

Clinical Significance of Aspiration Pneumonia and Diffuse Aspiration Bronchiolitis in the Elderly

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Abstract

Aspiration Pneumonia (AP) and Diffuse Aspiration Bronchiolitis (DAB) are often found in elderly, debilitated patients with dysphagia. The prevalence of AP in hospitals and nursing homes is rapidly expanding. The incidence of AP to total pneumonia is very high in elderly patients aged 70 years and older. For the diagnosis of AP or DAB, the evaluation of swallowing function is important. Food aspiration alone may cause DAB, but not always cause AP. Two different therapeutic approaches such as antibiotics administration and swallowing rehabilitation with oral hygiene are necessary for the cure of AP. Drugs that improve the swallowing reflex, vaccinations and oral health care management are effective in preventing aspiration pneumonia; however, percutaneous endoscopic gastrostomy is not recommended for the purpose of preventing aspiration pneumonia. The proper management of AP and DAB may be a central issue of geriatric medicine.

Keywords: Aspiration; Aspiration pneumonia; Dysphagia; Diffuse aspiration bronchiolitis; Nursing; Oral care; Elderly

Introduction

Pneumonia is the leading cause of death in developed countries including Japan, and most of the deaths from pneumonia occur in patients older than 65 years of age [1-3]. The developed countries are facing the advent of an unprecedented aging of society, and the field of nursing and the prevalence of aspiration pneumonia in both nursing homes and healthcare facilities are rapidly expanding [3-5]. However, the aspiration pneumonia have not yet fully determined in medical field.

In this review, we described the clinical significance, the mechanism, and therapeutic strategy of aspiration pneumonia distinct from conventional community acquired pneumonia in the aging population. Further, Diffuse Aspiration Bronchiolitis (DAB) in the elderly introduced for the advanced understanding of the differences between aspirations caused pneumonia and aspiration of foods materials alone [6,7].

Incidence of Aspiration Pneumonia (AP) in the Elderly

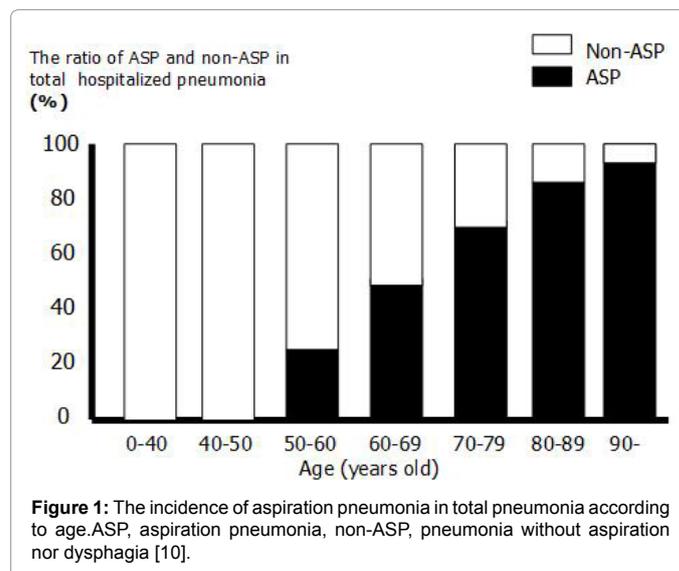
The incidence and the prevalence of aspiration pneumonia (AP) in the community are poorly defined. It increases in direct relation with age and underlying diseases [7-10]. The pathogenesis of AP presumes the contribution of risk factors that alter swallowing function and predispose the oro-pharyngeal and gastric region to bacterial colonization.

In our prospective one-year study, most of the patients hospitalized for pneumonia were elderly patients who are 70 years and older [10]. The ratio of AP to total cases of pneumonia increased with advancing age (Figure 1). Three hundred six of 382 pneumonia patients aged 70 years and older (80.1%) were diagnosed with aspiration pneumonia. In the study, the incidence of AP in overall hospitalized community-acquired pneumonia (CAP) was 60.1% (264/439 cases). Since the patients treated in hospitals and nursing homes are getting older and older, the incidence of AP may be quite high, which had not been previously expected.

Clinical Significance of Aspiration Pneumonia in Geriatric Medicine

Since facing the advent of an unprecedented aging society and

the field of nursing are rapidly expanding. Because of the advancing aging society, the patients with Aspiration Pneumonia (AP) increased years and years. AP is causing high hospitalization rates, morbidity, and often death. The major risk of AP is dysphagia, which is very often found in frail older people [11-13]. Further, the other contributors for AP such as cerebrovascular diseases, nervous system disorders, dementia, malnutrition, and comorbidities also increased with age. These functional and pathological abnormalities are major factors for



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the care dependency scale score [14]. Thus, the patients at nursing homes with comorbidities have a great risk for AP.

The very old people now comprise a high percentage of home-care patients and patients residing in medical and nursing care facilities and they are at high risk of aspiration pneumonia. As the population requiring nursing care increases, the incidence of AP is also expected to increase, and the significance of AP in the healthcare and nursing care may be evident in geriatric medicine.

Definition of Aspiration Pneumonia and Diffuse Aspiration Bronchiolitis

Pulmonary Aspiration Syndromes (PAS) or aspiration Associated Pulmonary Diseases (APD) refers to a group of pulmonary diseases

resulting from aspiration of foreign material into the lung. The type of syndrome depends on the quantity and nature of the aspirated material as well as its chronicity. The most common syndromes include Aspiration Pneumonia (AP), Diffuse Aspiration Bronchiolitis (DAB), and aspiration pneumonitis [3,6,15-17]. Aspiration pneumonia and diffuse aspiration bronchiolitis frequently occur in elderly. Both disorders are heavily associated the dysphagia and aspiration. However, the clinical pictures and inflammatory mechanisms are very different (Table 1).

Aspiration pneumonia is diagnosed on confirmation of inflammatory findings in the lungs and overt aspiration (apparent aspiration) or a condition in which aspiration is strongly suspected (abnormal swallowing function and dysphagia) (Figure 2). In elderly pneumonia, this occurs as one consequence of frequent silent

	AP	DAB
Age	elderly	elderly
Severity of dysphagia	Mild to severe	Mild
Underlying disorders	Stroke, post-stroke state, Parkinson disease, dementia, coma, alcoholism, poor dentition, tube feedings	Neurologic disorders, dementia, Achalasia, hiatus hernia, gastroesophageal reflux
Main cause	Silent aspiration Massive aspiration during eating	Recurrent small amount of aspiration during eating
Relation to eating and foods materials	Scanty connection	Tightly connected
symptoms	Anorexia, general fatigue, fever, cough, sputum, tachypnea, unconsciousness	paroxysmal dyspnea during eating, cough without fever, wheezing
Chest CT findings	Bilateral lower lobes infiltrates	centrilobular nodules with tree-in-bud appearance
Histologic findings	Bacterial infiltrates	localization of chronic mural inflammation with foreign body reaction in bronchioles Giant cells granuloma
Inflammatory cites	Alveolar spaces	Bronchioles
Histologic findings	Bacterial infiltrates	localization of chronic mural inflammation with foreign body reaction in bronchioles Giant cells granuloma
prognosis	High mortality	Not serious

Table 1: Features of aspiration pneumonia (AP) and diffuse aspiration bronchiolitis (DAB) in the elderly.

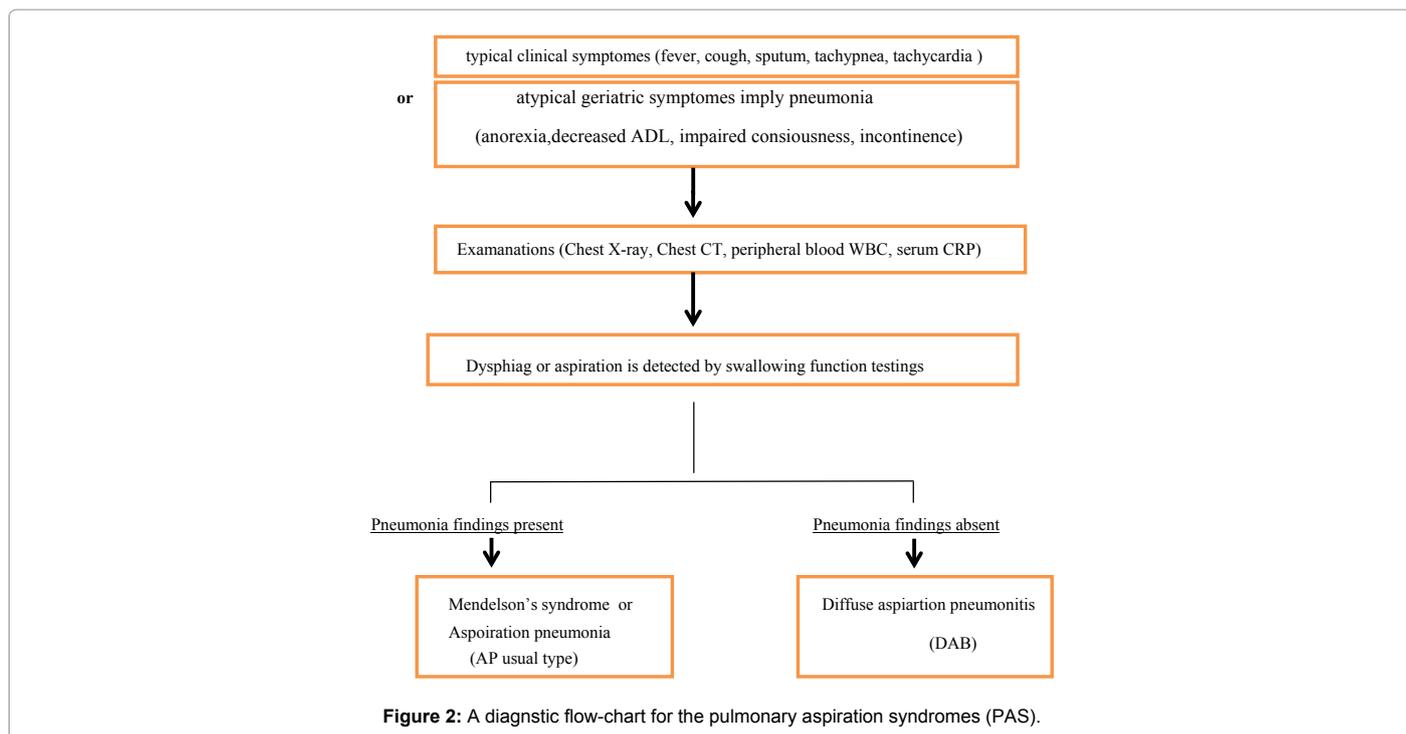


Figure 2: A diagnostic flow-chart for the pulmonary aspiration syndromes (PAS).

aspiration. In the diagnosis of aspiration pneumonia, evaluation of the risk of silent aspiration during the night and evaluation of swallowing function are important. When elderly patients with a risk of dysphagia and/or aspiration, the possibility of AP is carefully examined (Table 2). Methods of testing for dysphagia range from bedside assessments by speech therapists to videofluoroscopic examinations of swallowing by physicians (Table 3). Video-fluoroscopic and/or videoendoscopic swallowing studies may be used to determine the nature and extent of any swallow disorder. In the frail elderly patients who require a comprehensive nursing care, video fluoroscopic examination of swallowing is not recommended. The bedside swallowing function assessments including simple swallowing provocation tests and oximeter monitoring are safely performed [18-21].

On the other hand, Diffuse Aspiration Bronchiolitis (DAB) is defined as a clinical entity that is characterized by a chronic inflammation of bronchioles caused by recurrent aspiration of foreign particles [6]. The onset of DAB was more insidious than aspiration pneumonia, and in half of the patients with DAB episodes of aspiration were unrecognized. The frequency of DAB is approximately 0.1% of elderly autopsy cases. Importantly, those people are not died by the pneumonia. Therefore, the prognosis of DAB is not serious. That is why the food aspiration may cause bronchiolitis or pneumonitis, but does not always cause pneumonia in the elderly. In some cases, fungi-y flora staining, which is specific to fungi or vegetables, revealed the insidious low-grade lung inflammation caused by food materials (Figure 3) [22].

Causative Bacteria of Aspiration Pneumonia

Aspiration pneumonia is found in community-acquired pneumonia (CAP), Health Care-Associated Pneumonia (HCAP), nursing home-

associated pneumonia (NHAP), Nursing and Health Care-Associated Pneumonia (NHCAP), and hospital-acquired pneumonia (HAP) [4,23-27]. Oral microflora is usually the causative bacteria of pneumonia, and anaerobes are primarily the causative bacteria of aspiration pneumonia. Lober and Swenson have reported that anaerobic bacteria were isolated from 21 of 24 aspiration pneumonia of CAP and, in 13 cases, were the only isolates. Anaerobes were found in 8 of 23 cases and were the only isolates in 2 cases of aspiration pneumonia of HAP [23]. Gram-negative anaerobes and aerobes were common in the aspiration pneumonia of HAP. Gram negative rods and methicillin-resistant *Staphylococcus aureus* (MRSA) are often associated with aspiration pneumonia in elderly patients in HCAP, NHAP and HAP. Prevalent aerobes include *Streptococcus pneumoniae*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and enteric gram-negative rods (Table 4). The causative agents may be affected in the patient care circumstances and underlying diseases. That is why the reported causative agents were variously reported in aspiration pneumonia. The other reason is very difficult to identify the causative bacteria them in sputum specimens. Percutaneous lung biopsy is a reliable procedure for specimen collection, but it is highly invasive. When it is necessary to isolate and identify the causative bacteria, the transbronchial protected specimen brushing procedure is preferable. However, these methods are not suitable for the disabled elderly people with pneumonia. The empiric therapy is inevitable for the initial treatment for weekend elderly people with aspiration pneumonia.

Therapeutic Strategy for Aspiration Pneumonia and DAB

In view of possible therapeutic intervention for DAB, the recognizing

1	Neurological disorders
	Cerebrovascular disease (stroke, etc.) , post-stroke state
	Central neurodegenerative diseases (amyotrophic lateral sclerosis, etc.)
	Parkinson's disease
	Dementia (cerebrovascular, Alzheimer's type), Unconsciousness
2	Bedriddenness, disuse syndrome, geriatric syndrome
3	Oral disorders
	Dry mouth, periodontal disease, dentures, oral malignant tumors
4	Gastro esophageal disorders
	Esophageal diverticula, Esophageal motility disorders (achalasia, scleroderma)
	Gastroesophageal reflux disorders (GERD) (including esophageal hiatal hernia)
	Gastrectomy (total or subtotal gastrectomy)
5	Iatrogenic causes
	Sedatives, hypnotics, muscle relaxants
	Drugs that cause dry mouth, e.g., anticholinergic drugs, tricyclic antidepressant
	Tube feeding (nasogastric tubing,)
	Tracheal tubing, tracheotomy tubing
6	Physiologic abnormality
	Decrease in salivary secretion, obesity, emaciation, muscle weakness, constipation, ileus, atrophic gastritis, sleep disorders, sleep apnea.
7	Age-associated changes in skeletal structure
	Kyphosis, scoliosis, lower position of the larynx, temporomandibular dysfunction

Table 2: Pathological underlying disorders which predispose to aspiration or dysphagia.

1. Screening swallowing assessment methods
Bedside assessment of swallowing function (by speech therapist), arterial oxygen saturation monitoring during swallowing, repetitive saliva swallowing test, water swallowing test, simple swallowing provocation test, etc.
2. Further swallowing assessment methods
Water swallowing test, laryngoscopic evaluation of swallowing, swallowing pressure measurement, swallowing provocation test, video fluoroscopic examination of swallowing, Video endoscopic examination of swallowing, examination of pulmonary uptake of a radioisotope, such as indium chloride, dissolved in the mouth at the previous night

Table 3: The clinical assessment of swallowing function in the elderly patients predisposed to aspiration.

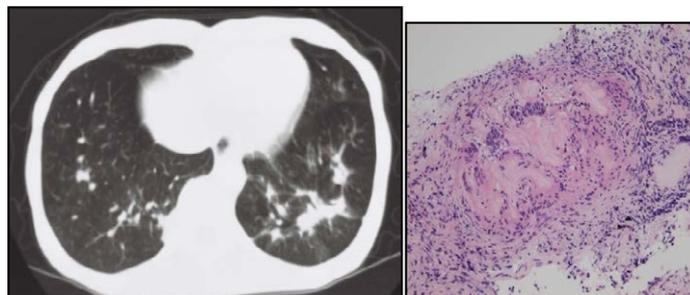


Figure 3: A case of diffuse aspiration bronchiolitis. Chest CT scan showed infiltration in the left lower lobe. The patient has no symptoms. Hematoxylin–eosin staining (magnification 20 times) of lung biopsy samples exhibited multi-nucleated giant cells engulfing foreign bodies.

investigators	Lober	Bartlett	Micek	carratala	maruyama	Ishida
reference No	23	24	25	26	27	28
number of patients	47	70	431	126	21	173
Mean age(years)	23-73	-	59.8	69.5	91.7	82
GPC <i>S. pneumoniae</i>	21.2%	15.7%	10.4%	27.8%	35.2%	31.8%
GPC <i>S. aureus</i>	8.5%	15.7%	13.9%	2.4%	3.7%	11.1%
GPC MRSA	-	-	30.6%	0.8%	-	8.1%
GNR <i>P. aeruginosa</i>	17%	10%	25.5%	1.6%	0%	13.3%
GNR <i>E. coli</i>	10.6%	8.6%	4.2%	2.4%	-	7.5%
GNR <i>H. influenza</i>	-	-	4.2%	11.9%	0%	9.2%
GNR <i>K. pneumoniae</i>	2.1%	11.4%	6.5%	0%	-	11.6%
GNR <i>Enterobacter</i>	-	5.7%	9.0%	-	3.7%	-
anaerobic bacteria	61.7%	61%	-	-	0%	2.9%

Gram positive cocci, GPC; Gram negative rods, GNR; *Streptococcus pneumoniae*, *S. pneumoniae*; *Staphylococcus aureus*, *S. aureus*, methicillin-resistant *Staphylococcus aureus* (MRSA); *Pseudomonas aeruginosa*, *P. aeruginosa*; *Escherichia coli*, *E. coli*; *Haemophilus influenza*, *H. influenzae*; *Klebsiella pneumoniae*, *K. pneumoniae*

Table 4: Possible causative microbiological results in the patients with aspiration-associated pneumonia.

of this specific clinical entity is important. Further, differentiating DAB from pulmonary diseases associated with bronchospasm in the elderly asthma is necessary. Although the dysphagia is a strong risk factor for both AP and DAB, the aspiration of food materials alone does not always cause pneumonia [28-34].

For the treatment of AP, two different approaches are necessary. The first one is proper antibiotic treatment strategies. Since there is greater involvement by indigenous oral bacteria and anaerobic bacteria in patients with aspiration pneumonia than in pneumonia patients with no risk of aspiration, antibiotics that are effective against indigenous oral bacteria and anaerobic bacteria are given priority when selecting antibiotics to treat patients with aspiration pneumonia. Therapy options include beta-lactamase-inhibitor-containing penicillins, carbapenem antibiotics, in combination with macrolides. However, a maximum effort should be made to identify the causative agents and select drugs with high activity against them. De-escalation procedures should be conducted when the causative agents have been identified and the clinical manifestations have improved.

The other approach is the therapy for the dysphagia. While the pneumonia of may be cured by antibiotics, the dysphagia of the patients does not improve by the agents. Episodes of aspiration may recur during treatment for pneumonia, and pneumonia that has improved may become worse again as a result of recurring aspiration. Both swallowing rehabilitation and oral health care should be started and continued in parallel with antibiotic treatment [3,35-37].

Percutaneous Endoscopic Gastrostomy (PEG) is often performed as a means of preventing AP, but there is little evidence that it prevents pneumonia. The incidence of aspiration pneumonia in PEG patients is

same as in patients fed through a nasogastric tube [38-42]. The route changes plus swallowing rehabilitation may be necessary to reduce silent aspiration in the patients. Slightly head-up by approximately 30 degrees during day and night may be effective to reduce the gastric regurgitation-associated aspiration in the patients [43,44]. The mosapride, which is a gastroprokinetic agent, may prevent the regurgitation of gastric contents and may reduce the pneumonia incidence in patients with PEG [45].

For the prevention of AP, the interesting pharmacologic approaches are introduced. ACE inhibitors [46-49] and cilostazol [50-52] have been reported to be effective in preventing pneumonia in patients who have a history of cerebral infarction and are at high risk of aspiration. Both agents are supposed to increase substance P levels in airways and plasma, then improve both swallowing and cough reflexes in the elderly. Unless the patient is bedridden and has a very low ADL level, these drugs can be expected to be effective in preventing aspiration pneumonia in the elderly [53-55].

The Importance of Oral Management for the Prevention of AP

The AP increases in direct relation with age and underlying diseases. The pathogenesis of AP presumes the contribution of risk factors that alter swallowing function and predispose the oropharynx and gastric region to bacterial colonization. Therefore, oral healthcare may be a preventive approach for aspiration pneumonia.

It has been reported that dependent for feeding, dependent for oral care, number of decayed teeth, and tube feeding are the significant predictors for the development of AP [56]. The edentulous patients

requiring help with feeding have a higher risk for AP [57]. Oral care was provided by a dentist and a dental hygienist once a day and the mouth cleansed with povidone iodine by nurses after each meal to restrict respiratory bacterial infection caused by silent aspiration [58]. In fact, pneumonia, febrile days, and death from pneumonia decreased significantly in patients with oral care [59-61]. Oral care was beneficial in edentate and dentate patients. Activities of daily living and cognitive functions showed a tendency to improve with oral care. Oral hygiene nursing aide intervention may be an efficient risk factor modifier of mortality from nursing home-associated pneumonia [61].

The Possible Roles of Vaccination for the Prevention of Pneumonia in the Elderly

Vaccines may play a role in preventing respiratory infections in elderly patients. The two types of vaccines that are being used to prevent pneumonia in the elderly are pneumococcal polysaccharide vaccine (PPV) and influenza vaccine. PPV contains the capsular polysaccharides of 23 serotypes of pneumococci and protects against *Pneumococcal pneumonia* in adults.

There is evidence that PPV injections reduce the incidence and mortality of pneumonia in elderly patients requiring nursing [53-55]. Because these elderly patients are very predisposed to aspiration pneumonia, the vaccination may be effective for the prevention of pneumonia in the elderly. The center of disease control and prevention (CDC) has recently recommend that one dose of pneumococcal conjugate vaccine (PCV13) is inoculated for adults aged 19 years and older with conditions that cause weakening of the immune system. The effectiveness for pneumococcal conjugate vaccination for the patients with a high risk of AP should be further examined by the several vaccines.

Influenza vaccine is also recommended. Although the effectiveness of influenza vaccine in elderly patients was not proven by a meta-analysis of the previous studies in terms of the hospitalization rate, and the mortality rate [62], a plenty of data suggest that combined vaccination with influenza vaccine and PPV is especially useful for elderly subjects [63,64]. The inoculation with both vaccines may have an additive effect of reducing hospitalizations for influenza or pneumonia in the elderly with a risk of AP.

Conclusion

The prevention and treatment of aspiration pneumonia are now the central issue of Geriatric Medicine. Since the dysphagia may not be totally cured, the various preventive approaches are developed for the prevention of AP. The understanding of similarities and differences between aspiration pneumonia and diffuse aspiration bronchiolitis tells us the mechanism of pneumonia and the disease management strategy in the elderly.

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