Echinococcus multilocularis

Phylum: Helminthes
Subphylum: Plathelminthes (tapeworm)

Parasite

anses
French agency for food, environmental and occupational health & safety

Characteristics and sources of *Echinococcus multilocularis*

Main microbiological characteristics

Echinococcus multilocularis is a small tapeworm of the Cestoda class. It is responsible for a parasitic zoonosis causing alveolar echinococcosis (AE), a potentially serious liver disease. The parasite's life cycle mainly occurs in the wild, and the worm in its adult form is found in the intestine of a wild carnivore, the fox, which is the definitive host. In the intestines, the parasite develops between the villi and when mature produces eggs or oncospheres that are released into the environment *via* the faeces. Small rodents, which are the intermediate hosts, become infested by ingesting plant matter soiled by the eggs. The hexacanth embryos released from the oncosphere into the intestine of the rodents migrate to the liver where the larval form develops. The cycle is completed when these small mammals or rodents become the prey of carnivores. The parasite's life cycle is summarised in Figure 1.

Adult of *Echinococcus multilocularis* © Franck Boué

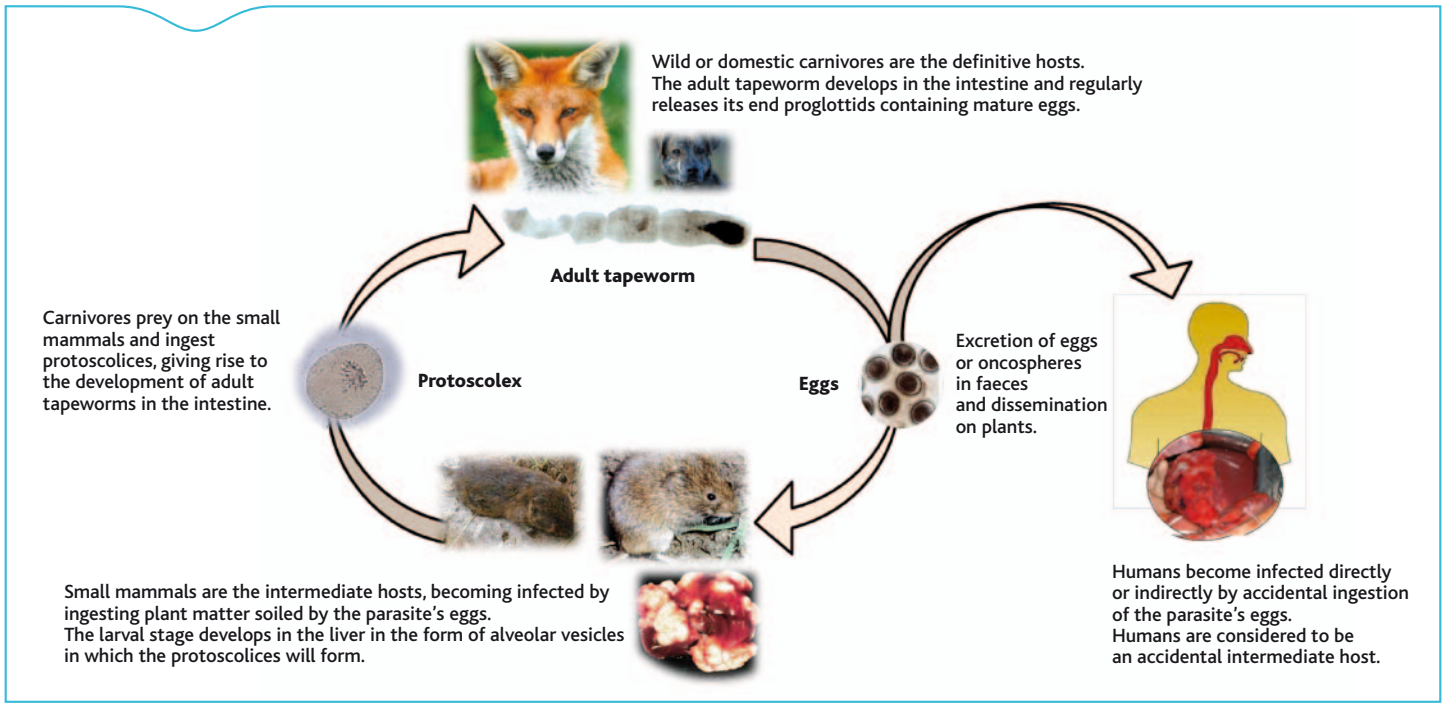

Figure 1. **Biological cycle of *Echinococcus multilocularis***

Data sheet on foodborne biological hazards
September 2011

Hazard sources

As definitive host, foxes are the main vector of this parasite. Pets such as dogs and cats can also be definitive hosts, but their role in maintaining the cycle is negligible compared to that of foxes. Furthermore, cats seem to be very poor carriers.

In humans, contamination is generally accidental and occurs through the ingestion of contaminated foodstuffs or through direct contact with infested animals. Humans therefore play an accidental role as intermediate hosts and form a biological and epidemiological dead end. The larval stage in small mammals is not dangerous to humans, and only carnivores ingesting infested rodents develop the adult tapeworms in their intestines.

The parasite is found throughout the Northern Hemisphere, particularly in Europe. The epidemiology of *E. multilocularis* is currently changing in Europe with the parasite now identified in animals outside its historical endemic area, this in countries that had either not been studied previously or that were apparently unaffected (Baltic countries, Sweden, Eastern Europe).

In France, until the end of the 1990s, the known distribution area of the parasite with foxes as a reservoir was limited to some fifteen *départements* in the north-east and the Auvergne region. A recent study carried out in 44 French *départements*, with nearly 5,000 foxes analysed, and showed that the parasite's distribution has been extended towards the west and the south (Figure 2).

There is no institutional monitoring programme of the parasite in foxes, nor any programme for eradicating it.

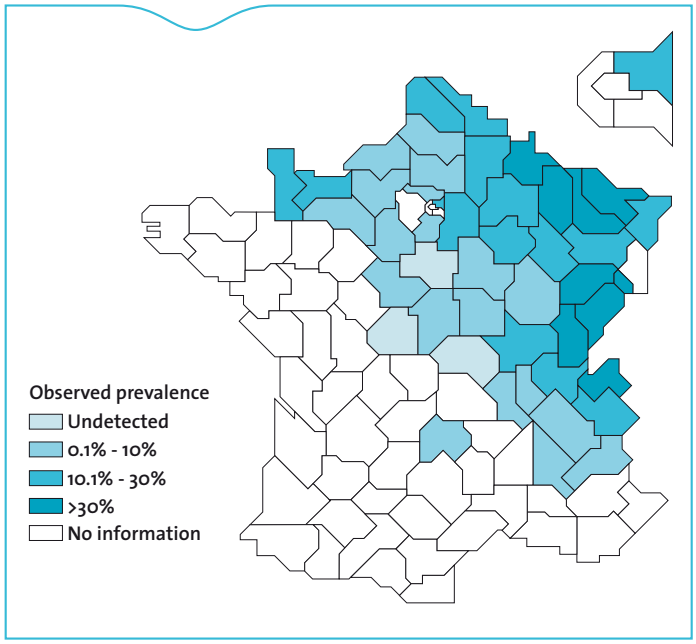

Figure 2. **Prevalence observed in foxes in France. The white areas have not been investigated.**

Transmission routes

Humans can only become infested by the oral route, by direct ingestion of the parasite's eggs on contaminated plant materials or, more rarely, indirectly by the ingestion of eggs carried *via* the hands after contact with the contaminated fur of animals carrying the parasite. However, in some exceptional extrahepatic forms, the larvae develop at the site of a bite from an infested animal.

There is no transmission between humans.

Recommendations for primary production

- **As the parasite's life cycle is sylvatic (occurring mainly in wooded areas frequented by foxes), farm animals are not concerned directly. Like in humans, the larval stage of the parasite can develop in the liver in the form of alveolar vesicles. In such cases, the liver is removed and discarded during veterinary inspection at the slaughterhouse.**
- **For domestic carnivores, in areas where foxes are known to be highly infected, it is advisable to treat pets regularly (monthly) with a vermifuge containing praziquantel (the only compound that is active against this parasite).**
- **For plant crops, wherever infection is highly endemic, it is strongly recommended that animals be prevented from entering growing areas by setting up effective fencing, so as to avoid contamination by the faeces of foxes or domestic carnivores.**

Human foodborne illness

Nature of the disease

The characteristics of the disease are presented in Table 1.

Human AE affects the liver in 97% of cases and acts like a very slow-developing cancer, gradually invading the hepatic tissue, the vascular and biliary systems and nearby organs. It is rare for other organs to be affected (diaphragm 35%, lungs 20%, spleen and pancreas <10%, central nervous system and bones <5%). The medical prognosis is generally less favourable when there is clinical expression.

Individual immune response to the parasite varies considerably and infection does not necessarily lead to the onset of an active parasitic illness (non-apparent forms, ranging from a simple serological form to calcified lesions).

Table 1. **Disease characteristics**

Mean incubation period	Target population	Main symptoms (at diagnosis)	Duration of symptoms	Complications	Asymptomatic forms
Several years before diagnosis (generally 5 to 15 years) Usual age when diagnosed: 45-70 years About one patient in three is diagnosed by chance (during a check-up for some other illness)	Anyone likely to ingest the eggs of the parasite No difference between men and women	Abdominal pain: 25-30% of cases Jaundice: 20% of cases. Hepatomegaly (enlarged liver): 15-20% of cases More rarely, weakness and symptoms related to the extension of the lesions or metastases	No spontaneous resolution without treatment	Superinfection of the lesion or the biliary tracts, septic shock Severe liver failure (recourse to liver transplants) Secondary biliary cirrhosis Metastases (lung, brain and skeleton)	Existence of asymptomatic calcified lesions diagnosed by chance (during a check-up for some other illness)

Dose-effect[1] and dose-response[2] relationships

No dose-effect relationship has been determined in humans. In theory, a single egg can lead to human infection.

Epidemiology

Surveillance system

There is no prospective surveillance for human AE at European level. This is not a legally notifiable disease in France, but there has been prospective surveillance for human AE in France since 1997 by the teams from the Besançon University Hospital Centre (CHU), as part of the European EurEchinoReg network and, since 2003, by the FrancEchino network, coordinated by the Besançon CHU with support from the French Institute for Public Health Surveillance. A National Centre of Reference for alveolar echinococcosis will be set up in 2012.

Prevalence

In Europe, human AE is now endemic beyond its historical area (Switzerland, eastern France, Germany and western Austria) spreading to the north and east (e.g. Lithuania, Poland and Slovenia). The number of cases of human AE diagnosed in Europe since 1982 is estimated at about 1100 (EurEchinoReg).

Four hundred and fifty one cases were recorded in France between 01 January 1982 and 31 December 2010 by the FrancEchino register (median: 15 cases/year, bounds: 8-29). The mean annual incidence is 0.26 cases for 1,000,000 inhabitants (bounds: 0.16-0.56). The mean annual incidence in five *départements* (Doubs, Haute-Saône, Jura, Vosges and Haute-Savoie) was greater than 2 for 1,000,000 inhabitants between 1982 and 2010 and accounted for 60% of known cases in France.

In Switzerland, a recent study shows a correlation between changes in the number of human cases and changes in the number of foxes with a time lag of ten years.

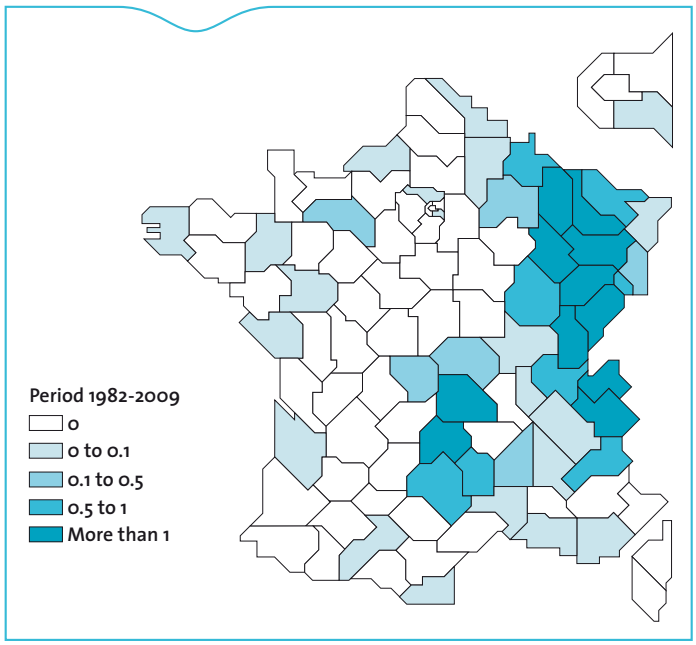

Figure 3. **Combined annual incidence rate of alveolar echinococcosis for 1,000,000 inhabitants per *département* of residence at time of diagnosis.**

Role of food

Main foods to consider

It has been clearly demonstrated that human infestation results from ingestion of the parasite's eggs, although the main source of contamination has not been formally identified. All foodstuffs harvested at ground level in regions where the illness is endemic are a possible source of contamination (lettuces, dandelion, garden vegetables, mushrooms, fruits such as strawberries, blackberries and other berries). However, the risk that these foods could have been contaminated by the faeces of carnivores carrying egg-bearing parasites is minute and difficult to control. Desiccation is the main limiting factor for the survival of *Echinococcus* eggs in the environment (3 months in summer and up to 8 months in autumn and winter).

Inactivation treatments in industrial environments

The eggs cannot be removed from vegetable matter by simple washing. They can only be inactivated by cooking or by deep freezing at -80°C for 5 days.

Industrial freezing (-30°C) does not guarantee inactivation of the parasite's oncospheres.

Table 2. **Inactivation of eggs in industrial environments**

Effect of temperature	
Temperature (°C) / Relative humidity (%)	**Duration of treatment**
+70°C	5 min
+45°C / 85-95%	3 hours
+25°C / 27%	2 days
–70°C	96 hours
–80°C to –83°C	48 hours
–196°C	20 hours
Ionisation	
0.4 kGy	

Monitoring in food

At only 30 µm in diameter, the parasite's eggs are too small to be detected visually in ground-growing fruit and vegetables.

Regarding production livestock, which can be intermediate hosts, infected organs are removed and discarded during veterinary inspection at the slaughterhouse.

(1) The relationship between the dose (the amount of microbial cells ingested during a meal) and the effect on an individual.

(2) For a given effect, the relationship between the dose and the response, i.e., the probability of this effect appearing in the population.

Domestic hygiene

Recommendations to consumers

- **In humans, individual prevention against contamination by the parasite begins with thorough hand-washing after handling animals that might be carrying the parasite's eggs (on their fur), especially foxes (dead animals should be handled with gloves) but also pets.**
- **Consumers should pay particular attention to the following points:**
  - **domestic freezing is insufficient to inactivate the parasite's eggs;**
  - **even intensive washing cannot guarantee the complete removal of the parasite's eggs from the surface of fruit and vegetables;**
  - **the use of vinegar, alcohol or diluted bleach does not reduce the risk of foods being contaminated;**
  - **it is recommended that foods gathered at ground level be cooked before eating (5 min at 70°C) as far as possible.**
- **One measure for avoiding the contamination of vegetables by the faeces of carnivores carrying the parasite is to fence off domestic gardens. Equally, hand washing after any gardening activity is indispensable.**
- **Monthly administration to pets of a vermifuge containing praziquantel reduces the risk**

References and links

General references

- Boué F, Combes B, Giraudoux P, Umhang G. *Echinococcus* multilocularis chez le renard et les carnivores domestiques : vers une nouvelle donne épidémiologique ? Bull. Epidémiol., 2010, n°38 (special zoonoses issue), pp 24-27.
- Eckert J, Deplazes P. Biological, epidemiological, and clinical aspects of echinococcosis, a zoonosis of increasing concern. Clin Microbiol Rev. 2004; 17(1):107-35.
- Vuitton DA, Bresson-Hadni S, Giraudoux P, Bartholomot B, Laplante JJ, Delabrousse E, Blagosklonov O, Mantion G. Échinococcose alvéolaire : d'une maladie rurale incurable à une infection urbaine sous contrôle ? Presse Med. 2010 Feb; 39(2):216-30.

Useful links

- European Union Reference Laboratory for Parasites: Istituto Superiore di Sanità (ISS) I-00161, Rome – Italie. http://www.iss.it/crlp/index.php
- French Institute for Public Health Surveillance (InVS): http://www.invs.sante.fr
- National Centre of Reference (NCR) for alveolar echinococcosis (from 01 January 2012) and the FrancEchino network – Parasitology-mycology Laboratory, Besançon University Hospital Centre, Boulevard Fleming, 25030 Besançon Cedex. francechino@chu-besancon.fr - Tel.: +33 3 81 66 82 86.
- National Reference Laboratory for Echinococcoses: Nancy Laboratory for Rabies and Wildlife - ANSES, NRL Echinococcoses, Technopôle agricole et vétérinaire, BP 40009, 54220 Malzéville – Tel.: +33 3 83 29 89 50.
- WHO Collaborating Centre (WHOCC) for the prevention and treatment of echinococcoses – Besançon University Hospital Centre – ccoms@chu-besancon.fr - Tel.: +33 3 81 66 89 28.
- WHO/OIE Manual on Echinococcosis in Humans and Animals: a Public Health Problem of Global Concern. Edited by Eckert J *et al*. 2000. http://whqlibdoc.who.int/publications/2001/929044522X.pdf