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Enterobius and Enterobiasis

FIVE INTESTINAL NEMATODE INFECTIONS—ancylostomiasis (chapter 22), ascariasis (chapter 23), strongyloidiasis (chapter 33), trichuriasis (chapter 35), and enterobiasis (this chapter)—are described in this book. Enterobiasis is atypical within this group because it is transmissable directly from one person to another without the need for a period of development in soil elsewhere, and because the *Enterobius* eggs are not normally excreted in the feces. Although enterobiasis is extremely common—the commonest in fact of all infections discussed in this book—it is of very minor public health importance.

Description of Pathogen and Disease

The literature on enterobiasis is limited because it is an infection that does not commonly cause serious disease.

Identification

Enterobiasis is an infection of the large intestine and appendix by the nematode *Enterobius vermicularis*. The heads of the worms are attached to the mucosa of the intestinal wall. There are usually only minor symptoms or none at all. Pruritus ani, causing disturbed sleep, is common, and there is sometimes mild catarrhal inflammation with nausea and diarrhea. Symptoms of appendicitis are a very rare occurrence. Migration of worms to the female genitalia frequently occurs. Diagnosis is by finding eggs on the perianal skin by means of sticky tape. Enterobiasis is treated by oral drug therapy with mebendazole, pyrantel pamoate, or piperazine citrate.

Occurrence

Enterobiasis occurs worldwide and is extremely common, particularly in children. There are probably over 1,000 million cases in the world. It is likely that virtually every person living in a temperate country is infected some time during childhood.

Infectious agent

E. vermicularis, a nematode, is the pinworm, threadworm, or seatworm of man. It is also known as *Oxyuris vermicularis*. The female worm measures 8–13 millimeters and contains about 10,000 eggs; and the male measures 2–5 millimeters (figure 26-1). The eggs measure 50–60 micrometers by 20–30 micrometers.

Reservoir

E. vermicularis is exclusively a parasite of man.

Transmission

The female worm migrates down the intestine and colon and emerges from the anus, usually at night. Eggs are normally laid on the perianal skin and are seldom found in the feces. Most female worms die after egg laying. The eggs develop to the infective stage in 4–7 hours at 35°C and 48 hours at 25°C. Under cool, moist conditions infective eggs remain alive for up to 8 weeks. When infective eggs are ingested, the larvae hatch in the small intestine and the adults are found in the large intestine, cecum, and appendix. Autoinfection often occurs by transmitting eggs from the anus to the mouth on contaminated fingers or by eggs hatching on the anal mucosa and the larvae migrating up into the bowel and there developing into an adult worm. Each egg ingested may develop into a male or female worm, so at least two are necessary for transmission.

Prepatent and incubation periods

Adult female worms begin to pass eggs 40–50 days after ingestion of eggs. The infections are often asymptomatic.

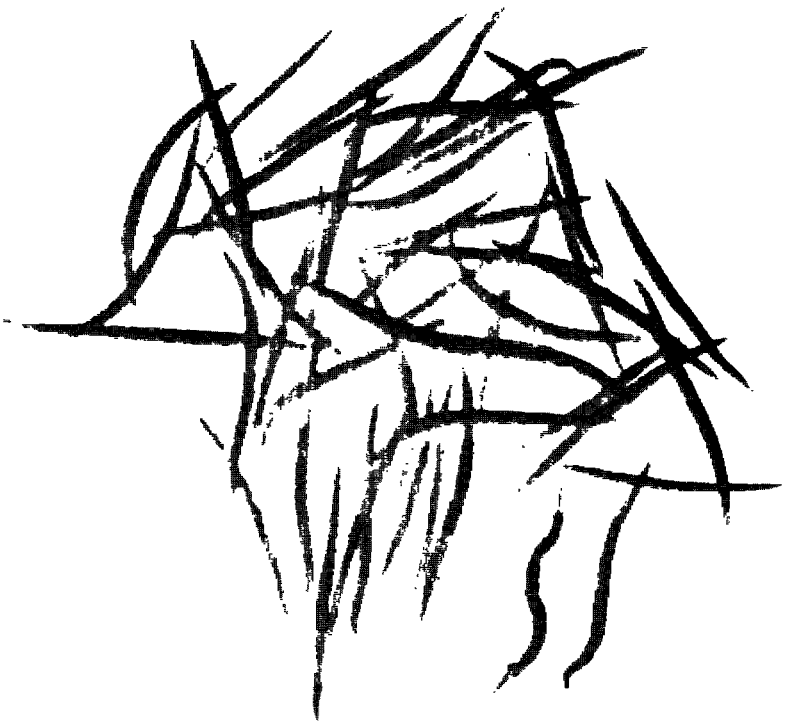

Figure 26-1. *Adult pinworms*, Enterobius vermicularis. Each worm is 5–10 millimeters long. (Photo: Wellcome Museum of Medical Science)

Period of communicability

The adults live for about 50 days, but because of autoinfection the period of communicability is usually much longer.

Resistance

Susceptibility is general, and there is no evidence of resistance due to past infection.

Epidemiology

Enterobiasis is a group infection, most common in children. Its transmission, by the anal-oral route, depends very much on personal hygiene. Contaminated fingers, fingernails, bed linen, table tops, doorknobs, and so forth can serve as sources of infection. In some cases airborne eggs, dislodged from contaminated areas, are inhaled and swallowed and cause infection. Overcrowding and poor housing encourage infection. Infection is most common in large families and institutions such as boarding schools, hospitals, prisons, and orphanages.

Enterobiasis is not an excreted infection in the same sense as the other worm infections described in chapters 22 to 35. Eggs are found in the feces of 5 percent or less of infected individuals. Eggs are normally laid on the perianal skin by female worms that have emerged from the anus at night. It follows that stool surveys greatly underestimate the prevalence of enterobiasis. For an accurate survey it is necessary to adopt the sticky tape method to pick eggs off the perianal skin and examine them under a microscope. For best results, the sticky tape should be applied very soon after waking and before bathing or passing stool. Even then a single survey will detect only 50 percent of infections; three tests will detect 90 percent, and five tests 99 percent (Wolfe 1978). Owing to these difficulties, practically no reliable community-wide prevalence data on enterobiasis exist, and most figures quoted are gross underestimates. This is not a matter for concern. Enterobiasis is an infection of negligible public health importance, and there is generally no reason for needing accurate prevalence data.

A survey of enterobiasis in orphanages in Taipei (Taiwan) showed an overall prevalence of 74 percent, with higher infection rates in more crowded orphanages (Chung, Chang and Horng 1978). Children's bodies were heavily contaminated with *Enterobius* eggs, and 12 percent had eggs on their ears. Bedpans,

linen, toilets, dust, stair rails, bedposts, closets, desks, and toys were contaminated by *Enterobius* eggs in decreasing order of frequency of egg detection (see also Chiu and others 1975). Seo and others (1969) found high rates (up to 80 percent) of enterobiasis among rural school children in South Korea. Other fairly recent surveys of enterobiasis in developing countries include those from Brazil (Dias 1967), Chile (Cuevas and others 1969), India (Sengbusch 1970), Mexico (Garrocho Sandoval and Rodríguez Medina 1968; Vázquez Compeán and Garrocho Sandoval 1972), the Philippines (Sengbusch 1963; Sengbusch and Sengbusch 1971), and Singapore (Kan, Siak and Singh 1971).

Enterobiasis is more common in temperate than in tropical climates because transmission is encouraged by wearing many clothes and by infrequent bathing. These practices maintain the perianal region in a cool, dark, and moist state that is ideal for the survival of *Enterobius* eggs on the perianal skin.

Enterobiasis is the most common worm infection in the USA and is found throughout the country and among all socioeconomic groups (Warren 1974). It is less common among black than white people for reasons that are not known. Prevalence is greatest among the 5–9 age group and is especially high in institutions. It was estimated that 42 million US citizens were infected in 1972 (Warren 1974).

In the course of 3 years (1975–78), systematic surveys were carried out in Azerbajian (USSR) on enterobiasis among the urban and rural populations (Chobanov and Salekhov 1979). A total of 9,914 persons were examined, using adhesive cellophane swabs. The prevalence of enterobiasis in towns and villages was similar (39 percent and 38 percent, respectively), and there was no difference in the infection rates that could be attributed to the level of sanitation and personal hygiene. The lowest infection rate was found in children of preschool age brought up at home (9 percent), whereas the highest was in children attending kindergartens, especially in the 4–7 age group (57–60 percent). The incidence among adults was considerably lower (6–11 percent). The high prevalence of enterobiasis in schools was mainly due to the introduction of the infection by children previously infected in kindergartens, for *Enterobius* eggs were found in up to 60 percent of this group, in comparison with 12 percent in schoolchildren brought up at home. A survey of 889 households showed that in childless families only 4 percent were infected, whereas in families with children the infection rate increased in proportion to their number, reaching 70 percent in families with six children and involving adult members of the family, especially women. Sanitary measures and mass treatment with specific anthelminthics of all the children and personnel of nineteen kindergartens in Baku resulted in a marked and rapid reduction in the cases of enterobiasis, which dropped from 35–68 percent to 4–17 percent a year later. At present, new pupils and personnel are admitted only after undergoing prophylactic treatment. Studies on enterobiasis in the USSR are also reported by Epifantsev and Petrov (1972) and Zhuravlev and Parfenova (1974).

Control Measures

Drugs such as piperazine, pyrantel pamoate, and mebendazole can be used for mass chemotherapy.

Reduction of overcrowding in living accommodation and adequate facilities for hand washing and personal cleanliness help in the prevention of the infection. Educational effort should be directed to stress personal hygiene.

Occurrence and Survival in the Environment

Enterobius eggs are not usually passed in the feces but are found in bedclothes and house dust. Eggs have been found in sewage in the German Democratic Republic (Kalbe 1956), India (Lakshminarayana and Abdulappa 1969), and the USSR (Vassilkova 1936); in river water contaminated by sewage in the USSR (Bukh 1945; Goryachev 1947; Usacheva 1951); in tap water in the USSR (Bukh 1945); and on crops irrigated with sewage in the USSR (Biziulevicius 1954; Khaustov 1935; Romanenko 1971). These eggs probably came from egg-filled female worms, which are often passed in the feces.

Enterobius eggs are not robust and survive for considerably shorter periods than *Ascaris* eggs (chapter 23). Eggs can survive for up to 8 weeks if kept cool and moist, but they are killed in a few days by desiccation. Mature eggs can remain viable for 2–3 days at 22°C and a relative humidity of 34–44 percent (Hulínská 1974).

Inactivation by Sewage Treatment Processes

Little information is available on *Enterobius* eggs during sewage treatment. It may be assumed that their removal characteristics closely resemble those of

Ascaris eggs (chapter 23). *Enterobius* eggs are absent from the effluent of well-designed waste stabilization pond systems (Lakshminarayana and Abdulappa 1969).

Inactivation by Night Soil and Sludge Treatment Processes

Nothing is known about *Enterobius* eggs during night soil or sludge treatment. *Enterobius* eggs are more rapidly killed by hostile environmental factors (especially heat and desiccation) than are *Ascaris* eggs, and they will be eliminated from night soil and sludge long before *Ascaris* eggs.

Literature Cited

Biziulevicius, S. K. (1954). Role of vegetables and berries in the epidemiology of helminthiasis in the population of Lithuania. *Meditsinskaia Parazitologiia i Parazitarnye Bolezni*, **23,** 124–126

Bukh, F. L. (1945). The data of helminth egg inspection of the sources of water supply of Ufa. *Meditsinskaia Parazitologiia i Parazitarnye Bolezni*, **14,** 66–67.

Chiu, J. K., Huang, R. J., Wang, Y. T. and Su, C. S. (1975). Prevalence of enterobiasis among children in Taipei City, Taiwan, with an evaluation of pyrantel pamoate in treatment. *Journal of the Formosan Medical Association*, **74,** 728–733.

Chobanov, R. E. and Salekhov A. A. (1979). Prevalence of enterobiasis among the urban and rural population of the Azerbaijan SSR. *Meditsinskaia Parazitologiia i Parazitarnye Bolezni*, **5,** 79–83.

Chung, W. C., Chang, K. C. and Horng, S. H. (1978). Epidemiology of *Enterobius vermicularis* infection among orphans in orphanages in Taipei City. *Chinese Journal of Microbiology*, **11,** 30–36.

Cuevas, R., Schenone, H., Silva, R., Galdames, M., Inzunza, E. and Romero, E. (1969). Prevalence of *Enterobius vermicularis* infection in a boarding school. *Boletín Chileno de Parasitología*, **24,** 121–123.

Dias, J. C. P. (1967). Enterobiasis among the juvenile population in western Minas Gerais. *Hospital*, **72,** 1611–1621.

Epifantsev, G. D. and Petrov, V. I. (1972). Problem of enterobiasis control among the population. *Meditsinskaia Parazitologiia i Parazitarnye Bolezni*, **41,** 745–746.

Garrocho Sandoval, C. and Rodríguez Medina, J. M. (1968). Enterobiasis among students of Mexquitic, San Luis. Potosí. *Salud Pública de México*, **10,** 215–217.

Goryachev, P. P. (1947). Investigation of helminth eggs in the waters of the river Irtish and Om. *Meditsinkaia Parazitologiia i Parazitarnye Bolezni*, **16,** 75–78.

Hulínská, D. (1974). Morphogenesis and viability of larvae in the eggs of *Enterobius vermicularis*. *Folia Parasitologica*, **21,** 225–232.

Kalbe, I. (1956). Investigations of parasites in sewage in several towns in East Germany. *Zeitschrift für die Gesamte Hygiene und ihre Grenzgebiete*, **2,** 334–343.

Kan, S. P. Siak, C. L. and Singh, M. (1971). Prevalence of enterobiasis in children admitted to a hospital in Singapore *Annals of Tropical Medicine and Parasitology*, **65,** 81–83.

Khaustov, J. M. (1935). Vegetables as a factor in transmission of *Trichocephalus* (*Trichuris*) *trichiuris*. *Trudy Leningradskogo Instituta Epidemiologii i Bakteriologii imeni Pastera*, **2,** 148–152.

Lakshminarayana, J. S. S. and Abdulappa, M. K. (1969). The effect of sewage stabilization ponds on helminths. In *Low Cost Waste Treatment*, ed. Sastry, C. A., pp. 290–299. Nagpur, India: Central Public Health Engineering Research Institute.

Romanenko, N. A. (1971). Sanitary-helminthological evaluation of new methods of irrigation with sewage. *Meditsinskaia Parazitologiia i Parazitarnye Bolezni*. **40,** 361–362.

Sengbusch, H. G. (1963). Enterobiasis in school children in the vicinity of Iloilo City, Republic of the Philippines. *Journal of the Philippine Medical Association*. **39,** 802–812.

—— (1970). Studies on enterobiasis. 3. The incidence of pinworm infection in a Mysore school. *Indian Journal of Paediatrics*, **37,** 229–238.

Sengbusch, H. G. and Sengbusch, C. H. (1971). Studies on enterobiasis. II. The incidence of pinworm infection in a secondary school in Iloilo City, R. P. *Journal of the Philippine Medical Association*, **47,** 455–462.

Seo, B. S., Rim, H. J., Loh, I. K., Lee, S. H., Cho, S. Y. Park, S. C., Bae, J. W., Kim, J. H., Lee, J. S., Koo, B. Y. and Kim, K. S. (1969). Study on the status of helminthic infections in Koreans. *Korean Journal of Parasitology*, **7,** 53–70.

Usacheva, A. M. (1951). Survival of helminth eggs in water and in river sediment. *Gigiena i Sanitaria*, No. 12, 12–17.

Vassilkova, Z. (1936). On the dehelminthization of purified sewage waters by intensive methods. *Meditsinskaia Parazitologiia i Parazitarnye Bolezni*, **5,** 671-674.

Vázquez Compeán, R. F. and Garrocho Sandoval, C. (1972). Childhood enterobiasis in the Mexican plateau. *Revista de Investigación en Salud Pública*, **31,** 209–214.

Warren, K. S. (1974). Helminthic diseases endemic in the United States. *American Journal of Tropical Medicine and Hygiene*, **23,** 723–730.

Wolfe, M. S. (1978). *Oxyuris, Trichostrongylus* and *Trichuris*. *Clinics in Gastroenterology*, **7,** 201–217.

Zhuravlev, S. E. and Parfenova, E. S. (1974). Intestinal infections. Contamination of hands with *Escherichia coli* and the micro flora condition of the large intestine in children affected and unaffected with *Oxyuris vermicularis*. *Meditsinskaia Parazitologiia i Parazitarnye Bolezni*, **43,** 482–485.