North American Paragonimiasis*

Case Report of a Severe Clinical Infection

Michael DeFrain, MD; and Robert Hooker, MD, FCCP

Paragonimiasis is an important cause of pulmonary disease worldwide. It results from an infection with Paragonimus, a parasite that reproduces through a complex life cycle involving snails, crustaceans, and mammals. Humans acquire the disease by ingesting uncooked freshwater crab or crayfish. Paragonimus species are distributed globally, and the disease is well known in endemic regions of Asia where culturally based methods of food preparation foster human transmission. Paragonimus also exists in regions of the United States but has been a rare cause of pulmonary disease. We report a case of a previously healthy young man who developed a dense empyema from Paragonimus kellicotti that ultimately required thoracotomy and praziquantel to eradicate his infection. (CHEST 2002; 121:1368–1372)

Key words: empyema; paragonimiasis; Paragonimus; parasitic worms; pleural; pleural effusion; praziquantel; thoracic surgery; thoracotomy

Abbreviation: EIA = enzyme immunoassay

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CASE REPORT

An 18-year-old man presented to our institution with a 1-month history of headache, fatigue, dyspnea on exertion, and weight loss. Two months prior to hospital admission, after ingesting a raw crayfish, the patient had a 3-day self-limited course of watery diarrhea. Physical examination revealed a thin male subject with obvious tachypnea. There was dullness to percussion and absent breath sounds in the lower two thirds of the chest bilaterally. There was no lymphadenopathy, and the remaining of his physical examination was normal.

A CBC demonstrated a WBC count of 8,000/µL with 25% eosinophils. The admission chest radiograph showed significant bilateral pleural effusions with an infiltrate in the left lung (Fig 1). CT confirmed the presence of the large effusions, with loculation and thickening of the pleura on the left (Fig 2). Ultrasound-guided thoracentesis on the right lung yielded 1,200 mL of serosanguinous fluid. Laboratory analysis demonstrated the fluid to be exudative: pH 7.2; lactate dehydrogenase, 4,431 IU/L; glucose, 5 mg/dL; RBC count, 5,000/µL; and WBC count, 2,900/µL. The differential of the WBC count measured 93% eosinophils. Pleural fluid Gram stain and culture findings were negative.

A left video-assisted thoracoscopic decortication was performed for the severely loculated empyema. Approximately 800 mL of fluid was removed. There was a dense thickened peel over both visceral and parietal pleural surfaces. Histologic examination of the pleura demonstrated eosinophilic pleuritis with polarizable birefringent material in the center of oval-shaped necrotizing granulomas (Fig 3). The lung parenchyma was heavily infiltrated with macrophages and eosinophils. Paragonimus infection was suspected. Blood was sent to the Centers for Disease Control and Prevention to test for Paragonimus by enzyme immunoassay (EIA). The patient was discharged home on postoperative day 4, and the chest radiograph at that time showed complete expansion of both lungs with no fluid. Interestingly, the right-sided effusion did not recur after the original thoracentesis.

Two weeks following surgery, results from the Centers for Disease Control and Prevention laboratories became available and demonstrated an IgG titer of 1:128 against Paragonimus by EIA. Based on the history of raw crayfish ingestion, the presence of operculated eggs in the operative specimen, and EIA results, the diagnosis was made and treatment with praziquantel was initiated. The patient then received praziquantel, 25 mg/kg tid for 2 days. Follow-up was scheduled to assess his response to therapy.

The patient was readmitted to the hospital exactly 1 month following decortication with mild recurrence of symptoms. A chest radiograph demonstrated a large left-sided pneumothorax with new loculated fluid collections. Tube thoracostomy failed to resolve the pneumothorax or drain the collections sufficiently. The patient underwent re-exploration of the left thoracic cavity through a posterolateral thoracotomy. Dense pleural thickening was encountered during the operation, and debridement into the lung parenchyma was necessary. Tissue analysis of the operative specimen once again yielded the presence of Paragonimus ova. One day following the second decortication, the patient was treated with another course of praziquantel, this time for 7 days.

In the initial postoperative period, the patient had a large volume air leak that eventually resolved, and discharge home was possible on postoperative day 20. At 3 months, his chest radiographic findings are normal. He remained well at 9 months, having regained his weight, and was involved in athletics.

DISCUSSION

Paragonimus is a highly adapted organism that reproduces through a complex life cycle involving snails, crustaceans, and mammals (Fig 4). Paragonimus eggs, present in soil, enter freshwater snails and are released as cercariae. Depending on the species and geographic region, the cercariae penetrate the crustacean shell of the freshwater crab or crayfish and development progresses to the metacercaria stage. The metacercaria is highly infectious and, when ingested, only a few organisms are required to establish patent mammalian infection. Once within the mammalian intestine, the metacercariae excyst, migrate through the intestinal wall to the peritoneal cavity, cross the diaphragm, and enter the pleural space. The pleura is

*From the Department of Surgery, Spectrum Health, Butterworth Campus, Grand Rapids, MI. Manuscript received April 18, 2001; revision accepted October 26, 2001. Correspondence to: Michael DeFrain, MD, Resident Physician, General Surgery, Spectrum Health, Butterworth Campus, Department of Surgery, 221 Michigan St NE, Suite 200A, Grand Rapids, MI; e-mail: mdefrain@home.com.
the most common end point of migration; however, other organs may be involved. The CNS is the most common site of extrapulmonary involvement.\(^1\) When the metacercariae reach the pleural space, they enter the lung and reside along bronchial passages. Sexual maturation occurs and culminates in the development of adult worms capable of egg production. The eggs eventually erode through the bronchial wall and lead to cough and expectoration of sputum laden with the eggs of Paragonimus.\(^1\) Alternatively, eggs may be released in the stool when the sputum is swallowed. The life cycle of the parasite is complete when the eggs are returned to the environment to repeat the process.

Paragonimus has a vast global range, and >40 species have been identified throughout Africa, Asia, the Pacific Islands, and the Americas.\(^1,2\) Ten different species of Paragonimus exist among these regions and are known to cause disease in wild and domestic animals, including dogs, cats, bear, skunk, opossum, and pigs.\(^3\) Like other mammals, human infection is acquired through the ingestion of viable metacercariae from uncooked freshwater crab or crayfish. Fortunately, metacercariae are sensitive to heat and are destroyed by usual cooking methods. Other mechanisms of transmission to humans exist and are reliant on the ingestion of viable metacercariae. There is no known route for direct human to human transmission, and infected persons pose no public threat.

Culinary preferences among people living in different regions of Asia favor the practice of eating raw or alcohol-soaked (pickled) crabs or crayfish and may partly explain the increased prevalence of paragonimiasis in these areas. US cases of paragonimiasis have been diagnosed and reported, but these have almost exclusively occurred in people previously living in parts of Asia where *Paragonimus westermani* is endemic. Only a handful of cases have been reported in US patients with no history of foreign travel or ingestion of foreign foods.\(^4,5\) These patients were infected with *P kellicotti*, a species known to exist in parts of the midwestern and eastern United States.\(^6\) Despite the existence of Paragonimus in the environment, current culinary habits in the United States do not foster ingestion of viable metacercariae and may partly explain the rarity of human disease resulting from *P kellicotti*.

Clinically, symptoms related to paragonimiasis parallel the migration and maturation of the parasite, and severity of infection correlates with worm load. Following ingestion of metacercariae, patients may complain of diarrhea or abdominal pain. Urticaria, pleuritic chest pain, thick sputum production, and hemoptysis are variably present as infection progresses. Patients rarely recall fever or lassitude, and many remain active. A thorough clinical history often reveals the handling or eating of raw freshwater crab or crayfish. Few signs are observed on physical examination, but fine rales or wheezing may be present. Sputum analysis can reveal the presence of the operculated egg of Paragonimus, necrotic pulmonary tissue, or Charcot-Leyden crystals. Chest radiographic findings are normal in 10 to 20% of infected persons. Findings in others include infiltrate, cavitation, fibrosis, effusion, or pleural thickening.\(^8\) The clinical presentation is frequently indistinguishable from pulmonary tuberculosis, and the diagnosis is often confused, leading to improper and inadequate chemotherapy.\(^9\)

Diagnosis begins with a thorough history, and can be straightforward if the possibility of paragonimiasis is entertained. Sputum laden with the operculated eggs of

![Figure 1](http://journal.publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/21976/ on 06/27/2017)
Paragonimus is the most sensitive indicator of disease. Alternatively, if the clinical history is suspicious and egg-laden sputum cannot be demonstrated, the humoral immune response to Paragonimus can be quantified through EIA. Antibody titers obtained through EIA are not only useful in diagnosis but permit an objective assessment of the response to therapy.

Praziquantel is the drug of choice for paragonimiasis and is effective treatment in > 90% of cases. Praziquantel is generally tolerated well and is administered at 25 mg/kg tid for 2 consecutive days. Treatment is recommended in all cases, regardless of symptoms, because of the possibility of cerebral paragonimiasis. Response to praziquantel can be followed by a downward trend in

Figure 2. CT of the chest demonstrating bilateral pleural effusions and left pleural thickening prior to any invasive intervention.
peripheral eosinophilia, cessation of egg passage in sputum or stool, improvement in chest radiograph, and a decreasing antibody titer to Paragonimus. Complications following chemotherapy occur rarely, but pneumothorax, pleural effusion, empyema, and persistent pulmonary infiltrate have been reported in cases related to *P. westermani*. Surgical intervention is often necessary to achieve cure when these complications develop. The critical point in treatment is accurate diagnosis and early application of appropriate chemotherapy to reduce the occurrence of complicated infections.

The case presented demonstrates a clinical extreme of paragonimiasis. Symptoms began within 1 month following the ingestion of a raw freshwater crayfish during a camping trip in northern Michigan. Hospital admission occurred 75 days after ingestion, and significant dyspnea related to restrictive lung disease had already developed. During the first hospital admission, the patient underwent thoracoscopic decortication to evacuate his left-sided effusion. This procedure yielded tissue that originally suggested paragonimiasis, but antiparasitic treatment was not initiated until 2 weeks later when EIA results became available. We presume that the delay from the time of the first surgical procedure to praziquantel administration resulted in suboptimal tissue levels of praziquantel, and incomplete clearance of *P. kellicotti*. These events may suggest a benefit for increasing the duration of praziquantel therapy from the standard 2-day course when treating infections complicated by dense pleural scarring.

Unlike previous reports of North American paragonimiasis, disease resulting from *P. kellicotti* infection can produce potentially life-threatening pulmonary disease. The diagnosis is greatly facilitated if it is initially suspected, and should be entertained in patients presenting with an appropriate clinical history who also have pulmonary complaints, sputum with atypical inclusions, unexplained peripheral eosinophilia, eosinophilic effusion, hemoptysis, or atypical pneumonia. It is especially important to consider paragonimiasis when these findings persist after administering treatment directed at the more common causes of these entities. Clinical suspicion of the disease will arise from a history of raw freshwater crab or crayfish ingestion, clinical signs, and sputum containing operculated eggs; these suspicions can be corroborated through antibody tests specific to Paragonimus. The benefits of early diagnosis and treatment are highlighted by the availability of praziquantel, an effective and often well-tolerated agent. An awareness of this disease may lead to earlier recognition, and help to avoid a potentially complicated clinical course.

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REFERENCES

7. Centers for Disease Control and Prevention. DPDx: identi-


