

# Prevalence and pathological lesions of ovine cysticercosis in slaughtered sheep in western Iran

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Received: 18 April 2015 / Accepted: 29 September 2015 / Published online: 12 January 2016  
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**Abstract** *Cysticercus ovis*, the intermediate stage of a canine tapeworm, *Taenia ovis*, produces cystic lesions in the skeletal and cardiac muscle of sheep which, if numerous, will result in the condemnation of an entire carcass. This study was carried out between March 2013 and March 2014 to estimate the prevalence of *Taenia ovis cysticercosis* in sheep slaughtered at the Kermanshah municipal abattoir, in western Iran. Of 69,198 sheep examined, 833 (1.27 %) were infected with cysticerci of *Taenia ovis*. The prevalence of *C. ovis* was significantly higher in males than females ( $P < 0.05$ ). Seasonal analysis revealed significantly higher prevalence in spring (1.8 %) than other seasons ( $P < 0.005$ ). The heart muscles (29.7 %), diaphragm (18.8 %), masseter muscles (18.2 %) and tongue (15.5 %) were the main predilection sites of the cysts. The cysts of *ovine cysticercosis* were also identified on the triceps, intercostal muscles, thigh muscles, intestinal mucosa, liver and Spleen. This parasite caused extensive damage resulting in infiltrative, degenerative changes, necrosis and exudation mainly in the vicinity of cysts. The results indicate that the prevalence of *C. ovis* in this area is high. Therefore improving the standard of disease prevention and control on farms is necessary.

**Keywords** *Cysticercus ovis* · Prevalence · Pathology · Kermanshah · Iran

## Introduction

*Taenia ovis* (*Cysticercus ovis* or ‘sheep measles’) is a tapeworm parasite with the adult stage of the parasite found in the intestines of dogs while the intermediate or larval stage is found in the muscles of sheep and goats. Sheep are infected by grazing pasture contaminated with the infective eggs that have been shed in dog faeces. Within skeletal and cardiac muscles of the intermediate host, *C. ovis* appears as a thin-walled, fluid-filled, cyst-like structure approximately 1 cm in diameter. Definitive host such as wild and domestic canids, are infected by the ingestion of viable cysts in ovine muscle. Over time, the cysts in the muscle will degenerate and then calcify and form a small nodule with a ‘gritty’ texture, which known as sheep measles (Soehl 1984, DeWolf et al. 2012).

Although *C. ovis* is neither a flock health nor zoonotic issue, it does impact food quality. The calcified and viable cysts are unpleasant to eat and can result in carcasses being downgraded or even condemned at the abattoir (DeWolf et al. 2012).

As a result, carcasses are condemned at slaughter using guidelines provided by the Food and Agricultural Organization of the United Nations (FAO). The FAO guidelines recommend that a carcass be condemned due to *C. ovis* infection if lesions are found in two of the usual inspection sites (masseter muscle, tongue, oesophagus, heart, diaphragm or exposed musculature) and in two sites during incision into the shoulder and the rounds (Food and Agriculture Organization 2000). Thus, *C. ovis* infection is a major concern for sheep industries in the endemic areas and cause economic loss in these countries (Lawson 1994).

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Currently, much of what is known about the epidemiology of *C. ovis* is based on research carried out in New Zealand, Australia, Canada and some African countries, where infection is endemic (Lawson 1994; DeWolf et al. 2012; Sissay et al. 2008). The epidemiology of *C. ovis* in Iran remains unknown, but is likely significantly different from mentioned countries because of differences in environmental conditions, flock management, the nature of the pasture, sheep predation and scavenging from wild canids, specifically foxes and wolves. Therefore, this survey was designed to estimate the prevalence of cysticercosis in sheep at Kermanshah abattoir, west of Iran in the period between March 2013 and March 2014, and also evaluation of microscopic lesions caused by parasite in different tissues.

## Materials and methods

### Field study area

The study was carried out in Kermanshah slaughterhouse, the western provinces of Iran, from March 2013 to March 2014 during the wet and dry seasons. Kermanshah province is located between latitude 33°35'N and longitude 45°47'E with altitude 1350 m above sea level.

Kermanshah has a moderate and mountainous climate and the annual rainfall is 500 mm. The average temperature in the hottest months is above 22 °C.

### Study animals

Postmortem inspection was conducted on 69,198 sheep (48,926 ♂ and 20,272 ♀) slaughtered at Kermanshah Abattoir, which originate from neighboring localities and different regions.

### Ante- and postmortem inspection

The ante-mortem examination included the general condition, posture and any abnormal clinical symptoms. Carcasses of these animals were subjected to routine meat inspection. *C. ovis* was determined by the presence of the vesicular larvae encysted the muscles and all visceral organs including diaphragm, triceps, thigh muscles, masseter muscle, heart muscle, intercostal muscles, lungs, liver, tongue, kidney, intestinal mucosa and spleen. The cysts observed were categorized into live and calcified cysts. The carcasses with two lesions in the usual inspection sites were considered as heavily infected and were condemned (Food and Agriculture Organization 2000). Tissues with gross pathological lesions were collected and examined histologically.

## Results

Of the total 69,198 animals inspected during March 2013 to March 2014, 833 (619 male and 214 female) were found positive for *ovine cysticercosis*. The prevalence of infection was 1.27 %. The prevalence of *C. ovis* was significantly higher in males than females ( $P < 0.05$ ) (Table 1). Seasonal analysis revealed significantly higher ( $P < 0.005$ ) prevalence in spring (1.8 %) than in summer (0.9 %), autumn (1.1 %) and winter (0.9 %).

The distribution of cysticerci in the carcasses is shown in Table 2. A significant difference in the distribution of cysticerci was observed among studied predilection sites ( $P < 0.005$ ). The maximum intensity of infection was observed in heart muscles (29.7 %) and followed by diaphragm (18.8 %), masseter muscles (18.2 %), tongue (15.5 %), triceps (7.2 %), intercostal muscles (4.2 %), thigh muscles (3.7 %), intestinal mucosa (1.7 %), liver (0.6 %) and Spleen (0.3 %).

Of the total number of cysts, nearly 65 % of them were live and the others were calcified. Both live and dead cysts of *ovine cysticercosis* were found in some organs inspected.

On macroscopic examination, yellowish-white cysts with ill-defined edges were easily visible with the naked eye, embedded in the tissues and caused extensive local damage.

Microscopically, the muscle fibers revealed severe degenerative and necrotic changes. Cystic membrane of

**Table 1** Sex distribution of *C. ovis* infection of sheep in Kermanshah Abattoir

Sex	No. examined	No. (%) infected
Male	48,926	619
Female	20,272	214
Total	69,234	833

**Table 2** Predilection sites of bovine *cysticercosis* cysts in slaughtered sheep in Kermanshah Abattoir

Predilection sites	No. (%) infected
Heart muscles	2410 (29.7)
Diaphragm	1530 (18.8)
Masseter muscles	1480 (18.2)
Tongue	1260 (15.5)
Triceps	585 (7.2)
Intercostals muscles	340 (4.2)
Thigh muscles	304 (3.7)
Intestinal mucosa	140 (1.7)
Liver	48 (0.6)
Spleen	21 (0.3)

*C. ovis* surrounded by a zone of inflammatory cells and fibroblasts (Fig. 1).

In chronic lesions, granulomatous inflammation, characterized with accumulation of epithelioid macrophages, giant cells, lymphocytes and much necrotic cellular debris were observed around the parasites and necrotic areas (Fig. 2a, b). In addition to the reaction adjacent to the parasite there was a more diffuse infiltration of polymorphonuclear leucocytes, lymphocytes, and fibroblasts between muscle bundles and individual fibers.

## Discussion

*Ovine cysticercosis* causes considerable economic losses in cattle due to the condemnation of carcasses and organs. Therefore, it is justifiable to find reliable data for

monitoring epidemiologic aspects of disease and prepare a baseline data for future comparison (DeWolf et al. 2012).

During the present study period, *ovine cysticercosis* was found in 1.27 % of sheep presented for slaughter at Kermanshah abattoir, west of Iran.

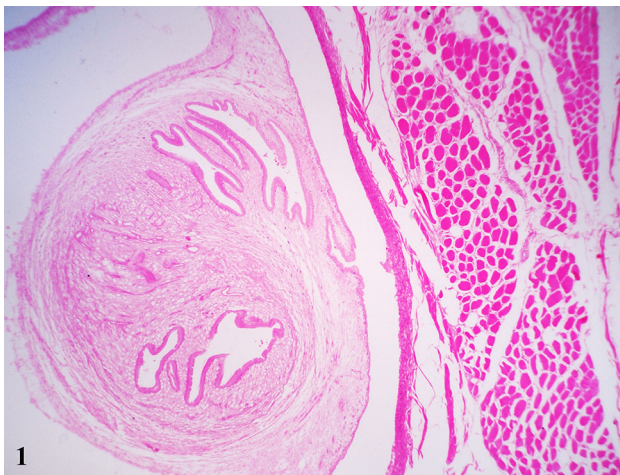
Prevalences of 26.0 % *C. ovis* infestation in sheep and 22.0 % in goats from eastern Ethiopia (Sissay et al. 2008), 20.5 % in sheep in Western Australia (White 1976), 2.3 % in sheep in Saudi Arabia (Al-Qureishy 2008) and 0.2 % and 0.095 % in sheep from southern Iran (Oryan et al. 1994, 2012) have previously been reported. Although the prevalence of *C. ovis* recorded in the present study was higher than those reported from southern Iran, but it was considerably lower in compared with other countries.

It seems that the lower rate of *ovine cysticercosis* in Kermanshah province may have been the result of a real decrease of infections or of a less careful inspection of the carcasses in the abattoirs (Hashemnia et al. 2015).

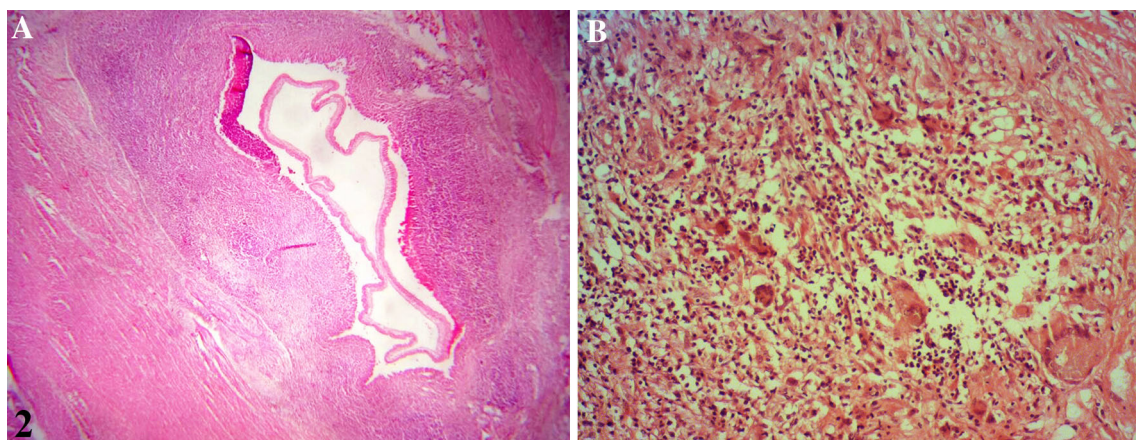
Cysticerci are easily missed, as they may not be present on routine cuts considering that most cases of cysticercosis are light infections. Differences in the skills and motivation of meat inspectors, the speed of the slaughter activity, and the meat inspection facilities, are among the many other contributory factors (Garedaghi et al. 2011).

High prevalence of *C. ovis* in this area in compared to southern Iran could be due to high population of carnivores particularly stray dogs in the grazing area of domestic ruminants and lack of proper efforts in segregating domestic and wild carnivores from livestock or their grazing areas. Feeding offal of ruminants to dogs also enhance completion of the life cycle.

The highest prevalence of infection in this investigation was in summer. This finding was in agreement with the results of Oryan et al. (1994) in Fars province, Iran. It should be noted that the suitable temperature and humidity in late spring and during summer and also easy access of



**Fig. 1** Cysticerci *Taenia ovis* surrounded by a zone of inflammatory cells and fibroblasts and degenerated muscle fibers (H&E; ×250)



**Fig. 2** Granulomatous inflammation including epithelioid macrophages, giant cells, lymphocytes and necrotic cellular debris around the parasite (H&E; a ×100; b ×1000)

animals to acquire infection with grass play an important role in the epidemiology of this infection in the west of Iran (Hashemnia et al. 2015).

Based on our observations, the main sites of predilection of this metacestode in sheep were heart muscles, diaphragm and masseter muscles whereas intestinal mucosa, liver and spleen showed less infection.

In the study conducted in Fars province, Iran, skeletal muscles and heart were predilection sites for the cysts of ovine cysticercosis (Oryan et al. 1994).

Although, the distribution of this cysticercus in different body parts followed no definite pattern, it appears that several factors, such as activity of the muscles, age, and the geographical area concerned determine largely the predilection sites in slaughtered animals (Minozzo et al. 2002; Opara et al. 2006).

The main histopathological lesions were severe degenerative and necrotic changes in the muscle fibers and also the sections of cysticerci in the affected organs were surrounded by a zone of degenerative, necrotic changes and polymorphonuclear leucocytes, lymphocytes and fibroblasts. These observations are similar to those reported in sheep (oryan et al. 1994), cattle (oryan et al. 1995; Geerts et al. 1980) and reindeer (Blazek et al. 1986).

## Conclusion

Although, some studies had previously been conducted in the west of Iran in relation with *bovine cysticercosis* (Jahed Khaniki et al. 2010; Hashemnia et al. 2015), there was not any data about *C. ovis* in this area. Although the meat-inspection records used in this study did not allow an estimation of the parasite's farm level prevalence, it did provide strong evidence that *C. ovis* can be found on sheep farms across West of Iran. The results indicate that the prevalence of *C. ovis* in this area is high and it seems that the programs of Veterinary Organization for control of ovine *cysticercosis* is not sufficient. Hence, improving the standard of disease prevention and control on farms is necessary.

Certainly, routinely examine canine feces for tapeworm segments, treat dogs regularly with anthelmintics effective against tapeworms, slaughter sheep and lambs at inspected abattoirs for monitoring purposes and do not allow access to raw mutton, offal and sheep carcasses by dogs and wild carnivores can help to control and prevention of the disease in this area.

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