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Review article

A systematic review on the global occurrence of *Taenia hydatigena* in pigs and cattle

Man Thi Thuy Nguyen[a], Sarah Gabriël[b], Emmanuel Nji Abatih[b,c], Pierre Dorny[b,d,*]

[a] National Center for Veterinary Diagnosis, Ha Noi, Viet Nam
[b] Institute of Tropical Medicine, Department of Biomedical Sciences, Antwerp, Belgium
[c] Ghent University, Department of Applied Mathematics, Computer Science and Statistics, Gent, Belgium
[d] Ghent University, Faculty of Veterinary Medicine, Merelbeke, Belgium

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ABSTRACT

Taenia hydatigena, a non-zoonotic tapeworm species shares the same intermediate hosts with other *Taenia* zoonotic species, such as *Taenia solium* in pigs and *Taenia saginata* in cattle. The occurrence of *T. hydatigena* in pigs and cattle may cause cross-reactions in immunodiagnostic tests and therefore, complicate the diagnosis of the zoonotic species. This study was conducted to systematically review the data on the prevalence of *T. hydatigena* in pigs and cattle, with the aim to assess the potential interference in serological diagnosis of zoonotic *Taenia* spp. due to *T. hydatigena* infection. We searched PubMed, Web of Science, Africa Journal Online, website http://www.google.com and article reference lists in English, French and Vietnamese with no restriction on research time and publication status. Eligible studies included observational studies that showed the occurrence of *T. hydatigena.* Twenty-six studies, divided into two animal groups, i.e. pigs and cattle, met the eligibility criteria for qualitative synthesis and 17 studies were included for the meta-analysis in three continents. *T. hydatigena* was found by necropsy in all included studies, which mostly were abattoir surveys. Overall, results showed the worldwide occurrence of *T. hydatigena* cysticercosis in pigs and cattle. In pigs, there was a marked higher prevalence in Asia and South America that was 17.2% (95% CI: 10.6–26.8%) and 27.5% (CI: 20.8–35.3%), respectively, compared to a low prevalence of 3.9% (95% CI: 1.9–7.9%) in Africa. Overall, the prevalence of *T. hydatigena* in cattle was low with a mean of 1.1% (95% CI: 0.2–5.2%). These results show that interpretation of results of sero-diagnostic tests for zoonotic *Taenia* species in pigs and cattle has to take into account the prevalence of *T. hydatigena* infections in different settings.

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* Corresponding author at: Institute of Tropical Medicine, Department of Biomedical Sciences, Antwerp, Belgium.
E-mail addresses: pdorny@itg.be, pierre.dorny@ugent.be (P. Dorny).

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1. Introduction

The genus *Taenia*, which belongs to the class Cestoda, subclass Eucestoda, order Cyclophyllidea and the family *Taeniidae*, contains many species infecting humans and domestic animals. Some members of this genus such as, *Taenia solium*, *Taenia saginata* and *Taenia asiatica* are responsible for taeniosis in humans; *T. solium* also causes human cysticercosis. Taeniosis is acquired by eating undercooked pork or beef containing cysticerci (Murrell, 2005). Diagnosis in animals of these zoonotic diseases requires methods that are highly sensitive and specific to prevent infection of humans. Necropsy of animal carcasses is the "gold standard" method when the entire carcass is dissected; routine meat inspection however, has a low sensitivity. Serological methods, such as antibody and antigen detection assays, are more sensitive than meat inspection (Gonzalez et al., 1990). In addition, the benefits of immunodiagnosis are: tests offer diagnosis on live animals; blood sampling followed by serological testing is more sensitive than the classical tongue examination in pigs infected with *T. solium*; and the tests are relatively inexpensive and easy to perform on large numbers of serum samples (Dorny et al., 2003). Unfortunately, the antigens of the different *Taenia* species are very similar and therefore, cross-reactions between *Taenia* spp. are common in immunodiagnosis. Craig and Rickard (1980), and Brandt et al. (1992) recorded cross-reactions between *Taenia hydatigena* and *T. saginata* in cattle while cross-reactions between *T. hydatigena* and *T. solium* in pigs are rather the rule than the exception in most antibody and antigen detecting tests (Dorny et al., 2003). This reduces the specificity of the diagnostic test, thereby seriously impairing the usefulness of immunodiagnostic methods for zoonotic cysticercosis.

T. hydatigena is a ubiquitous tapeworm found in domestic animals worldwide. Dogs and other carnivores such as, foxes, wolves and cats are the definitive hosts of *T. hydatigena* while the metacetodes are found in sheep, goats, cattle, pigs and wild boars, which act as the intermediate hosts (Soulsby, 1982). In pigs, the pathological picture of the migratory phase of the *T. hydatigena* cysticerci is characterized by haemorrhagia within the liver parenchyma and under the liver surface (Blazek et al., 1985). Immature stages migrate through the liver and lung before reaching their predilection sites. Dogs are kept throughout the world and in rural areas these are often free-roaming (stray) dogs; therefore, gravid proglottids containing eggs are excreted ubiquitously through the feces, thereby contaminating the environment. When these eggs are ingested by intermediate hosts they develop into large cysticerci in the abdomen and visceral organs of these animals. High prevalence of the tapeworm in definitive hosts may lead to high prevalence of *T. hydatigena* cysticercosis in pigs and cattle (Lan et al., 2011).

Considering the impact on the use of immunodiagnostic tools for the detection of *T. solium* cysticercosis in pigs and *T. saginata* cysticercosis in cattle, a clear view on the actual occurrence of *T. hydatigena* in the intermediate pig and cattle host is needed. Therefore, a systematic review of the prevalence of *T. hydatigena* cysticercosis in pigs and cattle was conducted with the objective of estimating the occurrence of *T. hydatigena* in different continents.

2. Materials and methods

Studies that related to the occurrence, incidence and prevalence of *T. hydatigena* in pigs and cattle were collected. This review included studies in English, French and Vietnamese language with no restriction on research time and publication status. The PRISMA flowchart was used for performing the study (Moher et al., 2009).

2.1. Search

Searching was done systematically in PubMed, Web of Science, Africa Journal Online with search terms and key elements using Boolean operators: (*Taenia hydatigena* OR *cysticercosis tenuicollis* OR cysticercosis) AND (epidemiology OR prevalence) AND (pig OR swine OR porcine OR sow OR bovine OR cattle OR calf OR cow). Articles were also searched on the website: http://www.google.com and the National library of Vietnam with key words: prevalence/epidemiology of helminths in cattle/bovine/pigs/swine/pork; prevalence of *Taenia hydatigena*/*Cysticercus tenuicollis*; abattoir survey in pigs/cattle. Other articles were retrieved from the reference section and citation lists of the full-texts such as original research articles and reviews.

The last search date in PubMed, Web of Science, Africa Journal Online, National library of Vietnam was 30th March, 2015, on the website http://www.google.com this was 25th April, 2015. However, three full-text articles, which were retrieved in PubMed after these dates (11th August, 2015), were also added the review.

2.2. Study selection

After removing duplicates, the titles and abstracts of articles were screened and rejected if they were not related to the pig and/or cattle host such as, human, sheep, goats, carnivores, wildlife; studies on pathology, biology, immunology, treatment, prevention, control, eradication or other diseases were also excluded.

Full-text records were rejected for the following reasons: unsuitable language (not English, French, Vietnamese); not reporting the occurrence of *T. hydatigena* in pigs, cattle; review articles; two articles using the same data. Remaining full-text records were included in a qualitative synthesis. Included records above were rejected for quantitative synthesis if records presented the incidence of *T. hydatigena*, sampling was not comprehensive such as: non-random sampling, the sample size was not clear or the sampling was only done on one of the organs.

2.3. Data collection

Titles, authors, year of publication were collected from every selected article and information of studies such as, animals, time, place, sample size, number of positive samples and diagnostic method were collected from the studies included in the qualitative and quantitative synthesis.

2.4. Statistical analysis

The prevalence of *T. hydatigena* in pigs in individual continents of the world and the prevalence of *T. hydatigena* in cattle in general were estimated using meta-analysis in R Software with package "meta" and based on a random effects model. The difference in prevalence between two continents was considered to be statistically significant in case their 95% confidence intervals did not overlap.

3. Results

3.1. Processing of the research articles used for the analysis

The process for selecting the articles is shown in Fig. 1. From 850 initial records and three extra articles, 104 full texts were retrieved. Twenty six studies were included in the qualitative synthesis. For the quantitative synthesis, the prevalence of *T. hydatigena* cysticercosis was determined in 17 studies, 10 studies in pigs, 6 studies in cattle and one study in both pigs and cattle (Table 1).