Zoo-15-DCE (M.Sc 2nd Sem) **Dr. Syed Tanveer**

ECHINOSTOMA REVOLUTUM

Echinostoma revolutum is a fluke that can be a parasite in humans. It causes the disease echinostomiasis

Distribution

Echinostoma revolutum is the most widely distributed species of all 20 Echinostomatidae species and it is found from Asia and Oceania to Europe and the Americas.

Echinostomiasis is not only an endemic infectious disease in Asian countries, but also can be imported by overseas travelers from the United States or Europe. An outbreak of echinostomiasis was reported among US travelers returning from Kenya and Tanzania, although the source of infection was uncertain.

Description

The worms are leaflike, elongated, and an average of 8.8 mm long (8.0–9.5 mm) and 1.7 mm wide (1.2–2.1 mm).

When first passed in the feces, they were pinkish red and coiled in a "c" or "e" shape. The eggs in uteri were an average of 105 μm long (97–117 μm) and 63 μm wide (61–65 μm).

Life cycle

Infection of *Echinostoma revolutum* usually results from ingestion of raw snails or frogs that serve as an intermediate host. This parasite is predominantly found throughout North America. Two asexual generations occur in a snail or mollusk.

The first snail host is penetrated by a miracidium, producing a sporocyst. Many sporocysts are produced and mother rediae emerge. Mother rediae asexually reproduce daughter rediae, which also multiply. Each rediae then develop into a cercariae, which penetrates a second host. The second host could be another snail or a tadpole, in which development into metacercaria occurs. Cercariae typically find a snail host through chemotaxis. The cercariae are attracted to the slime of the snail, which contains small peptides. The first larval stage is the miracidium, and are found to be attracted to macrocmolecular glycoconjugates associated with a possible snail host. Environmental stimuli such as light and gravity can also be used to assist in searching for a host.

Intermediate hosts of *Echinostoma revolutum* include:

- *Physa occidentalis*
- *Lymnaea stagnalis*
- *Lymnaea* sp. in Thailand
- *Radix auricularia*
- *Corbicula producta*
- *Filopaludina* sp. from Vietnam serves as a second intermediate host for *Echinostoma revolutum*

For example in Pursat Province, Cambodia the children were fond of eating undercooked snails or clams of unidentified species sold on the road to their homes after school. It was a source of infection in humans.

Prevalence

The first reported human infection was in Taiwan in 1929. The prevalence of *Echinostoma revolutum* flukes in Taiwan during 1929–1979 varied from 0.11% to 0.65%. Small *Echinostoma revolutum*–endemic foci or a few cases of human infection were discovered in the People's Republic of China, Indonesia, and Thailand until 1994. However, no information is available about human *Echinostoma revolutum* infection after 1994, even in areas where the parasite was previously endemic. The prevalence of infection with *Echinostoma revolutum* flukes ranged from 7.5% to 22.4% in 4 schools surveyed in Pursat Province, Cambodia, tested fecal specimens from 471 children, 10–14 years of age, in June 2007.[1] Authors reported echinostomiasis as an endemic trematode infection among schoolchildren in Pursat.

Symptoms

Signs of infection in humans due to this type of fluke can result to weakness and emaciation. In cases where infection is heavy, hemorrhagic enteritis can occur.

Diagnosis

Echinostoma revolutum could be detected through observing feces containing eggs under a microscope.

Treatment

Albendazole and praziquantel are typically prescribed to rid the parasite from the body.

TAENIA SAGINATA

Taenia saginata commonly known as the **beef tapeworm**, is a zoonotic tapeworm belonging to the order Cyclophyllidea and genus *Taenia*. It is an intestinal parasite in humans causing taeniasis (a type of helminthiasis) and cysticercosis in cattle. Cattle are the intermediate hosts, where larval development occurs, while humans are definitive hosts harbouring the adult worms. It is found globally and most prevalently where cattle are raised and beef is consumed. It is relatively common in Africa, Europe, Southeast Asia, South Asia, and Latin America. Humans are generally infected as a result of eating raw or undercooked beef which contains the infective larvae, called cysticerci. As hermaphrodites, each body segment called proglottidhas complete sets of both male and female reproductive systems. Thus, reproduction is by self-fertilisation. From humans, embryonated eggs, called oncospheres, are released with faeces and are transmitted to cattle through contaminated fodder. Oncospheres develop inside muscle, liver, and lungs of cattle into infective cysticerci.

T. saginata has a strong resemblance to the other human tapeworms, such as *Taenia asiatica* and *Taenia solium*, in structure and biology, except for few details. It is typically larger and longer, with more proglottids, more testes, and higher branching of the uteri. It also lacks an armed scolex unlike other *Taenia*. Like the other tapeworms, it causes taeniasis inside the human intestine, but does not cause cysticercosis. Its infection is relatively harmless and clinically asymptomatic

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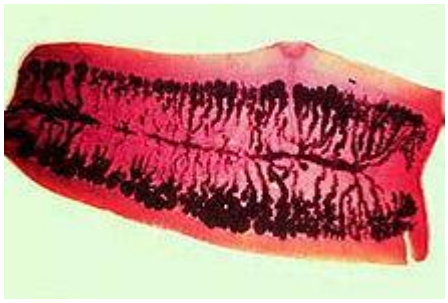
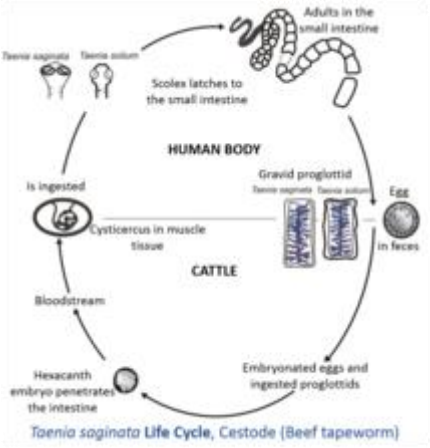


T. saginata proglottid stained to show uterine branches: The pore on the side identifies it as a cyclophyllidcestode.

T. saginata is the largest of species in the genus *Taenia*. An adult worm is normally 4 to 10 m in length, but can become very large; specimens over 22 m long are reported. Typical of cestodes, its body is flattened dorsoventrally and heavily segmented. It is entirely covered by a tegument. The body is white in colour and consists of three portions: scolex, neck, and strobila. The scolex has are four suckers, but they have no hooks. Lack of hooks and a rostellum is an identifying feature from other *Taenia* species. The rest of the body proper, the strobila, is basically a chain of numerous body segments called proglottids. The neck is the shortest part of the body, and consists of immature proglottids. The midstrobila is made of mature proglottids that eventually lead to the gravid proglottids, which are at the posterior end. An individual can have as many as 1000 to 2000 proglottids.

T. saginata does not have a digestive system, mouth, anus, or digestive tract. It derives nutrients from the host through its tegument, as the tegument is completely covered with absorptive hair-like microtriches. It is also an acoelomate, having no body cavity. The inside of each mature proglottid is filled with muscular layers and complete male and female reproductive systems, including the tubular unbranched uterus, ovary, genital pore, testes, and vitelline gland. In the gravid proglottid, the uterus contains up to 15 side branches filled with eggs.

Life cycle



The life cycle of *T. saginata* is indirect and digenetic, involving cattle and humans, with an interim of living in the environment. Humans as the definitive host harbour adult worms which release infective eggs into the environment through defecation. Cattle as the intermediate host pick up the viable eggs from contaminated vegetation.

Intermediate host

Cattle acquire the embryonated eggs, the oncospheres, when they eat contaminated food. Oncospheres enter duodenum, the anterior portion of small intestine, and hatch there under the influence of gastric juices. The embryonic membranes are removed, liberating free hexacanth ("six-hooked") larvae. With their hooks, they attach to the intestinal wall and penetrate the intestinal mucosa into the blood

vessels. The larvae can move to all parts of the body by the general circulatory system, and finally settle in skeletal muscles within 70 days. Inside the tissue, they cast off their hooks and instead develop a protective cuticular shell, called the cyst. Thus, they become fluid-filled cysticerci. Cysterci can also form in lungs and liver. The inner membrane of the cysticercus soon develops numerous protoscolices (small scolices) that are invertedly attached to the inner surface. The cysticercus of *T. saginata* is specifically named *cysticercus bovis* to differentiate from that of *T. solium*, *cysticercus cellulosae*.

Definitive host

Humans contract infective cysticerci by eating raw or undercooked meat. Once reaching the jejunum, the inverted scolex becomes evaginated to the exterior under stimuli from the digestive enzymes of the host. Using the scolex, it attaches to the intestinal wall. The larva to mature into adults about 5 to 12 weeks later. Adult worms can live about 25 years in the host. Usually, only a single worm is present at time, but multiple worms are also reported. In each mature proglottid, self-fertilisation produces zygotes, which divide and differentiate into embryonated eggs called oncospheres. With thousands of oncospheres, the oldest gravid proglottids detach. Unlike in other *Taenia*, gravid proglottids are shed individually. In some cases, the proglottid ruptures inside the intestine, and the eggs are released. The free proglottids and liberated eggs are removed by peristalsis into the environment. On the ground, the proglottids are motile and shed eggs as they move. These oncospheres in an external environment can remain viable for several days to weeks in sewage, rivers, and pastures.

Epidemiology

The disease is relatively common in Africa, some parts of Eastern Europe, the Philippines, and Latin America. This parasite is found anywhere where beef is eaten, even in countries such as the United States, with strict federal sanitation policies. In the US, the incidence of infection is low, but 25% of cattle sold are still infected. The total global infection is estimated to be between 40 and 60 million. It is most prevalent in Sub-Saharan Africa and the Middle East.

Symptoms

T. saginata infection is usually asymptomatic, but heavy infection often results in weight loss, dizziness, abdominal pain, diarrhea, headaches, nausea, constipation, chronic indigestion, and loss of appetite. Intestinal obstruction in humans can be alleviated by surgery. The tapeworm can also expel antigens that can cause an allergic reaction in the individual. It is an also rare cause of ileus, pancreatitis, cholecystitis, and cholangitis.

Diagnosis

The basic diagnosis is done from a stool sample. Feces are examined to find parasite eggs. The eggs look like other eggs from the family Taeniidae, so it is only possible to identify the eggs to the family, not to the species level. Since it is difficult to diagnose using eggs alone, looking at the scolex or the gravid proglottids can help identify it as *Taenia saginata*. Proglottids sometimes trickle down the thighs of infected humans and are visible with unaided eye, so can aid with identification. Observation of scolex help distinguish between *T. saginata, T. solium* and *T. asiatica*. When the uterus is injected with India ink, its branches become visible. Counting the uterine branches enables some identification (*T.*

saginata uteri have 12 or more branches on each side, while other species such as *T. solium* only have five to 10).

Differentiation of the species of *Taenia*, such as *T. solium* and *T. asiatica*, is notoriously difficult because of their close morphological resemblance, and their eggs are more or less identical. Identification often requires histological observation of the uterine branches and PCR detection of ribosomal 5.8S gene. The uuteri of *T. saginata* stem out from the center to form 12 to 20 branches, but in contrast to its closely related *Taenia* species, the branches are much less in number and comparatively thicker; in addition, the ovariesare bilobed and testes are twice as many.

Eosinophilia and elevated IgE levels are chief hematological findings. Also Ziehl–Neelsen stain can be used to differentiate between mature *T. saginata* and *T. solium*, in most cases *T. saginata* will stain while *T. solium* will not, but the method is not strictly reliable.

Treatment

Taenaisis is easily treated with praziquantel (5–10 mg/kg, single-administration) or niclosamide (adults and children over 6 years: 2 g, single-administration after a light breakfast, followed after 2 hours by a laxative; children aged 2–6 years: 1 g; children under 2 years: 500 mg). Albendazole is also highly effective for treatment of cattle infection.

Prevention

Adequate cooking (56°C for 5 minutes) of beef viscera destroys cysticerci. Refrigeration, freezing (-10°C for 9 days) or long periods of salting is lethal to

cysticerci. Inspection of beef and proper disposal of human excreta are also important measures.

ENTEROBIUS VERMICULARIS

Pinworm infection, also known as **enterobiasis**, is a human parasitic disease caused by the pinworm. The most common symptom is itching in the anal area. This can make sleeping difficult. The period of time from swallowing eggs to the appearance of new eggs around the anus is 4 to 8 weeks. Some people who are infected do not have symptoms.

The disease is spread between people by pinworm eggs. The eggs initially occur around the anus and can survive for up to three weeks in the environment. They may be swallowed following contamination of the hands, food, or other articles. Those at risk are those who go to school, are institutionalized, or take care of people who are infected. Other animals do not spread the disease. Diagnosis is by seeing the worms which are about one centimeter or the eggs under a microscope.

Treatment is typically with two doses of the medications mebendazole, pyrantel pamoate, or albendazole two weeks apart. Everyone who lives with or takes care of an infected person should be treated at the same time. Washing personal items in hot water after each dose of medication is recommended. Good handwashing, daily bathing in the morning, and daily changing of underwear can help prevent reinfection.

Pinworm infections commonly occur in all parts of the world. It is most common worm infection in the developed world. School aged children are the most commonly infected. In the United States about 20% of people at one point in time develop pinworm.[Infection rates among high risk groups may be as high as

50%. It is not considered a serious disease. Pinworms are believed to have affected humans throughout history.

Signs and symptoms

One third of individuals with pinworm infection are totally asymptomatic. The main symptoms are pruritus ani and perinealpruritus, i.e., itching in and around the anus and around the perineum. The itching occurs mainly during the night, and is caused by the female pinworms migrating to lay eggs around the anus. Both the migrating females and the clumps of eggs are irritating, but the mechanisms causing the intense pruritus have not been explained. The intensity of the itching varies, and it can be described as tickling, crawling sensations, or even acute pain. The itching leads to continuously scratching the area around the anus, which can further result in tearing of the skin and complications such as secondary bacterial infections, including bacterial dermatitis (i.e., skin inflammation) and folliculitis (i.e., hair follicle inflammation). General symptoms are insomnia (i.e., persistent difficulties to sleep) and restlessness. A considerable proportion of children suffer from loss of appetite, weight loss, irritability, emotional instability, and enuresis (i.e., inability to control urination).

Pinworms cannot damage the skin, and they do not normally migrate through tissues. However, in women they may move onto the vulva and into the vagina, from there moving to the external orifice of the uterus, and onwards to the uterine cavity, fallopian tubes, ovaries, and peritoneal cavity. This can cause vulvovaginitis, i.e. an inflammation of the vulva and vagina. This causes vaginal discharge and pruritus vulvae, i.e., itchiness of the vulva. The pinworms can also enter the urethra, and presumably, they carry intestinal bacteria with them. According to Gutierrez (2000), a statistically significant correlation

between pinworm infection and urinary tract infections has been shown;[however, Burkhart & Burkhart (2005) maintain that the incidence of pinworms as a cause of urinary tract infections remains unknown. Incidentally, one report indicated that 36% of young girls with a urinary tract infection also had pinworms. Dysuria (i.e., painful urination) has been associated with pinworm infection.

The relationship between pinworm infestation and appendicitis has been researched, but there is a lack of clear consensus in the matter: while Gutierres (2005) maintains that there exists a consensus that pinworms do not produce the inflammatory reaction, Cook (1994) states that it is controversial whether pinworms are causatively related to acute appendicitis, and Burkhart & Burkhart (2004) state that pinworm infection causes symptoms of appendicitis to surface.

Lifecycle

The lifecycle begins with eggs being ingested. The eggs hatch in the duodenum (i.e., first part of the small intestine). The emerging pinworm larvae grow rapidly to a size of 140 to 150 micrometers in size, and migrate through the small intestine towards the colon. During this migration they moult twice and become adults. Females survive for 5 to 13 weeks, and males about 7 weeks. The male and female pinworms mate in the ileum (i.e., last part of the small intestine), whereafter the male pinworms usually die, and are passed out with stool. The gravid female pinworms settle in the ileum, caecum (i.e., beginning of the large intestine), appendix and ascending colon, where they attach themselves to the mucosa[17] and ingest colonic contents. Almost the entire body of a gravid female becomes filled with eggs. The estimations of the number of eggs in a gravid female pinworm ranges from about 11,000 to 16,000. The egg-laying process

begins approximately five weeks after initial ingestion of pinworm eggs by the human host. The gravid female pinworms migrate through the colon towards the rectum at a rate of 12 to 14 centimeters per hour. They emerge from the anus, and while moving on the skin near the anus, the female pinworms deposit eggs either through (1) contracting and expelling the eggs, (2) dying and then disintegrating, or (3) bodily rupture due to the host scratching the worm. After depositing the eggs, the female becomes opaque and dies. The reason the female emerges from the anus is to obtain the oxygen necessary for the maturation of the eggs.

Diagnosis

Diagnosis depends on finding the eggs or the adult pinworms. Individual eggs are invisible to the naked eye, but they can be seen using a low-power microscope. On the other hand, the light-yellowish thread-like adult pinworms are clearly visually detectable, usually during the night when they move near the anus, or on toilet paper. Transparent adhesive tape (e.g. Scotch Tape) applied on the anal area will pick up deposited eggs, and diagnosis can be made by examining the tape with a microscope. This test is most successful if done every morning for several days, because the females do not lay eggs every day, and the number of eggs vary.

Pinworms do not lay eggs in the feces, but sometimes eggs are deposited in the intestine. As such, routine examination of fecal material gives a positive diagnosis in only 5 to 15% of infected subjects, and is therefore of little practical diagnostic use. In a heavy infection, female pinworms may adhere to stools that pass out through the anus, and they may thus be detected on the surface on the stool. Adult pinworms are occasionally seen during colonoscopy. On a microscopic level,

pinworms have an identifying feature of alae (i.e., protruding ridges) running the length of the worm.

Prevention

Pinworm infection cannot be totally prevented under most circumstances. This is due to the prevalence of the parasite and the ease of transmission through soiled night clothes, airborne eggs, contaminated furniture, toys and other objects. Infection may occur in the highest strata of society, where hygiene and nutritional status are typically high. The stigma associated with pinworm infection is hence considered a possible over-emphasis. Counselling is sometimes needed for upset parents that have discovered their children are infected, as they may not realize how prevalent the infection is.

Preventative action revolves around personal hygiene and the cleanliness of the living quarters. The *rate* of reinfection can be reduced through hygienic measures, and this is recommended especially in recurring cases. The main measures are keeping fingernails short, and washing and scrubbing hands and fingers carefully, especially after defecation and before meals. Under ideal conditions, bed covers, sleeping garments, and hand towels should be changed daily. Simple laundering of clothes and linen disinfects them. Children should wear gloves while asleep, and the bedroom floor should be kept clean. Food should be covered to limit contamination with dust-borne parasite eggs. Household detergents have little effect on the viability of pinworm eggs, and cleaning the bathroom with a damp cloth moistened with an antibacterial agent or bleach will merely spread the still-viable eggs. Similarly, shaking clothes and bed linen will detach and spread the eggs.

Treatment

Medication is the primary treatment for pinworm infection. They are so effective that many medical scientists regard hygienic measures as impractical. However, reinfection is frequent regardless of the medication used. Total elimination of the parasite in a household may require repeated doses of medication for up to a year or more. Because the drugs kill the adult pinworms, but not the eggs, the first retreatment is recommended in two weeks. Also, if one household member spreads the eggs to another, it will be a matter of two or three weeks before those eggs become adult worms and thus amenable to treatment.[Asymptomatic infections, often in small children, can serve as reservoirs of infection, and therefore the entire household should be treated regardless of whether or not symptoms are present.

The benzimidazole compounds albendazole (brand names e.g., *Albenza*, *Eskazole*, *Zentel* and *Andazol*) and mebendazole (brand names e.g., *Ovex*, *Vermox*, *Antiox* and *Pripsen*) are the most effective. They work by inhibiting the microtubule function in the pinworm adults, causing glycogen depletion, thereby effectively starving the parasite. A single 100 milligram dose of mebendazole with one repetition after a week, is considered the safest, and is usually effective with cure rate of 96%.Mebendazole has no serious side effects, although abdominal pain and diarrhea have been reported. Pyrantel pamoate (also called pyrantel embonate, brand names e.g., *Reese's Pinworm Medicine*, *Pin-X*, *Combantrin*, *Anthel*, *Helmintox*, and *Helmex*) kills adult pinworms through neuromuscular blockade, and is considered as effective as the benzimidazole compounds and is used as a second-line medication. Other medications are piperazine, which causes flaccid paralysis in the adult pinworms, and pyrvinium pamoate (also called pyrvinium embonate), which works by inhibiting oxygen uptake of the adult pinworms. Pinworms located in

the genitourinary system (in this case, female genital area) may require other drug treatments.