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Ascaris lumbricoides: The Unforeseen Diagnosis

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Introduction

Infections from *Ascaris lumbricoides* have become very prevalent in lesser developed countries. These infections are believed to migrate into the United States through the border with Mexico, and immigration from other countries, through increased world travel and international adoptions (Cardenas et al., 2010). *A. lumbricoides* have been found to cause cases in the United States, one being in Westerville, Ohio (J. Leonard, personal communication, September 6, 2014). As the world has become smaller, it has become imperative that as a nation we are able to prepare for infections that are popular outside the United States. The first step in preparing for an infection popular outside the United States, is understanding its pathology, in this poster we will begin this process examining *A. lumbricoides*.

Epidemiology

According to the Centers for Disease Control (CDC, 2014), the most common human helminthic infection worldwide is *Ascaris lumbricoides*, with the highest prevalence in both the tropical and subtropical regions, as well as areas with inadequate sanitation. *A. lumbricoides* has been found to occur in rural areas in the southeastern United States (CDC, 2014). In the United States, after hookworm and whipworm, *A. lumbricoides* is the third most common helminthic infection (CDC, 2014). According to the World Health Organization (WHO, 2014) it was estimated that the prevalence of *A. lumbricoides* was 1.221 million worldwide. It was recently estimated that *A. lumbricoides* has contributed to 1.31 million disability-adjusted life years to the global burden of disease (Betson, Nejsum, Bendall, Deb, & Stothard, 2014). Although studies conducted in 1982 found soil positive for *A. lumbricoides* in the southern United States and Appalachia, current published literature does not provide enough evidence to determine the status of soil transmitted helminths in these regions of the country. The increase poverty, poor sanitation conditions have aided in making certain Appalachian areas more prone for *A. lumbricoides* (Starr & Montgomery, 2011).

Epidemiology Continued

A study completed by Staat et al. (2011), examined intestinal parasites, including *A. lumbricoides*, found that 27% of the 1,042 screened stool specimens of internationally adopted children entering the United States were positive for an intestinal parasite. Current practice by the American Academy of Pediatrics recommends only one stool specimen for exam, however the study showed that a minimum of three stool specimens should be collected and analyzed for all internationally adopted children on arrival to the United States, regardless of gastrointestinal symptoms. Additional diagnosis of intestinal parasites were made on the third stool sample collected, that were not able to be diagnosed on stool samples one and two (Staat et al., 2011).

Life Cycle

According to the CDC (2014), the life cycle of the *A. lumbricoides* begins with their eggs, which are mainly transmitted by the hand to mouth route through ingestion. Common routes of ingestion include infected soil, contaminated food and drinking water, and amongst children, fingers and toys are common reservoirs for transmission. The shell of the egg is dissolved one to two days after ingested by gastric acids and the egg will hatch into larvae initiated by the bile salts and alkaline pH in the small intestine. Larvae will then molt into the second stage by penetration to the wall of the small intestine and will enter portal circulation and the lymphatic system. The larvae will follow the venous and lymphatic system to the right side of the heart and end in the pulmonary system. From the lungs the larvae will now penetrate into the alveoli in the capillary beds. While in the alveoli the larvae will undergo an additional two cycles of molting, he larvae will travel up the trachea to the pharynx where the host will swallow and they will return to the small intestine up to this life cycle the larvae is approximately three and a half weeks old. Once in the small intestine they will undergo final maturation with the life cycle lasting one to two years and begin egg production two to three months after initial transmission (CDC, 2014).

First Phase of A. lumbricoides

During the first phase which targets the pulmonary system *A. lumbricoides* can cause multiple mechanisms such as, a hypersensitive response which causes Loeffler's syndrome, pneumonitis due to larval migration, airway reactivity and bronchospasms, and bacterial infection that is secondary to migration and associated aspiration (Kanneganti et al. 2013). Patients may present with complaints of a nonproductive cough, dyspnea, mild hemoptysis, urticaria and a fever. Rales and crackles may be heard upon auscultation of the lung fields (Butts and Henderson, 2003). A chest x-ray is one diagnostic test used to diagnosis *A. lumbricoides* by revealing rounded infiltrates with peripheral eosinophilia (Kanneganti et al. 2013). Larvae can be identified also in sputum or gastric aspirate during the pulmonary migration phase (CDC, 2014). When there is the presence of larvae that causes secondary reactivity of the airway or bronchospasms, an inhaled bronchodilator therapy is advised to help treat the patients symptoms. The patient should be treated with antihelminthic agents to prevent further infection and intestinal complications, those most commonly used are mebendazole and albendazole (Butts & Henderson, 2003).

A study was done by Bragagnoli and Silva (2013), to compare the association of *A. lumbricoides* and its relationship with asthma. The study involved 233 children diagnosed with both *A. lumbricoides* and asthma. Data was examined by recording the child's number of wheezes and their fecal material was collected and measured the amount of *A. lumbricoides* eggs. Children with a heavy parasite load (over 10,000 eggs) proved in the study to be a risk factor for more severe asthma and its symptoms (Bragagnoli and Silva, 2013).

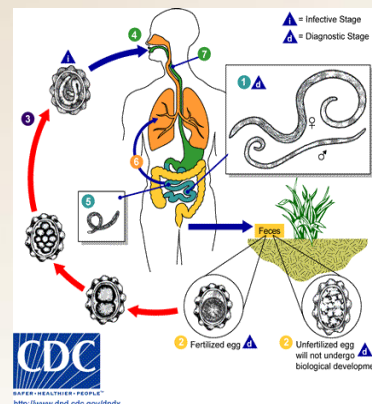


Above: Adult *A. lumbricoides*.
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Disease Course

Most cases of *A. lumbricoides* are asymptomatic with symptoms largely restricted to individuals with a high worm volume causing abdominal pain and intestinal obstruction, causing intestinal, biliary, pancreatic obstructions and malnutrition. (Kanneganti, Makker, and Remy, 2013). During the larval phase of *A. lumbricoides* when migration is occurring, pulmonary symptoms can occur, such as cough, dyspnea, hemoptysis, eosinophilic pneumonitis also known as Loeffler's syndrome. (CDC, 2014). Less common reported clinical syndromes include appendicular ascariasis, peritoneal ascariasis, suppurative cholangitis and liver abscess (Starr & Montgomery, 2011)

The lifecycle of *A. lumbricoides* can be divided into three phases of disease, which correlate directly with the lifecycle of the worm inside its host: the first phase is the pulmonary phase, second phase is the intestinal phase, and the third phase is the complication phase. (Butts and Henderson, 2013)



Above: Lifecycle of *A. lumbricoides*.
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Conclusion

Patients presenting with *A. lumbricoides* are generally asymptomatic, or can present with nonspecific constitutional, pulmonary, and gastrointestinal complaints. These complaints may represent an early disease or the onset of complications that may result from an infection due to *A. lumbricoides*. With early diagnosis and treatment this can help limit the incidence of complications and their severity to patients. Improvement in education, sanitation conditions and health services are essential in raising the standards of health and prevention of *A. lumbricoides* to those populations at risk (Gutierrez-Jimenez et al., 2012). Patients need to be educated prior to traveling to areas where *A. lumbricoides* is prevalent or coming into contact with persons who may be hosts of *A. lumbricoides* on their signs and symptoms. *A. lumbricoides* should always be kept in the differential diagnosis for someone presenting with abdominal or pulmonary symptoms that reside in inadequate living conditions, have had a recent travel history to indigenous areas or are recent immigrants. Previous infection does not confer future immunity and re-infection is common amongst those individuals who visit or reside in endemic areas. A nonspecific presentation can make a diagnosis of *A. lumbricoides* difficult to distinguish from other common illnesses that can be seen in an emergency department or clinic. A clinician's high degree of suspicion and appropriate diagnostic testing allows for rapid diagnosis and treatment. With an early diagnosis of *A. lumbricoides* patients may benefit from a decreased length of hospital stay as well as reduced complications.

Second Phase of A. lumbricoides.

The second phase is the intestinal phase, which results from the migration of *A. lumbricoides* through organs, entanglement of masses of worms and penetration of the diaphragm. Patients may present with abdominal pain, distension of the abdomen, nausea and diarrhea. The patient may notice the worms in their stool or emerging from body orifices (CDC, 2014). The presence of *A. lumbricoides* in the biliary tree can present in multiple ways, one being right upper quadrant pain that is associated with nausea and vomiting. Patients can also experience, right upper quadrant pain that is referred to the back or right shoulder that is associated with nausea, vomiting and fever and the patient guards the right upper quadrant upon palpation, symptoms similar to those of cholecystitis on exam. Patients may present with right upper quadrant pain, high grade fever and jaundice, which symptoms are similar to acute cholangitis (Butts and Henderson, 2003). Similar to the biliary obstruction, *A. lumbricoides* can also cause pancreatic obstruction or pseudocyst formation. Patients that have a pancreatic obstruction typically present with symptoms of pancreatitis, with epigastric pain radiating to the back, nausea and vomiting with tenderness noted to the epigastric area. One common way for diagnosis is a microscopic examination of a direct fecal smear can reveal eggs or ova of *A. lumbricoides* (Roberts and Kemp, 2001). Diagnosis can also be made by abdominal ultrasonography, revealing the presence of a sometimes mobile *A. lumbricoides*, CT scan and nuclear magnetic resonance imaging can also be used (Galzerano, Sabatini and Duri, 2010). *A. lumbricoides* can be identified as a curved echogenic structure with active movement on real time imaging (Riggin, Brewer, Turner, and Singh, 2012).

Patients with intestinal manifestations are usually treated with fluid and electrolyte replacement, nasogastric suction, antihelminthic drug therapy, and analgesic agents (Mwenda and Ilklu, 2013). The drug most commonly used is piperazine citrate. Piperazine citrate will paralyze *A. lumbricoides* and allows for removal by peristalsis (Butts and Henderson, 2013). In patients that have a more serious obstruction, surgical procedures may be required like extraluminal manual advancement, enterotomy, bowel resection and appendectomy (Kanneganti, et al. 2013). In patients with biliary or pancreatic *A. lumbricoides*, removal of the obstructing worm by endoscopic retrograde cholangiopancreatography, or cholecystectomy is useful in providing symptomatic relief (Butts & Henderson, 2003). The diagnosis of *A. lumbricoides* should be considered in patients who suffer from a prolonged ileus postoperatively, or other etiologies besides functional paralysis of the gastrointestinal tract.

Third phase of A. lumbricoides

The third phase is the complication phase that begins after larval migration is complete. During this phase the patient most commonly presents with malnutrition and anorexia. During this phase the larvae may migrate to the kidneys, brain, eyes, ears, heart, placenta, spleen, thoracic cavity, urethra or vagina, causing complications in these organs (Butts and Henderson, 2003).

A case study showed a 36 year old nulliparous woman who underwent a puerperal hysterectomy caused by uncontrolled postpartum hemorrhage, with no postoperative complications. The patients partial thromboplastin time 41 seconds and international normalized ratio was 1.6. One day after discharge the woman presented to the emergency room with intense abdominal pain and nausea, where she vomited a 24-cm long *A. lumbricoides*. The patient was treated with mebendazole 100mg over three days and discharged. Infestation of *A. lumbricoides* during gestation may cause hematologic disorders that have the ability to complicate pregnancy outcomes (Zapardiel, Peiretti, and Godoy-Tundidor, 2010). *A. lumbricoides* found in blood may inhibit the initiation and propagation phases of coagulation by means of trypsin and chymotrypsin inhibitors from the *A. lumbricoides* body walls and larval stages and prolonging prothrombin and partial thromboplastin times (Zapardiel et al. 2010). In the case presented it is believed that the alteration in coagulation parameters may have caused the postpartum hemorrhage that finally ended in puerperal hysterectomy (Zapardiel et al. 2010).

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