Severe Pleuropulmonary Paragonimiasis 8 Years after Emigration from a Region of Endemicity

Anne M. Meehan, Abinash Virk, Karen Swanson, and Eric M. Poeschla

Divisions of 1Infectious Diseases and 2Pulmonary and Critical Care and 3Molecular Medicine Program, Mayo Clinic, Rochester, Minnesota

A Laotian man who had resided only in the north-central United States for 8 years sought care for an acute, progressive syndrome of severe dyspnea, chest pain, bilateral pneumonia, lung and liver nodules, and marked peripheral blood eosinophilia. He habitually ate raw crabmeat imported pickled or frozen from Southeast Asia; he denied eating local crustaceans. Ova consistent with the lung fluke Paragonimus westermani were identified in a bronchoalveolar lavage specimen, and the eosinophilia and pulmonary symptoms resolved with praziquantel therapy.

Human infection by the lung fluke Paragonimus westermani is endemic in numerous countries in the Far East [1]. Infection results from ingestion of raw, inadequately cooked, or pickled crustaceans (crabs or crayfish), which are intermediate hosts for the organism during its transition from the cercaria to metacercarial larval stages [2]. Undercooked meat of crab-eating mammals (e.g., wild boars and rats) can also be a source of secondary (paratenic) human infection [1, 3]. The predominant clinical manifestations of symptomatic paragonimiasis are eosinophilia and chest complaints, which result from sequential migration of P. westermani metacercariae into the duodenum, within hours of ingestion, and, days to weeks later, from there to the peritoneal and pleural cavities. After traversing the visceral pleura, the larvae penetrate the lungs, where they form cysts and mature into worms.

Completion of the Paragonimus life cycle requires maturation of multiple larval stages through 2 obligate intermediate hosts (snails and crustaceans); therefore, hyperinfection, as seen with Strongyloides and Capillaria infection, does not occur. Development of pulmonary symptoms occurs at a mean of 6 months (range, 1–27 months) after ingestion [2]. In the United States, symptomatic pulmonary paragonimiasis due to P. westermani has only been reported in individuals recently arrived from regions where the parasite is endemic. Ingestion of undercooked crayfish harboring a different species, Paragonimus kellicotti, has also rarely been reported to result in paragonimiasis in the United States [4]. We report severe paragonimiasis in a Laotian man who had resided in the United States for 8 years. The patient regularly ate raw or pickled crabmeat that was commercially imported from Southeast Asia.

Case report. The patient, an 86-year-old man, had immigrated to the United States from rural Laos in 1992. He had not traveled outside the north-central United States since arrival. He was first admitted to the hospital in October 2000 with a chief complaint of 10 days of shortness of breath. He had no fever, cough, or chest pain. His medical history was significant for paroxysmal atrial fibrillation, coronary artery disease, β-thalassemia, and osteoarthritis of the knees. The patient's temperature was normal, his respiratory rate was 20 breaths/min, his blood pressure was 150/80 mm Hg, and his pulse was 80 beats/min. Bilateral lung rales and cutaneous leg nodules were noted. His total WBC count was 12.6 × 10⁶ cells/L, with 12% eosinophilia (1.5 × 10⁶ eosinophils/L), and the erythrocyte sedimentation rate was 98 mm/h. A chest radiograph revealed bilateral pleural thickening and cardiomegaly. A CT scan of the chest revealed a small left-apical pneumothorax, subpleural scarring in the bases of both lungs, interstitial changes in the apices consistent with fibrosis, and a 4 mm–diameter nodule in the right lower lobe. Cultures of 3 sputum samples were negative for Mycobacterium tuberculosis. Chart review showed that eosinophilia of varying degrees had been present during the preceding 5 years (table 1). The patient underwent extensive diagnostic testing, including multiple serologic tests and skin and temporal artery biopsies, results of which were all negative (table 1). Examination of a stool sample for ova and parasites was not performed at this time. The patient’s symptoms improved, and he was discharged from the hospital.

The patient was readmitted 2 months later with chief complaints of 3 days of dyspnea, pleuritic chest pain, weakness, and fatigue. Review of symptoms was notable for a 22.5-kg weight loss during the preceding 6 months. He denied fever or cough. His temperature was normal, his blood pressure was 98/64 mm Hg.
Hg, and his pulse was 84 beats/min. He had right-side chest rales. The total WBC count was 11.9 × 10^9 cells/L, with 25% eosinophilia (3.0 × 10^9 eosinophils/L), and the erythrocyte sedimentation rate was 106 mm/h. A chest radiograph revealed progression of the earlier findings, with bilateral pneumothoraces, an interstitial process in the right lower lung, and a new 2.5 cm–diameter nodule in the left apex. CT scan of chest and abdomen with use of intravenous contrast revealed bilateral pneumothoraces, an interstitial process in the right lower lung, and a new 2.5 cm–diameter mass in the left apex. (figure 1, top). As well as a 3 cm–diameter mass in the right lower lobe, a possible mass superior to the right hilum (figure 1, center), and 2 liver nodules >4.0 cm in diameter (figure 1, bottom).

The radiologic findings were felt to be consistent with metastatic malignancy. However, a tissue specimen of a liver mass was obtained with ultrasound guidance and showed acute inflammation consistent with an organizing abscess but did not reveal malignant cells. Results of Gomori–methenamine silver staining, auramine rhodamine staining, and periodic acid–Schiff staining were negative, as were cultures for bacteria, fungi, and mycobacteria.

Infectious disease and pulmonary consultations were done. The dietary history of the patient and his family revealed ongoing ingestion of a number of raw meats. These included large amounts of fish and crustaceans, as well as smaller amounts of beef, pork, and chicken, which the patient consumed regularly in a variety of Laotian dishes. His favorite dish incorporated raw freshwater crabmeat, which was imported either frozen or pickled from Southeast Asian countries. The items were purchased from local food stores in Minnesota and Wisconsin that specialize in East Asian foods. The patient denied eating fresh crab or other meats shipped by air to him directly by relatives or contacts in regions where paragonimiasis is endemic, and he denied eating local crustaceans.

Paragonimiasis was suspected because of the eosinophilia, chest findings, and dietary history. A bronchoscopy was performed, and examination of a sample of bronchoalveolar lavage fluid demonstrated Paragonimus ova (figure 2). The ova were asymmetrical and operculated at the broader end and had a thickened abopercular end; these findings were consistent with P. westermani infection. An interesting alternative diagnosis was P. kellicotti infection; although ova of this organism tend to be more broadly ovoid, definitive discrimination from P. westermani by morphology alone is difficult [4, 5]. Similarly, egg size discriminates P. westermani from the smaller Paragonimus africanus and Paragonimus mexicanus, but not from P. kellicotti [4, 5]. Examination of a second stool sample did not reveal evidence of other helminthic infections.

A survey of local Asian food stores in the Minnesota community where the patient resided identified vendors who imported frozen and pickled freshwater crabmeat from Vietnam and Laos. Ground and filtered extracts of imported crab meat purchased from one store that was frequented by the patient were examined, as described elsewhere [6], and found to contain encysted metacercariae. The viability of the organisms was not determined by feeding the crab to animals. Taken together with the patient’s history of exclusive consumption of imported crustaceans, the findings led us to make a diagnosis of paragonimiasis, probably due to P. westermani.

The patient was treated with praziquantel (1500 mg t.i.d. for 2 days). Ten days later, his eosinophil count became normal (0.18 × 10^9 eosinophils/L). However, there was a peak of severe eosinophilia in the first week after treatment (12 × 10^9 eosinophils/L; table 1), which may have reflected a response to an-

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Table 1. Laboratory data for an 86-year-old man, originally from Laos, who was infected with Paragonimus westermani and who received treatment with praziquantel.

<table>
<thead>
<tr>
<th>Laboratory value</th>
<th>Time relative to initiation of drug treatment (on day 0), days</th>
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<tbody>
<tr>
<td></td>
<td>−1460</td>
</tr>
<tr>
<td>WBCs × 10^9/L</td>
<td>9.4</td>
</tr>
<tr>
<td>Eosinophils</td>
<td></td>
</tr>
<tr>
<td>Absolute count, cells × 10^9/L</td>
<td>0.8</td>
</tr>
<tr>
<td>Percentagea</td>
<td>13</td>
</tr>
</tbody>
</table>

NOTE. Selected laboratory tests that were performed before the diagnosis of paragonimiasis was made had results that were normal or nondiagnostic. They were as follows: skin biopsy; temporal artery biopsy; liver biopsy; synovial fluid aspiration and culture; 4 blood cultures; serologic testing for Coccidioides, Cryptococcus, Histoplasma, and Blastomyces; skin testing for tuberculosis; testing for antinuclear antibodies, antimitochondrial antibodies, and Epstein-Barr virus nuclear antigen; determination of the angiotensin-converting enzyme level; testing for rheumatoid factor; and serum protein electrophoresis.

a Percentages do not correlate precisely with count ratios because of variation between manual and automated counts.
tigens released by dead or dying organisms [7]. The patient was clinically stable for several weeks after treatment, and his dyspnea diminished. However, he developed recurrent angina 6 weeks after treatment, and he died of an acute anterolateral myocardial infarction. Permission to perform an autopsy was refused.

**Discussion.** In the United States, symptomatic infection with *Paragonimus* species is mainly diagnosed in immigrants from Southeast Asia, where it is endemic [1, 2, 8, 9]. However, infection with these trematodes is most commonly diagnosed in the United States by means of biopsy of asymptomatic lesions that are discovered incidentally on routine chest radiography [1]. Other foci of endemic infection with *Paragonimus* species occur in West Africa and parts of Central and South America [1], and *P. kellicotti* has caused pulmonary paragonimiasis in residents of the southeastern United States who ingest raw crayfish [4]. Freshwater snails and crabs or crayfish are obligatory intermediate hosts for *Paragonimus* species. In regions of Asia where the parasites are endemic, virtually all crabs may be infected with *P. westermani*, and transmission is efficient [10].

The source and timing of the *Paragonimus* infection in this patient, as well as the organs involved and the causative species, merit discussion. He presented twice in 3 months with an acute syndrome of dyspnea, chest pain, pneumothoraces, enlarging lung and liver nodules, and progressive, severe eosinophilia (up to 57%, with an absolute peak of 12 × 10^9 eosinophils/L), all of which are consistent with recent *Paragonimus* infection. Eosinophil counts as high as 84 × 10^9 eosinophils/L have been reported in patients with acute paragonimiasis [11]. Symptoms develop an average of 6 months after ingestion of infested crab meat, although delays of up to 27 months have been reported [2].

Symptoms and signs of acute pleuropulmonary paragonimiasis result from early migration of metacercariae to the lungs [2, 12]. Within hours of ingestion, metacercariae excyst in the small intestine and penetrate the peritoneal cavity en route to the lungs, where, encapsulated in a cystlike structure, they grow to maturity in 6–8 weeks. Pleuritic chest pain and pneumothoraces are caused by the piercing of the pleura by the migrating larvae. Transient infiltrates, which are also characteristic of migrating larvae [9, 13, 14], were also noted in this patient. Radiographic manifestations have been correlated with clinical stage of disease in an animal model [12]. Early findings included pneumothorax or hydro pneumothorax, focal airspace consolidation, and linear opacities [12]. Sixty-two percent of infected cats developed pneumothoraces =3 months after infection.

In contrast, symptoms and signs of chronic infection result from the presence of encysted parasites, and they generally manifest as cough, hemoptysis (which is associated with cyst rupture), cavitation, bronchiectasis, and eosino-

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**Figure 1.** CT scans of an 86-year-old man from Laos with paragonimiasis. **Top and center,** CT scans of the chest with use of intravenous contrast showing (top) right pneumothorax and a left-lung apical nodule and infiltrate and (center) bilateral pneumothoraces and a right lower lobe nodule. **Bottom,** CT scan of the abdomen showing liver nodules.
philia at a lower level than in acute disease [2]. Although epidemiologic considerations make it certain that previous P. westermani infection occurred in this patient in Laos, the recurrent pneumothoraces, severe eosinophilia, and enlarging hepatic and pulmonary nodules are most consistent with the stage of larval migration. The helminth burden causing the acute pleuropulmonary syndrome probably resulted from ongoing infection due to the patient’s ingestion of raw or pickled crab meat in the 8 years since his immigration to the United States from Laos.

The development of hepatic lesions, as was observed in our patient, has been well documented both in infected humans and in animal models of this disease and is due to aberrant worm migration, which leads to hemorrhage and frank abscesses and may appear to be metastatic malignancy on radiologic examination [2, 6, 15]. The absence of fever, which has been present only in a minority of patients in published series, is also consistent with the diagnosis [2].

If the dietary history is not reliable and the patient has consumed North American freshwater crustaceans, as well as crustaceans from areas of endemicity, infection may have also occurred with P. kellicotti, the ova of which can resemble P. westermani ova [4, 5]. Although, in this case, the presence of viable organisms in crab meat was not confirmed by feeding the meat to a susceptible animal, ova of other trematodes have survived freezing [16], and brining and pickling reduce the hazard of Paragonimus infection but do not eliminate it [17].

In summary, this patient presented with symptomatically acute, severe pulmonary paragonimiasis, which resulted from ongoing ingestion of raw crustaceans. Although P. kellicotti infection acquired from North American crayfish cannot be definitively excluded, the preponderance of the evidence supports the diagnosis of P. westermani infection, in which case the source was imported crab meat. In either case, the food habits that the patient retained from his native Laos were the key epidemiologic red flag. Health care workers caring for individuals from regions where paragonimiasis is endemic should talk to their patients about the risks associated with ingesting raw crustaceans. Obtaining a dietary history from such patients and evaluating them for common causes of eosinophilia may prevent unnecessary diagnostic testing (table 1).

References