Human Trichinellosis From Laos

Kanitta Suwansrinon, MD,* Henry Wilde, MD,† Benjamin Burford, MD,‡ Rekha Hanvesakul, MD,§ and Visith Sitprija, MD*

*Queen Saovabha Memorial Institute, Thai Red Cross Society, Bangkok, Thailand; †Department of Medicine, King Chulalongkorn University Hospital, Bangkok, Thailand; ‡Australian Embassy Medical Center, Vientienne, Laos; §BNH Hospital, Bangkok, Thailand

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There are biblical references to an illness that could have been trichinellosis and which was associated with consumption of pork, but the nematode *Trichinella spiralis* was first described in 1835. The genus *Trichenella* contains at least seven species: *T spiralis*, *Trichenella nativa*, *Trichenella britovi*, *Trichenella pseudospiralis*, *Trichenella murrelli*, *Trichenella nelsoni*, and *Trichenella papuae*.[1] The geographical distribution of the different species is related to ecology, climate, and host behavior.[2] The host range of *Trichinella* is wider than previously believed. New species are being continuously recognized. Three classes of vertebrates are known to act as hosts (ie, mammals, birds, and reptiles). Mammals represent the most important hosts, and all *Trichinella* species are able to develop in this class. The nonencapsulated species *T pseudospiralis*, detected in both mammals and birds, show a cosmopolitan distribution. They tend to have a more prolonged clinical course. Three cases of trichinellosis, after a saltwater turtle dinner, were reported from Songkhla, Thailand, 14 years ago. The species of the turtle and of the *Trichinella* were not identified. Two additional nonencapsulated species, *T papuae*, detected in wild pigs and saltwater crocodiles of Papua, New Guinea, and *Trichenella zimbabwensis*, found in farmed Nile crocodiles and in sylvatic monitor lizards of Zimbabwe, have been reported.[3,4] The life cycle of *Trichinella* is completed when first-stage larvae mature in striated muscle. Such larvae are immunogenic, as evidenced by sustained antibody production against larval glycans. In contrast to a vigorous systemic immune response, local inflammation is limited. Nonencapsulating species of *Trichinella* such as *T pseudospiralis* induce little to no local inflammatory responses in reptilian, avian, and mammalian hosts. They also appear to remain viable longer. Encapsulated species induce limited local inflammation in a variety of mammalian hosts, which contributes to isolation and eventual calcification. Control of local inflammation promotes the survival of the parasite and of the host. The nature of responses is shared across host species and among related species. Trichinellosis can range from an asymptomatic to a fatal disease depending on the infective dose and host response. Most infections are asymptomatic. In the week following ingestion of contaminated meat, the patient may experience nausea, vomiting, diarrhea, and abdominal discomfort due to intraintestinal activities of the adult worms. If the infestation is significant, a sudden onset of muscle soreness, pain, fever, edema of the face and eyelids, and urticaria may appear 2 to 8 weeks after ingestion. Subungual hemorrhages, like those usually associated with infective endocarditis, are also occasionally observed. Laboratory tests showed a rapid increase in peripheral eosinophils. This is when larvae disseminate into muscle. Fever usually resolves after 1 to 6 weeks. Cardiac and neurological complications may develop in severe infestations and lead to death within 3 to 6 weeks. Enzyme-linked immunosorbent assays have largely replaced latex agglutination, bentonite flocculation, complement fixation, and indirect immunofluorescent tests. A muscle biopsy should confirm the diagnosis, and an impression smear, followed by direct microscopy may show mobile larvae. Molecular and genetic technologies are now available for species identification. Several food-borne parasitic infestations, including trichinellosis, are transmitted to humans because of improper animal management, food handling, or both. The organism is acquired from raw or inadequately cooked meat or

Corresponding Author: Professor Henry Wilde, MD, Queen Saovabha Memorial Institute, 1871 Rama IV Road, Bangkok 10330, Thailand. E-mail: wildehenry@yahoo.com

meat products containing viable *Trichinella*. Pork and pork products are the most likely source. Beef, which may become inadvertently adulterated with raw pork during processing, may also be a source. Trichinellosis from consumption of horse and bear meat in Europe and Australia has also caused outbreaks of trichinellosis.[5] The usual incubation period is 5 to 15 days. If large numbers of larva are ingested, symptoms may occur more rapidly. Trichinellosis is not transmitted directly from person to person. Animal hosts may retain viable larvae for months and their meat can be infective until sufficient cooking kills the larvae. All carnivores are considered potential hosts of most, if not all, *Trichinella* species. We encountered four human cases from Laos, which we present here to illustrate current issues.

Case Report

A 57-year-old Caucasian man working in rural Laos presented to the Australian Embassy Clinic in Vientiane, with persistent fever for 2 weeks, watery diarrhea, vague body aches, and muscle weakness. He denied eating any pork or "jungle meat" for at least 1 month, but stated that he had "dined" on rice whiskey and "sticky rice" dipped in duck meat mixed with blood while visiting some rural friends a few days prior to onset of his illness. He was referred to an Udon Thani, Thailand hospital, after he developed fever of 40ºC. When the fever persisted and the diagnosis was unclear, he was transferred to the BNH Hospital at Bangkok, for further investigation. His body temperature was 37.8°C, respiratory rate (RR) 20/min, pulse rate (PR) 96/min, and blood pressure 110/70 mmHg. He had a faint, generalized, erythematous, nonpruritic rash on his chest and upper back. There was no periorbital edema, and he denied having had any at the onset of his illness. His liver was barely palpable and nontender. His primary complaint was that he had marked proximal muscle weakness of his lower extremities and was unable to stand up from a squatting position without help. He did not complain of muscle pain or tenderness, and none could be elicited. Reflexes were equally present but diminished in his lower extremities. Sensory function and proprioception were normal. Laboratory investigation revealed the following: hemoglobin 15.3 g/dL, white blood cell count 18,800/μL with 14% eosinophilia, and platelets 801,000/μL. The transaminases were mildly elevated [aspartate aminotransferase 78 U/L (<50), alanine aminotransferase 121 U/L (<50)]. The serum Creatine kinase (CPK) level was 446 U/L (<200), Lactate dehydrogenase (LDH) 833 U/L (<250), and erythrocyte sedimentation rate (ESR) 36 mm/h. Blood and urine cultures resulted in no growth. A screening human immunodeficiency virus test and VDRL were negative. A stool examination for parasites revealed none. Thyroid function tests were within normal limits. Histological examination of deltoid muscle showed accumulation of inflammatory cells and muscle fiber degeneration. In addition, one focal lesion disclosed a *Trichinella* larva and associated inflammation. The patient was started on albendazole 400 mg thrice daily for 2 weeks. His clinical condition improved, and he was discharged on the third day and followed as an outpatient. He recovered fully within less than 1 month. Due to the patient's persistent denial of eating pork products, we considered the possibility of sylvatic trichinellosis. A formalin-fixed tissue sample was sent to Dr Edoardo Pozio at the Instituto Superiore di Samita at Rome, and was examined there. Briefly, the sample was deparafinized, rehydrated, and digested with 40 mg/mL proteinase K. DNA was extracted by magnetic beads using a hair extraction kit (Promega, Madison, WI). Multiplex polymerase chain reaction analysis was then used to identify the larvae at the species level.[6] The specimen was identified as *T spiralis*. No serological tests were carried out on this patient (Table 1).

Prior Cases From Laos

Human trichinellosis is common in Northern Thailand and Laos, and our prior experience usually allowed a clinical diagnosis based on a history of consuming poorly cooked pork and a classical clinical presentation with fever, facial edema, myalgia, and eosinophilia. Cases II to IV were seen at the Bangkok Nursing Home (now the BNH Hospital at Bangkok) by Henry Wilde in 1986. Cases II and III were mother and daughter who became infected at a diplomatic garden party at Vientiane, Laos, where poorly cooked, barbecued pork sausages had been served. Case IV lived at Luang Prabang, Laos, where he was presumably infected by eating pork sausages.

Only case I presented alone and was not aware of others. Case IV later became aware of other cases treated locally who had eaten at the same food vendor. The diplomatic garden party resulted in at least 20 patients who developed trichinellosis of mild to moderate severity. They received mebendazole once a clinical diagnosis was suspected, and all were said to have fully recovered within less than 1 month (Table 1).

Table 1 Details of four patients with trichinellosis

Case (year)	Age (y)	Sex	Ethnic	Origin of trichinellosis	Symptoms	White blood cells (/μL)	% Eosinophils	Creatine kinase (U/L)	Biopsy result	Polymerase chain reaction	Serology	Treatment	Duration of treatment (d)	Follow-up
I (2004)	57	Male	New Zealand	Unknown (Figure 2)	Weakness (Figure 1)	18,800	14	446	+ (Figure 3)	*Trichinella spiralis*	Not sent	Albendazole	14	Recovery
II (1986)	37	Female	French-Vietnamese	Pork sausages (Figure 2)	Classical	18,000	36	201	+	Not available	+	Mebendazole	14	Recovery
III (1986)	63	Female	French-Vietnamese	Pork sausages (Figure 2)	Classical	13,500	54	230	Not sent	Not available	+	Mebendazole	14	Recovery
IV (1986)	35	Male	Dutch	Pork sausages	Classical and also subungual hemorrhage, as shown in Figure 2, Figure 3	16,300	50	772	Not sent	Not available	+	Mebendazole	14	Recovery

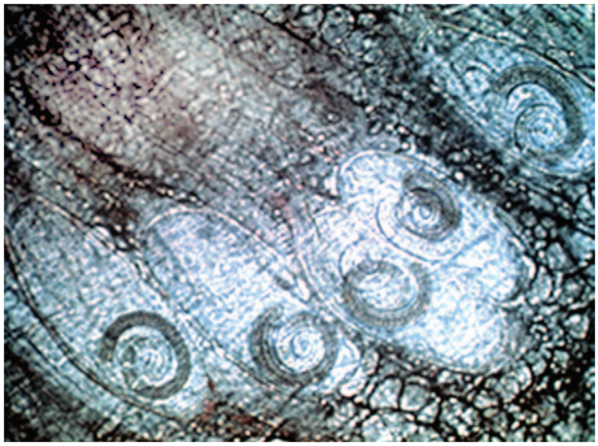

Figure 1 Laotian sausages were responsible for trichinellosis in cases II and III.

Discussion

Our most recent patient from Laos (case I) had a confusing history and physical findings that first suggested a neuropathy rather than trichinellosis. His eosinophilia was the clue that led us to carry out a diagnostic muscle biopsy. His persistent denial of having eaten any pork products and the village meal consisting of raw or nearly raw duck raised the question whether we could be dealing with a sylvatic *Trichinella*. Trichinellosis has long been recognized as a public health hazard in the northeastern part of Thailand, Laos, Cambodia, and Vietnam, where the consumption of raw or poorly cooked meat is a common practice. Dumplings with raw or near-raw pork (salapao) are popular in the north and northeastern parts of South-East Asia. Housewives may taste the raw meat fillings when preparing such dumplings and are thus at higher risk. Usually, people come down with trichinellosis in groups among

Figure 2 Splinter hemorrhage seen in case IV on admission.

Figure 3 Muscle biopsy from deltoid region of case I revealing *Trichinella spiralis* larvae.

participants at parties. Many of the lightly infected cases remain unrecognized. Another sources of *T spiralis* infestation in man are knives and tableware used during preparation of food. Most rural households use one knife and one chopping board for cooked and raw food, thus enhancing the risk.[6] Single and unrelated cases are the exception.[7] A single detected case of trichinellosis implies that other people may be infected. Individuals known to have recently ingested the same product as the index patient should consult with their healthcare provider regarding prophylactic treatment options. It is customary in Thailand to give such an exposed person prophylactic albendazole.

Trichinellosis has been associated with the consumption of improperly cooked or raw pork.[8] However, other types of meat can result in infestation. Meat from canines, horses, rodents, bears, badgers, wolves, walruses, foxes, wild cats, and even some birds and reptiles have all been documented causes of trichinellosis in man.[9] Discovery of trichinellosis in more exotic animals such as crocodiles and turtles has expanded the scope of this disease. Consuming uncooked or poorly cooked reptile meat is a risk factor for sylvatic trichinellosis, which may well present with different clinical manifestations.[10]

Our most recent patient was emphatic in that he had not eaten any pork for weeks prior to onset of his illness. He incriminated a poorly cooked, perhaps even raw, meal consisting of duck meat and blood responsible for his infection. This caused us to send a tissue sample to Drs Edoardo Pozio and Giuseppe La Rosa for molecular studies to exclude sylvatic trichinellosis. The organisms, however, turned out to be *T spiralis*. Nevertheless, the possibility that it originated from the raw duck meat could not be excluded. It is obvious that we need to learn more about the prevalence of *Trichinella* in other animals than in pigs in this region.

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Declaration of Interests

The authors state that they have no conflicts of interest.

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