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AHC Media

Epiglottitis

Since the introduction of the vaccine against H. influenzae, *there has been a significant decrease in the number of children presenting with epiglottitis. Although there is little evidence that the disease has increased in adults, clearly the percentage of cases in adults compared to children has increased. Further, there is greater recognition of milder cases with direct visualization and imaging.*

Early in my training, I was taught that adults could develop epiglottitis but that the size of their trachea made airway obstruction impossible. One very difficult intubation dealing with a very large epiglottis taught me a respect for this disorder.

Although adults with epiglottitis can develop airway obstruction, there are significant differences in the disease in adults compared to children. To paraphrase, adults are not just large children.

— Sandra M. Schneider, MD, Editor

Relevancy of the Problem to the Adult Population

Acute epiglottitis has traditionally been considered a pediatric disease. However, with the introduction of *Haemophilus influenzae* type b vaccination, the pediatric incidence has steadily decreased. Whether the incidence of acute epiglottitis is increasing or stable in adults is unclear. Acute epiglottitis results from edema and inflammation of the epiglottis and supraglottic structures, and requires urgent medical attention. It can rapidly progress to life-threatening airway obstruction.

Epidemiology

The symptoms of acute epiglottitis include fever, sore throat, dysphagia, drooling, stridor, muffled voice, hoarseness, and respiratory distress.[1-9] (*See Table 1.*) The overall incidence of adult acute epiglottitis is 1 to 3/100,000 per year,[1,7,10] and reported mortality rates vary widely from just under 1% to as high as 20% in some reviews.[11] Acute epiglottitis has traditionally been considered a pediatric disease. However, with the introduction of *Haemophilus influenzae* type b vaccination, the pediatric incidence has steadily decreased and its incidence is either increasing[1,7,10,12] or stable in adults.[3,13] The average age of patients with adult epiglottitis is between 42[14] and 47[3] years. Kass et al[4] have noted an increase in cases occurring during the summer months, although other studies have not been able to confirm this.[6,14] Male-to-female ratios of between 1.8:1 and 4:1 have been reported in the literature.[3,15] In adults, epiglottitis has been associated with a number of comorbid conditions, including hypertension, diabetes mellitus, substance abuse, and immune deficiency.[2,7,16-18]

Etiology

Various microorganisms have been implicated in epiglottitis[3,19-39] (*See Table 1.*) Isolated *H. influenzae* type b cases still appear in both children and adults, some of which constitute vaccine failure,[8,40,41] but other bacteria such as streptococci have become the most common causative agents.[10] In the majority of cases, however, no definite organism can be identified.[3,42,43] A viral etiology has been postulated for some cases of adult epiglottitis, especially in milder

Executive Summary

- Since the introduction of the *H. influenzae* vaccine, cases of epiglottitis are decreasing. Those children who get the disease represent vaccine failures (no vaccine offers 100% protection) or infection with other organisms, most often Streptococcus.
- Plain films of the neck are not very accurate in the diagnosis of epiglottitis. CT scans or direct visualization of the epiglottis is recommended.
- The primary concern in a patient with epiglottitis, regardless of age, is airway compromise. Adults with stridor are at particular risk. Those with respiratory distress or who appear toxic are at risk of airway compromise as well.
- As airway compromise can occur rather quickly, the patient should be admitted to an ICU with appropriate airway equipment, including that for a surgical airway, nearby. Treatment with antibiotics, either second- or third-generation cephalosporins or ampicillin with sulbactam, should be given.

cases.[43] However, of the viruses, only herpes simplex has been positively identified by histology.[34] Anaerobic organisms are major constituents of the microflora of the upper respiratory tract, but have rarely been reported as causing epiglottitis in adults.[27]

In immunocompromised hosts, epiglottitis may be caused by *Pseudomonas aeruginosa* and Candida species.[44-46] A case report of epiglottitis caused by *Histoplasma capsulatum* has also been described in an adult receiving infliximab, prednisone, and azathioprine for Crohn's disease.[47]

Noninfectious causes of epiglottitis should also be considered, including thermal injury, foreign body ingestion, and caustic ingestion.[48-50]

Table 1: Organisms Responsible for Epiglottitis in Adults

Bacterial Causes
• *Bacteroides melaninogenicus*
• Beta-hemolytic streptococcus
• *Branhamella catarrhalis*
• *Citrobacter diversus*
• *Enterobacter cloacae*
• *Escherichia coli*
• *Haemophilus influenzae*
• *Haemophilus parainfluenzae*
• *Kingella kingae*
• *Klebsiella pneumoniae*
• *Moraxella catarrhalis*
• *Mycobacterium tuberculosis*
• Neisseria spp
• *Pasteurella multocida*
• *Pseudomonas aeruginosa*
• *Serratia marcescens*
• *Staphylococcus aureus*
• *Streptococcus milleri*
• *Streptococcus pneumoniae*
• *Streptococcus pyogenes*
• *Streptococcus viridans*
• *Vibrio vulnificus*
Fungal Causes
• Aspergillus
• *Candida albicans*
• *Histoplasma capsulatum*
Viral Causes
• Herpes simplex

Pathophysiology

Acute epiglottitis in adults is a clinical condition requiring early diagnosis and treatment in order to avoid possible complications, which, although less frequent than that in the pre-antibiotic era or the pediatric population, may be serious and life-threatening.[6,9,51] The course of the disease in adults differs in several ways from that in pediatric patients. It has been suggested that both the relative size of the glottic aperture and the difference in anatomic configuration of the epiglottis are protective in adults.[52] Others have proposed that the comparative lack of reactive lymphoid tissue in the adult pharynx is another inherent protective factor.[6] Epiglottitis takes on two distinct forms. The first is localized cellulitis without bacteremia, and the second is a more serious and fulminant systemic infection with bacteremia and distant seeding.[53] Fulminant systemic infection and bacteremia are almost twice as common in pediatric patients (60–90%) as in adult patients (26–31%).[6,54]

Clinical Features

Severe cases of adult epiglottis are easily recognized, but a large number of less severe cases are initially misdiagnosed. In up to one-third of adult patients, epiglottitis is present but not diagnosed within 48 hours of admission.[55] Adults with epiglottitis typically experience a prodrome resembling that of a benign upper respiratory infection. The duration of the prodrome is usually 1–2 days, but may be as long as 7 days and as short as several hours. The progression of symptoms is slower in adults than in children. In one case series of 106 patients, 65% presented within two days of symptom onset, and 9% presented more than one week later.[16] Patients who have a rapid onset of disease and those with comorbid conditions are more likely to require airway intervention.[1,2,56] Sore throat is the most common complaint, with 90–100% of patients reporting a sore throat.[16,57,58] (*See Table 2.*) In an analysis of 158 cases from the literature, Khilanani and Khatib described the symptoms of epiglottitis as including a severe sore throat in 100% of cases, painful dysphagia in 76%, fever in 88%, and shortness of breath in 78%.[58] Other symptoms included anterior neck tenderness and hoarseness.

The signs of adult epiglottitis include lymphadenopathy, drooling, and respiratory distress.[59] Frantz et al found muffling of the voice occurred in 54% of patients.[3] Gentle palpation of the larynx is frequently extremely painful, which should immediately raise the suspicion of epiglottitis.[60] These findings have been confirmed in other studies.[59,61-63] Diagnosis in the emergency department or doctor's office requires a high index of suspicion. The presence of a severe sore throat with the associated signs and symptoms listed above in an adult should immediately raise the possibility of the diagnosis.

Adult patients with mild epiglottitis can be expected to have a sore throat, absent or mild fever, hoarseness, and no stridor or respiratory distress. In comparison, severe cases present with fever, toxic appearance, drooling, dysphagia, aphonia, stridor, and respiratory distress. The combination of dyspnea and stridor is the most ominous finding, and usually leads to intubation or the requirement for a surgical airway. Airway compromise is less common in adults than in children. Ng et al reported artificial airway support in only 7 of 106 adults (6.6%).[16] In a second study conducted by Solomon et al, 9 of 57 (16%) of patients required artificial airway support.[57]

Table 2: Presenting Signs and Symptoms of Epiglottitis in Adults

Signs or Symptoms	Incidence (%)
Sore throat	90 to 100%
Fever ≥ 37.5°C	30 to 90%
Muffled voice	50 to 80%
Dysphagia	61 to 76%
Drooling	50 to 80%
Hoarseness	20 to 40%
Pain with palpation of the larynx	20 to 36%

Examination of the Epiglottis

Visualization of the epiglottis is the accepted standard for clinical diagnosis. Direct examination through fiber-optic nasoendoscopy of the oropharynx as an initial step in examination is generally safer in adults than in children, given the lower frequency of airway compromise when epiglottitis is present.[57] Flexible fiber-optic nasoendoscopy is the preferred approach, as it provides direct, minimally invasive examination of the upper airway. Flexible nasoendoscopy makes it possible to examine the supraglottis to confirm the diagnosis, evaluate the extent of mucosal edema, and determine the degree of airway obstruction. Visualization reveals a swollen epiglottis and surrounding structures. The epiglottis may appear "cherry red," but is often pale and edematous.[1,56] Repeated nasoendoscopic examinations during treatment allow precise monitoring of the resolution of supraglottic edema.[64]

In patients with respiratory distress, drooling, aphonia, or stridor, flexible nasoendoscopy is contraindicated. In cases of respiratory distress, direct laryngoscopy should be undertaken as part of a "double setup," with the ability to proceed immediately with a surgical airway as needed.[2,56]

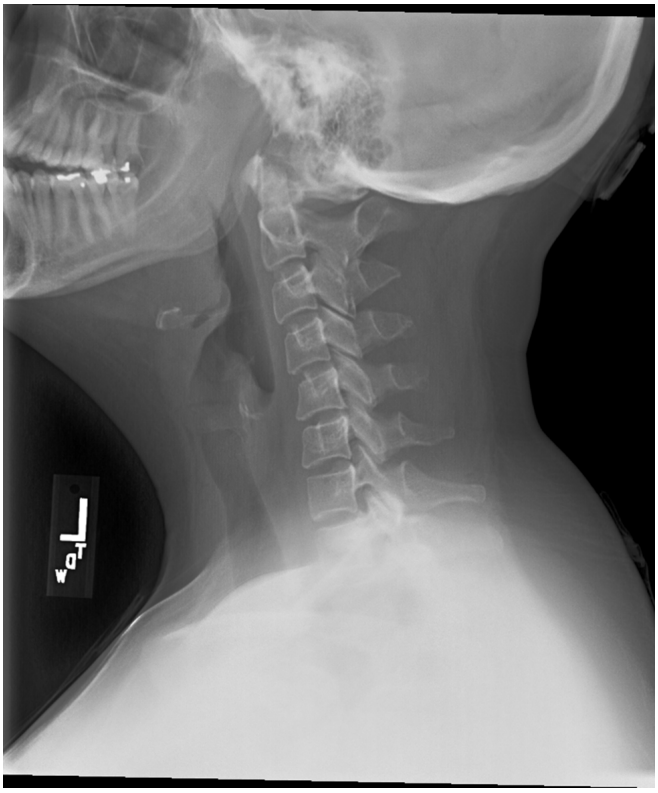
Imaging

Normal soft-tissue plain films do not exclude mild to moderate adult epiglottitis.[16,57] (*See Figures 1 and 2.*) Lateral neck films have been found to be extremely inaccurate for the diagnosis of epiglottitis in adults. In one retrospective review, the plain films were interpreted as positive in only 31% of patients with epiglottitis.[65] James and Holland reported a 33% incidence of false-positive diagnosis for epiglottitis when normal lateral neck radiographs were presented to a group of five radiologists.[66] Schumaker et al proposed that an epiglottic width of greater than 8 mm and an aryepiglottic width greater than 7 mm would accurately indicate epiglottitis.[67] More recently, Rothrock et al suggested that an epiglottic-width-to-epiglottic-height ratio greater than 0.6, and epiglottic-width-to-C3-vertebral-body-width ratio greater than 0.5, or aryepiglottic-width-to-C3-vertebral-body-width ratio greater than 0.35 are predictors of epiglottitis.[68]

Diagnosis

In the majority of patients, a diagnosis of epiglottitis is based on clinical history and physical examination results, occasionally assisted by lateral neck radiography. In instances in which the patient has

Figure 1: Normal Soft-tissue Lateral Radiograph



From the collection of Justin L. Weppner, DO

Figure 2: Soft-tissue Lateral Radiograph Demonstrating Epiglottitis

Image courtesy of J. Stephan Stapczynski, MD.

mild disease and a stable airway, CT is helpful. (*See Figures 3 and 4.*) Because the symptoms of epiglottitis can be nonspecific, CT can be useful in excluding conditions with symptoms similar to epiglottitis, such as peritonsillar abscess, abscesses of the deep neck space, lingual tonsillitis, laryngitis, or complications of the epiglottitis such as abscess formation.[69,70] CT scanning should be performed in patients who have a stable airway, are not in acute distress, and are able to lie flat without difficulty.

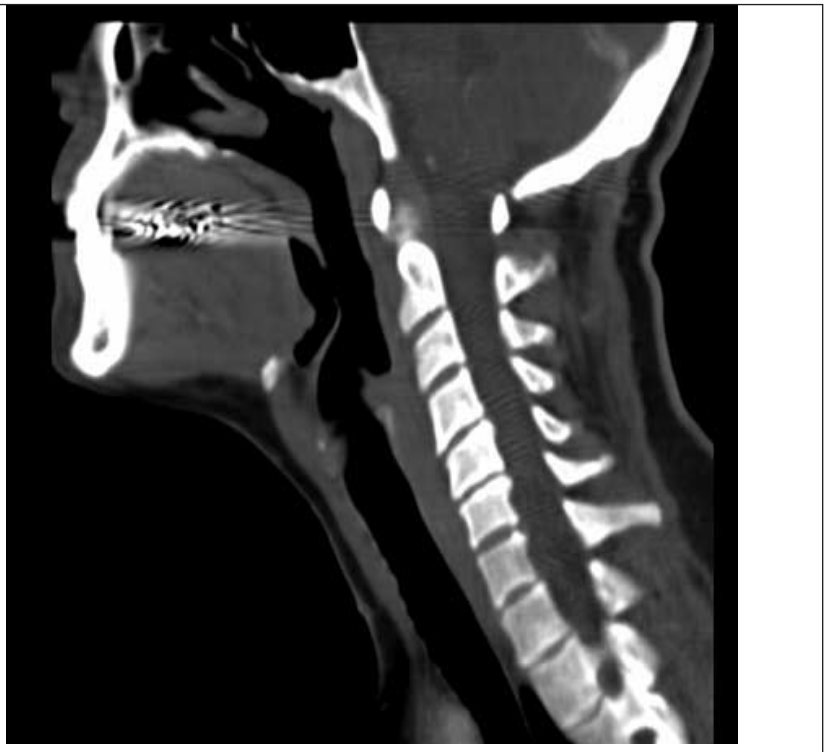
Differential Diagnosis

Epiglottitis should be considered in the differential diagnosis of patients thought to have other infectious processes such as mononucleosis, diphtheria, pertussis, lingual tonsillitis, and Ludwig's angina, as well as those with possible retropharyngeal and peritonsillar infections.[71] (*See Table 3.*) Conversely, noninfectious considerations, including allergic reactions,[72] angioedema, foreign bodies, tumors or trauma of the larynx, laryngospasm, and inhalation and aspiration of toxic chemicals such as hydrocarbons,[63] have all been misdiagnosed as epiglottitis. Morton and Barr reported a case of hyperventilation mimicking the signs of acute epiglottitis.[73] Epiglottitis has been related to the use of crack cocaine; in these cases, it is thought that edema from thermal injury of the epiglottis results from the inhalation of small wads of metal used when smoking cocaine.[74,75] (*See Table 4.*) Systemic diseases such as amyloidosis, sarcoidosis, pemphigus, pemphigoid, and Wegener's granulomatosis should also be considered as possible causes of upper airway obstruction.[76] (*See Table 5.*)

Management

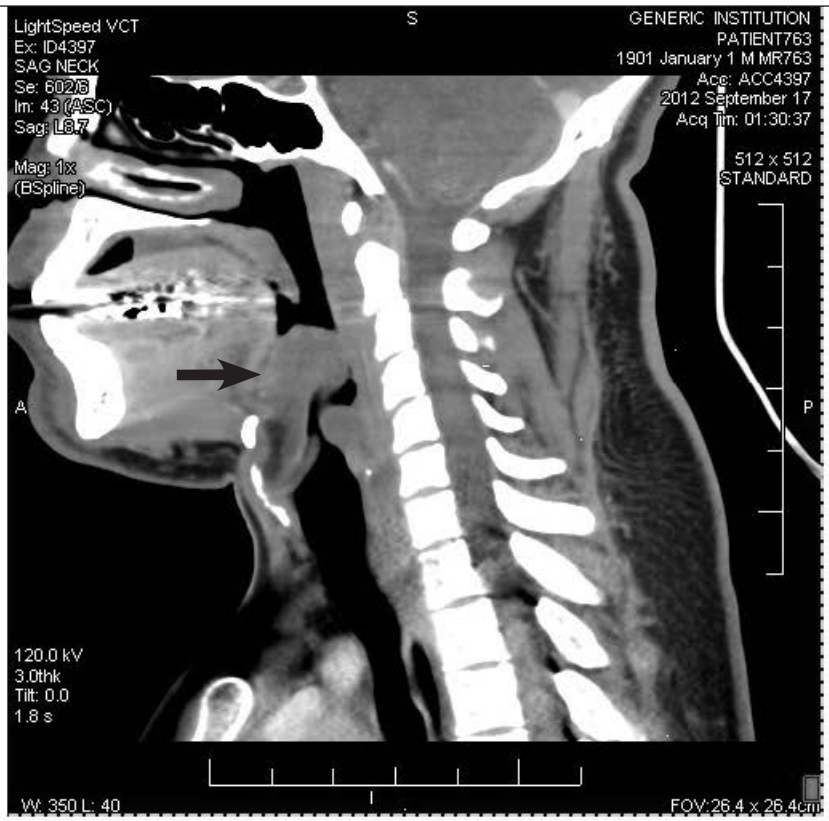
Patients with mild signs of epiglottitis such as dysphagia and sore throat, and who are not in respiratory distress or who do not have stridor at rest, may have their airway observed; if they clinically deteriorate, they should immediately undergo intubation.[1] A second option, which has lost a degree of support in the literature, is to immediately perform elective intubation in a controlled setting.[6,7] Stridor in adults is a distinctive indication of upper airway obstruction, and is regarded as a warning sign for occlusion of the upper airway. In cases of epiglottitis with stridor, toxic appearance, or respiratory distress, the clinician is presented with a difficult airway and there is risk of complete occlusion of the airway. Whenever possible, intubation should be performed under controlled conditions with an anesthetist on standby to assist with intubation. In addition, all the personnel and equipment needed to perform a cricothyroidotomy or tracheostomy should be present. Awake intubation is the technique

Figure 3: Normal CT Scan of the Neck



From the collection of Justin L. Weppner, DO

Figure 4: CT Scan of the Neck Revealing Swelling Epiglottis and Aryepiglottic Folds with Significant Subglottic Narrowing



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of choice, and an endotracheal tube with reduced diameter is often required.[77]

In addition to close monitoring and maintenance of airway patency, epiglottitis is treated with second- or third-generation cephalosporins or ampicillin with sulbactam. In those patients in whom MRSA is suspected, vancomycin or clindamycin may be added to the treatment regimen. The literature has not supported using steroids. Steroids do not reduce the period of intubation or the duration of hospital stay.[1,7,78,79] All of the reported studies on steroid use had retrospective designs. Many studies had clinical selection bias due to steroids being administered preferentially to patients with more serious disease. Steroid use for treating epiglottitis will remain controversial until randomized, controlled studies can confirm its efficacy.

Additional Aspects

Potential complications include the following:

- Airway Obstruction.
- Epiglottic Abscess. Epiglottic abscess may result from coalescent epiglottic infection or secondary infection of an epiglottic mucocele.[1,80] Epiglottic abscess occurs predominately in adults and may complicate as many as 30% of cases.[1] Patients with epiglottic abscess have more severe symptoms and are at increased risk of airway compromised compared to those without epiglottic abscess.[1,17,81,82] Epiglottic abscess can be diagnosed by direct visualization or computed tomography. Computed tomography should never be performed on patients with an unstable airway. Treatment of epiglottic abscess requires surgical drainage in addition to airway management and antibiotic therapy.
- Necrotizing Infection. Necrotizing infection is a rare complication of epiglottitis in patients with immunodeficiency.[83,84]
- Secondary Infection. Secondary infection such as abscess formation, cellulitis, cervical adenitis, meningitis, septic arthritis, and pneumonia

Table 3: Differential Diagnosis of Epiglottitis — Infectious Causes

Condition	Characteristic Features
Diphtheria	Gradual onset of sore throat, malaise, low-grade fever, and an adherent pseudomembrane on the tonsils, pharynx, and/or nasal cavity
Lingual tonsillitis	The lingual tonsil is a collection of lymphoid tissue behind the foramen cecum on the dorsal posterior surface of the tongue. Symptoms may include pain and irritation of the throat, sticky sensation in the throat, dysphagia, cough, and muffled voice. Diagnosis may be made by transnasal fiber-optic visualization or CT scan in a patient with a stable airway.
Ludwig's angina	A bilateral infection of the submandibular space that consists of the sublingual space and the submylohyoid space. The infection begins on the floor of the mouth and is an aggressive, rapidly spreading "woody" or brawny cellulitis involving the submandibular space. In general, there is no lymphatic involvement and no abscess formation. In those patients without respiratory compromise, computed tomography is the imaging modality of choice.
Mononucleosis	Characterized by a triad of fever, tonsillar pharyngitis, and lymphadenopathy. Fatigue and atypical lymphocytosis may also be present. Heterophile antibody testing may assist in differentiating mononucleosis from epiglottitis.
Peritonsillar abscess	Signs and symptoms include drooling, trismus, muffled voice, and unilateral tonsillar swelling with a deviation of the uvula.
Pertussis	Whooping cough is a highly contagious acute respiratory illness that manifests as a prolonged cough with one or more classic symptoms, including inspiratory whoop, paroxysmal cough, and post-tussive emesis.
Retropharyngeal abscess	Typical signs and symptoms include neck pain, fever, pain with swallowing, drooling, unwillingness to move neck, trismus, and midline or posterior swelling of the posterior pharyngeal wall. Neck radiographic films may reveal widening of the retropharyngeal space and reversal of the normal cervical spine curvature.

may result from bacteremia or direct extension of infection.[85,86]

• Death. Mortality rates vary widely from just under 1% to as high as 20% in some reviews, and death is almost always due to acute airway obstruction.[2,3,5,7,87,88]

Potential pitfalls include the following:

• Failure to recognize respiratory compromise and manage the airway in a timely manner.

• In cases of airway compromise and stridor, avoid any unnecessary intervention or airway manipulation until the airway is secured. Do not send a patient with an unstable airway for radiographs.

• When attempting direct laryngoscopy, failure to have a "double setup" with the ability to proceed immediately to a surgical airway.

Disposition

Any patient with a suspected or confirmed diagnosis of epiglottitis should be admitted to an intensive care unit (ICU) setting for intravenous antibiotics and airway management precautions. ENT consultation

Table 4: Differential Diagnosis of Epiglottitis — Noninfectious Causes

Condition	Characteristic Features
Allergic reaction	Rapid onset of swelling of the lips, tongue, or airway without a prodromal illness. This may be associated with an urticarial rash. The patient may have a history of a previous attack.
Angioedema	Rapid onset of swelling of the lips, tongue, or airway without a prodromal illness. This may be associated with an urticarial rash. Dysphagia without hoarseness. The patient may have a history of a previous attack.
Foreign body	History of sudden onset of choking with hoarseness or stridor with laryngeal or upper esophageal foreign body. Neck radiographic films may reveal a radio-opaque foreign body. An upper esophageal foreign body may cause distortion or deviation of the extrathoracic trachea.
Hyperventilation	History of sudden onset of transient increase in minute ventilation out of proportion to metabolic needs without a prodromal illness that may result in dyspnea, light-headedness, paresthesias, chest pain, diaphoresis, and carpopedal spasm.
Inhalation/aspiration of toxic chemicals	History of an exposure to a toxic chemical. Lack of fever or prodromal illness.
Laryngospasm	Laryngospasm is an involuntary muscular contraction of the laryngeal cords. It is characterized by stridor. In some individuals, this can occur spontaneously or as a result of reflux or impaired swallowing. GERD is a common cause of spontaneous laryngospasm. The onset is sudden without a prodromal illness.
Trauma of the larynx	History of trauma to the larynx. Lack of fever or prodromal illness.
Tumor	Neck tumors can cause hoarseness, stridor, and dysphagia. Symptoms usually progress slowly and may be associated with chest pain, neck pain, fatigue, malaise, unexplained fever, or weight loss.

should be obtained. Patients should not be discharged from the emergency department unless the diagnosis has been excluded by visualization of the supraglottic structures by a physician familiar with the physical appearance of the disease, and other concerning differential diagnoses have been excluded.

Summary

Epiglottitis is inflammation of the epiglottis and adjacent supraglottic structures. In adults, epiglottitis may be caused by a number of bacterial, viral, and fungal pathogens. Acute epiglottitis in adults can be a life-threatening medical condition that requires rapid evaluation and the early involvement of consultants. When available, flexible nasoendoscopy should be used to view the supraglottis and confirm the diagnosis. Soft-tissue radiographs of the lateral neck are not necessary to make a diagnosis of epiglottitis, but represent a reasonable choice in stable patients for whom there is a low clinical suspicion of epiglottitis, and may be indicated when other diagnostic considerations remain on the differential diagnosis. The clinician should be aware of false-negative rates for soft-tissue plain films. Normal soft-tissue plain films do not exclude mild to moderate adult epiglottitis. In addition to lateral neck radiography, CT may be used in diagnosing epiglottitis, and in excluding conditions with similar symptoms. CT scans should be performed in patients who have a stable

Table 5: Differential Diagnosis of Epiglottitis — Systemic Disease Causes

Condition	Characteristic Features
Amyloidosis	Tracheobronchial infiltration can cause hoarseness, stridor, airway obstruction, and dysphagia. The diagnosis of amyloidosis can be confirmed only by tissue biopsy, although the diagnosis may be suggested by history and clinical manifestations such as nephrotic syndrome in a patient with multiple myeloma or long-standing, active rheumatoid arthritis.
Mucous membrane pemphigoid	Mucous membrane pemphigoid is characterized by subepithelial blister formation on the mucous membranes. Typically presents as relapsing and remitting mucosal inflammation and erosions. In the oral cavity, the gingival and buccal mucosae are most commonly affected, but progressive laryngeal and tracheal involvement can result in respiratory distress and asphyxiation.
Pemphigus	Pemphigus is defined as a group of life-threatening blistering disorders characterized by acantholysis. The oral cavity is the most common site of mucosal lesions and often represents the initial site of disease. Since mucosal blisters erode quickly, oral erosions are often the only clinical findings. Swallowing may be difficult for patients with drooling, and there may be difficulty in controlling oral secretions in severe cases.
Sarcoidosis	Sarcoidosis is a multisystem granulomatous disorder of unknown etiology that affects individuals worldwide and is characterized pathologically by the presence of noncaseating granulomas in involved organs. Common presenting respiratory symptoms include cough, dyspnea, and chest pain and are sometimes accompanied by fatigue, malaise, fever, and weight loss. Bilateral hilar adenopathy on chest radiograph should raise suspicion for sarcoidosis.
Wegener's granulomatosis	A form of systemic vasculitis with necrotizing granulomatous inflammation of the upper and lower respiratory tracts, systemic necrotizing vasculitis, and necrotizing glomerulonephritis. Tracheobronchial disease includes subglottic and lower tracheal and bronchial stenosis. Nonspecific complaints of fever, anorexia, weight loss, and malaise are often present. Diagnosis is based on clinical assessment, serologic testing, pulmonary function testing, chest imaging, bronchoscopy, and tissue biopsy.

airway, are not in acute distress, and are able to lie flat without difficulty. Patients with mild signs of epiglottitis may have their airway observed and should undergo immediate intubation if clinical deterioration is observed. If the airway deteriorates, intubation should be performed under controlled conditions with an anesthetist and ENT specialist on standby. Epiglottitis is treated with second- or third-generation cephalosporins or ampicillin with sulbactam. In those patients in whom MRSA is suspected, vancomycin or clindamycin may be added to the treatment regimen. Although steroid use in epiglottitis is common, its use

will remain controversial until randomized controlled studies confirm its efficacy.

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The views expressed in this article are those of the authors and do not necessarily reflect the official policy or position of the Department of the Navy, Department of Defense or the United States Government.

CME Questions

1. What is the overall incidence of adult acute epiglottitis?
   A. 1 to 3/100,000 per year
   B. 1 to 3/100,000,000 per year
   C. 6 to 9/100,000 per year
   D. 6 to 9/100,000,000 per year

2. What is the accepted standard for diagnosis of epiglottitis?
   A. direct visualization of the epiglottis
   B. soft-tissue lateral radiograph of the neck
   C. CT scan of the neck
   D. AP radiograph of the neck

Emergency Medicine Reports

CME Objectives

Upon completion of this educational activity, participants should be able to:

- recognize specific conditions in patients presenting to the emergency department;
- apply state-of-the-art diagnostic and therapeutic techniques to patients with the particular medical problems discussed in the publication;
- discuss the differential diagnosis of the particular medical problems discussed in the publication;
- explain both the likely and rare complications that may be associated with the particular medical problems discussed in the publication.

3. Normal soft-tissue plain films definitively exclude mild to moderate adult epiglottitis.
   A. true
   B. false

4. Epiglottitis should be suspected when the epiglottis width is 8 mm and the aryepiglottic width is which of the following?
   A. 8 mm
   B. 7 mm
   C. 6 mm
   D. 5 mm

5. On plain films, the epiglottis width and aryepiglottic width are compared to which of the following?
   A. the height of the laryngeal cartilage
   B. the width of the esophagus
   C. the size of the prevertebral space
   D. the width of C3

6. Which of the following signs in adults is an indication of impending upper airway obstruction?
   A. sore throat
   B. wheezing
   C. stridor
   D. fever

7. Which of the following is an appropriate disposition of a patient with mild to moderate acute epiglottitis?
   A. Discharge home with oral antibiotics and steroids.
   B. Admit to a monitored setting for intravenous antibiotics and airway management precautions.
   C. Discharge home with oral antibiotics and with arrangements made for 24 to 48 hour ENT consultation.
   D. Admit the patient to an unmonitored setting for oral antibiotics and steroids.

8. In the literature, oral and intravenous steroids have been shown to decrease the number of days of intubation and duration of hospital stay.
   A. true
   B. false

9. What is the most common symptom of acute epiglottitis?
   A. hoarseness
   B. stridor
   C. dysphasia
   D. sore throat

10. What are the preferred antibiotics for the treatment of acute epiglottitis?
   A. first-generation cephalosporins
   B. penicillin VK
   C. second- or third-generation cephalosporins
   D. sulfamethoxazole/trimethoprim

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Epiglottitis

Differential Diagnosis of Epiglottitis — Infectious Causes

Condition	Characteristic Features
Diphtheria	Gradual onset of sore throat, malaise, low-grade fever, and an adherent pseudomembrane on the tonsils, pharynx, and/or nasal cavity
Lingual tonsillitis	The lingual tonsil is a collection of lymphoid tissue behind the foramen cecum on the dorsal posterior surface of the tongue. Symptoms may include pain and irritation of the throat, sticky sensation in the throat, dysphagia, cough, and muffled voice. Diagnosis may be made by transnasal fiber-optic visualization or CT scan in a patient with a stable airway.
Ludwig's angina	A bilateral infection of the submandibular space that consists of the sublingual space and the submylohyoid space. The infection begins on the floor of the mouth and is an aggressive, rapidly spreading "woody" or brawny cellulitis involving the submandibular space. In general, there is no lymphatic involvement and no abscess formation. In those patients without respiratory compromise, computed tomography is the imaging modality of choice.
Mononucleosis	Characterized by a triad of fever, tonsillar pharyngitis, and lymphadenopathy. Fatigue and atypical lymphocytosis may also be present. Heterophile antibody testing may assist in differentiating mononucleosis from epiglottitis.
Peritonsillar abscess	Signs and symptoms include drooling, trismus, muffled voice, and unilateral tonsillar swelling with a deviation of the uvula.
Pertussis	Whooping cough is a highly contagious acute respiratory illness that manifests as a prolonged cough with one or more classic symptoms, including inspiratory whoop, paroxysmal cough, and post-tussive emesis.
Retropharyngeal abscess	Typical signs and symptoms include neck pain, fever, pain with swallowing, drooling, unwillingness to move neck, trismus, and midline or posterior swelling of the posterior pharyngeal wall. Neck radiographic films may reveal widening of the retropharyngeal space and reversal of the normal cervical spine curvature.

Organisms Responsible for Epiglottitis in Adults

Bacterial Causes

- *Bacteroides melaninogenicus*
- Beta-hemolytic streptococcus
- *Branhamella catarrhalis*
- *Citrobacter diversus*
- *Enterobacter cloacae*
- *Escherichia coli*
- *Haemophilus influenzae*
- *Haemophilus parainfluenzae*
- *Kingella kingae*
- *Klebsiella pneumoniae*
- *Moraxella catarrhalis*
- *Mycobacterium tuberculosis*
- Neisseria spp
- *Pasteurella multocida*
- *Pseudomonas aeruginosa*
- *Serratia marcescens*
- *Staphylococcus aureus*
- *Streptococcus milleri*
- *Streptococcus pneumoniae*
- *Streptococcus pyogenes*
- *Streptococcus viridans*
- *Vibrio vulnificus*

Fungal Causes

- Aspergillus
- *Candida albicans*
- *Histoplasma capsulatum*

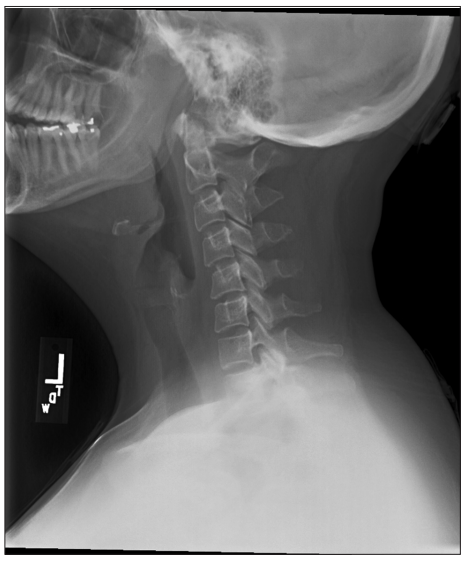
Viral Causes

- Herpes simplex

Presenting Signs and Symptoms of Epiglottitis in Adults

Signs or Symptoms	Incidence (%)
Sore throat	90 to 100%
Fever ≥ 37.5°C	30 to 90%
Muffled voice	50 to 80%
Dysphagia	61 to 76%
Drooling	50 to 80%
Hoarseness	20 to 40%
Pain with palpation of the larynx	20 to 36%

Normal Soft-tissue Lateral Radiograph



From the collection of Justin L. Weppner, DO

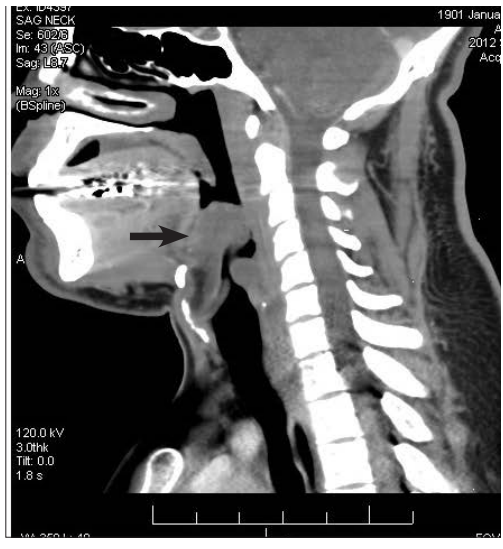
Soft-tissue Lateral Radiograph Demonstrating Epiglottitis

Image courtesy of J. Stephan Stapczynski, MD.

Normal CT Scan of the Neck

From the collection of Justin L. Weppner, DO

CT Scan of the Neck Revealing Swelling Epiglottis and Aryepiglottic Folds with Significant Subglottic Narrowing



From the collection of Justin L. Weppner, DO

Differential Diagnosis of Epiglottitis — Noninfectious Causes

Condition	Characteristic Features
Allergic reaction	Rapid onset of swelling of the lips, tongue, or airway without a prodromal illness. This may be associated with an urticarial rash. The patient may have a history of a previous attack.
Angioedema	Rapid onset of swelling of the lips, tongue, or airway without a prodromal illness. This may be associated with an urticarial rash. Dysphagia without hoarseness. The patient may have a history of a previous attack.
Foreign body	History of sudden onset of choking with hoarseness or stridor with laryngeal or upper esophageal foreign body. Neck radiographic films may reveal a radio-opaque foreign body. An upper esophageal foreign body may cause distortion or deviation of the extrathoracic trachea.
Hyperventilation	History of sudden onset of transient increase in minute ventilation out of proportion to metabolic needs without a prodromal illness that may result in dyspnea, light-headedness, paresthesias, chest pain, diaphoresis, and carpopedal spasm.
Inhalation/aspiration of toxic chemicals	History of an exposure to a toxic chemical. Lack of fever or prodromal illness.
Laryngospasm	Laryngospasm is an involuntary muscular contraction of the laryngeal cords. It is characterized by stridor. In some individuals, this can occur spontaneously or as a result of reflux or impaired swallowing. GERD is a common cause of spontaneous laryngospasm. The onset is sudden without a prodromal illness.
Trauma of the larynx	History of trauma to the larynx. Lack of fever or prodromal illness.
Tumor	Neck tumors can cause hoarseness, stridor, and dysphagia. Symptoms usually progress slowly and may be associated with chest pain, neck pain, fatigue, malaise, unexplained fever, or weight loss.

Supplement to *Emergency Medicine Reports*, May 18, 2014: "Epiglottitis." *Authors:* **LCDR Justin Weppner, DO,** Naval Hospital Jacksonville, Jacksonville, FL; and **James McCombs, DO**, Rush University Medical Center, Chicago, IL.

Trauma Reports

PRACTICAL, EVIDENCE-BASED REVIEWS IN TRAUMA CARE

Volume 15, Number 3 **May/June 2014**

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AHC Media

Fractures in Older Adults

As the population ages and continues to retain an increasingly high level of function, including driving and recreational activities, a unique pattern of injuries is emerging in older patients. The authors review risk factors for fractures, impact of comorbidities, and unique aspects for management strategies.

— Ann M. Dietrich, MD, Editor

Introduction

Older adults, adults 65 years and older, have both an increased rate of trauma and an increased predisposition to injury from even minimal force. This makes older adults a high-risk population for traumatic fracture from high- or low-impact mechanisms. High-impact fractures occur from falls from a height, motor vehicle collisions (MVCs), and sporting injuries. The number of high-impact fractures seen in older adults will continue to increase over the next 15 years as the U.S. population ages. For example, by 2030, motor vehicle crashes involving drivers older than 65 years are projected to increase 178%, and older adults will account for 25% of total driver fatalities.[1] High-impact fractures have high mortality rates, and even those who survive to discharge have increased mortality over the following year.[2] Surprisingly, MVCs are not the most common or the deadliest causes of fractures in older adults. Low-impact fractures, commonly called fragility fractures, have even higher mortality. Older patients with injuries from a fall have five times the mortality that their same age colleagues have from injuries from MVCs.[3] Five-year survival after an osteoporotic hip fracture is similar to that of patients with breast or other cancer.[4] Almost one in 13 (7.5%) of those with fragility fractures will die within 90 days of fracture.[5] Low-impact fractures from falls at standing height or lower are commonly associated with decreased bone mineral density (BMD). Falls resulted in 13.5% of older adult emergency department (ED) visits in 2010, and a fracture was the most common injury noted.[6,7] In total, U.S. older adults suffered from 2.5 million fractures in 2009-2010.[8]

A fracture can be a devastating blow to an older adult's health and independence, decreasing functional status and quality of life permanently.[9] While some may recover their independence, half of older adults will require home health care in the 6 months following a fracture, and many will have long-term functional decline.[10] Spine, hip, or upper leg fractures decrease long-term quality of life just as much as chronic diseases such as diabetes or chronic lung disease.[11] Acutely, the pain and shock of an injury may precipitate delirium, complicating diagnosis and treatment, increasing the need for further medication, and increasing the rate of long-term cognitive deficits. In addition to the morbidity related to the initial fracture, the risk of further falls and subsequent fractures is also greatly increased. Almost a quarter of older adults will have a second fracture within the next 5 years, and the risk of hip fracture is 17-fold higher in the first month after a fragility fracture.[12-14] Understanding the risk factors for fractures, the effects of common comorbidities, the differences in the type of fractures seen in older adults, and the different management strategies is important to optimize the care of this high-risk population.

Executive Summary

- Five-year survival after an osteoporotic hip fracture is similar to that of patients with breast or other cancer. Almost one in 13 (7.5%) of those with fragility fractures will die within 90 days of fracture.
- Each standard deviation decrease in BMD increases the relative risk of fracture by 1.5. Nearly all 80-year-old women have low BMD, with 27% being osteopenic and 70% osteoporotic.
- Thoracic and lumbar vertebral fractures are common from low-impact or high-impact trauma, and are estimated at 27% of fragility fractures.
- Patients diagnosed with a fracture in the ED should be considered high risk for future fractures and referred for preventative care, such as BMD testing, initiation of low BMD treatment, geriatric assessment, or home safety assessment.

Fracture Risk Factors in Older Adults

Due to the physiologic changes of aging as well as common comorbidities, older adults are at high risk for fractures. Difficulties with gait, vision, and proprioception (due to neuropathy or medications) contribute to falls. Household hazards such as throw rugs and lintels can contribute to falls. The utility of different fall risk interventions was assessed in a recent Cochrane Review.[15]

While interventions to prevent falls have had only moderate success, treatment of low bone mineral density (BMD) has been shown to significantly reduce fracture rates. Low BMD is classified as osteoporosis (< 2.5 standard deviations below normal) or osteopenia (between 1 and 2.5 standard deviations below normal) based on hip or vertebral DXA scan. Osteoporosis affects more than 10 million Americans, in addition to the numbers of untested older adults or those with only osteopenia. Each standard deviation decrease in BMD increases the relative risk of fracture by 1.5.[16] Nearly all 80-year old-women have low BMD, with 27% being osteopenic and 70% osteoporotic.[17] Men especially may not know that they have low BMD, as the screening rate in the United States for older men is as low as 11%.[18] Despite the lack of screening, men account for more than 25% of osteoporosis-related fractures.[19] As BMD testing currently is not feasible in the ED setting, any adult with a fracture (high or low impact) should be referred for outpatient testing. In older adults without osteoporosis, fracture risk factors include falls in the prior 12 months, any prior fractures, and any decrease in BMD.[20] Risk stratifying patients by BMD alone or even by FRAX guidelines (World Health Organization screening guidelines) may not be sufficient to identify patients at high risk for fracture.[21] Therefore, all older adults should be considered to be high risk for fracture, and imaging should be ordered liberally.

Multiple medical conditions also increase the risk of fracture. Any condition requiring chronic glucocorticoid use, such as inflammatory bowel disease, celiac disease, chronic obstructive pulmonary disease, and rheumatoid arthritis, decreases BMD.[22] Neurologic, endocrine, renal, and other problems also predispose older adults to fracture. (*See Table 1.*) Patients on dialysis have an increased risk of fracture that is most often seen in older Caucasian females.[23] An episode of acute kidney injury that requires dialysis, even if only temporarily, increases the risk of fracture.[24]

Other risk factors include changes in body mass index (BMI), socioeconomic factors, and prior fracture history. Low BMI is a risk factor for hip and osteoporotic fractures, but is a protective factor for lower leg fracture. High BMI is a risk factor for upper arm (humerus and elbow) and ankle fractures.[25,26] Socioeconomic factors also may play a role in patient health and are especially important in the older adult population. Poverty itself is a risk factor for low BMD and fragility fractures, and the risk may begin with low socioeconomic status in childhood.[27,28] The best predictor of future fracture, however, is prior fracture.[22] Prior wrist fracture doubles the risk of any future fracture.[29] Men with a prior non-hip, non-vertebral fracture have a 41% chance of having a second fracture within 5 years of the initial fracture.[30] Further fractures decrease an older adult's life expectancy significantly.[31] Patients diagnosed with a fracture in the ED should be considered high risk for future fractures and referred for preventative care, such as BMD testing, initiation of low BMD treatment, geriatric assessment, or home safety assessment.

Medications that Contribute to Fracture Risk and Complications

In addition to chronic glucocorticoid use, many other medications have been implicated in increasing the fracture risk in the elderly. Antipsychotic use in skilled nursing facility patients increases the risk of hip fracture in the first year after initiation,[32] and changes in any psychotropic medication including selective serotonin reuptake inhibitors (SSRIs) are associated with increased fall and fracture risk.[33] Long-term warfarin use increases the risk of osteoporotic fractures in elderly men with atrial fibrillation (versus those with atrial fibrillation not on warfarin), but a similar effect was not noticed in women.[34] Similarly, chronic levothyroxine use increases the risk of hip

fracture in men but not in women.[35] This gender disparity may be due to the already elevated risk in women compared to men so that the effect of medications is less apparent in women.

Anticoagulation use is also common and complicates fracture management. The use of oral anticoagulants may be associated with decreased BMD and increased fracture risk.[36] The evaluation of a patient on anticoagulation with a closed fracture should include an assessment for compartment syndrome due to expanding hematomas. Open fractures in any extremity may require anticoagulation reversal and transfusion. Perioperative bleeding is especially a concern in pelvic, acetabular, femur, and tibial fractures, and these injuries frequently require transfusions.[37] Patients on clopidogrel may have worse immediate outcomes with emergent surgery for hip fracture, but delaying surgery seven days to regain normal platelet function is associated with increased one-year mortality.[38,39] In fact, a delay to surgery of more than 24 hours for any reason is associated with increased mortality in patients with hip fractures.[40] Reversing anticoagulation reduces hospital length of stay and complications in hip fracture patients.[41] Vitamin K reversal for orthopedic trauma patients on warfarin is both effective and cost effective.[42]

Treatment of underlying predisposing factors such as reversal of anticoagulation (if indicated) and abnormal bone mineral density treatment can decrease morbidity and mortality. Treatment with calcium and vitamin D reduces overall three-year mortality from a hip fracture in men by 43% and in women (with the addition of anti-osteoporotic medications) by 36%.[43] The addition of calcium and vitamin D in the first six weeks after a proximal humerus fracture has been shown to increase callus formation and BMD.[44] Oral vitamin supplementation of 700-800 IU must be given to achieve this effect, which is greater than the typical 400 IU in multivitamins.[45,46] The effect of osteoporosis treatment on morbidity and mortality for other types of fragility fractures is not as well characterized. Given the benign side-effect profile of vitamin D supplementation, we recommend all older adults with fractures be discharged on vitamin D supplementation with follow up by their primary

Table 1. **Common Comorbidities that Increase the Risk of Fracture in Older Adults[9,98,16,17]**

Gastrointestinal	Inflammatory bowel disease, celiac disease
Neurologic	Multiple sclerosis, Parkinson's disease
Pulmonary	COPD, pulmonary fibrosis with steroid use
Endocrine	Type 1 diabetes, Addison's disease
Hematologic	Hemophilia A, hemophilia B
Renal	End stage renal disease and possibly long-term renal insufficiency
Rheumatologic	Rheumatoid arthritis
Oncologic	Cancer with bony metastases

Table 2. **Incidence of Fractures in Older Adult Men and Women[30,53,54,70,73,83,99-101]**

Fracture	Incidence (per 10,000 patient years)	
	Women	Men
Lower vertebral- clinical and incidental‡	680	700
Hip‡	50-76	33-36
C-spine**	18-85	18-85
Non hip, non vertebral, low trauma‡	154	78
Distal Radius†	75	19
Ankle*	58	24
Proximal Humerus††	42	15
Rib	40©	35*
Overall	2 million /year	

‡ Incidence in ages ≥ 60, low energy trauma fractures only
** Incidence from Norway increases from 18/10,000 in 60-75 year olds up to 85/10000 in the oldest old, genders combined
† Incidence from Norway, ages ≥ 50, high and low energy trauma fractures
†† Incidence from US, ages ≥ 70, high and low energy trauma fractures
© Incidence in ages ≥ 60 in hospitalized patients only, low energy trauma fractures only
* Incidence from US, ages ≥ 65, high and low energy trauma fractures

Figure 1. **Multiple Thoracic Spine Fractures**

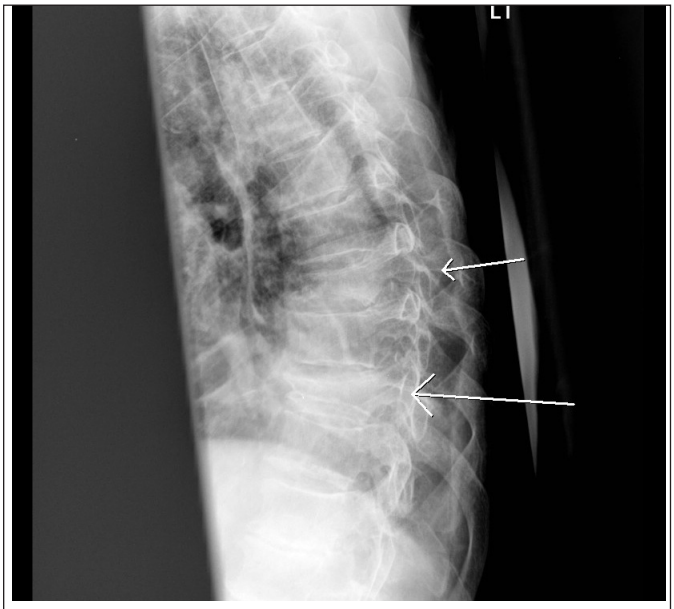


Image courtesy of Ademola Adewale, MD

Figure 2. **L1 Compression Fracture**

Image courtesy of Ademola Adewale, MD

care physician. Overall, older adults with fractures would benefit from a full medication review with attention to risks for immediate fracture treatment, as well as subsequent fracture prevention.

Overview of Common Fractures

Older adults are prone to different fractures and fracture mechanisms than a younger cohort. The fracture incidences tend to change after age 50, when post-menopausal changes to BMD start. The most common fractures in older adults are vertebral fracture from compression or trauma, followed by hip and distal radius fractures. (*See Table 2.*) One in two women and one in five men will suffer from an osteoporotic fragility fracture, which is defined as any low-energy trauma fracture. The most common fragility fractures are proximal humerus, hip, distal radius, and spinal fractures.

Thoracic and Lumbar Vertebral Fractures

Thoracic (*see Figure 1*) and lumbar vertebral fractures (*see Figure 2*) are common from low-impact or high-impact trauma, and are estimated at 27% of fragility fractures.[19] Degenerative changes in the more mobile thoracolumbar junction and lumbar spine place older adults at higher risk for injuries to this area in high-impact traumas such as MVCs. Trauma registries demonstrate that the oldest old (80+ years) tend to have more upper thoracic and T-L junction injuries, while the younger old (60-79 years) may have more lumbar spinal fractures. Younger adults tend to have flexion-distraction fractures, while older adults suffer the higher mortality extension fractures.[47] Stable compression fractures or mild burst fractures seen on X-ray and without neurologic symptoms may not need further imaging, but it is important to recognize that significant soft-tissue injuries can be missed with these injuries, and CT or MRI may better clarify the extent of the injury. Helical spine CT is 99% accurate in identifying spinal fractures, as compared to 87% accuracy of 2-view thoracolumbar X-rays (which may be even less accurate with low BMD). CT also aids in the assessment of fracture age and acuity.[48] Acute vertebral fractures have a three-year survival rate of 40-60% depending on the type of treatment. Acute fractures can be treated with analgesics only, or treated surgically with balloon kyphoplasty or vertebroplasty, which is best done in the first two months after an acute fracture.[49] Surgical treatment decreases mortality and chronic pain and increases quality of life compared to medical management.[50,51]

Thoracic and lumbar compression fractures from low BMD or low-impact trauma are a significant health problem. The prevalence is around 20% in both women and men 70 years and older, and most are between T6 and L1.[52] Asymptomatic compression fractures are often noted on routine chest X-rays. In one study of women with one or more risk factors for compression fractures, 31% had an undiagnosed moderate or severe vertebral fracture, and of these women, 75% did not have osteoporosis on DXA scan.[53] Additionally, 18% may develop a new compression fracture in the year following diagnosis of the initial compression fracture.[51] Therefore, prevention is very important, even if these fractures are asymptomatic. ED referral or discussion with the patient about treatment options is also important, as most compression fractures will be treated on an outpatient basis unless

there is uncontrollable pain or concern for cord injury.

Hip Fractures

Hip fractures (fractures of the proximal femur, including subcapital neck, intertrochanteric, subtrochanteric, and others) are some of the most common types of fragility fractures and are associated with the highest mortality. The incidence of hip fractures worldwide may be decreasing slightly due to implementation of national screening guidelines and preventative treatment .[54] (*See Table 2.*) Women more commonly suffer hip fractures at a rate of 4.5:1, but this difference is minimized after age 70.[55] Other risk factors may include low vitamin K and vitamin D levels.[56]

The clinical presentation of hip fracture classically occurs after a fall in an older individual, but can present after any type of traumatic injury. In most instances, a hip fracture can be diagnosed from the history and physical exam. Patients are usually unable to bear weight on the affected side, have tenderness to palpation over the greater trochanter, and pain with external rotation, abduction, or axial loading of the hip. More obvious fractures will present with the leg in external rotation and shortened. The diagnostic imaging modality of choice is plain film X-rays of hip (*see Figure 3*), but CT or MRI may help characterize more subtle fractures, as X-rays are only 90-98% sensitive.[57] Occult, or X-ray-negative hip fractures, make up 3-9% of hip fractures. Currently, MRI is the gold standard for the detection of occult fractures and should be considered in any at-risk patient unable to bear weight after a traumatic event.[57]

Treatment strategies include various surgical options. It is important to optimize pre-operative health, but delays in surgery have been shown to increase mortality.[38-40] Older adult patients commonly experience peri-operative complications such as hypoxia, delirium, anemia requiring transfusion, congestive heart failure, acute renal injury, and myocardial infarction.[58] The most common post-operative complications are pneumonia, acute renal injury, and pressure ulcers.[59] The risk of mortality is much higher in those who suffer one or more complications. Those at highest risk of mortality and complications include patients on dialysis, those presenting in shock, patients with obesity, history of cardiopulmonary disease, diabetes, or a delay to surgery of more than 48 hours.[59] In high-impact trauma patients, such as MVCs or motorcycle collisions, patients with any type of femur fracture (hip or distal) are more likely to have a perioperative MI; however, overall their mortality is similar to other older adult trauma patients without a femur fracture.[60] Despite definitive surgical management, hip fractures in the elderly have a high mortality rate of 8.1% at 30 days and 21.6% at one year,[58] and a similar five-year survival rate as breast cancer patients.[4] For those who survive, many do not regain their previous level of functioning and require skilled nursing care or home health assistance. The emergency physician can decrease morbidity and mortality by having a low threshold to proceed to CT or MRI to rule out occult fracture, facilitating pre-operative clearance (decreasing time to surgery), and discussing delirium and pressure ulcer prevention with family and staff. Depending on the anesthesia and hospitalist staff, pre-operative clearance usually involves a pulmonary exam and chest X-ray, a cardiac exam with EKG and possibly echocardiogram if the patient has a history of heart failure or valve disorders, and a medication review. Pre-operative labs such as a type and cross, coagulation parameters (PT and PTT), and basic blood counts and chemistries are also required. Many of these tests can be obtained quickly in the ED.

Figure 3. **Hip Fracture**

Cervical Spine Fracture

Cervical spine (c-spine) injury (*see Figures 4 and 5*) is a significant cause of morbidity and mortality in the geriatric trauma patient. Older adults account for 19% of c-spine injuries,[61] but the likelihood of a c-spine injury is twice as high as that for a younger trauma patient,[62] with many requiring surgical intervention. Rollover motor vehicle accidents and

Figure 4. Cervical Spine Fracture

Image courtesy of Howard Werman, MD

Figure 5. Cervical Spine Fracture

Image courtesy of Howard Werman, MD

Figure 6. C1 Fracture

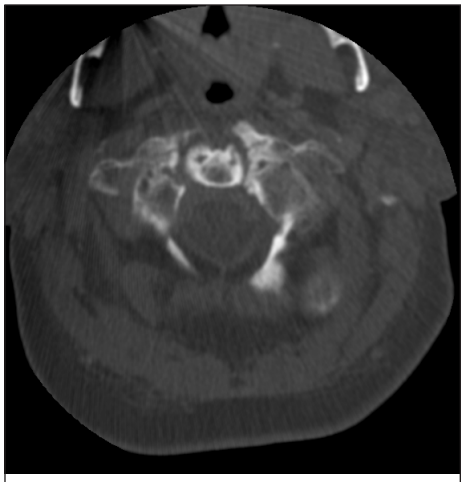


Image courtesy of Howard Werman, MD

Figure 7. C2 Fracture

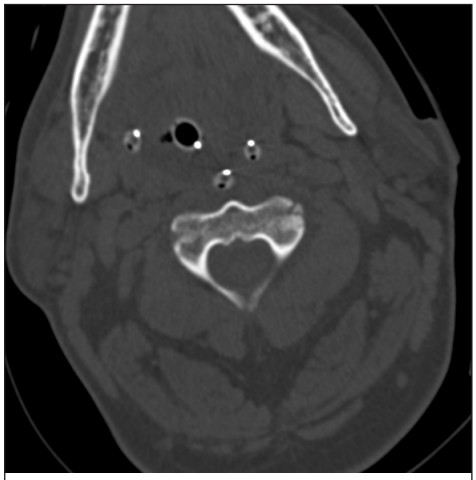


Image courtesy of Howard Werman, MD

older age increase the risk of c-spine fracture.[63] Low-impact mechanisms, however, cause more than 50% of c-spine fractures.[61] The injury pattern in older patients with cervical injury is also different than in younger patients. Due to the decreased range of motion of the cervical spine, elderly patients are more likely to sustain higher level c-spine fractures (*see Figures 6 and 7*), while younger patients are more likely to sustain lower c-spine injury. Elderly patients are also more likely to have additional intracranial injuries compared to younger patients.

The diagnosis of c-spine fractures in the elderly can be elusive. The NEXUS study provides practitioners with a set of clinical criteria that, if met, put the patient in a very low risk category for c-spine injury.[64] This landmark study did include a sufficient number of geriatric patients, and a geriatric subgroup analysis shows 100% sensitivity for clinically significant injuries.[62] However, many are reluctant to apply this clinical decision rule in the geriatric population due to the number of older adults with fractures from minimal trauma with minimal symptoms.[65,66] Various retrospective studies describe limitations,[63,67] but no clear prospective evidence has shown these criteria to be inferior in the geriatric population. The Canadian C-spine Criteria uses age 65 and greater as a high-risk feature that requires imaging, but fewer clinicians use these criteria, as it is a more complicated algorithm to implement.[65] The clinical exam is difficult in geriatric patients, as they commonly have decreased range of motion at baseline, baseline pathology that can make plain films difficult to interpret, and may have clinically significant spinal injuries with minimal symptoms. Therefore, CT (*see Figure 8*) should be the first imaging used to evaluate for c-spine injury in older patients.

Treatment options include nonoperative immobilization with cervical collar or surgery for internal fixation. Type II dens fractures are the most common type of cervical fracture in the elderly, and, thus, the best studied to determine the benefits from surgery. Some findings show protective effects with surgery in younger populations of geriatric patients.[68] Other non-randomized studies have shown a functional and mortality benefit with surgical intervention in those patients healthy enough to undergo surgery.[69] The only available studies to guide treatment options are limited to retrospective, uncontrolled studies. The decision to operate on cervical spine fractures in older adults depends on previous functional status and comorbidities in addition to the clinical judgment of the neurosurgical team. Despite intervention, mortality with c-spine injury is high; one-year mortality from dens fractures comparable to hip fractures at 37.5%.[70]

Distal Forearm Fractures

Distal forearm fractures account for 19% of osteoporosis-related fractures[19] and are almost always caused by a fall on an outstretched hand or an MVC. (*See Figures 9 and 10.*) Theoretically, as balance and motor coordination decrease with age, older women are more likely to fall onto their hip than an

Figure 8. C4 Fracture

Image courtesy of Howard Werman, MD

outstretched hand. However, the incidence of distal radius fracture still increases with age, with an increase from 34 per 10,000 patient years in women ages 50-54 to 101 in those 85 years and older.[71] This is more than double the incidence in men. Women are four times more likely to have a distal radius fracture overall, but men are five times more likely than women to have a high-impact fracture.[71] Older adults with distal radius fractures have a tendency toward better health than their peers with proximal humerus or hip fractures, and distal forearm fractures do not appear to increase mortality.[72] However, there is still an increased risk for further fractures.[12] Emergency department management includes a high index of suspicion in any older adult with wrist pain, and splinting or orthopedic consultation, as indicated, based on the severity and displacement of the fracture. While the patient population with distal forearm fractures tend to be high functioning, their ability to compensate for the immobilization of one hand may be decreased, especially if they normally walk with an assistive device. A home safety and functional assessment is indicated prior to discharge, with admission for rehabilitation placement if needed.

Figure 9. Distal Forearm Fracture

Figure 10. Distal Forearm Fracture

Ankle and Other Lower Extremity Fractures

Ankle, knee, and foot fractures are often seen after falls. Older adults suffer 20-30% of foot and ankle fractures, with an incidence of 42/10,000.[73,74] In addition to the risk factors for any fracture, an elevated BMI is associated with a higher risk for ankle fractures.[75] X-rays are usually sufficient to diagnose fractures. Surgical intervention is needed frequently for trimalleolar fractures (74%), but less frequently for isolated malleolar fractures (11-22%).[74] Surgical repair in patients with increasing age, diabetes, or smoking history have a complication rate greater than 20%, but surgery may provide improved long-term function.[76] A comparison of adults older than 70 years of age with ankle fractures treated conservatively (reduction and casting) versus operatively found that more than 25% of the conservative group had failure and required surgery at a later stage. Additionally, 72% of those treated operatively returned to their prior weight-bearing levels of activity, as opposed to only 42% in the conservative group.[77] Operative ankle fractures should be treated aggressively without prolonged delay to reduce the rate of wound and other complications.[78,79] Patella fractures usually occur from direct fall onto the knee. Depending on extensor tendon disruption and comminution, these may be treated operatively or conservatively. Both treatment courses result in 82% of patients returning to their prior functional status.[80]

Knee, foot, and ankle fractures may not be associated with low BMD as frequently as distal radius or vertebral fractures.[81] However, these patients should still be referred for testing for low BMD to ensure appropriate treatment. Treatment of any older adult with a lower extremity fracture should also include a safety assessment with assistive devices, as many of these patients may not be able to appropriately use crutches or a walker with a cast or splint on a lower extremity.

Figure 11. **Proximal Humerus Fracture**

Proximal Humerus Fractures

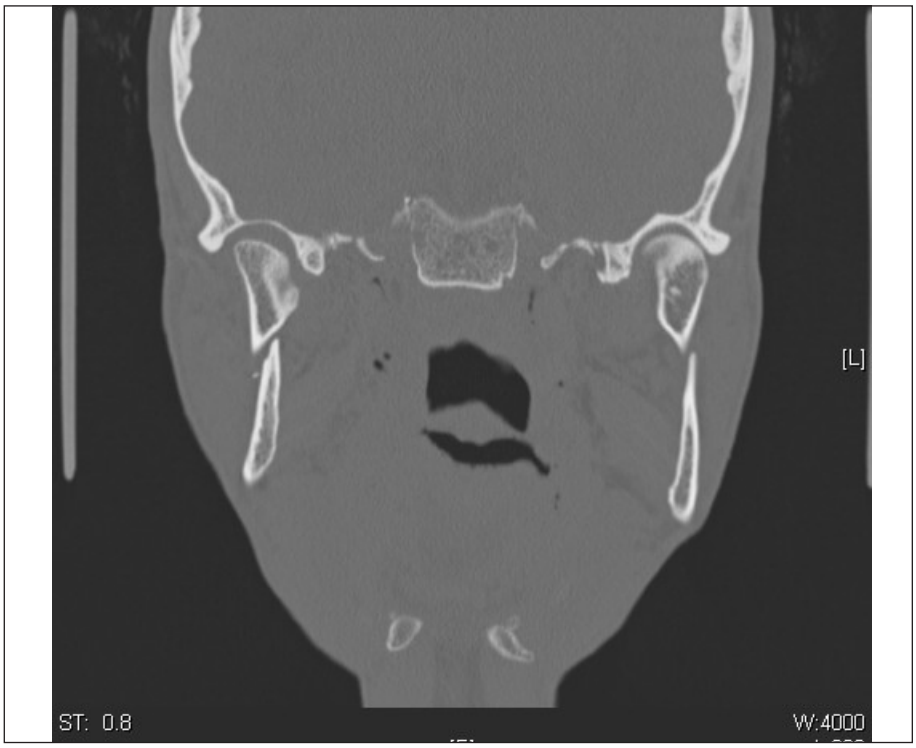
Men and women share similar risk factors for proximal humerus fractures, most notably decreased BMD.[82] In addition to low BMD and falls risk factors, antiepileptic use, diabetes mellitus, obesity, and left-handedness all increase the risk of proximal humerus fracture.[83] The risk increases with age, starting around 45 years old and peaking around 85 years old.[84] Older adults with proximal humerus fractures tend to be less physically and mentally impaired than age-matched colleagues with hip fractures, but they still have increased mortality in the initial year after fracture.[72] Women account for two-thirds of proximal humerus fractures in older adults, while men make up a greater proportion in younger adults. (*See Figure 11.*) Additionally, these fractures are more likely to be complicated by comminution or displacement in older adults.[85] In non-displaced fractures, there is insufficient evidence to recommend surgery versus immobilization, and, therefore, most non-displaced proximal humerus fractures are treated with a shoulder immobilizer and early physical therapy.[86] Despite treatment, proximal humerus fractures can decrease quality of life and independence chronically. If patients have not recovered good range of motion and strength within a year, they will continue to have chronic difficulties.[87] Additionally, this fracture may decrease a patient's ability to use adaptive equipment such as a walker, cane, or grab bars; a home healthcare needs and safety assessment should be done prior to discharging a patient who may not be able to maintain independence with this injury.

Facial Fractures

The most common mechanisms resulting in facial fractures include falls (50%) and motor vehicle crashes (20%).[88,89] These fractures are associated with significant morbidity and mortality, with up to 11% in-hospital mortality.[88,89] The most

Figure 12. Bilateral Mandibular Fracture

Figure 13. Bilateral Mandibular Fracture



common facial bone injured is the mandible (18%) (*see Figures 12 and 13*) and then the orbital floor (15%) (*see Figure 14*) and zygoma (15%) (*see Figure 15*). Providers should be aware that facial fractures along with upper extremity injuries are the most common presentations of elder abuse. Particular care should be taken to explore possible abuse in high-risk situations, such as when there is a culture of violence in the family or a vulnerable patient with dementia or social isolation.[90] If there is any concern for safety, the patient should be admitted until a full social work evaluation can be done.

Patients with any trauma and concerning bruising or tenderness of the face should undergo maxillofacial CT imaging. Patients with facial fractures may also sustain other injuries, including brain, extremity fractures, cervical spine fracture, and spinal cord injuries. Additional imaging, such as non-contrast CT of the brain or CT angiography, may be indicated to evaluate for intracranial pathology or blunt carotid injury. The majority of facial fractures in older adults are managed non-operatively.[88,89] In one clinical series, 30% of patients died before any operative intervention, 65.9% had non-operative management, and only 5% required internal fixation.

Mandible and LeFort fractures are the most likely to require operative intervention. Functional and cosmetic outcomes that affect quality of life determine the need for intervention. Fractures that interfere with mastication and jaw function are likely to be more problematic for long-term quality of life if left untreated.[91] In another reported series, open reduction was used in 28.8% of patients, 26.9% were treated with closed reduction, and 44.2% did not undergo any treatment.[92] The variation in treatment for similar fractures again may be dependent upon the baseline characteristics of the patient, including comorbidities and functional status. Emergency department management includes a low suspicion for facial

Figure 14. **Orbital Floor Fracture**

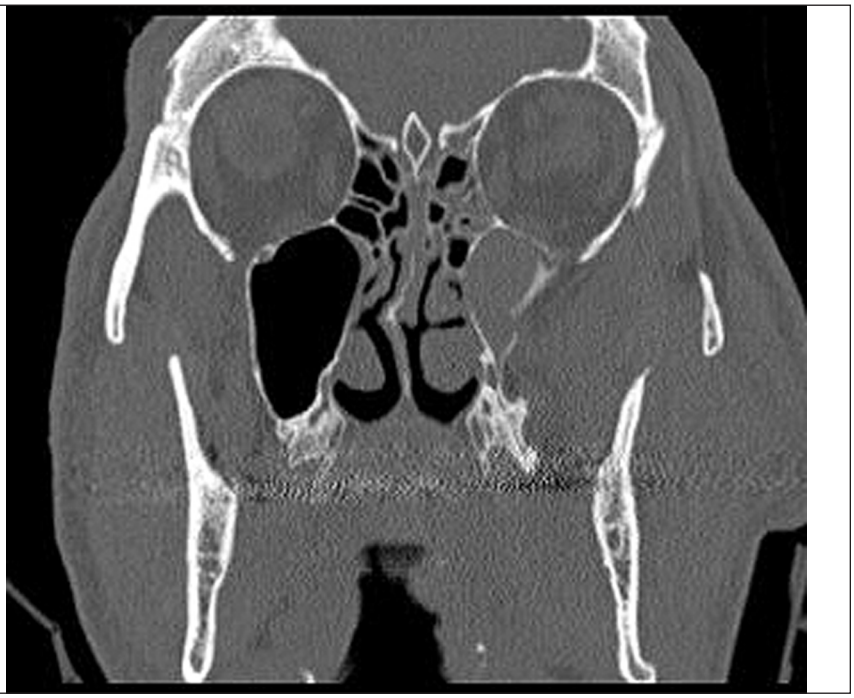
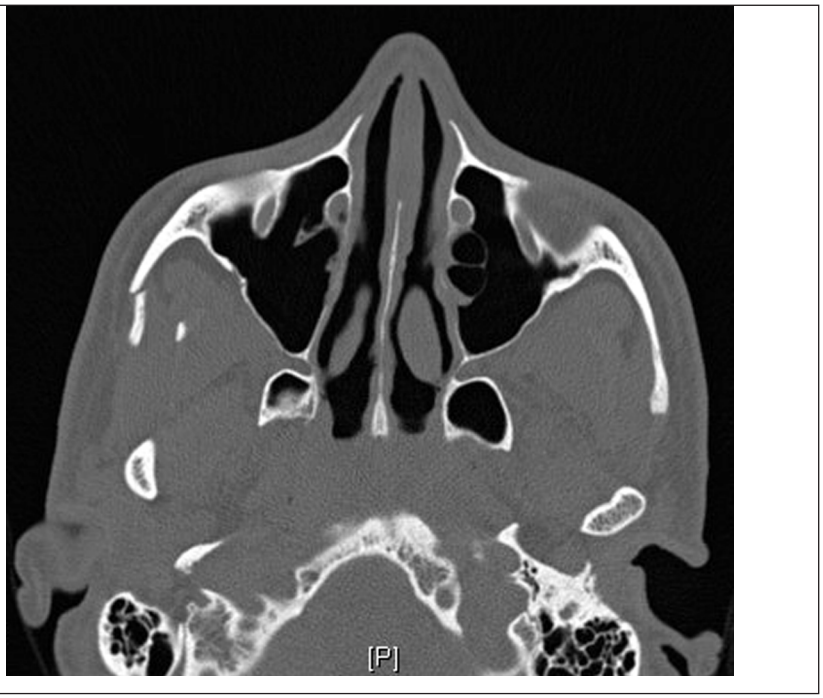


Figure 15. **Zygoma Fracture**



imaging, adequate pain control, and a thorough evaluation of function, including neurologic status, extraocular movements, and ability to masticate and swallow, in addition to specialist consultation as needed.

Rib Fractures

Ribs are commonly fractured in high-impact mechanisms. In trauma registries, rib fractures are found in 38% of admitted older adults.[93] Diagnosing rib fractures can be difficult, as plain films have low sensitivity, missing 50% of rib fractures. CT imaging of the chest, however, is highly sensitive. In clinical practice, rib fractures missed on plain films do not seem to impact clinical outcomes. One retrospective study found that any rib fracture or pulmonary contusion identified on plain films (*see Figure 16*) increased the incidence of pulmonary morbidity and mortality, whereas fractures identified only by CT did not increase mortality rates.[94]

Compared to the younger patient, older adults with rib fractures have greater incidence of morbidity (days on ventilator, pneumonia, etc.), along with an increased mortality. In one series, elderly patients with rib fractures suffered a mortality rate of 22%, compared to 10% for younger patients.[93,95] Also, the number of rib fractures correlates with increased morbidity and mortality. Geriatric patients had significantly increased mortality rates if they suffered three or more rib fractures. The incidence of complications of pneumonia or ARDS was also linearly associated with the number of rib fractures. A recent meta-analysis showed that age greater than 65, three or more rib fractures, pre-existing conditions, and pneumonia were strong predictors of mortality in patients with blunt traumatic chest wall injury.[96] In addition to increasing morbidity and mortality, a rib fracture in a post-menopausal woman (≥ 45 years old) increases the risk of further rib fracture by fivefold and the risk of any other fractures by more than double. Despite their association with MVC and high-energy trauma, rib fractures in post-menopausal women and older adults are associated with osteoporosis, and these patients should be referred for testing and treatment.[97]

Treatment of isolated rib fractures is largely supportive and often

Figure 16. Rib Fractures with Hemothorax

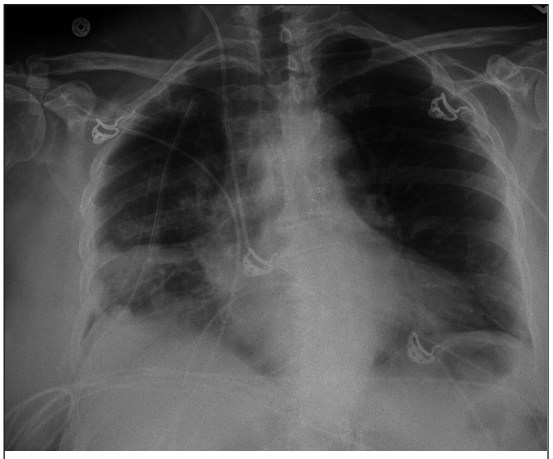


Image courtesy of Ademola Adewale, MD

done as an outpatient. Analgesia is important, as pain from rib fractures generates shallow breathing, leading to atelectasis and susceptibility to pneumonia. Some authors support the use of perioperative epidural anesthesia, which has been shown in limited studies to decrease morbidity and mortality.[95] This may limit the need for narcotic analgesia, which is associated with falls, over-sedation, and constipation in older patients. However, there have been no randomized trials to evaluate the potential benefits of epidurals. Surgical intervention may be warranted to improve ventilation when there are significant rib fractures or flail chest that is limiting the mechanical pull of the chest wall.[98] Incentive spirometers should be prescribed and instructions given to continue ambulation and deep breathing. If there are multiple comorbidities, concerns about the side effects of analgesics, or concerns about patient understanding, admission for initial pain control and pulmonary toilet is warranted.

Conclusions

Older adults have high rates of fractures, which are associated with higher morbidity, higher mortality, and more frequent social and home health care complications than in younger patients. Any fracture in an older adult may be complicated by low BMD, and all should be referred for testing and treatment. Starting vitamin D supplementation and referring for outpatient BMD testing can be done from the emergency department in order to improve healing and prevent subsequent fractures. Physicians must also give increased attention to a patient's social situation and ability to care for the injury at home. Physicians should be aware of occult fractures, or X-ray-negative fractures, especially when a patient has persistent pain or inability to ambulate. Once identified, older adults with fractures should be treated swiftly and aggressively. When surgical repair is indicated, it should not be delayed due to the patient's age, as delays more than 24 hours are associated with higher complication risks. Overall, this is a high-risk population prone to repeat injury that should be treated cautiously, with extra attention given to comorbidities, home safety, and future fracture prevention.

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CNE/CME Questions

1. After identifying a fragility fracture, the appropriate management includes which of the following?
   A. Assess patient's ongoing fall risk and intervene as needed.
   B. Prescribe calcium and vitamin D supplementation.
   C. Refer the patient to appropriate orthopedic specialists.
   D. all of the above

2. Which patient is at the highest risk of fragility fracture?
   A. 35-year-old obese woman on lisinopril

B. 65-year-old man with a prior fragility fracture
C. 60-year-old woman with known osteopenia
D. 68-year-old woman with normal BMD on DEXA

3. An elderly man presents to the ED after a fall at his nursing home. The only intervention done by EMS was to start an IV. The patient is able to talk and is complaining of hip pain. What should be done first in management of this patient?
   A. Fully undress the patient.
   B. Obtain a CT scan of the hip.
   C. Evaluate cervical spine and stabilize if needed.
   D. Obtain an MRI of the hip.

4. A 72-year-old female with a history of atrial fibrillation on Coumadin presents after a fall with a left intertrochlear hip fracture. According to the current literature, which of the following is true?
   A. Patients with open fractures should not have anticoagulation reversed prior to surgery.
   B. Surgical delay for full reversal is associated with increased mortality.
   C. Patients on warfarin are at lower baseline risk for fragility fracture.
   D. Reversing anticoagulation increases hospital length of stay.

5. A 78-year-old male presents after a rollover MVC. The initial chest X-ray shows four left-sided, minimally displaced rib fractures. In the trauma patient, which of the following is true?
   A. Clinically significant rib fractures can be reliably seen on plain films.
   B. Mortality and morbidity increase with the number of rib fractures.
   C. Pneumonia and ARDS are possible complications from rib fractures.
   D. All of the above are true.

6. A 62-year-old male on warfarin and hemodialysis presents for a syncopal episode. He was placed in cervical spine precautions en route, and on initial evaluation complained of midline cervical tenderness. An X-ray demonstrates non-displaced fracture of the C2 dens. When discussing the case with the junior neurosurgical resident, he proposes the possibility that this could be an old injury because he has never seen a dens fracture from the described mechanism. What additional information will help guide further management?
   A. Elderly patients are more likely to suffer cervical spine injury from minor trauma.
   B. The patient had decreased neck mobility at baseline.
   C. Warfarin and dialysis are not associated with decreased BMD.
   D. The patient has no neurological deficits.

7. A 68-year-old male with osteoporosis presents with a mid-shaft ulnar fracture. Three weeks ago he was seen for a fracture of the zygoma (a facial bone), which was managed conservatively. The patient appears disheveled and somewhat malnourished. After full trauma evaluation and splinting the arm with orthopedic referral, the next step in management should include which of the following?
   A. discharge to home with adequate analgesic medication
   B. additional history with social work consult
   C. CT of the brain
   D. referral to neurology for dementia

8. Patients with increased risk of fragility fracture include:
   A. patients with COPD
   B. patients with type 1 diabetes
   C. patients requiring dialysis
   D. all of the above

9. A 68-year-old woman slips on an icy sidewalk getting her mail and suffers a proximal humerus fracture. She is discharged with a shoulder immobilizer, a narcotic pain medication, and a referral for orthopedic follow-up. She is at risk for which of the following?
   A. further falls
   B. chronic decreased mobility in the shoulder joint
   C. difficulty with activities of daily living at home due to arm immobilization
   D. all of the above

10. A 71-year-old man presents to the ED with back pain of 2 days duration. No trauma was involved, and no neurologic deficits are noted on exam. X-rays demonstrate a compression fracture at T10, but cannot assess if this is new or old, and you have no prior imaging for comparison. Which of the following is *incorrect*?
    A. Spinal CT or MRI may further delineate acute vs chronic fracture.
    B. He has almost a 1 in 5 chance of a second vertebral compression fracture within a year of the first.
    C. He should be referred for BMD testing and started on vitamin D supplementation.
    D. This is probably incidental and can be ignored.

11. Which of the following is true regarding the use of oral anticoagulants and an older patient with a fracture?
    A. Use of oral anticoagulants may be associated with decreased BMD.
    B. Use of oral anticoagulants may be associated with increased fracture risk.
    C. Evaluation of the patient should include a careful evaluation for compartment syndrome.
    D. all of the above

12. Treatment of underlying predisposing factors such as bone mineral density treatment may decrease morbidity and mortality in patients with hip fractures.

CNE/CME Objectives

Upon completing this program, the participants will be able to:

- discuss conditions that should increase suspicion for traumatic injuries;
- describe the various modalities used to identify different traumatic conditions;
- cite methods of quickly stabilizing and managing patients; and
- identify possible complications that may occur with traumatic injuries.

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A. true
B. false

13. Which of the following is true regarding distal forearm fractures?
    A. The incidence of distal radius fracture decreases with age.
    B. Older adults with distal radius fractures have worse health in general than those with hip fractures.
    C. A home safety and functional assessment is indicated prior to discharge.
    D. There is no increased risk of future fractures.

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