Guidelines

For The Management Of

Pneumothorax

By

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Pneumothorax is defined as the presence of air in the pleural cavity resulting in partial or complete collapse of the lung on the affected side. Air can enter the intrapleural space through a communication from the chest wall (i.e., trauma) or through the lung parenchyma across the visceral pleura(rupture bullae)
Tension pneumothorax is a life-threatening condition that develops when air is trapped in the pleural cavity leading to progressive increase in the intrapleural pressure.

Presentation
Acute onset of chest pain and shortness of breath, history of previous pneumothorax is important, as recurrence is common.
Symptoms of tension pneumothorax may include chest pain, dyspnea, anxiety, fatigue, or acute epigastric pain (a rare finding).

Physical examination
Range from asymptomatic to respiratory distress. It may include diaphoresis, splinting chest wall to relieve pleuritic pain, and cyanosis (in the case of tension pneumothorax).
Affected patients may also reveal altered mental status changes.
Findings on lung auscultation vary depending on the extent of the pneumothorax & may include:

- Respiratory distress (considered a universal finding) or respiratory arrest
-Tachypnea (or bradypnea as a preterminal event)
-Asymmetric lung expansion: mediastinal and tracheal shift to the contralateral side can occur with a large tension pneumothorax.
-Hyperresonance on percussion: This is a rare finding and may be absent even in an advanced state of the disease.
-Decreased tactile fremitus
-Distant or absent breath sounds.
-Added lung sounds (crackles, wheeze)

Cardiovascular findings may include the following:
Tachycardia: This is the most common finding. If the heart rate is faster than 135/ minute, tension pneumothorax is likely.
Pulsus paradoxus
Hypotension
Jugular venous distention, generally seen in tension pneumothorax, although it may be absent if hypotension is severe.
Cardiac apical displacement (rare finding)

Tension pneumothorax may be a difficult diagnosis to make and may present with considerable variability in signs .
Subtle thoracic size and thoracic mobility differences
Abdominal distention may occur from increased pressure in the thoracic cavity and from secondary pneumoperitoneum
The development of tension pneumothorax in patients who are ventilated will generally be of faster onset with immediate, progressive arterial and mixed venous oxyhemoglobin desaturation & decline in cardiac output.
Cardiac arrest associated with asystole or pulseless electrical activity (PEA) may ultimately result.

- In general, the clinical symptoms associated with secondary pneumothoraces are more severe than those associated with primary pneumothoraces, and most patients with a secondary

pneumothorax complain of breathlessness which is out of proportion to the size of the pneumothorax

Differential diagnosis
Acute Coronary Syndrome
Acute Respiratory Distress Syndrome
Congestive Heart Failure and Pulmonary Edema
Pulmonary Embolism
Pulmonary Empyema and Abscess
Pneumonia
Pericarditis and Cardiac Tamponade
Aortic Dissection
Esophageal Rupture and Tears
Foreign Bodies
Rib Fracture

Diagnosis
Chest radiographs may fail to reveal pneumothorax or radiologists or emergency physicians may fail to recognize the presence of the pneumothorax, so:
- Ultrasonography becomes increasingly available in emergency situations, it could provide diagnostic and therapeutic benefit as it differentiate tension pneumothorax from pericardial tamponade especially after trauma
-Confirmation of a suspected pneumothorax that is not readily observed on standard supine anteroposterior (AP) radiograph can be demonstrated by obtaining a lateral decubitus film with the involved hemithorax positioned uppermost , the lateral decubitus radiograph is superior to the erect or supine chest radiograph and is felt to be as sensitive as CT scanning in pneumothorax detection.At times, expiratory film may be helpful.

-If emesis or retching is the precipitating event for a pneumothorax, an esophagogram should be obtained to evaluate for Boerhaave syndrome (an esophageal tear), which has a high mortality rate. Esophagoscopy could further be performed for esophageal perforations.

-Computed tomography (CT) scanning is the most reliable imaging study for the diagnosis of pneumothorax, but it is not recommended for routine use in pneumothorax. This imaging modality can help to accomplish the following:

-Determine the exact size of the pneumothorax, especially if it is small
-Distinguish between a large bulla and a pneumothorax
-Indicate underlying emphysema or when the plain chest radiograph is obscured by surgical emphysema
-Confirm the diagnosis of pneumothorax in patients with head trauma who are mechanically ventilated
-Assess the possibility of associated concurrent pulmonary disease.
-When aberrant chest tube placement is suspected
- When surgical intervention is planned especially if lung volume reduction surgery is being considered as an adjunctive procedure

Complications of pneumothorax
- Recurrence of spontaneous pneumothorax on the same side is as much as 30%; on the contralateral side, the rate of recurrence is approximately 10%.
- Bronchopleural fistula
- Pneumomediastinum and pneumopericardium

- Tension pneumothorax
- Pulmonary edema after reexpansion which is related to the length of time the lung has been collapsed before initiating therapy

Clinical assessment: the patient is considered unstable if:
patient cannot speak in whole sentences between breaths
respiratory rate ≥ 24 breaths/min
low BP
heart rate ≤ 60 beats/min or ≥120 beats/min
room air O_2 saturation < 90%
signs of tension pneumothorax have to be looked out(deviation of trachea and mediastinum to the contralateral side and rapid development of respiratory failure)

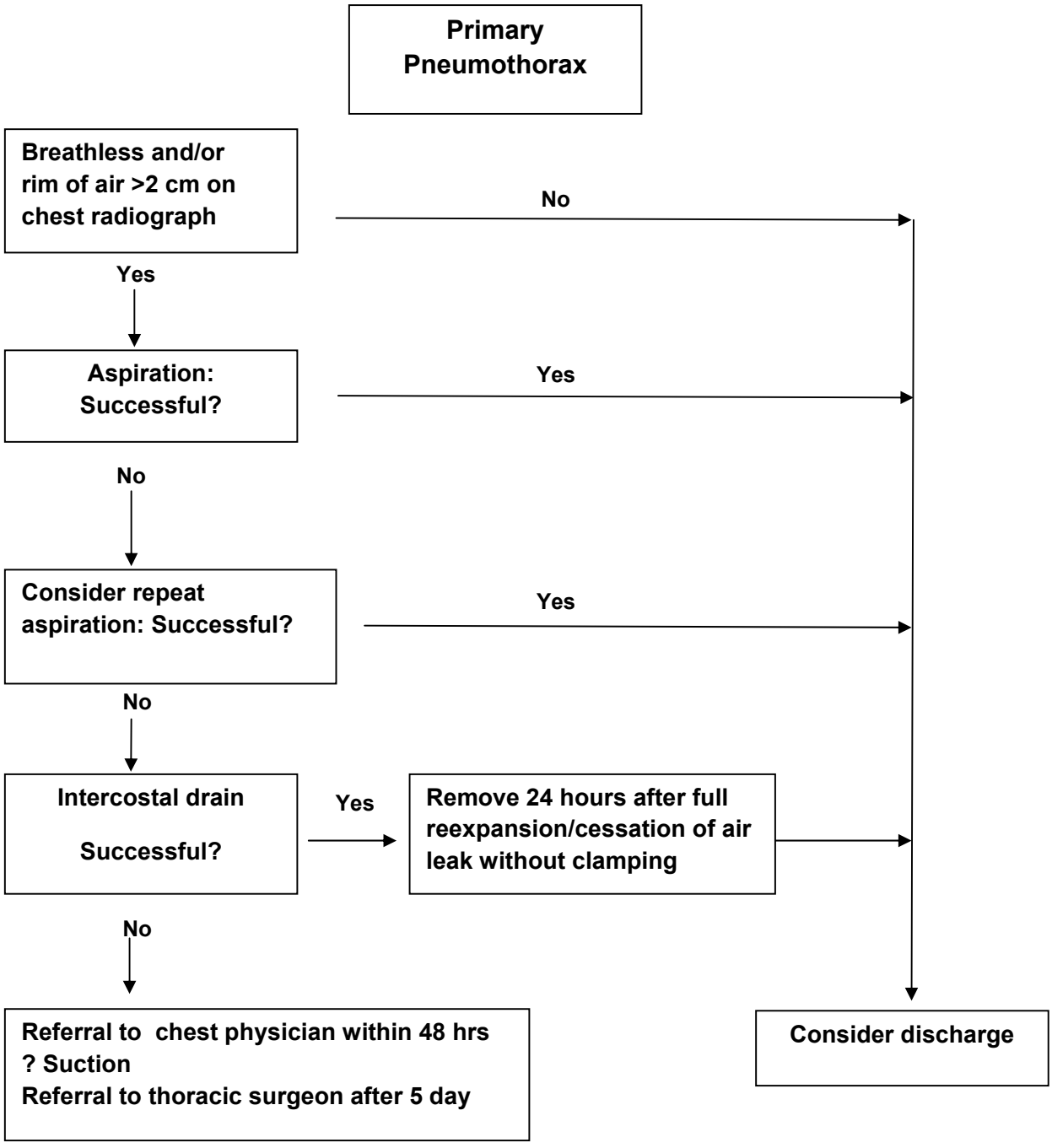
Estimating the size of the pneumothorax
The following methods may be used to estimate the size of the pneumothorax:
1-*The British Thoracic Society* *BTS guideline*
"small" or "large" pneumothorax depending on the presence of a visible rim of <2 cm or >2 cm between the lung margin and the chest wall.

2-The American College of Chest Physicians (ACCP) Delphi consensus statement ACCP guideline
Measure the distance from the apex of the lung to the top margin of the visceral pleura (thoracic cupola) on the upright chest radiograph
Small pneumothorax **<** 3 cm apex-to-cupola distance
Large pneumothorax **≥** 3 cm apex-to-cupola distance

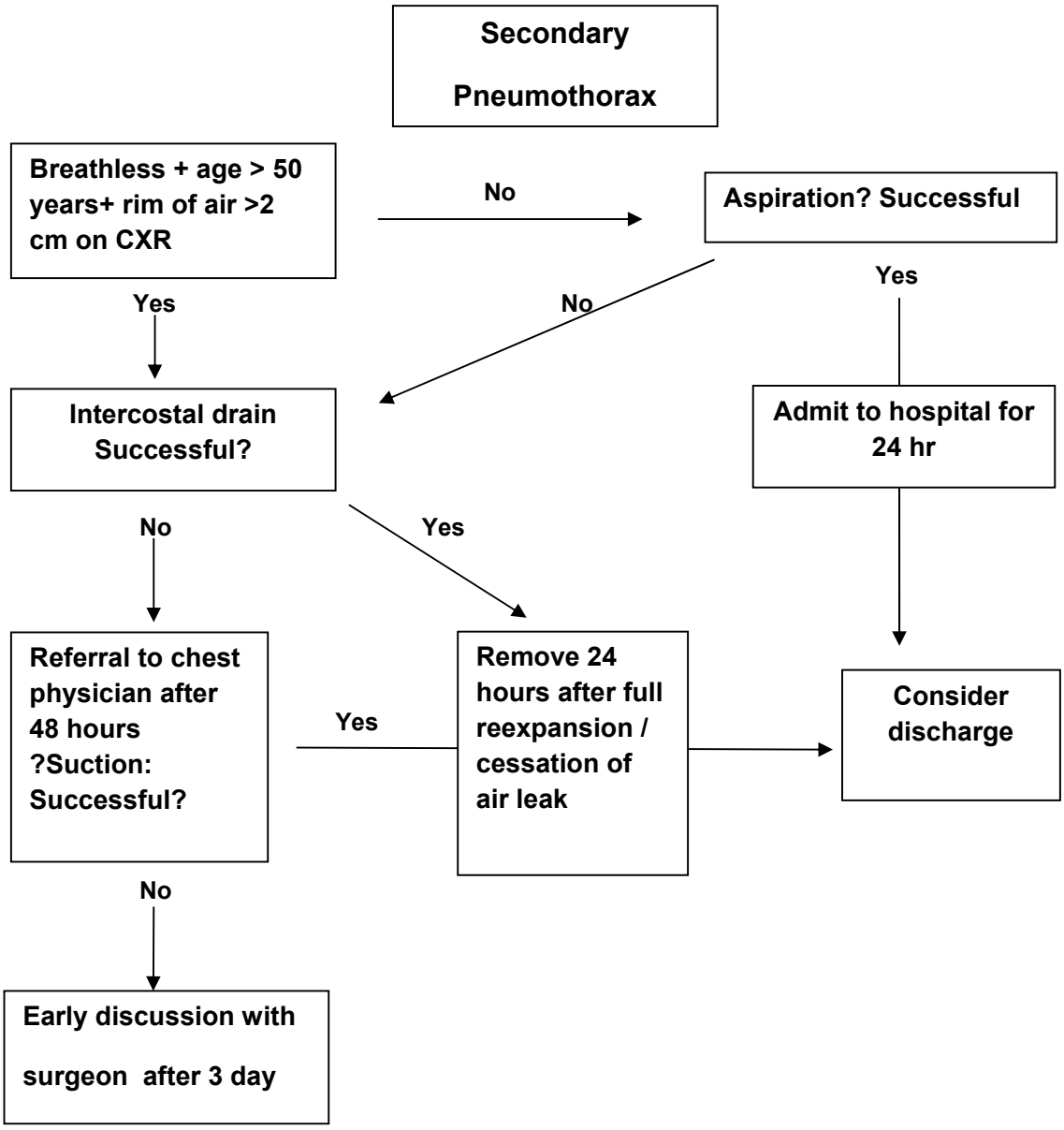
A pneumothorax of 1 cm on the PA chest X-ray occupies about 27% of the hemithorax volume.
A 2 cm radiographic pneumothorax occupies 49% of the hemithorax on the same basis.

Goals of treatment
>Restore an air-free pleural space
> Prevent recurrences.

Treatment
Assess the ABCs (airway, breathing, circulation), assess the vital signs, and perform pulse oximetry.
Evaluate the possibility of a tension pneumothorax which is almost always associated with hypotension.
Establish an intravenous (IV) line.
Clothing covering a wound that communicates with the chest cavity can play a role in producing a one way valve effect
The range of treatment options depending on age of the patient, size of pneumothorax, clinical stability & whether it is primary or secondary pneumothorax & include:
- observation with or without supplemental oxygen,
- simple aspiration
- tube drainage with or without medical pleurodesis
- Surgery: pleurodesis and/or closure of leaks, bullectomy, and open surgical procedures such as thoracotomy for pleurectomy or pleurodesis.



Thorax 2003;**58**:ii39-ii52 doi:10.1136/thorax.58.suppl_2.ii39



Thorax 2003;**58**:ii39-ii52 doi:10.1136/thorax.58.suppl_2.ii39

Interval of observation

Reviews serial vital signs and clinical assessments, using the direction and rate of change in the patient's clinical status to select imaging frequency

>At 0-6 hours: observation in an ED for 6 hours, and discharge to home if a follow-up chest radiograph shows no enlargement of the lesion, in reliable patients. .

>At 24-96 hours: Additional follow up in 2 days is recommended. Outpatient follow-up during the 96-hour window is essential to distinguish between a resolved pneumothorax and one that needs evacuation.

>At 1 month: Full lung reexpansion can occur, on average, 3 weeks after the initial event.

Simple observation

Simple observation can be considered for cases that are likely to resolve:

Small spontaneous or iatrogenic primary pneumothorax in an asymptomatic or minimal symptomatic patient who are hemodynamically stable (***BTS guideline*** rim of <2 cm i.e. pneumothorax occupies < 15-20% of the hemithorax). It has been estimated that 1.25% of the volume of the hemithorax could be absorbed each 24 hours.

Observation must be adopted with caution in small asymptomatic secondary spontaneous pneumothorax SSP.

If a patient with a pneumothorax is admitted overnight for observation high flow (10 l/min) oxygen can be administered to hasten the re-expansion process with appropriate caution in patients with COPD who may be sensitive to higher concentrations of oxygen.

Breathless patients should not be left without intervention regardless the size of the pneumothorax on a chest radiograph

Simple aspiration

Needle aspiration is as safe and effective as chest tube placement for primary spontaneous pneumothorax (PSP), conferring the additional benefits of shorter length of stay and fewer hospital admission

Simple aspiration was proposed as the first-line intervention of all symptomatic (and/or > 2cm size) PSP, however, only asymptomatic SSP patients with age under 50 and a rim smaller than 2 cm would be considered for aspiration owing to the relatively high failure rates

Simple aspiration can be considered in iatrogenic pneumothorax.

Failure to re-expand a primary pneumothorax with aspiration can be successfully corrected by a second aspiration unless >2.5 l was aspirated during the unsuccessful first attempt.

Chest tube drainage indicated in:

-Simple aspiration of any pneumothorax is unsuccessful in controlling symptoms

-Big symptomatic primary spontaneous pneumothorax PSP

-Traumatic pneumothorax

-All first-time secondary spontaneous pneumothorax (SPS) (including chronic obstructive pulmonary disease) **except** {in patients who are not breathless and have a very small (<2 cm) or isolated apical pneumothorax}

The chest tube should be attached either to one-way valve systems(Heimlich valve) or to a water seal device and may be left in place until the lung expands.

If the lung fails to reexpand quickly, suction should be applied to a water-seal device, alternatively suction may be applied immediately after chest tube placement for all patients managed with a water seal system. The presence of symptoms for > 24 h does not alter management recommendations

Air leaks resolve within 7 days of treatment in 80% of cases, with an average hospital stay of 5 days. Keep the tube in place for 24 hours after the air leak ceases.

Application of Suction
Indications
- persistent lung collapse and/or persistent air leakage
- removal of co-existing fluid, like blood or pus
Timing and amount of suction to be applied
- immediate suction after drainage is usually not necessary and might produce complications like reperfusion pulmonary oedema
- can be applied after 48 hours if re-expansion is suboptimal.

Chest Tube Removal*:*
Chest tubes should be removed in a staged manner so as to ensure that the air leak into the pleural space has resolved.
The first stage requires that a chest radiograph demonstrates complete resolution of the pneumothorax and that there is no clinical evidence of an ongoing air leak.
Some would clamp the chest tube approximately 4-12 h after the last evidence of an air leak, others don't clamp(clamping is contraindicated with persistent air leakage) Regardless of whether the tube was or was not clamped, repeat a chest radiograph 12 -24 h after the last evidence of an air leak to ensure that the pneumothorax had not reoccurred in preparation for pulling the chest tube.
If a patient with a clamped drain becomes breathless develops subcutaneous emphysema or oxygen desaturation: the drain must be immediately unclamped and medical advice sought

Persistent Air Leaks
For patients with persistent air leaks; it is recommended continued observation for 5 days for spontaneous closure of bronchopleural fistula.
Patients with air leaks persisting beyond 5 days should be evaluated for surgery to close the air leak and to perform a pleurodesis procedure to prevent pneumothorax recurrence.
Patients *should not* undergo the placement of an additional chest tube or bronchoscopy with attempts to seal endobronchial sites of air leaks.

Medical pleurodesis
Reserved for cases contraindicated to surgery, a poor prognosis from the patient's underlying disease or patient unwilling to undergo surgical pleurodesis(which provides a more definitive prevention of recurrence)
Tetracycline group (doxycline , minocycline) is the commonest agents employed and is recommended as the first-line agents of choice.
Talc is also widely used with its higher reported efficacy and lower cost.
Both agents are associated with pain and fever, but more severe complications such as respiratory failure and ARDS had been associated with the use of talc

Catamenial pneumothorax
Oral contraceptives carry a high success rate in the treatment of catamenial pneumothorax, although this condition may also (rarely) be treated surgically. Most cases present during or shortly after menses, and the spontaneous pneumothorax is usually right-sided

Indications for Surgical Assistance
Treatment options such as thoracoscopy, electrocautery, laser treatment, resection of blebs or

pleura, or open thoracotomy. In patients with repeated pneumothoraces who are not good candidates for surgery, pleurodesis (or sclerotherapy) may be necessary using the 2 major sclerosing agents: talc and tetracycline derivatives (eg, minocycline, doxycycline).:
- Failure of re-expansion & persistent air leak of more than 5 days
- Bronchopleural fistula persisting for 5 days or longer
- Recurrent, ipsilateral pneumothorax
- Contralateral pneumothorax
- Bilateral pneumothorax
- Spontaneous haemothorax
- First-time presentation in a patient with a high-risk occupation (e.g., diver, pilot) and choice of patient.
- Unacceptable risk of recurrent pneumothorax for patients with plans for extended stays at remote sites
- Patients with acquired immunodeficiency syndrome (AIDS) (because of extensive underlying necrosis)

Complications of pneumothorax
Hypoxemic respiratory failure
Respiratory or cardiac arrest
Hemopneumothorax
Bronchopulmonary fistula
Pulmonary edema (following lung reexpansion)
Empyema
Pneumomediastinum & Pneumopericardium

Guidelines for discharge from the Emergency Department:
-Small pneumothorax with no change in size following 4-6 hours observation
-Patients with a re-expanded pneumothorax, who show no evidence of ongoing air leak (catheter was clamped and re-xrayed) can be discharged with removal of the catheter on the same day.
-Patient will comply with treatment recommendations and can obtain prompt emergency medical care

Follow up:
1.Instruct the patient to return to the emergency department for reassessment and daily chest radiograph until no recurrence of an air leak
2.Persistent air leak greater than 5 days requires surgical consultation to assess the need for surgical intervention.
3. Patient without intervention: Should be advised to return for a follow up chest radiograph after 2 weeks
4.Primary pneumothorax patients treated successfully by simple aspiration should be observed to ensure clinical stability before discharge.
3-Secondary pneumothorax patients who are successfully treated with simple aspiration should be admitted for 24 hours before discharge to ensure no recurrence
4. Patient should also be advised to wear safety belts during driving
5. Clinicians should educate patients with pneumothorax/resolving pneumothorax about: prohibition of smoking, diving, and air travel/travel to remote regions
a - Should avoid air travel until a chest radiograph has confirmed resolution of the pneumothorax.
b - There should be a ***6 week*** interval between having a pneumothorax and travelling by air. A

recent chest radiograph before flight should confirm resolution of the pneumothorax.
c - Patient who had suffered a secondary spontaneous pneumothorax, should avoid flying for **one year** at least in the absence of a definitive surgical procedure.
d -Diving should be **permanently** avoided after a pneumothorax, unless a very secure definitive prevention strategy such as surgical pleurectomy has been performed.

Further reading
Risks factors for **primary spontaneous pneumothorax (PSP)** include the following:
Smoking
Tall thin stature in a healthy person
Marfan syndrome
Pregnancy
Familial pneumothorax

Diseases and conditions associated with **secondary spontaneous pneumothorax** include the following:
Chronic obstructive lung disease (COPD) or emphysema
Asthma
Human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS) with PCP infection (*Pneumocystis jiroveci pneumonia-previously known as Pneumocystis carinii pneumonia*
Necrotizing pneumonia
Tuberculosis
Sarcoidosis
Cystic fibrosis
Bronchogenic carcinoma or metastatic malignancy
Idiopathic pulmonary fibrosis
Inhalational and intravenous drug use (eg, marijuana, cocaine)
Interstitial lung diseases associated with connective tissue diseases
Severe acute respiratory syndrome (SARS)
Thoracic endometriosis and catamenial pneumothorax
Collagen vascular disease, including Marfan syndrome

Causes of **iatrogenic pneumothorax** include the following:

Transthoracic needle aspiration biopsy of pulmonary nodules (most common cause)
Transbronchial or pleural biopsy
Thoracentesis
Central venous catheter insertion, usually subclavian or internal jugular[15]
Intercostal nerve block
Tracheostomy
Cardiopulmonary resuscitation (CPR)
Acute respiratory distress syndrome (ARDS) and positive pressure ventilation in the ICU
Nasogastric feeding tube placement

Causes of **traumatic pneumothorax** include the following:
Trauma: Penetrating and non penetrating injury
Rib fracture
High-risk occupation (e.g., diving, flying)

Tension pneumothorax

The most common etiologies of tension pneumothorax are either iatrogenic or related to trauma, such as the following:

Blunt or penetrating trauma
Barotrauma secondary to positive-pressure ventilation
Pneumoperitoneum
Fiberoptic bronchoscopy with closed-lung biopsy
Markedly displaced thoracic spine fractures
Acupuncture
Preexisting Bochdalek hernia with trauma
Colonoscopy and gastroscopy have been implicated in case reports.
Percutaneous tracheostomy
Conversion of idiopathic, spontaneous, simple pneumothorax to tension pneumothorax
Unsuccessful attempts to convert an open pneumothorax to a simple pneumothorax in which the occlusive dressing functions as a 1-way valve

Tension pneumothorax typically occurs in the ICU setting in patients who are ventilated. Infants requiring ventilatory assistance and those with meconium aspiration have a particularly high risk for tension pneumothorax.

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