

Trichinella spp. (Pathogen – Tissue Nematode)

Organism:

Trichinella is quite different from many other helminths because all stages of development (adult and larva) occur within a single host. More than 100 different mammals are susceptible to infection, and the cysts can remain viable and infectious for many years, even in decaying muscle tissue. These factors ensure successful transmission and the survival of the parasite. There are now 11 recognized *Trichinella* species or genotypes, *T. spiralis*, *T. nativa*, *T. nelsoni*, *T. britovi*, *T. pseudospiralis*, *T. murelli*, T6, T8, T9, *T. papuae*, and *T. zimbabwensis*. Unless the clinician recognizes an appropriate history, fever, myalgia, periorbital edema, and/or rising eosinophilia (50% or higher), the cause may go undetected. Often, the first clue is the patient's history of possible ingestion of raw or rare pork or other infected meat.



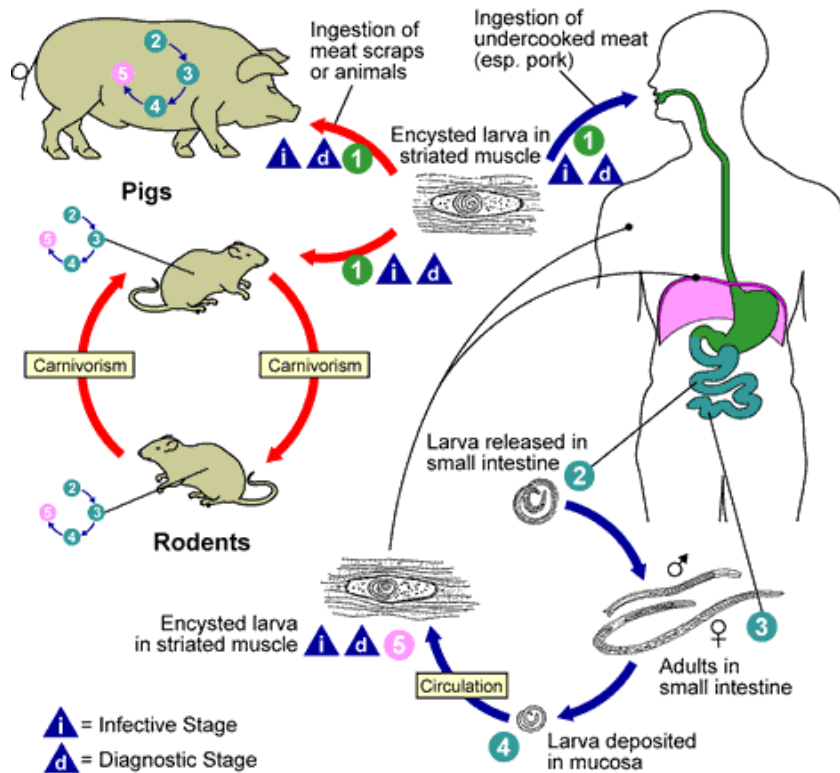
Swelling around eyes

Splinter hemorrhages in nails

Encysted *Trichinella* spp.



Reservoir animals: pig, bear, horse, walrus



Life Cycle:

Human infection is initiated by the ingestion of raw or poorly cooked pork, bear, walrus, or horse meat or meat from other mammals (carnivores and omnivores) containing viable, infective larvae. The tissue is digested in the stomach, and the first-stage larvae (L₁) are resistant to gastric juice. The excysted larvae then invade the intestinal mucosa, develop through four larval stages within about 36 h, mature, and mate by the second day. By the sixth day of infection, the female worms begin to deposit motile larvae, which are carried by the intestinal lymphatic system or mesenteric venules to the body tissues, primarily striated muscle. Deposition of larvae continues for approximately 4 to 16 weeks, with each female producing up to 1,500 larvae in the nonimmune host. Newborn larvae can penetrate almost any tissue but can continue their development only in striated muscle cells. As the larvae begin to coil, the nurse cell completes the formation of the cyst within about 2 to 3 weeks. Within the human host, the cyst measures about 400 by 260 μm, and within the cyst, the coiled larva measures 800 to 1,000 μm in length. At this point, the larvae are fully infective.

The very active muscles, which have the greatest blood supply, including the diaphragm, muscles of the larynx, tongue, jaws, neck, and ribs, the biceps, and the gastrocnemius, are invaded. The encysted larvae may remain viable for many years, although calcification can occur within less than a year. As few as five larvae per g of body muscle can cause death, although 1,000 larvae per g have been recovered from individuals who died from causes other than trichinosis.

Acquired:

Infection in humans is acquired through ingestion of raw or poorly cooked pork, bear, walrus, horse meat or meat from other mammals containing viable, infective larvae.

Epidemiology:

Trichinosis has a cosmopolitan distribution but is more important in the United States and Europe than in the tropics or the Orient. The prevalence in autopsies within the United States has declined from 15.9% of human diaphragms studied at autopsy from 1931 to 1944 to 4.5% from 1948 to 1963; in recent years, the prevalence has decreased to 2.2% and the mortality associated with this infection has decreased to less than 1%. In 1990, only 105 cases of human trichinosis were reported in the United States, and by 1994, the number had dropped to 35. During 1997 to 2001 the incidence decreased to a median of 12 cases annually and no reported deaths). However, in many areas of the world, trichinosis remains a problem. Cases are often associated with eating noncommercial pork from home-raised or direct-from-farm swine where United States commercial pork production industry standards and regulations are not applicable.

Clinical Features:

Pathologic changes due to trichinosis can be classified as (i) intestinal effects and (ii) muscle penetration and larva encapsulation. Any damage caused in either phase of the infection is usually based on the original number of ingested cysts; however, other factors such as the patient's general health, age, and size also play a role in the disease outcome. Symptoms of trichinosis are generally separated into three phases, with phase 1 being related to the presence of the parasite in the host prior to muscle invasion and phase 2 being related to the inflammatory and allergic reactions due to muscle invasion. There may also be an incubation period of up to 50 days. Phase 3 is the convalescent phase or chronic period.

Symptoms that may develop within the first 24 h include diarrhea, nausea, abdominal cramps, and general malaise, all of which may suggest food poisoning, particularly if several people are involved. Studies also indicate that the diarrhea can be prolonged, lasting up to 14 weeks (average, 5.8 weeks) with few or no muscle symptoms. It is still unknown whether this clinical presentation is related to variant biological behavior of Arctic *Trichinella* organisms, to previous exposure to the parasite, or to other factors.

During muscle invasion, there may be fever, facial (particularly periorbital) edema, and muscle pain, swelling, and weakness. The extraocular muscles are usually the first to be involved, followed by the muscles of the jaw and neck, limb flexors, and back. Muscle damage may cause problems in chewing, swallowing, breathing, etc., depending on which muscles are involved. The most severe symptom is myocarditis, which usually develops after the third week; death may occur between the fourth and eighth weeks. Other severe symptoms, which can occur at the same time, may involve the central nervous system (CNS). Although *Trichinella* encephalitis is rare, it is life threatening.

It is estimated that 10 to 20% of the patients with trichinosis have CNS involvement and that the mortality rate may reach 50% in these patients if they are not treated. Symptoms may mimic those of polyneuritis, acute anterior poliomyelitis, myasthenia gravis, meningitis, encephalitis, dermatomyositis, and polyarteritis nodosa. There may be focal paresis or paralysis (quadriplegia to single muscle group).

Peripheral eosinophilia of at least 20%, often over 50%, and possibly up to 90% is present during the muscle invasion phase of the infection. Fever can also be present at this time and can persist for several days to weeks,

depending on the intensity of the infection. However, once the larvae begin to encapsulate, patient symptoms subside, and eventually the cyst wall and larvae calcify.

Clinical Specimen:

Muscle: Confirmation of the infection depends on finding the encysted larvae; HOWEVER, it is important to remember that not all species form the capsule.

Serum: Serologic tests are also very helpful, the standard two being the enzyme immunoassay (EIA) and the bentonite flocculation test, which are recommended for trichinosis. The EIA is used for routine screening, and all EIA-positive specimens are tested by bentonite flocculation for confirmation.

Laboratory Diagnosis:

Muscle: Muscle biopsy (gastrocnemius, deltoid, and biceps) specimens may be examined by compressing the tissue between two slides and checking the preparation under a microscope at low power (10× objective). However, this method does not provide positive results until 2 to 3 weeks after the onset of the illness.

NOTE: Larvae or adult worms are rarely recovered in fecal specimens during the intestinal phase (diarrhea).

Serum: A positive reaction in the EIA and bentonite flocculation tests indicates infection with *T. spiralis* within the last few years. Often, antibody levels are not detectable within the first month postinfection. The titers tend to peak in the second or third months postinfection and then decline over a period of a few years. The indirect fluorescent-antibody test (IFAT) has also been used to track the course of disease after infection.

Organism Description:

Larvae: Using compression slides, examination of suspect meat may reveal larvae (artificial digestion procedure). Note: not all species of larvae will form the capsule; however, the unencapsulated larvae can still be seen in a “squash” preparation of biopsy material. Within the human host, the cyst measures about 400 by 260 µm, and within the cyst, the coiled larva measures 800 to 1,000 µm in length.

Laboratory Report:

Trichinella spp. larvae present OR serology results indicated (with interpretation)

Treatment:

Therapy depends on the phase of the disease, the immune status of the patient, and the intensity and length of the disease. For the early phase of infection, the objective is to reduce the number of larvae that will invade the muscles. Once larval invasion of the muscles has occurred, the objective becomes to reduce muscle damage. The current recommendation for the gastrointestinal phase is the use of mebendazole (200 to 400 mg/day for 3 to 5 days) or albendazole (400 mg/day); after the first 3 to 5 days of mebendazole therapy, the dose is changed (400 to 500 mg/day) and given for 10 days. For acute, severe infection, steroids are recommended (prednisolone, 40 to 60 mg/day) along with mebendazole (5 mg/kg/day) or albendazole (400 to 800 mg twice a day for 8 to 14 days). For moderate or mild infection, steroids can be given as required; once fever and allergic signs diminish, steroid administration can be discontinued. Unfortunately, the disease is often diagnosed well after muscle invasion has begun. At this point, supportive therapy may be the only option.

Garcia, L.S. 2007. Diagnostic Medical Parasitology, 5th ed., ASM Press, Washington, D.C.

Control:

Studies on a pig farm indicate that even in the absence of a known source of infected meat (garbage containing meat scraps or dead animals), the rat population maintained the infection, probably through cannibalism. Consequently, to reduce transmission of *T. spiralis* between rats and swine, rat populations in an agricultural ecosystem must be controlled. It is also important to limit access to the farmyard by wild and feral animals. Thorough cooking of infected meats is mandatory. While cases acquired from pork consumption continue to decline, the proportion of cases acquired from wild game meat has increased.