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# Imported disease of dogs and cats exotic to Ireland: *Echinococcus multilocularis*

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Changes in legislation that facilitate the movement of animals within the European Union may increase the risk that some microbial and parasitic organisms, currently exotic to Ireland, will be introduced by travelled pet animals. It is possible that the fox tapeworm, *Echinococcus multilocularis*, might be introduced in that manner from any of the several member states in which it is endemic. Red foxes are the principal definitive hosts of *E. multilocularis* but dogs and cats can also be infected. Infection in the definitive host is of little clinical significance, but aberrant infection of humans results in alveolar echinococcosis, a debilitating disease that has a high mortality rate. Humans acquire the organism by ingestion of *Echinococcus multilocularis* eggs excreted by definitive hosts; the larval metacestodes develop primarily in the liver, in the initial asymptomatic phase as small, well-encapsulated cysts. Over time, perhaps five to 15 years, progressive local infiltration and secondary cyst development at distant sites occur with resultant clinical signs. Patients with infiltrative liver disease present with cholestatic jaundice, epigastric pain, fatigue, weight loss and hepatomegaly. If left untreated, the disease can be fatal.

This paper recounts the life cycle of the parasite, and discusses the control measures on which its exclusion from Ireland depend. Strict adherence to the routine worming of travelled dogs with praziquantel, at appropriate doses, 24 to 48 hours prior to entry into the country will minimise the likelihood of introduction of this zoonosis.

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## Introduction

*Echinococcus multilocularis*, commonly known as the fox tapeworm, is endemic to areas of central and northern Europe, northern Asia and parts of North America. The life cycle is primarily sylvatic, involving foxes and small herbivores such as voles, but the domestic dog can also act as a definitive host. Aberrant infection of humans results in alveolar echinococcosis, a debilitating and possibly fatal disease. A thorough knowledge of the life cycle of this parasite and its control underpins its successful exclusion from Ireland and reinforces the importance of prior praziquantel treatment of imported animals.

## Life cycle

Although the red fox and the arctic fox are the most well-known definitive hosts, others include the coyote, racoon dog, sand fox and Tibetan fox. Other canids, including the domestic dog, can also become definitive hosts if they ingest an intermediate host harbouring the infective metacestode. Cats are capable of acting as aberrant definitive hosts with low or negligible egg excretion. The principal intermediate hosts are small herbivores or insectivores: voles, squirrels, hamsters, mice, jerboas, shrews and, occasionally, moles and desmans.

Infection in the definitive host is often asymptomatic. The adult stage of *Echinococcus multilocularis* is a cestode similar in appearance to *Echinococcus granulosus*. The cestode is 1.2mm to 4.5mm long, usually with five segments (there is a range of two to six) terminating in a sac-like 'uterus' (**Figure 1**). Adults are resident deep into the crypts of Lieberkuhn of the intestinal mucosa where they cause flattening, but not disruption, of the epithelium. As there are no gross intestinal lesions, there are few or no ill effects on definitive hosts, even in the face of a heavy burden.

The prepatent period is unclear but eggs are thought to be excreted by definitive hosts from day 35. Eggs are immediately infective and infection of the intermediate host occurs through ingestion. Within the intermediate host, metacestodes develop primarily in the liver but occasionally they are found in other organs, including the lungs and central nervous system. This metacestode stage consists of aggregations of small vesicles ('hydatid cysts') in which infective

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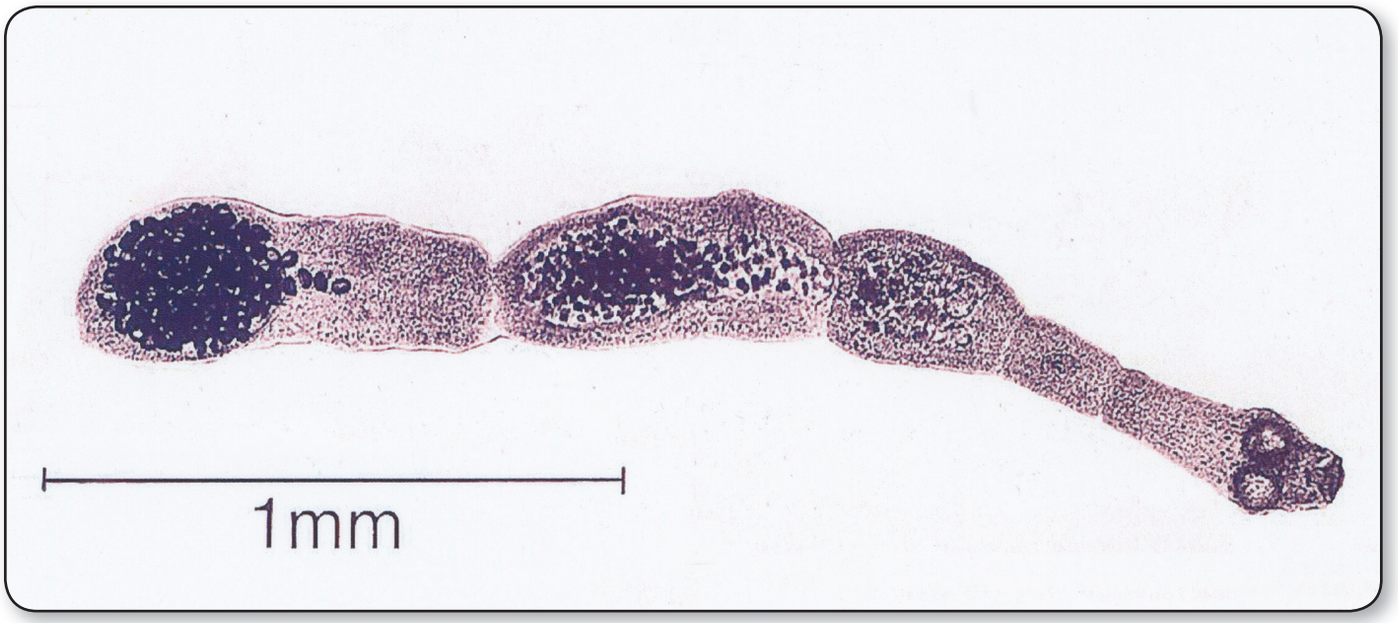


**Figure 1:** Adult *E.multilocularis*. Photo: Institute of Parasitology, University of Zurich.

protoscoleces are produced. The cysts vary in size, shape and number and aggregate to form alveolar structures 1mm to 30mm in diameter, containing a variable number of protoscoleces that have the capacity to proliferate and progressively invade the surrounding host tissue. During this process the parasite is protected from the host immune response by its carbohydrate-rich laminated layer. Metacestode development is well adapted to the naturally short-lived intermediate hosts and protoscoleces are produced in 40 to 45 days. In experimental models natural intermediate hosts will die from the consequences of parasitic organ infiltration about five months following infection. However, in the wild the host might succumb to predation by a carnivore before this occurs.

A wide variety of species has been observed to act as aberrant intermediate hosts such as rodents, lagomorphs, domestic and wild pigs, domestic dogs, domestic cats, monkeys, horses and humans. In fact, there are reported occurrences of individual dogs acting as both definitive and intermediate host concurrently. The development of the metacestode in these aberrant intermediate hosts is similar to that in the natural intermediate host with the coalescence of numerous hepatic vesicles to form alveolar structures. Local tissue invasion results in hepatic and other organ dysfunction. Dogs have been reported to present with abdominal enlargement, ascites and hypergammaglobulinaemia.

## Epidemiology and control in endemic countries

*Echinococcus multilocularis* is endemic to areas of France, Spain, Portugal, Greece, Germany, Austria, Switzerland, Belgium, the Czech Republic, Denmark, Liechtenstein, Luxembourg, Poland and the Slovak Republic. This range then extends east as far as Japan, Canada and the northern United States and is proposed to include parts of north Africa. The principal reservoir of infection is the native fox population, although in some areas self-perpetuating reservoirs exist in domestic dogs. Young foxes and dogs tend to have the heaviest burdens, but older animals can also be infected regardless of prior exposure.

Infection of domestic pets with *Echinococcus multilocularis* has been documented throughout Europe. For example, prevalence of infestation in the domestic dog and cat populations in France and Germany is estimated, from necropsy studies, to be 0.4% to 5.6%. Necropsy studies, however, will tend to overestimate prevalence in a population. Newer faecal coproantigen tests on randomly selected Swiss dogs and cats give a prevalence of 0.3% in dogs (rising to 7% in urban populations) and of 0.4% in cats (rising to 3% in urban populations). Many of these areas were previously perceived to be free from the parasite. These trends of increasing prevalence may be due to increased diagnostic accuracy or, more likely, to the spread of the parasite's range, associated with increasing urban fox population or travel of infected dogs. Irrespective of cause, this increased parasite density constitutes an increased risk to domestic pets and to the human population.

Control of *Echinococcus multilocularis* in domestic pets living in countries where the disease is endemic involves a combination of routine anthelminthic use, public area hygiene, control of the stray dog population and, perhaps most importantly, public education. In addition, there have been efforts to control infection in the wild fox population in Germany with aircraft-dropped baits spiked with praziquantel, which have been more successful than fox culling programmes.

## Diagnosis and treatment

Briefly, diagnosis in intermediate and definitive hosts uses a number of techniques to achieve cestode identification. Unfortunately, routine coprological microscopic examination does not allow the differentiation of *Echinococcus* and *Taenia* spp eggs thus serology, faecal antigen ELISA or PCR are required. In living patients, ultrasound examination of abdominal organs or the characteristic cysts may be beneficial in achieving a diagnosis.

Because domestic dogs and cats with intestinal *Echinococcus multilocularis* represent a potential risk to humans, infected animals

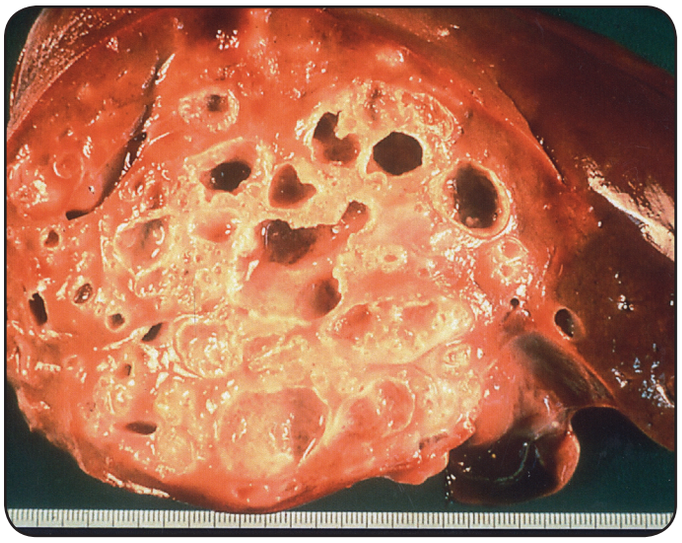

**Figure 2:** Human liver with alveolar echinococcosis. Photo: Institute of Parasitology, University of Zurich.

should be treated immediately. A single dose of praziquantel (**Appendix 1**) virtually eliminates the entire worm burden.

Confirmed infected cases should receive two doses on consecutive days and, four or five days afterwards, the results should be assessed by coproantigen ELISA.

Owners of infected dogs should be advised to contact their doctor for serological testing within several weeks, and for this to be repeated in six and 12 months.

## Human alveolar echinococcosis

Human infection is sporadic and possibly fatal. In Europe, human alveolar echinococcosis occurs at a prevalence ranging from 0.03 (Austria) to 1.4 (Doubs, France) per 100,000 members of the population. The majority of cases are thought to be due to environmental or food contamination with infected fox or dog faeces and poor hygiene precautions. Eggs can survive for up to eight months in winter conditions and three months in summer.

Alveolar echinococcosis follows ingestion of eggs that have been shed in the faeces of a definitive host. The initial phase, characterised by development of small well-encapsulated hepatic cysts, is asymptomatic, but local infiltration and secondary cyst development at distant sites occur progressively with resultant clinical signs. The incubation period prior to clinical symptoms is prolonged, perhaps five to 15 years and clinical symptoms only occur when large parts of the liver are already infiltrated (**Figure 2**). Patients with infiltrative liver disease present with cholestatic jaundice, epigastric pain, fatigue, weight loss and hepatomegaly. Treatment is rarely curative and involves partial or radical surgical resection of lesions with long-term or life-long treatment with a benzimidazole, specifically albendazole. Some cases require liver transplantation. Long-term treatment is well tolerated but is parasitistatic not parasiticidal.

## Risk factors for the travelling pet

The authors are not aware that risk factors for pets travelling to, or imported from, countries where *Echinococcus multilocularis* is endemic have been characterised. Logic would dictate that dogs and cats should be prevented from hunting and consuming small herbivores. Ingestion of fox faeces could result in the pet becoming an intermediate host and whilst this would pose no zoonotic risk, nor risk of introduction of the disease to Ireland, clinical signs would result. Zoonotic risk is perhaps greatest when bathing pet dogs that have rolled in fox faeces; strict personal hygiene should be observed.

At present, maintenance of Ireland's disease-free status is dependant on strict adherence to the pre-treatment of pets entering Ireland with praziquantel, at appropriate doses, 24 to 48 hours prior to entry into the country. In addition, it would be prudent to ensure that all pets' coats are free of fox faeces. Should these rules not be adhered to, *Echinococcus multilocularis* infestation in an imported domestic pet poses both a zoonotic risk and the risk of introduction of this disease into the domestic pet or fox population. Furthermore, diagnosis and treatment of *Echinococcus multilocularis* in a travelled pet should hopefully never be required, if the requirement for worming with praziquantel 24 to 48 hours prior to return to Ireland is observed.

## Conclusions

Whilst infection in the definitive host is of little clinical significance, the potential ramifications of introduction of *Echinococcus multilocularis* into the Irish dog and fox populations are immense. The disease is zoonotic, often incurable and potentially fatal. Strict adherence to the routine worming of travelled dogs with praziquantel, at appropriate doses, 24 to 48 hours prior to entry into the country will minimise the likelihood of introduction of this potentially devastating disease.

### Appendix 1

| Praziquantel (Droncit, Bayer and others) | |
|---|---|
| Dogs | 5.0 mg/kg PO |
| | 5.7 mg/kg IM |
| Cats | 8.0 mg/kg Topical formulation |

**Appendix 1:** Appropriate praziquantel dosages in pets.

## Further reading

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