29

Hymenolepis and Hymenolepiasis

THREE GENERA of tapeworm are parasites of the human intestine and are transmitted when proglottids or eggs are passed in the feces. These are *Diphyllobothrium* (chapter 25), *Taenia* (chapter 34), and *Hymenolepis* (this chapter). The *Hymenolepis* species that infects man, *H. nana*, is unusual in that it can be transmitted directly from person to person without a cystic stage in an intermediate host. This is in contrast to *Diphyllobothrium* (which has intermediate stages in a copepod and a fish) and *Taenia* (which has an intermediate stage in a cow or a pig).

Description of Pathogen and Disease

Hymenolepiasis is not a major public health problem, although in certain localities it is common and is regarded seriously by clinicians. The literature on hymenolepiasis epidemiology is limited.

Identification

Hymenolepiasis is an infection of the small intestine by the tapeworm (cestode) *Hymenolepis*. With a light infection, symptoms are often vague or absent. Heavy infections can result in enteritis with abdominal pain, diarrhea, loss of appetite, and dizziness. Epileptic fits are an occasional complication in children. Diagnosis is by identifying *Hymenolepis* eggs in the feces. Treatment is by oral drug therapy with niclosamide. Praziquantel, a newer drug under trial, shows promise (Schenone 1980).

Occurrence

Hymenolepiasis occurs worldwide and is especially prevalent among children. It is more common in warm climates than in cold climates. It is most common in South America, North India, the Mediterranean countries, Eastern Europe, and the Pacific islands.

Infectious agent

Hymenolepis nana, a cestode, is the dwarf tapeworm of man. The entire worm measures only 15–40 millimeters by 1 millimeter and has approximately 200 proglottids. The minute scolex has four suckers and a row of hooks and is embedded in the wall of the ileum (figure 29-1). The mature proglottids measure 0.22 by 0.88 millimeters and the eggs measure 30–47 micrometers in diameter.

Reservoirs

The reservoir of *H. nana* is probably man. A morphologically identical tapeworm (*H. nana* var. *fraterna*) is common in mice, but it is not certain whether this normally infects man.

The rat tapeworm, *H. diminuta*, is a common parasite of rodents in many parts of the world. Like most cestodes it has an intermediate host, in this case a rat flea or flour beetle that must eat the excreted eggs. *H. diminuta* cannot be transmitted directly from rodent to rodent (Salem, Sidky and Abdel-Rehim 1980). The rodent is reinfected by eating the flea or beetle containing the encysted worm. Children occasionally ingest infected fleas or beetles, and *H. diminuta* infections are found in children in some countries. *H. diminuta* has little medical or public health importance but has been much used as a laboratory model for cestode infections, and there is a substantial literature on it. A very similar pattern of occasional human infection is found for the dog tapeworm (*Dipylidium caninum*), for which the intermediate host is a dog flea.

Transmission

The gravid proglottids containing 80–200 eggs are usually broken up in the intestine so that free eggs are found in the feces. Eggs passed in feces are immediately infective if ingested by a new host. The eggs are not resistant to heat or desiccation and normally survive

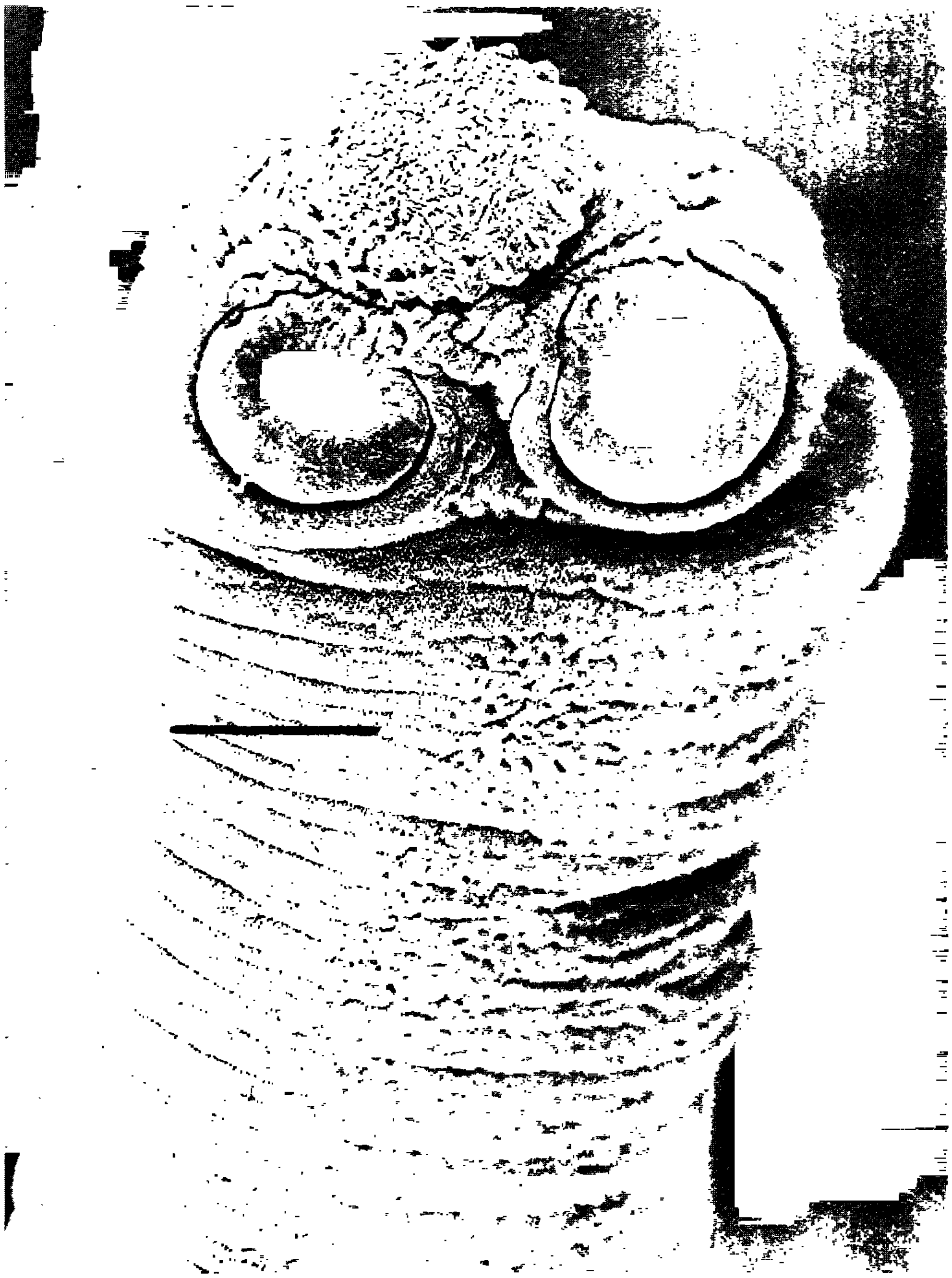

Figure 29-1. *Head (scolex) and neck of* Hymenolepis nana *under scanning electronmicroscopy.* Two of the four suckers and the protruding rostellum with a circle of hooks are prominent. The suckers and hooks attach to the wall of the small intestine while the worm hangs in the lumen. Scale bar = 0.1 millimeter. (Photo: H. Mehlhorn, Institut für Zoologie, Düsseldorf, Federal Republic of Germany.)

for less than 10 days in the environment. Transmission is usually from hand to mouth, although it can be via food or water. The contained larva is liberated in the small intestine and penetrates a villus. After development it emerges into the lumen and develops into a mature tapeworm in 10–12 days. Autoinfection is possible by eggs hatching in the intestine and developing into new tapeworms without leaving the host. One ingested egg is potentially capable of starting a new infection.

H. nana is an unusual cestode in that it can pass directly between two primary hosts (man) without first encysting in an intermediate host (in contrast to *Taenia*—see chapter 34). *H. nana* can, however, develop in certain insects, and some transmission may take place via the accidental ingestion of infected insects by children.

Prepatent and incubation periods

Worms mature and start shedding egg-filled proglottids about 30 days after the ingestion of eggs. Symptoms may never develop.

Period of communicability

Eggs will be passed in the feces as long as adult tapeworms are in the intestine. Although these live only for a few months, regular autoinfection can cause eggs to be excreted for years.

Resistance

Although susceptibility is general, there is evidence for acquired immunity (Rifaat, Salem and Hegazi 1978).

Epidemiology

Hymenolepiasis infection is considerably more common in children than in adults and is also especially common in crowded homes and institutions. Major local and regional variations in prevalence exist. In a survey of children 0–6 years old, hymenolepiasis prevalences of 0 percent were found in Bangladesh and Sri Lanka, 9 percent in Venezuela, and 20 percent in Iran (van Zijl 1966).

A study of a village in Rajasthan (India) showed an overall hymenolepiasis prevalence of 6 percent. Infection was more common among those under 15 years old (10 percent) than among adults (4 percent). Larger and more crowded households were more infected than other households. Of all those infected, 35 percent had symptoms, of which the most common were diarrhea and abdominal pain (Biswas, Arora and Sehgal 1978). Other studies of hymenolepiasis in developing countries include those from Brazil (Huggins and others 1973), Egypt (Chandler 1954), India (Buscher and Haley 1972), Iran (Ghadirian and Arfaa 1972; Massoud and others 1980), South Africa (Van Niekerk and others 1979), South Korea (Seo and others 1969), and Turkey (Yaşarol, Orhan and Erefe 1970).

Hymenolepiasis occurs in the USA, especially in the southern states of Florida, Kentucky, Mississippi, North and South Carolina, and Tennessee (Eyles, Jones and Smith 1953; Melvin and Brooke 1962; Warren 1974). Warren (1974) estimated that 100,000 US citizens were infected in 1972. Hymenolepiasis is very common in some regions of the USSR and has been the subject of considerable research and control activity (Kuznetsov 1979; Lerner and others 1970). Human infection by *H. diminuta* has been described in Malaysia (Sinniah 1978), Papua New Guinea (McMillan, Kelly and Walker 1971), Thailand (Chitchang, Sooksala and Radomyos 1978), Zambia (Hira 1975), and elsewhere.

Control Measures

Mass chemotherapy with niclosamide, praziquantel, or other suitable drugs can temporarily reduce local prevalences.

Eggs are infective when passed in the feces. Therefore, direct fecal-oral transmission is likely, particularly among children or others with poor standards of personal hygiene. Control must lie in improving personal hygiene, as well as in improving the methods for excreta disposal.

Occurrence and Survival in the Environment

Hymenolepis eggs may be expected in sewage and night soil, and in environments contaminated by sewage or night soil, wherever hymenolepiasis is endemic. *Hymenolepis* eggs in the environment have not attracted much research interest, however, and few reports are available. *H. nana* eggs have been found in sewage in India (Lakshminarayana and Abdulappa 1969; Panicker and Krishnamoorthi 1978) and in sewage sludge in Czechoslovakia (Králová and Šafránek 1957) and the USA (Wright, Cram and Nolan 1942).

Hymenolepis eggs do not survive for long in the environment compared with *Ascaris* eggs (chapter 23). They are especially sensitive to warmth and desiccation. Table 29-1 summarizes the findings of Simitch, Bordjochki and Angelovski (1955). Another study found that *H. nana* eggs were rapidly killed at $-1°C$ and at 45°C, and by drying for 30 minutes at 37°C (Foresi and Ruschi 1968).

Inactivation by Sewage Treatment Processes

Data from India (table 22-4) suggest that *H. nana* eggs are removed somewhat less effectively than

Table 29-1. *Duration of infectivity of* Hymenolepis nana *eggs stored under various conditions*

	Duration of infectivity at various temperatures (hours)					
Environment	*0°C*	*2°C*	*20°C*	*37°C*	*41°C*	*41°C in* [illegible]
Crumbled feces	ND	ND	<30	<4	<4	<2
Compact feces	>144	>240	<72	<8	<4	<3
Feces in water	ND	ND	>720	<120	<10	<30

ND No data.
Source: Simitch. Bordjochki and Angelovski (1955).

Ascaris eggs during sewage treatment. Nonetheless, it is to be expected that *H. nana* eggs, like all other helminth eggs, are mainly concentrated into the raw sludge of the primary and secondary sedimentation tanks. *H. nana* eggs are completely removed from the effluent of well-designed waste stabilization pond systems (table 22-4 and Lakshiminarayana and Abdulappa 1969).

Inactivation by Night Soil and Sludge Treatment Processes

H. nana eggs will be readily eliminated from night soil and sludges, especially if warm temperatures are created (table 29-1) or if desiccation takes place. Thermophilic composting destroys *H. nana* eggs (Gudzhabidze and Lyubchenko 1959), and *H. nana* eggs will be eliminated from all processes long before *Ascaris* eggs.

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