MINISTRY OF HEALTH CARE OF UKRAINE

KHARKIV NATIONAL MEDICAL UNIVERSITY

Department of Phthisiology and Pulmonology

The 2nd Medical Faculty

METHODICAL RECOMMENDATION FOR THE STUDENT'S SELF WORK

Educative discipline

"Current Problems of Phthisiology and Pulmonology"

for students of 5 course of 6th medical faculty

"Approved"
Educative-methodical counsel of
Department of
Phthisiology and Pulmonology
«____» _____ 20___ p.
protocol № _____
Head of Department
Professor Shevchenko O.S.

KHARKIV – 2016

Topic "Pneumothorax. History. Epidemiology. Definition. Classification. Diagnosis. Management. Treatment.Pleurodes and surgery. Prevention. Pneumothorax in animals".

1.Quantity of hours 4

2.Financial and methodical support of the topic: tables, results of patients examination and their case histories, X-ray pictures.

3.Currency of the topic. Pneumothorax present in patients in a variety of ways, as acute emergencies in trauma in prehospital settings or as subacute presentations in hospitals. Tension pneumothorax is particularly a fatal complication which can result in cardiovascular collapse and death.

4.Educative goal:

- **General goal:** To create for students the appropriate terms, which provide knowledge gaining, and abilities, allowing to recognize, diagnose and treat spontaneous pneumothorax.

- **Concrete aims:**

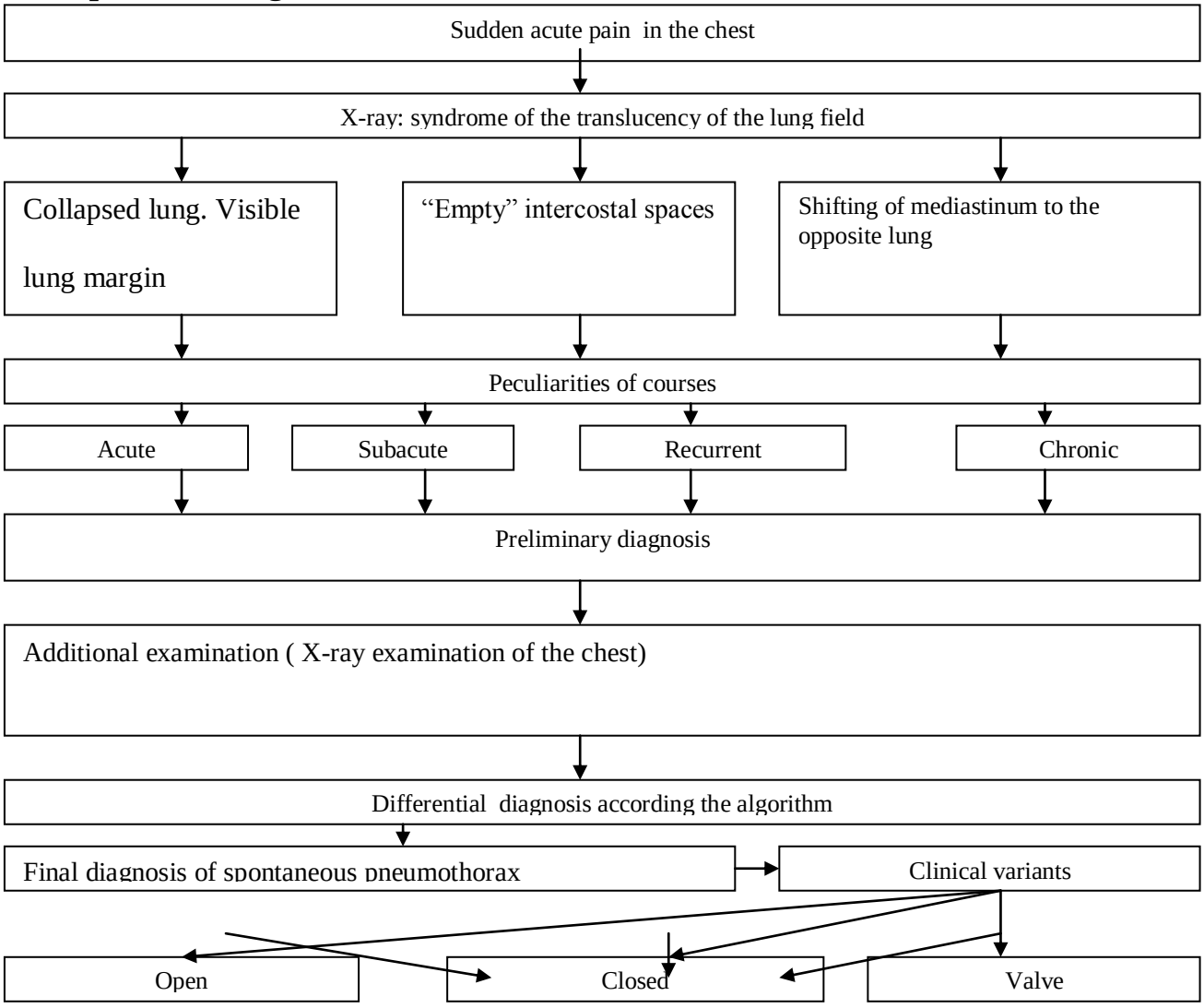
- To identify the basic syndromes of spontaneous pneumothorax.
- To diagnose spontaneous pneumothorax.
- To formulate the clinical diagnosis spontaneous pneumothorax. according to the classification.
- To institute complex therapy of various forms of spontaneous pneumothorax.
- To diagnose complications of spontaneous pneumothorax. and to render urgent aid in emergency cases.

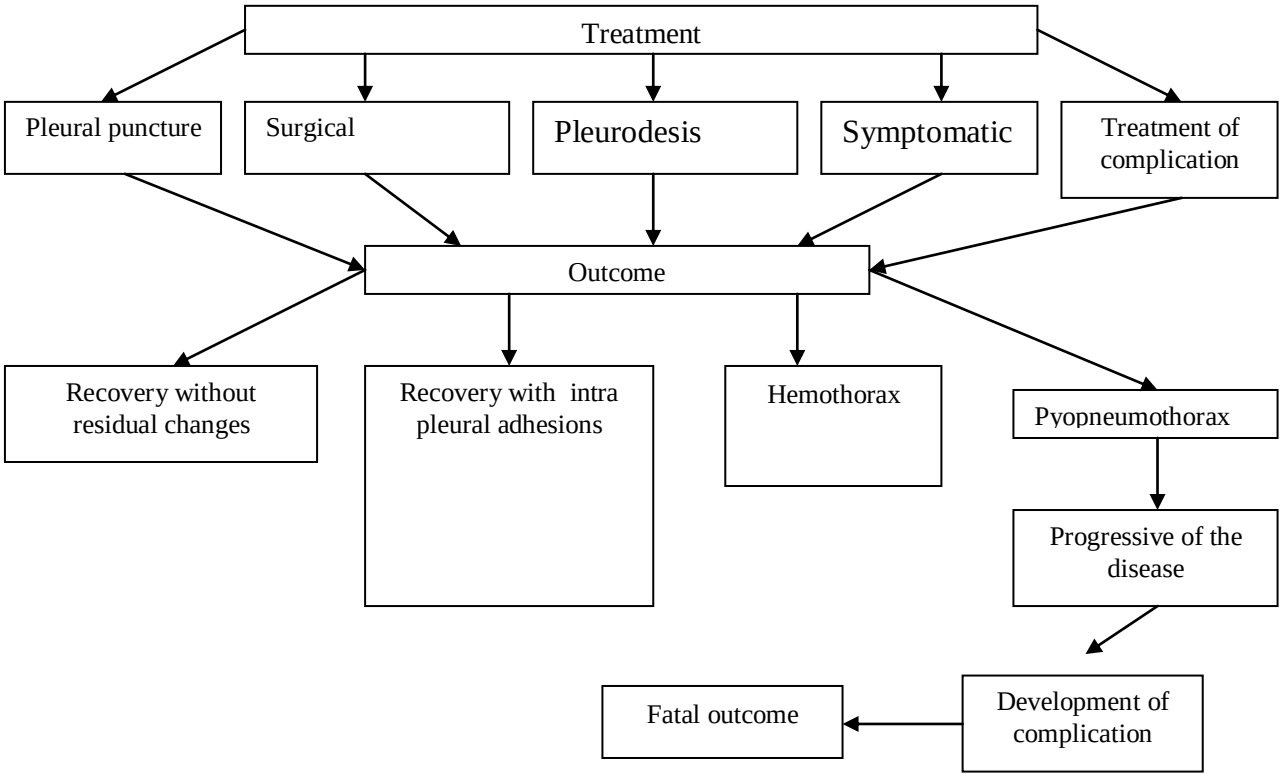
a) **To know** definition of pleurisy and pleural effusion;
- etiology and pathogenesis of spontaneous pneumothorax;
- classification of spontaneous pneumothorax;
- methods of investigations of spontaneous pneumothorax.

b) **To be able to** interpret data of laboratory and instrumental investigations in spontaneous pneumothorax;
- to manage a case with spontaneous pneumothorax.

c) To master **practical skills:**
- Palpation of the chest (elasticity, resistance, vocal phremitus);
- Topographic percussion of the lungs;
- Assessment of low lung edge excursion;
- Comparative percussion of lungs;

- Auscultation of lungs;
- Assessment of bronchophony
- **5.Graphs of the logical structure:**





6. Reference student's card

SPONTANEOUS PNEUMOTHORAX

History

An early description of traumatic pneumothorax secondary to rib fractures appears in *Imperial Surgery* by Turkish surgeon Şerafeddin Sabuncuoğlu (1385–1468), which also recommends a method of simple aspiration.

Pneumothorax was described in 1803 by Jean Marc Gaspard Itard, a student of René Laennec, who provided an extensive description of the clinical picture in 1819. While Itard and Laennec recognized that some cases were not due to tuberculosis (then the most common cause), the concept of spontaneous pneumothorax in the absence of tuberculosis (primary pneumothorax) was reintroduced by the Danish physician Hans Kjærgaard in 1932. In 1941, the surgeons Tyson and Crandall introduced pleural abrasion for the treatment of pneumothorax.

Prior to the advent of anti-tuberculous medications, iatrogenic pneumothoraces were intentionally given to people with tuberculosis in an effort to collapse a lobe, or entire lung, around a cavitating lesion. This was known as "resting the lung". It was introduced by the Italian surgeon Carlo Forlanini in 1888, and publicized by the American surgeon John Benjamin Murphy in the early 20th century (after discovering the same procedure independently). Murphy used the (then) recently discovered X-ray technology to create pneumothoraces of the correct size. Epidemiology

The annual age-adjusted incidence rate (AAIR) of PSP is thought to be three to six times as high in males as in females. Fishman cites AAIR's of 7.4 and 1.2 cases per

100,000 person-years in males and females, respectively. Significantly above-average height is also associated with increased risk of PSP—in people who are at least 76 inches (1.93 meters) tall, the AAIR is about 200 cases per 100,000 person-years. Slim build also seems to increase the risk of PSP.

The risk of contracting a first spontaneous pneumothorax is elevated among male and female smokers by factors of approximately 22 and 9, respectively, compared to matched non-smokers of the same sex. Individuals who smoke at higher intensity are at higher risk, with a "greater-than-linear" effect; men who smoke 10 cigarettes per day have an approximate 20-fold increased risk over comparable non-smokers, while smokers consuming 20 cigarettes per day show an estimated 100-fold increase in risk.

In secondary spontaneous pneumothorax, the estimated annual AAIR is 6.3 and 2.0 cases per 100,000 person-years for males and females, respectively, with the risk of recurrence depending on the presence and severity of any underlying lung disease. Once a second episode has occurred, there is a high likelihood of subsequent further episodes. The incidence in children has not been well studied,[6] but is estimated to be between 5 and 10 cases per 100,000 person-years.

Death from pneumothorax is very uncommon (except in tension pneumothoraces). British statistics show an annual mortality rate of 1.26 and 0.62 deaths per million person-years in men and women, respectively. A significantly increased risk of death is seen in older victims and in those with secondary pneumothoraces.

A **pneumothorax** (pneumo + thorax; plural **pneumothoraces**) is an abnormal collection of air or gas in the pleural space that causes an uncoupling of the lung from the chest wall. Like pleural effusion (liquid buildup in that space), pneumothorax may interfere with normal breathing. It is often called **collapsed lung**, although that term may also refer to atelectasis. One or both lungs may be affected.

A **primary pneumothorax** is one that occurs spontaneously without an apparent cause and in the absence of significant lung disease, while a **secondary pneumothorax** occurs in the presence of existing lung pathology. Pneumothoraces can be caused by physical trauma to the chest (including blast injury), or as a complication of medical or surgical intervention; in this case it is referred to as a **traumatic pneumothorax**. In a minority of cases of both spontaneous or traumatic pneumothorax, the amount of air in the chest increases markedly when a one-way valve is formed by an area of damaged tissue, leading to a **tension pneumothorax**. This condition is a medical emergency that can cause steadily worsening oxygen shortage and low blood pressure. Unless reversed by effective treatment, these sequelae can progress and cause death.

Symptoms typically include chest pain and shortness of breath. Diagnosis of a pneumothorax by physical examination alone can be difficult or inconclusive (particularly in smaller pneumothoraces), so a chest radiograph or computed tomography (CT) scan is usually used to confirm its presence.

Small spontaneous pneumothoraces typically resolve without treatment and require only monitoring. This approach may be most appropriate in subjects who have no significant underlying lung disease. In larger pneumothoraces, or when there are marked symptoms, the air may be extracted with a syringe or a chest tube connected to a one-way valve system. Occasionally, surgical interventions may be required when tube drainage is unsuccessful, or as a preventive measure, if there have been repeated episodes. The surgical treatments usually involve pleurodesis (in which the layers of pleura are induced to stick together) or pleurectomy (the surgical removal of pleural membranes).

A primary spontaneous pneumothorax (PSP) tends to occur in a young adult without underlying lung problems, and usually causes limited symptoms. Chest pain and sometimes mild breathlessness are the usual predominant presenting features. People who are affected by PSPs are often unaware of potential danger

and may wait several days before seeking medical attention. PSPs more commonly occur during changes in atmospheric pressure, explaining to some extent why episodes of pneumothorax may happen in clusters. It is rare for PSPs to cause tension pneumothoraces. Secondary spontaneous pneumothoraces (SSPs), by definition, occur in individuals with significant underlying lung disease. Symptoms in SSPs tend to be more severe than in PSPs, as the unaffected lungs are generally unable to replace the loss of function in the affected lungs. Hypoxemia (decreased blood-oxygen levels) is usually present and may be observed as cyanosis (blue discoloration of the lips and skin). Hypercapnia (accumulation of carbon dioxide in the blood) is sometimes encountered; this may cause confusion and - if very severe - may result in comas. The sudden onset of breathlessness in someone with chronic obstructive pulmonary disease (COPD), cystic fibrosis, or other serious lung diseases should therefore prompt investigations to identify the possibility of a pneumothorax.

Traumatic pneumothorax most commonly occurs when the chest wall is pierced, such as when a stab wound or gunshot wound allows air to enter the pleural space, or because some other mechanical injury to the lung compromises the integrity of the involved structures. Traumatic pneumothoraces have been found to occur in up to half of all cases of chest trauma, with only rib fractures being more common in this group. The pneumothorax can be occult (not readily apparent) in half of these cases, but may enlarge - particularly if mechanical ventilation is required. They are also encountered in patients already receiving mechanical ventilation for some other reason.

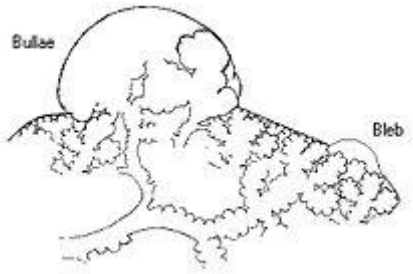
Upon physical examination, breath sounds (heard with a stethoscope) may be diminished on the affected side, partly because air in the pleural space dampens the transmission of sound. Measures of the conduction of vocal vibrations to the surface of the chest may be altered. Percussion of the chest may be perceived as hyper resonant (like a booming drum), and vocal resonance and tactile phremitus can both be noticeably decreased. Importantly, the volume of the pneumothorax

can show limited correlation with the intensity of the symptoms experienced by the victim, and physical signs may not be apparent if the pneumothorax is relatively small.

Tension pneumothorax

Although multiple definitions exist, a tension pneumotorax is generally considered to be present when a pneumothorax (primary spontaneous, secondary spontaneous, or traumatic) leads to significant impairment of respiration and/or blood circulation. Tension pneumothorax tends to occur in clinical situations such as ventilation, resuscitation, trauma, or in patients with lung disease. The most common findings in people with tension pneumothorax are chest pain and respiratory distress, often with an increased heart rate (tachycardia) and rapid breathing (tachypnea) in the initial stages. Other findings may include quieter breath sounds on one side of the chest, low oxygen levels and blood pressure, and displacement of the trachea away from the affected side. Rarely, there may be cyanosis (bluish discoloration of the skin due to low oxygen levels), altered level of consciousness, a hyper resonant percussion note on examination of the affected side with reduced expansion and decreased movement, pain in the epigastria (upper abdomen), displacement of the apex beat (heart impulse), and resonant sound when tapping the sternum. This is a medical emergency and may require immediate treatment without further investigations. Tension pneumothorax may also occur in someone who is receiving mechanical ventilation, in which case it may be difficult to spot as the person is typically receiving sedation; it is often noted because of a sudden deterioration in condition. Recent studies have shown that the development of tension features may not always be as rapid as previously thought. Deviation of the trachea to one side and the presence of raised jugular venous pressure (distended neck veins) are not reliable as clinical signs.

Cause



A schematic drawing of a bulla and a bleb, two lung abnormalities that may rupture and lead to pneumothorax.

Primary spontaneous pneumothorax

Spontaneous pneumothoraces are divided into two types: *primary*, which occurs in the absence of known lung disease, and *secondary*, which occurs in someone with underlying lung disease. The cause of primary spontaneous pneumothorax is unknown, but established risk factors include male sex, smoking, and a family history of pneumothorax.−The various suspected underlying mechanisms are discussed below.

Secondary spontaneous

Secondary spontaneous pneumothorax occurs in the setting of a variety of lung diseases. The most common is chronic obstructive pulmonary disease (COPD), which accounts for approximately 70% of cases. Known lung diseases that may significantly increase the risk for pneumothorax are

Type	Causes
Diseases of the airways	COPD (especially when emphysema and lung bullae are present), acute severe asthma, cystic fibrosis
Infections of the lung	Pneumocystis pneumonia (PCP), tuberculosis, necrotizing pneumonia
Interstitial lung disease	Sarcoidosis, idiopathic pulmonary fibrosis, histiocytosis X, lymphangioleiomyomatosis (LAM)

Connective tissue diseases	Rheumatoid arthritis, ankylosing spondylitis, polymyositis and dermatomyositis, systemic sclerosis, Marfan's syndrome and Ehlers–Danlos syndrome
Cancer	Lung cancer, sarcomas involving the lung
Miscellaneous	Catamenial pneumothorax (associated with the menstrual cycle and related to endometriosis in the chest)

In children, additional causes include measles, echinococcosis, inhalation of a foreign body, and certain congenital malformations (congenital cystic adenomatoid malformation and congenital lobar emphysema). 11.5% of people with a spontaneous pneumothorax have a family member who has previously experienced a pneumothorax. The hereditary conditions—Marfan syndrome, homocystinuria, Ehlers–Danlos syndrome, alpha 1-antitrypsin deficiency (which leads to emphysema), and Birt–Hogg–Dubé syndrome—have all been linked to familial pneumothorax. Generally, these conditions cause other signs and symptoms as well, and pneumothorax is not usually the primary finding. Birt–Hogg–Dubé syndrome is caused by mutations in the *FLCN* gene (located at chromosome 17p11.2), which encodes a protein named folliculin. *FLCN* mutations and lung lesions have also been identified in familial cases of pneumothorax where other features of Birt–Hogg–Dubé syndrome are absent. In addition to the genetic associations, the HLA haplotype A_2B_{40} is also a genetic predisposition to PSP.

Traumatic

A traumatic pneumothorax may result from either blunt trauma or penetrating injury to the chest wall. The most common mechanism is due to the penetration of sharp bony points at a new rib fracture, which damages lung tissue. Traumatic pneumothorax may also be observed in those exposed to blasts, even though there is no apparent injury to the chest.

Medical procedures, such as the insertion of a central venous catheter into one of the chest veins or the taking of biopsy samples from lung tissue, may lead to pneumothorax. The administration of positive pressure ventilation, either mechanical ventilation or non-invasive ventilation, can result in barotrauma (pressure-related injury) leading to a pneumothorax. Divers who breathe from an underwater apparatus are supplied with breathing gas at ambient pressure, which results in their lungs containing gas at higher than atmospheric pressure. Divers breathing compressed air (such as when scuba diving) may suffer a pneumothorax as a result of barotrauma from ascending just 1 metre (3 ft) while breath-holding with their lungs fully inflated. An additional problem in these cases is that those with other features of decompression sickness are typically treated in a diving chamber with hyperbaric therapy; this can lead to a small pneumothorax rapidly enlarging and causing features of tension.

Mechanism

CT scan of the chest showing a pneumothorax on the person's left side (right side on the image). A chest tube is in place (small black mark on the right side of the image), the air-filled pleural cavity (black) and ribs (white) can be seen. The heart can be seen in the center.

The thoracic cavity is the space inside the chest that contains the lungs, heart, and numerous major blood vessels. On each side of the cavity, a pleural membrane covers the surface of lung (visceral pleura) and also lines the inside of the chest wall (parietal pleura). Normally, the two layers are separated by a small amount of lubricating serous fluid. The lungs are fully inflated within the cavity because the

pressure inside the airways is higher than the pressure inside the pleural space. Despite the low pressure in the pleural space, air does not enter it because there are no natural connections to an air-containing passage, and the pressure of gases in the bloodstream is too low for them to be forced into the pleural space. Therefore, a pneumothorax can only develop if air is allowed to enter, through damage to the chest wall or damage to the lung itself, or occasionally because microorganisms in the pleural space produce gas.

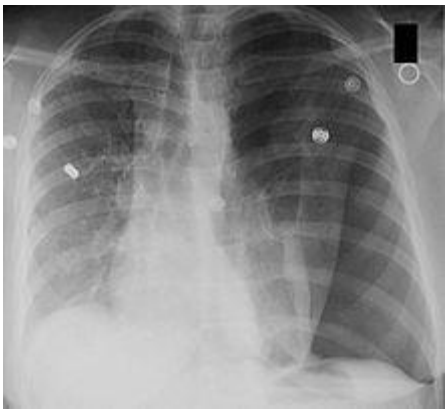
Chest-wall defects are usually evident in cases of injury to the chest wall, such as stab or bullet wounds ("open pneumothorax"). In secondary spontaneous pneumothoraces, vulnerabilities in the lung tissue are caused by a variety of disease processes, particularly by rupturing of bullae (large air-containing lesions) in cases of severe emphysema. Areas of necrosis (tissue death) may precipitate episodes of pneumothorax, although the exact mechanism is unclear. Primary spontaneous pneumothorax has for many years been thought to be caused by "blebs" (small air-filled lesions just under the pleural surface), which were presumed to be more common in those classically at risk of pneumothorax (tall males) due to mechanical factors. In PSP, blebs can be found in 77% of cases, compared to 6% in the general population without a history of PSP. As these healthy subjects do not all develop a pneumothorax later, the hypothesis may not be sufficient to explain all episodes; furthermore, pneumothorax may recur even after surgical treatment of blebs. It has therefore been suggested that PSP may also be caused by areas of disruption (porosity) in the pleural layer, which are prone to rupture. Smoking may additionally lead to inflammation and obstruction of small airways, which account for the markedly increased risk of PSPs in smokers. Once air has stopped entering the pleural cavity, it is gradually reabsorbed. Tension pneumothorax occurs when the opening that allows air to enter the pleural space functions as a one-way valve, allowing more air to enter with every breath but none to escape. The body compensates by increasing the respiratory rate and tidal

volume (size of each breath), worsening the problem. Unless corrected, hypoxia (decreased oxygen levels) and respiratory arrest eventually follow.

Diagnosis

The symptoms of pneumothorax can be vague and inconclusive, especially in those with a small PSP; confirmation with medical imaging is usually required. In contrast, tension pneumothorax is a medical emergency and may be treated before imaging - especially if there is severe hypoxia, very low blood pressure, or an impaired level of consciousness. In tension pneumothorax, X-rays are sometimes required if there is doubt about the anatomical location of the pneumothorax.

Chest X-ray



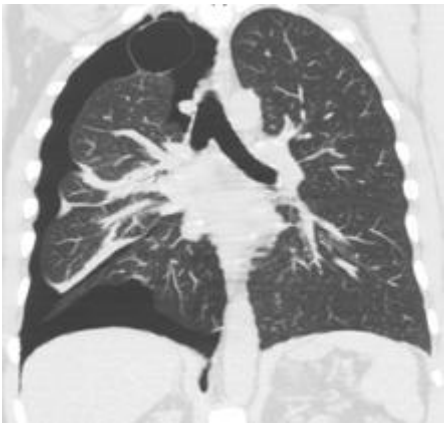
Chest X-ray of left-sided pneumothorax (seen on the right in this image). The left thoracic cavity is partly filled with air occupying the pleural space. The mediastinum is shifted to the opposite side.

Traditionally a plain radiograph of the chest, ideally with the X-ray beams being projected from the back (posteroanterior, or "PA"), has been the most appropriate first investigation. These are usually performed during maximal inspiration (holding one's breath); no added information is gathered by obtaining a chest X-ray in expiration (after exhaling). If the PA X-ray does not show a pneumothorax but there is a strong suspicion of one, lateral X-rays (with beams projecting from the side) may be performed, but this is not routine practice. It is not unusual for the mediastinum (the structure between the lungs that contains the heart, great blood

vessels and large airways) to be shifted away from the affected lung due to the pressure differences. This is *not* equivalent to a tension pneumothorax, which is determined mainly by the constellation of symptoms, hypoxia, and shock.

The size of the pneumothorax (i.e. the volume of air in the pleural space) can be determined with a reasonable degree of accuracy by measuring the distance between the chest wall and the lung. This is relevant to treatment, as smaller pneumothoraces may be managed differently. An air rim of 2 cm means that the pneumothorax occupies about 50% of the hemithorax. British professional guidelines have traditionally stated that the measurement should be performed at the level of the hilum (where blood vessels and airways enter the lung) with 2 cm as the cutoff, while American guidelines state that the measurement should be done at the apex (top) of the lung with 3 cm differentiating between a "small" and a "large" pneumothorax. The latter method may overestimate the size of a pneumothorax if it is located mainly at the apex, which is a common occurrence. The various methods correlate poorly, but are the best easily available ways of estimating pneumothorax size. CT scanning (see below) can provide a more accurate determination of the size of the pneumothorax, but its routine use in this setting is not recommended. Not all pneumothoraces are uniform; some only form a pocket of air in a particular place in the chest. Small amounts of fluid may be noted on the chest X-ray (hydropneumothorax); this may be blood (hemopneumothorax). In some cases, the only significant abnormality may be the "deep sulcus sign", in which the normally small space between the chest wall and the diaphragm appears enlarged due to the abnormal presence of fluid.

Computed tomography



CT with the identification of underlying lung lesion: an apical bulla.

Computed tomography (CT, or "CAT scan") is not necessary for the diagnosis of pneumothorax, but it can be useful in particular situations. In some lung diseases, especially emphysema, it is possible for abnormal lung areas such as bullae (large air-filled sacs) to have the same appearance as a pneumothorax on chest X-ray, and it may not be safe to apply any treatment before the distinction is made and before the exact location and size of the pneumothorax is determined. In trauma, where it may not be possible to perform an upright film, chest radiography may miss up to a third of pneumothoraces, while CT remains very sensitive. A further use of CT is in the identification of underlying lung lesions. In presumed primary pneumothorax, it may help to identify blebs or cystic lesions (in anticipation of treatment, see below), and in secondary pneumothorax it can help to identify most of the causes listed above.

Ultrasound[edit]

Ultrasound is commonly used in the evaluation of people who have sustained physical trauma, for example with the FAST protocol. Ultrasound may be more sensitive than chest X-rays in the identification of pneumothorax after blunt trauma to the chest. Ultrasound may also provide a rapid diagnosis in other emergency situations, and allow the quantification of the size of the pneumothorax. Several

particular features on ultrasonography of the chest can be used to confirm or exclude the diagnosis.

Management

The treatment of pneumothorax depends on a number of factors, and may vary from discharge with early follow-up to immediate needle decompression or insertion of a chest tube. Treatment is determined by the severity of symptoms and indicators of acute illness, the presence of underlying lung disease, the estimated size of the pneumothorax on X-ray, and - in some instances - on the personal preference of the person involved.

In traumatic pneumothorax, chest tubes are usually inserted. If mechanical ventilation is required, the risk of tension pneumothorax is greatly increased and the insertion of a chest tube is mandatory. Any open chest wound should be covered with an airtight seal, as it carries a high risk of leading to tension pneumothorax. Ideally, a dressing called the "Asherman seal" should be utilized, as it appears to be more effective than a standard "three-sided" dressing. The Asherman seal is a specially designed device that adheres to the chest wall and, through a valve-like mechanism, allows air to escape but not to enter the chest.[18]

Tension pneumothorax is usually treated with urgent needle decompression. This may be required before transport to the hospital, and can be performed by an emergency medical technician or other trained professional. The needle or cannula is left in place until a chest tube can be inserted. If tension pneumothorax leads to cardiac arrest, needle decompression is performed as part of resuscitation as it may restore cardiac output.

Conservative

Small spontaneous pneumothoraces do not always require treatment, as they are unlikely to proceed to respiratory failure or tension pneumothorax, and generally

resolve spontaneously. This approach is most appropriate if the estimated size of the pneumothorax is small (defined as <50% of the volume of the hemithorax), there is no breathlessness, and there is no underlying lung disease. It may be appropriate to treat a larger PSP conservatively if the symptoms are limited. Admission to hospital is often not required, as long as clear instructions are given to return to hospital if there are worsening symptoms. Further investigations may be performed as an outpatient, at which time X-rays are repeated to confirm improvement, and advice given with regard to preventing recurrence (see below). Estimated rates of resorption are between 1.25% and 2.2% the volume of the cavity per day. This would mean that even a complete pneumothorax would spontaneously resolve over a period of about 6 weeks. There; however, is no high quality evidence comparing conservative to non conservative management. Secondary pneumothoraces are only treated conservatively if the size is very small (1 cm or less air rim) and there are limited symptoms. Admission to the hospital is usually recommended. Oxygen given at a high flow rate may accelerate resorption as much as fourfold.

Aspiration

In a large PSP (>50%), or in a PSP associated with breathlessness, some professional guidelines recommend that reducing the size by aspiration is equally effective as the insertion of a chest tube. This involves the administration of local anesthetic and inserting a needle connected to a three-way tap; up to 2.5 liters of air (in adults) are removed. If there has been significant reduction in the size of the pneumothorax on subsequent X-ray, the remainder of the treatment can be conservative. This approach has been shown to be effective in over 50% of cases. Compared to tube drainage, first-line aspiration in PSP reduces the number of people requiring hospital admission significantly, without increasing the risk of complications.

Aspiration may also be considered in secondary pneumothorax of moderate size (air rim 1–2 cm) without breathlessness, with the difference that ongoing observation in hospital is required even after a successful procedure. American professional guidelines state that all large pneumothoraces - even those due to PSP - should be treated with a chest tube. Moderately sized iatrogenic traumatic pneumothoraces (due to medical procedures) may initially be treated with aspiration.

Chest tube

A chest tube (or intercostal drain) is the most definitive initial treatment of a pneumothorax. These are typically inserted in an area under the axilla (armpit) called the "safe triangle", where damage to internal organs can be avoided; this is delineated by a horizontal line at the level of the nipple and two muscles of the chest wall (latissimus dorsi and pectoralis major). Local anesthetic is applied. Two types of tubes may be used. In spontaneous pneumothorax, small-bore (smaller than 14 F, 4.7 mm diameter) tubes may be inserted by the Seldinger technique, and larger tubes do not have an advantage. In traumatic pneumothorax, larger tubes (28 F, 9.3 mm) are used. Chest tubes are required in PSPs that have not responded to needle aspiration, in large SSPs (>50%), and in cases of tension pneumothorax. They are connected to a one-way valve system that allows air to escape, but not to re-enter, the chest. This may include a bottle with water that functions like a water seal, or a Heimlich valve. They are not normally connected to a negative pressure circuit, as this would result in rapid re-expansion of the lung and a risk of pulmonary edema ("re-expansion pulmonary edema"). The tube is left in place until no air is seen to escape from it for a period of time, and X-rays confirm re-expansion of the lung. If after 2–4 days there is still evidence of an air leak, various options are available. Negative pressure suction (at low pressures of –10 to –20 cmH_2O) at a high flow rate may be attempted, particularly in PSP; it is thought that this may accelerate the healing of the leak. Failing this, surgery may be required, especially in SSP.[3]

Chest tubes are used first-line when pneumothorax occurs in people with AIDS, usually due to underlying pneumocystis pneumonia (PCP), as this condition is associated with prolonged air leakage. Bilateral pneumothorax (pneumothorax on both sides) is relatively common in people with pneumocystis pneumonia, and surgery is often required. It is possible for a patient with a chest tube to be managed in an ambulatory care setting by using a Heimlich valve, although research to demonstrate the equivalence to hospitalization has been of limited quality.

Pleurodesis and surgery

Pleurodesis is a procedure that permanently obliterates the pleural space and attaches the lung to the chest wall. Although no long-term study has been performed on its consequences, the best results are achieved with a thoracotomy (surgical opening of the chest)—with identification of any source of air leakage and stapling of blebs—followed by pleurectomy (stripping of the pleural lining) of the outer pleural layer and pleural abrasion (scraping of the pleura) of the inner layer. During the healing process, the lung adheres to the chest wall, effectively obliterating the pleural space. Recurrence rates are approximately 1%. Post-thoracotomy pain is relatively common.

A less invasive approach is thoracoscopy, usually in the form of a procedure called video-assisted thoracoscopic surgery (VATS). The results from VATS-based pleural abrasion are slightly worse than those achieved using thoracotomy, but produce smaller scars in the skin. Compared to open thoracotomy, VATS offers a shorter in-hospital stays, less need for postoperative pain control, and a reduced risk of lung problems after surgery. VATS may also be used to achieve chemical pleurodesis; this involves insufflation of talc, which activates an inflammatory reaction that causes the lung to adhere to the chest wall.

If a chest tube is already in place, various agents may be instilled through the tube to achieve chemical pleurodesis, such as talc, tetracycline, minocycline or doxycycline. Results of chemical pleurodesis tend to be worse than when using surgical approaches, but talc pleurodesis has been found to have few negative long-term consequences in younger people.

Aftercare

If pneumothorax occurs in a smoker, this is considered an opportunity to emphasize the markedly increased risk of recurrence in those who continue to smoke, and the many benefits of smoking cessation. It may be advisable for someone to remain off work for up to a week after a spontaneous pneumothorax. If the person normally performs heavy manual labor, several weeks may be required. Those who have undergone pleurodesis may need two to three weeks off work to recover.

Air travel is discouraged for up to seven days after complete resolution of a pneumothorax if recurrence does not occur. Underwater diving is considered unsafe after an episode of pneumothorax unless a preventative procedure has been performed. Professional guidelines suggest that pleurectomy be performed on both lungs and that lung function tests and CT scan normalize before diving is resumed. Aircraft pilots may also require assessment for surgery.

Prevention

A preventative procedure (thoracotomy or thoracoscopy with pleurodesis) may be recommended after an episode of pneumothorax, with the intention to prevent recurrence. Evidence on the most effective treatment is still conflicting in some areas, and there is variation between treatments available in Europe and the US. Not all episodes of pneumothorax require such interventions; the decision depends largely on estimation of the risk of recurrence. These procedures are often

recommended after the occurrence of a second pneumothorax. Surgery may need to be considered if someone has experienced pneumothorax on both sides ("bilateral"), sequential episodes that involve both sides, or if an episode was associated with pregnancy.

Animals

Animals may experience both spontaneous and traumatic pneumothorax. Spontaneous pneumothorax is, as in humans, classified as primary or secondary, while traumatic pneumothorax is divided into open and closed (with or without chest wall damage). The diagnosis may be apparent to the veterinary physician because the animal exhibits difficulty breathing in, or has shallow breathing. Pneumothoraces may arise from lung lesions (such as bullae) or from trauma to the chest wall. In horses, traumatic pneumothorax may involve both hemithoraces, as the mediastinum is incomplete and there is a direct connection between the two halves of the chest. Tension pneumothorax—the presence of which may be suspected due to rapidly deteriorating heart function, absent lung sounds throughout the thorax, and a barrel-shaped chest—is treated with an incision in the animal's chest to relieve the pressure, followed by insertion of a chest tube.

7. TASKS FOR SELF-ASSESMENT OF THE TOPIC

Questions:

1. What is spontaneous pneumothorax?
2. What are patient’s complaints with spontaneous pneumothorax?
3. What is heard over the percussion at spontaneous pneumothorax?
4. What is heard over the auscultation at spontaneous pneumothorax?
5. Which types of spontaneous pneumothorax do you know?
6. What is peurodesis?
7. Which investigation is the most sensitive for detection spontaneous pneumothorax?

8. What is the treatment of spontaneous pneumothorax? 9.

9.What are the complications of spontaneous pneumothorax?

10. Which diseases can be complicated by spontaneous pneumothorax?

Tests:

1. **The method of the definition of a type of spontaneous pneumothorax.**
   A. X-ray.
   B. Clinical data.
   C. Measurement of the pressure in the pleural cavity (manometry).
   D. Computer tomography.
   E. Fibrobronchoscopy.
2. **Which of those complications are specific for TB?**
   A. Tuberculosis laryngitis.
   B. Atelectasis.
   C. Pulmonary hemorrhage.
   D. Spontaneous pneumothorax.
   E. Chronic *cor pulmonale*.
3. **An urgent care at valve spontaneous pneumothorax?**
   A. Fibrobronchoscopy.
   B. Artificial lung ventilation.
   C. Pleural cavity drainage.
   D. Respiratory gymnastic.
   E. Bed rest.
4. **Female patient Z., 29years old, was brought by the ambulance to a regional tuberculosis dispensary. She complains on cough, dyspnea, pain in the right side of the chest. Objectively: tympanic sound at the percussion, the absence of breathing above the right side of the chest. What is the most probable diagnosis?**
   A. Lung infarction.
   B. Atelectasis.
   C. Exudative pleurisy.

D. Spontaneous pneumothorax.

E. Pleuropneumonia.

5. More frequently spontaneous pneumothorax arrives in patients with pulmonary diseases:

A. At fibrobronchoscopy.

B. During pleural puncture.

C. At cavern wall rupture

D. At subpleural emphysematous bullas rupture.

E. At pneumotachometria.

6. What is the most common cause of spontaneous pneumothorax?

A. Pneumonia.

B. Congestive heart failure.

C. Malignancy.

D. Tuberculosis.

E. Bullas emphysema.

7. Which symptom is mostly specific for spontaneous pneumothorax?

A. Cough.

B. Fever.

C. Chest pain.

D. Dyspnea.

E. C. and D.

8. Which sign is mostly typical for identifying of spontaneous pneumothorax during percussion?

A. Tympanic sound.

B. Dull sound.

C. Resonant sound.

D. “Band box’”.

E. A and D.

9. Which investigation is of most value for the detection of **spontaneous pneumothorax**?

A. Ultrasound.

B. Chest X-ray.

C. Bronchoscopy.

D. Functional lung tests.

E. CT scan.

10. What is the spontaneous pneumothorax?

A. Inflammation of pleural layers

B. Gas in the pleural cavity.

C. Infection in the lung parenchyma.

D. Infection in the pleural space.

E. Fluid in the pleural cavity.

12. What is the hemothorax?

A. Accumulation of blood in the pleural cavity.

B. Accumulation of air in the pleural cavity.

C. Accumulation of urine in the pleural cavity.

D. Accumulation of transudation in the pleural cavity.

E. Accumulation of exudates in the pleural cavity.

13. The complications of diagnostic thoracentesis are all of the following, except:

A. Pneumothorax.

B. Spleen or liver puncture.

C. Heart failure.

D. Bleeding (local, intrapleural, or intra-abdominal).

E. Empyema.

8.CASE-BASED QUESTIONS

Task 1.

28-years old male known to be drug dependent complains on cough, chest pain, shortness of breath, weakness, fever - 39.9° C. He was treated at home, feeling progressively worse and finally at 4-day hospitalized. The condition is severe. Skin is pale, respiration rate - 26/min, HR - 108/min, BP - 105/80 mmHg. There is tympanic sound on percussion below the angle of the right scapula and absence of any sound in this area on auscultation. Cardiac rhythm is regular, tachycardia. What is the most likely diagnosis?

A. Pneumonia.

B. Lung gangrene.

C. Lung abscess.

D. Spontaneous pneumothorax.

Task 2.

68-years old male patient complains on cough, increased body temperature to 37.5° C, dyspnea, chest pain in the left side of the chest. There was chest trauma 5 days ago. On examination: paleness, lagging the left half of the chest during breathing. Percussion: tympanic sound over the left side of the chest. Auscultation: absence of breathing over the left side of the chest. Blood analysis revealed: leukocytosis, increased ESR. Chest X-ray: External margin of collapsed left lung is seen. Intercostal spaces present between it and external border of left lung field are “empty”. What is the clinical diagnosis?

A. Dry pleurisy.

B. Pneumonia.

S. Pleural effusion.

D. Pneumothorax.

E. Lung cancer.

9.Further reading:

Main literature:

1. Phthisiology. Textbook / Petrenko V.I., Kyiv – Medicine, 2008 - 288 p.

2. Phthisiology A teaching manual in Ukrainian and English / Pyatnochka I.T., Ternopol, - Ukrmedknyga, 2002. - 257 p.

Additional literature:

1. Clinical Tuberculosis. Manual /Crofton I., Horne N., Miller F. London, 1992. – 210 p.

2. WHO. 2008. WHO Report 2008 Global tuberculosis control - surveillance, planning, financing. WHO/HTM/TB/2008.393

3. Crofton J. Clinical Tuberculosis / J.Crofton, N. Horne, F.Miller – London.: Macmillan press LTD, 1995. - 210 p.

4. Harryes A.TB. Clinical manual for South East Asia/ A.Harryes,D. Maner, M. Uplecar – Biella: WHO, 1997 – 145 p.

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With the changes and additions:

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