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PREVALENCE, FERTILITY AND VIABILITY OF CYSTIC ECHINOCOCCOSIS IN SHEEP AND CATTLE OF ALGERIA

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Summary

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A total of 1973 sheep and 799 cattle were examined at the Tiaret abattoir in order to determine the prevalence of cystic echinococcosis (CE). *Echinococcus granulosis* metacestodes were found in 25.66% of cattle and 3.8% of sheep. The rates of lungs and liver CE were 8.29% and 6.34% in cattle, respectively, and 17.33% and 34.66% in sheep, respectively. However, the prevalence of co-infection (liver and lungs) was the highest with 85.36% in cattle and 48% in sheep. The fertility rate of the cysts was significantly greater ($P<0.05$) in sheep than in cattle with 72.45% and 7.04% respectively. The viable protoscoleces of fertile cysts in sheep were also significantly more numerous ($P<0.05$) than in cattle with 61.22% and 4.22% respectively. These findings reflect the life cycle maintenance and the transmission of the cestode *Echinococcus granulosis* from definitive hosts (dogs) to intermediate hosts (sheep and cattle) in Tiaret region and prompt plans for further epidemiological studies and control programmes.

Key words: cattle, cystic echinococcosis, fertility, sheep, viability

INTRODUCTION

Cystic echinococcosis (CE) is a widespread zoonosis caused by *Echinococcus granulosis*. The adult worm lives in the small intestine of carnivore (definitive host). The intermediate larval stage develops in the internal organs of many mammal species (including humans) which acquire the infection through accidental ingestion of the tapeworm eggs. Intermediate hosts are ungulates, mainly sheep and cattle (Kaplan & Baspinar, 2009).

CE is one of the major parasitic diseases in the Middle East and Arabic North Africa from Morocco to Egypt. Both cystic and alveolar echinococcosis have been reported in these areas, however, cystic echinococcosis is more prevalent (Sadjjadi, 2006).

In Algeria, CE is a serious economic and public health problem. The common sheep/dog cycle is usually considered as the major source of human contamination (Bardonnet *et al.*, 2003). Livestock infection leads to economic losses, and the feeding of stray dogs with offal discarded from animals slaughtered for human consumption helps to maintain the life cycle of *Echinococcus granulosis* (Daryani *et al.*, 2009).

The pathogenecity of hydatidosis heavily depends on the extent and severity of infection, and the organ on which it is located (Kebede *et al.*, 2009). The liver

and the lungs are the most commonly affected, although other organs can also be involved (Ceballos *et al.*, 2008).

The fertility of hydatid cysts is one of the important factors in the epidemiology of *Echinococcosis granulosis*. It varies depending on the intermediate hosts and geographical situation. The sheep strain G1 is the predominating *Echinococcosis* species in the Mediterranean countries and part of Great Britain (Wales) (Köse & Kircali, 2008).

The aim of this work was to determine the prevalence, the fertility and the viability of hydatid cysts in liver and lungs of sheep and cattle. These findings are important because they provide reliable indicators of the importance of each type of animal as a potential source of infection to dogs.

MATERIALS AND METHODS

The present study was conducted in Tiaret Abattoir and the Parasitology lab of the Veterinary Sciences Institute. Tiaret region is situated in the high plateau of Algeria, a semi-arid area characterised by cold and humid winter and hot and dry summer.

This study was carried out on 2772 animals (1973 sheep and 799 cattle), from April to December 2010. During this work study, the abattoir was visited periodically to examine the liver and lungs of slaughtered animals for the presence of cystic echinococcosis.

From September to December 2011, individual cysts were grossly examined for degeneration and calcification. The cyst wall was penetrated with scalpel and scissors. The contents were transferred into a sterile container and examined microscopically (10×) for the presence of protoscoleces. Cysts which contained no protoscoleces as well as heavily suppurative or calcified ones were considered unfertile (Daryani *et al.*, 2009). The viability of protoscoleces was assessed by morphology, movement and presence of flame cells and when necessary, by neutral red viable staining (Scala *et al.*, 2006)

Statistical tests were performed with Statistica software to compare the prevalence, location, rate of fertility and viability of hydatid cysts in sheep and cattle.

RESULTS

A total of 205 (25.66%) of the 799 slaughtered cattle and 75 (3.8%) of 1973 slaughtered sheep in Tiaret region were infected with hydatid cysts ($P<0.05$). The infection rates in both cattle and sheep are given in Table 1.

Table 1. Prevalence of hydatid cysts in sheep and cattle slaughtered in the Tiaret abattoir

Animals	Examined animals	Infected animals
Sheep	1973	75 (3.80%)
Cattle	799	205 (25.66%)

Co-infection of the liver and lungs was most commonly seen – in 85.36% of cattle and 48% of sheep ($P<0.05$). Separately, the liver in sheep was more commonly infected with 34.66% as compared to lungs with 17.33% ($P<0.05$). In cattle, the prevalence of CE only in the liver and lungs was 6.34% and 8.29%, respectively. The distribution of the cysts in the infected organs are shown in Table 2.

The fertility rate of cysts and the viability of protoscoleces from fertile cyst in lungs or livers of sheep and cattle are shown in Table 3. The cysts recovered from liver and lungs of sheep showed higher fertility rates: 76.7% in liver and

Table 2. The location of the cysts in the organs of the infected animals

Location	Sheep		Cattle	
	Number	%	Number	%
Liver only	26	34.66	13	6.34
Lungs only	13	17.33	17	8.29
Co-infection (liver + lungs)	36	48.00	175	85.36

Table 3. Fertility of hydatid cysts and viability of protoscoleces of fertile cysts recovered from liver and lungs of slaughtered sheep and cattle.

Animals	Infected organs	Number of examined cysts	Fertile cysts		Viable protoscoleces in fertile cysts	
			Number	%	Number	%
Sheep	Liver	43	33	76.70	29	67.40
	Lungs	55	38	69.00	31	56.30
	Total	98	71	72.45	60	61.22
Cattle	Liver	34	2	5.80	1	2.90
	Lungs	37	3	8.10	2	5.40
	Total	71	5	7.04	3	4.22

69% in lungs vs only 5.8% and 8.1% in liver and lungs of cattle, respectively. The fertility rates of infected sheep and cattle were 72.45% and 7.04% respectively ($P<0.05$). In sheep, but not in cattle, the fertility of cysts in the liver was higher than that in lungs. The viable protoscoleces of all fertile cysts in sheep and cattle was 61.22% and 4.22, respectively ($P<0.05$). The viable protoscoleces of fertile hepatic cysts of sheep and cattle was 67.4% and 2.9%, respectively and of fertile pulmonary cysts – 56.3% (sheep) and 5.4% (cattle).

DISCUSSION

The present findings indicate the essential elements of the life cycle of *Echinococcus granulosis*. The synanthropic cycle involving domestic dogs and livestock (e.g., sheep and cattle) is the most common transmission pattern and the main source of infection for humans (Zhenghuan *et al.*, 2008).

The occurrence of cystic echinococcosis (CE) studied in different geographical areas (Syria, North Jordan, Iran, Sudan, Turkey and Morocco) ranges from low (5.2% in Syria) to very high in Morocco (48.72%), Iran (38.3%), Turkey (29.47%) (Gebremeskel & Kalayou, 2009).

In the present study, the infection rate of cattle of 25.66% could be classified as high. Lower prevalence rates were reported – 5.2% in Syria (Dajani, 1978), 5.8% in North Jordan (Abdel-Hafez *et al.*, 1986), 6.7% in Mazandaran province of Iran (Sharif, 2000), 6.4% in Libya (Al-Khalidi, 1998), 7% in Sudan (El-Mahdi *et al.*, 2004). In Thrace (Turkey) the rate was 11.6% (Meltem & Erkut, 2007), in Iran – 16.4% (Dalimi *et al.*, 2002), in Ethiopia – 12.7% (Daniel, 1995). Higher prevalences among cattle were reported in Central Morocco, Rif mountains and South Morocco – 10.29%, 10.11% and

13.33% respectively (Azlaf & Dakkak, 2006) and 19.4% in Northern Turkana, Kenya (Njoroje *et al.*, 2002).

The infection rate of cattle in the present study was similar to incidence rates reported by Jobre *et al.* (1996) in Gondar (24.3%) and South Omo (25.7%) in Ethiopia. Higher prevalence rates were reported in Afyonkarahisar, Turkey (29.47%) (Köse & Kiracli Sevilmi., 2008), Northwest Iran (38.3%) (Daryani *et al.*, 2006), Loukkos and Middle Atlas of Morocco (37.61% and 48.72% respectively) (Azlaf & Dakkak, 2006).

The rate of infection of sheep in our study (3.8%) was lower than the rate of 8.7% reported by Al-Khalidi (1998) in Libya, the overall infection rate of 14.7% reported by Yousefi *et al.* (2007) in Iran, in Rif and Middle Atlas (Morroco) with 7.37% and 11.14% respectively (Azlaf and Dakkak, 2006), in North Jordan 27.8% (Abdel-Hafez *et al.*, 1986). In Italy, Scala *et al.* (2006) established a very high incidence of 75%.

Similar percentages to ours were communicated in other studies: 3.21% in Yemen (Baswaid, 2007), 3.2% in lambs in Kirikkale, Turkey (Yildiz & Gurcan, 2003), 3.5% in Thrace, Turkey (Meltem & Erkut, 2007) and 3.6% in Northern Turkana, Kenya (Njoroje *et al.*, 2002).

In other studies, lower infection rates were reported: 0.3% (Haridy *et al.* 2005) and 0.66% (Abu-Elwafa *et al.* 2009) in Egypt. In Kashan region of Iran the prevalence was 2.7% (Arbabi & Hooshyar, 2005). In our survey, the lower prevalence (3.8%) in sheep was probably due to the fact that the most of the animals were young. Most of the slaughtered cattle were adult, i.e. they had an increased exposure to the disease over a long period of time with a higher possibility of acquiring the infection (Kebede *et al.*, 2009). Some previous studies strongly suggest that the prevalence of bovine hydatidosis is heavily influenced by age (Lahmar *et al.*, 2001). Furthermore, the mode of grazing on pasture differs between cattle and sheep. Cattle graze on more limited areas, with regular presence of definitive hosts (carnivores).

The majority of infected cattle (85.36%) and sheep (48%) had hydatid cysts in both liver and lungs, as reported also by Giannetto *et al.* (2004), Azlaf & Dakkak (2006), Kebede *et al.* (2009) in cattle, and Yildiz & Gurcan (2003) in sheep. This is explained by the fact that lungs and liver possess the first great capillaries sites encountered by the migrating *Echinococcus* oncosphere which adopts the portal vein route and primarily negotiate hepatic and pulmonary filtering system sequentially before any other peripheral organ is involved (Kebede *et al.*, 2009). Furthermore, in sheep, the liver only was more frequently infected than lungs as reported by Giannetto *et al.* (2004).

The proportion of animals with fertile, viable cysts is an important indicator of the significance of a species as an intermediate host (Gebresmeskel & Kalayou, 2009). In the present study, 72.45% of infected sheep (liver 76.7% and lungs 69%) had fertile cysts. This percentage was higher compared to reports from Yemen – 46.8% (Baswaid, 2007), Iraq – 39.4% (Al-Abbassy, 1980), the Manzandaran Province, Northern Iran – 42.6% (Daryani *et al.*, 2009), Pakistan – 80.95% (Anwar *et al.* 1993). In infected cattle 7.04% of cysts were fertile (liver 5.8% and lungs 8.1%). Daryani *et al.* (2009) also reported 5.3% fertile cysts (liver 1.4% and lungs 8.1%). Higher fertility rates were established by Dalimi *et al.* (2002) – 14.7% in lungs and 10.2% in liver. Regarding the fertility of hydatid

cysts in sheep and cattle, several studies reported that cysts collected from sheep, camels and humans were more than those of cattle origin (Azlaf & Dakkak, 2006).

The viable protoscoleces from fertile cysts in sheep and cattle were 61.22% (liver 67.4% and lungs 56.3%) and 4.22% (liver 2.9% and lungs 5.4%), respectively. Dalimi *et al.* (2002) also reported that cyst viability rate in sheep (82%) was higher than that in cattle (75%). On the contrary, Daryani *et al.* (2009) reported lower viability rate in sheep (76.92%) than in cattle (82.5%).

According to this study, hydatidosis was shown to exist both in cattle and sheep in the Tiaret region. The fertility rate of hydatid cysts in sheep was higher than that in cattle. However, the role of sheep remains unclear in relation to dog-man cycle. Cattle is of less importance as they carry mostly sterile cysts. Therefore, efforts should be made to control transmission of cysts from slaughterhouses by safe disposal of infected offal.

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