Journal Homepage: -www.journalijar.com
INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)
Article DOI:10.21474/IJAR01/1585
DOI URL: http://dx.doi.org/10.21474/IJAR01/1585
ISSN NO. 2320-5407

RESEARCH ARTICLE

Pleural Effusion and Thoracocentesis.

Omar Rabee Hashim Aldahhan.
Fallujah Teaching Hospital , Department of Thoracic Surgery ,Anbar,Iraq.

Manuscript Info

Manuscript History

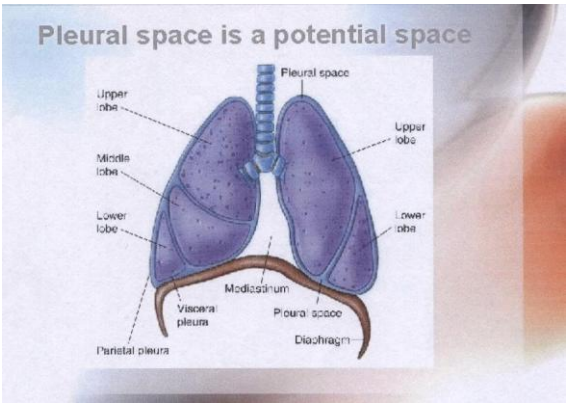
Received: 12 July 2016
Final Accepted: 19 August 2016
Published: September 2016

Key words:-pleural effusion, thoracocentesis (pleural aspiration).

Abstract

This is a prospective study of 110 patients having pleural effusion conducted in surgical specialty hospital in Iraq from January to May 2005 that shows different causes of pleural effusion .in this study we try to understand the etiology of pleural effusion depending on clinical, radiological and biochemical analysis of the pleural aspirate for better understanding and better treatments of pleural effusion according to Iraq situation.

Introduction:-



(Picture taken from internet www.intermed.com)

Anatomy of Pleural Space:-

Anatomy of Pleural Space: -

The pleural cavity is created between the 4th and 7th week of embryologic development and is lined by the splanchnopleurae and somatopleurae. These embryonic components of visceral and parietal pleurae develop different anatomic characteristics with regard to vascular, lymphatic, and nervous supply. Both pleurae have two layers: a superficial mesothelial cell layer facing the pleural space and an underlying connective tissue layer (21).

Various ultrastructures of the pleura show a close relationship to the basic functions of the pleural membranes, such as local inflammatory response and maintenance of the pleural fluid. The latter function is especially important in the mechanical coupling of the lung and chest wall. The fluid in the pleural space transmits transpleural forces involved in normal respiration, and the maintenance of the optimal volume and thickness is regulated closely. Fluid

Corresponding Author:-Omar Rabee Hashim Aldahhan. Cardiothoracic Surgeon
Address:- Fallujah Teaching Hospital , Department of Thoracic Surgery ,Anbar,Iraq.

is filtered into the pleural space according to the net hydrostaticoncotic pressure gradient. It flows downward along a vertical pressure gradient, presumably determined by hydrostatic pressure and resistance to viscous flow. There also may be a net movement of fluid from the costal pleura to the mediastinal and interlobar regions. In these areas, pleural fluid is resorbed primarily through lymphatic stomata on the parietal pleural surface (12).

Physiology of The Pleural Space: -

The pleural space is approximately 10-20mm in width and normally contains less than 50 ml of fluid. The predominate cell type in normal pleural fluid is the monocyte, and pleural fluid normally contains small numbers of lymphocytes, macrophages and mesothelial cells. Red Blood Cells RBC' s and Polymorph Nuclear Cells (PMN) can be present in very low numbers in normal conditions. Fluid is continuously produced at a low rate by transudation from the vascular space and is absorbed by lymphatics on the parietal surface.

Pleural fluid accumulates in the pleural space causing pleural effusions by a variety of mechanisms (16).

Mechanisms of Pleural fluid accumulation: -

1. Increased hydrostatic pressure, e.g. CHF (congestive heart failure).
2. Decreased oncotic pressure, e.g. Nephrotic syndrome
3. Decreased pressure in pleural space, e.g. atelectasis, after lung resection
4. Increased permeability, e.g. inflammation
5. Impaired lymphatic drainage, e.g. malignancy
6. Communication with peritoneal space and fluid, e.g. ascites (1).

Pleural Effusion: -

Pleural effusion is defined as an abnormal accumulation of fluid in the pleural space. Excess fluid results from the disruption of the equilibrium that exists across pleural membranes (27).

In terms of anatomy, the pleural space is bordered by parietal and visceral pleura. Parietal pleurae cover the inner surface of the thoracic cavity, including the mediastinum, diaphragm, and ribs. Visceral pleurae envelop all surfaces of the lungs, including the interlobar fissures. This lining is absent at the hilum, where pulmonary vessels, bronchi, and nerves enter the lung tissue. The mediastinum completely separates the right and left pleural spaces(21).

Both parietal and visceral membranes are smooth, glistening, and semitransparent. Despite these similarities, the two membranes have unique differences in anatomic architecture, innervation, pain fibers, blood supply, lymphatic drainage, and function. For example, the visceral pleurae contain no pain fibers and have a dual blood supply (bronchial and pulmonary)(21).

Pathophysiology: -

Pleural effusion is an indicator of a pathologic process that may be of primary pulmonary origin or of an origin related to another organ system or to systemic disease. It may occur in the setting of acute or chronic disease and is not a diagnosis in itself (20).

Normal pleural fluid has the following characteristics: clear ultrafiltrate of plasma, pH 7.60-7.64, protein content less than 2% (1-2 g/dL), fewer than 1000 WBCs per cubic millimeter, glucose content similar to that of plasma, lactate dehydrogenase (LDH) level less than 50% of plasma and sodium, and potassium and calcium concentration similar to that of the interstitial fluid (20).

The principal function of pleural fluid is to provide a frictionless surface between the two pleurae in response to changes in lung volume with respiration. The following mechanisms play a role in the formation of pleural effusion(11).

- Altered permeability of the pleural membranes (eg, inflammatory process, neoplastic disease, pulmonary embolus)
- Reduction in intravascular oncotic pressure (eg, hypoalbuminemia, hepatic cirrhosis)
- Increased capillary permeability or vascular disruption (eg, trauma, neoplastic disease, inflammatory process, infection, pulmonary infarction, drug hypersensitivity, uremia, pancreatitis)
- Increased capillary hydrostatic pressure in the systemic and/or pulmonary circulation (eg, congestive heart failure, superior vena caval syndrome)
- Reduction of pressure in pleural space; lung unable to expand (eg, extensive atelectasis, mesothelioma)

- ❖ Decreased lymphatic drainage or complete blockage, including thoracic duct obstruction or rupture (eg, malignancy, trauma)
- ❖ Increased fluid in peritoneal cavity, with migration across the diaphragm via the lymphatics (eg, hepatic cirrhosis, peritoneal dialysis)
- ❖ Movement of fluid from pulmonary edema across the visceral pleura
- ❖ Persistent increase in pleural fluid oncotic pressure from an existing pleural effusion, causing accumulation of further fluid
- ❖ Iatrogenic causes (eg, central line misplacement)
- ❖ In contrast, exudates are produced by a variety of inflammatory conditions and often require more extensive evaluation and treatment. The more common causes of exudates include the following (2),(1)
  - Parapneumonic
  - Malignancy (carcinoma, lymphoma, mesothelioma)
  - Pulmonary embolism
  - Collagen-vascular (rheumatoid arthritis, lupus)
  - Tuberculous
  - Asbestos-related
  - Pancreatitis
  - Trauma
  - Postcardiac injury syndrome
  - Esophageal perforation
  - Radiation pleuritis
  - Drug-induced
  - Chylothorax
  - Meigs syndrome
  - Sarcoidosis
  - **Causes:**

Transudates are ultrafiltrates of plasma in the pleura caused by a small, defined group of etiologies. The following cause transudates (10)

- Congestive heart failure
- Cirrhosis (hepatic hydrothorax)
- Atelectasis (which may be due to malignancy or pulmonary embolism)
- Hypoalbuminemia
- Nephrotic syndrome
- Peritoneal dialysis
- Myxedema
- Constrictive pericarditis

Diagnosis Of Pleural Effusion:-

(1) Symptoms: -

- ❖ Dyspnea is the most common symptom associated with pleural effusion and is related more to distortion of the diaphragm and chest wall during respiration than to hypoxemia. In many patients, drainage of pleural fluid alleviates symptoms despite limited improvement in gas exchange (3)
- ❖ Less common symptoms of pleural effusions include mild, nonproductive cough or chest pain.
- ❖ Other symptoms may suggest the etiology of the pleural effusion.
  - More severe cough or production of purulent or bloody sputum suggests an underlying pneumonia or endobronchial lesion.
  - Constant chest wall pain may reflect chest wall invasion by bronchogenic carcinoma or malignant mesothelioma.
  - Pleuritic chest pain suggests either pulmonary embolism or an inflammatory pleural process.
  - Systemic toxicity evidenced by fever, weight loss, and inanition suggests empyema .

(2) Signs:-

Physical findings, which do not usually manifest until pleural effusions exceed 300 mL, include the following:

- Decreased breath sounds

- Dullness to percussion
- Decreased tactile fremitus
- Egophony (E-to-A change)
- Pleural friction rub
- Mediastinal shift away from the effusion (observed with effusions >1000 mL): Displacement of the trachea and mediastinalshift toward the side of the effusion indicate obstruction of a lobar bronchus by an endobronchial lesion, which can be due to malignancy or, less commonly, a nonmalignant cause such as a foreign body(6).
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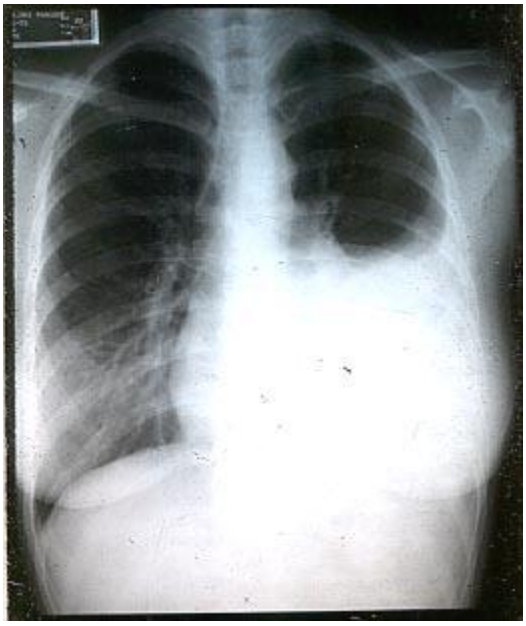
(3) imaging studies:-

- Chest radiograph



- ❖ Effusions of more than 175 mL are usually apparent as blunting of the costophrenic angle on upright posteroanterior chest radiographs(6).
- ❖ On supine chest radiographs, which are commonly used in the intensive care setting, moderate-to-large pleural effusions may appear as a homogenous increase in density over the lower lung fields on a supine chest radiograph(26).
- ❖ Apparent elevation of the hemidiaphragm, lateral displacement of the dome of the diaphragm, or increased distance between the apparent left hemidiaphragm and the gastric air bubble suggests subpulmonic effusions.
- ❖ Lateral decubitus films more reliably detect smaller pleural effusions.
- ❖ Layering of an effusion on lateral decubitus films defines a freely flowing effusion and, if the layering fluid is 1 cm thick, indicates an effusion of greater than 200 mL that is amenable to thoracentesis.
- ❖ Failure of an effusion to layer on lateral decubitus films indicates loculated pleural fluid or some other etiology causing the increased pleural density (29) .
- ❖ Chest radiographs can reveal other diagnostic clues to the cause of an effusion.
- ❖ Large unilateral effusions typically shift the mediastinum to the contralateral hemithorax. Lack of a mediastinal shift with an apparent large effusion suggests bronchial obstruction, infiltration of the lung with tumor or inflammatory cells, mesothelioma, or a fixed mediastinum from tumor or fibrosis.
- ❖ Bilateral effusions accompanied by an enlarged heart shadow are usually caused by congestive heart failure.
- ❖ Pleural plaques and calcifications usually indicate previous asbestos exposure.
- ❖ Radiographic findings of pneumonia or malignancy suggest these processes as etiologies for the associated effusion.
- ❖ Air-fluid levels in the pleural space suggest bronchopleural fistula, pneumothorax, gas-forming organisms, diaphragmatic hernia, or esophageal rupture. (26).

- Ultra sonograms help identify the safest site for performing thoracentesis or pleural biopsy and have the advantage of being obtainable at the bedside. However, a chest CT scan is preferred for drainage of empyema loculations.
- A CT scan can reveal very small effusions of 10 mL or even less. More importantly, a chest CT scan can provide detailed information about pleural and parenchymal lesions, which indicate the underlying disease causing the pleural effusion (eg, pneumonia, malignancy, hemothorax, asbestos exposure, chylothorax)(23).
- The presence of small collections of pleural gas, loculations, or pleural thickening suggests empyema.
- A finding of higher-attenuation pleural fluid densities (35-70 Hounsfield units) indicates hemothorax.
- The presence of pleural plaques with calcifications, especially on the diaphragmatic pleura, indicates asbestos-related pleural disease.
- A finding of lower-attenuation pleural fluid densities suggests chylothorax.
- Chest CT scanning is typically preferred over ultrasonography for the placement of small drainage catheters into loculated pleural collections.
- Spiral CT angiography may be useful if pulmonary embolism is suspected as the cause of the effusion.

(4)Thoracocentesis:_

Thoracocentesis is a procedure where by fluid is removed from pleural cavity.

Procedures:

Perform diagnostic thoracentesis if the etiology of the effusion is unclear or if the presumed cause of the effusion does not respond to therapy as expected(16).

- Pleural effusions do not require thoracentesis if they are too small to safely aspirate or, in clinically stable patients, if their presence can be explained by underlying congestive heart failure (especially bilateral effusions) or by recent thoracic or abdominal surgery.
- Relative contraindications to diagnostic thoracentesis include a small volume of fluid (<1 cm thickness on a lateral decubitus film), bleeding diathesis or systemic anticoagulation, mechanical ventilation, and cutaneous disease over the proposed puncture site.
- Complications of diagnostic thoracentesis include pain at the puncture site, cutaneous or internal bleeding, pneumothorax, empyema, and spleen/liver puncture.
- Pneumothorax complicates approximately 12% of thoracenteses but requires treatment with a chest tube in less than 5% of cases.
- Use of needles larger than 20 gauge increases the risk of a pneumothorax complicating the thoracentesis. In addition, significant chronic obstructive or fibrotic lung disease increases the risk of a symptomatic pneumothorax complicating the thoracentesis.
- In patients with large, freely flowing effusions and no relative contraindications to thoracentesis, diagnostic thoracentesis can usually be performed safely, with the puncture site initially chosen based on the chest radiograph and located at 1-2 rib interspaces below the level of dullness to percussion determined during the physical examination.
- Once the site is disinfected with povidone /iodine solution (Betadine) and sterile drapes are placed, confirm the correct location for thoracentesis by aspirating pleural fluid through a 22-gauge needle before introducing larger-bore thoracentesis needles or catheters. Usually, pleural fluid is obtained with the 1.5-inch, 22-gauge needle used for local anesthesia; but, for patients with larger amounts of subcutaneous tissue, a 3.5-inch, 22-gauge spinal needle with inner stylet removed can be used to find the effusion.
- When possible, patients should sit upright for thoracentesis. Patients should not lean forward because this causes pleural fluid to move to the anterior costophrenic space.
- For debilitated and ventilated patients who cannot sit upright, obtain pleural fluid by puncture over the eighth rib at the mid-to-posterior axillary line.
- Supplemental oxygen is often administered during thoracentesis, both to offset hypoxemia produced by changes in ventilation-perfusion relationships as fluid is removed and to facilitate reabsorption of pleural air if pneumothorax complicates the procedure.
- The frequency of complications from thoracentesis is lower when a more experienced clinician performs the procedure. Consequently, a skilled and experienced clinician should perform thoracentesis in patients who have a higher risk of complications or relative contraindications for thoracentesis or those who cannot sit upright.
- Postprocedure chest radiographs to exclude pneumothorax are not needed in asymptomatic patients after uncomplicated procedures(18).

Indications for use

- Analysis of fluid - The type of fluid removed from the thorax can be a valuable diagnostic aid: Milky Fluid- Probably chyle, it indicates rupture of the thoracic duct within the thorax. This condition is called chylothorax.
  Bloody- Blood removed from the thorax is a sign of crushing of the great vessels and is often a sequel to a crushing injury such as road traffic injury. This is called haemothorax.
  If air is removed from the thorax the condition is called pneumothorax. This can be due to many things, an example of which is a penetrating wound to the thorax.
- Improved radiographs - Pleural fluid can be seen on a radiograph and is common to many diseases. Analysis of the fluid allow more accurate diagnosis to be made. Since fluid is radiodense it may obscure pathological changes within the mediastinum. Removal of the fluid will hence allow better radigraphs to be made(21).

Lab study :_

- Thoracentesis should be performed for new and unexplained pleural effusions when sufficient fluid is present to allow a safe procedure. Observation of pleural effusion(s) is reasonable in the setting of overt congestive heart failure, viral pleurisy, or recent thoracic or abdominal surgery.
- Laboratory testing helps distinguish pleural fluid transudates from exudates; however, certain types of exudative pleural effusions might be suspected simply by observing the quality of the fluid obtained during thoracentesis(22).
- Frankly purulent fluid indicates an empyema.
- A putrid odor suggests an anaerobic empyema.
- A milky, opalescent fluid suggests a chylothorax, resulting most often from lymphatic obstruction by malignancy or thoracic duct injury by trauma or surgical procedures.
- Grossly bloody fluid indicates the need for a spun hematocrit test of the sample. A pleural fluid hematocrit level of more than 50% of the peripheral hematocrit level defines a hemothorax(16).
- The initial diagnostic consideration is distinguishing transudates from exudates. Although a number of chemical tests have been proposed to differentiate pleural fluid transudates from exudates, the tests first proposed by Light have become the criterion standards. The fluid is considered an exudate if the following apply:
  - Pleural fluid serum protein ratio more than 0.5
  - Pleural fluid serum lactate dehydrogenase (LDH) ratio more than 0.6
  - Pleural fluid LDH more than two thirds of normal serum value
  - These criteria require simultaneous measurement of pleural fluid and serum protein and LDH. However, a more recent meta-analysis suggests that pleural fluid measurement alone might have sensitivity and specificity comparable to Light's criteria for distinguishing transudates from exudates(27).
  - Pleural fluid LDH more than 0.45 of the upper limit of normal serum values
  - Pleural fluid cholesterol more than 45 mg/dl.
  - Pleural fluid protein more than 2.9 g/dl.
  - Pleural effusions in patients on chronic diuretic therapy for congestive heart failure may be incorrectly classified as exudates when using these criteria because of the concentration of protein and LDH within the pleural space due to diuresis. Using the criterion of a of serum minus pleural protein concentration of less than 3.1 g/dl, rather than a serum/pleural fluid ratio of greater 0.5, more correctly identifies exudates in these patients(5).
  - In addition to these tests, pleural fluid pH and glucose should be measured during the initial thoracentesis in most situations.
- Handle pleural fluid samples as carefully as arterial samples for pH measurements, with fluid collected in heparinized syringes and ideally transported on ice for measurement within 6 hours. However, recent studies have shown that when collected in heparinized syringes, pleural fluid pH does not change significantly even at room temperature over several hours. Consequently, if appropriately collected samples can be processed quickly, pH measurements should not be canceled simply because the sample was not transported on ice.
- Pleural fluid pH is highly correlated with pleural fluid glucose levels, and, for parapneumonic effusions, pleural fluid pH is more predictive of complicated effusions than is pleural fluid glucose.
- In parapneumonic effusions, pleural fluid pH less than 7.1-7.2 indicates the need for urgent drainage of the effusion, and pleural fluid pH more than 7.3 suggests that the effusion may be managed with systemic antibiotics alone.

- In malignant effusions, pleural fluid pH less than 7.3 is associated with more extensive pleural involvement, higher yield on cytology, decreased success of pleurodesis, and shorter survival times.
- A very low serum glucose concentration (<30 mg/dL) indicates rheumatoid pleurisy or empyema, and a low serum glucose concentration (30-60 mg/dL) suggests malignant effusion, tuberculouspleuritis, or lupus pleuritis.
- If an exudate is suggested clinically or is confirmed by chemistry tests, send the pleural fluid for total and differential cell counts, Gram stain, culture, and cytology(8).
  - Pleural fluid lymphocytosis, with lymphocytes greater than 85% of the total nucleated cells, suggests tuberculosis (TB), lymphoma, sarcoidosis, chronic rheumatoid pleurisy, yellow nail syndrome, or chylothorax. Pleural lymphocytes of 50-70% of the nucleated cells suggests malignancy.
  - Pleural fluid eosinophilia, with eosinophils greater than 10% of nucleated cells, is seen in hydropneumothorax, hemothorax, pulmonary infarction, benign asbestos pleural effusion, parasitic disease, fungal infection, drugs, and malignancy(4).
  - Mesothelial cells are found in variable numbers in most effusions, but their presence at more than 5% of total nucleated cells makes a diagnosis of TB unlikely.
  - Markedly increased numbers of mesothelial cells, especially in bloody or eosinophilic effusions, suggests pulmonary embolism as the cause(28).
- Culture of infected pleural fluid is positive in approximately 60% of cases, although less often for anaerobic organisms. Diagnostic yields may be increased by directly culturing pleural fluid into anaerobic blood culture bottles(14).
- Malignancy is suspected in patients with known cancer or with lymphocytic, exudative effusions, especially when bloody. Direct tumor involvement of the pleura is diagnosed most easily by performing pleural fluid cytology(15).
  - Heparinize samples of 300-500 mL of pleural fluid if bloody, and refrigerate if not processed within 1 hour.
  - The reported diagnostic yields of cytology vary from 60-90%, depending on the extent of pleural involvement and the type of primary malignancy.
  - The sensitivity of cytology is not related to the volume of pleural fluid tested; sending more than 50 mL of pleural fluid for cytology does not increase the yield.
  - Cytology findings are positive in 58% of effusions related to mesothelioma
  - Tumor markers, such as carcinoembryonic antigen, Leu-1, and mucin, are suggestive of malignant effusions (especially adenocarcinoma) when pleural fluid values are very high; however, because of low sensitivity, they are not helpful if values are normal or only modestly increased.
  - Closed-needle pleural biopsy is a bedside procedure that can diagnose 7-12% of malignant effusions when cytology findings alone would be negative(25).
  - Suspect TB pleuritis in patients with a history of exposure or a positive purified protein derivative (PPD) finding and in patients with lymphocytic exudative effusions, especially if less than 5% mesothelial cells are detected on differential cell counts(5).
- Because most tuberculous pleural effusions probably result from a hypersensitivity reaction to the mycobacterium rather than from microbial invasion of the pleura, acid-fast bacillus stains of pleural fluid are rarely diagnostic (<10% of cases), and pleural fluid cultures grow *Mycobacterium tuberculosis* in less than 65% of cases(13).
- In contrast, the combination of histology and culture of pleural tissue obtained by pleural biopsy increases the diagnostic yield to 90%.
- Adenosine deaminase (ADA) activity of more than 43 U/mL in pleural fluid supports the diagnosis of TB pleuritis. However, the test has a sensitivity of only 78%; therefore, pleural ADA values less than 43 U/mL do not exclude the diagnosis of TB pleuritis(9).
- Interferon-gamma concentrations in pleural fluid greater than 140 pg/mL also support the diagnosis of TB pleuritis, but this test is not routinely available.
- Additional specialized tests are warranted when specific etiologies are suspected.
  - Measure pleural fluid amylase if a pancreatic origin or ruptured esophagus is suspected or if a unilateral left pleural effusion remains undiagnosed after initial testing. An additional assay of amylase isoenzymes can help distinguish a pancreatic source from other etiologies.
  - Measure triglycerides and cholesterol on milky pleural fluids when chylothorax or pseudochylothorax is suspected.
  - Consider immunologic studies, including pleural fluid antinuclear antibody and rheumatoid factor, when collagen-vascular diseases are suspected.

- Despite primary evaluation with serial thoracenteses with cytology and closed-needle pleural biopsy, approximately 20% of exudative effusions remain undiagnosed.
- Clues to the diagnosis that may have been overlooked include
- (1) occupational exposure to asbestos 10-20 years earlier, which may suggest benign asbestos effusion; (2) medication exposure to nitrofurantoin, amiodarone, or medications associated with a drug-induced lupus syndrome; and (3) hepatic hydrothorax unrecognized in a patient with minimal or undetectable ascites(10).
  - The 2 diagnostic imperatives in this situation are pulmonary embolism and tuberculouspleuritis. In both cases, the pleural effusion is a harbinger of subsequent morbidity if undiagnosed. In contrast, a short delay in diagnosing metastatic malignancy to the pleural space has less clinical significance.
  - Pulmonary embolism should be considered and CT angiography should be ordered if clinical suspicion is high.
  - Studies discussed previously, including pleural biopsy, should be pursued when clinical findings suggest TB.
  - Among patients with undiagnosed pleural effusions after the primary evaluation, predict a benign course for those who meet all 6 of the following clinical parameters. No further evaluation is necessary(10).
    - Patients are clinically stable.
    - Patients do not have weight loss.
    - The results of the PPD test are negative and the pleural ADA value is less than 43 U/mL.
    - The patient does not have a fever.
    - The pleural fluid differential cell count has less than 95% lymphocytes.
    - The effusion occupies less than 50% of the hemithorax.
  - (5) For other patients with undiagnosed exudative effusions, approximately 20% will have a specific etiology determined, including malignancy. For such patients, weigh the benefits and risks of pursuing a diagnosis using progressively more invasive procedures, given the low likelihood of finding a curable etiology(2).
    - Consider bronchoscopy only if a patient has parenchymal abnormalities or hemoptysis.
    - Surgical approaches to the diagnosis of pleural effusions include thoracoscopy (pleuroscopy) and open thoracotomy, which reveal an etiology in 92% of effusions that remain undiagnosed.
    - Note that in most medical centers, surgical exploration using thoracoscopy or thoracotomy entails the risks of general anesthesia and is probably warranted only in patients who are symptomatic and anxious for a diagnosis(12).

Treatment :-

This is by treating the cause :

(1) Via therapeutic thoracentesis or tube thoracostomy:

- therapeutic thoracentesis with a catheter rather than a sharp needle. Various specially designed thoracentesis trays are available for introducing small catheters into the pleural space. Alternatively, newer systems using spring-loaded, blunt-tip needles that avoid lung puncture are also available(3).
- Monitor oxygenation closely during and after thoracentesis because arterial oxygen tension paradoxically might worsen after pleural fluid drainage. Patients should receive supplemental oxygen during the procedure.
- Only remove moderate amounts of pleural fluid to avoid reexpansion of pulmonary edema and to avoid causing a pneumothorax.
- A mediastinal position on the chest radiograph may predict whether a patient is likely to benefit from the procedure. A mediastinal shift away from the pleural effusion indicates a positive pleural pressure and compression of the underlying lung that can be relieved by thoracentesis. In contrast, a mediastinal shift towards the side of the effusion indicates lung entrapment by extensive pleural involvement or endobronchial obstruction that will prevent reexpansion of the lung when the pleural fluid is removed.
- Removal of 400-500 mL of pleural fluid might be enough to alleviate symptoms. The recommended limit is 1000-1500 mL in a single thoracentesis procedure.
- Larger amounts of pleural fluid can be removed if pleural pressure is monitored by manometry and maintained above -20 cm water.
- The onset of chest pressure or pain during the removal of fluid indicates trapped lung physiology, and the procedure should be stopped(1).

(2) Tube thoracostomy

- Although small, freely flowing parapneumonic effusions can be drained by therapeutic thoracentesis, most larger effusions and complicated parapneumonic effusions or empyemas require drainage by tube thoracostomy(2).
- Traditionally, large-bore chest tubes (20-36F) have been used to drain thick pleural fluid and to break up loculations in empyemas. However, such tubes are not always well tolerated by patients and are difficult to direct correctly into the pleural space.
- More recently, small-bore tubes (8-14F) inserted at the bedside or under radiographic guidance have been shown to provide adequate drainage, even when empyema is present. These tubes cause less discomfort and are more likely to be placed successfully within a pocket of pleural fluid. The use of 20 cm water suction and flushes of the tube with normal saline every 6-8 hours may prevent occlusion of small-bore catheters.
- Insertion of additional pleural catheters, usually under radiographic guidance, or instilling fibrinolytics (eg, streptokinase, urokinase) through the pleural catheter can help drain multiloculated pleural effusions.
  - Pleurodesis or pleural sclerosis
- Pleurodesis or pleural sclerosis is most often used for recurrent malignant effusions, such as in patients with lung cancer or metastatic breast or ovarian cancer(11).
- Given the limited life expectancy of these patients, the goal of therapy is to palliate symptoms while minimizing patient discomfort, hospital length of stay, and overall costs(13).
- Patients with poor performance status (Karnofsky score <70) and life expectancy of less than 3 months can be treated with repeated outpatient thoracentesis as needed to palliate symptoms. Unfortunately, pleural effusions can reaccumulate rapidly, and the risk of complications increases with repeated drainage. Alternatively, the best treatment for effusions in such patients may be insertion of an indwelling tunneled catheter, which allows patients to remove pleural fluid as needed at home.
  - Various agents, including talc, doxycycline, bleomycin sulfate (Blenoxane), zinc sulfate, and quinacrine hydrochloride can sclerose the pleural space and effectively prevent recurrence of the malignant pleural effusion(19).
- Talc is the most effective sclerosing agent and can be administered as slurry through chest tubes or pleural catheters. This has been shown to be as effective as direct insufflation of talc via thoracoscopy.
- Doxycycline and bleomycin are also effective in most patients and can be administered more easily through small-bore catheters, although they are somewhat less effective and substantially more expensive than talc(7).
- All sclerosing agents can produce fever, chest pain, and nausea.
- Talc rarely causes more serious adverse effects such as empyema and acute lung injury. The latter appears to be related to the particle size and amount of talc injected for pleurodesis.
- Injection of 50 mL of 1% lidocaine hydrochloride prior to instillation of the sclerosing agent might help alleviate pain. Additional analgesia might be required in some cases.
- Clamp chest tubes for approximately 2 hours after instillation of the sclerosingagent(13).
- Rotating the patient through different positions does not appear necessary to ensure distribution of soluble sclerosing agents throughout the pleural space. However, some experts still advocate rotating patients when using talc slurry for pleurodesis(31).
- Pleural sclerosis is likely to be successful only if the pleural space is drained completely before pleurodesis and if the lung is fully reexpanded to appose the visceral and parietal pleura after sclerosis. Animal studies suggest that systemic corticosteroids can reduce inflammation during sclerosis and can cause pleurodesisfailures(32).

(3) Video-assisted thoracoscopy (VATS) surgery. This requires a general anesthetic, which is given by an anesthesiologist., the thoracic surgeon inserts the thoracoscope through a small incision in your chest. The pleural fluid is removed. If necessary, pleural biopsies can be obtained(30)

A talc solution is then insufflated (blown in) over the lung and pleural surfaces. A chest tube is then inserted and connected to a collection container, which is connected to suction. The chest tube remains in place (with a dressing over it) until the fluid output to be significantly decreased(31).

(4) An additional treatment option includes having a very small drainage tube inserted by the doctor. This tube is then connected to a portable bulb collection device (called a Pleurex) and you are sent home with it for 2-3 weeks to drain the effusion. Once the fluid is drained, the lung re-expands and eventually pleurodesis occurs this way as well(32).

Once your doctor determines the drainage is adequately decreased, the chest tube is removed (after a chest x-ray is obtained and confirms there is no significant amount of fluid left in the chest). A dressing is applied over the chest tube site and should be left in place for 24-48 hours, depending on your doctor's preference. It is common to experience a fever after this procedure and you may have some pain at the chest tube site or when taking a deep breath. Pain medication will most likely be prescribed for you. You should avoid taking Ibuprofen, or any anti-inflammatory agents for a period of time specified by your doctor after this procedure to allow irritation necessary to obliterate the pleural space. Ask your doctor when you can restart anti-inflammatory agents if you normally take these. Also be aware that if you are taking pain medicine, you can become easily constipated. Increasing fiber in your diet and eating prunes (or drinking prune juice) can help prevent constipation.(24)

Patients, Methods And Results:-

This is a prospective study of 110 patients with pleural effusions admitted at Surgical Specialties Hospital from January 2005 to May 2005.

The patients in whom the comprehensive investigations needed , their course of assessment or follow up could not be traced were excluded from the study and the studied patients were followed up for a period ranged from one month to six months duration and assessed clinically and radiologically.

The history, physical examination , chest roentgenogram, complete blood picture, ESR , pleural fluid analysis , sputum examination for Acid Fast Bacilli , cytology , pleural biopsy ,bronchoscopy ,abdominal ultrasound , CT scan , surgical findings and follow up course of patients were studied.

pleural effusions were divided into two types according to their pleural fluid analysis , transudative pleural effusion (protein level < 3.0 g/dl) and an exudative pleural effusion (protein level > 3.0 g/dl) .

Total patients 110 were observed and 14 patients were found to have transudative pleural effusion (15.4%) were as 96 patients (84.6%) with exudative pleural effusion(Figure 1) .

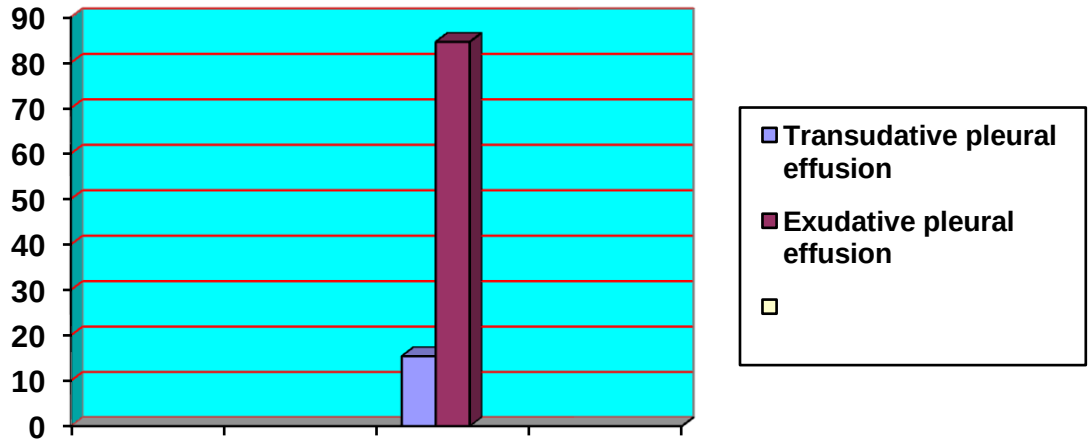


Figure No. (1):- types of pleural effusion.

Sixty two patients were males (68.2%) and 48 patients were females(31.8%) , with an age range from 3 months to 78 years , with male to female ratio 2.1:1(Figure 2).

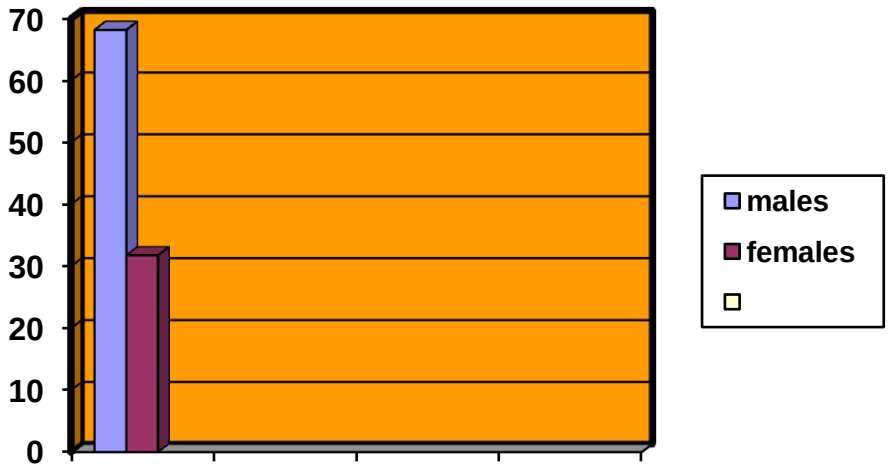


Figure No. (2):- male and female distribution .

Transudative pleural effusion were divided into four groups according to the cause of pleural effusion , cardiac , renal , hepatic ,and other rare causes (table 1).

Causes	Number of patients	Percentage
Cardiac	5	35.7
Renal	6	42.8
Hepatic	2	14.3
Other rare causes	1	7.2

Table No. (1) causes of transudative pleural effusion.

The exudative pleural effusion were divided into four groups according to the cause of effusion : malignant, tuberculous, parapneumonic and other rare causes (table 2).

Causes of pleural effusion	Number of patients	Percentage
Malignancy	44	45.5
Tuberculosis	31	32.6
Parapneumonic	12	12.4
Other	9	9.5

Table N0. (2) causes of exudative pleural effusion.

The presenting symptoms , were mainly shortness of breath, tightness of chest, cough, and other symptoms such as fever, loss of weight , haemoptesis and fatigability were related to the etiological causes of the pleural effusion (table 3).

symptoms	Malignancy		Tuberculosis		Parapneumonic		Others	
	No.	%	No.	%	No.	%	No.	%
Shortness of breath	32	73	25	81	3	25	4	44.4
Cough	26	59	29	94	10	83	5	55.6
Fever	8	18	24	77	11	92	4	44.4
Loss of weight	33	75	19	61	4	33.3	3	33.3
Haemoptesis	28	63	8	26	1	8.3	0	0
Total	44		31		12		9	

Table No. (3) presenting symptoms in patients with exudative pleural effusion.

Pleural fluid aspiration was carried out for all patients and revealed serous pleural effusion in 72 patients (69.1%), and haemorrhagic pleural effusion in 24 patients (30.9%). In haemorrhagic pleural effusion maliganancy was predominant malignant pleural effusion reported in 21 patients (88.4%) as shown in the (table 4) .

Causes	Number of patients	Percentage
Malignancy	21	88.4
Tuberculosis	1	4.2
Parapneumonic	1	4.2
Unknown reason	1	4.2
Total	24	

Table No. (4) causes of haemorrhagic pleural effusion Total No. (24)

The cytological types of malignant pleural effusions according to the definite diagnosis were illustrated in table number (5).

Causes	Number of patients	Percentage
Bronchogenic carcinoma	18	41
Breast carcinoma	7	15.9
Sarcoma	6	13.6
Lymphomas	6	13.6
Ovarian tumor	4	9.1
Adenoid cyst carcinoma of parotid gland	2	4.5
Testicular tumor	1	2.3

Table No. (5) the cytological types of malignant pleural effusion .Total No. (44).

Bronchogenic carcinoma was the leading cause of malignant pleural effusion (41%), breast carcinoma was the second cause (15.9%), four of whom had unilateral pleural effusion and the other three with bilateral pleural effusion.

Types of bronchogenic carcinoma	Serous pleural effusion		Haemorrhagic pleural effusion	
	No.	%	No.	%
Sequamous cell carcinoma	7	70	3	37.5
Adenocarcinoma	3	30	5	62.5
Total	10		8	

Table No. (6) types of effusion in bronchogenic carcinoma .

In malignant pleural effusion caused by bronchogenic carcinoma , most serous pleural effusion were mainly due to sequamous cell carcinoma (70%) while adenocarcinoma was mostly responsible for haemorrhagic effusions (62.5%) as shown in (table No. 6).

Protein	3-4 g/dl			> 4 g/dl		
	No.	%		No.	%	
	34	77.3		10	22.7	
Glucose	< 60 mg/dl			> 60 mg/dl		
	No.	%		No.	%	
	19	43.2		25	56.8	
pH	<7.2		7.2-7.3		>7.3	
	No.	%	No.	%	No.	%
	2	4.5	13	29.5	29	66
Red cells	<10000/mm3		10000-20000/mm3		>20000/mm3	
	No.	%	No.	%	No.	%
	9	20.5	25	56.8	10	22.7
Cytology	Positive finding			Negative finding		
	No.	%		No.	%	
	30	68.2		14	31.8	

Table No.(7) pleural fluid analysis in malignant pleural effusion.

Method of diagnosis	No. of patients	Positive results	
		No.	%
Cytology	44	32	72.7
Pleural biopsy	16	13	81.3
Bronchoscopy	40	28	70

Table No.(8) methods of diagnosis in malignant pleural effusion.

The most accurate diagnostic tool of malignant pleural effusions was the cytological examination. This was used in all patients. Positive results of cytological examination was obtained in (72.7%) of patients. Other procedures such pleural biopsy gave a positive results in (11.4%) of patients , and bronchoscopy in (15.9%) of patients.

Tuberculous pleural effusion is the second cause of exudative pleural effusion , it forms 32 male patients (72.7%), and 12 female patients (27.3%), with male to female ratio 2.7:1.

The presenting symptoms of tuberculous pleural effusion were fever, unproductive cough, loss of appetite and weight , shortness of breath , and haemoptysis. Haemoptysis was the presenting symptom in about (22%) of patients in this group especially those with a history of previous tuberculosis with incomplete treatment.

All patient were investigated by complete blood picture, ESR, chest x-ray, pleural fluid analysis ,glucose , pH , sputum for AFB and pleural biopsy was done for 50% of patients .

Protein	3-4 g/dl			> 4 g/dl		
	No.	%		No.	%	
	15	48.4		16	51.6	
Glucose	<60 mg/dl			>60 mg/dl		
	No.	%		No.	%	
	11	35.5		20	64.5	
pH	<7.2		7.2-.3		>7.3	
	No.	%	No.	%	No.	%
	7	22.6	15	48.4	9	29
AFB	2			6.5%		

Table No. (9) pleural fluid analysis in tuberculous pleural effusion .

The diagnosis of tuberculous pleural effusion was confirmed by different laboratory means as shon in table number 10.

Method of diagnosis	No. of samples	Positive results	
		No.	%
Sputum for AFB	31	12	38.7
Chest x-ray	31	29	93.5
Pleural biopsy	16	7	43.8
Pleural fluid for AFB	31	2	6.5

Table No. (10) pleural fluid analysis in tuberculous pleural effusion.

Parapneumonic pleural effusion is the third cause of exudative pleural effusion , it constitutes 12 patients (12.4%) 5 male patients (41.6%) and 7 females (58.4%).

Female to male ratio 1.4:1.the age group ranges from 3 months to 75 years.

They usually had history of flu like illness, productive cough ,fever, shortness of breath and chest pain were the common symptom , full investigations were carried out for most patients , chest x-ray , complete blood picture ,ESR, pleural aspiration and pleural fluid analysis with measurements of protein , glucose , pH, W.B.C. and pleural fluid culture and sensitivity.

Protein	3-4 g/dl			> 4 g/dl		
	No.	%		No.	%	
	4	33.3		8	66.7	
Glucose	<60 g/dl			>60 g/dl		
	9	75		4	25	
pH	<7.2		7.2-7.3		>7.3	
	No.	%	No.	%	No.	%
	1	8.3	8	66.7	3	25
W.B.C.	<5000/mm3		5000-10000/mm3		> 10000/mm3	
	No.	%	No.	%	No.	%
	2	16.7	6	50	4	33.3
Culture	Negative					

Table No. (11) pleural fluid analysis in parapneumonic pleural effusion.

Regarding the management of patients withparapneumonic pleural effusion, 8 patients were treated conservatively, 3 requires tube thoracostomy only, and one patient needed surgical interference for loculated pleural effusion was found .

Method of treatment	No. of patients	Percentage
Conservative treatment	8	66.7
Tube thoracostomy	3	25
Surgical treatment	1	8.3

Table No (12) Methods of management of patients with parapneumonic pleural effusions.

The other causes of exudative pleural effusion includes rheumatoid arthritis , Systemic lupus erythematosus , Ruptured hydatid cyst and unkown cause.

Causative disease	No. of patients	Percentage
Rheumatoid arthritis	2	16.7
Systemic lupus erythematosus	4	44.5
Ruptured hydatid cyst	2	16.7
Unknown cause	1	11.1

Table No. (13) The causative disease for other pleural effusion.

Pleural aspiration was carried out for a period of 24-48 hours. Massive Pleural effusion (more than 4 liters), the most leading cause was malignant Pleural effusion , tuberculosis was the second cause. The aspiration was done gradually by using clamp to control the amount of aspiration.

Cause	< 1000 ml		1000-2000 ml		2000-3000 ml		3000-4000 ml		>4000 ml	
	No.	%	No.	%	No.	%	No.	%	No.	%
Malignant pleural effusion	2	4.6	4	9.1	12	27.3	7	16	19	43
Tuberculous pleural effusion	4	12.9	10	32.3	4	12.9	6	19.4	7	22.6
Paranpneumonic pleural effusion	2	16.7	7	58.3	3	25	-	-	-	-
Others	2	22.2	2	22.2	3	33.3	1	11.1	1	11.1

Table No. (14) pleural effusion according to amount.

Discussion:-

A primary diagnostic step in the differential diagnosis of effusion is the identification of a pleural effusion as either a transudate or an exudate. If an exudative effusion is present , further diagnostic procedures are imperative such as cytopathology , pleural biopsy, and sometimes even thoracotomy, so that a definitive diagnosis can be made and specific therapy for pleural disease may be instituted.

On the other hand, if the fluid is clearly a transudate , the management will be directed to underlying cause only. The use of several chemical tests to separate transudates from exudates are recommended as a useful first step in

determining the cause of a pleural effusion. Pleural exudates are secondary to alteration of capillary permeability to lymphatic drainage.

In our study malignant pleural effusion was the commonest cause of exudative pleural effusion. This does not concide with other studies which considered parapneumonic pleural effusion are the first cause of exudative pleural effusion. These results were attributed to the fact that :(12)

Many parapneumonic pleural effusions are small and not suitable for thoracocentesisand is becoming less due to better antibiotic therapy.

Because of socio-economic and environmental changes rendering malignant pleural effusion more common and listed as the first cause of exudative pleural effusion.

After excluding traumatic pleural effusion haemorrhagic pleural effusion is mainly due to malignant disease involving the pleura. This goes with other study done by Light and associates which revealed (55%) of haemorrhagic pleural effusions were due to malignant disease. (16)
Bronchogenic carcinoma was the first cause of malignant pleural effusion. Disseminated breast cancer was the second most common cause of malignant pleural effusion , but it is the first cause of malignant pleural effusion in female patients, that was similar to other studies(15). Osteosarcoma was the third cause of malignant pleural effusion in our study, while lymphoma was the fourth in contrast with other studies lymphoma was considered the third cause of malignant pleural effusion(15).

Most of malignant pleural effusion werehaemorrhagic in appearance. The etiological cause was mainly extra thoracic tumor which metastasized from extrapulmonary origin and the second cause was intrathoracic tumor that is secondary tumor from the lung to the pleura, but still intrathoracic in origin. This was contrary to a study done by Johnson in 1985 revealed that intrathoracic tumor was the first cause of malignant pleural effusion. In our study adenocarcinoma was the main intrathoracic tumor that was considered as the first cause of haemorrhagic pleural effusion while sequamous cell carcinoma was the common cause of serous pleural effusion. This goes with results of other studies.

Breast cancer is the second leading cause of malignant pleural effusion and most of the cases had ipsilateral pleural effusion while about half of cases with bilateral pleural effusion(14).

In our study the percentage of cytologiacal examination to diagnose malignant pleural effusion was (72.7%) which is comparable to figures obtained from other studies. Pleural biopsy was positive in (81.3%) and the diagnosis depending on bronchoscopic diagnosis reaches (70%)(28).

Patients with low pleural fluid pH (below 7.3) also tend to have a lower survival rate than individuals with malignant pleural effusion and pH above 7.3, the pathogenesis of this is attributed to combination of acid production by pleural fluid or the pleura and block to the movement of carbon dioxide out of the pleural space.

Tuberculosis was the second cause of massive pleural effusion in our study. In our study Z.N. stain test was positive in two patients (6.5%).

Most other studies showed that pleural biopsy give a rang of sensitivity (55-80%) (11) and in our study we obtain a less figure equals (81.3%) positive rates. This lead us to conclude that pleural biopsy is more important than pleural aspirate for detection of tuberculous lesion. In our study protein in pleural fluid was higher than in cases of malignant pleural effusion .

Majority of cases of parapneumonic pleural effusion were treated conservatively (66.7%), while (25%) of cases were subjected to tube thoracostomy due to delay in diagnosis, and only one case (8.3%) was subjected to surgery. The pH should be used as a guide for the placement of tube thoracostomy in parapneumonic effusions, because other pleural effusions due to rheumatoid disease , malignancy, and tuberculosis may also have a low ph or a low glucose level and need not always be treated by tube thoracostomy , and this result is consistent with other studies(9).

Conclusion:-

Several strategies exist for clinicians in utilizing pleural fluid tests to classify effusions as exudates or transudates. Massive pleural effusions especially when it is haemorrhagic based on radiological findings and thoracocentesis , they are usually malignant in origin . Cytological examination of the pleural fluid is the most accurate way of diagnosis of malignant disease involving the pleura mors than other means.

pleural biopsy versus pleural fluid acid –fast-bacilli , is an important test to establish the diagnosis of tuberculous pleural effusion.

The pleural effusion with pneumonia is a common complication Early diagnosis and adequate treatment are required diagnosis is based fundamentally on the characteristic of pleural fluid. Antibiotic therapy and pleural drainage should be adequate, in most cases.

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