

ASCARIS LUMBRICOIDES: EPIDEMIOLOGY, DIAGNOSIS, TREATMENT, AND CONTROLKANAAN AL-TAMEEMI¹, RAIAN KABAHLI^{2*}¹Department of Microbiology, Faculty of Pharmacy, Al Andalus University for Medical Sciences, Tartous, Syria. ²Department of Basic Sciences, Faculty of Pharmacy, Al Andalus University for Medical Sciences, Tartous, Syria. Email: raiaan.youssef@gmail.com

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ABSTRACT

Although *Ascaris lumbricoides* is a common intestinal parasite of humans with worldwide distribution causing ascariasis, *Ascaris* is a neglected disease and still is a burden in developing countries. Furthermore, the parasite's permanence and prevalence present difficulties in control strategies. Therefore, more research on the mechanisms of resistance to infection is required for reducing prevalence parasite and control of infections.

Keywords: *Ascaris lumbricoides*, Ascariasis, Intestinal obstruction, The prevalence.

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INTRODUCTION

A. lumbricoides is one of the most common intestinal helminthic human parasites, infecting 1.2 billion people worldwide [1]. This is due to the fertilization ability of female worms to produce large numbers of eggs that are characterized by being highly resistant to environmental conditions, as well as to the ease of infection transmission among people due to the ingestion of eggs containing the larvae in its second stage with food and water that are contaminated with them. There is no immunity when reinfection occurs [2]. Acute *Ascaris* infections cause about 60,000 deaths per year, mainly in children due to intestinal obstruction [3]. An infection occurs to both male and female, but children are more susceptible to infection than adults, especially between the ages of 3 and 8 years [3,4]. This is mainly distributed in areas with warm, moist climates. Ascariasis is prevalent in at least 150 countries around the world. The distribution of ascariasis shows that 8.3% of cases were in South America, Central America, and the Caribbean, and 16.7% of cases were in Africa and the Middle East, and 75% of cases were in Central and Southeast Asia and the Oceanic region [5].

More advances happened over the past century in reducing the prevalence of parasitic infection in many regions, but regrettably, these infections remain part of the daily life of impoverished populations living in the tropical and subtropical regions where sanitation and hygiene are poor [6].

LIFE CYCLE AND PATHOLOGY

Transmission of *Ascaris* eggs is associated with accidental contact with soil [7] or ingestion of contaminated vegetables, greens, and fruits [3,8]. The infection may also occur in those regions where human feces are used as a fertilizer for growing vegetables [9].

Soils may contain unfertilized eggs (not infective) Fig. 1a and fertilized eggs Fig. 1b which cause the infection. Hatching of the eggs does not happen in the soil but occurs in the intestines of hosts. The eggs in the soil remain viable and capable of infection for a period of up to 10 years. They are also resistant to the usual ways of chemical water purification [9,10].

Adult worms are creamy-white organisms with a pinkish color. Male worms measure 15–31 cm in length and have posterior end curved ventrally, Fig. 2b. Female worms are larger, 20–49 cm in length, Fig. 2a. The fertilized egg contains a second-stage larva that measures 50–70×40–50 μm (infective stage).

The eggs hatch in the jejunum into larvae within a few hours of ingestion, Fig. 3. The larvae pass the intestinal mucosa and migrate through the lymphatic system into the portal vein to the liver in 2–8 days. They move through the heart to the lungs. They penetrate the capillary walls and enter the lung alveoli where they measure 564×28 μm. They stay about 10 days in the lungs when they molt twice before reaching the fourth-stage larvae and grow to 1700–2000 μm in size. Then, they get back to the trachea and the pharynx.

The larvae pass the esophagus and through the stomach to the small intestine. When they arrive at the small intestine, they molt and then become immature adults (Fig. 4). These worms develop into adult males and females in 14–20 days after mating. The female releases millions of eggs into the feces after about 70 days of ingestion of infective eggs. The shell of eggs gives the ability to resist to various environmental conditions and can remain in the soil for up to 6 years [1,3,5,10-13]. They can be carried by the wind in dry dust and contaminate new human regions, Fig. 2. In general, the eggshell consists of three basic layers [14,15]:

- Lipoidal inner layer: It regulates the temperature for larvae
- Chitinous middle layer: It protects larvae from different environmental conditions
- The outer layer of protein: It gives eggs the ability to adhere to other objects.

SYMPTOMS

The first stages of infection are asymptomatic, especially when the number of present worms in the samples is tenuous [1]. Moderate and



Fig. 1: (a) Unfertilized egg of *Ascaris lumbricoides*, (b) fertilized egg of *A. lumbricoides* [6]

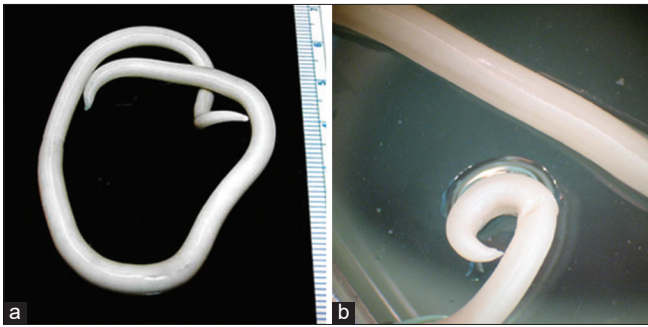


Fig. 2: (a) Adult female *Ascaris lumbricoides*, (b) posterior end of a male *A. lumbricoides*, showing the curled tail [6]



Fig. 3: Larva of *Ascaris lumbricoides* hatching from an egg [6]

chronic infections cause various symptoms, depending on which part of the body is affected. For example, in the lungs, the migrating larvae cause cough, fever, and skin rashes for a few days [2,16-18]. When the larvae move from the blood in capillaries into the lung alveoli result in hemorrhage and the alveolar sacs become filled with serous exudate.

A large number of adult worms presented in the intestines cause mechanical obstruction of the bowel and bile and pancreatic ducts, Fig. 5, vomiting, and abdominal pain. Worms migration leads to bowel perforation and peritonitis. In some cases, the adult worms passing from anal or mouth [16,19] cause diarrhea or bloody stools, nutrient malabsorption that happens by *Ascaris* secreting a number of digestive enzymes such as amylase, protease, and lipase into the intestinal canal [20,21]. Worms may invade the bile ducts, the liver, pancreatic duct, surgical wounds, and the peritoneum causing abscesses [3,22].

DIAGNOSIS

A. lumbricoides can be diagnosed by the following methods: [7,12,24]

1. Seeing the worms in the intestines through endoscopy [17,25], sonographic images [26], X-ray photographs, and tomographic images [27-33]
2. Seeing worms after they are expelled naturally
3. Detecting the worms' metabolites in urine such as 2-methyl-butylamide and 2-methyl-valeramide [34]
4. Seeing the worms' eggs and larvae in feces under a microscope (Kato-Katz thick smear, FLOTAC, McMaster egg counting technique, Baermann). This way is the simplest and widely used in developing countries [30-36]
5. Serological diagnosis: Detection of antibodies could be a simpler, more rapid diagnosis of infection than conventional stool microscopy. Few studies have evaluated the use of this method, antibody titers have been associated with larval stage and may remain in high rates for several months, even after treatment, especially in regions where

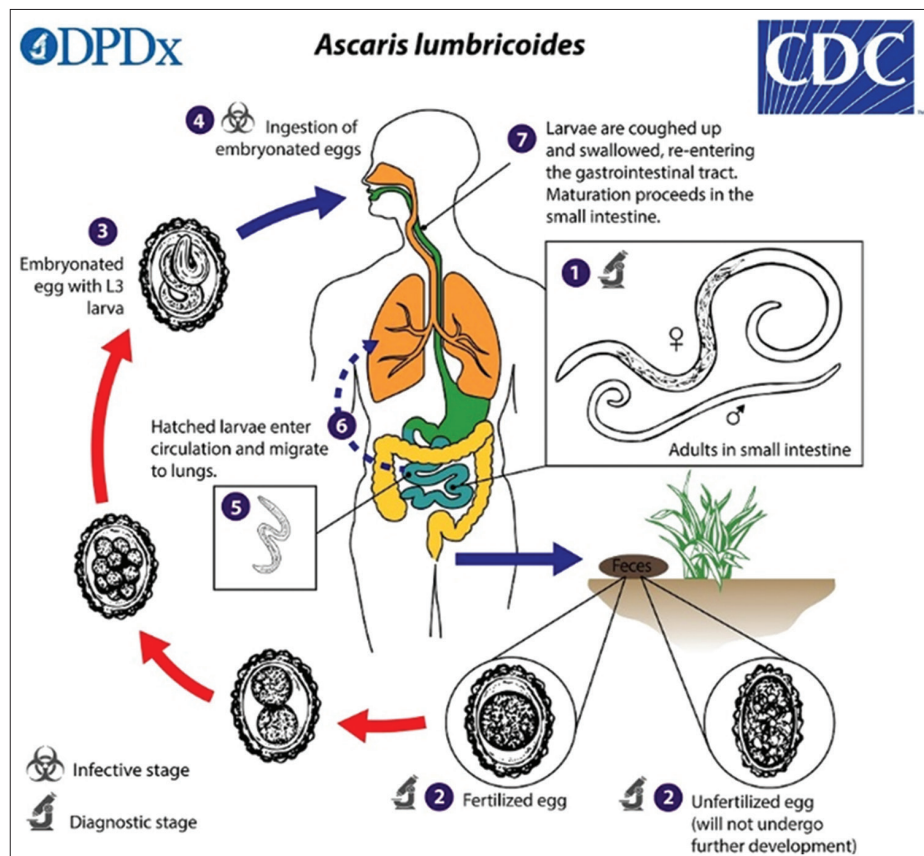


Fig. 4: Life cycle of *Ascaris lumbricoides* [6]

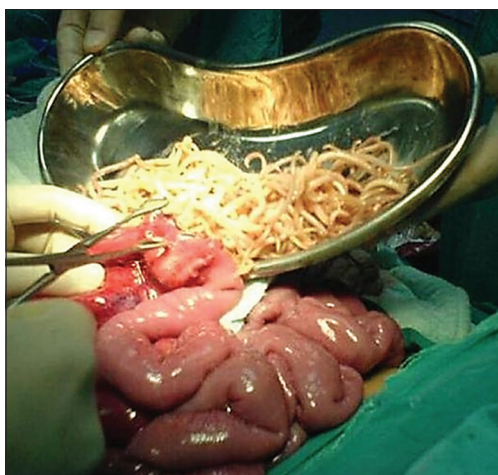


Fig. 5: Extraction of *Ascaris lumbricoides* from jejunum [23]

reinfection is continual [30,36-39]; therefore, this method is not suitable to detect active *Ascaris* infection and could not give a real number of patients in need of treatment [35].

TREATMENT AND CONTROL

The aim of the most control programs is to reduce the intensity of infection, thus there are strategies for *Ascaris* control, such as improvements in sanitation hygiene and health education and chemotherapy [1,11,40,41]. Early diagnosis of *A. lumbricoides* infection provides the choice of suitable and typical treatment for saving a patient's life [42].

The drugs recommended by the WHO for treatment are albendazole, mebendazole, levamisole, and pyrantel pamoate [11,43-45], and other drugs including piperazine and nitazoxanide. Albendazole is supplied in tablets of 200 mg albendazole, it is used as two tablets or 20 ml suspension to both adults and children above the age of 2 years. Mebendazole is used to kill the worms in the intestines then expels them within 24 h of drug administration. Mebendazole is available in oral tablets (100 mg) and a suspension containing 20 mg Mebendazole/ml [3,7,46].

Vaccines were made from antibodies (predominantly immunoglobulin E) and the response is thought to be responsible for some immunity, but this way has proved none effective [47]. Future efforts may lead to the development of vaccines that will provide better control and management of the infection [3].

Certain local herbs, in some countries, are used as an alternative treatment of ascariasis. The plants include *Prunus mume*, *Asarum heterotropoides*, *Zingiber officinale*, *Angelica sinensis*, *Phellodendron amurense*, *Panax ginseng*, *Cinnamomum cassia*, and *Zanthoxylum bungeanum* [48-51]. *Chenopodium ambrosioides* is used as a herbal remedy in South and Central America [3].

CONCLUSION

Briefly, *A. lumbricoides* infection is a significant global health problem, especially in tropical and subtropical developing countries. Patients can be infected with abdominal pain symptoms and will continue to cause repeated complications throughout life.

Ascaris is an infectious and persistent parasite; its large size and its migratory pathway through the tissues enhance its danger on public health.

More awareness is very important to promote good hygiene and creative programs in the affected areas to disposal of fecal material and regular deworming.

AUTHORS' CONTRIBUTIONS

Both authors have contributed to the preparation of this review and editing of the manuscript.

CONFLICTS OF INTEREST

There are no conflicts of interest.

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