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Paragonimus and Paragonimiasis

THE LIFE CYCLE of *Paragonimus* is similar to that of *Clonorchis*, *Heterophyes*, and *Metagonimus* except that the metacercariae encyst in crabs and crayfish rather than fish. Paragonimiasis is therefore a disease of people who customarily eat raw crabs or crayfish.

Description of Pathogen and Disease

Paragonimiasis can be a very serious disease and has been studied in detail, especially in China, Japan, South Korea, and Taiwan.

Identification

Paragonimiasis is an infection, principally of the lungs but sometimes of the brain, with a trematode of the genus *Paragonimus*. It is characterized by severe chest pains, dyspnea, and bronchitis. Symptoms resemble those of tuberculosis, especially blood-stained sputum. Cerebral paragonimiasis may result in epileptic seizures, headache, visual disturbances, and symptoms of meningitis.

Diagnosis is by finding eggs in feces or sputum. Treatment is by oral drug therapy with bithionol or praziquantel.

Occurrence

Paragonimiasis in animals occurs worldwide among mammals that feed on crabs or crayfish. Paragonimiasis in man is limited to areas where dietary customs allow infection. *P. westermani* infections occur mainly in China, Japan, Korea, the Philippines and Taiwan—with cases also reported from India, Indonesia, Malaysia, Thailand, and Vietnam. Other *Paragonimus* species occasionally infect man in Asia, Africa, and Central and South America (figure 31-1).

Infectious agent

Paragonimus westermani, a trematode, is the lung fluke of man. The adult worm, which typically lives encapsulated in pockets of the lung, is a thick, fleshy, ovoid fluke measuring 8–16 by 4–8 millimeters (figure 31-2). The eggs are 80–110 by 50–60 micrometers.

Reservoir

Paragonimiasis is an infection found in a great variety of mammals that feed on crabs. *P. westermani* can infect a range of wild animals such as tigers, lions, wild cats, and foxes and domestic animals such as cats and dogs. Although in endemic areas man is the most important reservoir, the persistence of *P. westermani* in nature does not depend only on the human reservoir.

Various other *Paragonimus* species are maintained solely by animals in most tropical areas of the world and are the cause of occasional cases in man. For instance, *P. africanus* is the lung fluke of the crab-eating mongoose and infects man in parts of eastern Nigeria and Cameroon.

Transmission

The unsegmented fertilized eggs are passed out in sputum or swallowed and passed out in feces. For further development they have to reach water. At an optimum temperature of 27°C, a larva (miracidium) develops in 3 weeks. After hatching, it swims in the water and survives for around 24 hours. Further development takes place inside various operculate freshwater snails (*Semisulcospira libertina*, *S. amurensis*, *Thiara granifera*, *Oncomelania nosophora*). Asexual multiplication, taking 3 months, occurs in the snail so that a few hundred of the emerging larval stage (cercariae) are formed from each miracidium.

The cercariae can swim in the water for 24–48 hours but require another intermediate host, a freshwater

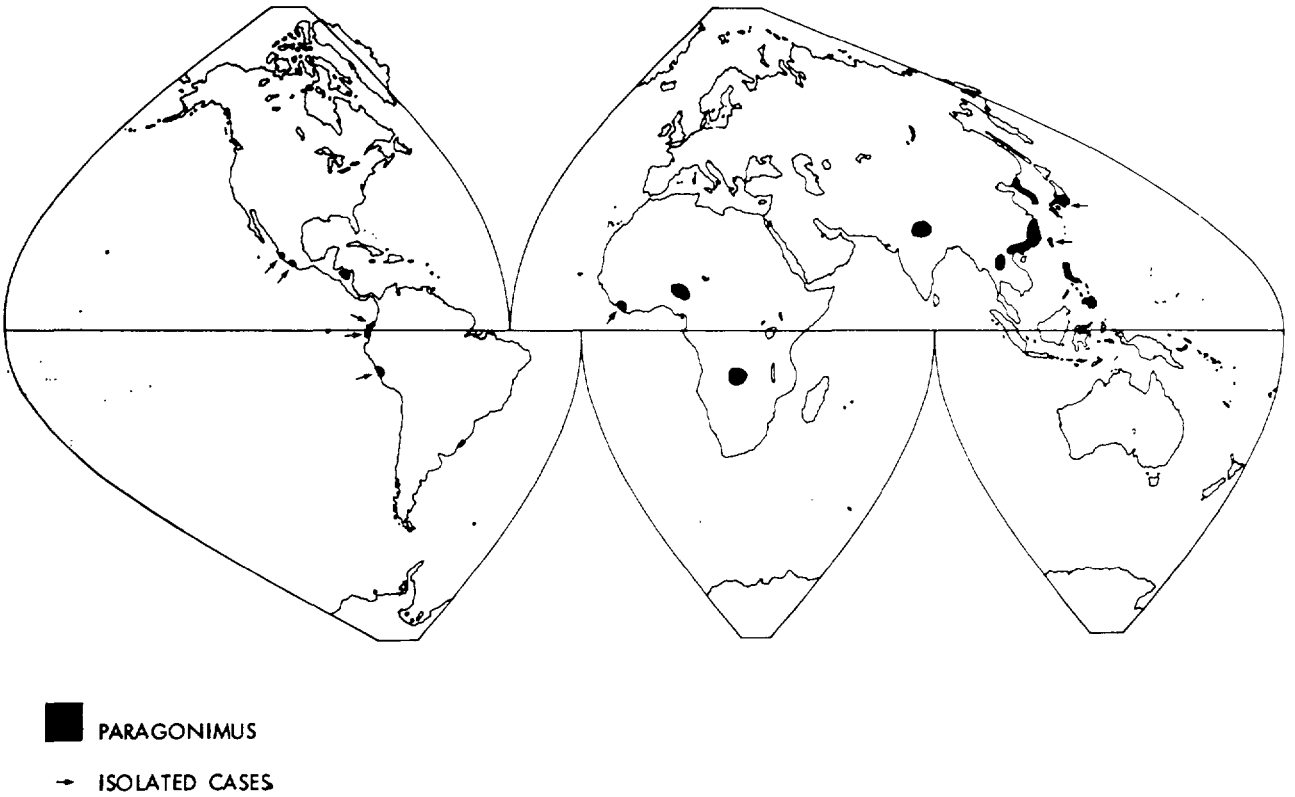

Figure 31-1. *Known geographical distribution of* Paragonimus. The infection may occur in areas as yet unrecorded

Figure 31-2. *An adult* Paragonimus westermani *under a light microscope.* Scale bar = 1 millimeter. (Photo: Wellcome Museum of Medical Science)

edible crab or crayfish. This second intermediate host lives mainly in fast-flowing mountain streams, although some species can be found in rivers and rice fields. The parasites form encysted metacercariae in the muscles or gills of the crustaceans and reach a new mammalian host when crabs or crayfish are eaten raw. The cysts hatch in the duodenum, and the young flukes migrate through the peritoneal cavity and diaphragm to the lungs, reaching maturity 5–6 weeks later and living for 6–20 years.

Prepatent and incubation periods

Worms reach maturity 5–6 weeks after encysted metacercariae in freshwater crustacea are ingested. Symptoms develop over longer and variable periods.

Period of communicability

The adult worm can live between 6–20 years and can produce eggs all this time, but worms normally become walled off after 1–2 years, and very few eggs are passed.

Resistance

Susceptibility is general. Increased resistance possibly develops as a result of infection.

Epidemiology

The distribution of paragonimiasis in man is determined by numerous factors—especially by the presence of particular snails and crustacean hosts in local streams and by dietary customs that include eating the crustaceans in a raw or semicooked state. Infection is not only associated with eating raw or pickled crabs and crayfish, but also with eating crab or crayfish juices, which are popular in parts of China, Korea, the Philippines and elsewhere. The encysted metacercariae are sticky and can contaminate knives, chopping boards, hands, and vegetables in the kitchen while crabs or crayfish are being prepared. As with clonorchiasis, infection is generally more common in adults than in children and in males than in females. This is due to different dietary customs.

In some endemic areas the crab and crayfish hosts live in mountain streams that are some distance from human settlement. It is likely that they become infected chiefly as a consequence of the contamination of these streams by animal, rather than human, feces. In such situations the eggs passed in human feces may be unimportant in maintaining transmission; therefore excreta disposal programs are irrelevant as an initial control strategy.

Major reviews of paragonimiasis include those by Yokogawa (1964, 1969) and Yokagawa, Cort and Yokogawa (1960). Other accounts of paragonimiasis include those from Africa (Nwokolo 1974), Cameroon (Sachs and Voelker 1975; Sirol, Kerfelec and Papinutto 1967), China (Chung and others 1975; Fan, Zihe and Daixia 1976), Costa Rica (Miyazaki 1974), Indonesia (Kwo and Miyazaki 1968), Ivory Coast (Nozais and others 1980), Japan (Katamine and others 1970, 1972; Sano and others 1979; Yoshida 1916), Laos (Soh 1973), Liberia (Voelker 1973), Malaysia (Miyazaki and Kwo 1969; Rohde 1967), Mexico (Martínez-Báez 1970), Nigeria (Nwokolo 1972; Voelker and Nwokolo 1973), North America (Ameel 1934), Panama (Miyazaki 1972), Peru (Miyazaki and Grados 1972), Philippines (Cabrera 1973; Cabrera and Fevidal 1974; Cabrera and Vajrasthira 1972, 1973), South Korea (Kim and Bang 1974; Rim and others 1975; Sadun and Buck 1960; Yun and others 1966), Sri Lanka (Kannangara and Karunaratne 1969), Taiwan (Huang and Chiu 1966; Huang and others 1966; Liu 1970; Liu and Cross 1971), and Thailand (Miyazaki and Vajrasthira 1967).

Control Measures

Mass chemotherapy with bithionol has been effective in Japan and the Philippines.

In areas where the zoonotic reservoir is more important in maintaining transmission than the human reservoir (because it is primarily animal feces that reach the stream where the intermediate hosts reside), excreta disposal programs may not greatly reduce transmission. In areas, such as parts of Japan, where the human reservoir is important in maintaining transmission, any measures that prevent untreated human excreta from reaching surface waters should reduce the prevalence of infection in snails and may reduce infection in crabs and humans.

Another important approach to paragonimiasis control is to attempt to change human habits of consuming raw or insufficiently cooked crabs and crayfish. Infection often occurs when uncooked soft parts (such as leg muscles) are eaten raw. Pickling in brine, vinegar, or wine will not kill the encysted metacercariae, but heating for 10 minutes in water at 55°C is effective. Educational campaigns should inform the public of the danger of eating raw or insufficiently cooked crabs and crayfish and explain the possibility of infection through contamination of kitchen utensils while preparing infected crabs.

Occurrence and Survival in the Environment

Paragonimus eggs develop most rapidly in water at 28–32°C, and miracidia hatch out in about 3 weeks. Eggs are quickly killed by freezing but survive for long periods at 4°C. Eggs do not develop at temperatures above 35°C and are rapidly killed by desiccation (Yokogawa, Cort and Yokogawa 1960). *Paragonimus* eggs in a biogas plant in China survived for 13 days (Hou and others 1959).

Encysted metacercariae can live for one week in the tissue of dead crabs at cool temperatures. Traditional methods of preparing crabs—such as soaking in a weak solution of salt, rice wine and spices–do not kill all metacercariae (Khaw 1935). Chemical treatments are also not reliable (Tsuda 1959). Metacercariae are rapidly killed above 50°C, and so most techniques of cooking, or dipping in boiling water, should destroy encysted larvae in the tissues of crabs and crayfish.

Inactivation by Sewage Treatment Processes

No specific data are reported.

Inactivation by Night Soil and Sludge Treatment Processes

No specific data are reported.

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