes have a lower incidence of pneumonia than patients fed with nasogastric tubes.[93,94] Similarly, the incidence of aspiration pneumonia has been shown to be similar in stroke patients with postpyloric as compared to intragastric feeding tubes.[95–97] Over the long term, aspiration pneumonia is the most common cause of death in gastrostomy tube-fed patients.[98,99] Patients who are likely to recover their ability to swallow within a few weeks are not candidates for gastrostomy tubes.

Oral Hygiene

Occupants of residential homes have been shown to have poor oral hygiene and rarely receive treatment from dentists and oral hygienists.[100,101] An aggressive protocol of oral care will reduce colonization with potentially pathogenic organisms and decrease the bacterial load, measures likely to reduce the risk of pneumonia. Yoneyama and colleagues[102] demonstrated that aggressive oral care lowered the risk of pneumonia in institutionalized elderly patients. Yoshino and coworkers[103] demonstrated that a protocol of aggressive daily oral care among elderly nursing home patients resulted in a significant decrease in the latency time of the swallow and in an increase in salivary substance P compared to a control group of patients; these authors suggest that the elevated substance P levels in the saliva reflect enhanced activity of the afferent pathway of the swallow mechanism (see below).

Pharmacologic Management

The neurotransmitter, substance P, is believed to play a major role in both the cough and swallow sensory pathways. Angiotensin-converting enzyme (ACE) inhibitors prevent the breakdown of substance P and may theoretically be useful in the management of patients with aspiration pneumonia. Arai et al[104] measured serum substance P levels in hypertensive patients with cerebrovascular disease and symptomless dysphagia and control patients with no dysphagia. The patients with symptomless dysphagia had significantly lower serum levels of substance P than the control subjects. In this study, dysphagia as assessed by Tc tin colloid scanning improved in 62% of patients treated with an ACE inhibitor, this improvement being associated with a normalization of the serum substance P levels. Sekizawa and colleagues[105] studied the incidence of pneumonia in 127 stroke patients treated with ACE inhibitors compared with 313 patients treated with other antihypertensive agents. During a 2-year follow-up period, pneumonia was diagnosed in 7% of patients receiving an ACE inhibitor compared to 18% in patients receiving other hypertensive agents (relative risk, 2.65; 95% CI, 1.3 to 5.3; $p = 0.007$). Similarly, Arai and coworkers[106] compared the risk of pneumonia in 576 elderly hypertensive patients who were treated with an ACE inhibitor or a calcium-channel blocker. The rate of pneumonia was 3.3% in the ACE group compared to 8.9% in the patients who were treated with a calcium-channel blocker ($p = 0.025$). In a follow-up study, Arai and colleagues[107] demonstrated a significantly lower rate of pneumonia in elderly hypertensive patients randomized to an ACE inhibitor compared to an angiotensin-II receptor antagonist. These studies provide compelling evidence that patients with oropharyngeal dysphagia should be considered for treatment with an ACE inhibitor (even if normotensive).

Sedative medication has been demonstrated to increase the risk of pneumonia in residents of long-term care facilities and should therefore be avoided.[20] The prescription of phenothiazines and haloperidol should be very carefully considered, as they reduce oropharyngeal swallow coordination, causing dysphagia.[108,109] Medications that dry up secretions, including antihistamines and drugs with anticholinergic activity, make it more difficult for patients to swallow and should therefore also be avoided.[108,110]

Conclusion

The medical, social, and psychological impact of dysphagia is significant, with dysphagia in the elderly often being underrecognized and poorly diagnosed and managed. Dysphagia is the major pathophysiologic mechanism leading to aspiration pneumonia in the elderly. Dysphagia has a negative impact on the quality of life for those suffering from it. Awareness of dysphagia in the elderly, the diagnostic procedures, and treatment options available should be increased among the medical profession.[111] All elderly patients with clinical signs suggestive of dys-

phagia and pneumonia should be referred for a swallow evaluation. Patients with dysphagia require a multidisciplinary approach to swallowing management, aggressive oral care, and consideration for treatment with an ACE inhibitor.

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