Case Report: Human Pulmonary Infection by the Zoonotic Metastrongylus salmi Nematode. 
The First Reported Case in the Americas

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Abstract. Pulmonary metastrongylosis, a zoonotic disease found primarily in pigs, is caused by eight different species of the cosmopolitan nematode Metastrongylus genus. To date, only four human cases have been reported, all from Europe. Herein, a severe case of pulmonary infection caused by Metastrongylus salmi in an Ecuadorian man, with successful treatment with ivermectin, is described.

INTRODUCTION

Metastrongylus species (lungworms) are parasitic nematodes of the respiratory tract, where both domestic and wild pigs, and pecaris are found with highly prevalent infections.1–4 Human infections rarely occur, with only four cases to date described in the literature. These human cases, reported from Europe in the years of 1845, 1855, 1888, and 1956, were caused by Metastrongylus elongatus.1,5 The clinical symptoms of human infection are unknown, as they were not described in the previous reported cases. In pigs, an infection produces pneumonitis and bronchitis, which may be fatal in young animals, and dead worms may produce whitish nodular patches in the lungs.1 An infection is acquired either by the ingestion of the infective third-stage larvae (L3) found in earthworms or after they accidentally escape from these annelids.1 The Metastrongylus genus, comprising eight different species: Metastrongylus apri or M. elongatus, Metastrongylus salmi, Metastrongylus pudendotectus, Metastrongylus confusus, Metastrongylus asymmetricus, Metastrongylus madagascariensis, Metastrongylus pulmonalis, and Metastrongylus tschaukii, are distributed worldwide.6,7 They usually present as mixed infections as reported in Florida, where feral swine were infected with M. apri, M. salmi, and M. pudendotectus with a prevalence of 94%, 76%, and 64%, respectively.8 In Ecuador, M. salmi has been reported infecting Tayassu pecari from the Amazon region.8 It was also found in domestic pigs from the province of Pichincha in the Andes region,8 as well as from the province of El Oro in the Pacific Coast region.9,10 For the treatment of pigs infected by Metastrongylus spp., the following drugs are recommended: ivermectin, doramectin, moxidectin, fenbendazole, or levamisole.11

Reported here is the first human case of pulmonary metastrongylosis in Ecuador and the Americas, diagnosed by direct and microscopic observation of adult worms and eggs in bloody sputum, identified as M. salmi, and its response to ivermectin treatment.

CASE REPORT

A 63-year-old male, a resident of Puyo-Pastaza Province in the Amazon region, was admitted to the SOLCA hospital in Quito, where a year ago he was diagnosed with intestinal Hodgkin’s lymphoma (Burkitt’s lymphoma) and received chemotherapy. Having been recently diagnosed with recurrent lymphoma because of the thickening of bowel loops shown in computed tomography (CT) scan, he was transferred from the Shell Hospital, arriving with fever and diarrhea. On hospital admission, he was febrile (38.4°C), malnourished, with oral herpes, but with no palpable lymphadenopathy. Pulmonary and cardiac auscultation were normal. Standard chest X-ray was reported as being normal. Edema of the lower limbs was present. He was experiencing six bowel movements daily with the stool characterized as liquid, abundant, and greenish in color. During this period, he received antibiotics (metronidazole and ciprofloxacin), upon which the fever and diarrhea subsided. The laboratory results showed a leukocyte count of 11,600/μL with 87% neutrophils and 13% lymphocytes, 180,000 platelets/μL, a hemoglobin of 13.6 g/L, a hematocrit value of 45.9%, and an erythrocyte sedimentation rate of 24/60. Stool examination was negative for pathogenic parasites. Screening for human immunodeficiency virus antigen and hepatitis B (by HbS antigen) were both negative.

Six days after admission, the patient developed a productive cough with a bloody thick sputum, fatigue, chest pain, and progressive dyspnea. Sputum samples were examined. Macroscopically, dozens of worms were seen; filiform in shape, brownish in color, measuring from 10 to 30 mm in length (Figure 1). Several female and male worm specimens were clarified in lactophenol solution and identified as to the genus and species by utilizing documented morphological characteristics.2,6,7 With the females, measuring from 15 to 30 mm, the caudal end was a finger-like tail, with the vulva situated just anterior to the anus, and several eggs in their uteri. For the males, measuring from 10 to 18 mm, the bursa copulatrix was relatively small with doubled dorsal rays; the spicule measured 1,940 μm long (Figure 2). Furthermore, a head of a female was processed for scanning electron microscopic observation with JSM-6380LV (JEOL, Tokyo, Japan) showing a rudimentary buccal cavity and a mouth surrounded by two lateral trilobed lips (Figure 3). Thick-shelled, hyaline eggs were also observed microscopically in the sputum, measuring 45 to 55 by 30 to 40 μm. They were all unembryonated, showing different shapes; some were round and others were spherical. On the basis of these morphological characteristics, the worms were identified as M. salmi Gedoelst 1923. Extraction of genomic DNA for molecular phylogenetic analysis was unsuccessful, probably because the specimens had been fixed in formalin. Sputum samples were also examined for pathogenic bacteria.
Paragonimus spp., Mycobacterium, and fungus but with negative results. At this time, an X-ray image showed several and bilateral bronchopneumonic shadows with bilateral pleural effusion and effacement of costophrenic and cardiophrenic angles. The shadows were mainly in basal regions and pleural effusions were confirmed by CT scan. Antihelminthic therapy was initiated with ivermectin, 400 μg/kg/day, for two consecutive days. Three days later, all pulmonary symptoms had disappeared and no worms/eggs were seen in sputum specimens. Unfortunately, 7 days later, the patient expired, after having developed septic shock with neurological complications probably due to his metastatic lymphoma and/or bacterial or mycotic nosocomial infection. The adult worms are maintained in the Centro de Biomedicina, Quito, Ecuador, for future studies.

DISCUSSION

The present case demonstrated that M. salmi can infect humans; whereas the previous cases were by M. elongatus. Also, a pulmonary infection can produce severe pulmonary distress with bilateral pleural effusion, cough with bloody dense sputum, fatigue, and progressive dyspnea. This is the first human case diagnosed in the Americas. To date, only four human cases have been published; all four from Europe. The reported cases involved a 6-year-old boy, an adult,12 and two from Romania; a pork vendor and a male adult.5,13 The first three cases were reported more than 128 years ago and the last one, about 60 years ago. Human infection seems to be very rare, probably because the source of infection is by ingestion of earthworms, the intermediate host, carrying the L3 infective larvae or by the mucus secretions of an infected earthworm.1 Another reason could be Metastrongylus adults and eggs can be misdiagnosed as other parasites, which is what initially occurred in our case, when it was diagnosed as Strongyloides stercoralis, even those nematodes have different size.

Several veterinary practitioners advocate that the Metastrongylus nematode can pose a potential risk for human infection since this genus is distributed worldwide, infecting both wild and domestic swine, with a high prevalence of infection.2–4,6,14 Other animals such as sheep, cattle, deer, and other ruminants are less commonly infected.1 In Ecuador, infection in swine has been reported from the three geographical regions. In the Amazon region, from where our patient originated, T. pecari has been shown to have a 30% infection rate with M. salmi.4 This is the same species that was identified in the patient.

There is no available information regarding drug treatment of human metastrongylosis. For Metastrongylus infection in pigs, independent of the species involved, avermectins and benzimidazoles derivatives are recommended.11 Oral ivermectin, when administered to our patient, showed to be very effective; clearing the adult parasites and eggs within 3 days of treatment.

With domestic pigs being raised extensively in periurban and more so in rural areas of developing countries, along with the vast number of wild swine population and the knowledge that most species of earthworms can serve as intermediate host, the occurrence of human cases of metastrongylosis could increase. Finally, we would like to encourage physicians and laboratory technicians to consider the importance of including pulmonary Metastrongylus spp.
infection in the differential diagnosis of patients presenting with bloody sputum. This case clearly shows how a parasitological diagnosis and species identification can be easily made by observing their different features under a light microscopy.

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