

## Pneumonia: An Update and Overview

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The term *pneumonia* denotes an infection of the lung parenchyma, as opposed to the bronchi or upper airway. It occurs in patients of all ages, but particularly in the very young and old, and those with compromised immune systems. Pneumonia is an exceptionally common cause of death and hospitalization. Distinct forms occur in patients with different risk factors and in varying settings. Among these, the four most common categories include community acquired pneumonia (CAP), nosocomial pneumonia (i.e., that occurring in a hospital or extended care facility), aspiration pneumonia, and pneumonia in the immunocompromised host. In each category, the risk of pneumonia relates to the virulence of the infecting organisms and the ability of the host to avoid or fight infection. This paper will review the definitions, clinical presentation, and treatment of various forms of pneumonia occurring in adults.

### Community Acquired Pneumonia

Community acquired pneumonia (CAP) refers to that which develops outside the hospital or in patients hospitalized less than 3 days. Patients at particular risk include smokers, alcoholics, those with underlying structural lung disease (e.g., chronic obstructive pulmonary disease [COPD], lung cancer), and patients with recent viral illness such as influenza.

CAP is classically divided into two broad classes—"typical" and "atypical"—differing both in clinical presentation and by the organisms causing the infection. Patients with typical pneumonia present with the abrupt onset of chills, fever, pleuritic chest pain, and a productive cough

with purulent sputum. The physical exam frequently demonstrates evidence of focal consolidation in a specific region of the lung, which can be confirmed by chest radiography showing focal areas of abnormality, for example dense consolidation of one or more lobes. The two organisms most frequently associated with typical CAP are *Streptococcus pneumoniae* and *Hemophilus influenzae*.

In contrast, atypical pneumonia classically presents with more vague symptoms and systemic complaints, including headache, sore throat, low-grade fever without chills, non-productive cough and wheeze, rash, myalgias, and gastrointestinal complaints. Organisms associated with atypical pneumonia include *Legionella*, *Mycoplasma*, and *Chlamydia*. The physical exam is less likely to demonstrate focal pulmonary findings. Similarly, the chest radiograph may show vague patchy or interstitial infiltrates. It is important to emphasize that the presentation and findings in patients with both typical and atypical forms of pneumonia frequently overlap, making it hazardous to plan therapy entirely on the basis of clinical features.

In stable outpatients without significant comorbidity, a reasonable treatment is a macrolide, such as azithromycin, or one of the newer quinolones, such as gatifloxacin or moxifloxacin. In patients admitted to the hospital, treatment generally requires intravenous (IV) therapy with one of the newer quinolones (again, gatifloxacin or moxifloxacin) or a combination that includes a third generation cephalosporin (e.g., ceftriaxone) and a macrolide (e.g., azithromycin). Factors influencing the decision to hospitalize include severity of illness; the number of lobes involved on the chest radiograph; comorbidities such as cancer, diabetes,

or underlying lung disease; hypoxia; history of substance abuse; dehydration; and concern that a patient is unlikely to be compliant with an outpatient antibiotic regimen. All patients who develop pneumonia and all those with risk factors, including chronic lung disease and age over 65, should be given the pneumovax to decrease the risk of future, severe pneumococcal pneumonia.

### Nosocomial Pneumonia

Pneumonia is categorized as nosocomial when it develops after 3 days of hospitalization or residence in an extended care facility. It occurs in approximately 5-10 cases per 1,000 hospital admissions and can increase length of the stay by an average of 7-9 days. Mortality is up to 70%, although much of this may be due to underlying disease as opposed to pneumonia per se.

The most important feature distinguishing nosocomial from community-acquired pneumonia is the type of infecting organism. In contrast to CAP, nosocomial infections are most commonly caused by *Staphylococcus aureus*, including methicillin resistant forms (i.e., MRSA) and specific gram negative bacteria, particularly *Pseudomonas aeruginosa*, *Acinetobacter*, and *Serratia*. The frequency with which different bacteria infect patients varies significantly by region and between hospitals.

Nosocomial pneumonia can be subcategorized into that occurring in association with intubation and mechanical ventilation (i.e., ventilator associated pneumonia, VAP) and that occurring without the ventilator. Factors contributing to the development of nosocomial pneumonia in patients who are not intubated and mechanically ventilated include depressed mental status, colonization of the upper airway with potential pathogens, generalized weakness and debility, and immunocompromised states. Patients already admitted to the hospital with lung disease (e.g., patients with COPD), patients with depressed mental status (e.g., those

admitted with stroke), and the elderly are at particular risk.

VAP is one of the most common complications occurring in patients requiring mechanical ventilation and is a significant cause of morbidity and mortality among patients in intensive care units. Factors contributing to VAP include bypassing the upper airway defenses with the endotracheal tube, weakened pulmonary defenses due to underlying lung disease, reflux and aspiration of gastric contents, microaspiration of organisms colonizing the oropharynx, and direct inoculation through the endotracheal tube.

The diagnosis of VAP can be challenging, given that most intubated patients are colonized with bacteria that can cause infections, making routine culture relatively non-specific. In addition, the chest radiograph is often unhelpful, particularly in patients who already have radiographic abnormalities. Finally, patients with underlying lung disease may be hypoxic and produce respiratory secretions, even if they do not have an untreated infection. Factors that favor the diagnosis of VAP include the development of fever in association with new radiographic infiltrates, worsening oxygenation, and purulent secretions. Techniques designed to increase the specificity of cultures obtained to evaluate for VAP include bronchoscopy (particularly with quantitative lavage and brushing) and use of quantitative tracheal aspirates. Whether these specialized techniques truly offer a clinical advantage over routine culture remains a matter of debate.

Empiric treatment for VAP is the same as for other forms of nosocomial pneumonia. Prior to obtaining culture results, antibiotics should be directed towards Staph and gram negative species. In stable patients (i.e., without respiratory failure or septic shock), it is reasonable to use a single agent, such as piperacillin-tazobactam, which should cover the majority of bacteria in most hospitals. In sicker patients, broader coverage

is necessary while waiting for culture results, because it would be devastating to miss a pathogen with initial antibiotic coverage. For this reason, vancomycin is often chosen to cover for methicillin resistant Staph aureus, in addition to two drugs to cover gram negatives, such as piperacillin-tazobactam and ciprofloxacin. The best antibiotics vary by site, and clinicians should choose antibiotics based on the results of antibiograms, available from most local microbiology labs. Antibiotics can generally be narrowed when culture results return. Continued treatment with unnecessary antibiotics increases the risk that resistant organisms will emerge both in the patient and in other patients in the intensive care unit.

There are several techniques that can decrease a patient's risk for nosocomial pneumonia. The most important is discontinuing intubation and mechanical ventilation as soon as it is feasible because the risk of pneumonia rises steadily with duration of mechanical ventilation. Other important interventions include raising the head of the bed in intubated patients by at least 30-45°, particularly in those receiving enteral nutrition; using in-line suction devices; and maintaining excellent oral hygiene. Use of non-invasive ventilation (e.g., non-invasive positive ventilation by face mask or BiPAP) in selected patients, such as those with COPD, significantly decreases the risk that pneumonia will occur. More controversial interventions include maintaining gastric acidity by using sucralfate instead of H<sub>2</sub> blockers when prophylaxing against gastrointestinal hemorrhage, selectively decontaminating the gut of intubated patients, and using endotracheal tubes with antibacterial coating.

Nosocomial pneumonia is also common in patients who have recently been extubated and removed from the mechanical ventilator. Dysphagia and potential aspiration of food and oropharyngeal matter is a common and potentially important

contributing factor, although significant work needs to be done to specifically define and quantify the risk. Other factors include generalized weakness and debility, altered or depressed mental status, poor nutrition, persistent or incompletely healed lung disease, weak cough, and immunosuppression related to underlying disease or medication. In this population, careful screening for aspiration may allow clinicians to identify those at risk and to make potential interventions, such as modifying diets, to decrease the possibility of infection.

### *Aspiration Pneumonia*

The term aspiration denotes the deposition of foreign material into the airway or distal lung and represents one of the most common and feared complications of other illnesses or accidents. Predisposing factors include altered consciousness (for example, intoxication, coma, sedation); seizures; abnormal upper airway anatomy (for example head and neck tumors, tracheoesophageal fistula); and dysphagia.

There are three main aspiration syndromes. The first, asphyxiation, can occur when foreign material, almost always solid, occludes the central airway, generally at the level of the vocal cords. It is almost always fatal unless the obstruction is alleviated immediately by techniques such as the Heimlich maneuver or, if that fails, by emergency placement of an artificial airway such as a cricothyrotomy.

The second aspiration syndrome is chemical pneumonitis ("aspiration pneumonitis"), which occurs in patients who aspirate significant quantities of gastric contents or other foreign material (for example, water during drowning). The chemical pneumonitis can progress over hours to days and lead in the worst cases to respiratory failure requiring mechanical ventilation. Factors which determine the severity of lung injury in-

clude the volume aspirated, the composition of the aspirated material, its pH, the presence of particulate matter, and the presence and quantity of bacteria. Treatment is generally supportive with oxygen and mechanical ventilation if necessary. Antibiotics are reserved for patients with evidence of superimposed infection.

The third syndrome, aspiration pneumonia, indicates pneumonia that occurs as a direct consequence of aspiration. Although, strictly speaking, other forms of pneumonia frequently result from aspiration of oropharyngeal material, the term aspiration pneumonia refers to a specific syndrome involving larger quantities of material, generally from the oropharynx or stomach. In contrast to other forms of pneumonia, aspiration pneumonia almost exclusively involves dependent regions of the lung—particularly the bases, the superior segments of the lower lobes, and the posterior segments of the upper lobes, leading to characteristic radiographic abnormalities. Frequently, anaerobic bacteria are involved, particularly in outpatients, leading to an often indolent, slowly progressive infection. Treatment includes antibiotics, which cover anaerobes (such as clindamycin or ampicillin-sulbactam), and drainage if complications such as lung abscess or empyema (infection of the pleural space) occur. In some cases, particularly in hospitalized patients, aspiration can involve more virulent organisms, leading to a much more rapidly progressive infection, requiring treatment similar to other forms of nosocomial pneumonia.

### ***Pneumonia in the Immunocompromised Host***

With the advent of transplantation medicine, AIDS, use of immunosuppressive drugs to treat various rheumatologic diseases such as systemic lupus, and aggressive treatment of malignancies with che-

motherapy, it is becoming increasingly important for clinicians to be aware of specific forms of pneumonia and other non-infectious pulmonary complications in patients with compromised immune systems. Although immunocompromised patients can develop pneumonia with the same organisms causing disease in normal hosts, they can also develop infections with relatively indolent organisms that would not cause illness in those with intact immune systems.

The particular organisms causing pneumonia in this population depend on a variety of factors, including the specific form of immunocompromise and how long the immune system has been impaired. For example, patients with multiple myeloma often have difficulty defending against encapsulated bacteria, such as the *Streptococcus pneumoniae*. Neutropenic patients, such as those with leukemia or those receiving chemotherapy, are particularly at risk for infection by gram-negative bacteria, such as *Pseudomonas aeruginosa* or fungi such as *Aspergillus fumigatus*. Patients with cellular immunodeficiency, such as AIDS and transplant patients, are at increased risk for *Pneumocystis carinii* and viruses such as *Cytomegalovirus*.

Physicians caring for immunocompromised patients need to maintain a high level of suspicion for pneumonia and evaluate aggressively for infection, recognizing that delays in diagnosis and treatment can greatly decrease a patient's chances of recovery. Empiric therapy is often necessary based on the patient's particular immunodeficiency and clinical and radiologic characteristics. In many cases, invasive diagnostic techniques, such as bronchoscopy, are necessary. Treatment, in addition to specific antibiotics, may include immune reconstitution, for example, using G-CSF in patients who are neutropenic.

### ***Conclusion***

Pneumonia is one of the most common and feared infections. Left untreated, it is a source of major morbidity and mortality, carrying the highest death rate of any infectious disease. Effective therapy requires rapid diagnosis, appropriate antibiotics, and supportive care, including oxygen, pulmonary toilet, and, if needed, mechanical ventilation. Equally important, patients at risk for pneumonia require preventive measures such as the pneumovax, annual influenza vaccination, smoking cessation, and, if possible, immune system support. Given that many forms of pneumonia occur in the presence of dysphagia, collaboration between physicians and speech-language pathologists specializing in swallowing disorders can be extremely valuable.

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### ***For Further Reading***

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## Continuing Education Questions

1. People at risk for community acquired pneumonia are those with
  - a. alcohol abuse.
  - b. stroke.
  - c. recent viral illness.
  - d. a and c.
  - e. all of the above.
2. MRSA can cause a community acquired pneumonia.
  - a. True
  - b. False
3. Intubated patients are at particular risk for nosocomial pneumonia.
  - a. True
  - b. False
4. Asphyxiation generally occludes the airway at the level of the trachea.
  - a. True
  - b. False
5. Lung regions involved in aspiration pneumonia include
  - a. the bases.
  - b. the superior segments of the lower lobes.
  - c. the posterior segments of the upper lobes.
  - d. a and b.
  - e. all of the above.

*Therese O'Neil-Pirozzi, Column Editor*

## Student Abstracts

The purposes of this Student Abstracts column are:

1. To provide a mechanism for Division 13 affiliates to be updated on recent quality field-related research, and
2. To provide graduate students with an opportunity to identify a recent swallow-related research article of interest, review it, and abstract it for the division affiliates.

To date, students attending Arizona State University, Eastern Washington University, Edinboro University of Pennsylvania, Florida International University, Florida State University, George Washington University, Illinois State University, Louisiana State University Health Sciences Center (New Orleans), Louisiana State University Health Sciences Center (Shreveport), Louisiana Tech University, Northeastern University, Northern Arizona University, Southeastern Louisiana University, Southern Illinois University, Teachers College-Columbia University, University of Central Arkansas in Conway, University of Kansas, University of Memphis, University of New Hampshire, and University of Wisconsin-Madison have published abstracts in this newsletter column. **Please invite all of the graduate students who you teach and/or supervise to consider taking advantage of this opportunity. The abstract guidelines are as follows:**

1. Select a quality swallowing related experimental/prospective research article that has been published within the past 12 months;
2. Select an article from any journal other than *Journal of Speech, Language, and Hearing Research* and *American Journal of Speech-Language Pathology: A Journal of*

*Clinical Practice* (since most Division 13 members already read these);

3. Use the following headings: title, author(s), journal citation, purpose(s), design, setting, subjects, interventions, outcome measures, results, conclusions, comments/impressions;
4. Include student mailing and e-mail addresses.

Theme and abstract submission deadline for the final 2003 issue are: Sensory Aspects of Food—September 21. Themes and abstract submission deadlines for the 2004 issues are: Legal and Financial Documentation—December 18 for the March issue, Specialty Recognition and Encroachment—March 18 for the June issue, Radiation Safety—July 18 for the October issue, and State of the Clinical Examination—September 18 for the December issue. Abstracts should be sent for consideration on a PC-formatted Word disk to Abstracts should be sent for consideration on a PC-formatted Word disk to: Therese O'Neil-Pirozzi, ScD, CCC-SLP, Northeastern University, Speech-Language Pathology and Audiology, 103 Forsyth Building, Boston, MA 02115, (phone: 617-373-5750, e-mail: toneilpi@lynx.dac.neu.edu)

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## Incidence and Type of Aspiration in Acute Care Patients Requiring Mechanical Ventilation via a new Tracheotomy

*Author: Steven B. Leder  
Journal Citation: Chest 122(5); Nov. 2002: 1721-1726.*

### Purpose

The primary purpose of this study was to determine incidence

of aspiration and type (silent or overt) in acutely ill patients requiring ventilation with a new tracheotomy for two months or less.

### Method

**Research Design:** A prospective, descriptive design was used to complete this study.

**Setting:** This study was conducted at an acute care teaching hospital in New Haven, CT.

**Subjects:** Subjects consisted of 52 consecutive acute care adult inpatients referred for a swallow evaluation, who were receiving mechanical ventilation via a new tracheotomy for 2 or less months time second to various medical diagnoses. Twenty-eight subjects were men, with a mean age of 58 years, and 24 were women, with a mean age of 70 years. The subjects presented with various medical diagnoses.

**Interventions:** Incidence and type of aspiration were determined based on objective assessment using fiberoptic endoscopic evaluation of swallowing (FEES). FEES was performed at bedside with each subject in as much of an upright position as was possible, without topical anesthesia. Each subject was first given 3-5 mL puree boluses via a spoon and then 3-5 mL liquid boluses via a straw. If successful swallowing (the blue dyed) pureed and liquid consistencies and if dentition was appropriate for mastication,

each subject was also tested swallowing solid boluses. Video recordings of the studies were not made.

**Outcome Measures:** FEES measures of incidence of aspiration (present/absent) and type of aspiration (overt/silent) were the primary outcome measures used in this study. Subject age, number of days post-tracheotomy, and duration of trans-laryngeal intubation were secondary outcome measures used to further investigate the incidence and type of aspiration results.

### Results

FEES testing revealed that 35 of the 52 subjects (67%) did not aspirate. Of the remaining 17 (33%) that did aspirate, 14 of them (82%) aspirated silently. In regard to age, those who aspirated were significantly older than those who did not aspirate (mean age of 73 years versus 59 years) ( $p < 0.05$ ). In regard to number of days post-tracheotomy, those who aspirated were post-tracheotomy for significantly fewer days than those who did not aspirate (mean of 14 days versus 23 days) ( $p < 0.05$ ). In regard to duration of trans-laryngeal intubation, there were no significant differences between aspirators and non-aspirators (mean of 14 days versus 14 days) ( $p > 0.05$ ).

### Conclusions

Two thirds of this study's 52 acutely ill subjects requiring me-

chanical ventilation with a new tracheotomy for two or less months swallowed without aspiration. The aspiration that study subjects experienced was primarily silent in nature. Aspirators were significantly older and were more recently post-tracheotomy than non-aspirators.

The author discusses the importance of appropriate timing to objectively evaluate aspiration in this population on a patient-by-patient basis. Based on the results of this study, he suggests that the optimal time to assess aspiration and achieve a positive outcome (i.e., no aspiration) in patients greater than 70 years of age is approximately three weeks post-tracheotomy and in patients less than 70 years of age is approximately one week post-tracheotomy.

### Comments/Impressions

Patients receiving mechanical ventilation via a tracheotomy warrant an objective swallow assessment, to test for aspiration, which was the focus of this study, and to test for other swallowing impairments as well. Not only should these patients' swallow function be evaluated in a timely fashion, their dysphagia and overall feeding status should also be managed in a timely fashion. More research on this topic, with specifics regarding tracheostomy tube and ventilatory status specified, is greatly needed.



### Attention Affiliates!

You are eligible to receive a 50% discount on select Short Courses at Convention (see page 54 of the Convention Program for a complete list)!

Don't miss Division 13's master Short Course titled "The Biophysiologic Relationship Between Alimentary and Pulmonary Systems: A Delicate Balance" (SC 29) Saturday, November 15, 9-12 a.m. Immediately following, join your colleagues for our annual business meeting, 12-1 p.m.