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PREVALENCE OF HYDATIDOSIS AND FERTILITY OF HYDATID CYSTS IN SHEEP IN KIRIKKALE, TURKEY

K. YILDIZ[1*] and S. GURCAN[2]

[1]Department of Parasitology, Faculty of Veterinary Medicine, Kirikkale University, Campus 71450 Kirikkale, Turkey; [2]Department of Biometry, Faculty of Veterinary Medicine, Ankara University, Ankara, Turkey

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This study was conducted in order to determine the prevalence and fertility of hydatid cysts in sheep in Kirikkale, Turkey. A total of 3.2% of 553 lambs and 50.9% of 1320 adults were found to be infected with hydatid cysts. The most common locations of cysts were in the liver and lung. Liver cysts tended to be more fertile than lung cysts (81.53% v. 76.47%), though the difference was not significant. The mean number of viable protoscoleces in the liver and lung cysts were 12,400 and 5,800, respectively. In general, 1–10 cysts were found in liver (51.8%) and lung (64.7%). The findings of this study indicate that hydatid cysts are common in sheep and the fertility rate of cysts is quite high. Sheep play an important role in the life cycle of *Echinococcus granulosus* in this region.

Key words: Larval *Echinococcus granulosus*, hydatid cyst, fertility, prevalence, sheep

Cystic hydatidosis, caused by *Echinococcus granulosus,* is a problem of zoonotic importance in the Mediterranean and the Middle East countries (Abdel-Hafez et al., 1986; Farah, 1987; Gusbi et al., 1987; Bortoletti et al., 1990; Himonas et al., 1994; Kamhawi et al., 1995; Mehrebani et al., 1999). The definitive hosts of *E. granulosus* are mainly stray dogs and sheepdogs. Various animals including sheep, goats and cattle act as intermediate hosts. Hydatidosis in animals is of economic importance due to the losses caused by the condemnation of organs of slaughtered animals, and because of the indirect losses from their reduced yield.

Several strains of *Echinococcus* such as the common sheep strain, cattle strain, horse strain, etc. have been described from different geographic areas or intermediate host species (Thompson and Lymbery, 1988). Most strains of *Echinococcus* are identified on the basis of presumed differences in intermediate host preference, usually evident from epidemiology. The strain variation in *Echinococcus* species is important for the life cycle of the organism which affects the epidemiology and control of hydatid disease (Thompson and Lymbery, 1990).

[*]Corresponding author: Dr. Kader Yildiz; E-mail: kaderyildiz@hotmail.com; Tel: +90-318-357 33 01-03; Fax: +90-318-357 33 04

Hydatidosis is one of the major infectious zoonotic diseases in Turkey, where carcass wastes are easily accessible to stray dogs and other wild carnivores. High rates of echinococcosis in stray dogs (28–40.5%) play an important role in the transmission of the parasite in this region (Atas et al., 1997; Umur and Aslantas, 1998). The prevalence of hydatid cysts among sheep has been reported previously in Turkey (Oge et al., 1998; Senlik, 2000).

The fertility of hydatid cysts occurring in various intermediate host species is one of the most important factors in the epidemiology of the disease (Irshadullah et al., 1989; Bortoletti et al., 1990; Himonas et al., 1994). The fertility of hydatid cysts varies depending on intermediate host species and geographical areas (Abdel-Hafez et al., 1986; Farah, 1987; Gusbi et al., 1987; Irshadullah et al., 1989; Bortoletti et al., 1990; Himonas et al., 1994; Kamhawi et al., 1995; Saeed et al., 2000).

The first objective of this study was to determine the prevalence and infectivity rates of hydatid cysts and the number and viability of protoscoleces obtained from liver and lung cysts in sheep. The second objective was to examine the relationship between the cyst diameter and the mean number of viable protoscoleces (MNVP), and also between the cyst volume and MNVP.

Materials and methods

Regular visits were made to the local abattoir in Kirikkale for 12 months (1999–2000). All sheep slaughtered at the abattoir originated from small farms located around Kirikkale. The heads of animals were removed from the carcasses following slaughter. Due to the difficulty of determining the exact age of these carcasses, it was decided to include two distinct age groups in the study. A total of 1873 sheep were examined in this period: 553 sheep under one year of age were grouped as ‘lambs’, and 1320 older animals were classified as ‘adults’. The liver, lung, heart and spleen of each sheep slaughtered were routinely inspected at each visit to the abattoir. Hydatid cysts found in adults were examined in this study, assuming that in lambs the cysts had not developed fully. The prevalence of hydatidosis was studied in lambs. Infected organs of adults were selected randomly and were removed immediately after slaughtering and taken into the laboratory within an hour of slaughter.

A detailed record was kept including location and measurements of hydatid cysts found in 44 organs (27 of liver, 17 of lung) chosen depending on the number of cysts per organ in the laboratory. Hydatid fluid was aspired from the cysts and the volume of cysts was estimated by measuring this fluid. Ten samples of 100 µl suspension of the protoscoleces were taken from the hydatid fluid of each cyst. Eosin was added to each sample. All dead protoscoleces were stained red but the viable ones did not take up the stain, and also flame cell ac-

tivity was observed in unstained protoscoleces. The fertility rates of cysts were calculated from the numbers of viable and dead protoscoleces assessed by relating the number found in the 1000 µl examined to the total volume of cystic fluid.

Hydatid cysts were classified into three groups; fertile (containing live protoscoleces), sterile (full of fluid, but without protoscoleces) and calcified (containing cheese-like material).

Data set of this study was examined at two stages. First, logarithmic transformation was used to provide normal distribution on quantitative data, then Pearson correlation test, Student's *t*-test and chi-squared test were used for comparing the fertility rate of the liver and lung cysts and establishing the relationship between the different groups.

Results

Table 1 summarises results related to the prevalence of hydatid cysts and organ localisation in two age groups of sheep. Hydatid cysts were found in 673 adults (50.9%) and in 18 lambs (3.2%). The sites were liver and lung only, and cysts were not observed in other organs. Infections involving both liver and lung were common in the adult sheep (52.4%) but in lambs liver cysts were observed in general (83.3%).

Table 1

Organ localisation and percentage of hydatid cysts in two age groups of sheep

Organs with cysts	Adults (n = 1320)		Lambs (n = 553)	
	No. of infected animals	Infection rate (%)	No. of infected animals	Infection rate (%)
Liver	222	33.0	15	83.3
Lung	98	14.5	1	5.5
Liver + lung	353	52.4	2	11.1
Total	673	51.0*	18	3.2*

*$p < 0.001$

Table 2 shows the fertility rate of protoscoleces found in hydatid cysts. The fertility rate of cysts in the liver (81.54%) was higher than that of cysts in the lungs (76.47%) ($t = 0.775$, $p > 0.05$). Mean number of viable protoscoleces (MNVP) in liver cysts (12,400) was also higher than that of lung cysts (5,800) ($t = 2.26$, $p < 0.05$).

The relationship between cyst diameter and MNVP is summarised in Table 3. There was a weak correlation only between cyst diameter and MNVP in the liver ($r = 0.38$) and no correlation in the lungs.

Table 2

Fertility rate of hydatid cysts in the liver and lungs of adult sheep

	Liver (n = 27)			Lungs (n = 17)		
No. of fertile cysts	53			13		
No. of sterile cysts	12			4		
No. of calcified cysts	–			–		
Fertility rate (%)	81.54			76.47		
Sterility rate (%)	18.46			23.53		
	Min–max	Mean	SD	Min–max	Mean	SD
No. of protoscoleces in cysts	100–289,800	26,100	48,713	100–169,100	15,000	30,664
No. of viable protoscoleces in cysts	70–136,600	12,400	22,622	300–37,300	5,800	8,768

Table 3

Relationship between hydatid cyst diameter and the mean number of viable protoscoleces

Cyst diameter (mm)	Liver cysts (n = 65)			Lung cysts (n = 32)		
	n	MNVP*	Fertility rate (%)	n	MNVP*	Fertility rate (%)
10–19	10	2,000	35.1	7	2,700	48.4
20–29	13	1,200	46.3	7	2,900	82.8
30–39	14	7,400	62.7	9	700	29.5
40–49	10	6,700	60.5	5	5,400	72.8
50–59	11	13,900	61.0	2	19,600	56.8
60–69	4	51,300	41.6	2	16,900	74.9
≥ 70	3	12,600	53.2	0	–	–

*Mean number of viable protoscoleces

The MNVP increased in parallel with the volume of hydatid cysts (Table 4). The biggest cyst volume was observed in the liver. There was no correlation between cyst volume and the fertility rate.

Damage to organs due to hydatid cysts was assessed on the basis of the cyst number. In general, 1–10 cysts and 11–20 cysts were observed in the liver (51.8% and 14.8%) and lungs (64.7% and 23.5%), respectively, 21–44 cysts were found only in the liver (25.9%) (Fig. 1). More than 44 cysts occurred in both liver (11.1%) and lungs (11.7%). MNVP in the cysts decreased with increasing cyst number in liver ($r = –0.408$), but this was not the case in lung cysts ($r = –0.283$). A relationship was found only between the number of cysts in the liver and the fertility rate ($p > 0.05$).

Table 4

Relationship between hydatid cyst volume and the mean number of viable protoscoleces

Cyst diameter (ml)	Liver cysts (n = 65)			Lung cysts (n = 32)		
	n	MNVP*	Fertility rate (%)	n	MNVP*	Fertility rate (%)
1–10	16	2,400	44.6	13	1,800	57.1
11–20	26	5,800	54.7	10	5,000	50.8
21–30	12	10,000	62.2	3	4,600	59.3
31–40	6	19,700	46.5	6	19,700	46.5
41–70	5	37,300	41.3	0	–	–

*Mean number of viable protoscoleces

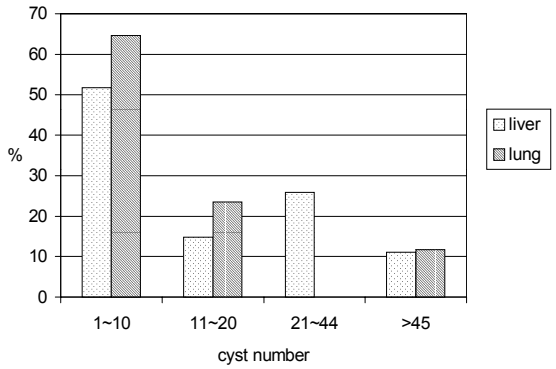

Fig. 1. The number of hydatid cysts in liver and lungs

Discussion

The present study indicates that hydatid cysts are common parasites in sheep from the Kirikkale region. The high prevalence of hydatidosis in adults (50.9%) in this study was in agreement with previous data on hydatidosis in sheep in Turkey. The reported prevalence of hydatidosis was between 5.9% and 50.7% (Oge et al., 1998; Senlik, 2000). Although there were some data on the prevalence of larval echinococcosis in Turkey, the number of protoscoleces in cysts in sheep, the relationship between cyst number and volume and MNVP remained unknown.

The age-related prevalence of hydatidosis observed in our study supports the results of previous studies (Gusbi et al., 1987; Bekele et al., 1988; Lahmar et al., 1999; Senlik, 2000). The low infection rate found in lambs (3.2%) might be attributed to the relatively short period of exposure to the contaminated environment and to the slow development of cysts.

The true interpretation of fertility in terms of importance of disease transmission depends on the number of viable protoscoleces capable of causing infection in definitive hosts. The fertility rate of hydatid cysts in sheep reported in the literature varies in different regions of the world. Cyst fertility rates in sheep were reported as 84% in Saudi Arabia (Farah, 1987), 90% in India (Singh and Dhar, 1988), 7.6% in Sardinia (Bortoletti et al., 1990), 51% in Greece (Himonas et al., 1994), 38.1% in Jordan (Kamhawi et al., 1995) and 64% in Iraq (Saeed et al., 2000). The cyst fertility rate in sheep of the Kirikkale region was similar to that known from previous studies reported in Turkey as 61.2% (Senlik, 2000) and 93% (Guralp and Dogru, 1971). The reasons for the variation in the fertility levels of hydatid cysts are not totally understood. This might be related to the age of the intermediate hosts and to the strain of *E. granulosus* (Thompson and Lymbery, 1990).

Some authors emphasise that the fertility rate of cysts in the liver and lungs is different. Himonas et al. (1994) found that sheep in Greece carried more viable protoscoleces in the lungs (82.3%) than in the liver (71.2%). In Libya, it was reported that the cysts in the lungs of sheep were more fertile (91.52%) than those in the liver (74.16%) (Gusbi et al., 1987). Abdel-Hafez et al. (1986) found that there was no significant difference between the viability rates of protoscoleces obtained from liver (66%) and lungs (71%). It was reported in Turkey that sheep carried more viable protoscoleces in the lungs (63.9%) than in the liver (41%) (Senlik, 2000). In the present study the fertility rate of liver cysts was slightly higher (81.53%) than that of lung cysts (76.47%); however, the difference was statistically not significant (chi-square = 0.22, $p > 0.05$).

Hydatid cysts cause tissue damage in the intermediate hosts and economic loss because of condemnation of the affected organs and reduced productivity. In the present study, generally 1 to 10 cysts were found in an organ (Fig. 1). This result is in line with that of Kamhawi et al. (1995). However, cyst numbers exceeding 44 were recorded in some organs in the present study. The number of cysts in the liver was higher than that in the lungs.

Liver and/or lungs infected with few cysts might be cut away in butcher shops, but heavily infected organs are discarded in Turkey. The economic loss due to hydatidosis in sheep is mainly because of discarded organs and also reduced productivity. In the present study, nearly half of the livers of slaughtered animals were discarded during a period of one year.

In conclusion, from the present and previous studies on hydatidosis of domestic animals, it is clear that sheep play an important role as intermediate host in the life cycle of *E. granulosus* in Turkey. Sheep might be slaughtered uncontrolled, particularly during religious festivals, offering an easy access by stray dogs. The intermediate and final hosts must be inspected extensively for a successful control of hydatidosis.

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