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Malignant Pleural Effusion

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D.J. is a 64-year-old female with metastatic breast cancer. She initially was treated with a right modified radical mastectomy followed by adjuvant chemotherapy with an anthracycline-based regimen. Repeat multiple gated acquisition scans demonstrated a left ventricular ejection fraction of 42%, so she was switched to cyclophosphamide, methotrexate, and 5-fluorouracil (CMF). She denies any cardiac history and has remained active. She developed liver metastasis two years after completing adjuvant treatment and was placed on docetaxel, which she has tolerated well.

D.J. presents at the clinic for her fourth cycle of CMF chemotherapy complaining of fatigue, a dry cough, and mild exertional dyspnea. On physical examination, her blood pressure is 130/82, apical pulse is 114, respiratory rate is 24 breaths per minute, temperature is 98.8ºF, and arterial blood oxygen saturation on room air is 98%. A complete blood count with differential, platelets, and electrolytes is within normal limits. Her lactic dehydrogenase (LDH) level remains high but stable at 643 IU/L, and her cancer antigen 15.3 level is 25% higher than the previous measurement. Physical examination reveals absent breath sounds and dullness on percussion over the lower right half of the chest.

A chest radiograph shows a collection of fluid in the right chest. A lateral decubitus film is ordered and reveals free-flowing fluid. Coagulation studies are within normal limits, and a thoracentesis is performed. Five hundred and fifty ml of serosanguineous fluid is removed and sent for laboratory analysis. D.J.'s pleural fluid LDH is 500 mg/dl. Her ratio of pleural fluid LDH to serum LDH is 0.8, and her pleural fluid protein to serum protein ratio is 0.7. Her pleural fluid pH is 6, carcinoembryonic antigen is 15 ng/ml, and red blood cell count is 120,000.

Several days later, the culture, gram stain, and cytology of the pleural fluid are negative. D.J. is scheduled for further testing, including an echocardiogram and a computed tomography (CT) of the chest. The echocardiogram reveals no cardiac dysfunction and a left ventricular ejection fraction of 48%. The CT of the chest shows a new 0.75 cm nodule in the right lower lobe of the lung. A needle biopsy is performed, and the pathology is consistent with breast cancer.

Pathophysiology

The space between the visceral pleura (i.e., lining of the lung) and the parietal pleura (i.e., lining of the thoracic cavity) is known as the pleural space. In healthy adults, about 10–50 ml of fluid can be found in the pleural space. The fluid lubricates the pleural layers, allowing them to move smoothly over each other. Fluid enters the pleural space in several ways: from the capillaries in the parietal pleura, via the interstitial spaces of the lung in the visceral pleura, and from the peritoneal cavity through small holes in the diaphragm (Light, 2001). Fluid is removed from the pleural space by means of capillaries in the parietal pleura or lymphatics, primarily the thoracic duct. As much as a liter of fluid can move through the pleural space in a 24-hour period (Goldman, 2004).

A pleural effusion develops when either excess fluid is formed in or decreased fluid is removed from the pleural space. Nonmalignant factors associated with the development of pleural effusions include infection, drug reactions, and radiation therapy.

Malignant pleural effusions (MPEs) can be caused by direct tumor involvement of the pleural space by solid or hematologic malignancies. Other tumor-related conditions, such as superior vena cava syndrome, bronchial obstruction, or pericardial constriction, also can produce effusions by mechanical or obstructive mechanisms (Goldman, 2004; Huether & McCance, 2004; Light, 2001; Works & Maxwell, 2000).

An MPE can occur as a result of the implantation of cancer cells on the pleural surface (e.g., solid tumors), leading to increased permeability of capillaries; the obstruction of lymphatics (e.g., lymphomas or breast cancer), preventing removal of fluid; the obstruction of pulmonary vessels by a tumor (e.g., lung cancer); changes in the osmotic pressure of the pleural space because of the presence of malignant cells (e.g., lung or breast cancer); or the perforation of the thoracic duct (e.g., lymphoma) (Goldman, 2004; Huether & McCance, 2004; Muller, Fraser, Colman, & Pare, 2001). The obstruction of lymphatics is the leading cause of MPE. Pleural effusions are categorized by the characteristics of the pleural fluid (see Figure 1), with most MPEs being exudative.

Lung cancer, breast cancer, and lymphoma are associated with 75% of MPEs. Effusions occurring in lung and breast cancer generally occur on the same side of the body as the primary lesion. Bilateral effusions usually are associated with liver metastases. About 30%

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