BMJ Best Practice

# Acute aspiration

Straight to the point of care

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# Summary

Acute aspiration is the inhalation of foreign material into the airways beyond the vocal cords with variable manifestations that result in aspiration bronchiolitis, aspiration pneumonitis, aspiration pneumonia, and acute respiratory distress syndrome (ARDS).

Usually occurs in patients with altered level of consciousness, dysphagia, or impaired cough reflex.

Screening for dysphagia is recommended for patients at risk of, or following, aspiration (including all patients after an acute stroke).

Clinical presentation and severity depends on the volume and type of the aspirated material as well as the host defenses, such as adequate cough reflex, intact mucociliary barrier, and respiratory reserve.

Anesthesia-related aspiration of gastric contents can be prevented by identifying patients susceptible to vomiting and reflux, minimizing gastric contents before surgery, avoiding drugs that reduce gastric emptying, minimizing emetic stimuli, and avoiding complete loss of protective reflexes from oversedation.

Antibiotics are not indicated early after aspiration of gastric contents but they should be considered if the pneumonitis does not resolve after 48 hours or if there is clear risk or susceptibility for infection.

Patients with neurologic deficits, infants, older patients (age >70 years), and debilitated patients with dysphagia may also aspirate barium sulfate during radiologic procedures, which can result in severe bronchiolitis and pneumonitis.

# Definition

Aspiration is the inhalation of liquid or solid particles, particularly food or gastric contents, into the airways below the vocal cords.[1] It can result in aspiration pneumonitis (chemical injury) or aspiration pneumonia (infection), both of which can lead to acute respiratory distress syndrome (ARDS). See Aspiration pneumonia and Acute respiratory distress syndrome .[1] [2] If the central airways are completely occluded, asphyxiation may quickly ensue. See Foreign body aspiration . Awareness is increasing for silent or more subclinical chronic micro-aspiration, which has been implicated as a potential aggravating mechanism across a variety of disorders, such as interstitial lung disease, asthma, COPD, and chronic cough. Chronic micro-aspiration is not covered in this topic.[3]

# Epidemiology

One of the common settings in which pulmonary aspiration is known to take place is the perioperative period. Various risk factors including reduced consciousness, prolonged supine positioning, and illness acuity can predispose an individual to aspiration of gastric contents. In the US, reported incidence of perioperative pulmonary aspiration in the adult population ranges from 1 in 3216 (in 1993) to 1 in 7103 (in 2006).[5] [6] Studies published in 1986 and 1993 reported that aspiration occurred in 1 in every 3000 cases of anesthesia and accounted for 10% to 30% of deaths associated with anesthesia.[2] [5] [7] Although the incidence of aspiration is low, the extent of surgery has increased in people with comorbidities and the older population, and these patients are expected to have a higher incidence of aspiration.[8]

In the pediatric population, one UK study published in 2013 notes an incidence of perioperative pulmonary aspiration of 1 in 4932 anesthetics in the elective setting and 1 in 4498 in the emergency setting.[9] This suggests an improvement compared with two prior US landmark studies in children, which reported an incidence of 1 in 2632 aspirations during general anesthesia between 1985 and 1997, and 1 in 978 between 1988 and 1993.[10] [11]

Despite a low incidence, perioperative pulmonary aspiration carries a risk of morbidity and mortality. In US anesthesia malpractice claims data, 5% were attributed to aspiration, with a 57% mortality directly attributable to anesthesia.[12] Of those who aspirated, 61% had gastrointestinal obstruction or an acute abdomen.[12]

The body of literature regarding acute aspiration outside of the perioperative time frame is smaller, and limited by the lack of specific diagnostic testing for aspiration when it is not witnessed. Between 5% and 15% of community-acquired pneumonia has been attributed to aspiration.[2] Pneumonia due to aspiration events is more frequent in patients ages >80 years (10%) compared with patients ages <80 years (5%).[13] Predisposing factors for aspiration included dysphagia, and impaired consciousness and gag reflex.[13] Another study noted that of a cohort of patients admitted with pneumonia ages >70 years, about 55% were found to have dysphagia and aspiration on testing with a water swallow test.[14] In the Lung Injury Prediction Score cohort, aspiration was the third leading cause of acute lung injury among at-risk patients admitted to the US hospitals.[15]

Dysphagia may cause "acute on chronic" aspirations. According to one systematic review from 2005, the incidence of dysphagia (swallowing difficulties) following acute stroke was reported to vary from 37% to 78% depending on the site of the stroke and screening tools used to identify dysphagia.[16] [17] A review from 2010 reported that up to 30% of older patients with dysphagia present with aspiration.[18]

Among patients admitted to the hospital who are receiving enteral nutrition, the reported prevalence varies widely from 4.4% to nearly 90%, depending on how aspiration is defined (silent versus symptomatic), the method of diagnosis, the position of the feeding tube in the gastrointestinal tract (nasogastric or nasojejunal), and the type of feeding tube (nasogastric or gastrostomy).[19] [20] One meta-analysis conducted in 2019 including 41 studies and involving 3248 participants suggests there is a lower incidence of pulmonary aspiration with postpyloric feeding tube positioning compared with gastric positioning.[21] Clinically evident aspiration, however, is rare and is seen in <1% of patients given enteral nutrition.[20]

In the setting of severe trauma, the incidence of gross aspiration can be as high as 38%.[22]

Accidental aspiration of barium contrast medium during radiologic investigations is rare but can occur in up to 8% of children with GERD.[23] The severity of pulmonary damage depends on the density of the suspension,

with high-density barium sulfate causing the most damage and being potentially fatal, especially in older patients.[4] [24] [25]


*Bronchoscopy showing barium aspiration in a lung transplant patient in the right mainstem bronchus after a barium swallow study*

*From the collection of Dr Kamran Mahmood*

*Barium aspiration. A barium swallow was conducted in a 53-year-old woman. Imaging revealed hyperdense airway-centered material in the left lower lobe consistent with barium aspiration bronchiolitis. A tracheoesophageal fistula was confirmed*



# Etiology

Physiologic mechanisms that normally reduce the risk of aspiration include the gastroesophageal junction, upper esophageal sphincter, and protective laryngeal reflexes. These protective mechanisms can be affected by several conditions, age, or drugs.[26]

Aspiration of food and liquids is more common in:[27]

- Patients with oropharyngeal dysphagia, especially when it is due to stroke, Parkinson disease, dementia, or cervical spine surgery[28][29][30]

- Older patients
- Patients who are taking sedatives
- Patients being fed by a gastric tube[29]
- Patients who depend on others for feeding
- Current smokers
- Patients taking >8 drugs
- Pregnant women.

Among critically ill patients, the major risk factors for aspiration include:[31]

- Documented previous episode of aspiration
- Decreased level of consciousness (Glasgow coma scale score <9 or a high level of sedation)
- Neuromuscular disease, or congenital or acquired structural abnormalities of the aerodigestive tract
- Endotracheal intubation
- Vomiting
- Persistently high gastric residual volume
- Supine positioning.

Additional risk factors include the presence of a nasoenteric tube, intermittent feeding, abdominal/thoracic surgery or trauma, delayed gastric emptying, older age, inadequate nursing staff, large size or diameter of feeding tube in children, malpositioning of the feeding tube, and transport.

In the perioperative period, factors that increase the likelihood of aspiration include:[8]

- A high urgency of surgery
- Difficult airways
- Inadequate depth of anesthesia
- Use of the lithotomy position
- Gastrointestinal problems such as delayed gastric emptying, gastroesophageal reflux, ileus, acute abdomen, or bowel obstruction[12]
- Depressed consciousness
- Increased severity of illness
- Obesity
- Use of drugs that reduce lower esophageal sphincter pressure or delay gastric emptying.
    - Certain drugs reduce the lower esophageal sphincter pressure and promote gastroesophageal reflux in anesthesia and disease states, and thereby increase the risk for aspiration. These drugs include atropine, glycopyrrolate, dopamine, nitroprusside, ganglion blockers, thiopental, tricyclic antidepressants, beta-adrenergic stimulants, halothane, opioids, and propofol.
    - Certain drugs delay gastric emptying. Opioids can significantly delay gastric emptying and promote ileus. Glucagon-like peptide-1 (GLP-1) receptor agonists and dual glucose-dependent insulinotropic polypeptide (GIP)/GLP-1 receptor agonists are known to delay gastric emptying, and because of retained gastric contents, their use is a risk factor for aspiration during procedures requiring general anesthesia or deep sedation.[32][33][34]

# Pathophysiology

A higher prevalence of cerebrovascular and degenerative neurologic disease in people ages >70 years explains why increased age is a risk factor for aspiration. These conditions result in dysphagia and an impaired cough reflex, both of which increase the risk for aspiration of foreign bodies, food, liquids, and barium contrast.[4] [35]

 

Anticholinergics, antipsychotics, or anxiolytics may also impair the cough reflex and/or swallowing.

Tachypnea, resulting from various medical conditions, alters the coordination between deglutition and respiration, and increases the risk for aspiration.[36]

The lower and upper esophageal sphincter tone is decreased in GERD, by certain drugs (anticholinergics, antipsychotics, and anxiolytics), and by indwelling endotracheal, tracheostomy, gastric, or nasogastric tubes. This decrease in sphincter tone increases the risk for gastric content aspiration.[8]

The loss or impairment of protective laryngeal reflexes during the perioperative period contributes to the increased risk for anesthesia-related pulmonary aspiration. In addition to the obtunded reflexes from anesthesia and sedation, the supine position during diagnostic, surgical, and dental procedures aligns the trachea and the oropharynx, thereby increasing the risk for aspiration.[37]

Altered physiologic states such as pregnancy, gastrointestinal disorders, and diabetes mellitus are associated with delays in the rate of gastric emptying, which increase the gastric volume. Opioids can significantly delay gastric emptying and promote ileus. Glucagon-like peptide-1 (GLP-1) receptor agonists and dual glucose-dependent insulinotropic polypeptide (GIP)/GLP-1 receptor agonists have been shown to delay gastric emptying.[32] [33]

Pregnancy increases the risk of aspiration because progesterone decreases the tone of the lower esophageal sphincter and delays gastric emptying, in addition to the increase in intra-abdominal pressure secondary to the gravid uterus. Gastric juice aspiration and the resulting pneumonitis occurring in the context of pregnancy and anesthesia was first described by the eponymous Mendelson and is the basis for the wide practice of preoperative fasting.[38]

Aspiration of different gastric materials may have different effects. Low pH (acidic) material leads to neutrophil-predominant lung injury. There is apoptosis of type I alveolar epithelium caused by direct acid contact, and release of proinflammatory mediators secondary to activation of capsaicin-sensitive (TRPV-1) receptors. Alternatively, aspiration of small nonacidified gastric particles (SNAP) or bacteria directly stimulates alveolar macrophages to release innate immune/proinflammatory mediators through activation of polyanionic scavenger receptors or Toll-like receptors. Even without particulate or acid-related injury, gastric juice can contain digestive enzymes such as pepsin and bile salts that are caustic to the respiratory epithelium and likely to influence the type and severity of the respiratory presentation.[39] Most patients aspirate complex gastric contents, which are a combination of gastric food particles, bacterial products, cytokines, and acid, referred to as CASP (combined acid and small food particles). Aspiration of CASP may exacerbate damage due to the synergistic effect of acid and small gastric particles. The volume, viscosity, force of inhalation during aspiration, and host defenses contribute to the variable presentation that can manifest as bronchitis, bronchiolitis, pneumonitis/pneumonia, and ultimately acute respiratory distress syndrome.

Regardless of the type of aspiration material, there is an acute inflammation in the lung characterized by neutrophil infiltration, alveolar hemorrhage, intra-alveolar and interstitial edema, and impairment of alveolar fluid clearance. This is followed by a repair process characterized by scavenging of alveolar detritus by macrophages and proliferation of type II alveolar epithelial cells.[40]

# Case history

## Case history #1

A 62-year-old woman with systemic lupus erythematosus undergoes a head magnetic resonance imaging for acute mental status changes suggesting lupus cerebritis. The patient has been taking prednisone each day for several months. She has a diagnosis of GERD, for which she takes a proton-pump inhibitor. During the imaging study in the supine position, the patient vomits and aspirates gastric contents consisting of yellowish-greenish fluid. Severe respiratory distress and hypoxemia develop, and she requires endotracheal intubation, mechanical ventilation, and admission to the intensive care unit. Physical exam reveals bilateral crackles and wheezes.

## Case history #2

An 80-year-old male with a past medical history of ischemic stroke, COPD, obstructive sleep apnea (noncompliant with noninvasive ventilation), and diabetes mellitus presents after being found by his partner with altered mental status. He had undergone a recent dental procedure and had been managing his pain with opioids. Physical exam reveals severe hypoxemia and the patient requires immediate intubation for airway protection. Right-sided crackles are identified on auscultation. Imaging reveals dense right lower lobe consolidation.

## Other presentations

Aspiration is more common in older patients who have comorbid conditions that may lead to altered mental status. This population includes patients with swallowing dysfunction, disruption of the gastroesophageal junction, or anatomic abnormalities of the upper airway or digestive tract. Additionally, patients undergoing upper airway or endoscopic procedures are at risk. Any situation in which mental status is altered and airway protection mechanisms are lost increases the risk of aspiration. Limited protection is provided by a nasogastric tube, a percutaneous endoscopic gastrostomy, or an endotracheal or tracheostomy tube, and in fact they may increase the risk.[2] Patients with aspiration of gastric contents can develop aspiration bronchiolitis, pneumonitis, pneumonia, and acute respiratory distress syndrome. Patients with neurologic deficits, infants, older patients, and debilitated patients with dysphagia may aspirate barium sulfate during radiologic procedures, which can result in severe pneumonitis and death.[4]


*Bronchoscopy showing barium aspiration in a lung transplant patient in the right mainstem bronchus after a barium swallow study*

*From the collection of Dr Kamran Mahmood*

*Barium aspiration. A barium swallow was conducted in a 53-year-old woman. Imaging revealed hyperdense airway-centered material in the left lower lobe consistent with barium aspiration bronchiolitis. A tracheoesophageal fistula was confirmed*

# Approach

The diagnosis of acute aspiration is primarily by history, bearing in mind the presence of risk factors, with confirmation when necessary by imaging studies. At times it can be witnessed: for example, during intubation or in a patient who is vomiting and then aspirates. The signs, symptoms, and imaging studies can be indistinguishable from pneumonia and other causes of acute respiratory distress syndrome (ARDS), so the possibility of gastric aspiration must be considered in high-risk patients.

## History, physical exam, and lab tests

Aspiration usually takes place in the presence of risk factors, typically in patients ages >70 years who have comorbid conditions that may alter mental status, or in patients with a depressed level of consciousness due to intoxication, illness, or drugs. A sudden onset of fever, cough paroxysms, wheeze, laryngospasm, or cyanosis in at-risk patients should prompt consideration for acute aspiration. Aspiration in the setting of general anesthesia or intoxication, or in the intensive care unit, is also common, but may not present with overt symptoms. It may be silent and may only be apparent from the consequences of aspiration such as bronchospasm, hypoxia, bronchiolitis/bronchitis, pneumonia, atelectasis, fever, and even respiratory failure from noncardiogenic pulmonary edema.[37] [41]

A complete blood count (CBC) and blood gas analysis can determine leukocytosis and hypoxia.

If pneumonia develops after the aspiration of gastric contents, hypoxia, leukocytosis, and other features of systemic inflammatory response may ensue, though these findings may not distinguish infection from more chemical pneumonitis. See Aspiration pneumonia .

Aspiration pneumonitis caused by barium sulfate should be suspected in patients who develop respiratory distress after upper gastrointestinal studies with barium. This is often directly visualized radiographically given the high-density material.


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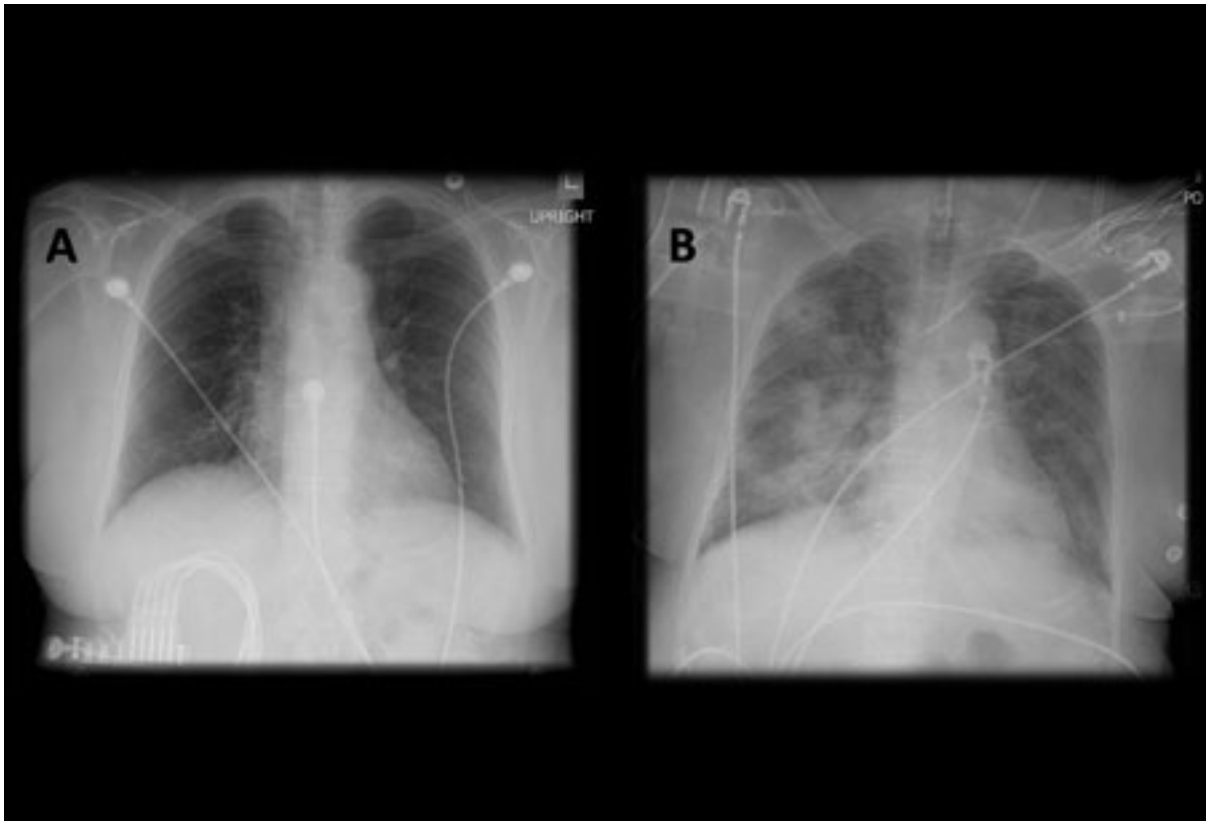
## Chest x-ray

When aspiration of gastric contents results in aspiration pneumonitis or pneumonia, the chest x-ray reveals patchy, bilateral airspace consolidations with a perihilar and basilar distribution.[48] However, an estimated 25% of cases may not be apparent on chest x-rays relative to computed tomography (CT) imaging.[68] The right lung may be involved more frequently because of the obtuse angle between the trachea and the right main bronchus. The most commonly involved segments are the superior and posterobasal segments of the right lower lobe and the posterior segment of the right upper lobe because of their dependent location in the supine position. If the patient is in a different position, other segments can be involved.

Chest x-ray findings of aspiration pneumonitis usually develop within 2 hours of aspiration and sometimes resolve quickly. However, if pneumonia develops, opacities can become apparent days later and can take weeks to resolve.

Barium aspiration should be confirmed by chest x-ray, which may reveal hyperdense opacities in the mid and lower lungs, sometimes outlining the tracheobronchial tree, and more distally, with a bronchiolocentric or centrilobular pattern.[70] [71] [72]




*A. Portable upright chest x-ray before aspiration; B. Chest x-ray 1 hour after aspiration, showing bilateral diffuse alveolar infiltrates, worse at the bases on the right side*

*From the collection of Dr Henri Colt*



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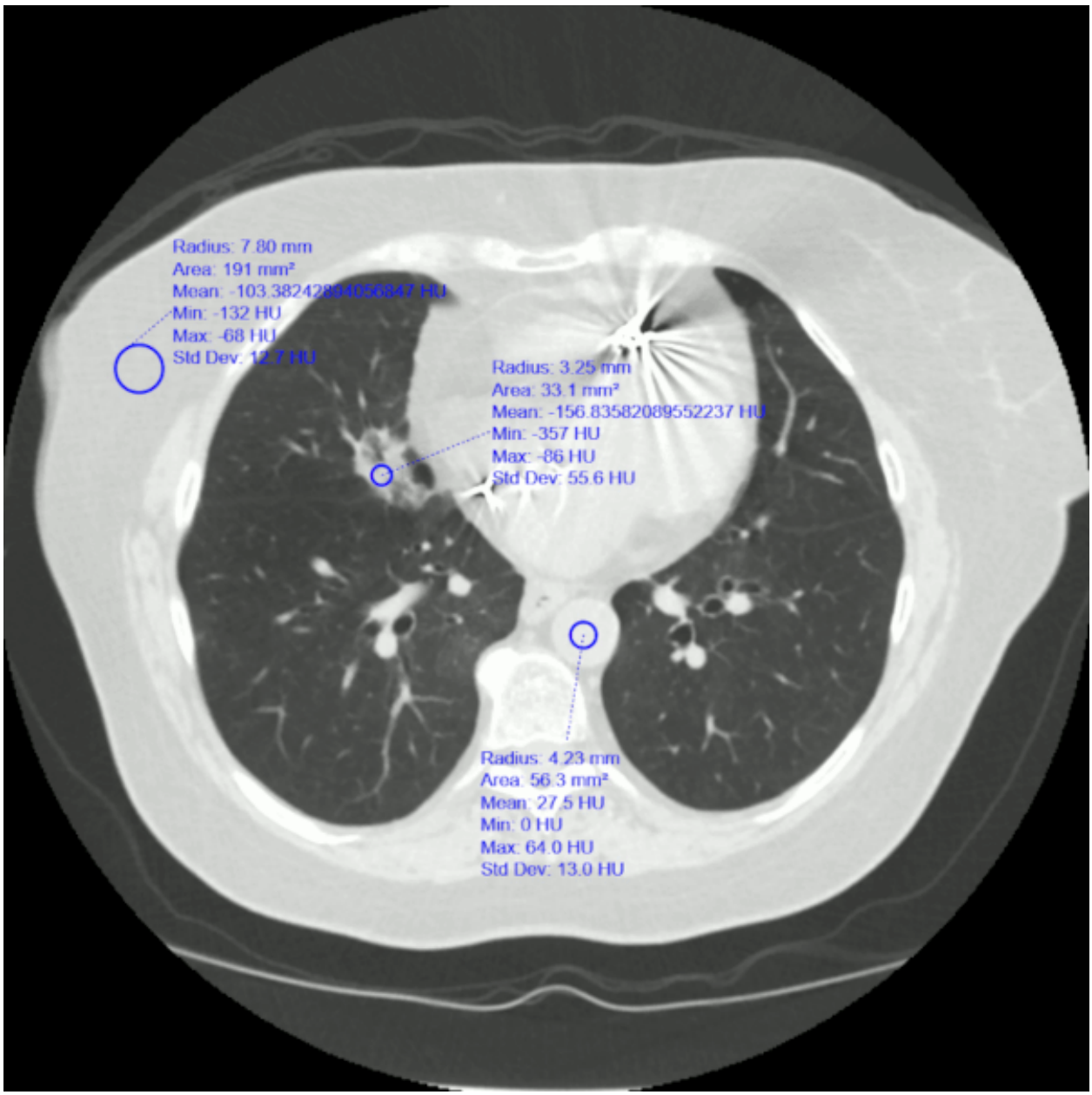
## Chest CT

In cases of aspirated gastric content, chest CT may show opacities in the posterior segments of the upper lobes and the superior segments of the lower lobes. In advanced cases, the findings may be indistinguishable from those of ARDS. CT scanning precisely delineates the location of the lobar and segmental opacities. Aspiration of fat (exogenous lipoid pneumonia) or contrast material can sometimes be determined by measuring the tissue attenuation on CT scans. Lung abscess and empyema are potential complications of aspiration that are visualized better with CT than with plain chest x-ray.[73] See Lung abscess and Empyema .

Although chest x-ray is sufficient in most cases of aspiration, a CT chest should be ordered if foreign body aspiration is suspected (to plan extraction) or if the patient fails to improve with initial therapy (to rule out empyema or lung abscess). Chest CT is superior compared with chest x-ray in the detection of aspiration pneumonia, and if initial chest x-ray is inconclusive, CT should be ordered.[68]




*Lipoid pneumonia. A 77-year-old woman with dysphagia and achalasia following a stroke presented with recurrent lung infiltrates, including a persisting right middle lobe lesion. Hounsfield units (HU) measurement was -157, consistent with lipoid pneumonia. Comparative subcutaneous fat and aorta (blood/tissue) HU are shown*



## Bronchoscopy and bronchoalveolar lavage

Bronchoscopy can play both a diagnostic and therapeutic role. If the aspirated material is particulate or potentially obstructive, or if there is radiographic evidence of lobar or segmental collapse, the airway can be cleared and further evolution to ARDS may be avoided. In cases of aspiration of barium sulfate,

especially if a patient has hypoxia or respiratory distress, early bronchoscopy may be helpful, but incurs some risk of disseminating the contrast to unaffected airways.[24] [74]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Another occasional therapeutic role besides airway and lung lavage is the potential placement of tracheal or bronchial stents in cases of tracheoesophageal fistula, as well as the placement of percutaneous tracheostomy for those with severe dysphagia.

Aside from potential therapeutic roles, bronchoscopy is also important diagnostically. Bronchoalveolar lavage techniques or protected brush specimens can be used to identify, confirm, or refute the presence of an infection, which will have direct impact on the patient's antibiotic management.[2] In addition to infection, bronchoalveolar lavage can diagnose acute eosinophilic pneumonia and diffuse alveolar hemorrhage, both of which can present similarly to acute aspiration with acute respiratory distress and lung infiltrates.[75] Occasionally, cytologic analysis can pick up unusual tumors that can appear pneumonic on imaging. When the differential is broader, a bronchoscopic biopsy may occasionally be employed for interstitial pneumonias and other considerations, though not often in the acute setting.[75] Finally, a careful bronchoscopic exam may be important to identify a tracheoesophageal fistula that may be complicating cancer, surgery, radiation, or trauma.

### Biomarkers of aspiration syndromes

Multiple biomarkers are used in the research setting and at some centers. These have included the evaluation of lipid laden macrophages, pepsin, amylase, bile, and cytokines directly from lower airway samples.[40] [76] The sensitivity and specificity of these markers remain unclear, and they lack clinical validation.[40]

### Tests to identify need for antibiotics

Tests to identify a bacterial component to the pneumonic presentation depend on the clinical scenario and may include culture and sensitivities of samples obtained from bronchoalveolar lavage and brushing, venepuncture, or thoracentesis. See Aspiration pneumonia , Hospital-acquired pneumonia , Community-acquired pneumonia , Pleural effusion , Empyema , Lung abscess , and Sepsis in adults .

## History and exam

### Key diagnostic factors

#### acute or chronic cough (common)

- Seen in 36% of patients with aspiration of gastric contents.[77] However, this presumes that the patient's cough reflex is intact. Those with absent or diminished cough reflex (e.g., due to opioid intoxication or respiratory muscle weakness related to amyotrophic lateral sclerosis or critical illness myopathy) may have more consequential aspiration.[18] [42]

#### fever (common)

- Extremely common after aspiration of gastric contents, occurring in 94% of cases.[77]

#### dyspnea (common)

- Extremely common after aspiration of gastric contents, seen in 78% of cases.[77] In severe cases, respiratory failure may result from noncardiogenic pulmonary edema.

#### wheezing (common)

- Occurs in 32% of patients after aspiration of gastric contents.[77]

#### crackles (common)

- Presence on lung auscultation is common after aspiration of gastric contents, occurring in 72% of cases.[77]

### Other diagnostic factors

#### laryngospasm (uncommon)

- May be induced by laryngopharyngeal reflux, and serves as a protective mechanism against aspiration, though may lead to other dire consequences. In one series about 8% of patients with confirmed aspiration also had laryngospasm.[78]

# Risk factors

## Strong

### decreased level of consciousness (Glasgow coma scale score <9)

- Associated with trauma, use of sedatives, alcohol, general anesthesia, or neurologic disorders (e.g., brain tumor, seizure, Parkinson disease, mental retardation, stroke). Impairs the protective airway mechanisms and increases the risk for aspiration of foreign objects.[20] [35]

### increased severity of illness

- Critical illness and higher anesthesia risk classification (defined as class III, IV, or V in the American Society for Anesthesiology risk classification system, which is based on physical status) indicates higher risk of aspiration.[5] [41] [42]

### general anesthesia

- Decreased level of consciousness results in loss of protective reflexes. Anesthetic drugs may decrease lower and upper esophageal sphincter tones, and promote ileus and gastroparesis, increasing risk for gastrolaryngeal reflux. Supine positioning and unsecured airways may add to the increased risk for reflux and subsequent aspiration.[8]

### age >70 years

- Risk of aspiration is higher in older patients, especially during and after the seventh decade, probably because of higher prevalence of aging-associated degenerative neurologic and cerebrovascular disorders that can cause dysphagia and/or impaired cough reflex.[27] [35][41] Over 50% of patients with acute food asphyxiation are 71-90 years of age.[43]

### head trauma

- Can result in altered mental status and impaired airway reflexes. Also increases risk for gastric content aspiration because the elevated intracranial pressure that may result from head trauma delays gastric emptying.[44]

### cerebrovascular disease

- Over one third of patients with acute stroke have aspiration documented on radiologic studies.[27] Abnormal swallowing increases risk for aspiration.[27] Patients with dysphagia have delayed triggering of the pharyngeal motor response and decreased laryngeal elevation, resulting in poor coordination and timing of oral, pharyngeal, and laryngeal events during swallowing.[45]

### endotracheal or tracheostomy tube

- Indwelling endotracheal or tracheostomy tube raises risk for aspiration. Cuffed tubes are not completely protective and mechanically interrupt glottic closure or the lower esophageal sphincter.[41] [46] [47][48] Endotracheal intubation that lasts >8 hours can result in laryngotracheal complications, which increase the risk for aspiration after extubation.[49]
- Aspiration has been documented in up to 45% of critically ill trauma patients after extubation. The mechanisms are multiple and include changes in glottis anatomy caused by vocal cord ulceration and laryngeal edema, and disruption of the swallowing reflex caused by muscle atrophy, incoordination, and diminished sensory abilities of the larynx.[50] Traumatic intubations (blood in the endotracheal tube, esophageal intubation, and multiple intubation attempts) increase the risk for aspiration after

extubation. Patients are often sedated and critical illness further impairs swallow and cough reflexes. Muscle weakness associated with critical illness can further diminish effective cough that might otherwise offset aspiration events.[42]

### dysphagia

- Abnormal swallowing increases risk for aspiration.[27] Patients with dysphagia have delayed triggering of the pharyngeal motor response and decreased laryngeal elevation, resulting in poor coordination and timing of oral, pharyngeal, and laryngeal events during swallowing.[45]
- High-risk conditions resulting in oropharyngeal dysphagia include neurologic disorders (cerebrovascular disease, head trauma, closed head injury, cervical spine injury, anoxia, seizure disorder, vocal cord paralysis, Parkinson disease, amyotrophic lateral sclerosis, Alzheimer disease), certain surgeries (for head and neck cancer, anterior and posterior cervical spine surgery, brain surgery, coronary artery bypass grafting, esophagogastrectomy), structural abnormalities (oropharyngeal tumors, tracheoesophageal fistula), gastrointestinal disorders (laryngopharyngeal reflux), tracheostomy, and adverse effects from sedatives and antipsychotics.

### airway difficulties

- Difficult intubation and laryngospasm are reported risk factors for aspiration during the perioperative period.[5] [7]

### barium meal

- Can be aspirated during a barium radiographic exam.



 


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## Weak

### male sex

- Risk for aspiration in males is almost twice that in females, probably because of the higher rates of neurologic and cardiovascular disorders in males.

### gastroesophageal reflux disease

- Independent risk factor for aspiration in critically ill patients and during perioperative period in patients undergoing general anesthesia.[8] [20] Conditions that increase the risk for gastroesophageal reflux

include esophageal disease (collagen vascular disease, cancer, achalasia, dysmotility), hiatal hernia, peptic ulcer disease, gastritis, bowel obstruction, ileus, and elevated intracranial pressure.[41]

### feeding tubes

- Nasoenteric feeding tubes may stimulate the pharynx and increase risk for aspiration by decreasing lower esophageal sphincter tone.[51] Gastric placement of feeding tubes increases risk for aspiration, and postpyloric placement of tube may have a protective effect.[20] Large feeding tubes increase risk, especially in infants and young children. It is unclear whether gastrostomy feeding tubes have lower risk for aspiration than nasogastric feeding.[44]

### supine position

- Supine positioning during dental, medical, or radiologic procedures, transport, and general anesthesia aligns the trachea and oropharynx, and facilitates gravitational flow of gastric content in the oropharynx. Also associated with difficulty swallowing. Sedation and anesthesia enhance risk of aspiration by obtunding the protective reflexes.[37]

### delayed gastric emptying

- High gastric residual volume is common in critically ill patients who receive enteral nutrition. This increases risk for vomiting or regurgitation of feeds and makes patients prone to aspiration.[44] Associated factors include abdominal surgery, sepsis, metabolic abnormalities (hyperglycemia, diabetes mellitus, hypokalemia), renal failure, increased intracranial pressure, and some drugs (e.g., opioids).
- Glucagon-like peptide-1 (GLP-1) receptor agonists and dual glucose-dependent insulinotropic polypeptide (GIP)/GLP-1 receptor agonists are known to delay gastric emptying, and because of retained gastric contents, their use is a risk factor for aspiration during procedures requiring general anesthesia or deep sedation.[32] [33][34]

### obesity

- Independent risk factor for aspiration related to general anesthesia.[52] This association may be partly influenced by the presence of obstructive sleep apnea.[53]

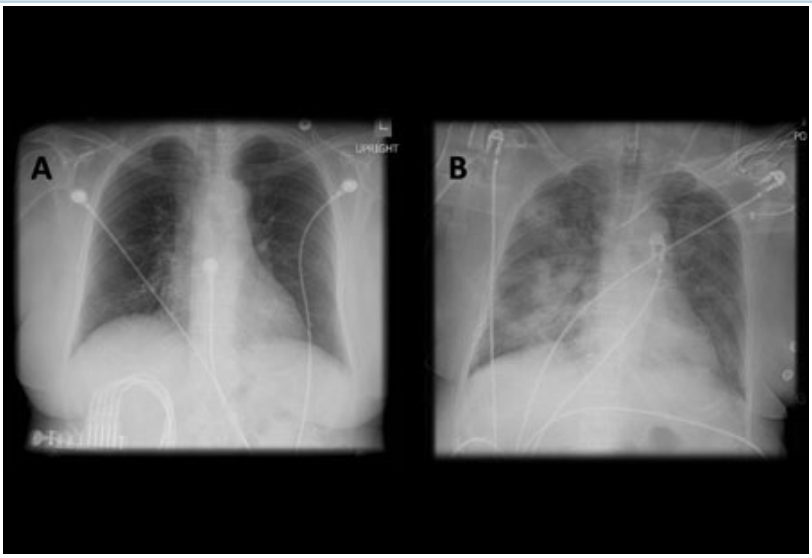
### drugs that reduce esophageal sphincter tone

- Drugs used in anesthesia and in the intensive care unit may reduce the lower and upper esophageal sphincter tone and increase risk for aspiration. Drugs include atropine, glycopyrrolate, dopamine, nitroprusside, ganglion blockers, thiopental, beta-adrenergic stimulants, halothane, and propofol. Tricyclic antidepressants also have this effect.[8]

# Tests

## 1st test to order

| Test | Result |
| --- | --- |
| **chest x-ray**<br>• In pneumonitis or pneumonia resulting from aspirated gastric contents, there are patchy, bilateral airspace consolidations with a perihilar and basilar distribution.[48] The most commonly involved areas are the superior and posterobasal segments of the right lower lobe and the posterior segment of the right upper lobe because of their dependent location in the supine position. If the patient is in a different position, other segments can be involved.<br>• X-ray changes are usually apparent within 2 hours of aspiration but if pneumonia develops, opacities can become apparent days later and take weeks to resolve. See Aspiration pneumonia .<br>• Barium aspiration should be confirmed by CXR.[70] [71] [72] | **patchy, bilateral airspace consolidations; barium may be identified by hyperdense opacities in the mid and lower lungs, sometimes outlining the tracheobronchial tree, and more distally, with a bronchiolocentric or centrilobular pattern** |




*A. Portable upright chest x-ray before aspiration; B. Chest x-ray 1 hour after aspiration, showing bilateral diffuse alveolar infiltrates, worse at the bases on the right side*
*From the collection of Dr Henri Colt*



| Test | Result |
| --- | --- |

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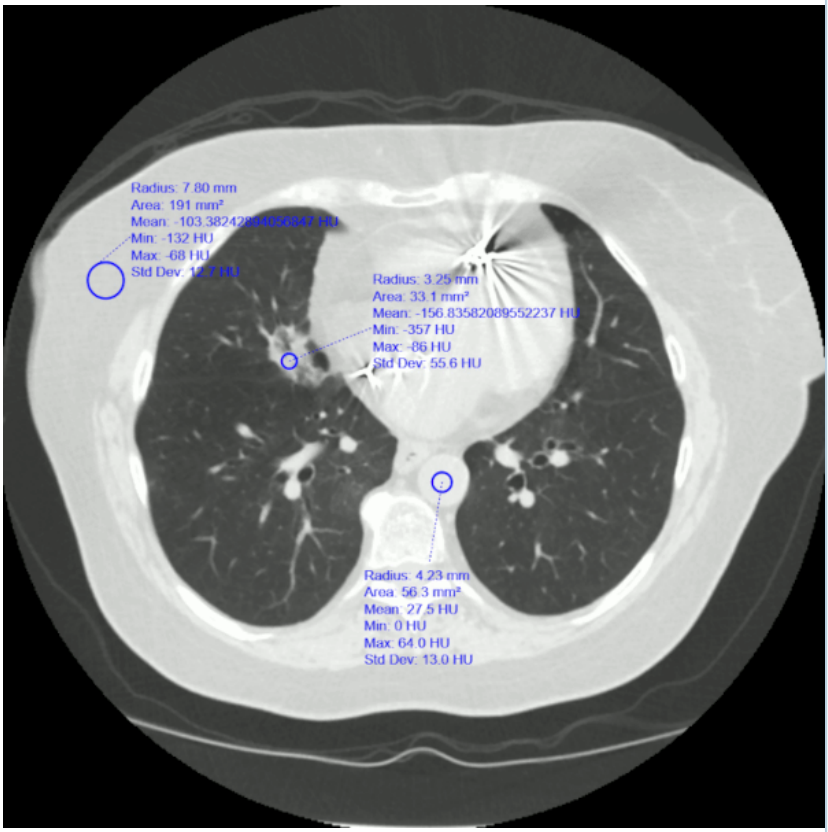
- An estimated 25% of cases may not be apparent on CXRs relative to CT imaging.[68]

## Other tests to consider

| Test | Result |
| --- | --- |
| **chest CT**<br>• In cases of aspirated gastric contents, opacities may be seen in dependent segments of the lung. Chest CT scanning precisely delineates the location of the lobar and segmental opacities. In advanced cases, the findings may be indistinguishable from those of acute respiratory distress syndrome. See Acute respiratory distress syndrome .<br>• Aspiration of fat (exogenous lipoid pneumonia) or contrast material can sometimes be determined by measuring the tissue attenuation on CT scans. Lung abscess and empyema are potential complications of aspiration that are visualized better with CT than with plain chest x-ray.[73] See Lung abscess and Empyema .<br>• Although CXR is sufficient in most cases of aspiration, a CT chest should be ordered if foreign body aspiration is suspected (to plan extraction) or if the patient fails to improve with initial therapy (to rule out empyema or lung abscess).<br>• Chest CT is superior compared with CXR in the detection of aspiration pneumonia, and if initial CXR is inconclusive, CT should be ordered.[68]<br>•  <br>*Lipoid pneumonia. A 77-year-old woman with dysphagia and achalasia following a stroke presented with recurrent lung infiltrates, including a persisting right middle lobe lesion. Hounsfield units (HU) measurement was -157, consistent with lipoid pneumonia. Comparative subcutaneous fat and aorta (blood/tissue) HU are shown*<br>*From the collection of Dr Augustine Lee, used with permission of Mayo Foundation for Medical Education and Research, all rights reserved* | **opacities in dependent segments** |



| Test | Result |
| --- | --- |
| **bronchoscopy with bronchoalveolar lavage**<br>• Bronchoscopy is indicated if aspirated material is particulate or potentially obstructive, or if there is radiographic evidence of lobar or segmental collapse, in order to clear the airway. In addition, bronchoscopy can be used to collect quantitative cultures on bronchoalveolar lavage or protected specimen brush, which can be used to guide antibiotic therapy, particularly in patients who fail to respond to empiric antibiotic treatment.<br>• Cytologic analysis can pick up unusual tumors that can appear pneumonic on imaging. When the differential is broader, a bronchoscopic biopsy may occasionally be employed for interstitial pneumonias and other considerations, though not often in the acute setting.[75] Finally, a careful bronchoscopic exam may be important to identify a tracheoesophageal fistula that may be complicating cancer, surgery, radiation, or trauma.<br>• In cases of aspiration of barium sulfate, especially if a patient has hypoxia or respiratory distress, early bronchoscopy should be performed to remove the barium from the airway, but there is some risk of disseminating the contrast to unaffected airways. Deaths have been reported in patients who aspirated barium and for whom bronchoscopy was not performed for airway clearance.[24] [74]<br>  <br>*Bronchoscopy showing barium aspiration in a lung transplant patient in the right mainstem bronchus after a barium swallow study*<br>*From the collection of Dr Kamran Mahmood* | **airway erythema; particulate matter, barium may be seen; protected brush specimens can be used to identify, confirm, or refute the presence of an infection; eosinophils or tumor cells may be present** |
| **CBC**<br>• Performed if pneumonia develops after the aspiration of gastric contents. | **leukocytosis** |
| **arterial blood gases**<br>• Aspiration may cause hypoxia. | **reduced oxygen tension** |
| **blood culture**<br>• In the context of small bowel obstruction, where there is a high risk of bacterial translocation, bacterial contamination of gastric juice, and sepsis, the initiation of antibiotics should be considered up front and | **growth of causative bacterial species** |

| Test | Result |
| --- | --- |
| should be adjusted when pathogens are identified.[2] [79] See Small bowel obstruction and Sepsis in adults . | |
| **thoracentesis**<br>• Thoracentesis for microscopy, culture, and sensitivity should be considered if there is concern for a complicated parapneumonic effusion. See Pleural effusion and Empyema . | **growth of causative bacterial species** |

# Differentials

| Condition | Differentiating signs / symptoms | Differentiating tests |
|---|---|---|
| **Acute respiratory distress syndrome** | • Seen in the setting of sepsis, chemical exposure, drug reactions, toxic inhalation, or trauma. No difference in signs and symptoms from aspiration pneumonitis, which can itself lead to acute respiratory distress syndrome.[80] | • Bilateral alveolar infiltrates can be indistinguishable from those seen in aspiration pneumonitis.<br>• Aspiration pneumonitis is usually distinguished from aspiration pneumonia on the history of a witnessed large-volume aspiration. In aspiration pneumonitis, the patient often has a reduced level of consciousness. |
| **Asthma exacerbation** | • Wheezing is paroxysmal and intermittent and usually diffuse. It decreases after bronchodilators, is polyphonic, and is characterized by many different pitches. Cough is triggered by exercise, cold, sleep, and allergens. Patient may have history and/or family history of atopy or asthma.[81] | • Pulmonary function tests usually show reversible obstructive ventilatory impairment.[81] |
| **Cystic fibrosis with exacerbation** | • Wheezing presents early in life, with accompanying poor weight gain, diarrhea, and recurrent sinus and pulmonary infections. Nasal exam may reveal polyps. Cough is productive and wet, suggesting a suppurative process such as bronchiectasis. Patient may have family history of bronchiectasis.[81] | • Sweat chloride test shows elevated level of chloride. Chest x-ray may reveal bronchiectasis, but CT scan is more sensitive.[82] |
| **COPD exacerbation** | • Wheezing is diffuse and associated with increased mucus production and history of progressive dyspnea. | • Chest x-ray shows peribronchial cuffing and hyperinflation. |
| **Community-acquired pneumonia** | • No difference in signs and symptoms. | • Chest x-ray may show lobar consolidation. |
| **Hospital-acquired pneumonia** | • No difference in signs and symptoms. | • Chest x-ray may show lobar consolidation. |
| **Congestive heart failure** | • Orthopnea, paroxysmal nocturnal dyspnea, and right | • Chest x-ray may reveal enlarged pulmonary |

| Condition | Differentiating signs / symptoms | Differentiating tests |
|---|---|---|
| | upper quadrant discomfort may be features. Sputum, if present, is usually frothy. Fever is usually absent.[83]<br>• The third heart sound gallop rhythm has up to 50% sensitivity but 90% specificity. Pulsus alternans, characterized by evenly spaced strong and weak peripheral pulses, is pathognomonic of severe left ventricular failure.[83] [84] | vessels, cardiomegaly, and pulmonary edema; the infiltrates improve quickly after diuresis.<br>• Brain natriuretic peptide >100 picograms/mL makes a diagnosis of heart failure with sensitivity of 90%, specificity of 76%, and predictive accuracy of 83%.[85] |
| **Acute#exacerbation of interstitial lung disease (ILD)** | • No differentiating symptoms or signs, but they develop over a few days to several weeks. In some cases it is idiopathic (Hamman-Rich syndrome) or related to other ILD including idiopathic pulmonary fibrosis.[75] Some connective tissue disease-ILDs such as systemic sclerosis are prone to esophageal dysmotility and consequent reflux and aspiration. Drug and radiation toxicity should also be considered in the appropriate clinical context. | • Bilateral alveolar infiltrates can be indistinguishable from those seen in aspiration pneumonitis or acute respiratory distress syndrome (ARDS). However, evidence of background fibrotic lung disease such as honeycombing may be present. Comparison to prior imaging when available is critical.<br>• Bronchoalveolar lavage cell count reveals >10% neutrophils, and lung biopsy shows diffuse alveolar damage.[75] |
| **Acute bronchiolitis obliterans organizing pneumonia** | • No differentiating symptoms or signs. Can be idiopathic or due to collagen vascular disorders, drugs, radiation, or infection.[75] | • Bilateral alveolar infiltrates can be indistinguishable from those seen in aspiration pneumonitis. Bronchoalveolar lavage cell count in organizing pneumonia may reveal neutrophilia and sometimes lymphocytosis (but <25% lymphocytes) with eosinophilia (but <25% eosinophils).[75] |
| **Acute eosinophilic pneumonia** | • No differentiating symptoms or signs, but duration of illness is usually <1 week. Can be idiopathic or caused by drugs.[75] | • Bilateral alveolar infiltrates can be indistinguishable from those seen in aspiration pneumonitis. Bronchoalveolar lavage cell count reveals >25% eosinophils. Eosinophilic pleural effusion is rare. Eosinophilic infiltration and |

| Condition | Differentiating signs / symptoms | Differentiating tests |
|---|---|---|
| | | diffuse alveolar damage may be seen on lung biopsy.[86] |
| **Acute hypersensitivity pneumonitis** | • No differentiating symptoms or signs, but usually develops within 4-6 hours after inhalation of an organic agent. Caused by environmental and work-related antigens.[75] | • Bilateral alveolar infiltrates can be indistinguishable from those of aspiration pneumonitis. Granulomatous and cellular pneumonitis with diffuse alveolar damage may be seen on lung biopsy. Bronchoalveolar lavage cell count shows lymphocytosis (>25%) and sometimes neutrophilia (<10%).[75] |
| **Diffuse alveolar hemorrhage** | • Hemoptysis is absent in 33% of patients. Causes include vasculitis, collagen vascular disorders, antibasement membrane antibody disease, coagulopathies, antiphospholipid antibody syndrome, and diffuse infections.[75] | • Bilateral alveolar infiltrates can be indistinguishable from those of aspiration pneumonitis. Pulmonary capillaritis, bland hemorrhage, and diffuse alveolar damage seen on lung biopsy.<br>• Bronchoalveolar lavage shows progressively bloodier return. Cytology shows red blood cells and hemosiderin-laden macrophages.<br>• Urinalysis may show proteinuria, hematuria, and red cell casts in cases of pulmonary-renal syndromes.[75] |
| **Neurogenic pulmonary edema** | • No differentiating symptoms or signs. Usually develops within minutes to hours after acute central nervous system injury such as seizures, head injury, or cerebral hemorrhage. Resolves within 48-72 hours.[87] | • Bilateral alveolar infiltrates may be indistinguishable from those seen in aspiration pneumonitis.[87] |

DIAGNOSIS

# Screening

The most commonly used diagnostic test for aspiration is the bedside swallow evaluation. This test includes a patient interview, a physical exam, and the assessment for signs of aspiration. While this is usually performed by a speech-language pathologist, to streamline the diagnostic evaluation some of the more sensitive components of the bedside swallow evaluation can be performed individually or in combination as screening tests.[88] These screening tests include a patient's attempts to swallow small quantities of water or ice chips while being observed by a nurse, a speech-language pathologist, or a physician. Screening tests should be considered whenever aspiration is suspected based on the presence of risk factors. Furthermore, all patients suffering from an acute stroke should undergo a bedside swallow evaluation by a speech-language pathologist, largely because between 40% and 78% of stroke patients have dysphagia.[16] [68]

Dysphagia program studies applied as a result of these screening methods could substantially reduce the rates of pneumonia in stroke patients.[89]

## Bedside swallow evaluation

Patients thought to have any risk factors for aspiration should undergo a complete neurologic evaluation before feeding.[90] This includes assessing cortical functions, bulbar muscles, gag reflex, and cough reflex. Alert patients with cough who are at high risk of aspiration should be observed drinking small amounts of water. If the patient coughs or shows signs of aspiration, the patient should be referred for a detailed swallowing evaluation.[27] Early bedside swallow screening (within 1 day of admission and before any oral intake) and dysphagia management in patients with acute stroke reduces the risk of aspiration pneumonia, may be cost-effective, and may assure quality care with optimal outcome.[91] If doubt exists or if silent aspiration is suspected, imaging studies should be performed.[16] Phonetic assessment independent of and during the swallow provocation tests may be a useful adjunct to bedside tests for aspiration risk, but it is not validated.[88] [92] Although a multitude of other screening tests are available, they have variable sensitivity.[93] In the opinion of the authors, however, there may be a benefit to obtaining an assessment of aspiration risk from more than one test.

## Flexible endoscopic evaluation of swallowing

Flexible endoscopic evaluation of swallowing (FEES) can be performed by speech pathologists at the bedside. With the use of a flexible fiberoptic scope, direct evidence of aspiration is documented by detecting the presence of food or a thick liquid over the vocal cords. The test also assesses the vocal cord function. In a study of critically ill trauma patients, FEES performed within 24 hours after extubation showed aspiration in 45% of the patients, of whom almost half were silent aspirators. These patients resumed an oral diet at a mean of 5 days after extubation and had no pulmonary complications.[50] FEES avoids exposure to radiation; however, modified barium swallow is noninvasive and more widely available.[56][94]

## Videofluoroscopic swallowing study and modified barium swallow

For these tests, the patient swallows barium under fluoroscopic imaging. Passage or retention of the radiopaque material in the respiratory tract is seen.[16] On videofluoroscopic swallowing study, 38% of patients with acute stroke had overt aspiration and 67% had silent aspiration.[95] Modified barium swallow performed in patients with indwelling tracheostomies on positive-pressure ventilation showed an incidence of aspiration of 50%, and 77% of these patients were silent aspirators.[46]

## Emerging assessments for dysphagia

Interventions targeting improved respiratory sensation and respiratory mechanics may prove to be beneficial in patients (such as those with Parkinson disease) who have impaired airway protection.[96] Various tests of respiratory mechanics have been employed to determine aspiration risk or at least the ability to compensate for a respiratory event. For example, a reduction in the peak cough flow was an independent risk factor for pneumonia.[97] Phonetic screening is a novel technique that may be used to identify dysphagia and aspiration risk at the bedside.[92]

# Approach

Patients that aspirate will often have a reduced level of consciousness and require close observation for at least 48 hours, either in the hospital or in another care facility. Although some patients may have dramatic signs and symptoms, many are asymptomatic, and infectious complications and acute respiratory distress syndrome (ARDS) can be delayed.[2] A high index of suspicion and prompt action are required if optimum outcomes are to be obtained.

## Aspiration pneumonitis

Aspiration of gastric contents

Patients with recent suspected or witnessed aspiration of gastric contents should, whenever possible, be immediately placed semi-prone and tilted to a 30° head-down position. This positions the larynx at a higher level than the oropharynx and allows the gastric content to drain externally. The oropharynx should be gently suctioned, taking care to avoid initiating a gag reflex that may worsen aspiration.[2]

Once the oropharynx has been suctioned, the airway should be secured by endotracheal intubation after rapid sequence induction with cricoid pressure if the patient is deemed to be at risk of further aspiration, is unable to protect their own airway (regurgitation, poor cough reflex), or shows signs of respiratory failure (tachypnea, dyspnea, confusion, cyanosis).[62] [63] Once the airway is secured, a nasogastric tube should be inserted to empty the stomach, and where possible the patient can be tilted to a 45° head-up position to help prevent further aspiration.

If a substantial amount of gastric content (>20-25 mL in an adult) is likely to have been aspirated, prompt (within a few hours) bronchoscopy and suctioning can remove aspirated gastric fluid and solid material from the central airways, thereby helping reduce inflammatory reaction, prevent lung collapse, and lessen the risk of subsequent infection.[98] A volume of gastric aspirate >0.3 mL per kilogram of body weight (i.e., 20-25 mL in adults) with a pH <2.5 is believed necessary for the development of aspiration pneumonitis, although aspiration of particulate food matter can cause severe pulmonary damage, even if the pH of the aspirate is above 2.5.[2] [99] Animal studies have shown a biphasic pattern to injury, with an initial peak at 1-2 hours after aspiration (direct burn effects) and a second peak at 4-6 hours (related to neutrophil infiltration).[1] [2]

Gastric aspirate is sterile under normal conditions due to the low pH, so bacterial infection does not have an important role in the early stages of acute lung injury.[2] Consequently, immediate routine antibiotic therapy is not recommended for aspiration pneumonitis.[2] Even if a patient has fever, leukocytosis, or pulmonary infiltrates, immediate use of antibiotics may be unnecessary and may select resistant organisms in an uncomplicated case of chemical pneumonitis.

The empiric use of antibiotics should, however, be considered depending on the clinical situation (e.g., severe respiratory involvement; severe preexisting lung pathology such as advanced COPD or interstitial lung disease; immunocompromise, including corticosteroid or immunomodulator use, post-transplant immunosuppression, chemotherapy, neutropenia; poor dentition; or the development of lung abscess, necrotizing pneumonia, or empyema).[100] In the context of small bowel obstruction, where there is a high risk of bacterial translocation, bacterial contamination of gastric juice, and sepsis, the initiation of antibiotics should be considered up front and should be adjusted when pathogens are identified.[2] See Small bowel obstruction and Sepsis in adults .

In practice, antibiotics should be initiated based on clinical concern and if the patient is not responding to supportive care. Local microbiology, resistance patterns, and risks for anaerobic infection should be considered when choosing the antibiotic regimen. Culture and sensitivities of samples obtained via bronchoscopy with bronchoalveolar lavage or protected brush specimens, thoracentesis, or blood taken for culture should guide antimicrobial management.[101] Empiric therapy with broad-spectrum antibiotics is recommended if the pneumonitis does not resolve 48 hours after aspiration.[2] [102] Antibiotics should be stopped if concern for infection drops and narrowed quickly if a specific pathogen is identified. See Aspiration pneumonia , Community-acquired pneumonia , and Hospital-acquired pneumonia .

Computed tomography (CT) imaging can identify related pathologies indicating a need for antibiotic therapy (e.g., empyema, abscess, necrosis). See Lung abscess , Empyema , Pleural effusion , and Sepsis in adults .

Positive-pressure ventilation with positive end-expiratory pressure can be used in patients who are intubated for airway protection or respiratory failure. However, positive pressure ventilation without a secure endotracheal tube is generally contraindicated in patients with known or suspected aspiration causing respiratory failure. Positive pressure helps to prevent atelectasis and improve the ventilation-perfusion ratio in patients who have aspirated gastric content.[37] However, it is essential that endotracheal suctioning, and if needed, post-intubation bronchoscopy, is performed before positive-pressure ventilation is employed, to avoid forcing aspirated material deeper into the lungs.[35] [37] Mechanical ventilatory support should follow lung-protective strategies as per ARDS guidelines. See Acute respiratory distress syndrome .

Respiratory cultures should be obtained from patients on mechanical ventilation, and antibiotics should be initiated immediately because of a high risk of developing ventilator-associated pneumonia.[1] See Hospital-acquired pneumonia .

Aspiration of barium

This usually occurs in the context of upper gastrointestinal radiologic studies.


*Bronchoscopy showing barium aspiration in a lung transplant patient in the right mainstem bronchus after a barium swallow study*

*From the collection of Dr Kamran Mahmood*

Bronchoscopy with suctioning, if considered, should be done immediately post-aspiration with the aim to remove any residual barium from the proximal airway and to reduce hypoxemia. Care should be taken to minimize potential spread of barium to unaffected areas from washing or lavage techniques. Owing to the inert nature of barium sulfate, usually no severe long-term harm is to be expected; however, severe pneumonitis and death has been reported in infants, and in older or debilitated patients.[4] [24] Infants, older adult patients, and those of any age with significant symptoms, should be admitted for observation if not already hospitalized.

There is no evidence for routinely prescribing antibiotics after barium aspiration, but antibiotics for possible pneumonia are usually considered if infiltrates do not resolve 48 hours post-aspiration.[70] See Aspiration pneumonia .

## Corticosteroids

Human studies have shown no improvement in mortality, and the rate of gram-negative pneumonia 5 days after aspiration was higher in patients receiving corticosteroids.[103] Although the infiltrates improve more quickly in the patients given corticosteroids than in those given placebo, patients given corticosteroids might have a longer intensive care unit (ICU) stay.[104] [105]

Overall, because of the increased risk for gram-negative bacterial pneumonia and a prolonged stay in the ICU, together with the lack of any mortality benefit, corticosteroids are not indicated in the initial or empiric

management of aspiration pneumonitis. They are also not indicated with aspiration pneumonitis that is complicated by acute respiratory distress syndrome.[2] However, corticosteroids may be considered if other indications develop such as in select patients with severe ARDS.[106] [107] See Acute respiratory distress syndrome .

# Treatment algorithm overview

Please note that formulations/routes and doses may differ between drug names and brands, drug formularies, or locations. Treatment recommendations are specific to patient groups: see disclaimer

| Acute | | ( summary ) |
|---|---|---|
| **pneumonitis due to aspiration of gastric contents** | | |
| | 1st | immediate positional drainage |
| | plus | oropharyngeal suctioning |
| | adjunct | endotracheal intubation + nasogastric tube |
| | adjunct | bronchoscopy + endotracheal suctioning |
| | adjunct | antibiotics |
| | adjunct | positive-pressure ventilation |
| **pneumonitis due to aspiration of barium** | | |
| | 1st | immediate positional drainage |
| | plus | bronchoscopy + endotracheal suctioning |



# Treatment algorithm

Please note that formulations/routes and doses may differ between drug names and brands, drug formularies, or locations. Treatment recommendations are specific to patient groups: see disclaimer

## Acute

### pneumonitis due to aspiration of gastric contents

**1st** **immediate positional drainage**

» Patients with recent suspected or witnessed aspiration of gastric contents should, whenever possible, be immediately placed semi-prone and tilted to a 30° head-down position. This positions the larynx at a higher level than the oropharynx and allows the gastric content to drain externally.

**plus** **oropharyngeal suctioning**

Treatment recommended for ALL patients in selected patient group

» The oropharynx should be suctioned gently, taking care to avoid initiating a gag reflex that may worsen aspiration.[2]

**adjunct** **endotracheal intubation + nasogastric tube**

Treatment recommended for SOME patients in selected patient group

» Once the oropharynx has been suctioned, if the patient is deemed to be at risk of further aspiration, is unable to protect their own airway (regurgitation, poor cough reflex), or shows signs of respiratory failure (tachypnea, dyspnea, confusion, cyanosis), their airway should be secured by endotracheal intubation via rapid sequence induction with cricoid pressure.[62] [63] Once the airway is secured, a nasogastric tube should be inserted to empty the stomach, and where possible the patient can be tilted to a 45° head-up position to help prevent further aspiration.

**adjunct** **bronchoscopy + endotracheal suctioning**

Treatment recommended for SOME patients in selected patient group

» If a substantial amount of gastric content (>20-25 mL in an adult) is likely to have been aspirated, prompt (within a few hours) bronchoscopy and suctioning can remove aspirated gastric fluid and solid material from the central airways, thereby helping reduce inflammatory reaction, prevent lung collapse, and lessen risk of subsequent infection.[98]

## Acute

» A volume of gastric aspirate >0.3 mL per kilogram of body weight (i.e., 20-25 mL in adults) with a pH <2.5 is believed necessary for the development of aspiration pneumonitis, although aspiration of particulate food matter can cause severe pulmonary damage, even if the pH of the aspirate is above 2.5.[2] [99] Animal studies have shown a biphasic pattern to injury, with an initial peak at 1-2 hours after aspiration (direct burn effects) and a second peak at 4-6 hours (related to neutrophil infiltration).[1] [2]

**adjunct** **antibiotics**

Treatment recommended for SOME patients in selected patient group

» Gastric aspirate is sterile under normal conditions due to the low pH, so bacterial infection does not have an important role in the early stages of acute lung injury in most cases.[2] Consequently, immediate routine antibiotic therapy is not recommended for aspiration pneumonitis.[2] Even if a patient has fever, leukocytosis, or pulmonary infiltrates, immediate use of antibiotics may be unnecessary as this may select resistant organisms in an uncomplicated case of chemical pneumonitis.

» The empiric use of antibiotics should, however, be considered depending on the clinical situation (e.g., severe respiratory involvement; severe preexisting lung pathology such as advanced COPD or interstitial lung disease; immunocompromise, including corticosteroid or immunomodulator use, post-transplant immunosuppression, chemotherapy, neutropenia; poor dentition; or the development of lung abscess, necrotizing pneumonia, or empyema).[100] In practice, antibiotics should be initiated based on clinical concern and if the patient is not responding to supportive care.

» Culture and sensitivities of samples obtained via bronchoscopy with bronchoalveolar lavage or protected brush specimens, thoracentesis, or blood taken for culture should guide antimicrobial management.[101] Empiric therapy with broad-spectrum antibiotics is recommended if the pneumonitis does not resolve 48 hours after aspiration.[2] [102] Antibiotics should be stopped if concern for infection drops and narrowed quickly if a specific pathogen is identified. See Aspiration pneumonia , Community-acquired pneumonia , and Hospital-acquired pneumonia .

» Computed tomography (CT) imaging can identify related pathologies indicating a need

## Acute

for antibiotic therapy (e.g., empyema, abscess, necrosis). See Lung abscess , Empyema , Pleural effusion , and Sepsis in adults .

» In the context of small bowel obstruction, where there is a high risk of bacterial translocation, bacterial contamination of gastric juice, and sepsis, the initiation of antibiotics should be considered up front.[2] See Small bowel obstruction and Sepsis in adults .

» Local microbiology, resistance patterns, and risks for anaerobic infection should be considered when choosing the antibiotic regimen.

**adjunct** **positive-pressure ventilation**

Treatment recommended for SOME patients in selected patient group

» Positive-pressure ventilation with positive end-expiratory pressure can be used in patients who are intubated for airway protection or respiratory failure. However, positive pressure ventilation without a secure endotracheal tube should generally be considered contraindicated in patients with known or suspected aspiration causing respiratory failure. Positive pressure helps to prevent atelectasis and improve the ventilation-perfusion ratio in patients who have aspirated gastric content.[37] However, it is essential that endotracheal suctioning, and if needed, post-intubation bronchoscopy, is performed before positive-pressure ventilation is employed, to avoid forcing aspirated material deeper into the lungs.[35] [37]

» Mechanical ventilatory support should follow lung-protective strategies as per acute respiratory distress syndrome guidelines. See Acute respiratory distress syndrome .

» Respiratory cultures should be obtained from patients on mechanical ventilation, and antibiotics should be initiated immediately because of a high risk of developing ventilator-associated pneumonia.[1] See Hospital-acquired pneumonia .

### pneumonitis due to aspiration of barium

**1st** **immediate positional drainage**

» Patients with recent suspected or witnessed aspiration of barium should, whenever possible, be immediately placed semi-prone and tilted to a 30° head-down position. This positions the

## Acute

larynx at a higher level than the oropharynx and allows the gastric content to drain externally.

**plus** **bronchoscopy + endotracheal suctioning**

Treatment recommended for ALL patients in selected patient group

» Bronchoscopy with suctioning, if considered, should be performed immediately post-aspiration to remove any residual barium from the airway and reduce hypoxemia. Care should be taken to minimize potential spread of barium to unaffected areas from washing or lavage techniques.

» Infants, older adult patients, and those of any age with significant symptoms should be admitted for observation if not already hospitalized.

» There is no evidence for routinely prescribing antibiotics after barium aspiration, but antibiotics for possible pneumonia are usually considered if infiltrates do not resolve 48 hours after aspiration.[70]

» See Aspiration pneumonia .

# Primary prevention

Patients with comorbidities or neurologic disorders, or in critical care

Measures to identify gastroesophageal reflux disease, oropharyngeal dysphagia, gastrointestinal motility, and metabolic disorders (including diabetes mellitus) and to reduce oropharyngeal load of pathogenic organisms, particularly in patients with neurologic disease, patients with comorbidities, and those who are intubated, can potentially help to reduce aspiration and associated complications such as aspiration pneumonia.[54] [55]

Patients with stroke or other disorders who have impaired swallowing should be managed using a multidisciplinary approach.[56] Patients thought to have any risk factors for aspiration should be carefully evaluated before attempting feeding. This includes neurologic evaluation with assessment of cortical function, bulbar muscle gag, and cough reflex. A speech pathologist should evaluate swallowing in unclear cases.[48] Modified diets (nectar-thick instead of thin liquids) may be easier to swallow. These patients may benefit from swallow rehabilitation, including training like upright posture, chin tuck, and slow swallowing.

Keeping the head of the patient's bed higher than 30° to 45° reduces the risk of aspiration, especially in critically ill or mechanically ventilated patients.[57] [58] Other potentially useful measures to prevent aspiration in critically ill patients include oral decontamination with antiseptic solutions; a chin-down position while feeding for patients with dysphagia; percutaneous endoscopic gastrostomy tube or percutaneous endoscopic jejunostomy tube for feeding chronically debilitated patients; feeding by hand rather than inserting feeding tubes for geriatric patients; feeding a soft mechanical diet and thickened liquids; using capsaicin to sensitize the gag reflex; suctioning subglottic secretions in patients with endotracheal tubes; suppressing gastric acid with drugs; minimizing use of sedative drugs; monitoring gastric residual volumes as a marker of aspiration risks; and placing a postpyloric feeding tube.[37] [59]

Anesthesia

Anesthesia-related aspiration of gastric contents can be prevented by identifying patients susceptible to vomiting, minimizing gastric contents before surgery, minimizing emetic stimuli, and avoiding complete loss of protective reflexes from oversedation.[37] Antiemetics may be considered for patients at increased risk of postoperative nausea and vomiting.[54]

Aspiration of gastric contents during anesthesia can be prevented by adhering to national anesthesiology societies' guidelines. Water and other clear liquids (e.g., tea, coffee, soda water, apple juice, pulp-free orange juice) are allowed up to 2 hours before anesthesia in otherwise healthy adults (including pregnant women not in labor) and children who are scheduled for elective surgery.[54] [60] The fasting period after intake of solids should not be less than 6 hours. However, in the emergency procedural setting when the opportunity to use preventive strategies may not be available, there are no data to suggest that the risk of aspiration is increased due to lack of fasting.[61] Cricoid pressure (Sellick maneuver) is commonly employed to minimize the risk of aspiration during endotracheal intubation in patients at high risk of aspiration; however, its routine use is of uncertain benefit.[62][63]

A nasogastric tube is commonly inserted prophylactically in patients at high risk for aspiration during general anesthesia.[8]

Gastrointestinal stimulants or proton-pump inhibitors (or nonparticulate antacids) may be given to patients preoperatively only if they are at increased risk of aspiration.[54] Use of perioperative H2 antagonists may maintain gastric pH >2.5 in unfasted patients, providing a theoretical benefit in preventing lung injury from aspiration.[64] [65][66] However, no data exist that demonstrate improvement in outcome with this approach. One meta-analysis comparing the effectiveness of H2 antagonists with proton-pump inhibitors (PPIs) concluded that a single oral dose of an H2 antagonist before surgery is more effective than PPI. However, when given as two oral doses preoperatively or using the intravenous route, both classes are equally effective.[67] Pregnant patients requiring anesthesia should receive a preoperative H2 antagonist to increase gastric pH and undergo early intubation with cricoid pressure.[38] Routine preoperative use of H2 antagonists, PPIs, antacids, antiemetics, or anticholinergics is not recommended for patients with no apparent increased risk for pulmonary aspiration.[54]

Pharmacologic management options to prevent aspiration are limited, and depend on the mechanism of aspiration risk. ACE inhibitors have been shown to increase the cough reflex in Chinese and Japanese patients at risk of aspiration after stroke.[68]

Barium studies

Postural techniques during barium studies can reduce or eliminate the risk of aspiration when small volumes of barium sulfate are used.[69] Radiologists should try to avoid barium entering the tracheobronchial tree by assessing the likelihood of aspiration in patients at risk before starting the exam.[4] Patients at high risk should swallow a contrast medium such as iopydol that is less likely to harm the lungs. Gastrografin can cause pulmonary edema and should be avoided if aspiration is suspected.[24]

# Secondary prevention

Patients with ≥2 risk factors or with documented aspiration, persistent feeding intolerance, or both can be treated with a prokinetic drug and/or fed with tubes placed with the tip at or below the ligament of Treitz (suspensory ligament of the duodenum).[44] [116] [117] Relatively small, single-center trials have suggested reduction in pneumonia with both metoclopramide and postpyloric feeding.[116] [117] These findings need to be confirmed in larger randomized controlled studies. Improved oral hygiene may also decrease the risk of aspiration pneumonia.[16] [118]

Patients with stroke or other disorders who have impaired swallowing should be managed using a multidisciplinary approach.[56] Although swallowing function may return in most patients within 6 months of a stroke, tube feeding may be indicated in the acute phase. The Feed or Ordinary Diet (FOOD) study, a 3-part randomized controlled trial, found no significant benefit from nutritional supplements in patients with stroke.[119] [120] Early nutrition within the first week decreased mortality. In this study, percutaneous endoscopic gastrostomy tubes, when compared with nasogastric tubes, were associated with higher mortality or adverse outcomes at 6 months. The data available on the optimal type of feeding tube are conflicting. Postpyloric placement of feeding tubes has been shown to decrease pneumonia risk in small,

single-center studies, though no difference has been shown in other outcomes such as the duration of mechanical ventilation, vomiting, or mortality.[116] [121] [122] [123][124]

Tracheostomy or laryngectomy may be options to be considered in highly select cases such as patients with neurodegenerative disorders (e.g., amyotrophic lateral sclerosis), or those with irreversible dysphagia and recurrent aspiration (e.g., previous radiation and surgery for throat cancer).

# Patient discussions

All patients undergoing general anesthesia should fast preoperatively. Clear fluids of 400 mL or less (water, clear juices, coffee, or tea) up to 2 hours preoperatively, light meals up to 6 hours, and up to 150 mL of clear fluid up to 1 hour before surgery with oral drugs are recommended.[52] [54][115]

These recommendations do not apply to milk, fat-containing fluids, or solids. For solids, a fasting period of at least 6 hours is recommended. Use of chewing gum and any form of tobacco is discouraged during the last 2 hours before induction of anesthesia because they can increase the gastric content. There are no clear recommendations regarding patients at high risk for aspiration.

FOLLOW UP

# Monitoring

## Monitoring

Measuring gastric residual volume (GRV) in excess of a threshold value has been used to monitor the risk for aspiration in tube-fed patients. Because the cutoff values for GRV that clearly indicate aspiration risks vary among studies, these assessments should be combined with clinical evaluation of feeding intolerance, which includes auscultation of bowel sounds and evaluation of abdominal distention.[44] Measures to reduce aspirations should be initiated when a GRV is >200 mL, and aspiration of gastric contents from any in-place nasogastric tube should be performed if anesthesia is imminent.[109]

The quality of evidence regarding measurement of GRV and its effect on parameters such as mortality, pneumonia, and length of stay is uncertain, and it is difficult to draw conclusions about the value of GRV in the clinical setting.[110] The practice of not monitoring GRV was not inferior to routine monitoring in regard to the outcome of ventilator-associated pneumonia in 452 intensive care unit (ICU) patients randomized in a noninferiority, open-label, multicenter trial conducted in adults requiring invasive mechanical ventilation for more than 2 days and given enteral nutrition within 36 hours after intubation at nine French ICUs.[111] Furthermore, in one study of 61 patients receiving mechanical ventilation and continuous enteral feeding, measurement of residual gastric volume by suctioning was inaccurate.[112]

The Society of Critical Care Medicine (SCCM) and the American Society for Parenteral and Enteral Nutrition (ASPEN) do not endorse using GRV as part of routine monitoring in the ICU.[113] The European Society for Clinical Nutrition and Metabolism (ESPEN) does suggest delaying commencement of feeding if GRV is >500 mL in a 6-hour window but also acknowledges SCCM/ASPEN guidelines regarding routine monitoring.[114] Clinicians should consider these guidelines within the context of the individual patient, particularly in those at high risk for aspiration, who have ileus, esophageal dysfunction, or gastroparesis.

Because of the inert character of barium, long-term reactions and late toxicities are not usually expected, and complete radiologic clearance is the norm. There are no extensive data on long-term complications from massive barium aspiration, but case reports suggest that abnormalities can be seen on high-resolution computed tomography scan up to 1 year later.[108] Therefore, it is reasonable to obtain follow-up chest imaging during the year after barium aspiration.

# Complications

| Complications | Timeframe | Likelihood |
|---|---|---|
| **pneumonia related to aspiration of gastric contents** | **short term** | **medium** |
| One quarter of patients with aspiration of gastric contents develop expanding infiltrates, probably because of superimposed bacterial infection, which should be treated with antibiotics that cover for gram-negative bacteria and gram-positive cocci.[48] [77] | | |
| **acute respiratory distress syndrome related to aspiration of gastric contents** | **short term** | **low** |
| May be a complication of pulmonary aspiration of gastric contents. About 12% die, usually shortly after the aspiration.[77] | | |
| **fibrosis related to aspiration of barium sulfate** | **long term** | **low** |
| Mild fibrotic changes have been described on high-resolution computed tomography scans of the chest 1 year after barium aspiration.[108] | | |

# Prognosis

Aspiration of gastric contents results in limited disease in most patients. Aspiration can be asymptomatic, but it can result in chemical pneumonitis and acute respiratory distress syndrome (ARDS).[2] Mortality is high, however, if patients progress to ARDS. ARDS usually develops within 2-5 hours of aspiration, but can be delayed.[15] The clinical course is variable: in one small retrospective study, 12% of patients had a fulminant course and died shortly after aspiration of gastric contents; in 62% the chest x-ray improved rapidly within 5 days after aspiration; however, in 26% this initial improvement was followed by the development of new infiltrates on chest x-ray, probably indicating complicating bacterial pneumonia, and of this group over 60% died as a consequence.[77] The aspiration injury usually begins to resolve within 72 hours, if pneumonia or ARDS has not developed. Death as a result of aspiration of gastric contents as a consequence of anesthetic practice is rare, with rates varying from 0% to 5%, but is a leading cause of malpractice claims with high mortality in these reports.[8] [12]

Because of the inert character of barium, long-term reactions and late toxicities are not usually expected, and complete radiologic clearance is the norm. There are no extensive data on long-term complications from massive barium aspiration, but case reports suggest that abnormalities can be seen on high-resolution computed tomography scan up to 1 year later.[108] Therefore, it is reasonable to obtain follow-up chest imaging during the year after barium aspiration.

# Diagnostic guidelines

## International

### ACR appropriateness criteria: dysphagia (https://www.acr.org/Clinical-Resources/Clinical-Tools-and-Reference/Appropriateness-Criteria) [94]

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# Key articles


- Marik PE. Aspiration pneumonitis and aspiration pneumonia. N Engl J Med. 2001 Mar 1;344(9):665-71. Abstract (http://www.ncbi.nlm.nih.gov/pubmed/11228282?tool=bestpractice.bmj.com)
- Smith Hammond CA, Goldstein LB. Cough and aspiration of food and liquids due to oral-pharyngeal dysphagia: ACCP evidence-based clinical practice guidelines. Chest. 2006 Jan;129(1 suppl):154S-68S. Full text (http://journal.chestnet.org/article/S0012-3692(15)52844-4/fulltext) Abstract (http://www.ncbi.nlm.nih.gov/pubmed/16428705?tool=bestpractice.bmj.com)
- American Society of Anesthesiologists. Practice guidelines for preoperative fasting and the use of pharmacologic agents to reduce the risk of pulmonary aspiration: application to healthy patients undergoing elective procedures - an updated report by the American Society of Anesthesiologists task force on preoperative fasting and the use of pharmacologic agents to reduce the risk of pulmonary aspiration. Anesthesiology. 2017 Mar;126(3):376-93. Full text (https://journals.lww.com/anesthesiology/fulltext/2017/03000/practice_guidelines_for_preoperative_fasting_and.14.aspx) Abstract (http://www.ncbi.nlm.nih.gov/pubmed/28045707?tool=bestpractice.bmj.com)


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# Images




*Figure 1: Bronchoscopy showing barium aspiration in a lung transplant patient in the right mainstem bronchus after a barium swallow study*

*From the collection of Dr Kamran Mahmood*

*Figure 2: Barium aspiration. A barium swallow was conducted in a 53-year-old woman. Imaging revealed hyperdense airway-centered material in the left lower lobe consistent with barium aspiration bronchiolitis. A tracheoesophageal fistula was confirmed*

*From the collection of Dr Augustine Lee; used with permission of Mayo Foundation for Medical Education and Research, all rights reserved*



 

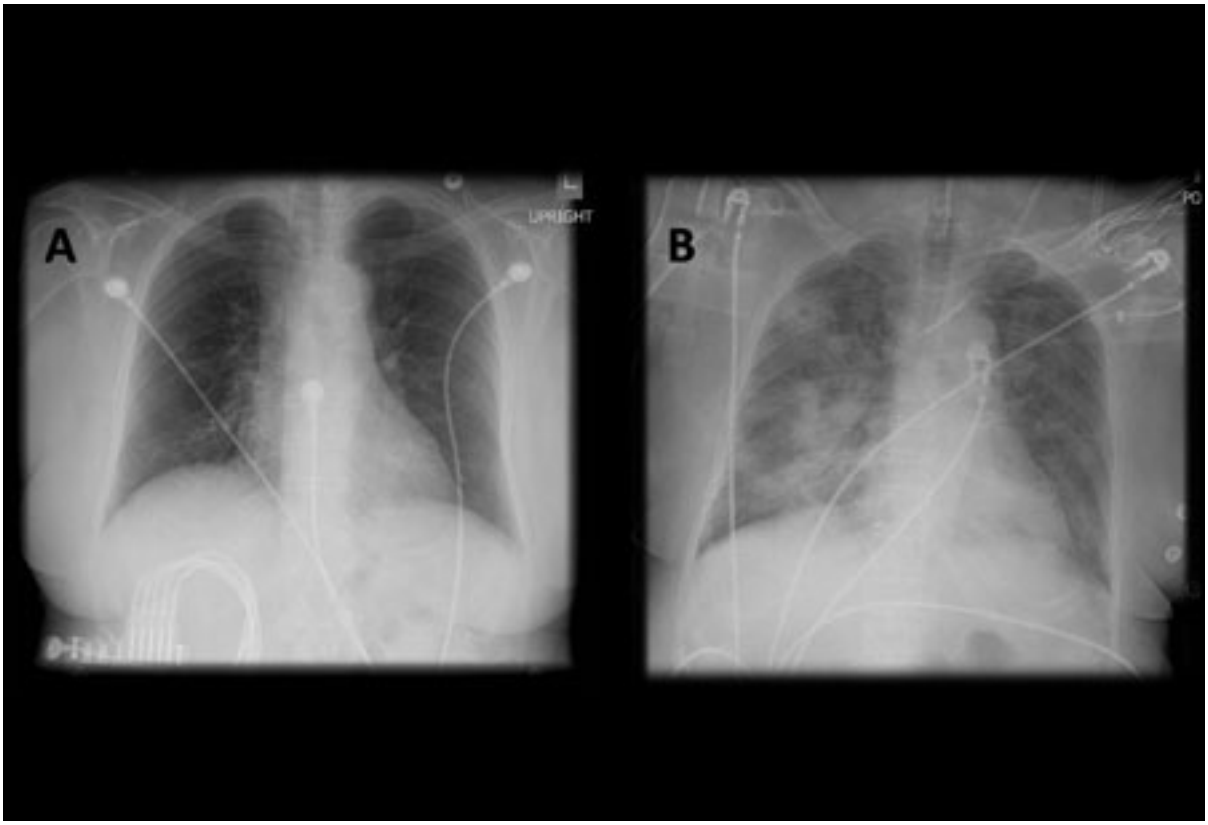


*Figure 3: A. Portable upright chest x-ray before aspiration; B. Chest x-ray 1 hour after aspiration, showing bilateral diffuse alveolar infiltrates, worse at the bases on the right side*

*From the collection of Dr Henri Colt*

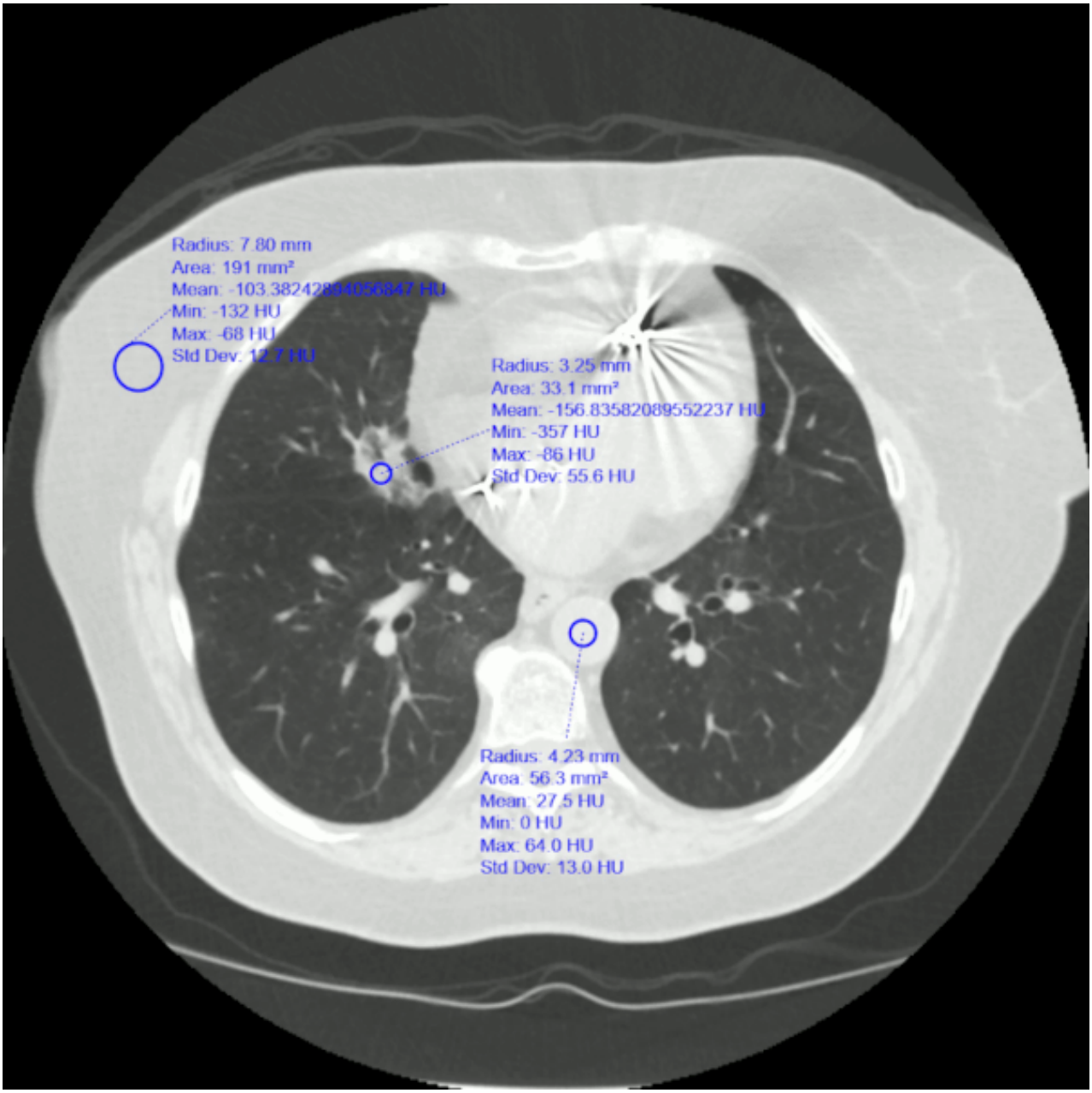


*Figure 4: Lipoid pneumonia. A 77-year-old woman with dysphagia and achalasia following a stroke presented with recurrent lung infiltrates, including a persisting right middle lobe lesion. Hounsfield units (HU) measurement was -157, consistent with lipoid pneumonia. Comparative subcutaneous fat and aorta (blood/tissue) HU are shown*

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**Figure 1 – BMJ Best Practice Numeral Style**

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