Preventive measures are still the best strategy

Aspiration syndromes: Pneumonia and pneumonitis

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abstract: While the risk factors for aspiration pneumonia are similar to those for aspiration pneumonitis, the 2 syndromes have different presentations. Aspiration pneumonia tends to occur in older patients or in those with neurological diseases, and the aspiration is not usually witnessed. Aspiration pneumonitis is more likely to occur in patients undergoing anesthesia or in those with acute drug and alcohol overdoses, and the aspiration is often witnessed. The workup may include bedside assessment of the cough and gag reflexes, chest radiography, videofluoroscopic imaging, or fiberoptic endoscopy. Empiric antibiotic therapy should be avoided in most patients with pneumonitis; however, antibiotics may be indicated for those at high risk for bacterial colonization of oropharyngeal and gastric contents who have fever, increasing sputum production, or new infiltrates or for those who fail to improve within 48 hours. (J Respir Dis. 2007;28(9):370-385)

Aspiration is defined as the misdirection of oropharyngeal or gastric contents into the larynx and lower respiratory tract. This can result in a wide spectrum of clinical syndromes depending on host factors, the type and amount of the material aspirated, and the frequency of aspiration. Although aspiration occurs during normal sleep, mucociliary defense mechanisms and cough reflexes usually clear the airways and prevent pulmonary complications from occurring. If these mechanisms are impaired or absent, chemical pneumonitis from acidic gastric fluid, infection from aspirated bacterial pathogens, and airway obstruction from particulate matter may result.

The purpose of this review is to focus on the clinical manifestations, diagnosis, and treatment of aspiration pneumonitis and aspiration pneumonia. While these 2 terms are often used interchangeably, they represent 2 separate and distinct clinical syndromes.

ASPIRATION PNEUMONITIS

Aspiration pneumonitis is defined as the inhalation of regurgitated gastric contents that results in acute chemical lung injury. Normally, gastric contents are sterile because of the acidic suppression of bacterial growth. Therefore, lung injury from aspiration pneumonitis is usually not a consequence of bacterial infection. However, in patients receiving acid suppression therapy (antacids, proton pump inhibitors, H₂ blockers) or enteral feeding, bacterial colonization of the normally sterile gastric contents may occur and infection may play a role.

Gastric contents may be liquid or particulate matter, and aspiration may result from passive regurgitation or active vomiting of gastric contents in patients who do not have the protection of upper airway reflexes. In a healthy, conscious person, the lower esophageal sphincter tone and upper airway reflexes prevent aspiration of gastric contents into the respiratory tract. With altered levels of consciousness, as occurs with drug overdose, seizures, or the use of anesthetics, these reflex mechanisms are impaired and aspiration may take place.

The aspiration event is usually acute and may be witnessed. In 1946, Mendelson first described this aspiration syndrome in obstetric patients who were in labor; the event is widely recognized as a potential complication of anesthesia during the perioperative and postoperative periods. The clinical response to aspiration of gastric contents depends on the type of material aspirated. Mendelson described 2 separate clinical syndromes. The first syndrome is the inhalation of particulate matter that can cause airway obstruction and asphyxiation. Smaller particles may lead to distal atelectasis, granulomatous inflammation, pulmonary edema, or the nidus for abscess formation.

The second syndrome is the chemical damage to lung tissue that can result from sterile but acidic gastric fluids. The amount of damage depends on the volume and pH of the aspirate, with larger volumes and lower pH having more deleterious effects. Damage from acidic fluid occurs in 2 phases. The first phase occurs within 1 to 2 hours, when the direct toxic effects of the acidic fluid
cause damage to the alveolar cells, leading to increased permeability and pulmonary edema (Figure 1).

The second phase occurs after 2 to 3 hours, peaks at about 4 to 6 hours, and is characterized by acute inflammation. Patients may initially be asymptomatic, but bronchospasm, shortness of breath, hypoxia, wheezing, and eventually shock may occur. **ASPIRATION PNEUMONIA**

Aspiration pneumonia occurs when oropharyngeal or gastric contents that have been colonized with pathogenic bacteria are aspirated into the lower respiratory tract. This event is an infectious process, whereas aspiration pneumonitis is a chemical injury. Aspiration pneumonitis may lead to pneumonia if the aspirate contains bacteria or if the chemical lung injury results in a secondary bacterial infection, but this should be considered a separate disease process.

When bacterial infection develops, the term "aspiration pneumonia" should be used. Although some community-acquired pneumonias are caused by aspiration of oropharyngeal secretions that have been colonized by pathogenic bacteria, aspiration pneumonia refers to the development of pneumonia as demonstrated by clinical and radiographic findings in a patient who is at high risk for oropharyngeal aspiration. Often, the aspiration episode is not witnessed, and it may be a chronic process.

Typical organisms that may colonize the oropharynx include *Streptococcus pneumoniae*, *Haemophilus influenzae*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Enterobacter* species, anaerobes, Klebsiella species, and *Escherichia coli*, although no single organism is more prevalent than the other. Risk factors for aspiration pneumonia are similar to those for aspiration pneumonitis and include altered mental status, dysphagia, gastro-esophageal reflux disease, neurological disorders, drug overdose, and anesthesia.

In addition, the risk of aspiration pneumonia is associated with critical illness; supine position; the presence of oropharyngeal mechanical devices, such as nasogastric or endotracheal tubes; and increasing age. The symptoms are similar to those seen in community-acquired pneumonia and include fever, tachypnea, hypoxia, and productive cough.

**EPIDEMIOLOGY**

Although the pathophysiology and risk factors for aspiration pneumonitis and aspiration pneumonia are similar, these 2 syndromes tend to affect different populations. Aspiration pneumonitis is more likely to occur in younger patients, particularly those with drug and alcohol overdoses and those undergoing anesthesia. Approximately 10% of drug overdoses may be complicated by aspiration pneumonitis; in addition, aspiration pneumonitis may occur in about 1 of 3000 patients undergoing general anesthesia and is estimated to cause 10% to 30% of all anesthesia-related deaths. The aspiration episode is usually acute and often witnessed.

Aspiration pneumonia is more likely to occur in older populations, particularly in chronically ill patients who are hospitalized or institutionalized. Not only are these patients at increased risk for aspiration, but also they are more likely to be colonized with pathogenic organisms and to have impaired host defenses.

Aspiration pneumonia is an important cause of morbidity and mortality in older patients, but the incidence has been difficult to quantify because most episodes of aspiration are not witnessed. However, aspiration has been estimated to cause 5% to 10% of all community-acquired pneumonias.

**RISK FACTORS**

The risk factors for aspiration are summarized in Table 1. Although the risk factors for aspiration pneumonitis and pneumonia are similar, several factors predispose patients to the development of pneumonia as opposed to pneumonitis. In general, any condition that leads to altered mental status or decreased level of consciousness, depressed upper airway reflexes, increased gastric volume, or delayed gastric emptying can result in aspiration.

Factors that predispose patients to the development of pneumonia are related to conditions that alter oropharyngeal or gastric flora or impair host defenses. Specifically, any condition that leads to impaired immunity, stasis of oropharyngeal secretions, or impaired mucociliary clearance increases the risk of pneumonia.

**DIAGNOSIS**

The diagnosis of aspiration pneumonitis or pneumonia can often be made on the basis of the history and symptoms. In aspiration pneumonitis, the aspiration is often witnessed in patients undergoing anesthesia or in those with acute drug and alcohol overdoses. Initially, patients may be asymptomatic. With aspiration of particulate matter, signs of airway obstruction, including stridor and wheezing, may be present. Coughing, shortness of breath, hypoxia, and cyanosis subsequently may develop. Abnormal radiographic findings may or may not be present initially with aspiration pneumonitis, but new infiltrates or atelectasis may develop. In severe cases, shock and acute respiratory distress syndrome may develop (Figures 2 and 3).

Aspiration pneumonia is diagnosed when a patient at high risk for aspiration has signs, symptoms,
and radiographic findings suggestive of pneumonia. Although the signs and symptoms of aspiration pneumonitis and pneumonia are similar, they are differentiated on the basis of patient history, epidemiological factors, and radiographic findings. Patients may have signs and symptoms similar to those of community-acquired pneumonia, including productive cough, fever, shortness of breath, and hypoxia.

Radiographic findings depend on the body position of the patient at the time of the aspiration. Patients aspirating in the recumbent position have infiltrates in the posterior segments of the upper lobes or superior segments of the lower lobes, while patients aspirating in the upright position have infiltrates in the basal segments of the lower lobes. Patients who aspirate in the prone position—alcoholics for example—may have infiltrates in the right middle lobe and left lingula. Bibasilar infiltrates, bronchiectasis, and pulmonary fibrosis may develop in patients who chronically aspirate.1

Patients considered to be at high risk for chronic aspiration should undergo further assessment of the swallowing function. Although there is no accepted gold standard for evaluation, the available techniques include simple bedside techniques; more sophisticated imaging modalities, such as videofluoroscopic imaging; and fiberoptic endoscopic evaluation.

Bedside evaluation of swallowing

Bedside assessment of the cough and gag reflexes should be done; however, this may be insufficient to diagnose aspiration.2,14,19 In one study of 144 healthy patients, 37% lacked a gag reflex.20 Pulse oximetry to monitor for desaturation during feeding has also been used, as well as observing oral residue, voice quality, and cough after swallowing.14,19

Assessment is usually performed by having the patient swallow water or food; the severity of aspiration is based on the ability to swallow and on the presence of dysphonia, cough, and dyspnea.21 Adding dye to enteral feeds to visualize gastric contents that have been aspirated and using glucose oxidase reagent strips to test tracheobronchial secretions for glucose also have been used but have limited clinical value because of the lack of specificity and sensitivity, potential harm from dyes, and cost of testing supplies.22 Videofluoroscopy

Also referred to as a modified barium swallow, videofluoroscopy provides dynamic imaging during the oral and pharyngeal phases of swallowing (Table 2).19 The test is performed with the patient in the seated or standing position at a 45- to 90-degree angle. The patient is given liquids or foods mixed with barium, and fluoroscopic images are obtained during swallowing. Assessment of the dynamic images allows visualization of any ingested material that is aspirated.

Videofluoroscopy is an effective tool for the diagnosis of aspiration, but it has limitations. It cannot be performed in patients who are unable to sit up, and it requires subjective interpretation by the operator performing the examination and radiation exposure.19 In addition, the limited swallowing time does not allow for assessment of patient fatigue as a contributor to aspiration, and study protocols may vary between institutions.18 Fiberoptic endoscopy

Fiberoptic endoscopic evaluation of swallowing allows for immediate visualization of the pharynx and larynx before and after swallowing and for an assessment of aspirated material expelled from the trachea with coughing.19,23 A flexible laryngoscope is passed through the nose into the hypopharynx, and imaging is performed as liquid and solid food is swallowed.14 The images obtained provide information on the motor function of the pharynx and larynx during swallowing.

In addition to observing motor function with fiberoptic endoscopy, sensory function also can be assessed with fiberoptic endoscopic evaluation of swallowing with sensory testing. During this examination, air pulse stimuli are delivered to the mucosa innervated by the superior laryngeal nerve, and objective measures of laryngopharyngeal sensory discrimination thresholds are made.24

Advantages of these procedures are that they can be performed at the bedside, they avoid radiation exposure, they can be repeated easily, and images can be recorded for review.23 However, both examinations require skilled operators to perform endoscopic evaluation.

Other modalities

Esophageal and pharyngeal manometry, radionuclide scintigraphy, ultrasonography, and electromyography have been studied as potential modalities for the evaluation of aspiration, but their use has been limited because of their complexity and invasiveness.19 Because of this, these modalities are infrequently used for evaluation.

TREATMENT

The treatment of aspiration pneumonitis and pneumonia requires prompt recognition and initiation of therapy. If the aspiration episode is witnessed, the patient should be placed in the head-down position to limit the amount of pulmonary contamination, the airway should be cleared of material using suction and forceps, and oxygenation and airway patency should be maintained with cricoid pressure and endotracheal intubation if necessary.3

The use of noninvasive positive pressure ventilation should be avoided in obtunded patients because it may force any residual aspirated material into the distal airways. Bronchoscopy may aid in the
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The prevention of aspiration in patients who are at risk for aspiration pneumonia is critical given the high morbidity and mortality associated with aspiration pneumonia. Strategies are aimed at preventing aspiration and at reducing bacterial colonization of the oropharyngeal and gastric contents. Measures designed to prevent aspiration include elevating the head of the bed to a 30- to 45-degree angle, avoiding excessive sedation, maintaining appropriate endotracheal cuff pressures in intubated and tracheostomy patients, monitoring gastric residual volumes during enteral feeding, avoiding long-term use of nasogastric tubes, selecting appropriate diets for patients who have dysphagia (Table 3), and aspirating subglottic secretions. The use of feeding tubes--whether nasogastric, orogastric, or percutaneous--to prevent aspiration pneumonia has remained controversial. In a large meta-analysis, there was no evidence to support the use of feeding tubes to reduce the risk of aspiration. Although feeding tubes deliver nutrition directly into the stomach or a distal, postpyloric site, they do not reduce or prevent the aspiration of oropharyngeal secretions. In addition, the use of feeding tubes may be associated with an increased risk of oropharyngeal bacterial colonization. The use of smaller feeding tubes has not been shown to reduce aspiration rates.

The treatment of aspiration pneumonia begins with the same principles as the treatment of aspiration pneumonitis. However, to initiate prompt treatment is difficult, since the aspiration event is often unwitnessed. Attempts to clear the airway using suction should be made, and oxygenation and airway patency should be maintained. As noted above, bronchoscopy may be useful and may be considered if radiographic evidence of endobronchial debris or atelectasis is present. Antibiotics should be administered, and the choice of agents depends on the clinical situation. Unfortunately, no standardized guidelines for antibiotic therapy for aspiration pneumonia have been developed. For institutionalized patients or for those with hospital-acquired infections, broad-spectrum antibiotics to empirically cover resistant organisms, particularly Gram-negative bacteria and methicillin-resistant *S. aureus*, should be initiated. Antibiotics with anaerobic coverage should be added to the drug regimen in patients with significant periodontal disease, foul-smelling sputum, or evidence of necrotizing pneumonia or lung abscess. Anaerobic coverage should not be used alone because it may be insufficient given the high number of resistant organisms that may colonize patients at high risk for aspiration pneumonia. Sputum and blood cultures should be performed and antibiotic therapy adjusted as necessary, although it is often difficult to isolate specific pathogens.

**PREVENTION**

Using preventive measures to avoid complications is crucial in clinical situations in which the risk of aspiration is high. Since aspiration and the development of pneumonitis during anesthesia and during labor are of concern, specific measures have been suggested to reduce the risk of aspiration in the perioperative and postoperative periods. Fasting before anesthesia minimizes gastric volume and may reduce the risk of aspiration. It is recommended that patients fast for 2 hours after liquids and 9 hours after heavier meals preoperatively. However, the stomach may still contain acidic fluids from gastric secretions as well as biliary fluids, which may be aspirated. Preoperative fasting may result in missed doses of oral medications, dry mouth, thirst, increased postoperative nausea and vomiting, and hypovolemia. The use of pharmacotherapy to reduce gastric secretion volume and acidity has also been suggested. Studies using antacid agents, such as H₂ blockers, proton pump inhibitors, and sucralfate, have demonstrated a reduction in gastric secretion volume and acidity but have had no effect on aspiration rates. Prokinetic agents, such as metoclopramide, and erythromycin have also been evaluated and have demonstrated similar results. Therefore, routine use of these medications is not recommended; these medications should be used only in patients who are considered to be at increased risk for aspiration.

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The pharmacological therapies that have been studied in this setting include angiotensin-converting enzyme (ACE) inhibitors, amantadine, and cilostazol. Substance P, a neurotransmitter, may affect the function of the glossopharyngeal nerve, which is integral to upper airway reflexes.\textsuperscript{34} ACE inhibitors prevent the breakdown of substance P and have been shown to reduce aspiration rates in hypertensive patients with cerebrovascular disease.\textsuperscript{14,34} Amantadine increases levels of dopamine, which may up-regulate substance P production and improve swallowing and cough reflexes.\textsuperscript{34} It has been shown to reduce aspiration risk in post-stroke patients.\textsuperscript{30} Cilostazol, a phosphodiesterase inhibitor with antiplatelet activity, may improve brain circulation in patients who have cerebrovascular disease and may increase dopamine and substance P production.\textsuperscript{34} This agent has been shown to reduce aspiration rates in patients with cerebrovascular infarction, but it may also be associated with increased risk of bleeding.\textsuperscript{30,34} Because of the limited data available, none of these medications are recommended for routine use to prevent aspiration.

Preventing bacterial colonization of the oropharynx is also an important measure to prevent aspiration pneumonia. Meticulous oral hygiene and treatment of dental caries and periodontal disease may reduce bacterial colonization.\textsuperscript{29} Patients without teeth may have a reduced risk of aspiration pneumonia because of decreased colonization.\textsuperscript{35} In addition, various antiseptic compounds used during oral care to reduce bacterial colonization have been studied, and the results have been generally poor.\textsuperscript{36}

CONCLUSION

Although aspiration pneumonitis and aspiration pneumonia share many common features, it is important to recognize each as a separate disease process so that the appropriate treatment measures can be initiated. For both syndromes, the best strategy is prevention. Preventive measures in the preoperative period and in the chronically ill patient at high risk for aspiration must be ensured to avoid complications. Further studies are necessary to improve preventive therapy to reduce the morbidity and mortality associated with aspiration.

References:


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