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SHORT COMMUNICATION

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Cluster of *Capillaria hepatica* infections in non-commensal rodents from the canton of Geneva, Switzerland

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Abstract We trapped 664 rodents belonging to five non-commensal species in the canton of Geneva, Switzerland, and found a significant cluster of *Capillaria hepatica* infections in three species in rural and urbanized areas of the northern part of the canton. *C. hepatica* infections were discovered in the yellow-necked mouse *Apodemus flavicollis* ($n = 99$) with an overall prevalence (OP) of 7.0% and a clustered prevalence (CP) of 20%, in the bank vole *Clethrionomys glareolus* ($n = 58$, OP 5.2%; CP 19%), and in the water vole *Arvicola terrestris scherman* ($n = 466$; OP 0.2%; CP 4%). The estimated numbers of *C. hepatica* eggs isolated from infected livers ranged from 1,914 to 938,000 per animal.

Keywords *Capillaria hepatica* · Non-commensal rodent · Arvicola · Apodemus · Clethrionomys

Introduction

Capillaria hepatica (Bancroft 1893) is a nematode affecting a wide range of mammal hosts, including humans. It has been described worldwide, primarily as a parasite of the hepatic parenchyma of a number of rodent species (Spratt and Singleton 2001). Females deposit along sinuous tracts clusters of uncleaved eggs that become encapsulated within a fibrotic reaction of the host. Eggs are liberated via natural death of the host and liver decay or through digestion of the liver by a carnivore or a scavenger. In the case of predation, eggs are released with the faeces of the carnivore, contributing to the dissemination of the parasite. Whereas the deer mouse (*Peromyscus maniculatus*) and the red-backed vole (*Clethrionomys gapperi*) are important hosts in North America (Solomon and Handley 1971; Spratt and Singleton 2001), rat species, notably the Norway rat (*Rattus norvegicus*), are considered as the main parasite reservoirs in Eurasia and Australia (Singleton et al. 1991; Ceruti et al. 2001; Spratt and Singleton 2001). In domestic animals, such as dogs, cats and horses, *C. hepatica* infections have rarely been diagnosed at necropsy (references see Brander et al. 1990). Humans are accidental hosts of *C. hepatica* and children under 5 years of age are at particular risk of developing the disease (Berger et al. 1990; Juncker-Voss et al. 2000; Spratt and Singleton 2001). The occurrence of the cycle of this zoonotic parasite within cities has been investigated, and several studies have assessed the prevalence of *C. hepatica* infections in commensal rodents (*Mus musculus* and *Rattus* spp.) from urban areas (Spratt and Singleton 2001) or from city zoological parks e.g. in Baltimore and Vienna (Farhang-Azad 1977; Juncker-Voss et al. 1998). However, reports of *C. hepatica* infections in other European rodent species have rarely been described (Schmidt 2002). In this paper, we report a cluster of *C. hepatica* infections in three non-commensal species of rodents captured in the urbanized northern part of the canton of Geneva.

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Material and methods

In the framework of a study on the epidemiology of the zoonotic cestode *Echinococcus multilocularis*, we captured 664 rodents belonging to 5 non-commensal species, in 15 trapping sites during fall 2003 (all species) and spring 2004 (species from open habitat only). The study was conducted in the Eastern half of the canton of Geneva. Rodents from covered and open habitat were captured with Longworth traps (Penlon Ltd, Oxon, GB) and Topcat traps (TOPCAT GmbH, Wintersingen, CH), respectively, and kept frozen at −20°C until

dissection. Livers and internal cavities were carefully examined for parasitic lesions. *C. hepatica* infections were diagnosed microscopically by the presence of the typical bi-polar eggs with a double-layer shell and radial striations in the outer shell (Calle 1961). The infected liver tissues were squashed and washed with PBS through a sieve (80 µm mesh size). The flow-through material was passed through a mesh of 20 µm, which retains *C. hepatica* eggs. These eggs were resuspended in 50–100 ml of PBS and egg counts per liver were performed with three subsamples of 100 µl by light microscopy. Prevalences are reported with the exact binomial 95% confidence interval (CI). Purely spatial analysis using the Poisson model was performed with the SaTScan software (Kulldorff 2003).

Results and discussion

Highest prevalence of *Capillaria hepatica* was recorded in *Apodemus flavicollis* (7.0%, CI 2.7–13.3%, $n=99$), followed by *Clethrionomys glareolus* (prevalence of 5.2%, CI 1.1–14.4%, $n=58$) and *Arvicola terrestris scherman* (prevalence of 0.2%, CI 0–1.2%, $n=466$). No *C. hepatica* infection was found in *Microtus arvalis* ($n=35$) and in *Apodemus sylvaticus* ($n=6$). In most cases, eggs were recovered from livers only, and their calculated numbers ranged from 1,914 to 938,000 in yellow-necked mice, from 5,926 to 39,286 in bank voles, and was estimated to be 3,900 in the water vole (Fig. 1). In the three yellow-necked mice with the highest egg burdens, clusters of *C. hepatica* eggs were additionally discovered in the spleen.

The recorded prevalence rates were lower than those generally found in the Norway rat, which is considered as the primary host and reservoir of *C. hepatica* in Eurasia (Ceruti et al. 2001; Spratt and Singleton 2001). In Germany, a stable endemic area of *C. hepatica* infections was found in two non-commensal rodent species in Saxony-Anhalt, with a prevalence of 8.5% in the yellow-necked mouse, and of 15.1% in the bank vole (Schmidt 2002).

The positive cases were all located in the northern part of the canton of Geneva in three trapping sites, forming a significant cluster of infection (radius of 1.35 km; LR ratio = 12.6, $P=0.001$) containing sampling sites from both rural (one site) and urbanized (two sites) parts of the canton. The clustered prevalence was 20% (CI 8.5–37%) in the yellow-necked mouse, 19% (CI 4–45.5%) in the bank vole, and 4% (CI 0.1–19%) in the water vole. Childs et al. (1988) assessed *C. hepatica* infection rates in four rodent species from different habitats in the city of Baltimore. The transmission of this parasite in the Norway rat population was more intense in residential areas than in parklands, with possible risk to public health implications. A possible explanation is the higher density of this commensal rodent and its potential predators in residential areas, resulting in an increased potential for predation and cannibalism, and contacts with eggs. The cluster of infection described in this paper was centered on the residential area along the Western edge of Lake Geneva. We did not find any significant decrease in the capture success of *A. flavicollis* at the other trapping sites and with regards to urbanization. Presence of red foxes, favored in residential areas by a high availability of anthropogenic food resources (Contesse et al. 2004), and presence of other predators (notably domestic carnivores and stone marten *Martes foina*) is likely to increase the risk of dissemination of *C. hepatica* eggs in the urbanized environment, by predating on infected rodents. *C. hepatica* infections related to a non-commensal rodent reservoir in an urbanized environment may imply a specific exposure risk for humans or domestic animals.

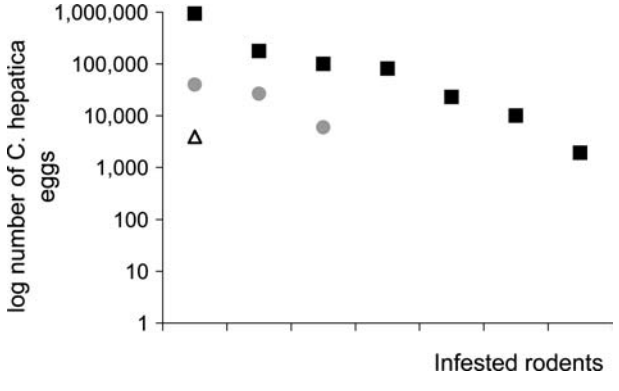

Fig. 1 Number of eggs (total number: 1,406,245) of *Capillaria hepatica* in 11 infected rodents sampled in the northern part of the canton of Geneva (7 *Apodemus flavicollis*—black squares; 3 *Clethrionomys glareolus*—gray circles; 1 *Arvicola terrestris scherman*—white triangle)

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