Aspiration: /aspə'rāSH(ə)n/: Noun: An Ambiguous Term Used for a Diagnosis of Uncertainty

John Ferguson, MD, Brian Ravert, MD,† and Michael Gailey, DO‡*

Abstract: Aspiration is a mechanism in which liquid or solid penetrates into the lungs, which overlaps several disease states. Use of the terms aspiration and aspiration pneumonia is ambiguous and may include pulmonary infection, oropharyngeal dysphagia, or gastroesophageal reflux disease. This article reviews the literature and classifies 13 distinct syndromes, grouped into 3 categories to help delineate the different disease states associated with pulmonary aspiration. Chronic anaerobic pulmonary infection should be most precisely referred to as anaerobic pneumonia. The commonly used term, aspiration pneumonia, is misleading to clinicians and should be abandoned.

Key Words: anaerobic pneumonia, aspiration pneumonia, gastroesophageal reflux, dysphagia

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BACKGROUND

The terms aspiration pneumonia and aspiration event are increasingly being used in hospitals with an aging patient population.[1] These terms are often used to describe a clinical syndrome (pneumonia), while incorporating a mechanism (aspiration) that overlaps several disease states.[2] Educating patients and physicians alike is challenging while grouping pulmonary infections, oropharyngeal dysphagia, and esophageal reflux all under an umbrella term of aspiration. Appropriate clinical terminology should carefully attempt to describe the precise clinical-radiographic-pathologic state. Vague terms such as reactive airway disease being used in place of diseases including asthma or obliterative bronchiolitis contribute toward difficulty in communication among physicians and impede furthering medical education.[3] This terminology may be considered lazy or dangerous and are often used when the diagnosis is uncertain, leading to a false sense of security by clinicians.[3] The terms aspiration event, aspiration pneumonitis, aspiration pneumonia, or anaerobic bacterial pneumonitis similarly lead to confusion in the pathogenesis of the disease state.[4] Indeed, many pulmonary disease processes have been linked to aspiration of material into the trachea, including chronic diffuse interstitial lung disease, bronchiectasis, acute respiratory failure, and empyema, although with few vigorous clinical trials.[5] Often in the face of clinical uncertainty, the term aspiration event is utilized. Dangerous use of aspiration event to describe clinical uncertainty has led to missed diagnoses including vocal cord dysfunction, pulmonary embolism, hypoventilation, aseptic meningitis, atelectasis, or mechanical ventilator problems. Aspiration pneumonia is often mistakenly used to describe an anaerobic pneumonia, which itself is a distinct clinical syndrome. Careful evaluation of the clinical presentation and breaking down an aspiration event into subgroups may help properly diagnose the condition (Table 1).

From the *Rocky Mountain Pulmonary and Critical Care Medicine, Wheat Ridge; †Rocky Mountain Radiologists; and ‡AmeriPath: Anatomic Pathology Services, Denver, CO.

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Address correspondence to: John Ferguson, MD, 8550 W. 38th Avenue, Suite 202, Wheat Ridge, CO 80403. E-mail: jferguson@rockymtnpulmonary.com.

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We review the data and propose: (1) a simplified classification to distinguish diseases caused by a common mechanism of aspiration; (2) a definition of anaerobic pneumonia as an indolent pulmonary infection caused by anaerobic organisms; and (3) the term aspiration pneumonia be abandoned.

GROUP 1 INFECTIOUS ASPIRATION SYNDROMES [COMMUNITY-ACQUIRED PNEUMONIA (CAP), HOSPITAL-ASSOCIATED PNEUMONIA (HAP), VENTILATOR-ASSOCIATED PNEUMONIA (VAP), ANAEROBIC PNEUMONIA)]

Group 1 aspiration diseases include those of infection. The terms community-acquired pneumonia (CAP), or if hospitalized beyond 48 hours hospital-associated pneumonia (HAP), or if intubated beyond 48 hours ventilator-associated pneumonia (VAP) should be used for acutely ill patients, irrespective of individual risk factors.[6] Common aerobic organisms responsible for acute adult community-acquired bronchopneumonia include *Streptococcus pneumoniae*, *Staphylococcus aureus*, *Hemophilus influenzae*, *Moraxella catarrhalis*, *Pseudomonas aeruginosa*, and gram-negative Enterobacteriaceae including *Escherichia coli* and *Klebsiella pneumoniae*.[1,7] Nasal colonization of these organisms is common in asymptomatic individuals,[8–10] but plays a clear role in the pathogenesis of disease formation.[11,12] Microaspiration of virulent bacteria or macroaspiration overwhelming pulmonary defense mechanisms leads to disease. The onset of CAP is acute, with symptoms of cough, fever, and dyspnea. A limited 5 to 7-day duration of antibiotics is typically sufficient to treat, although mortality may be high when complicated by sepsis or acute respiratory distress syndrome complications of pneumonia.[6] Historically, cultures in CAP obtained by transtracheal aspiration have yielded anaerobic *Fusobacterium*, *Peptococcus*, *Peptostreptococcus*, *Veillonella*, and *Bacteroides* species[13–16] by techniques that are not used today, and reflected tracheal contamination and colonization[17,18] rather than infection as currently obtained by bronchoalveolar lavage.[19,20] Although anaerobes may still be infrequently identified in culture,[21,22] they are typically nonpathogenic in CAP and present nearly always with coexisting pathogenic aerobic infection,[23] and should be covered with standard empiric CAP therapy,[6] irrespective of the presence of anaerobic bacteria.[24,25] Failure of appropriate aerobic Enterobacteriaceae coverage may lead to death,[23,26] whereas failure of treatment of anaerobes in CAP does not seem to lead to treatment failure.[23]

Colonization by hospital-associated organisms poses a risk in HAP and VAP.[27] A shift in the kinds of organisms is the reason for a distinct diagnosis of HAP or VAP. Pseudomonas and methicillin-resistant Staphylococcus aureus (MRSA) are more likely to colonize nasogastric and endotracheal tubes in hospitalized patients.[1,7] The microbiome of patients with nasogastric tubes in a hospital setting changes to colonization by *P. aeruginosa*,[28] pathogenic *Enterococcus*,[29] and *Acinetobacter* species.[29] After extubation, the microbiota of the oral cavity frequently reverts to normal from the colonized *S. aureus* and *P. aeruginosa*.[30,31] The symptoms are identical to CAP and should be suspected in hospitalized patients

TABLE 1. Classification of Aspiration-related Pulmonary Disease

Syndrome	Clinical Description
Group 1: infection-related	
Community-acquired pneumonia	Acute infectious bronchopneumonia from oral and esophageal colonized organisms that are commonly found in the community
Hospital-associated pneumonia	New-onset pneumonia during hospitalization for > 48 h, not present at admission
Ventilator-associated pneumonia	New-onset pneumonia > 48 h after mechanical ventilation, not present before intubation
Anaerobic pneumonia	Chronic infection characterized by low-grade fevers, chest pains, often with abscess formation or empyema
Group 2: dysphagia-related	
Accidental foreign body aspiration	Inadvertent foreign body passed into the tracheal tree such as seeds, coins, teeth, or barium
Oropharyngeal dysphagia-related cough	Dysphagia related often to weakness or neurological conditions. A risk factor for any of the group 1 infections and common cause of cough and throat clearing
Near-drowning	Diffuse pulmonary edema, similar to negative pressure pulmonary edema after inhalation of a large volume of liquid
Exogenous lipoid pneumonia	Low-density pulmonary infiltrates or mass lesion after lipid substances passing into the alveoli, commonly from the nose
Group 3: stomach acid-related	
Gastroesophageal reflux-associated cough	Acid or non–acid irritation of the esophagus or the vocal cords. This may lead to diseases such as chronic cough, bronchiectasis, or erosive esophagitis
Obliterative bronchiolitis	Diffuse tree-in-bud opacities, heterogenous attenuation, small airway disease pathologically, commonly with airflow obstruction on spirometry
Bronchiectasis	Dilated, nontapering airways, may be of any pattern (cystic, varicose, or cylindrical)
Mycobacterium fortuitum	Rapid-growing nontuberculous mycobacterium, generally not requiring treatment, but rather control of reflux
Sterile chemical pneumonitis	Rapid diffuse noninfectious pneumonitis related to vomiting, generally resolves with supportive care alone

with new-onset fever, sputum, and pulmonary infiltrates. Treatment of VAP includes coverage of Methicillin-resistant *S. aureus* (if antibiotics in the past 90 d or high local prevalence of MRSA) and coverage of *P. aeruginosa* with 1 or 2 antipseudomonal antibiotics. Treatment of HAP is similar to that of VAP, with coverage directed toward MRSA and *P. aeruginosa* with 1 or 2 antipseudomonal antibiotics.[32]

RECOGNITION OF A DISTINCT CLINICAL SYNDROME: ANAEROBIC PNEUMONIA

We utilize the term anaerobic pneumonia for indolent chronic (usually 2 to 3 wk) infections of the lung that present with malaise, chest pain, and dense chronic infiltrates, often with cavitation, pleural empyema, pulmonary necrosis, or putrid sputum, and often associated with alcoholism.[33] These patients are often not sufficiently ill to require hospitalization, although they may be admitted because of complications of empyema or weight loss.[23,33] Consideration of anaerobic pneumonia should be made for nonresolving pneumonia as ~15% of the predominant organisms identified with rRNA testing in CAP are obligate anaerobes.[34] Tuberculosis should alternatively be considered with a gradual onset similar to anaerobic pneumonia. Differentiation of CAP and anaerobic pneumonia should be made on the basis of the severity of illness, clinical course including cavitation or pleural disease, rather than risk factors of vomiting, age, dentition, neurological disorders, seizures, or dysphagia alone, although these are risk factors for this syndrome. Evaluation for dysphagia or silent aspiration is recommended in these individuals with a high prevalence,[35] as is good oral care of dentition. The causative organisms in anaerobic pneumonia include *Fusobacterium*, *Prevotella*, *Peptostreptococcus*, *Actinomyces*, *Veillonella*, and *Bacteroides* species, although may be mimicked by microaerophilic *Streptococcus anginosus* or *intermedius*.[36] Oral streptococci were not historically considered pathogens and may be underestimated with increasing recognition in pulmonary-pleural disease.[37] Dependent-lung segments (posterior basilar lower lobes, posterior segments upper lobes, or superior segments of the lower lobes) are more likely to be affected on chest imaging,[20] which may be related to gravity while in the supine position, or related to regions of the lung with low ventilation-perfusion relationships and low alveolar oxygen tension. These infections do not typically lead to sepsis, but often require weeks to months of anaerobic bacterial coverage until radiographic resolution and clinical improvement, and obtaining bronchoscopic cultures with susceptibilities may be useful when prescribing prolonged antibiotics (Table 2).

TABLE 2. Features of Aerobic and Anaerobic Pneumonia

	Aerobic Pneumonia (CAP, VAP, HAP)	Anaerobic Pneumonia
Time until presentation	Acute onset (1-7 d)	Delayed onset to presentation, often 2-3 wk
Clinical features	High fevers, productive sputum	Low-grade fevers, malaise, chest discomfort
Risk factors	Immunodeficiency, elderly	Poor dentition, need for assisted feeding, alcoholism
Organisms	*S. pneumoniae*, *S. aureus*, *M. catarrhalis*, *H. influenzae*, *E. coli*, *K. pneumoniae*	*Prevotella*, *Peptostreptococcus*, *Veillonella*, *Fusobacterium*, *Actinomyces*, *Bacteroides*
Cavitation	Infrequent, other than MRSA	Common
Pleural disease	10% of hospitalized patients, more common in *S. pneumoniae* and *S. anginosus or intermedius*	Common
Treatment	Short (7 d) duration of beta-lactam/macrolide, pseudomonas, or MRSA coverage in VAP/HAP	Long (mo) duration of beta-lactam/lactamase, carbapenem, or augmentin/clavulanic acid

CAP indicates community-acquired pneumonia; E. coli, Escherichia coli; H. influenzae, Haemophilus influenzae; HAP, hospital-associated pneumonia; K. pneumonia, Klebsiella pneumoniae; M. catarrhalis, Moraxella catarrhalis; MRSA, methicillin-resistant Staphylococcus aureus; S. aureus, Staphylococcus aureus; S. anginosus or intermedius, Streptococcus anginosus or *intermedius*; *S. pneumoniae, Streptococcus pneumoniae*; VAP, ventilator-associated pneumonia.

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GROUP 2 NONINFECTIOUS ASPIRATION SYNDROMES (OROPHARYNGEAL DYSPHAGIA)

Group 2 aspiration syndromes include noninfectious diseases caused by oropharyngeal dysphagia above the glottis. The term accidental foreign body aspiration should be used when a peanut, bolt, currency, teeth, metal, or other similar material foreign to the human body is aspirated. This may become a serious medical condition if left untreated,[38,39] and early bronchoscopic or surgical removal is recommended.[39] If pulmonary infection occurs later in the course, the common organisms to treat would be those of CAP such as *S. pneumoniae*, *H. influenzae*, and *M. catarrhalis*.[40] Cavitation, chronicity, or pleural disease should be treated as anaerobic pneumonia as described above. Rare syndromes such as lentil aspiration pneumonia[41] may occur after legume aspiration with pulmonary nodules on chest x-ray and cough and dyspnea.

The terms oropharyngeal dysphagia should be used for a description of swallowing dysfunction, which may itself increase the risk of pneumonia.[6,42–46] The swallowing mechanism is complicated with several phases: oral, oral propulsive, pharyngeal, and esophageal.[47,48] When dysphagia leads to a chronic cough or vocal cord dysfunction in the outpatient setting, we prefer the term oropharyngeal dysphagia-related cough. Dysphagia rehabilitation,[49] food texture modification,[50] and oral care[51] may decrease the risk of pneumonia.[42–46] Other potentially beneficial interventions include levodopa,[52] capsaicin,[53] and angiotension-converting enzyme-inhibitor use.[54] Less common diseases such as a congenital (or acquired from tuberculosis or malignancy) tracheoesophageal fistula would best fall within this group[55] of disease related to dysphagia.

Aspiration of contrast material during upper gastrointestinal studies is included in group 2 aspiration syndromes. Barium contrast is often used to visualize the gastrointestinal tract in studies for reflux, dysphagia, or abdominal imaging. High-osmolar water-soluble contrast agents may lead to severe pulmonary edema and death.[56,57] Iso-osmolar or low-osmolar agents are preferred and may have less pulmonary toxicity.[58] The quantity of barium aspirated is likely to overwhelm the lung's tolerance.[59] Supportive care alone is recommended,[60,61] although chest physiotherapy has been utilized.[62]

Near-drowning[63] is a group 2 dysphagia syndrome caused by inhalation of liquid above the glottis, progressing to diffuse pulmonary edema after a water-related accident. This is usually initiated by aspiration of a small volume of liquid, followed by severe laryngospasm and hypoxemia,[64] and may lead to pulmonary edema and death. Supportive care with resuscitation and oxygenation is recommended. There is no evidence to support glucocorticoids or antibiotics.[65]

Exogenous lipoid pneumonia is a rare syndrome related to mineral oil ingestion aspirated into the trachea or nasal lipids aspirated inadvertently below the glottis, leading to dyspnea and hypoxemia. This syndrome has been described after ingestion of mineral oil for constipation. Several patterns have been described, including a radiographic consolidation demonstrating negative Hounsfield units, or a more fatal diffuse pneumonitis.[33]

GROUP 3 NONINFECTIOUS ASPIRATION SYNDROMES (GASTROESOPHAGEAL REFLUX)

Group 3 aspiration syndromes include noninfectious diseases caused by reflux of stomach contents. Gastroesophageal reflux disease should be used to describe reflux of both acid and non–acid material from the stomach proximal to the lower esophageal sphincter. Esophageal reflux in pulmonary disease should be used in conjunction with the end result, such as *Mycobacterium fortuitum* infection, obliterative bronchiolitis, bronchiectasis, or chronic cough.[66,67] Gastroesophageal reflux-associated cough should be used to describe the protective cough mechanism associated with reflux into the distal esophagus.

Chronic inflammatory pulmonary diseases such as obliterative bronchiolitis from reflux leads to heterogenous attenuation and pulmonary nodules on imaging with cellular bronchiolitis findings on biopsy.[23] Bronchiolitis symptoms are similar to asthma, with dyspnea from small airway airflow obstruction, often poorly responsive to bronchodilators. Gastroesophageal reflux similarly seems to be a risk factor in the development of noncystic fibrosis bronchiectasis, confirmed by pH and impedance monitoring in adults and children.[68,69] Imaging shows dependent-lung dilated airways often with small foci of consolidation.[70] Any pattern of cylindrical, varicose, or cystic bronchiectasis may be seen on computed tomographic imaging. Treatment of reflux may help prevent disease progression,[71] although unlikely to reverse any permanent airway dilation.

M. fortuitum is a rapid-growing nontuberculous mycobacterium aspirated into the lung related to gastroesophageal reflux. Effective antibiotic therapy is not well established and is beyond the scope of this discussion, but generally not needed after good control of esophageal reflux.[72]

Although there have been associations between esophageal reflux and interstitial lung disease (ILD) such as idiopathic pulmonary fibrosis and scleroderma,[73,74] there is insufficient evidence to state that esophageal reflux is causal in the development of ILD, and we have intentionally left this out of our classification.

We use the term chemical pneumonitis to describe the sterile chemical injury from gastric acid after vomiting, as first described by Dr Mendelson in 1946.[75] This syndrome results in severe respiratory distress with diffuse pulmonary infiltrates, generally followed by rapid clinical recovery.[75] Chest imaging shows diffuse symmetric bilateral opacities that can progress to diffuse opacification and acute respiratory distress syndrome.[33] This syndrome should not require antibiotics as gastric acid should inhibit the growth of bacteria.[29] Supportive care alone is recommended and if the disease persists at 48 hours, progressing to a group 1 infection, it should be treated as either CAP, HAP, VAP, or anaerobic pneumonia on the basis of the clinical course, as described above in group 1 infectious syndromes. Fatalities have been reported,[76] but are relatively uncommon with supportive care. We recommend against the term aspiration pneumonitis as it contributes to confusion regarding the sterile chemical injury to the lungs. The confusion between pneumonitis and pneumonia is exacerbated when it is often compared and contrasted with another confusing term, aspiration pneumonia.

ABANDONING THE TERM ASPIRATION PNEUMONIA

There is no uniform definition for the term aspiration pneumonia, no gold standard test to diagnose aspiration,[77] and it has been considered to overlap with other forms of pneumonia.[78–80] It is estimated that 50% of healthy adults aspirate at night,[81,82] and most of course do not develop pneumonia. The pathophysiology of both aspiration pneumonia and "nonaspiration pneumonia" is identical, in which microorganisms colonize the oropharynx and nasopharynx, leading to either microaspiration or macroaspiration.[2,8–11] In fact, nearly all organisms, other than *Mycoplasma pneumoniae*, *Chlamydophilia pneumoniae*, zoonoses, and biological

organisms such as *Bacillus anthracis*, are acquired through aspiration and inhalation of nasal and oral colonized organisms.[83–86] Not surprisingly, the nasopharynx, oropharynx, lung, and esophagus share a similar microbiome because of chronic microaspiration that occurs naturally,[87–91] which varies by diet,[92,93] age,[94–96] and geographic location.[97]

Clinically, there is no difference between these entities in terms of temperature, respiratory rate, hyponatremia, pleural disease, or cavitary lesions,[79] and in the intensive care unit, there is no mortality difference.[98] There is also considerable overlap in organisms, with slightly increased prevalence *E. coli*, *H. influenzae*,[99] and *K. pneumoniae* described in aspiration pneumonia and more *S. pneumoniae* and *S. aureus* in "non-aspiration pneumonia."[100] The shared risk factors, pathophysiology, symptoms, and infectious organisms raise the question as to whether aspiration pneumonia should even be recognized as a distinct clinical entity.[79]

Moreover, clinicians frequently infer,[100] incorrectly, that a diagnosis of aspiration pneumonia demands anaerobic coverage, despite an abundance of data contradicting its necessity.[21,23,25,80,101] To the contrary, pneumonia is more likely to develop as the oropharynx loses its benign population of *Prevotella* ssp. and *Veillonella* spp. and is overgrown with *P. aeruginosa*, *K. pneumoniae*,[102–108] and *Proteus* ssp.[109–114] Overgrowth by more virulent pathogens and impaired immune response through T-cell and dendritic cell depletion[105,115] and pulmonary IgA deficiency[116,117] lead to development of pneumonia, especially in the elderly. Despite the evidence, students and physicians continue to be taught to treat aspiration pneumonia as a pathogenic anaerobic infection and often lack the understanding that the pathogenesis of nearly all forms of pneumonia are caused by aspiration. The importance of where the organism is acquired, especially in hospitalized patients, should be stressed instead of the mechanism of infection. Empiric treatment of aspiration pneumonia in those patients hospitalized with HAP or VAP with medications including ampicillin/sulbactam or clindamycin would be ineffective in treating pathogenic *Pseudomonas*,[118] MRSA, and many Enterobacteriaceae,[23,28,29,31,32] and may lead to death.[26]

The risk factors for aspiration of oral contents are already widely agreed upon, including neurological disorders, tube feeding, dysphagia, older age, and cognitive impairment.[119] Many studies have reported characteristics of an elderly state, frailty, dementia, nursing home residence, and cognitive dysfunction associated with poor outcomes in aspiration pneumonia.[79,120] An increased mortality in aspiration pneumonia seems to be a self-fulfilling phenomenon noted by retrospective review as clinicians are more likely to diagnose older, sicker, nursing home patients as having aspiration pneumonia. It should already be self-evident, however, that older, frailer, and more debilitated patients are more likely to die of nearly any infectious disease, pneumonia included.[99,121]

An attempt to delineate whether it is a "regular pneumonia" or an aspiration pneumonia on the basis of a speech therapy evaluation is needless and inaccurate as dysphagia and chronic silent aspiration are often not witnessed,[122] and unlikely to reduce recurrent pneumonia.[123] A patient with a history of head and neck cancer, previous stroke, or neurological disorder is commonly reflexively diagnosed with aspiration pneumonia despite a lack of findings of dysphagia, much like the elderly patient. Good oral care for all patients, however, especially after stoke, may prevent recurrent pneumonia episodes[124–127] as poor dentition, care, and changes in salivary flow are more likely to lead to colonizaiton by pathogenic Enterobacteriaceae or *Streptococcus* ssp.[128–130]

With a lack of precise diagnostic criteria, a lack of distinction in pathophysiology, microbiology, and treatment, with a potential for harm in overtreatment of anaerobes or undertreatment of aerobes by overdiagnosis, we believe that there is insufficient evidence to suggest that aspiration pneumonia should be recognized as a distinct entity.

CONCLUSIONS

In summary, proper grouping of aspiration syndromes originating above or below the glottis and its infectious features should be utilized for clarity, rather than using vague and potentially harmful terms such as an aspiration event. It is hoped that our proposed grouping of these heterogenous aspiration syndromes helps to more precisely diagnose and classify the disease state in question. Terms attempting to describe a chronic anaerobic lung infection with dysphagia or dental risk factors in elderly patients or those with neuromuscular disease should generally be replaced with the diagnosis of anaerobic pneumonia.[131] Finally, we recommend abandoning the term aspiration pneumonia because of its ambiguous definition in the literature and practice, potential harm to patient care and physician education, and lack of sufficient diagnostic criteria to be considered a distinct clinical diagnosis.

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