TABLE 20-1 CAUSES OF PLEURAL EFFUSIONS

CONDITIONS ASSOCIATED WITH TRANSUDATES	CONDITIONS ASSOCIATED WITH EXUDATES
Ascites	Asbestosis
Cirrhosis	Chylothorax
Congestive heart failure	Collagen vascular disease
Hypoalbuminemia	Complications of abdominal surgery
Intra-abdominal fluid	Dressler's syndrome (myocardial infarction, cardiotomy)
Malnutrition	Drug-induced lupus
Nephrotic syndrome	Empyema
Peritoneal dialysis	Hemothorax
	Infection
	Intra-abdominal pathologic abnormalities (abscess)
	Lymphedema
	Malignancy (primary lung cancer, lymphoma, metastatic cancer)
	Meigs' syndrome (benign ovarian tumor)
	Myxedema
	Pancreatitis
	Parapneumonic causes (pneumonia, lung abscess, bronchiectasis)
	Pulmonary embolism and infarction
	Rheumatoid arthritis (pleurisy)
	Ruptured esophagus
	Subphrenic abscess
	Systemic lupus erythematosus
	Trauma
	Uremia
	Urinothorax
	Miscellaneous sources

Modified from Light RW, Macgregor MI, Luchsinger PC, et al: Pleural effusions: the diagnostic separation of transudates and exudates, Ann Intern Med 77:507–513, 1972.

TABLE 20-2 DIFFERENTIATION OF EXUDATIVE AND TRANSUDATIVE PLEURAL EFFUSIONS

CHARACTERISTIC	EXUDATE	TRANSUDATE
Pleural fluid–to-serum protein ratio	>0.5	<0.5
Pleural fluid LDH level	> ⅔ of the upper limit of normal	< ⅔ of the upper limit of normal
Pleural fluid–to-serum LDH ratio	>0.6	<0.6

LDH, Lactate dehydrogenase.

Modified from Light RW, Macgregor MI, Luchsinger PC, et al: Pleural effusions: the diagnostic separation of transudates and exudates, Ann Intern Med 77:507–513, 1972.

universally are related to dysfunction of the left side of the heart, although they rarely can result from right heart failure (e.g., advanced pulmonary arterial hypertension).

Transudative effusions may be seen in cirrhosis, nephrotic syndrome, myxedema, pulmonary embolism, superior vena cava obstruction, and peritoneal dialysis. In patients with cirrhosis, the effusions are often right sided, and the mechanism may be related to flow from the peritoneal space across diaphragmatic defects into the pleural space (i.e., hepatic hydrothorax). Transudative effusions are typically small to moderate sized and rarely require drainage to improve symptoms.

Exudates

Exudative effusions occur when there is an alteration in vascular permeability or pleural fluid resorption. They can be observed in inflammatory, infectious, or neoplastic conditions.

To distinguish an exudate from a transudate, one of three criteria must be fulfilled: (1) An exudate must have a pleural fluid–to-serum protein ratio greater than 0.5; (2) a pleural fluid–to-serum lactate dehydrogenase (LDH) ratio must be greater than 0.6; or (3) a pleural fluid LDH level must be greater than two thirds of the upper limit of normal (Table 20-2). When all three criteria are met, the sensitivity, specificity, and positive predictive value exceed 98% for defining an exudative effusion.

Measuring pleural fluid cholesterol may also help to distinguish an exudate from a transudate. Pleural fluid cholesterol is derived from degenerating cells within the pleural space and from vascular leakage due to increased permeability. A cholesterol level greater than 45 mg/dL is consistent with an exudative effusion.

Exudative effusions are commonly caused by infection. Parapneumonic effusion typically occurs in patients with bacterial pneumonia and can be further classified as an uncomplicated or complicated effusion. Uncomplicated parapneumonic effusions do not require drainage and respond to antibiotic therapy alone used for treatment of the underlying pneumonia. In contrast, complicated parapneumonic effusions do not respond to antibiotic therapy alone and require drainage to prevent the formation of an empyema. The transition from uncomplicated to complicated can occur extremely rapidly, within a 24-hour period in some cases.

Typically, an uncomplicated parapneumonic effusion has a pH level greater than 7.3, a glucose level greater than 60 mg/dL, and an LDH level less than 1000 IU/L. A pH level of less than 7.2 usually identifies a complicated effusion. However, this finding is not specific for infection, and the cause may be malignancy, rheumatoid arthritis, or trauma with esophageal disruption causing an associated reduction in pH level.

Complicated exudative effusions require drainage to avoid development of loculation, cutaneous fistulas, bronchopleural fistulas, or fibrothorax. Pus aspirated from the pleural space or cultured or Gram-stained bacteria isolated from the fluid confirm an empyema, which requires immediate drainage. The injection of fibrolytic agents and DNase into the pleural space can augment full drainage of infected pleural effusions; however, treatment of complicated pleural effusions occasionally requires surgical intervention and lung decortication.

Pleural effusions due to primary tuberculosis may be seen in up to 30% of patients in endemic areas. The effusion is caused by increased vascular permeability of the pleural membrane because of a hypersensitivity reaction, not direct infection. Typically, the pleural fluid is lymphocyte predominant and acid-fast stain and culture negative. Adenosine deaminase levels greater than 50 U/L may be helpful in identifying tuberculous pleural effusions. Tuberculous empyema is distinct from a tuberculous pleural effusion and can occur when there is an extension of infection from the thoracic lymph nodes into the pleural space or hematogenesis spread of tuberculosis to the pleural space.

Malignant effusions are the second most common cause of exudative pleural effusions and imply a poor prognosis. Seeding of the parietal or visceral pleura with malignant cells can change vascular permeability and impede resorption, resulting in effusion formation. However, the finding of a pleural effusion in an individual with malignancy does not necessarily imply that there is a malignant process in the pleural space. Effusions in these individuals may be caused by atelectasis, postobstructive pneumonia, hypoalbuminemia, pulmonary emboli, or complications from irradiation or chemotherapy.

The most common cause of malignant effusion is lung cancer, followed by breast cancer and lymphoma. An effusion that is