

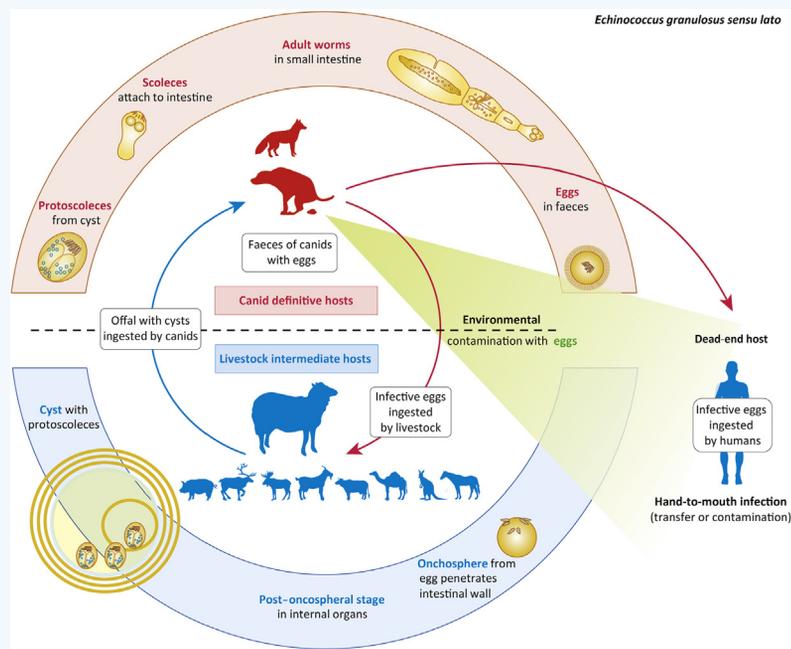
Echinococcus granulosus sensu lato

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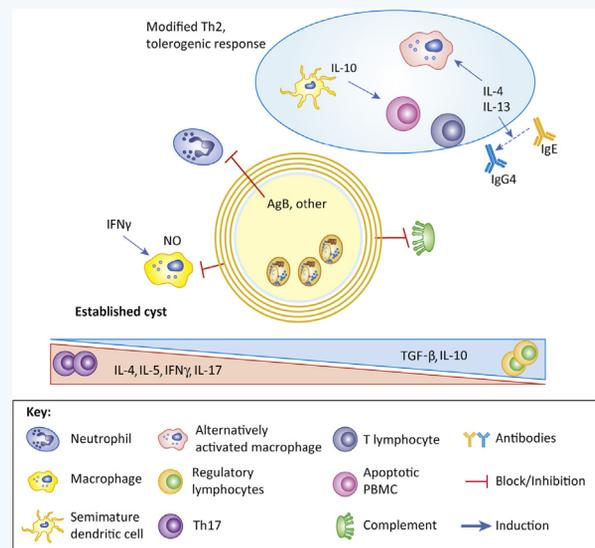
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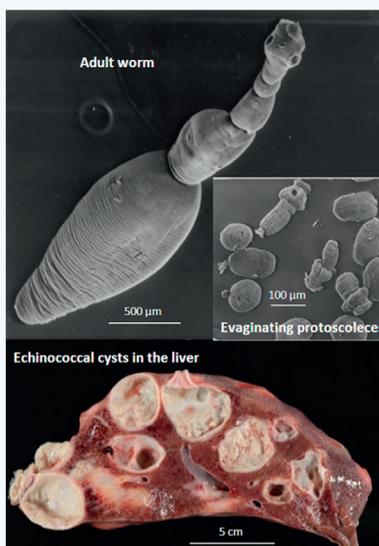


Trends in Parasitology

The larval stage of *Echinococcus granulosus sensu lato* (*sl*) causes cystic echinococcosis (CE), a neglected and chronic parasitic zoonotic disease infecting over an estimated one million people worldwide. *E. granulosus sl* is a species complex with uncertain taxonomic status, including several cryptic species (genotypes): *E. granulosus sensu stricto* (*ss*) (G1/3); *E. canadensis* cluster [G6/7, G8, G10, proposed to be split into *E. intermedius* (G6/7), *E. borealis* (G8), and *E. canadensis* (G10)]; *E. ortleppi* (G4); *E. equinus* (G5); and *E. felidis*. Canids, in particular dogs, are definitive hosts for the sexual stage adult worms, while livestock, predominantly sheep, are intermediate hosts for the asexual larval stage metacestodes. Adult worms induce no evident pathology in canids, but metacestodes moderately reduce livestock productivity. Humans are accidental dead-end intermediate hosts who are infected by the ingestion of eggs shed in the faeces of infected canids.



Trends in Parasitology



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KEY FACTS:

CE is most prevalent in poor pastoral communities in close contact with competent hosts.

E. granulosus ss (G1/3) causes the majority of human infections, followed by *E. canadensis* (G6/7).

CE is 100% preventable, and the WHO advocates concerted efforts for its control.

Control measures aim to interrupt the transmission cycle by dog deworming with praziquantel, abattoir control, culling of aged sheep, and lamb vaccination with the EG95 vaccine.

Most frequent parasite transmission pathways to humans, and risk factors for infection, are difficult to define, due to its complex life cycle and the temporal lag between infection and diagnosis.

DISEASE FACTS:

Human CE is a chronic, disabling disease mainly affecting the liver and lungs. Fluid-filled echinococcal cysts develop through different stages and grow concentrically, mainly causing compression on neighboring structures.

Imaging, in particular with ultrasound, is the reference technique for human CE diagnosis based on the visualization of pathognomonic signs, while serology is only supportive.

The management of CE envisages four clinical options, guided by cyst-stage classification as seen in imaging: surgery, percutaneous treatments, antiparasitic treatment with albendazole, and watch and wait (active surveillance by imaging).

TAXONOMY AND CLASSIFICATION:

- PHYLUM:** Platyhelminthes
- CLASS:** Cestoda
- ORDER:** Cyclophyllidea
- FAMILY:** Taeniidae
- GENUS:** *Echinococcus*
- SPECIES:** *E. granulosus sensu lato*

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Resources

www.who.int/echinococcosis/en/

www.cdc.gov/parasites/echinococcosis/index.html

www.heracles-fp7.eu/index.html

www.who.int/echinococcosis/resources/WHO_HTM_NTD_NZD_2017.01/en/

Literature

1. Craig, P.S. *et al.* (2007) Prevention and control of cystic echinococcosis. *Lancet Infect. Dis.* 7, 385–394
2. Brunetti, E. *et al.* (2010) Expert consensus for the diagnosis and treatment of cystic and alveolar echinococcosis in humans. *Acta Trop.* 114, 1–16
3. Brunetti, E. *et al.* (2011) Cystic echinococcosis: chronic, complex, and still neglected. *PLoS Negl. Trop. Dis.* 5, e1146
4. Díaz, Á. *et al.* (2015) The laminated layer: Recent advances and insights into *Echinococcus* biology and evolution. *Exp. Parasitol.* 158, 23–30
5. Kozioł, U. and Brehm, K. (2015) Recent advances in *Echinococcus* genomics and stem cell research. *Vet. Parasitol.* 213, 92–102
6. Lightowler, M.W. *et al.* (1996) Vaccination against hydatidosis using a defined recombinant antigen. *Parasite Immunol.* 18, 457–462
7. Manzano-Román, R. *et al.* (2015) Serological diagnosis and follow-up of human cystic echinococcosis: a new hope for the future? *Biomed. Res. Int.* 2015, 428205
8. Siles-Lucas, M. *et al.* (2018) Progress in the pharmacological treatment of human cystic and alveolar echinococcosis: novel compounds and therapeutic targets. *PLoS Negl. Trop. Dis.* 12, e0006422
9. Tamarozzi, F. *et al.* (2018) Prevalence of abdominal cystic echinococcosis in rural Bulgaria, Romania and Turkey: a cross-sectional, ultrasound-based, population study from the HERACLES project. *Lancet Infect. Dis.* 18, 769–778
10. Thompson, A. *et al.*, eds (2017) *Echinococcus and echinococcosis*. *Adv. Parasitol.* 95, 1–526 and 96, 1–406