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A 9-Year-Old Boy With a Chest Mass and Eosinophilia

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CASE PRESENTATION

A previously healthy 9-year-old boy was hospitalized after a 1-day history of a softball-sized mass over his left chest along the midaxillary line. There was no erythema, warmth, or pain associated with the mass. Four months earlier, the boy experienced painless swelling of his left hand (Figure 1) and forearm and had a firm nodule over the extensor surface of his forearm. He received 6 days of clindamycin followed by 2 weeks of azithromycin without any obvious effect on the swelling; however, the extremity swelling gradually resolved over the course of 3 months. He subsequently was evaluated by a rheumatologist; his physical examination was normal, and results of blood testing (basic metabolic panel, liver function tests, and C-reactive protein measurement) were within the reference ranges. His erythrocyte sedimentation rate was slightly elevated at 27 mm/hour, and his peripheral blood eosinophil count was elevated (absolute eosinophil count, 3.77×10^3 μL). During the 4 months preceding the chest swelling, the boy complained of fatigue and occasional night sweats. He denied fevers, weight loss, and respiratory and gastrointestinal symptoms.

He did not have any chronic medical problems and had not had any previous hospitalization or surgery. He had received all recommended immunizations.

He participated in frequent outdoor activities, including hiking, spelunking, and camping in Missouri and Arkansas. He drank well water and had frequent contact with cats and dogs.

On physical examination, he had a 4-cm lobular soft-tissue swelling several centimeters below his left axilla at the midaxillary line (Figure 2). No overlying skin changes

were noted, and the swelling was nontender to palpation. Auscultation revealed diminished breath sounds in the left lung base. The remainder of his examination was normal.

Blood testing (basic metabolic panel, liver function tests, and C-reactive protein measurement) was repeated, and the results were within the reference limits. His erythrocyte sedimentation rate was 16 mm/hour, and a complete blood count again showed an increase in his absolute eosinophil count (4.1×10^3 μL), but the results were otherwise within the reference limits. A chest ultrasound examination revealed a thick-walled septated fluid collection within the left chest. Chest computed tomography revealed small nodules in the right upper and lower lobes and a nonenhancing low-density lobular lesion along the left chest wall with suggestion of extrathoracic involvement associated with soft-tissue fullness of the superficial subcutaneous left chest tissues (Figure 3). Radiology reported that differential considerations included empyema necessitans, a rare complication of pleural space infections in which infected fluid dissects spontaneously into surrounding tissue [1, 2]. Cloudy serous fluid with 4975 nucleated cells per μL (80% eosinophils) was aspirated from the soft-tissue swelling; no organisms were seen with Gram staining of the fluid.

Differential Diagnosis

The differential diagnoses that were considered in this case included tuberculosis, actinomycosis, paragonimiasis, toxocariasis, histoplasmosis, and aspergillosis. The imaging findings consistent with empyema necessitans made tuberculosis and actinomycosis a consideration; however, the peripheral eosinophilia and eosinophil predominance in the pleural fluid were more consistent with parasitic



Figure 1. Hand swelling that occurred 4 months before presentation.

infection. The patient had exposure to dogs and cats, which made toxocariasis a consideration. After further discussion, the patient's father also reported that the patient had consumed boiled crayfish caught from a creek approximately 4 months before the development of swelling in his arm. This history also made paragonimiasis a diagnostic possibility.

Diagnostic Evaluation

Fluid aspirated from the chest swelling was reviewed for pathology, and no evidence of parasitic infection or malignancy was seen. Review of the slides by the Centers for



Figure 2. Chest swelling.

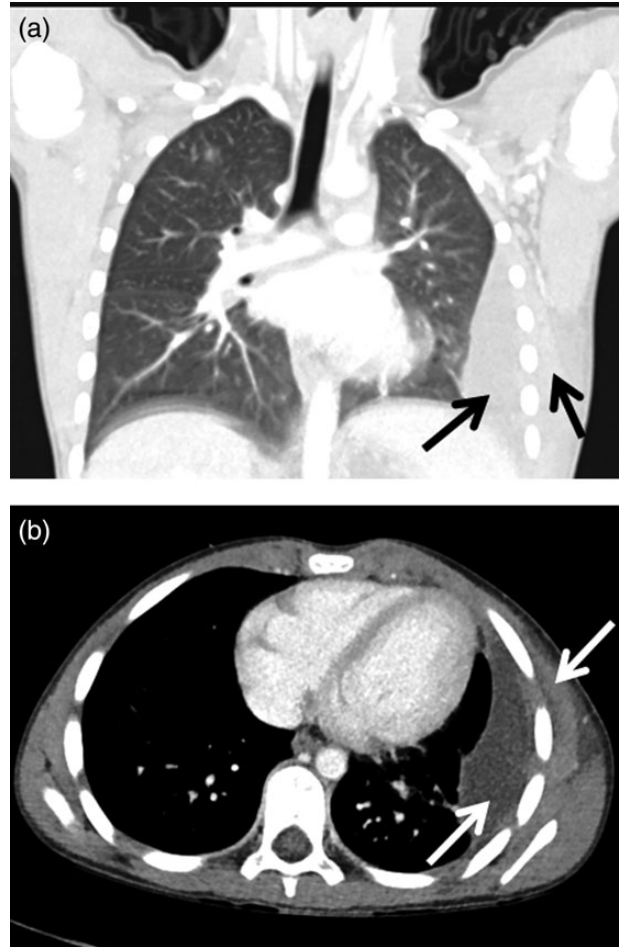


Figure 3. Coronal (a) and axial (b) computed tomography views of the chest; arrows point to pleural effusion with extrathoracic extension.

Disease Control and Prevention (CDC) confirmed the lack of observable parasites. The results of aerobic, anaerobic, fungal, and acid-fast bacillus cultures of the fluid were negative, as were the results of an interferon-gamma release assay, testing for *Histoplasma capsulatum* antibodies and urine antigen, and a *Toxocara* antibody test. The results of a *Paragonimus* antibody immunoblot assay performed by the CDC Reference Diagnostic Laboratory were positive.

DIAGNOSIS: PARAGONIMIASIS

DISCUSSION

Parasites that are associated more commonly with pleuropulmonary involvement include *Toxocara* spp., *Strongyloides* spp., *Entamoeba histolytica*, *Echinococcus* spp., and *Paragonimus* spp.. Humans can become infected by *Toxocara* by ingesting soil that contains embryonated eggs passed by infected dogs and cats. Toxocariasis is associated with visceral larva migrans, which can include

pulmonary symptoms such as cough, wheezing, and eosinophilic pneumonia [3]. *Strongyloides* infection can also result in symptoms such as cough, wheeze, eosinophilic pneumonia, and eosinophilic pleural effusions. *Strongyloides* infection is endemic in the tropics and subtropics, but transmission in the United States has been reported in rural Appalachian regions and southeastern states [3–6]. Amebic liver abscesses caused by *Entamoeba histolytica* can be associated with pleuropulmonary complications. The pleural involvement seen with amebiasis is typically right sided because of direct hepatic extension [7]. Cystic echinococcosis, or hydatidosis, is the most common variant of echinococcosis. It is common in Mediterranean countries, the Middle East, South America, and Australia; however, local transmission has been reported in some parts of the United States [7, 8]. The lung is the second most common organ (after the liver) involved in hydatidosis. Pleural thickening, eosinophilic pleural effusions, and pneumothoraces can occur with hydatidosis [7].

Paragonimiasis is caused by *Paragonimus* trematodes, also known as lung flukes. Human disease typically occurs after the consumption of raw or undercooked crustaceans, which harbor infective metacercariae [9]. Metacercariae excyst in the human small intestine and release larvae. These larvae penetrate into the peritoneal cavity and then migrate through the diaphragm to the lungs where they encapsulate and mature. Human infection was also found in a patient in Japan after consumption of raw boar [10]. Metacercariae are killed if the crustacean host, or other paratenic host, is cooked thoroughly.

Paragonimus westermani is the most widely distributed species, with areas of endemicity ranging from Japan throughout southeast Asia to India. The only species with known endemicity in North America is *Paragonimus kellicotti*, which is distributed throughout the Midwest region of the United States [10, 11]. Human infection with *Paragonimus* is rare in the United States, but multiple cases have occurred, including 9 cases in Missouri between 2006 and 2010 [9]. Consumption of uncooked or undercooked crayfish from rivers in Missouri before the diagnosis of paragonimiasis was documented in each of the 9 cases.

Fever, abdominal pain, and diarrhea are early manifestations of paragonimiasis; however, early infection can be asymptomatic [11]. Eosinophilia is a common laboratory finding. The late stage of infection typically involves pulmonary symptoms, including cough, dyspnea, chest pain, and hemoptysis. Chest radiograph findings associated with paragonimiasis include cysts, infiltrates, cavitory lesions, nodules, pleural thickening and effusions, and pneumothoraces. Cysts are usually found in small groups and have a smooth inner margin and thin wall with a ring

shadow appearance on radiographs [12]. Aberrant migration of flukes to other organs can occur, and the brain is the most common site of such migration. Cerebral paragonimiasis can result in eosinophilic meningoencephalitis or a space-occupying lesion [10]. Migratory skin nodules have also been reported with *P kellicotti* infection [11]. We suspected that the forearm nodule and arm swelling in our patient were manifestations of ectopic paragonimiasis.

A definitive diagnosis of paragonimiasis is made by microscopic visualization of *Paragonimus* eggs or parasites in tissue or bodily fluids, but eggs are usually not present until 2 to 3 months after infection [9]. An examination of multiple stool and sputum specimens can increase sensitivity [10]. A serologic antibody immunoblot assay, available through the CDC, targets antibodies directed against *P westermani* antigens. This testing might be less sensitive for the early detection of infection caused by *P kellicotti*, but a positive test result is helpful in confirming the diagnosis of paragonimiasis [9]. Praziquantel is the treatment of choice for paragonimiasis and is associated with high cure rates [10].

CLINICAL COURSE

The patient underwent treatment with praziquantel. He was seen for outpatient follow-up 2 weeks after treatment, at which point his chest swelling was improved, the pleural effusion appeared nearly resolved on a chest radiograph, and his peripheral blood eosinophilia was improved. He was seen again 1 month after treatment, and his chest swelling had resolved completely.

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Potential conflicts of interest. All authors: No reported conflicts.

All authors have submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest. Conflicts that the editors consider relevant to the content of the manuscript have been disclosed.

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