

water or ingestion of food items washed with such water. Acquisition of human infection through consumption of freshly prepared raw liver containing immature flukes has been reported. Infection is initiated when metacercariae excyst, penetrate the gut wall, and travel through the peritoneal cavity to invade the liver capsule. Adult worms migrate through the liver parenchyma and finally reach bile ducts, where they produce large operculated eggs that are voided in bile through the gastrointestinal tract to the outside environment. The flukes' life cycle is completed in specific snails (the first intermediate host) followed by encystment on aquatic plants.

Clinical features of fascioliasis relate to the stage and intensity of infection. Acute disease develops during parasite migration (1–2 weeks after infection) and includes fever, right-upper-quadrant pain, hepatomegaly, and eosinophilia. Computed tomography (CT) of the liver may show multiple parenchymal holes or migratory tracks. Symptoms and signs usually subside as the parasites reach their final habitat. In individuals with chronic infection, bile duct obstruction and biliary cirrhosis are infrequently demonstrated. No relation to hepatic malignancy has been ascribed to fascioliasis.

DIAGNOSIS

Diagnosis of infection with any of the biliary flukes depends on a high degree of suspicion, elicitation of an appropriate geographic history, and stool examination for characteristically shaped parasite ova. Additional evidence may be obtained by documenting peripheral-blood eosinophilia or imaging the liver. Serologic testing is helpful, particularly in lightly infected individuals.

TREATMENT BILIARY FLUKES

Drug therapy (praziquantel or triclabendazole) is summarized in Table 259-2. Patients with anatomic lesions in the biliary tract or malignancy are managed according to general medical guidelines.

INTESTINAL FLUKES



Two species of intestinal flukes cause human infection in defined geographic areas worldwide (Table 259-1). The large *Fasciolopsis buski* (adults measure 2 × 7 cm) is endemic in Southeast Asia, whereas the smaller *Heterophyes heterophyes* is found in the Nile Delta of Egypt. Infection is initiated by ingestion of metacercariae attached to aquatic plants (*F. buski*) or encysted in freshwater or brackish-water fish (*H. heterophyes*). Flukes mature in human intestines, and eggs are passed with stools. Most individuals infected with intestinal flukes are asymptomatic. In heavy *F. buski* infection, diarrhea, abdominal pain, and malabsorption may be encountered. Heavy infection with *H. heterophyes* may be associated with abdominal pain and mucous diarrhea. The diagnosis is established by detection of characteristically shaped ova in stool samples. The drug of choice for treatment is praziquantel (Table 259-2).

LUNG FLUKES



Infection with the lung fluke *Paragonimus westermani* (Table 259-1) and related species (e.g., *P. africanus*) is endemic in many parts of the world, excluding North America and Europe. Endemicity is particularly noticeable in West Africa, Central and South America, and Asia. In nature, the reservoir hosts of *P. westermani* are wild and domestic felines. In Africa, *P. africanus* has been found in other species, such as dogs. Adult lung flukes, which are 7–12 mm in length, are found encapsulated in the lungs of infected persons. In rare circumstances, flukes are found encysted in the CNS (cerebral paragonimiasis) or the abdominal cavity. Humans acquire lung fluke infection by ingesting infective metacercariae encysted in the muscles

and viscera of crayfish and freshwater crabs. In endemic areas, these crustaceans are consumed raw, marinated, or pickled. Once the organisms reach the duodenum, they excyst, penetrate the gut wall, and travel through the peritoneal cavity, diaphragm, and pleural space to reach the lungs. Mature flukes are found in the bronchioles surrounded by cystic lesions. Parasite eggs are either expectorated with sputum or swallowed and passed to the outside environment with feces. The life cycle is completed in snails and freshwater crustaceans.

When maturing flukes lodge in lung tissues, they cause hemorrhage and necrosis, resulting in cyst formation. The adjacent lung parenchyma shows evidence of inflammatory infiltration, predominantly by eosinophils. Cysts usually measure 1–2 cm in diameter and may contain one or two worms each. With the onset of oviposition, cysts usually rupture in adjacent bronchioles—an event allowing ova to exit the human host. Older cysts develop thickened walls, which may undergo calcification. During the active phase of paragonimiasis, lung tissues surrounding parasite cysts may show evidence of pneumonia, bronchitis, bronchiectasis, and fibrosis.

Pulmonary paragonimiasis is particularly symptomatic in persons with moderate to heavy infection. Productive cough with brownish sputum or frank hemoptysis associated with peripheral-blood eosinophilia is usually the presenting feature. Chest examination may reveal signs of pleurisy. In chronic cases, bronchitis or bronchiectasis may predominate, but these conditions rarely proceed to lung abscess. Imaging of the lungs demonstrates characteristic features, including patchy densities, cavities, pleural effusion, and ring shadows. Cerebral paragonimiasis presents as either space-occupying lesions or epilepsy.

DIAGNOSIS

Pulmonary paragonimiasis is diagnosed by detection of parasite ova in sputum and/or stools. Serology is of considerable help in egg-negative cases and in cerebral paragonimiasis. The differential diagnosis includes active tuberculosis, bacterial lung abscess, and lung carcinoma.

TREATMENT LUNG FLUKES

The drug of choice for treatment is praziquantel (Table 259-2). Other medical or surgical management may be needed for pulmonary or cerebral lesions.

CONTROL AND PREVENTION OF TISSUE FLUKES



For residents of nonendemic areas who are visiting an endemic region, the only effective preventive measure is to avoid ingestion of local plants, fish, or crustaceans; if their ingestion is necessary, these items should be washed and cooked thoroughly. Instruction on water and food preparation and consumption should be included in physicians' advice to travelers (Chap. 149). Interruption of transmission among residents of endemic areas depends on avoiding ingestion of infective stages and disposing of feces and sputum appropriately to prevent hatching of eggs in the environment. These two approaches rely greatly on socioeconomic development, health education, and significant behavioral change. In countries where economic progress has resulted in financial and social improvements, transmission has decreased. The third approach to control in endemic communities entails selective use of chemotherapy for individuals posing the highest risk of transmission (i.e., those with heavy infections). The availability of praziquantel—a broad-spectrum, safe, and effective anthelmintic agent—provides a means for reducing the reservoirs of infection in human populations. However, the existence of most of these helminthic infections as zoonoses in several animal species complicates control efforts.