Prevalence and Long Term Trend of Liver Fluke Infections in Sheep, Goats and Cattle Slaughtered in Khuzestan, Southwestern Iran

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ABSTRACT

Liver fluke infections in herbivores are common in many countries, including Iran. Meat-inspection records in an abattoir located in Ahwaz (capital of Khuzestan Province, in southwestern Iran), from March, 20, 1999 to March, 19, 2008 were used to determine the prevalence and long term trend of liver fluke disease in sheep, goats and cattle in the region. A total of 3186755 livestock including 2490742 sheep, 400695 goats and 295318 cattle were slaughtered in the 9-year period and overall 144495 (4.53%) livers were condemned. Fascioliasis and dicrocoeliosis were responsible for 35.01% and 2.28% of total liver condemnations in this period, respectively. Most and least rates of liver condemnations due to fasciolosis in slaughtered animals were seen in cattle and sheep, respectively. The corresponding figures from dicrocoeliosis were goats and sheep, respectively. The overall trend for all livestock in liver fluke was a significant downward during the 9- year period. The prevalence of liver condemnations due to fasciolosis decreased from 7.37%, 1.80%, and 4.41% in 1999–2000 to 4.64%, 1.12%, and 2.80% in 2007–2008 for cattle, sheep and goats, respectively. Dicrocoeliosis was less prevalent than fasciolosis, but similarly declined from 0.35 % and 0.15% in 1999–2000 to 0.00% and 0.08 % in 2007–2008 in cattle and sheep, respectively. Data showed significant seasonal pattern for Dicrocoelium dendriticum in sheep and goats, but for Fasciola spp. in different animals there were no statistically significant differences with respect to season. Liver condemnations due to fasciolosis and dicrocoeliosis were more prevalent in cattle slaughtered during summer, whereas they were higher in winter for both sheep and goats. The odds ratio showed a slightly different pattern in some years; however, the overall declining trend was still observed. This survey provides baseline data for the future monitoring of these potentially important parasitic infections in the region, and demonstrating possible long term trends.

Keywords: Prevalence; Fasciolosis; Dicrocoeliosis; Long Term Trend; Khuzestan Province; Iran

INTRODUCTION

Information resulting from meat inspection records has been used as useful sources of data for evaluation of the epidemiological aspects of certain diseases in several countries [1- 5]. Among diseases which are not often apparent to the farmers, the liver fluke infections are of considerable economic and public health importance. Liver fluke diseases caused by Fasciola spp. (F. hepatica; F.gigantica) and Dicrocoelium dendriticum are common in grazing ruminants in many countries including Iran [6-10, 2].

The incidence of human fasciolosis has been increasing in 51 countries of the five continents [11, 6, 7]. Recent papers estimate human infection up to 2.4 million [12], up to 17 million people [13], or even higher depending on the hitherto unknown situations in many countries, mainly of Asia and Africa [14, 7]; whereas dicrocoeliosis occasionally affects humans [8, 15].

Human fasciolosis was sporadic until 1987, when an outbreak occurred in Iran (Gilan Province) and affected more than 10,000 people [16]. The second outbreak occurred some 10 years later and several thousand people were infected [17]. Reports of several hundred cases of human disease during inter-epidemic periods and recent years are present. In Mazandaran province, fasciolosis has very recently shown to be a major human health problem too [9]. Recently, a minor emergence of fasciolosis, with 17 non-fatal cases, reported in the western province of Kermanshah [18], which is located in adjacency of Khuzestan Province (the studied area). Human dicrocoeliosis has already been established in Iran by Farid [15], though that is very rare. In the absence of statistically sound

epidemiologic data, evaluating liver fluke prevalence in livestock based on liver condemnation statistics might be useful. Information about infections of cattle, sheep and goats with liver fluke in south-western Asia were reported from some countries such as Iraq [19], Pakistan (Kashmir) [20], Saudi Arabia [21] and Turkey [5]. An old report has only been published on prevalence of Liver fasciolosis in sheep, cattle, goats and buffaloes from Ahwaz [22], although several reports exist on those in other places of Iran [9, 10, 2].

Since in south-western Iran there is a high concentration of pastured livestock on traditional farms and there was no epidemiologic data and long term trend about Fasciola and Dicrocoelium in this area, this study was conducted to estimate the prevalence and trends of liver fluke infections in abattoir populations of cattle, sheep and goats in Ahwaz for the period 1999–2008.

MATERIALS AND METHODS

This study is a retrospective survey from March, 20, 1999 to March, 19, 2008. All daily condemnation records for cattle, sheep and goats in the large Meat Complex abattoir of livestock animals, in Ahwaz (Khuzestan Province, southwest of Iran) were used. As a part of continuous surveillance system, each slaughtered animal is inspected individually by veterinarians in the course of their routine duties. The presence of liver flukes and distinction between types are recognized macroscopically based on gross appearance. The reasons for condemnation of organs including liver flukes are recorded daily on prepared data sheets. The prevalence was collected on a monthly basis. This time interval was chosen as being likely to indicate any seasonal trends. Odds ratios (odds of condemnation of liver due to liver fluke disease in successive years) were calculated. Data analysis was done using SPSS 10 software for windows XP. Seasonal pattern of hepatic trematodes on host species and long term trends in risk of fluke-specific liver condemnations across the 9-year period was analyzed by ANOVA tests. In all tests, a p-value less than 0.05 was considered statistically significant.

RESULTS

In the 9-year period (1999-2008), 3186755 livestock including 2490742 sheep, 400695 goats and 295318 cattle were slaughtered at Ahwaz Meat Complex abattoir, Khuzestan Province (Table 1). Of these livestock, 144495 and dicrocoeliosis were responsible for 35.01 % and 2.28 % of total liver condemnations in this period, respectively. Hence, total condemnation of liver caused by fasciolosis in all animals was almost 15.3 times more than dicrocoeliosis (Table 2). Liver condemnations due to fasciolosis in slaughtered cattle during this survey were almost 6 and 2 times more those observed in sheep and goats, respectively (Table 1).

The annual prevalence rates for these parasitic infections in the 9-year period are shown in Table 1. The overall trend was a significant decline in the prevalence of liver fluke disease over the study period ($P<0.01$) which was more remarkable in the first several (1 or 2) years. The prevalence of liver condemnations due to fasciolosis decreased from 7.37%, 1.80%, and 4.41% in 1999–2000 to 4.64%, 1.12%, and 2.80% in 2007–2008 for cattle, sheep, and goats, respectively ($P<0.01$). Dicrocoeliosis was less prevalent than fasciolosis, but similarly declined from 0.35% and 0.15% in 1999–2000 to 0.00% and 0.08 % in 2007–2008 in cattle and sheep, respectively ($P<0.01$).

The seasonal variation of liver fluke disease according to prevalence of liver condemnations could be seen in Table 3. The significant level of seasonal patterns were observed in sheep and goats infected with Dicrocoelium dendriticum ($P<0.01$), and also liver condemnation due to dicrocoeliosis had relatively more seasonal fluctuation than fasciolosis.

The odds ratios (ORs) were calculated, assuming the first year's OR equal to 1.00 as the basis for comparison. The results are shown in Table 4. As it is seen, the overall declining trend was still observed and is statistically significant ($P<0.01$); however, the details were slightly varied.

DISCUSSION

Hepatic fluke infections cause considerable economic loss in livestock due to condemnation of organs and reduction of milk and meat production. Therefore, it is justifiable to find reliable data for monitoring epidemiologic aspects of the disease and prepare a baseline data for future comparison. Although abattoir surveys have limitations, they are an economical way of gathering information on livestock disease. It is suggested that an efficient meat inspection service should function as an important monitor of animal disease, being particularly valuable in the field of chronic and ill-defined

conditions which are not apparent to either the stockowner or his veterinary surgeon but must be of considerable economic and animal health significance [3]. Also, a feedback from the slaughterhouse to the individual farm is of great value in the field of preventive medicine.

Fasciola spp. and Dicrocoelium dendriticum are common parasites of ruminants in different parts of Iran [22, 9, 10, 2]. At the end of the 1980s and during the 1990s several large epidemics, including thousands of human fasciolosis, were reported [16, 9, 17] in Iran; whilst human dicrocoeliosis has seldom been reported. In 2000, there was a minor emergence of fasciolosis, in the western province of Kermanshah [18], which is located next to Khuzestan Province (the studied area). In this study, fasciolosis and dicrocoeliosis were responsible for 35.01% and 2.28% of total liver condemnations, respectively (Table 2).

Table 1. Total number of animals slaughtered and the liver-condemnation risks for liver fluke infections in Khuzestan, Iran

Year	Sheep			Goats			Cattle		
	Number slaughtered	Fasciolosis (%)	Dicrocoeliosis (%)	Number slaughtered	Fasciolosis (%)	Dicrocoeliosis (%)	Number slaughtered	Fasciolosis (%)	Dicrocoeliosis (%)
1999-2000	628514	11344 (1.80)	928 (0.15)	157334	6946 (4.41)	202 (0.13)	80513	5934 (7.37)	283 (0.35)
2000-2001	283037	960 (0.34)	189 (0.07)	11261	187 (1.66)	44 (0.39)	34224	1498 (4.38)	7 (0.02)
2001-2002	228589	906 (0.40)	153 (0.07)	10516	171 (1.63)	85 (0.81)	29159	1274 (4.37)	10 (0.03)
2002-2003	210853	900 (0.43)	95 (0.05)	22534	137 (0.61)	27 (0.12)	25307	1156 (4.57)	4 (0.02)
2003-2004	184781	970 (0.52)	77 (0.04)	20951	157 (0.75)	58 (0.28)	21666	1023 (4.72)	2 (0.01)
2004-2005	178319	818 (0.46)	121 (0.07)	23020	216 (0.94)	64 (0.28)	20342	1227 (6.03)	3 (0.01)
2005-2006	213082	1294 (0.61)	337 (0.16)	40241	660 (1.64)	131 (0.33)	26425	1499 (5.67)	2 (0.01)
2006-2007	279686	2691 (0.96)	118 (0.04)	58035	1114 (1.92)	13 (0.02)	33398	1616 (4.84)	2 (0.01)
2007-2008	283881	3176 (1.12)	221 (0.08)	56803	1593 (2.80)	118 (0.21)	24284	1126 (4.64)	0 (0.00)
Total	2490742	23059 (0.93)	2239 (0.09)	400695	11181 (2.79)	742 (0.19)	295318	16353 (5.54)	313 (0.11)

Table 2. Total number of condemned livers and number (%) condemned due to Fasciolosis and Dicrocoeliosis in Khuzestan Province

Host	Total	Fasciolosis	Dicrocoeliosis
Sheep	80346	23059 (28.70)	2239 (2.79)
Goats	31148	11181 (35.90)	742 (2.38)
Cattle	33001	16353 (49.55)	313 (0.95)
Total	144495	50593 (35.01)	3294 (2.28)

Table 3. Seasonal prevalence rate (%) of liver fluke disease in animals slaughtered in Khuzestan Province

		Spring	Summer	Fall	Winter
Sheep					
	Animal slaughtered	679708	687518	583676	539840
	Fasciolosis (%)	4742 (0.70)	5622 (0.82)	6007 (1.03)	6688 (1.24)
	Dicrocoeliosis (%)	338 (0.05)	252 (0.04)	481 (0.08)	1168 (0.22)
Goats					
	Animal slaughtered	94366	112930	101671	91728
	Fasciolosis (%)	2158 (2.29)	3052 (2.70)	2768 (2.72)	3203 (3.49)
	Dicrocoeliosis (%)	62 (0.07)	127 (0.11)	225 (0.22)	328 (0.36)
Cattle					
	Animal slaughtered	71518	76214	70600	76986
	Fasciolosis (%)	3757 (5.25)	4583 (6.01)	3892 (5.51)	4121 (5.35)
	Dicrocoeliosis (%)	72 (0.10)	120 (0.16)	56 (0.08)	65 (0.08)

Table 4. Changes in the odds ratios (ORs) for number of liver condemnations due to liver fluke infections in animals slaughtered in Khuzestan Province, Iran

	Fasciolosis			dicrocoeliosis		
Year	Sheep	Goats	Cattle	Sheep	Goats	Cattle
1999-2000[a]	1.00	1.00	1.00	1.00	1.00	1.00
2000-2001	0.19	0.37	0.58	0.45	3.05	0.06
2001-2002	0.22	0.36	0.57	0.45	6.34	0.10
2002-2003	0.23	0.13	0.60	0.30	0.93	0.04
2003-2004	0.29	0.16	0.62	0.28	2.16	0.03
2004-2005	0.25	0.21	0.81	0.46	2.17	0.04
2005-2006	0.33	0.36	0.76	1.07	2.54	0.02
2006-2007	0.53	0.42	0.64	0.29	0.17	0.02
2007-2008	0.62	0.62	0.61	0.53	1.62	0.00

[a] Assuming the 1999–2000 year OR equal to 1.00 as the basis for comparison.

Hence, total condemnation of liver caused by fasciolosis in different animals was by far more than that observed in dicrocoeliosis (Table 1). In a study performed in slaughterhouse of Shiraz (Fars Province), fasciolosis and dicrocoeliosis were responsible for 54% and 21% of total liver condemnations, respectively [2]. In the present survey, mean prevalence of fasciolosis in cattle, sheep and goats was 5.54%, 0.93% and 2.79%. On the other hand mean prevalence of dicrocoeliosis in those animals was 0.11%, 0.09%, and 0.19%, respectively (Table 1). Liver condemnation due to Fasciola spp. in slaughtered cattle during this survey was almost 6 and 2 times more than those observed in sheep and goats, respectively. The epidemiologic implication of this finding might be attributed at least partly to the sources of their main food. Main food of sheep and goats belonged to plants which are present in mountains and plains, while cattle is mainly fed with herbs close to the sources of water such as slough, stream, creek, and swampland. It is clear that the plants which are close to water due to higher infection with fasciola metacercaria might be attributed in more distribution fasciolosis in cattle. The overall prevalence of fasciolosis was by far lower than previous report in the region by Sahba et al. [22], with 49.2% of cattle, 29% of sheep and 11.4% of goats. Daryani et al. [10], in a study in Ardabil Province, reported that prevalence of Fasciola spp. in cattle, sheep and goats was 25.9%, 5.3%, and 4.9%; as such prevalence of Dicrocoelium dendriticum in those animals was 10.6%, 6.8%, and 12.4%, respectively. In a slaughterhouse survey in ruminants of Mazandaran Province 4.6% of cattle, 5.7% of sheep and 1.6% of goats were infected with Fasciola spp. [9]. Studies carried out in the neighboring countries of Iran have reported different prevalence in different animals. In Pakistan (Kashmir), infection rate of Fasciola hepatica in cattle, sheep and goats was 85.1%, 51.3%, and 14.8%, respectively [20]. In Iraq, an abattoir survey in Basrah revealed that the prevalence for hepatic fasciolosis among cattle, sheep and goats was 0.13%, 0.72%, and 3.30%, respectively [19]. The corresponding figures from Saudi Arabia were 1.20%, 0.04%, and 0.00%, respectively [21]. In Turkey, 3.99% and 23.55% of sheep and 0.48% and 2.65% of cattle were infected with Fasciola hepatica and Dicrocoelium dendriticum, respectively [5].

On the whole, infection with Fasciola spp. in ruminants of Khuzestan was less than Ardabil in all species [10] and Mazandaran for sheep, but the prevalence in cattle and goats of Khuzestan and Mazandaran [9] was almost the same. In comparison to Iran, Pakistan (Kashmir region), a neighboring country, has shown a higher rate in all species [20], but infection with Fasciola in livestock of Khuzestan Province (Iran) was more than that in Saudi Arabia (for all species) and in Turkey (only for cattle) [21, 5]. Infection rate caused by fasciolosis in small ruminants (sheep and goats) of Iraq [19] was similar to our results. In comparison to Turkey, Iran (the studied area) showed lower rate of dicrocoeliosis in all species.

Present data showed an overall downward long term trend for annual percentages of liver condemnations due to fasciolosis in all livestock and dicrocoeliosis in sheep and cattle during the 9-year period (Table 1; $P<0.01$).

These results are consistent with reports from other studies of Iran [2]. Our results are plausible, considering the relative drought conditions, and the effect that it would have on the snail intermediate host. So, climatic conditions could be responsible for this improvement. The extreme drought that prevailed during the years 1998–2000 all over the country led to slaughtering many animals due to food scarcity. This is apparent from the total number of slaughtered animals which had a remarkable increase in years 1999–2000 (see Table 1). It could be hypothesized that disappearance of large number of infected animals accompanied with very hot and dry environmental condition at that time caused dramatic declines in infection prevalence in subsequent years. Also it may be attributed partly to the greater awareness among farmers of the losses caused by fluke infections that caused more effective use of available treatments. These treatments are usually mass chemotherapy of animals by triclabendazole or albendazole.

Data showed significant seasonal pattern for dicrocoeliosis in sheep and goats ($P<0.01$), but for fasciolosis in different animals there were no statistically significant differences with respect to season (Table 3). This is close to the results reported from Ardabil by Daryani et al. [10], and Mazandaran by Moghaddam et al. [9]. As it is clear from Table 3, liver condemnations due to fasciolosis and dicrocoeliosis were more prevalent in cattle slaughtered during summer (6.01% and 0.16%, respectively), whereas liver condemnations caused by liver flukes (Fasciola and Dicrocoelium) were higher in winter for both sheep and goats. The epidemiologic implication of this finding might be attributed at least partly to the sources of slaughtered animals. In winter, usually greater proportion of the sheep and goats slaughtered belonged to migratory tribal people. It is reported that the prevalence of parasites is relatively higher in animals belonging to this population [23, 24]. Considering that tribal people are essentially sheep and goat owners, the causes of seasonal pattern in other animals need to be elucidated. It may be due to changes in management practices and ecological factors. Without obtaining data concerning these issues, actual importance of seasonal fluctuations could not be demonstrated and their actual significance is questionable. Studies on this issue are needed for correct interpretation and understanding such seasonality in Khuzestan Province.

Odds ratios (odds of condemnation of liver due to liver fluke disease in successive years) were calculated (Table 4). The odds ratio showed a slightly different pattern in some years; however, the overall declining trend was still observed ($P<0.01$), which was particularly more remarkable in the first several years. The odds ratio of liver condemnations due to fasciolosis was decreased from 1 in 1999–2000 to 0.61, 0.62 and 0.62 in 2007–2008 for cattle, sheep, and goats, respectively ($P<0.01$). Dicrocoeliosis similarly declined from 1 in 1999–2000 to 0.00 and 0.53 in 2007–2008 in cattle and sheep respectively (Table 4; $P<0.01$). According to the odds ratio, it seems that chance of liver fasciolosis was increased in sheep (OR=0.33) and goats (OR=0.36) in 2005–2006 compared with 2004–2005 for those animals (OR=0.25 and OR=0.21, respectively); and also this is true for 2006-2007 and 2007-2008 compared with one year ago. For dicrocoeliosis, the trend of odds ratio was relatively more fluctuating in sheep and goats during successive years, and this ratio in goats rose to 6.34 in 2001-2002, and then decreased during successive years to 1.62 in 2007-2008 ($P<0.01$). Observed decreases caused by dicrocoeliosis were significant in sheep during 2000-2004 years, and then increased in 2005-2006.

In conclusion, we found a generally low prevalence, also great reduction of liver condemnations in sheep, cattle and goats due to liver fluke infections during a 9-year period. This survey has helped to illustrate the usefulness of meat inspection records in monitoring disease situations and demonstrating possible long term trends. Also it provides a preliminary baseline data for the future monitoring of these potentially important parasitic diseases.

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