Among older adults, aspiration pneumonia is associated with higher rates of morbidity and mortality than community-acquired pneumonia. Individuals admitted to acute care from continuing care facilities are at increased risk for aspiration pneumonia. Risk factor assessment forms a cornerstone in diagnosing aspiration pneumonia syndromes. Monitoring for timely clinical response to therapy and for potential complications is an important step in the care of patients with aspiration pneumonia. Further high-quality research is needed to better delineate the effects of risk factor modification on the incidence of aspiration pneumonia. Aiming to prevent aspiration pneumonia poses health care providers with an opportunity for ongoing development, study, and implementation of preventive strategies for older adults.

Key words: aspiration, pneumonia, older adults, geriatric, risk factor

Introduction

Aspiration occurs, and is resolved, on a daily basis in healthy people of all ages, but, occasionally, aspiration results in pulmonary syndromes. A key distinction is defined by Marik, who defines aspiration pneumonia as acute lung injury due to gastric contents, and aspiration pneumonia as a radiographic infiltrate and bacterial infection in an individual at increased risk of aspiration. Others would divide the pulmonary syndromes into three distinct categories: chemical pneumoniaitis (Mendelson’s syndrome), foreign body obstructive pneumonia, and aspirated bacteria causing pulmonary infection (aspiration pneumonia). Aspiration pneumonia is associated with a statistically significant increase in the rate of intensive care admissions, mortality, and hospital costs compared with community-acquired pneumonia (CAP) alone, particularly among older adults. We aim to summarize the diagnosis, risk factors, complications, prevention, and treatment of aspiration pneumonia among older adults. A clinical case is used to highlight some of the key issues.

Case Report

A 70-year-old man with a longstanding history of alcohol use was assaulted while intoxicated and was reportedly left on the ground for a 3-day period. He was brought to a community emergency department and, although rousable, was found to have a temperature of 38.9°C. He was coughing, and his oxygen saturations were 85% while breathing room air. A chest radiograph confirmed lower lobe opacities (Figure 1). How would you manage this patient? What is his diagnosis, and what would you prescribe for his fever?

Ten days later, despite antibiotic therapy, he still had fever measuring up to 39.0°C. What would be your approach at this stage?

Diagnosis

The diagnosis of aspiration pneumonia can be challenging. Aspiration may be described as macro (typically large volume and witnessed) or micro (often unknown to the patient but described by scintigraphic studies). Just as aspiration may vary in inoculum size, it may also vary in clinical presentation and course. For this reason, precise definitions are difficult and are variable in clinical practice and in research studies.

Aspiration of naso- or oropharyngeal contents may result in aspiration of typical respiratory pathogens such as Haemophilus influenzae, Streptococcus pneumoniae, gram-negative bacilli and Staphylococcus aureus, but aspiration of anaerobic oral flora is also possible. Studies conducted in the 1970s by Bartlett et al., succeeded in isolating anaerobes from transtracheal aspiration. Commonly isolated anaerobes included Peptostreptococcus spp., Fusobacterium nucleatum, Prevotella spp., and Bacteroides spp. A later study of institutionalized individuals with risk factors for aspiration who were admitted to intensive care with pneumonia also demonstrated anaerobic bacteria isolated from respiratory specimens in at least 16% of individuals. Unlike the case with typical pyogenic pathogens, a higher inoculum is likely required for clinical disease to result from anaerobic bacteria. The source of the inoculum is typically the oropharynx; thus, assessment of oral hygiene is important for the diagnosis and recognition of aspiration pneumonia syndromes.

Gram stains of bronchial brush specimens, or even sputum specimens, are occasionally helpful but are limited by variable sensitivity and specificity. Characteristic morphologies of anaerobic bacteria, such as that of Fusobacterium spp. or Actinomyces spp., may be recognized on Gram-stained specimens (as in the polymicrobial specimen shown in Figure 2), but Gram stain interpretation requires expertise in microscopy, and not all anaerobic bacteria have such distinctive morphology.

Complicating definitive etiological diagnosis, anaerobic bacteria are not routinely cultured from respiratory specimens. Anaerobic bacteria may not survive transport in usual aerobic transport systems, they may be particularly
difficult to isolate after even a single dose of antibiotic, and they are not easily cultivated from clinical specimens, even in experienced laboratories, where specialized equipment such as a gas chromatograph would often be required for speciation.

Microbiological diagnosis from respiratory specimens, at least in the current era of bacterial culture, is not prompt or definitive, so treatment is typically prescribed based on empirical principles. For this reason, identification of aspiration risk factors forms a cornerstone in the diagnosis of aspiration pneumonia.

**Risk Factor Assessment**

In the clinical case presented, the patient’s chronic alcohol use, acute intoxication, and decreased level of consciousness all put him at risk for aspiration pneumonia. On further examination, he was found to have severe periodontal disease and putrid sputum, which put him at risk for anaerobic infection. His case represents a typical profile of patients with CAP at high risk for aspiration and anaerobic infection.

Periodontal disease and oral hygiene have been the focus for research in pneumonia syndromes. Researchers have examined dental plaque of dependent older adults. Sumi et al. demonstrated that dental and denture plaque may serve as reservoirs for respiratory pathogens. They found respiratory pathogens in 64.5% of subjects’ dental plaque, and while this was 1.5 times higher than that found on denture plaque, both dental and denture plaque were demonstrated to be potential reservoirs for respiratory pathogens. Similarly, Abe et al. demonstrated that tongue coating was associated with viable salivary bacterial cells among edentulate individuals, and they have developed a tongue-coating index to be tested as a tool for pneumonia risk assessment among edentulate individuals. There is clear evidence that the oropharynx, being in persons with or without teeth or dentures, is a potential reservoir for pneumonia-causing pathogens.

Older adults living in long-term care (LTC) facilities represent a unique subpopulation at increased risk for aspiration pneumonia. In a recent cohort study, aspiration was diagnosed among roughly 10% of individuals admitted to hospital with CAP, which is consistent with previous studies, but 30% of individuals from LTC facilities admitted to hospital with CAP were diagnosed with aspiration pneumonia. Additional risk factors for pneumonia studied in cohorts of individuals in LTC facilities include poor swallowing capabilities, lack of dental care (defined as the lack of a dental visit within the past year), and lack of influenza vaccination (increasing the risk of lower respiratory infection or pneumonia). Cerebrovascular disease, neuromuscular disorders, and disorders of the basal ganglia likely account for many of the swallowing difficulties of persons in LTC facilities and pose a risk for aspiration.

**Clinical Considerations Including Potential Complications**

The case presented describes an individual who remained febrile 10 days after appropriate antimicrobial therapy was initiated. When bacterial pneumonia is suspected, an important next step in continued care is monitoring the time to clinical response after appropriate antibiotic therapy is initiated. Studies demonstrate that patients may be expected to defervesce in approximately 2–4 days following hospital admission with CAP. In a multicentre observational cohort study, the median time to resolution of fever following admission for CAP (temperature <37.2°C) was 3 days. The median time to stability was 2 days for heart rate (<100 beats/minute) and systolic blood pressure (>90 mm Hg) and 3 days for respiratory rate (<24 breaths/minute) and oxygen saturation (>90%). The median time to overall clinical stability was 3 days for the most lenient definition of stability and 7 days for the most conservative definition.

Careful and repeated reassessments of antibiotic therapy are important, but so too is investigation for complications of pneumonia and other potentially coincident etiologies for fever. Knowledge of expected times to clinical response should guide further investigation and reassessment.

Empyema and lung abscesses are serious potential complications of aspiration pneumonia. Anaerobes are frequently isolated from empyema. Diagnosing these potential sequelae requires repeat

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**Figure 1: Chest Radiograph of Patient Admitted with Aspiration Pneumonia**

This radiograph was taken of the patient described in the case report. Note the patchy opacities at the lung bases, suggestive of acute inflammatory changes (more prominent on the right side).

Source: Dr. R. Harrison and Dr. T. Marrie.

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**Figure 2: Gram-Stained Polymicrobial Sputum Specimen**

This specimen includes morphologies suggestive of *Fusobacterium* and *Actinomyces* spp., along with two morphotypes of gram-positive cocci.

Source: Photo courtesy of Dr. Jana Nigrin of Dynacare Kasper Medical Laboratories, Edmonton, AB.
This computed tomographic scan was taken of the patient described in the case report. This scan confirmed the consolidation. Although the patient did have a small lung effusion, he did not have lung abscess and ultimately did not have empyema as a source for his fever. The absence of these potential complications prompted the concomitant search for an alternative etiology for his fever when he failed to reach clinical stability in the expected time.

In the case presented, the initial antibiotic coverage was appropriate, and there was no evidence of lung abscess or empyema on computed tomography (Figure 3). The search for a concomitant etiology for his fever led to an obvious source: his poor dentition (see Figure 4). A dental panoramic radiograph confirmed multiple dental abscesses (Figure 5). After more than a week of fever on appropriate antibiotic therapy, his fever resolved within 48 hours of dental extraction. The diagnosis for this case is perhaps best defined as severe periodontal disease complicated by multiple dental abscesses and aspiration pneumonia.

### Prevention

Just as risk factors form a cornerstone for diagnosis, prevention should form the foundation for any discussion on treatment. Despite established risk factors, a systematic review of the literature (1966–2001) found insufficient data to determine the effectiveness of aspiration pneumonia preventive strategies. This systematic review was restricted to randomized controlled clinical trials (RCTs) and included an assessment of positioning strategies, modified diets, oral hygiene, feeding tube placement, and methods of food delivery. The effectiveness of oral hygiene programs appeared promising in one RCT by Yoneyama, et al., but was of borderline statistical significance.

While pharmacological strategies have also been proposed (e.g., amantadine and cilostazol), the potential for harm with these drugs could limit their acceptability. A systematic review of controlled prospective studies of pharmacological prevention of aspiration (1974–2006) concluded that there are insufficient data to support an evidence-based approach to aspiration pneumonia prevention with pharmacological agents at this time.

Loeb, et al. called for more large, high-quality RCTs on the effectiveness of these preventive interventions because aspiration pneumonia is common and associated with significant morbidity and mortality among older adults. Robust evidence could help guide the standard implementation of preventive interventions in care facilities and education programs for caregivers.

Evidence-based preventive measures should guide future technology and preventive strategy implementation. In the interim, the identification of potentially modifiable risks such as periodontal disease, poor oral hygiene, excessive alcohol use, and witnessed positional aspiration should prompt intervention aimed at eliminating the risks.

### Treatment

Once a patient is diagnosed with CAP, treatment regimens may be considered and tailored to individual risk profiles. If uncomplicated, the treatment of CAP due to an aspirated bacterial inoculum relies primarily on antibiotic therapy.

In the case presented, we learned that the patient had putrid sputum and poor oral hygiene. A further history-taking revealed that his symptoms were subacute and included nonspecific symptoms such as fatigue and anorexia for days before he developed cough and fever. These findings are in keeping with a potential anaerobic pulmonary infection. It is perhaps important to recognize that not every patient fits this classic description for anaerobic infection, and that anaerobic bacterial coverage may not always be necessary.

Recommendations for the management of aspiration pneumonia differ, and a frequent debate is whether anaerobic coverage is indicated. The Infectious Disease Society of America/American Thoracic Society 2007 guidelines state that the need for specific anaerobic coverage for CAP is generally overestimated and that antibiotic trials have not demonstrated a need to specifically treat these organisms.
in the majority of CAP cases. They further state that anaerobic coverage is “clearly indicated only in the classic aspiration pleuropulmonary syndrome in patients with a history of loss of consciousness as a result of alcohol/drug overdose or after seizures in patients with concomitant gingival disease or esophageal motility disorders.” For such cases, they recommend therapy with amoxicillin and clavulanic acid or with clindamycin. For all other cases, they recommend therapy with a respiratory fluoroquinolone or a beta-lactam and macrolide combination.

In the clinical case presented, the patient was prescribed moxifloxacin. As a fourth-generation fluoroquinolone with demonstrated anaerobic activity in vitro, this is a suitable option. Moxifloxacin should provide broad gram-positive (including *Streptococcus pneumoniae* and methicillin-susceptible *Staphylococcus aureus*), gram-negative (including *Klebsiella* spp., *Haemophilus influenzae*, and *Moraxella* spp.), anaerobic (including *Peptostreptococcus* spp., *Bacteroides* spp., and *Fusobacterium* spp.), and atypical organism coverage (for *Mycoplasma* spp., *Chlamydia pneumoniae*, or *Legionella* spp.). This choice is supported by recommendations from the Canadian Infectious Diseases Society and the Canadian Thoracic Society in the *Canadian Guidelines for the Initial Management of Community-Acquired Pneumonia*, published in 2000.

Other recommended options included amoxicillin and clavulanic acid plus a macrolide or a third-generation respiratory quinolone (e.g., levofloxacin) with metronidazole or clindamycin.

An additional important consideration with all cases of CAP is whether there is a risk for the typically nosocomial-acquired and aggressive pathogens such as *Pseudomonas aeruginosa*, drug-resistant *Streptococcus pneumoniae*, and methicillin-resistant *Staphylococcus aureus*. These are particularly important considerations for older adults who may visit hospitals repeatedly as in- or outpatients, including those who live in LTC facilities. When studied, the population with frequent health care visits was reported to be more prone to aspiration and less likely to receive appropriate empirical antibiotic therapy (*appropriately* defined as amoxicillin and clavulanic acid for suspected aspiration). These individuals merit careful and targeted assessment.

While the focus of this review has been aspiration pneumonia, rather than chemical pneumonitis, it should be noted that the management of chemical pneumonitis may also be challenging. In 1946, Mendelson described a classic syndrome of acute respiratory distress associated with radiographic infiltrates after ether anesthesia in a series of 61 obstetrical patients who aspirated gastric contents. Although all the individuals recovered, subsequent study suggests that some people may develop acute respiratory distress syndrome before improving, and some may go on to develop secondary bacterial pneumonia. Careful observation for developing signs of infection or complication seems a reasonable approach.

### Conclusion

In summary, while definitions for aspiration pneumonia are variable, clearly identifiable risk factors for aspiration combined with chest radiographs showing infiltrate and clinical symptoms suggestive of pneumonia should prompt the diagnosis of aspiration pneumonia and treatment to prevent repeated pneumonia among older adults. In select cases of aspiration pneumonia, anaerobic bacteria may be the pathogens involved. Treatment regimens should reflect this possibility and should be tailored to each individual patient’s clinical syndrome and presentation. The diagnosis of aspiration should not detract from the basic management of CAP among older adults. Patients should be monitored for appropriate clinical response to therapy, and if response is delayed, potential complications such as empyema and lung abscess should be considered. Aspiration pneumonia is a common and significant problem among older individuals; it poses health care providers with the opportunity for the ongoing development, study, and implementation of preventive strategies.

### Key Points

- Risk factor assessment is key to diagnosis and, ideally, prevention of aspiration pneumonia.
- Risk factors for aspiration pneumonia, such as poor oral hygiene, impaired swallowing capability, neurological disease, or decreased level of consciousness, are prevalent among older adults, and particularly those living in long-term care facilities.
- Older adults with teeth or dentures, and even edentulous older adults, may harbour respiratory pathogens in their oropharynx that are easily aspirated.
- Bacterial pathogens may include anaerobic bacteria in aspiration pneumonia syndromes, and antibiotic therapy should be based on individual patient risk profiles.
- The expected time to clinical stability with pneumonia syndromes is 3 days from the time appropriate antibiotic therapy is initiated. If response is delayed, physicians should consider inappropriate antibiotic coverage, screen for potential complications of pneumonia, and consider other diagnoses.

### References

Aspiration Pneumonia among Older Adults


