

Survey of Echinococcosis and Hydatidosis in Kashan Region, Central Iran

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Abstract

Hydatidosis is one of the major zoonotic diseases that cause considerable economic losses and public health problems worldwide. The present study was conducted to determine the prevalence of *E. granulosus* in domestic and wild carnivores and the infection rate of hydatid cyst in slaughtered animals and people in Kashan area, central Iran. A total of 142 carnivores including 70 stray dogs, 40 jackals, 22 red foxes, and 10 wolves were examined for the presence of *E. granulosus*, as well as, 170510 slaughtered sheep, 162665 goats and 13059 cattle for hydatid cyst infection. In addition, 500 inhabitants in rural areas were examined for antibodies to hydatid cyst. Results indicated that 43.7% of carnivores were infected with *E. granulosus*. Infection rate in slaughtered animals was 2.7%. Overall, the seroprevalence rate in human cases was 2.4%. Eighty-five patients including 47 females and 38 males were hospitalized. The mean annual incidence rate of hydatidosis in human was three cases per 100 000 populations. In general, the situation of the hydatidosis in the livestock and human and echinococcosis in the carnivores of the Kashan is similar to the other zones in Iran.

Keywords: Hydatidosis, Echinococcosis, Prevalence, Carnivores, Slaughtered animals, Iran

Introduction

Echinococcus granulosus and its metacestode in herbivores and humans have been recognized as the most important helminthes zoonoses, with great economic and public health significances in developing countries(1).

Hydatidosis is endemic in the entire Mediterranean zone including all Middle Eastern countries (2). Despite the provision of modern abattoirs and municipality by laws in the Middle East, it is believed that the domestic and feral cycles of *E. granulosus* are indistinguishable and unlike other large endemic areas of the world, a close association with dogs is not a definitive risk factor (3). But the domestic dog as a definitive host for *E. granulosus* plays an important role in the spread of infection in the Middle East countries via contamination of environment. Sheep, goats, cattle, camels, buffaloes, pigs, and donkeys have been repeatedly

found infected with hydatid cysts in Iran, Iraq, Jordan, Lebanon, Syria, Kuwait, and Saudi Arabia (4-11).

In Iran, hydatidosis is one of the major infectious zoonotic diseases, where sheep, cattle and goats are still slaughtered traditionally and carcass wastes are easily accessible to scavenging dogs and other wild carnivores (12). *E. granulosus* infection in wild carnivores (13, 14) as well as hydatidosis in wild ruminants such as the wild sheep and the gazelle has been reported in Iran. However, it is not clearly known whether infection in wild carnivores is acquired from domestic or wild animals. The dogs are generally easily infected with this parasite and are the major source of hydatidosis of herbivores and man in the Kashan. Determine the frequency of infection of *E. granulosus* in carnivores and its metacestode in herbivores and man has a public-health significant, but is time-

consuming, expensive and dangerous to research personnel. Adequate information on the prevalence and incidence of echinococcosis/hydatidosis infection of carnivores and herbivores and man in this area is not yet available. Therefore, the present study was conducted to determine the prevalence of echinococcosis in domestic and wild carnivores of Kashan area, Isfahan province in Iran. The infection rate of hydatidosis in different slaughtered animals, the rate of prevalence in at risk population and patients hospitalized in the same area was also included in the study.

Materials and Methods

Study area The present study carried out in a total area nearly 2100 km² in central Iran. This sheep-raising area located at an average altitude of 982 m, has an average annual precipitation of less than 150 mm, which mostly falls in the winter. The population of the area is approximately 400 000 inhabitants, most of them living in urban areas. Inhabitants living in this rural area are farmers actually involved in animal production. The dogs either live with herds of sheep or look after the house or farm. In addition, stray dogs and some other carnivores, may enter the human houses and farms in search of food. These carnivores may consume infected organs of slaughtered animals, which sometimes are left behind around the non-standard abattoirs in small village.

Collection and examination of carnivores From May 1998 to September 2000, a total of 142 carnivores, including 70 stray dogs (36 males and 34 females), 40 jackals (*Canis aureus*, 26 males and 14 females), 22 red foxes (*Vulpes vulpes*, 12 males and 10 females) and 10 wolves (*Canis lupus*, 6 males and 4 females), from different residential areas of Kashan were randomly shot by skilled gunmen after authorization and cooperation of Iranian dog-killing team of Municipality. Their carcasses were autopsied not later than 5 hours after killing and examined for the presence of *E. spp.* Information

related to animals, including age (according to dental formula), sex (physical appearance), gender and locality were recorded.

The abdominal cavity of the carnivores was opened and the small intestine was tightly ligated with a double ligature close to the pyloric region, ileocecal site and the terminal portion of the rectum. The intestines were then opened longitudinally under a slow flow of tap water. The mucosa was scraped between the blades of a forceps and the contents with epithelial scrapings passed through 40- and 60 -mesh per inch brass sieves. The filtrate retained in the sieve was washed into a glass container and examined carefully for helminthic parasites.

Recovered parasites were fixed in 70% ethanol. *Echinococcus* species were identified according to the guidelines given by Kumaratilake and Thompson (15).

Examination of slaughtered animals A total of 170 510 sheep, 162 665 goats and 13 059 cattle were examined for hydatid cyst infection at slaughterhouses of Kashan during a two-year period (2000-2001). All animals were adult, indigenous to the area and originally from small farms in the village and Kashan. Each animal carcass was inspected by at least two veterinarians. The organs were carefully examined for infection.

Hospitalized patients A retrospective study was undertaken to determine the incidence of cystic hydatid disease (CHD) among patients hospitalized in Kashan during 1993-2000. All medical documents of patients with hydatid cyst in all public hospitals were reviewed.

Seroepidemiological survey Five hundred sera from adult inhabitants covered by rural health and hygiene system were examined for determination of antibodies to hydatid cyst. Information related to age, sex, location of inhabitant and occupations were recorded. IHA kit (Bahar-Afshan Co.Iran) test for immunoglobulin G (IgG) was used to detect anti-hydatidosis antibodies. Titration of 1:32 or higher was taken as positive test and positive samples were tested further for true titer.

Statistical analysis Chi-square and Confidence interval were applied for analysis of the data.

Results

Echinococcosis in carnivores Of 142 examined carnivores, 62 were infected with *E. granulosus*. Overall, 39 stray dogs, 16 jackals, 3 foxes and 4 wolves were infected with *E. granulosus*. Stray dogs had the highest rate of infection among the carnivores, while foxes showed the lowest. Chi-square test showed that the prevalence of infection in dog was same as wolf and jackal ($P > 0.05$), but different from Fox ($P < 0.01$)

Prevalence of *E. granulosus* in different carnivores of Kashan is showed in Table 1.

It was found that 45 carnivores older than two-year age and 17 below two years were infected with *E. granulosus*, whereas 24 of the females and 38 of the males were infected with this parasite ($P > 0.05$). The prevalence rate of infection in different carnivores according to sex is showed in Table 2.

The size of the adult worms ranged from 3.5 to 8 mm and they had 3-5 segments.

Hydatidosis in herbivores In examined ruminants, the lungs were more often infected than

livers. The rate of infection of livers and lungs with the metacestode in different animals is shown in Table 3.

Seroepidemiological survey Overall, the seroprevalence in the adult group was 2.4%. Infection rate in male and females were 0.9% and 3.5%, respectively. The highest rate of infection (3.4%) was found in <20 year old group. Housewives were the most infected group (5%).

Hospital-based study From 85 patients, 47 females (55.3%) and 38 males (44.7%) had hydatid cysts. In the 20-29 y old group there was a significantly high rate of hydatid cysts (20%), compared with other age groups. Housewives were the most infected group (47%) ($P < 0.05$) Rate of disease in urban and rural regions were 68.2% and 31.8%, respectively. 11.8% of patients had previous contact with dog. The distributions of cysts were liver 82%, lung 28.2%, peritoneal 3.5%, kidney, bones and spleen 2.4%, ovary and pancreas 1.2%. The distribution of manifestations were: abdominal pain 62.2%, coughing 29.4%, vomiting 28.2%, thoracic pain 24.7%, haemoptysis 11.7%, palpitation 11.2%, pruritus 10% and jaundice 2.4%. The mean annual incidence rate of hydatidosis in human was 3 cases per 100 000 populations.

Table 1: Prevalence and intensity of *Echinococcus granulosus* infection in different carnivores in Kashan –Iran

Carnivores	No of animals examined	No of infected animals	Infected animals (%)	C.I	Intensity of infection range	Mean±Sd
Dog	70	39	55.7	55.7±11.6	2-10000	1192 ±2845
Jackal	40	16	40	40 ±15.1	1-5000	478±1266
Fox	22	3	13.6	13.6±14.3	5-10	6.7±2.9
Wolf	10	4	40	40±30.3	2-10	8 ±4
Total	142	62	43.7			

Table 2: Prevalence of *Echinococcus granulosus* infection in carnivores in Kashan-Iran according to sex

Sex	Male No. (%)	Female No. (%)	Total No. (%)
Carnivore			
Dog (n=70)	24 (61.5)	15 (38.5)	39 (55.7)
Jackal (n=40)	11 (68.8)	5 (31.2)	16 (40)
Fox (n=22)	2 (66.7)	1 (33.3)	3 (13.6)
Wolf (n=10)	1 (25)	3 (75)	4 (40)
Total	38	24	62

Table 3: Organ distribution of hydatid cysts recovered from slaughtered animals of Kashan-Iran

Animals	No. of animals	No. of infected	Infected animals (%)	Infected organs			
				Liver		Lung	
				No.	%	No.	%
Sheep	170510	3833	2.25	2973	1.7	4693	2.8
Goats	162665	5050	3.1	3679	2.3	4620	3.9
Cattle	13059	529	4	577	4.4	480	3.7
Total	346234	9412	2.4				

Table 4: Frequency of hydatid cyst antibody in human in Kashan-Iran according to age

Age groups (Yr)	Positive No. (%)	Negative No. (%)	Total No. (%)
< 20	2 (3.4)	56 (96.6)	58(100)
20-29	4(3.3)	119(96.7)	123(100)
30-39	3(3.2)	91(96.8)	94(100)
40-49	2(2.5)	77(97.5)	79(100)
+50	1(1.6)	145(98.4)	146(100)
Total	12(2.4)	488(97.6)	500(100)

Discussion

In some parts of Iran, particularly in the north, where a large population of jackals and foxes live near human settlements, interaction between domestic cycle and sylvatic cycles may occur. In this regard, the animals may become infected by consuming infected organs of slaughtered animals left around the non-standard small abattoirs in villages. According to other studies in the north and west of Iran (13, 14) similar rate of infection with *E. granulosus* in stray dogs and golden jackals was 22% and 23 %, respectively. No morphological difference between adult forms of the helminthes isolated from both animals had been observed. Although, the role of jackal and fox in the domestic cycles has not been proved, but some workers reported that jackal and fox can be naturally and experimentally infected with *E. granulosus* (13, 16-18).

The prevalence of *E. granulosus* in carnivores and its metacestode in herbivores and human varies considerably throughout the world (19). The studies from different parts of Iran confirm the fact that Iran is an endemic or hyper en-

demic area for *E. granulosus* and hydatidosis (19-21).

The infection rate of stray dogs in the present study (43.7%) is within the range of that of other studies conducted in different parts of Iran as 22.3% in the northern region of Iran (13); 50% in Isfahan (19); 36.19% in Shiraz (19); 26.74% in Tehran (22) and 6.8% in Kerman (23).

In the present study, the infection rate was higher in male dogs (61.5%) than in females (38.5%). This, possibly, could be due to dominance and hunting habits of the male dogs. Infection was also higher in more than two-year-old dogs compared to less than it. This could be owing to the linking habit of old dogs. In Kashan area sheep, goats and cattle are mostly reared in the southern and eastern area and less in the northern and western parts, and this could result in a higher rate of infection of *E. granulosus* infection in the southern and eastern areas.

It is reported that an average infection incidence of 20% or more echinococcosis/ hydatidosis in one or more species of definitive or

intermediate host should be regarded as high infection (19). The high rate of infection with the parasite in carnivores especially in dogs reported from different areas of Iran clearly indicates the risk of transmission of the disease from dogs to human beings (24).

In the Middle East, a hydatidosis infection rate of 1.5% to 37.8% has been reported (26). In Iran, infection rates of 6.6%, 4.5% and 22.11% have been reported in sheep, goats and cattle, respectively (19). In addition, the rate of infections has been reported as: Isfahah (19), in sheep and cattle, 16.8% and 26.4%, respectively; in Tehran (20), 27.5% in sheep, 16.1% in goats and 25.9% in cattle; in Hamadan (21) 25.9% in cattle, 27.5% in sheep and 16.1% in goats; in Shiraz (19), 2.68%, 2.36% and 6.48% in sheep, goats and cattle, respectively and in western Iran (14), 11.1% in sheep, 6.3% in goats and 12.4% in cattle.

The present study shows that the rate and intensity of infection of fox in the Kashan was much lower than stray dogs. In comparison with the north and west Iran, the lower prevalence of infection in wild carnivores living in the Kashan may be due to different geographical and environmental situation. In Kashan, the lands are more distinct, the population of the wild carnivores is much lower than the north and west and animals mostly live far away from human settlements in mountainous regions. Therefore, fox, wolf and jackal probably do not can have a major role in the epidemiology of the echinococcosis in the studied region.

In Iran, the mean prevalence of hydatidosis of sheep in different regions has been reported as 8.1%, which varies from 1 to 27.5% (25).

Since goats feed mainly by browsing, rather than grazing, they usually show lower rates of infection. In the present study, 3.1% of goats were infected with hydatid cyst, while the mean prevalence of infection in goats of various regions of Iran has been reported 6.5% ranging from 0.5 to 20 % (25).

In the cattle, 4% of the examined animals were infected with hydatid cysts, while the mean

prevalence of infection in cattle of various regions of Iran has been reported as 12%, ranging from 1 to 28%. The cysts were found in lungs and liver, mostly occurred in liver (4.4%) (25).

In the present study, the mean annual incidence rate of hydatidosis in human was 3 cases per 100 000 populations. The range of the disease in human is wide and varies between 0.1 in Hormozgan in the south coast to 4.45 in Khorasan in the northeast (25). More than 67.5% of population live in the area with less than one per 100 000 prevalence (14 provinces), 14.6 including 5 provinces; in the area where the disease is prevalent in 1-2 per 100 000. The population who lives in more prevalent areas (2-3% per 100 000) is not more than 7.6% (25).

In relation to organ involvement, males are more likely to have the lung disease, whereas, liver is more infected in females (25). In both sexes, the right lung is more affected than the left lung. The same is true for the right lobe of the liver in comparison with the left lobe ($P < 0.05$).

The high rate of household or occupational contact with dogs and the habit of feeding dogs the raw viscera of home slaughtered sheep or goats create excellent conditions for the maintenance of the parasite. In view of the high prevalence and intensity of infection among carnivores in this study, the risk of infection to human being is also very likely. Such a high risk of infection in man and animals, combined with huge economic losses in the animal industry, justifies a serious program of hydatidosis control in the area. An increase in echinococcosis prevalence may result after premature cessation of control programs.

In general, the situation of the hydatidosis in the livestock and human and echinococcosis in the carnivores of the Kashan is similar to that of the other zones in Iran.

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References

1. Eckert J, Gemmel MA, Soulsby E JL (1982). Echinococcosis/hydatidosis surveillance, prevention and control. *FAO/UNEP/WHO guidelines. FAO. Animal production and Health*, paper 29.
2. Andersen FL, Ouhelli H, Kashani M (1997). *Compendium on cystic echinococcosis*. Brigham Young University, Provo, UT 84602 USA.
3. Dar FK (1987). Human hydatid disease in the Arab world. In: *Proceedings of the Pediatric Infectious Diseases in Arab Countries*. Ed, Elzouki AY. Wiley, Chichester Inc. UK, pp.191-97.
4. Oryan A, Moghaddar N, Gaur SN (1994). Metacestodes of sheep with special reference to their epidemiological status, pathogenesis and economic implications in Fars province, Iran. *Vet Parasitol*, 51: 231-40.
5. Molan AL (1993). Epidemiology of hydatidosis and echinococcosis in Theqar province, southern Iraq. *Jpn J Med Sci Biol*, 46: 29-35.
6. Al-Yaman FM, Assaf L, Hailat N, Abdel-Hafez SJ (1985). Prevalence of hydatidosis in slaughtered animals from north Jordan. *Ann Trop Med Parasitol*, 79: 501-6.
7. Abdel-Hafez SK, Al Yaman FM (1986). Further studies on prevalence of hydatidosis in slaughtered animals from north. *Jordan Z Parasitenkd*, 72: 89-96.
8. Abo-Shehada MN (1993). Prevalence of hydatidosis in donkeys from central Jordan. *Vet Parasitol*, 30: 125-30.
9. Dajani YF, Khalaf FH (1978). Hydatidosis and tenuicollosis in sheep and goats of Jordan: a comparative study. *Ann Trop Med Parasitol*, 75: 175-79.
10. Hassounah A, Behbehani K (1976). The epidemiology of *Echinococcus* infection in Kuwait. *J Helminthol*, 50: 65-73.
11. Ghadour AM (1988). Health hazards in humans and animals caused by imported livestock disease in Saudi Arabia. *Fauna Saudi Arabia*, 9: 468-477.
12. Eslami A, Hosseini SH (1998). *Echinococcus granulosus* infection of farm dogs of Iran. *Parasitol Res*, 84(3): 205-7.
13. Dalimi A, Mobedi I (1992). Helminth parasites of carnivores in northern Iran. *Ann Trop Med Parasitol. Med Parasitol*, 86: 395-97.
14. Dalimi A, Motamedi G, Hosseini M, Mohammadiann B, Malaki H, Ghamari Z, Ghaffari Far F (2002). Echinococcosis /Hydatidosis in western-Iran. *Vet Parasitol*, 105(2):161-67.
15. Kumaratilake LM, Thompson RCA (1982). A review of taxonomy and speciation of the genus *Echinococcus rudolphi* 1801. *Z Parasitenkunde*, 68: 121-46.
16. Macpherson CNL (1983). An active intermediate host role for man in the life cycle of *Echinococcus granulosus* in Turana. Kenya. *Am J Trop Med Hyg*, 32: 397- 404.
17. Cook BR (1989). The epidemiology of *Echinococcus granulosus* in Great Britain. Part V. The status of subspecies of *Echinococcus granulosus* in Great Britain. *Ann Trop Med Parasitol*, 83: 51-61.
18. Thompson RCA (1983). The susceptibility of the European red fox (*Vulpes vulpes*) to infection with *Echinococcus granulosus* of Australian sheep origin. *Ann Trop Med Parasitol*, 77: 75-82.
19. Mehraban D, Oryan A, Sadjjadi S M (1999). Prevalence of *Echinococcus granulosus* infection in stray dogs and herbivores in Shiraz, Iran. *Veterinary Parasitology*, 86: 217- 20.

20. Eslami A, Mohebbali M (1988). Parasitism des chiens de bergers et implication en sante publique en Iran. *Bulletin de la Societe de pathologic Exotique*, 81:94-6.
21. Arbabi M, Massoud J, Dalimi-Asl, A, Sadjajadi SM (1998a). Prevalence of hydatidosis in slaughtered animals in Hamedan (In Persian). *Daneshvar Sci J Shahed University*, 20: 57-61.
22. Zohoor A (1989). The prevalence of intestinal helminthes of stray dogs in Tehran. [MS thesis]. School of Public Health, Tehran University of Medical Sciences, Iran.
23. Sharifi I, Tasbiti AH (1994). Helminth parasites of stray dogs in Kerman. *Iranian J Public Health*, 23: 13-23.
24. Arbabi M, Massoud J, Dalimi-Asl A, Sadjajadi SM (1998b). Seroepidemiologic prevalence of hydatid cyst in Hamedan (In Persian). *Feyz J Kashan University Med Sc Health Services*, 2(6): 43-50.
25. Cheraghchi Bachi MT (1989). A Short Review on Echinococcosis/ Hydatidosis in Islamic Republic of Iran. *Intercountry Consulation on Prevention and Control of Echinococcosis/ Hydatidosis*. Amman, 3-5 April.
26. Matossian RM, Rickard MD, Smyth JD (1977). Hydatidosis a global problem in increasing importance. *Bull WHO*, 55: 499-507.

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