ECHINOSTOMIASIS: A COMMON BUT FORGOTTEN FOOD-BORNE DISEASE

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Abstract. Human echinostomiasis, endemic to southeast Asia and the Far East, is a food-borne, intestinal, zoonotic parasitosis attributed to at least 16 species of digenean trematodes transmitted by snails. Two separate life cycles of echinostomes, human and sylvatic, efficiently operate in endemic areas. Clinical symptoms of echinostomiasis include abdominal pain, violent watery diarrhea, and anorexia. The disease occurs focally and transmission is linked to fresh or brackish water habitats. Infections are associated with common sociocultural practices of eating raw or insufficiently cooked mollusks, fish, crustaceans, and amphibians, promiscuous defecation, and the use of night soil (human excrement collected from latrines) for fertilization of fish ponds. The prevalence of infection ranges from 44% in the Philippines to 5% in mainland China, and from 50% in northern Thailand to 9% in Korea. Although the patterns of other food-borne trematodiases have changed in Asia following changes in habits, cultural practices, health education, industrialization, and environmental alteration, human echinostomiasis remains a health problem. The disease is most prevalent in remote rural places among low-wage earners and in women of child bearing age. Echinostomiasis is aggravated by socioeconomic factors such as poverty, malnutrition, an explosively growing free-food market, a lack of supervised food inspection, poor or insufficient sanitation, other helminthiases, and declining economic conditions. Furthermore, World Health Organization control programs implemented for other food-borne helminthiases and sustained in endemic areas are not fully successful for echinostomiasis because these parasites display extremely broad specificity for the second intermediate host and are capable of completing the life cycle without involvement of the human host.

PARASITES AND EPIDEMOIOLOGY

Echinostomiasis is a food-borne, intestinal, zoonotic, snail-mediated parasitosis caused by distomate digenean trematodes mainly of the genus *Echinostoma*. The flukes are small, typically 3–10 mm in length and 1–3 mm in width, with a large ventral sucker and distinctive collar spines surrounding an oral sucker. Human echinostomiasis, attributed to at least 16 species, is endemic to southeast Asia and the Far East, i.e., mainland China, Taiwan, India, Korea, Malaysia, Philippines, and Indonesia. Adult trematodes infect a variety of mammals and aquatic birds. Two separate life cycles of echinostomes, i.e., the human life cycle and the sylvatic life cycle (which have common zoonotic potential) have been identified and demonstrated to efficiently operate in endemic areas. In endemic areas, the disease occurs focally and is associated with common socioeconomic practices. The foci of pathogen transmission and natural reservoirs are widespread and are linked to fresh or brackish water habitats. Metacercariae, the infectious stage, are ingested by humans in raw or undercooked fresh or brackish water mollusks (pulmonate and opisthobranch snails or bivalves), fish, crustaceans, and amphibians (tadpoles or frogs), which constitute a substantial portion of the diet in endemic areas. Adult flukes are also found in a wide range of domesticated mammals and birds in these areas. Prevalence of human infection, based on finding echinostome eggs in the stool or presence of worms at autopsy, suggests efficient transmission in some parts of the world.

CLINICAL DISEASE

Morbidity and mortality due to echinostomiasis are difficult to assess in endemic areas because of a prolonged latent phase, a short acute phase, asymptomatic presentations, and also because of a similarity of clinical symptoms to other intestinal helminthiasis. Clinical symptoms are related to parasite load. In light-to-moderate infections, anemia, headache, dizziness, slight anemia, stomachache, gastric pain, and loose stools have most often been reported. Heavy infections are associated with eosinophilia, abdominal pain, profuse watery diarrhea, anemia, edema, and anorexia. Pathologically, echinostomes damage the intestinal mucosa and cause extensive intestinal and duodenal erosions and catarrhal inflammation.

DIAGNOSIS AND TREATMENT

Diagnosis of echinostomiasis is routinely done by finding characteristic operculate, unembryonated, ellipsoidal, yellow to yellow-brown eggs in fecal specimens. Egg size varies among species of echinostomes. Speciation can be done based on morphology of adult worms following anthelmintic treatment. Infections may be readily terminated by mebendazole, albendazole, praziquantel, or niclosamide. Diagnosis and treatment programs should also include domestic animal reservoirs.

ECHINOSTOMIASIS IN INDONESIA

One of the most dramatic changes in the prevalence of trematode diseases in the past was related to echinostomiasis. In the Lake Lindu Valley of central Sulawesi, Indonesia, surveys of stool specimens from 1937 to 1956 demonstrated a consistently high prevalence of infection with *E. echinatum* (= *E. lindoense*). The average prevalence was 42.6%, but in some parts of the valley it reached 96%. Human infections were on average longer than 10 months. Eating of raw or insufficiently cooked lake mollusks was a common practice. The bivalves *Corbicula lindonensis* and *C. subplanta*, once abundant in the Lindu Lake, were incriminated as the primary source of human infection. A 1970s survey of more than 30,000 stools of the Lindu Valley residents revealed occasional presence of echinostome eggs. Epidemiologic
surveillance showed that Corbicula clams were eliminated from the diet. Environmental monitoring showed the decrease in Corbicula populations in the lake was due to the introduction of a new species of fish, Tilapia mossambica. This species feeds on the veliger stage of Corbicula clams, and successfully competed with Betok (Anabas testudineus), the only native fish in Lake Lindu. Introduction of T. mossambica was also associated with reduction of other mollusks, i.e., Thiaridae, Ampullaridae, Viviparidae, Planorbidae, and Bithyniidae present in Lake Lindu. Elimination of Corbicula clams from Lake Lindu disrupted the human life cycle; however, worm extinctions did not occur because the sylvatic life cycle was unaffected. The disappearance of echinostomiasis from human populations illustrates successful, although unplanned, interruption of the trematode life cycle. Elimination of echinostomiasis from Lindu Valley residents in the 1970s was so efficient that the status of food-borne parasitic zoonoses in Indonesia issued in 1991 listed human echinostomiasis in that area as a historical disease. Despite this epidemiologic event, human echinostomiasis still occurs in Indonesia with an average prevalence of 1%. In West Kalimantan, Borneo, echinostome eggs are frequently observed in fecal specimens. Five species of echinostomes (E. ilocanum, E. malayanum, E. revolutum, E. echinatum, and Echinoparyphium recurvatum) are reported from the major islands (Sumatra, Java, and Sulawesi) of the Indonesian archipelago. The increased number of cases is due to the growing popularity of exotic food available in Korean and Japanese restaurants in Indonesia. Although the Lake Lindu Valley of central Sulawesi provides an excellent example of elimination of food-borne trematodiasis from the human population, biomedical surveys indicate that echinostomiasis remains a health problem in other parts of Indonesia and the world.

THE PHILIPPINES, CHINA, MALAYSIA, KOREA, JAPAN, AND THAILAND

In the Philippines, two echinostome species (E. ilocanum and E. malayanum) infect humans with an overall prevalence of 3%. In Northern Luzon, the Philippines, the prevalence of echinostome infection among Ilocanos averages 11%, reaching up to 44% in some areas. Consumption of freshwater snails such as Pila luzonica (large rice field snail), Gyraulus phrasadi, and fish as kilawen (a preparation of raw fish meat, shrimp, and mollusks with vinegar, salt, and spices) was incriminated as the main mode of echinostome transmission. In the Philippines, humans also acquire echinostome infection by eating raw snails (Lymnaea cumingiana, and P. luzonica), fish, and tadpoles as birabird, bagoong, or ilkohl, (a raw or salted preparation). Infections with E. malayanum and E. ilocanum follow a familial trend as food preparation and eating habits are passed from one generation to the next.

Three species of echinostomes (E. melis, E. revolutum, and Echinoparyphium recurvatum) were reported from Taiwan from humans, and the prevalence of infection, based on surveys of stool samples, varied from 11% to 65%. Freshwater bivalves (Corbicula fluminea and Unis spinfoei), snails (Cipangopaludina chinensis, C. miyazagii, and Sinotia quadrata), and fish were incriminated as sources of infection. Corbicula clams are eaten raw; other mollusks are pickled overnight; however, pickling does not alter infectivity of metacercariae. Raw fish is eaten with rice gruel.

In mainland China, an average prevalence of 5% was reported from Fujian and Guangdong provinces. Seven echinostome species were reported from humans in mainland China up to 1991. A survey of distribution of human food-borne trematodiasis for the period 1988–1992 conducted under the auspices of the Ministry of Public Health revealed three new species: Echinocohusmus liliplan tus, Echinochasmus fujilanensis, and Echinochasmus angustitessi. The primary mode of transmission is a practice commonly observed throughout Southeast Asia of using night soil (human excrement collected from latrines) for fertilization of fish ponds.

In Malaysia and Singapore, only one species, E. malayanum was reported from the human population. The cases of human food-borne trematodiasis encountered at the University Hospital and General Hospital, Kuala Lampur (west Malaysia) are probably acquired outside Malaysia. Three species of echinostomes have been reported in Korea from humans. These include E. cinetochris, E. hortense, and E. japonicum. Human infections with echinostomes have been frequently demonstrated in Korea starting in 1923. The prevalence of human infection in Cheongsong-gun, an island area in the southeastern part of Korea, was 22.4%. In another foci of echinostomiasis, 9.5% of specimens collected from three provinces, Koje-myon, Koyang-gun, and Kyongsangnam-do, contained echinostome eggs. Greater than 50% of stool samples collected from junior high school students located along Namhan River contained echinostome eggs. Eating of raw snails and raw or insufficiently cooked fish was incriminated as the primary mode of human infection.

Numerous cases of human echinostomiasis were reported from Japan. Eating of raw freshwater fish, in particular sashimi, was identified as the main mode of human infection with E. cinetochris, E. hortense, and E. japonicum. Four species of echinostomes (E. malayanum, E. revolutum, E. echinatum, and Hypoderaeum conoides) were reported from Thailand. Greater than 50% of the stool samples collected in northern Thailand residents contained echinostome eggs. Eating of raw snails and tadpoles was identified as a mode of transmission. Echinostomiasis is particularly prevalent in rural Thai women of child-bearing age. Two echinostome species (E. malayanum and Paryphostomum suffrartyfex) were reported in humans in India.

ECONOMIC IMPACT

Economic assessment of human echinostomiasis as well as assessment of disease morbidity and mortality are difficult because quantitative data are not available. Considering the occurrence of the food-borne trematodiasis in the areas where echinostomiasis is common, it is difficult to provide an accurate economic assessment exclusive for echinostomiasis. It is evident, however, that in the endemic areas the disease is underreported, and is most prevalent in remote rural places among the low-wage earning population and women of child-bearing age. In many countries, echinostomiasis is aggravated by socioeconomic factors such as poverty, malnutrition, and an explosively growing free-food.
As in other food-borne zoonotic parasites, i.e., paragonimiasis, fascioliasis, fascioliasis, clonorchiasis, and metagonomiasis, the endemicity of echinostome transmission depends upon the interplay of host, pathogen, and environment. As demonstrated by recent epidemiologic surveys in Asia, the patterns of food-borne trematode diseases, i.e., echinostomiasis, paragonimiasis, fasciolopsiasis, clonorchiasis, and metagonomiasis, changed following changes in habits, cultural practices, health education, industrialization, and environmental alteration.

CONTROL AND PREVENTION

The nature of echinostomiasis does not justify the establishment of a separate control program because it can be controlled along with the other food-borne parasites for which there are sustained World Health Organization (WHO) control programs. Control of human echinostomiasis via blocking or interruption of the life cycle can be achieved through proper diagnosis followed by pharmacologic treatment, and prevention of reinfection. Since human infections result from eating of raw mollusks, fish, crustaceans, and amphibians, the infections could be prevented if people change their eating habits. Significant changes in the control of intestinal helminthiasis include: 1) the development of effective broad-spectrum anthelmintics, 2) an understanding of the differences between intestinal helminths and arthropod-borne infectious agents, and 3) the implementation of control programs in school-age children with strong community therapy programs delivering multiple treatments against concurrent helminthic infections. A decreasing pattern of some food-borne trematode diseases along with industrialization, health education, and alteration of environment has been observed in certain areas of Southeast Asia. This is particularly true for Taiwan and mainland China where industrial development and wastewater discharge pollutes streams and rivers, practically destroying those aquatic animals involved in trematode life cycles. Although reduction in the number of cases of paragonimiasis, fasciolopsiasis, fascioliasis, clonorchiasis, and metagonomiasis was recognized in endemic regions, the prevalence of echinostomiasis has not changed. The disease remains a public health problem in endemic areas. The WHO control programs operating through the essential components of diagnosis, treatment, and prevention for controlling human zoonotic trematodiasiess have not been successful against echinostomiasis (although they have been successful for other trematode diseases).

WHAT MAKES ECHINOSTOMIASIS SO DIFFICULT TO CONTROL?

Echinostomiasis differs from paragonimiasis, fasciolopsiasis, fascioliasis, clonorchiasis, and metagonomiasis in that echinostomes have a much broader second intermediate host range. A wide variety of aquatic animals, i.e., snails, bivalves, crustaceans, fish, and amphibians serve as the second intermediate hosts for echinostomes. In other food-borne trematodiasiess, a second intermediate host is either lacking, as in fascioliasis, or represents a single group of organisms, i.e., crustaceans in the case of paragonimiasis, or fish in the case of clonorchiasis, fasciolopsiasis, and metagonomiasis. If transmission of trematodiasiess is going through a single group of hosts, it is relatively easy to interrupt the life cycle, and with proper diagnosis and treatment eliminate the disease from humans. In the case of echinostomiasis even with control programs that are successfully implemented and sustained by a community, the pathogens still remain in the reservoir due to the sylvatic life cycle, which has common zoonotic potential. These pools of parasites are capable of reinfecting the human population as demonstrated by follow-up stool examination of Korean soldiers stationed in foci of echinostome transmission. Reservoirs of the pathogens include a wide variety of domesticated and wild mammals and birds, and basically all aquatic organisms that sustain the first and the second intermediate hosts occurring in a particular endemic area. Human infection with echinostomes can be prevented by appropriate changes in diet and food preparation, including thorough cooking of food and giving up the habit of eating raw aquatic animals. Changing of eating habits should be implemented together with more aggressive health education campaigns in endemic areas. This is because the residents in most endemic areas consider that cooking of food destroys its flavor and nutritional value. A comprehensive community-based educational program needs to be formulated and implemented in echinostomiasis-endemic areas.

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