Chapter 3
Diagnosis of Aspiration Pneumonia: What Is the Definition of Aspiration Pneumonia in Clinical Practices?

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Abstract Aspiration is defined as the entry of oropharyngeal or gastric contents into the larynx and the lower respiratory tract. Aspiration is often the result of impaired swallowing, which allows oropharyngeal or gastric contents to enter the lungs, especially in patients who also have an ineffective cough reflex. Aspiration may involve the airways or lung parenchyma and several pulmonary syndromes may occur after aspiration, depending on the amount and nature of the aspirated material, the frequency of aspiration, and the host's response to the aspirated material. In these, aspiration pneumonia is an infectious disease caused by the inhalation of oropharyngeal secretions colonized by pathogenic bacteria, whereas aspiration pneumonitis is a chemical injury caused by inhalation of sterile gastric contents. Although there is some overlap between these syndromes, they are distinct clinical entities. In patients with aspiration pneumonia, unlike those with aspiration pneumonitis, the episode of aspiration is generally not witnessed. Thus, the diagnosis of aspiration pneumonia depends on clinical history, risk factors, and compatible findings on chest radiography. These radiographic findings include infiltrates in gravity-dependent pulmonary segments. Elderly persons frequently receive poor oral care, resulting in oropharyngeal colonization by potential respiratory tract pathogens, including *Enterobacteriaceae*, *Pseudomonas aeruginosa*, and *Staphylococcus aureus*. These pathogens are aspirated and may cause pneumonia.

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1 Introduction

Pneumonia is a common cause of death among older people despite the availability of potent novel antimicrobials. Both the increased incidence of pneumonia and high mortality among older people are a consequence of a number of age-related factors including comorbidities, therapeutic interventions, decreased host defense mechanisms, and site of acquisition. In these, aspiration is possibly the most important risk factor for pneumonia in the elderly. This chapter focuses on the pathophysiology, clinical features, clinical definition, and diagnosis of aspiration pneumonia and aspiration pneumonitis.

2 Definitions of Aspiration Pneumonia and Aspiration Pneumonitis in Clinical Practice

Aspiration is defined as the inhalation of oropharyngeal or gastric contents into the larynx and the lower respiratory tract [1, 2]. Aspiration is often the result of impaired swallowing, which allows oropharyngeal or gastric contents to enter the lungs, especially in patients who also have an ineffective cough reflex [1, 2]. Aspiration may involve the airways or lung parenchyma and several pulmonary syndromes may occur after aspiration, depending on the amount and nature of the aspirated material, the frequency of aspiration, and the host's response to the aspirated material [3]. In these, aspiration pneumonia is an infectious process caused by the inhalation of oropharyngeal secretions that are colonized by pathogenic bacteria, whereas aspiration pneumonitis (Mendelson's syndrome) is a chemical injury caused by inhalation of sterile gastric contents [3, 4]. Although there is some overlap between these syndromes, they are distinct clinical entities (Table 3.1).

Table 3.1 Characteristic features of aspiration pneumonia and aspiration pneumonitis

Features	Aspiration pneumonia	Aspiration pneumonitis
Trigger	Silent aspiration	Witnessed aspiration
Aspirated materials	Oropharyngeal secretions with bacteria	Gastric juice
Pathology	Bacterial pneumonia	Acute lung injury
Pathogens	*Enterobacteriaceae*	Acid
	Ps. aeruginosa	Pepsin
	Sta. aureus	Particulate matter
Patient	Older subjects	Adolescent or older subjects

3 Mechanisms for Development of Aspiration Pneumonia and Aspiration Pneumonitis

3.1 Aspiration Pneumonia

Although aspiration is an essential feature of aspiration pneumonia, many episodes are unwitnessed [2, 5, 6]. Such "silent aspiration" frequently occurs and is a more important cause of pneumonia than acute aspiration of gastric content in older people [7]. Silent aspiration of oropharyngeal bacterial pathogens to the lower respiratory tract is an important risk factor for community-acquired pneumonia [8] and also nosocomial pneumonia in the elderly [9].

Although approximately half of all healthy adults aspirate oropharyngeal secretion during sleep [1, 3], they are less likely to develop pneumonia because of smaller volumes or ability to clear bacteria rapidly [10]. A micro-aspiration could be a major pathogenic mechanism of most aspiration pneumonia because an extremely small volume (0.01 mL) of saliva contains pathogenic numbers of bacteria [10]. Elderly patients with a predisposition to aspiration frequently aspirate oropharyngeal secretions and the development of pneumonia occurs when normal pulmonary defense mechanisms are overwhelmed [11]. Aspiration pneumonia is usually acute, with symptoms developing within hours to a few days after a sentinel event, although anaerobic aspiration may be subacute because of the less virulent bacteria, and clinical features are difficult to distinguish from those of other bacterial pneumonias [1]. Most patients with poor performance and poor oral hygiene have diffuse and not focal infiltrates (Fig. 3.1).

Adequate protective reflexes in the airway are important and suppression or absence of these reflexes has led to pneumonia [11]. For example, Nakajoh et al. reported that the incidence of pneumonia was higher in patients having both a latency of swallowing response longer than 5 s following stimulation with 1 mL of distilled water and a cough threshold for inhalation of citric acid aerosol higher than a concentration of 1.35 (log mg mL^{-1}) [12]. Thus, the progressive loss of protective

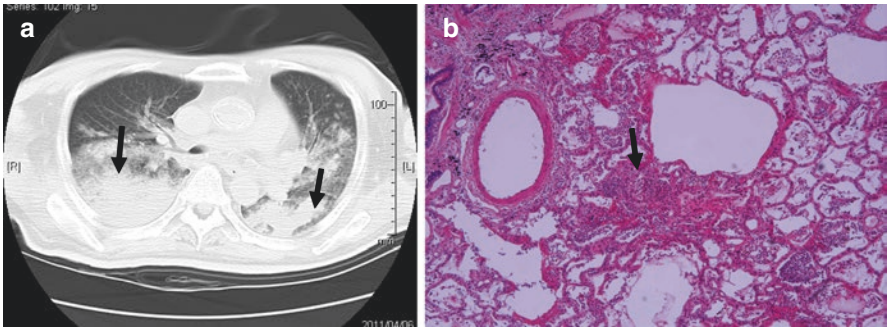

Fig. 3.1 Characteristic findings in a patient with aspiration pneumonia. The chest CT scan shows new bilateral consolidations (arrows) in posterior, gravity-dependent pulmonary segments in a patient with aspiration pneumonia (**a**). A histological examination reveals alveolar exudates and accumulation of neutrophils (arrows) along the peripheral airways (**b**)

Table 3.2 Diseases or conditions that serve as risk factors for aspiration

1.	Central nervous system diseases
	(a) Stroke
	(b) Parkinson's disease
	(c) Dementia
	(d) Epilepsy
	(e) Other neurodegenerative diseases
2.	Disturbed consciousness
3.	General anesthesia
4.	Dysphagia due to head, neck, and esophageal cancer
5.	Esophageal obstruction and motility disorders
6.	Gastroesophageal reflux
7.	Ileus
8.	COPD
9.	Overuse of anti-psychotic medications
10.	Alcohol
11.	Bedridden conditions
12.	Poor oral hygiene

reflexes (i.e. swallowing and cough reflexes) with age is thought to be one of the mechanisms for aspiration pneumonia that is often seen in older people [13]. In fact, impaired swallowing and cough reflexes have been shown in patients suffering from aspiration pneumonia [14, 15]. However, re-evaluation of age-related changes in protective reflexes in individuals who lead active daily lives has shown that both reflexes do not decrease with increasing age [16, 17], indicating that involutional and degenerative changes associated with aging often result in marginally compensated protective reflexes [18].

Disorders of the central nervous system are more likely to develop in the elderly, and pneumonia has been estimated to occur in about one-third of patients with stroke [19, 20] (Table 3.2). The most important factor contributing to the development of pneumonia in patients with stroke is suggested to be dysphagia with aspiration [21]. Nakagawa et al. have shown that the risk of pneumonia was significantly higher in patients with basal ganglia infarcts than in patients with or without cerebral hemispheric strokes in other locations [11]. They found that multiple episodes of pneumonia occurred frequently in patients with bilateral basal ganglia infarcts and that there was a higher mortality rate associated with pneumonia in these patients. Delayed triggering of the swallowing reflex occurs in patients with basal ganglia infarcts [18]. These results strongly suggest that disruption of basal ganglia functions is critically important in the development of aspiration pneumonia.

The pharyngeal, laryngeal, and tracheal epithelia, the most important sites for the initiation of swallowing and cough reflexes, have an extensive plexus of nerves that contains substance P [22, 23]. Capsaicin desensitization, which diminishes substance P from the airway and upper digestive tract, or an administration of neurokinin (NK)-1 receptor antagonist, remarkably attenuated the cough response to tussive stimuli [24–26] and distilled water-induced swallowing reflex in guinea pigs [27],

suggesting an important role of substance P-containing nerves in the initiation of these protective reflexes [28, 29] (see Part III11). Thus, irritation of laryngeal and pharyngeal mucosa by stimuli may activate capsaicin-sensitive sensory nerves, releasing substance P, with the result that protective reflexes are initiated by stimulation of the glossopharyngeal and vagal sensory nerves.

Treatment with a dopamine agonist in rats bring about a heightened striosomal expression of substance P, and both dopamine D1 and D2 antagonists decrease substance P [30]. Mice lacking the dopamine D1 receptor [31] and those treated with dopamine D1 receptor antagonist [32] showed abnormal motor activities and feeding and swallowing problems. An impaired dopamine metabolism in the basal ganglia is observed in patients with basal ganglia infarcts [33, 34]. Patients with basal ganglion infarcts or Parkinson's disease may suffer from reduced dopamine metabolism, which decreases substance P in the glossopharyngeal and vagal sensory nerves. Reduction in substance P concentration in these nerves impairs both swallowing and cough reflexes, which increases the frequency of silent aspiration. Because the action of swallowing and coughing is a fundamental defense mechanism against aspiration of oropharyngeal contents into the respiratory tract, impairment of both reflexes is one of the major reasons for the development of aspiration pneumonia [5].

3.2 Aspiration Pneumonitis

Aspiration pneumonitis occurs after a witnessed (macro)-aspiration. Aspiration pneumonitis is defined as acute lung injury after the inhalation of regurgitated sterile gastric contents [1, 3, 4]. This syndrome occurs in patients who have a marked disturbance of consciousness such as that resulting from a drug overdose, seizures, a massive cerebrovascular accident, or use of anesthesia [1, 3] (Table 3.2). Historically, the syndrome most commonly described as aspiration pneumonitis is Mendelson syndrome, reported in 1946 in patients who aspirated while receiving general anesthesia during obstetrical procedures [4].

Gastric contents can lead to chemical pneumonitis only with large-volume or low-pH (usually <2.5) aspiration [1, 3]. Later, it was shown that if the pH of gastric contents was neutralized before aspiration, the pulmonary injury was minimal [3]. It is agreed that a pH of <2.5 and a volume of gastric aspirate >0.3 mL per kilogram of body weight (20–25 mL in adults) are required for the development of aspiration pneumonitis [3]. Aspiration of particulate food matter from the stomach may cause severe pulmonary damage, even if the pH of the aspirate is >2.5 [3, 35].

Aspiration pneumonitis is characterized by a sudden onset of dyspnea, hypoxemia, tachycardia, and diffuse wheezes or crackles on examination. A chest radiograph is usually abnormal, and a pattern that is characteristic of acute respiratory distress syndrome develops in up to 16.5% of patients with witnessed aspiration [1]. Low-pH aspirates are usually sterile and bacterial infection is unusual initially, although superinfection may develop subsequently [1].

4 Risk Factors for Aspiration

Large-volume aspiration occurs with dysphagia such as head, neck, and esophageal cancer; esophageal obstruction and motility disorders; COPD; and seizures [1, 3] (Table 3.2). Additional risks include degenerative neurologic diseases such as Parkinsonism or dementia and disturbed consciousness, particularly as a result of stroke, which can also impair cough reflexes. Impaired consciousness can also result from drug overdose and medications including narcotic agents, general anesthetic agents, certain antidepressant agents, and alcohol [1, 3]. Antipsychotic medications increased the risk of aspiration pneumonia by a factor of 1.5 in a study involving 146,552 hospitalized patients [1, 3]. Enteral feeding can lead to high-volume aspiration, especially when associated with gastric dysmotility, poor cough, and altered mental status (Table 3.2). Those with two or more risk factors had an increased incidence of recurrent pneumonia and increased 30-day and 6-month mortality, with rates rising in parallel with the number of risk factors [1].

5 Diagnosis of Aspiration Pneumonia and Aspiration Pneumonitis

Aspiration pneumonia is best considered not as a distinct entity but as part of a continuum that also includes community- and hospital-acquired pneumonia. It is estimated that aspiration pneumonia accounts for 5%–15% of community-acquired pneumonia cases [1]. Robust diagnostic criteria for aspiration pneumonia are lacking, and as a result, studies of this disorder include heterogeneous patient populations. In patients with aspiration pneumonia, unlike those with aspiration pneumonitis, the episode of aspiration is generally not witnessed. The diagnosis of aspiration pneumonia depends on a history, risk factors (Table 3.2), and compatible findings on chest radiography. These radiographic findings include infiltrates in gravity-dependent pulmonary segments (superior lower lobe or posterior upper lobe segments, if the patient is in a supine position during the event, or basal segments of the lower lobe, if the patient is upright during the event) [1] (Fig. 3.1). Elderly persons frequently receive poor oral care, resulting in oropharyngeal colonization by potential respiratory tract pathogens, including *Enterobacteriaceae*, *Pseudomonas aeruginosa*, and *Staphylococcus aureus*. These pathogens are aspirated and may cause pneumonia [3].

6 Conclusion

Aspiration pneumonia is an infectious process caused by the inhalation of oropharyngeal secretions that are colonized by pathogenic bacteria, whereas aspiration pneumonitis is a chemical injury caused by inhalation of sterile gastric contents. In

patients with aspiration pneumonia, unlike those with aspiration pneumonitis, the episode of aspiration is generally not witnessed. Since robust diagnostic criteria for aspiration pneumonia are lacking, the diagnosis of aspiration pneumonia depends on clinical history, risk factors, and compatible findings on chest radiography. These radiographic findings include infiltrates in gravity-dependent pulmonary segments.

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