Mixed Pulmonary Infection with *Strongyloides stercoralis* and *Blastomyces dermatitidis*

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We report the first case of mixed pulmonary infection with *Strongyloides stercoralis* and *Blastomyces dermatitidis*. Histopathology from the lung biopsy showed structures consistent with *B. dermatitidis* and *S. stercoralis*. Parasitology exam from a bronchi alveolar lavage yielded an immature rhabditiform larva and female worm. Fungal cultures grew *B. dermatitidis*.

**Case Report**

The patient is a 55-year-old male rural hermit, who had worked in several outdoor jobs with no permanent residence. The patient first visited the Veterans’ hospital in Hawaii and presented with depression and a history of persistent 5 week cough. His chest X-ray demonstrated a right upper lobe mass, which was interpreted and treated on outpatient basis as community acquired pneumonia. The patient presented to the Louisville, Kentucky, Veterans Affairs Medical Center, for follow-up care due to
worsening of his respiratory condition. He was admitted for evaluation of night cough and occasional vomiting over a 5 week period. His physical examination was normal. Computed tomography of the chest showed a large, soft, tissue mass opacity in the left upper lobe of the lung and several, slightly enlarged hilar and mediastinal lymph nodes. Chest x-ray showed a 5-6 cm mass in the left upper lobe and no residual finding in the right lobe. Laboratory findings demonstrated a white blood cell count of 12.8 x 10^9/liter (neutrophils 9.3 x 10^9/liter; monocytes 1.0 x 10^9/liter; lymphocytes 2.3 x 10^9/liter; eosinophils 0.1 x 10^9/liter; and basophils 0.1 x 10^9/liter). Blood cultures and bronchoalveolar lavage (BAL) cultures were negative for bacterial pathogens. BAL fungal cultures were obtained but remained negative for 5 weeks. No stool specimens were submitted for parasitology exam. The initial parasitological exam of the BAL was negative for ova and parasites. A transbronchial biopsy of the lung lesion yielded 4, brown to white-tan, irregular tissue fragments, ranging from 0.1-0.2 cm and aggregately measuring 0.6 x 0.4 x 0.3 cm^3. The entirety was embedded in paraffin, thin-sectioned, and stained with hematoxylin-eosin, periodic acid-Schiff (PAS), Grocott-methenamine-silver (GMS), and acid-fast stain. Papanicolaou-stained concentrated smears (Thinprep©) and cell blocks were prepared from the BAL; sections from cell blocks were stained similar to the biopsy sections.

Microscopic examination of the biopsy sections revealed most of the pulmonary parenchyma to be replaced by non-necrotizing giant-cell granulomata, acute and chronic inflammatory infiltrate, and fibrosis. Some giant cells showed spherical-to-ovoid structures with thick outer membrane/capsules and one-to-few, small, internal (nuclear) particles. These structures (8-15 µm in diameter) were negative with acid-fast stain but
showed variable or weakly positive reaction with PAS and GMS stains; their features being suggestive of the dimorphic fungus *B. dermatitidis* (Fig. 1A, B) (1). Further examination revealed that some of these yeast-like structures were more consistent with the morphology of cross-sectioned *Strongyloides* (Fig. 1A, C). Some demonstrated a cuticle-like membrane with variable-to-no internal morphology, surrounded by an outer capsular material. Other structures showed extensive internal morphology with a rigid membrane that sheared during the histological sectioning (Fig. 1A, lower left star). With this presentation, the BAL fluid was re-examined for the presence of parasites. Three ml of the BAL were concentrated to 0.5 ml by centrifugation and examined by iodine wet-mount. One immature rhabditiform larva and female worm (Fig. 2) were observed. We obtained additional consultation from the Armed Forces Institute of Pathology, Bethesda, MD, and sent representative material, including photomicrographs. Their staff concurred with our observations that some structures seen were consistent with *B. dermatitidis* and that others were consistent with parasite larvae.

Fungal cultures yielded *B. dermatitidis* at 5 weeks. Cultures of *B. dermatitidis* on brain heart infusion blood agar failed to convert at 37°C to the yeast-phase. The isolate identity was confirmed as *B. dermatitidis* using AccuProbe® genetic-hybridization analysis (Gen-Probe, Inc., San Diego, CA, 92121).

The patient was initially placed on a course of ivermectin for *Strongyloides* infection while awaiting confirmation of fungal culture results. The patient was scheduled for return to clinic in two weeks, but did not return and was not located.
In this report, we have shown evidence of a mixed pulmonary infection with *S. stercoralis* and *B. dermatitidis*. Our observations presented an unusual morphology for *S. stercoralis*. The female worm and rhabditiform larva both appeared as immature stages. We propose that the unusual influences of nourishment and temperature within a granulomatous lung may have caused changes in the life cycle and morphology of this organism. Gardner et al. reported that aging of *Strongyloides ratti* females resulted in unusual morphological forms affected by temperature (3). Likewise, Shiwaku et al. reported that rhabditiform larvae of *S. stercoralis* developed predominantly to free-living females at incubation temperatures of 15-30°C and low fecal dilutions, but filariform larvae appeared mainly under extreme conditions such as high temperatures (10). The host immune response was shown to affect the developmental stages of *S. ratti*, causing a reduction in parasite size as well as reproductive relocation within the gut (11).

*Strongyloides* often occurs in mixed infections. The most common mixed infections with *Strongyloides* occur with gram-negative bacteria as they are carried by the migrating larvae from the intestine to the blood and lungs (7, 8). Others have noted that pleural space infections may be complicated by mixed infections with rare organisms (2).

The difficulty of establishing a diagnosis by histopathologic evaluation can lead to erroneous results complicated by “pseudomicrobes” (4). Images observed in histopathology and cytopathology can mimic mycotic agents, parasites, bacteria or viruses (5). Demonstrated here, open communications between the pathologist and microbiologist allowed recovery of both pathogens. Physicians' direct communications with the laboratory are essential to assure the best patient care (9). They often prompt the laboratory to examine the specimen with techniques that are more specialized for the
recovery of specific microorganisms. Failure to explore all microbiological methods for
recovery of nematodes can result in death (6).

We believe this report to be unique and important, because it describes the first
case of pulmonary infection with both \textit{S. stercoralis} and \textit{B. dermatitidis}. It is interesting
because of the recovery from the BAL of the fungus and parasite with corroborating
histopathology. This report adds to our knowledge of parasitic infections and their
clinical diagnosis mediated by concerted efforts of physicians and laboratory specialists.

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recovery of both isolates.

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FIG. 1. Histopathology of lung tissue stained by: A) GMS, showing cellular morphologies consistent with *S. stercoralis* (stars) or *B. dermatitidis* (arrows). Magnification, x 1,000. B) Hematoxylin-eosin stain, showing cellular morphologies consistent with *B. dermatitidis* (arrows). Magnification, x 500. C) PAS stain, showing cellular morphology consistent with *S. stercoralis* larva. Magnification, x 1,200.
FIG. 2. Iodine wet preparation showing *S. stercoralis* immature rhabditiform larva measuring 8 x 24 µm (lower left inset) and female worm (approximately 500 µm in length, 1-12 µm in diameter). Each bar = 20 µm.