

Prevalence and morphological characterisation of *Cysticercus tenuicollis* (*Taenia hydatigena* cysts) in sheep and goat from north India

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Abstract *Taenia hydatigena* is an adult parasite of dogs with the metacestode (*Cysticercus tenuicollis*) stage residing in ruminants and pigs. Documentation and surveillance data concerning to the prevalence and risk factors associated with the disease in India is largely lacking. In this experiment, 3,199 carcasses, including 760 sheep and 2,439 goat were examined for the presence of *C. tenuicollis* (*T. hydatigena* cysts) on post-mortem inspection at different slaughter houses/shops in northern India. Morphological analysis was also conducted on five samples from each species. Out of 3199 carcasses examined, 135 were found containing cysts of *T. hydatigena* indicating a prevalence of 4.22 %. Most of the cysts were present in abdominal cavity, except few which were embedded in the liver. The high prevalence of 4.83 was recorded in goats as compared to 2.23 % in sheep. Principal component analysis was applied for statistical analysis. The results of morphological analysis indicated its usefulness as a valid criterion for differentiation of *T. hydatigena* cysts and that there might be possibility of two different strains infecting sheep and goat.

Keywords Prevalence · Morphological characterisation · *Cysticercus tenuicollis* · Sheep · Goat · North India

Introduction

Taenia hydatigena is an adult parasite of dogs with the metacestode (*Cysticercus tenuicollis*) stage residing in ruminants

and pigs. The metacestode infection due to *C. tenuicollis* is important because it causes huge economic losses due to condemnation of infected offal or meat (Flisser et al. 1982; Eckert et al. 1984; Thompson and Lymbery 1995). Additionally, the cysticerci of *T. hydatigena* are responsible for production losses and mortality in livestock (Abidi et al. 1989). Migration of cysticerci can lead to formation of haemorrhagic and fibrotic tracts, serofibrinous peritonitis in the liver (Soulsby 1982; Blazek et al. 1985) with heavy infections leading to traumatic hepatitis and death in young lambs (Soulsby 1982) depending upon the organ involved, infestation of the parasite and other concurrent infections (Urquhart et al. 1996). Diagnosis in livestock is usually based on the host and the location of the metacestode when identified at meat inspection or necropsy (WHO and OIE 2001). Size of the cysts (*C. tenuicollis*) varies from one cm up to 6–7 cm, and the scolex has a long neck. They are found attached to the omentum, mesentery and occasionally on the liver surface, particularly of sheep (OIE 2008).

The biotic potential of *T. hydatigena* is high and estimates suggesting that *E. granulosus* has about 1/100th and 1/30th the biotic potential of *T. hydatigena* and *T. ovis* (WHO and OIE 2001). Documentation and surveillance data concerning to the prevalence and risk factors associated with the disease in India is largely lacking. The present study was contemplated to document the prevalence and morphological characterization of *C. tenuicollis* in North India.

Materials and methods

Parasite/biological material

In this experiment, 3,199 carcasses, including 760 sheep and 2,439 goat were examined for the presence of

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C. tenuicollis (*T. hydatigena* cysts) on post-mortem inspection at different slaughter houses/shops in northern India. The visceral organs of every animal included in the survey were examined visually, palpated and incised for the detection of the cysts on post-mortem inspection. Intact cysts recovered from the infected animals were placed separately in the polythene bags containing ice and were further processed. Epidemiological data related to each animal were collected. The effect of geographical area, age, breed and sex on prevalence of infection was studied.

Rostellar hook morphology

Morphological analysis was conducted on five samples from each species. The scoleces were mounted and sufficient pressure was applied to the cover slip to cause the hooks to lie flat. For statistical analysis, five variables were considered: number of hooks per rostellum (NUH), blade length of large (LHBL) and small (SHBL) hooks, and total length of large (LHTL) and small (SHTL) hooks.



Fig. 1 *T. hydatigena* cysts recovered from peritoneal cavity of sheep



Fig. 2 *T. hydatigena* cysts recovered from liver of goat

Morphometry/micrometry observations

Studies on morphology and dimensions of the different protozoocysts were made using software DPZ-BSW (OLYMPUS).

Permanent staining of *T. hydatigena* cysts

The cysts of *T. hydatigena* were placed between the two slides and flattened. The two slides were tied with a piece of thread and placed in 70 % alcohol for 24 h. The cysts were stained using Borax carmine solution. The slides were placed in diluted stain for 24 h, destained in 4–5 % acid alcohol and then transferred in 70 % alcohol to wash out acid alcohol. The slides were further dehydrated in 90 % and absolute alcohol by keeping them for 1 h each. The slides were then transferred to xylene (a clearing agent) and mounted in Canada balsam. The slides were dried in incubator at 37 °C for 2 days.

Statistical analysis

Data were analyzed using Statistical Package for Social Sciences (SPSS 2001 for windows version 11.1 SPSS INC,

Table 1 Age wise prevalence of *Cysticercus tenuicollis* in sheep and goats

Age in years	Sheep		Goats	
	No. of carcasses examd.	No. positive	No. of carcasses examd.	No. positive
0–2	156	3	985	29
2–4	436	9	1159	72
>4	168	5	295	17
Total	760	17	2439	118

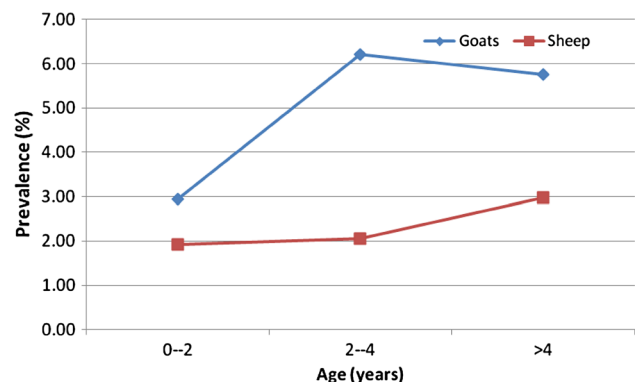
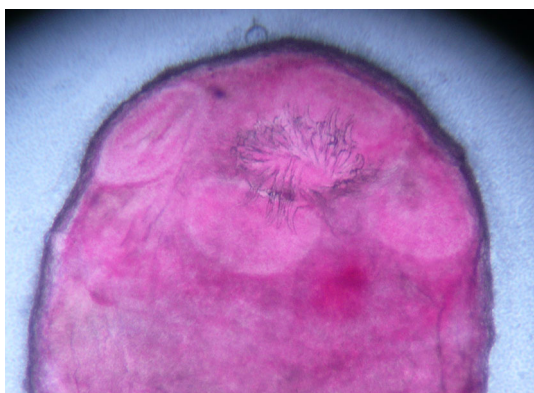
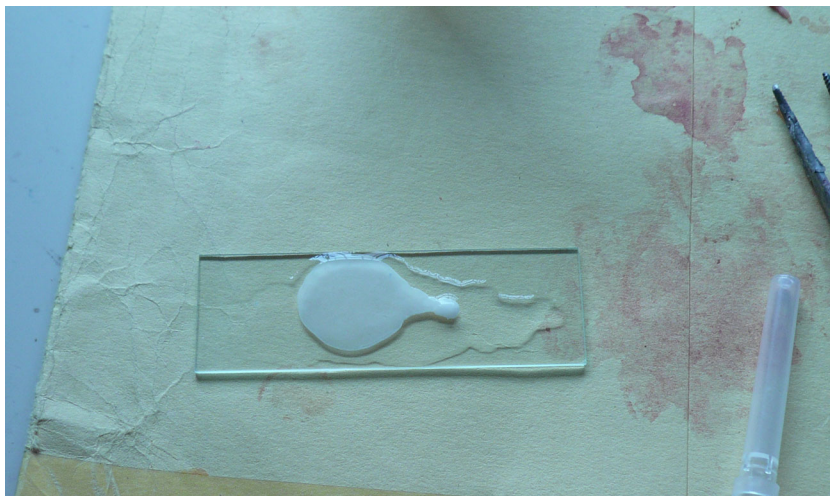


Fig. 3 Age wise prevalence of *Cysticercus tenuicollis* in sheep and goats

Fig. 4 Scolex collected from *T. hydatigena* cyst



Figs. 5 Four suckers and rostellar hooks in borax carmine stained scolices

Chicago, Illinois). Principal component analysis was applied for statistical analysis.

Results

Out of 3,199 carcasses examined, 135 were found containing cysts of *T. hydatigena* (Figs. 1, 2) indicating a prevalence of 4.22 %. Most of the cysts were present in abdominal cavity, except few which were embedded in the liver. The high prevalence of 4.83 (118/2439) was recorded in goats as compared to 2.23 % (17/760) in sheep. Age wise, the prevalence was found to be highest in 2–4 year old goats and in >4 year old sheep (Table 1; Fig. 3). *T. ovis* was not detected in any of the animals.

Table 2 Rostellar hook characteristics of the scolices from *Cysticercus tenuicollis* in sheep and goat

Name of the animal	Number of samples analyzed	Number of hooks	Arrangement of hooks	Large hooks		Small hooks	
				Total length	Blade length	Total length	Blade length
Goat	5	28–31	Alternate small and large hooks in	194–205.0	92.0–99.0	137–147	72.0–78.0
Sheep	5	29–31	2 rows	193.0–207.0	91.0–99.0	131.0–147.0	70.5–77.0

Table 3 Correlation matrices from the five variables considered using data from ten animal samples

	NUH	LHTL	LHBL	SHTL	SHBL
Sig. (1-tailed)					
NUH		.208	.332	.487	.335
LHTL	.208		.000	.026	.000
LHBL	.332	.000		.013	.000
SHTL	.487	.026	.013		.002
SHBL	.335	.000	.000	.002	

Determinant = .003

Table 4 Percentage of total variance explained by five possible factors, using ten animal samples

Component	Initial eigenvalues			Rotation sums of squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	3.493	69.864	69.864	3.428	68.559	68.559
2	1.026	20.512	90.375	1.091	21.817	90.375
3	.364	7.287	97.662			
4	.091	1.827	99.489			
5	.026	.511	100.000			

Table 5 Component score coefficient matrix resulting from principal component analysis, rotated (varimax), Factor inter correlation $-.88$

	Component	
	1	2
NUH	-.088	.932
LHTL	.248	.164
LHBL	.273	.014
SHTL	.279	-.245
SHBL	.288	-.017

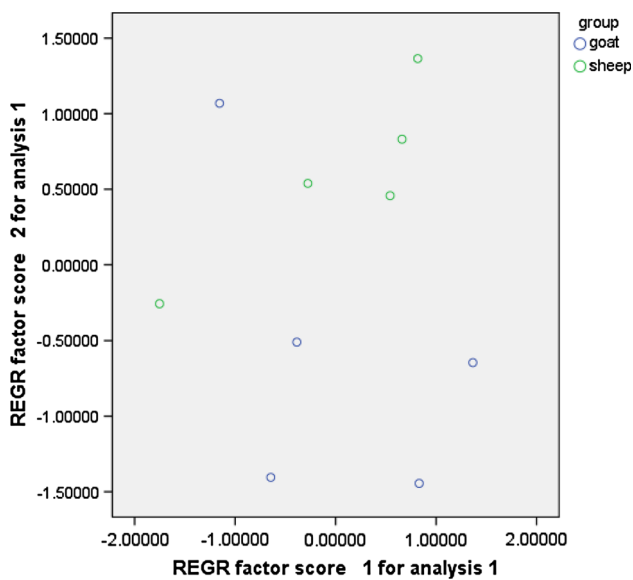


Fig. 6 Plot of 10 animal samples of *T. hydatigena* cysts for the two factors extracted by Principal component analysis, rotated (varimax) solution

Rostellar hook morphology of *C. tenuicollis*

The arrangement of hooks in rostellum was alternate with large and small hooks in two rows in all the samples and the shape of the hooks was smooth in their outline. The other characteristics (total number of hooks, total and blade length of large hooks, total and blade length of small hooks (Figs. 4, 5) are mentioned in Table 2. Principal component analysis was performed on five samples from each species.

Strong positive correlations were found between LHTL, LHBL, SHTL and SHBL with NUH (.208, .332, .487, .335) whereas no correlation was found (Table 3) between LHTL with LHBL and SHBL (.0). In PCA, criteria considered for determining the number of factors to extract were the factors having eigen value >1.0. Factor 1 and 2 represented 90 % of the variance (Table 4). If the second factor (explaining nearly 21 % of total population variance) is considered, then the first factor represented hook length while the second factor represented NUH (Table 5). When samples were plotted with both factors, two different groups were observed (Fig. 6), the first corresponding to samples from sheep; a second group corresponding to goat samples. The results indicate that morphological analysis can be used as a valid criterion for differentiation of *T. hydatigena* cysts and there might be possibility of two different strains infecting sheep and goat.

Discussion

High incidence of *C. tenuicollis* has been reported from other parts of the country. This might be due to difference in managerial practices, environmental and other factors. Pathak and Gaur (1982) examined 810 sheep, 1015 goats and 1040 pigs for the presence of *C. tenuicollis*, to determine the incidence of these parasites. *C. tenuicollis* was found in 37.03 % of sheep, 27.29 % of goats and 8.30 % of pigs. The rate of infection was higher in sheep than in goats or pigs. A high incidence of infection was found in the rainy season. The intensity of infection was higher in old than in young animals. Nath et al. (2010) examined 652 goats from the slaughter house at Supela, Bhilai, Chhattisgarh and found that 137 (21.01 %) goats were positive for *T. hydatigena* cysticercosis. Organ-wise studies showed that the cyst were present mainly at mesentery and omental fat region (84.67 %) followed by liver (8.03 %) and diaphragm (.73 %). Around 6.57 % goats showed the cysts both in liver and mesentery and omental fat.

High prevalence of *C. tenuicollis* has been reported from sheep and goat in Ethiopia (Sissay et al. 2008). In sheep, the overall prevalence was 26 % for *C. ovis*, 79 % for

C. tenuicollis, and 68 % for hydatid cysts. Similarly, for goats, the corresponding prevalence was 22, 53 and 65 %, respectively.

The results of morphological characterization are in parity with Radfar et al. (2005) who observed that morphological characters were significantly different in cysticerci from sheep and goats ($p < .05$) and concluded that the cysticerci of sheep and goat origin probably represent two different strains and possibly follow the same pattern of speciation as reported in the related taeniid, *Echinococcus granulosus*.

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