Epidemiological aspects of cystic echinococcosis in slaughtered herbivores in Sari abattoir, North of Iran

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Received: 1 May 2011 / Accepted: 25 June 2011 / Published online: 5 July 2011
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Abstract A study was conducted to assess the ruminants' hydatidosis in Mazandaran Province, Northern Iran. A total, 1,799 sheep, 985 goats and 362 cattle slaughtered at Sari industrial slaughter house were examined for hydatid cyst infection. The results indicated that 65.2% of sheep, 37.8% of goats and 40.1% of cattle were infected. The liver and lung infection rate in sheep were 18.8 and 4.3%, goats 17.2 and 12.6% and cattle 44.1 and 7.6%, respectively. The study showed that 766 (45.3%) out of 1,691 infected animals had moderate degree of infection. Geographical zone survey indicated that 1,381 (89.2%) out of 1,546 sheep and goats infected with hydatid cyst were non-indigenous and originated from north-eastern provinces of Iran. On the contrary, 50.3% of infected cattle originated from Mazandaran Province (indigenous).

Keywords Epidemiological aspects · Hydatidosis · Cystic echinococcosis · Intensity of infection · Slaughtered herbivores · Iran

Introduction

Hydatidosis/echinococcosis is a zoonotic disease that occurs throughout the world and causes considerable economic losses and public health problems in many countries. Cystic echinococcosis (CE) is considered endemic or hyper endemic in Mediterranean region including all countries of the Middle East as well as the North of Africa (Eckert 2001; Sadjjadi 2006). In Iran, epidemiological evidence indicates the rate of human infection with CE is 0.6–1.2/100,000 (Rokni 2009). Investigations in various parts of Iran confirm the fact that Iran is a hyper endemic area for *Echinococcus granulosus* and hydatidosis (Rafiei et al. 2007; Tavakoli et al. 2008; Rokni 2009).

Domestic dogs as definitive hosts of the adult *E. granulosus* play the most important role in scattering infection in the Middle East countries including Iran via contamination of environment. In addition, sheep, goats, cattle, camels, and buffaloes have been repeatedly found infected with CE in Iran (Fakhar and Sadjjadi 2007; Daryani et al. 2007; Sadjjadi 2006; Ahmadi 2005). Molecular data shows that the G6 genotype (camel/dog strain) and G1 genotype (common sheep strain) of *E. granulosus* occurs in Iran (Rokni 2009).

Considering the lack of data on the status of CE in herbivores in Mazandaran Province of Northern Iran since 1999, the present study was conducted to determine actual CE in indigenous herbivores and those that originated from other parts of provinces but slaughtered there.

Materials and methods

The study was carried out in central zone of Mazandaran Province between 36–23°N and 53–6°E where the mean

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annual relative humidity was 86% with an average temperature of 19°C. From December 2008 to May 2009, internal organs of 1,799 sheep, 985 goats and 362 cattle slaughtered at industrial slaughter house of Sari city, as most important and central slaughterhouse in the province, were randomly examined for the presence and location of hydatid cysts. All animals were adult, indigenous to the area or originated from other provinces, especially north-eastern parts of Iran. Each animal carcass was inspected at least by two veterinary technicians. Infected organs, intensity of infection and the origin of animals were recorded. Intensity of infection was categorized as follows: mild infection (1–10 cysts), moderate infection (11–20 cysts), and severe infection (over 20 cysts). The overall prevalence of hydatidosis was estimated with a 95% confidence interval (CI) using binomial exact methods. To confirm infected organs with hydatid cyst and differentiation than other cysts, the cyst fluid was aspirated with a needle and then examined microscopically ($\times 40$) for the presence of protoscoleces.

Results

Altogether, 65.2% (95% CI = 63–67.4) of sheep, 37.8% (95% CI = 34.7–40.9) of goats, 40.1% (95% CI = 35–45.3) of cattle were found to be infected with hydatid cyst (Table 1). The rate of infection of different slaughtered animals and the distribution of infection in different organs are shown in Table 1. Sheep had the highest rate of infection, while goats had the lowest. Cysts were located in the liver of all infected animals more frequently than in other organs. Intensity of infection by cysts is shown in Table 2. Table shows that 766 (45.3%) out of 1,691 infected animals had moderate degree of infection. Cattle had the highest (51%) degree of intensity of infection whereas goats had the lowest (14.8%). Geographical zones survey showed that 1,381 (89.2%) out of 1,546 sheep and goats infected with CE were non-indigenous and originated from north-eastern Iran; 10.8% were indigenous. Regarding cattle, 50.3% of infected cattle originated from Mazandaran Province (indigenous) (Table 3).

Table 1 Distribution of hydatid cysts according to infected organ in different herbivores in Mazandaran Province of Iran

Animal	Number of animals examined	Number of infected animals	Infected animals (%)	Infected organs					
				Liver		Lungs		Liver and lungs	
				No.	%	No.	%	No.	%
Sheep	1799	1174	65.2	221	18.8	50	4.3	903	76.9
Goats	985	372	37.8	64	17.2	47	12.6	261	70.2
Cattle	362	145	40.1	64	44.14	11	7.6	70	48.3

Table 2 Distribution of hydatid cysts according to the intensity of infection in different herbivores in Mazandaran Province of Iran

Animals	Number of infected animals	Intensity of infection					
		Mild		Moderate		Severe	
		No.	%	No.	%	No.	%
Sheep	1174	325	27.7	581	49.5	268	22.8
Goats	372	191	51.3	126	33.9	55	14.8
Cattle	145	12	8.3	59	40.7	74	51

Table 3 Distribution of hydatid cysts according to geographical origin in different herbivores in Mazandaran Province of Iran

Animals	Site of origin			
	Mazandaran province		Other provinces	
	No.	%	No.	%
Sheep	124	10.6	1050	89.4
Goats	41	11	331	89
Cattle	73	50.3	72	49.7

Discussion

A high prevalence of CE has been reported in various species of livestock animals, including sheep, cattle, camel and goats, and at least 2 distinct cycles of transmission had occurred (Dar and Alkarmi 1997). Considering Iran as one of the hyper endemic areas for echinococcosis, three distinct cycles of *E. granulosus* have been suggested; a domestic cycle between dogs and livestock; a nomadic cycle between dogs and camels; and a sylvatic cycle between wild carnivores and wild ruminants (Mobedi et al. 1971; Eslami and Hosseini 1998). Data on the prevalence of CE in various domestic herbivores offer reliable index of the importance of each type of animal as a possible source of infection to dogs.

Based on abattoir data the prevalence of infection with hydatid cyst in sheep, goats, cattle in 14 out of 30 provinces of Iran showed that the highest and the lowest rate of infection were in Ardabil, in northwest, (44.2%) and Qom, in central (4.9%) provinces, respectively. In an inclusive

recent study, the average of infection in livestock reported 6.73% (Tavakoli et al. 2008). In our study, 65.2% of the sheep were found to be infected with CE.

Commonly, the sheep with high rate of fertile cysts and viable protoscoleces have important role in maintained *E. granulosus*. Since sheep are the animals that are slaughtered in the abattoirs and on spiritual and public occasions throughout the year, thus in special residential compounds and the carcass from these animals (especially the livers and lungs) is usually accessible to domestic dogs or is dumped in garbage bins, outside houses, where stray dogs may easily feed on it.

Recently, Daryani et al. (2009) reported that in an abattoir in Sari, Mazandaran Province, the fertility rates of hepatic cyst of sheep and cattle were 47.1 and 1.4%, respectively and the fertility rates of pulmonary cyst of sheep and cattle were 39.4 and 8.1%. In the sheep, the fertility of cysts in the liver was higher than that in lungs, but in the cattle the fertility of cysts in lungs was higher than liver. Consequently, as fertility rate of hydatid cysts in sheep is higher than those in cattle, so it clear that sheep have an important role to play in the contamination of the *E. granulosus* life cycle in studied area.

In our survey, the highest prevalence was in non-indigenous sheep originating from other provinces (89.4%) because the majority of non-indigenous animals belonged to hyper endemic areas where located in north-eastern Iran especially Northern Khorasan Province.

The prevalence of infection with hydatid cyst in sheep, goats, cattle and buffaloes in different regions of Iran showed that the highest and the lowest rate of infection were in Northern Khorasan and Yazd provinces, respectively. (Tavakoli et al. 2008). Only previous survey at Sari slaughter house in Mazandaran Province during 1999 showed the infection rate of 14.7% in sheep, 2.7% in goats and 6.3% in cattle originated from Mazandaran Province (indigenous herbivores) (Sharif 2000). Consequently, our data also confirm the lower prevalence (10.8%) of CE in indigenous sheep and goats in this area than other provinces.

Cysts were found in liver, lungs frequently in the liver alone (18.8.3%); while goats feed mainly by browsing, rather than grazing, they usually show lower rates of infection. In the present study 37.8% of the goats were found to be infected with CE, while the mean prevalence of infection in goats of various regions of Iran has been reported 6.5% ranging from 0.5 to 20% (Dalimi et al. 2002). The cysts were found mainly in the liver (17.2%). In Middle East, the most common location of hydatid cysts in sheep has been reported as the liver, followed by the lungs but for cattle was reversed (Kamhawi et al. 1995).

In cattle, 40.1% of the examined animals were infected with CE, while the mean prevalence of infection in cattle in other parts of Iran has been reported to be 12%, ranging

from 1 to 28% (Dalimi et al. 2002). The cysts were found mainly in liver (44.1%). The highest prevalence of CE in cattle was in indigenous cases (50.3%). It seems that the reason of this condition is frequent cattle husbandry and high affinity to consumption of beef's meat in this area.

In Iran, the mean prevalence of hydatidosis in sheep in different regions has been reported to be 8.1%, varying from 1 to 27.5%. According aforementioned data in different regions of Iran, the highest prevalence of CE occurs in domestic herbivores slaughtered at Sari abattoir in Mazandaran Province, North of Iran.

In general, the high capacity of Mazandaran Province for slaughtering of livestock and neighboring to Tehran as capital of Iran has caused with a high consumption need of meat from north-eastern Iran, especially Bojnourd, Sabzevar and Gonbad cities in Northern Khorasan and Golestan provinces to be slaughtered at industrial slaughter house of sari in Mazandaran Province. Thus, the high prevalence of hydatidosis in sheep and goats is not directly related to Mazandaran Province.

Regarding high prevalence of CE in slaughtered herbivores, accessible scavenging dogs and other wild carnivores will pose risk. The slaughtering of goat and sheep which is still practiced by this province without any municipal veterinary supervision should be controlled. Unfortunately, no information is yet available regarding the prevalence in human population and dogs even though a preliminary survey in this area has been recently revealed the low infection rate to *E. granulosus* in stray dogs (Unpublished data).

In an extensive study conducted in 13 provinces of Iran, the mean prevalence of *E. granulosus* in sheepdogs and stray dogs was detected as 27.2 and 28.9% respectively. Consequently, the lowest and the highest prevalence in sheepdogs was 3.3 and 63.3% in Sistan—Baluchestan and Esfahan provinces, respectively. As well as in stray dogs was 50.5 and 5% in Esfahan and Kerman Province respectively. (Eslami and Hosseini 1998; Rokni 2009). The high prevalence of infection in animals originated from north-eastern Iran indicates that CE is a highly common disease within herbivores in north-eastern Iran.

In brief, hydatidosis must be considered as an important subject in health policy and also more effective measures must be given to control the stray dog population. Alternatively, considerable efforts must still be done in killing of stray dogs, health education and improving the instrument of slaughterhouses to achieve effective control of the disease.

Acknowledgments We want to thank Dr. R. A. Mohammad Pourtahamtan for his comments on statistical analysis. The authors thank veterinary technicians at sari slaughterhouse and H. Alizadeh for their useful co-operation. We would also like to thank the Office of the Vice Chancellor for Research of Mazandaran University of Medical Sciences, Sari, Iran, for financial support of this study.

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