A 52-year-old male smoker presented with a 1-week history of fever, left-sided pleuritic chest pain, and body aches. Four days later, cough with hemoptysis developed. He visited the local hospital and was suspected to have left-sided parapneumonic pleural effusion. Repeated attempts at needle aspiration yielded a small amount of pleural fluid, which was exudative with a total leukocyte count of 23,300/μL and 98% polymorphs. The procedure resulted in worsening chest pain and dyspnea. The patient was transferred to our hospital, and chest radiography demonstrated a large left-sided pneumothorax. An intercostal chest tube was inserted and relieved the pneumothorax. A chest radiograph was obtained after placement of the chest tube (Fig 1).

What is the diagnosis?

Figure 1. Chest radiograph demonstrates a left lower-zone cavitary lesion with visible contents. A chest tube, placed for pneumothorax, is also seen in the left mid-zone.
Diagnosis: Ruptured hydatid cyst of the left lower lobe. The inner membrane has been ruptured and is seen collapsed and floating on the cyst fluid (water-lily sign).

The chest radiograph at initial presentation had shown uniform opacification of left lower zone, which mimicked pleural effusion and obscured the underlying cyst (Fig 2). The history of liver surgery 12 years previously to remove two cysts was not elicited at presentation. The recent symptoms and pleural fluid analysis had suggested that the hydatid cyst had become infected. The second radiograph shows an iatrogenic pneumothorax; the cyst, being thin walled, had collapsed and was again not visible (Fig 3). Re-expansion of the lung after drainage of pneumothorax allowed the cyst to expand and become visible on chest radiograph (Fig 1). A CT scan of the chest demonstrates the cyst with ruptured membranes (Fig 4). At thoracotomy a hydatid cyst in the left lower lobe invading the left hemidiaphragm was found; left lower lobectomy with resection and repair of portion of the left hemidiaphragm was performed.

**Discussion**

Hydatid lung disease is caused by larvae of the class Cestoda, genus Echinococcus, species granulosus. *Echinococcus granulosus* is prevalent worldwide (Africa, Middle East, Latin America, Southwest United States, Southern Europe), predominantly in livestock-rearing areas.

The mature *E. granulosus* worm resides in the intestinal tract of the definitive host, which is a dog or other carnivore. It attaches itself to the mucosa by a double row of hooklets contained in its head (scolex). From its terminal segment (proglottid), numerous eggs are passed into the animal’s stool. Intermediate hosts (sheep or other ruminants) graze on the contaminated soil and so become infected. A chitinous layer surrounds the eggs; this is digested in the duodenum and the embryos are released. The embryos then enter the portal circulation through the intestinal wall and travel to visceral capillary beds where they develop into cystic metacestodes. The life cycle of *E. granulosus* is complete when carnivores ingest hydatid cysts in the viscera of ruminants. Humans may serve as intermediate hosts by ingesting eggs from contaminated food, water, or soil, or by contact with infected dogs.

The liver is the most common site of infection followed by the lung in 10 to 30% of cases, and other sites (spleen, kidney, brain, bone) in about 10% cases. In one series of 386 patients with pulmonary hydatid cysts, 59 patients (15%) had extrapulmonary cysts, of which 54 were in the liver, 4 were in the kidney, and 1 was intraperitoneal. Approximately 60% were located in the lower lobes, and a predilection for the right lung was seen in 56% cases.
The cysts are composed of three layers: the outer layer (the pericyst) is formed of inflamed fibrous tissue derived from the host; the ectocyst is an acellular, laminated, outer membrane; and the endocyst is a one-cell-thick inner germinal membrane that gives rise to brood capsules, within which larval scolices develop. Occasionally, daughter cysts may directly develop from the endocyst, resulting in multicystic structures. The endocyst can be easily separated from the pericyst due to the presence of a potential space in between. The three layers of an intact cyst are seen as a single wall on CT examination.

Most intact lung cysts are asymptomatic and incidentally discovered on routine radiologic examination; symptoms may occur due to compression of adjacent structures (mediastinal) or cyst rupture. Rupture can result in sudden cough, hemoptysis, expectoration of cyst contents (fluid and membranes), or rarely anaphylaxis. Ruptured cysts can secondarily become infected, usually with saprophytic or invasive fungi or bacteria.

Radiographically, the cysts are most commonly seen as spherical, homogenous masses with smooth borders surrounded by normal lung tissue. Occasional appearances are the presence of accompanying pleural effusion (3%), empty cyst cavities appearing as bullae (1%), and calcification (0.7%). An intact cyst is filled with clear fluid. Debris within the fluid may occasionally be seen on ultrasound; this is formed of hooklets and scolices, and is referred to as hydatid sand.

Cysts may rupture spontaneously or due to trauma. As the cyst enlarges and erodes into bronchioles, air enters the potential space between pericyst and endocyst, and appears as a thin, lucent crescent (crescent or meniscus sign). When the endocyst completely separates, it collapses internally and can be seen floating freely on the cyst fluid (“water-lily” or “iceberg” sign). Like the crescent sign, the water-lily sign, which is pathognomonic of a collapsed endocyst, is seen in only a minority of cases. Other classically described CT appearances are Cumbo sign (air-fluid level in the endocyst capped with air between the pericyst and endocyst) and “signet ring” sign (bleb of air dissecting into the wall of the cyst).

Although the diagnosis relies heavily on radiographic appearance and epidemiologic setting, serologic testing can provide indirect evidence of echinococcosis. Enzyme-linked immunosorbent assay, indirect hemagglutination or immunofluorescence assay, radioallergosorbent testing, and latex fixation are all sensitive methods but are compromised by nonspecific cross reactivity with other helminths. The results of standard serologic assays are positive, however, in only 50% of cases with lung hydatid cysts.

Lung-preserving surgical resection has remained the mainstay of therapy. Ultrasound-guided cyst puncture has been tried with some success in selected patients, although anaphylactic and allergic reactions due to spillage of cyst contents have oc-
ocurred. More recently, medical therapy using benzimidazoles for prolonged courses has been described; albendazole appears to be more effective than mebendazole. Surgical resection remains an option for large cysts with multiple daughter cysts, complicated cysts such as those infecting or compressing vital organs.

REFERENCES