Morphological characterization of *Cysticercus cellulosae* in naturally infected pigs in Punjab (India)

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Abstract Porcine cysticercosis is an important medical and veterinary concern in the developing world. The present study was carried out to determine the morphological characteristics of *Cysticercus cellulosae*, so as to differentiate the *C. viscerotropica* (larval form of *T. asiatica*) which is having only rudimentary hooks on their rostellum. Morphological analysis was conducted on 22 *Cysticercus* positive samples. Measurements for number of hooks (large and small), the total length and blade length of large and small hooks per rostellum were carried out as per previous studies. Microscopic examination of all the cysts showed typical characteristic of *T. solium* i.e. presence of hooks in all the cysts. The results indicated absence of *T. asiatica* from naturally infected pigs in Punjab (India).

Keywords *Taenia solium* · *Cysticercus cellulosae* · Morphology · Punjab · India

Introduction

Porcine cysticercosis is one of the most serious cestode zoonosis spreading worldwide, even in Muslim and Jewish communities where consumption of pork is prohibited (Schantz et al. 1998; Singh et al. 2010). The disease is caused by larval form of *Taenia solium* which is a two host cestode (Sing and Juyal 2013). The adult tapeworms are flat, sectioned worms with three anatomic regions (Stillman 2003).

Humans are the only natural definitive host of *T. solium*. In humans it causes very important zoonosis known as neurocysticercosis (Eddie et al. 2006).

Pigs acquire the infection after ingestion of embryonated eggs or gravid proglottids passed through human faeces (Mutua et al. 2007). Many factors such as presence of scavenging pigs and absence of sewage disposal systems further enhance the transmission cycle of the disease (Singh et al. 2011). *T. solium* cysticerci are found in almost all tissues of pigs (Boa et al. 2002), but mostly remain asymptomatic. Although the disease usually remains asymptomatic, it could cause production and economic losses in the pork production (Zoli et al. 2003).

The present study was carried out to determine the morphological characteristics of *C. cellulosae*, so as to differentiate the *C. viscerotropica* (larval form of *T. asiatica*) which is having only rudimentary hooks on their rostellum and *C. bovis* which is having no hooks on the rostellum.

Materials and methods

The research work was carried out in the School of Public Health and Zoonoses, College of Veterinary Science, Guru Angad Dev Veterinary and Animal Sciences University, Ludhiana, Punjab (INDIA).

Rostellar hook morphology

Morphological analysis was conducted on 22 *Cysticercus* positive samples. Measurements for number of hooks (large and small), the total length and blade length of large and small hooks per rostellum were carried out as per the method of Fan et al. (2001).

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Permanent staining of *T. solium* cysts

The cysts of *T. solium* were placed between the two slides and flattened. The 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.

Morphometry/micrometry observations

Studies on morphology and dimensions of the different protoscoleces were made using software Prog Res CT5-Prog Res Capture Pro v 2.8.8 (OLYMPUS).

Results

Based on morphological analysis, the results indicated presence of *C. cellulosae* and absence of *C. viscerotropica* (larvae of *T. asiatica*) in all the samples.

Rostellar hook morphology

The double rows of rostellar hooks on the scolex i.e. the arrangement of hooks in rostellum was alternate with large and small hooks in two rows (Fig. 1) in some of the samples, whereas only small hooks were observed in other samples. The other characteristics like total number of hooks (large and small), total and blade length of large hooks (Fig. 2), total and blade length of small hooks

(Fig. 3) of all the positive samples were measured. Diameter of scolex and suckers were also measured (Fig. 4). The average parameters of total number of hooks, total and

Fig. 2 Full length and blade length of large hook

Fig. 3 Full length and blade length of small hook

Fig. 1 Alternate arrangement of hooks

Fig. 4 Measurement of scolex and suckers of *C. cellulosae*

Table 1 Measurement of total and blade length of hooks

Total no of hooks		Total length of hooks (in μm)		Blade length of hooks (in μm)	
Large	Small	Large	Small	Large	Small
12–14	9–12	159	118	89.3	65.6

blade length of large and small hooks are mentioned in the Table 1.

Discussion

The length of large and small hooks has been reported to be 160–170 μm and 110–140 μm by Verster (1967) and 140–180 μm and 110–140 μm by Soulsby (1982), respectively. Boa et al. (1995) examined eighty-three carcasses of pigs and reported that the mean number of hooks on the protoscolices was 27 and the length of the small hooks varied from 105 to 130 microns while that of the larger hooks varied from 168 to 174 microns.

Among all the cysts which were examined microscopically showed the typical characteristic of *T. solium* i.e. presence of hooks in all the cysts. These results indicated the absence of *T. asiatica* from naturally infected pigs in Punjab (India).

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Conflict of interest No financial or personal relationships between the authors and other people or organizations have inappropriately influenced (bias) this work.

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