Journal of Parasitology and Vector Biology Vol. 4(1), pp. 1 – 6, March 2012
Available online at http://www.academicjournals.org/JPVB
DOI: 10.5897/JPVB11.020
ISSN 2141-2510 ©2012 Academic Journals

Full Length Research Paper

Prevalence and characterization of hydatidosis in animals slaughtered at Addis Ababa abattoir, Ethiopia

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Accepted 19 March, 2012

Hydatidosis, caused by the larval stage of *Echinococcus granulosus*, is one of the most important helminthzoonosis in the world. The distribution of hydatidosis is normally associated with underdeveloped countries, especially in rural communities where humans maintain close contact with dogs and various domestic animals, which may act as intermediate hosts. This study was conducted in order to determine the prevalence of hydatidosis and the fertility/sterility rates of hydatid cysts in cattle and sheep slaughtered in Addis Ababa Abattoir, Ethiopia. Postmortem examination, hydatid cyst characterization and questionnaire survey were conducted. In the study, 19.7% cattle and 13.47% sheep were found harboring hydatid cyst. Though it was difficult to know the exact origin of the animals, cattle brought from Harar 36%, northern Shewa 28%, Nazareth 22%, Arsi 10% and others 4% were infected. Difference in prevalence rates were highly significant (p < 0.005) between cattle and sheep. The occurrences of hydatid cyst were 48, 31.7, 16.3, 1.7 and 2.4% in cattle and 41.7, 56.7, 0.8 and 0.8% in sheep, lung, liver, kidney, spleen and heart, respectively. Of the total of 1479 hydatid cysts in cattle and 175 in sheep counted 38.2, 29.8, 7.3, and 24.7% in cattle and 64, 11.4, 1.7 and 22.9% in sheep were found to be small, medium, large and calcified cysts, respectively. Among the hydatid cysts, 55.4, 19.3 and 25.3% in cattle (n = 1479) and 22.5, 59.1 and 18.5% in sheep (n = 175) were sterile, fertile and calcified, respectively. Viability rates of 60.5% in cattle and 78.3% in sheep were observed. The rate of calcification was higher in the liver than in the lung while fertility rate was higher among the cysts of the lung for both cattle and sheep. The questionnaire survey revealed the difference in the awareness about zoonotic Hydatidosis, that is, 8, 100 and 16% in household, abattoir workers and butchers, respectively. The findings of the present study reflect the economic and zoonotic impact of hydatidosis which deserves serious attention by the various stakeholders in order to reduce losses and safe guard the public health.

Key words: Prevalence, hydatidosis, cattle, sheep, Ethiopia.

INTRODUCTION

Hydatidosis is a term used to describe infection of animals and human with metacestode stage of Echinococcus species (Grant and McManus, 2003; Parija, 2004). Dogs and other canids are definitive hosts for the parasite while livestock are intermediate hosts. Man is aberrant intermediate host. The outcome of infection in livestock and man is hydatid cyst development in lung, liver or other organs. Hydatid cyst causes sever disease and death in humans and results in economic loss for treatment costs, lost wages and livestock annual production loss (Budke et al., 2006). The fertility of hydatid cysts occurring in various intermediate host species is one of the most important factors in the epidemiology of the disease (Himonas et al., 1994). The fertility of hydatid cysts varies depending on intermediate host species and geographical areas (Saeed et al., 2000). In Ethiopia, there are very few studies conducted about hydatidosis and the prevalence rates were changing between 13.7 to 72.44% in cattle and 9.9 to

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35% in sheep in Assela, Nazareth, Gondar, Bahir Dar and Dire Dawa abattoirs, respectively were recorded (Jobre et al., 1996; Kebede et al., 2009). The purpose of this study was to determine the prevalence and the fertility/sterility rate of hydatidosis in cattle and sheep slaughtered in Addis Ababa abattoir.

MATERIALS AND METHODS

Study area

Addis Ababa is the capital city of Ethiopia. It covers about 540 km^2, of which 18.2 km^2 is rural. It lies between 2,200 and 2,500 m above sea level. In Addis Ababa, there is one municipal abattoir where cattle, sheep, goats and swine are slaughtered and animals for slaughter come from different regions of the country. The main purposes of the Addis Ababa abattoir are processing of one or several classes of livestock into fresh meat for human consumption, hygienic processing and storage of meat and edible by-products, exercise close control over environmental conditions at all stages of processing and breakdown the transmission of zoonotic meat borne diseases through meat inspection.

Study animals and sampling methods

The study was an active abattoir survey, which includes cattle and sheep brought for slaughter from various locations to Addis Ababa abattoir. The sample size was determined for both species under study by 95% confidence interval at a desired accuracy level of 5% (Cannon and Roe, 1982). Therefore, the determined sample size was 1069 cattle and 542 sheep. Using random sampling method the study animals were selected from cattle and sheep registered for slaughter.

Study design

Postmortem examination

To estimate the prevalence of bovine and ovine hydatidosis a through meat inspection was conducted on 1069 heads of cattle and 542 heads of sheep slaughtered in Addis Ababa abattoir during the study period (June 2007 to July 2008). During antemortem inspection, each of the study animals was given an identification number and age, sex, breed and origin of the animals were recorded. However, all cattle were adult local zebu cattle breeds. An attempt was made to know the geographical origins of animals slaughtered and relate the findings to a particular locality; most of them were brought from Harar, Northern Shewa, Arsi, Nazareth and other places surrounding Addis Ababa.

In the abattoir, meat inspection was carried out on different organs of slaughtered animals, particularly lung, liver, kidney, spleen, heart and the muscles. Each organ was assessed macroscopically either by visual inspection and palpation and where necessary one or more incisions were made in order to detect small hydatid cysts. During postmortem inspection, meat inspectors made the incision according to MoA (1972).

Hydatid cyst characterization

The infected organs from each positive animal were collected and recorded. The total numbers of hydatid cysts were counted and recorded per infected organ. The cyst counts were also recorded and correlated with body condition scoring. The size of the diameter of the collected hydatid cyst was measured and classified as small (diameter less than 4 cm), medium (diameter between 4 and 8 cm) and large (diameter greater than 8 cm) (Schantz, 1990).

The collected hydatid cysts were taken to Aklilu Lemma Institute of Pathobiology laboratory. Individual cyst was carefully incised and examined for protoscolices which look like white dots on the germinal epithelium; such cysts were characterized as fertile cysts. Fertile cysts were subjected for viability test. A drop of the sediment, containing the protoscoleces was placed on microscopic glass slide and covered with coverslip and observed for amoeboid like peristaltic movement (flame cell activity) objective × 40. A drop of 0.1% aqueous eosin solution was added to equal volume of protoscolices in hydatid fluid on a microscopic slide with the principle that protoscolices should completely or partially exclude the dye while the dead once take it up (Macpherson,1985). Furthermore, infertile hydatid cysts were classified as sterile or calcified by their smooth inner lining usually with slight turbid fluid in its content. Typical calcified cysts produce a gritty sound feeling upon incision (Parija, 2004; Soulsby, 1982).

The association of body condition scoring and hydatid cyst count was analyzed. Body condition scores of animals were classified in to three as lean (score 1, 2, 3), medium (score 4, 5, 6) and fat (score 7, 8, 9) (Nicholson and Butterworth, 1986).

Questionnaire survey

Questionnaires were prepared in the local language and interviews were conducted with 50 households, 50 abattoir workers and 50 butchers. The questionnaire was aimed at gathering information on the extent of awareness on hydatidosis.

Analysis

Data obtained from postmortem examination, laboratory findings and questionnaire survey were entered into Ms Excel and analyzed using SPSS version 12.

RESULTS

Postmortem examination

Of the study animals, 1069 cattle and 542 sheep examined, 211(19.7%) cattle and 73(13.5%) sheep were found harboring hydatid cysts. The magnitude of the disease between the two species was significantly different ($p < 0.05$, $\chi^2 = 9.829$). The distribution and number of organs infected with hydatid cysts in cattle and sheep were described (Table 1). The distribution of hydatid cysts between organs of infected animals was significantly different in cattle ($p < 0.001$) and sheep ($p < 0.005$).

Out of the total infected organs, the involvement of lung and liver accounted for 79.6 and 91.7% in cattle and sheep, respectively. The relative prevalence of hydatidosis in each organ was described (Tables 1 and 2).

Assessments of hydatid cyst count with body condition scoring were made; accordingly cattle with poor body condition scouring had higher number of hydatid cyst

Table 1. Number of organs affected and distribution of hydatid cyst in cattle slaughtered in Addis Ababa abattoir.

Organ	Number of organs affected	Relative prevalence	Cyst count mean/organ	Range	Total	%
Lung	203	48	4.61	1-51	936	63.3
Liver	134	31.7	3.24	1-17	434	29.3
Spleen	7	1.7	1	1	7	0.5
Kidney	69	16.3	1	1	69	4.7
Heart	10	2.4	1	1	10	0.7
Total	423	100	3.49	1-51	1479	100

Table 2. Number of organs affected and distribution of hydatid cyst in sheep slaughtered in Addis Ababa abattoir.

Organ	Number of organs affected	Relative prevalence	Cyst count mean/organ	Range	Total	%
Lung	56	46.7	1.7	1-7	93	53.1
Liver	54	45.0	1.5	1-4	80	45.7
Spleen	1	0.8	1	1	1	0.6
Kidney	1	0.8	1	1	1	0.6
Heart	-	-	-	-	-	-
Total	120	68.6	1.5	1-4	175	100

Table 3. The relationship between body condition and cyst counts in cattle slaughtered in Addis Ababa abattoir.

Body condition	Total examined	Positive	Number of affected organs and cyst						Cyst count	
			Lung	Liver	Kidney	Spleen	Heart	Total	Total	Average
Lean	386	142	128 (632)	74 (287)	48 (62)	4 (4)	5 (5)	259	990	3.8
Medium	508	49	64 (280)	45 (117)	15 (21)	2 (2)	4 (4)	130	424	3.3
Fat	175	20	11 (24)	15 (30)	6 (9)	1 (1)	1 (1)	34	65	2.0
Total	1069	211	203 (936)	134 (434)	69 (92)	7 (7)	10 (10)	423	1479	3.5

count. On average, 3.8 hydatid cysts per organ while those of fat cattle had 2.0 on average hydatid cysts per organ. The relationship between body condition and cyst counts has a significant difference ($p < 0.001$) (Table 3).

It was difficult to precisely trace back the geographical origin of all animals slaughtered and relate the findings to a particular locality. However, some of them were brought from Harar, Northern Shewa, Arsi, Adama and other places surrounding Addis Ababa and 36, 28, 22, 10 and 4% were infected, respectively.

Hydatid cyst characterization

Exceptionally one large cyst was found in the lung of cattle measuring 21 cm in diameter and containing about 2 L of fluid. The total cyst counts with respect to size in each affected organ for cattle and sheep were described (Tables 4 and 5). Fertility and sterility of hydatid cyst was recorded both in cattle and sheep. The viability percentage of protoscolices was higher in sheep (78.3%) than in cattle (60.5%) (Tables 6 and 7).

Questionnaire survey

The questionnaire survey revealed the difference in the awareness about zoonotic hydatidosis, that is, 8, 100 and 16% in household, abattoir workers and butchers, respectively. Questionnaire surveys conducted on different categories of the society revealed that their awareness on hydatidosis is generally varied. 50 households from different sub-cities who owned an average of 2 livestock and 1 dog per household were interviewed and only 3 (8%) of the respondents has awareness about the disease. The owners kept animals as a source of food and income. The questionnaire survey revealed the difference in the awareness about zoonotic Hydatidosis, that is, 8, 100 and 16% in household, abattoir workers and butchers, respectively.

Table 4. Cyst size and counts in relation with organ involvement in cattle slaughtered in Addis Ababa abattoir.

Organ	Small cyst		Medium cyst		Large cyst		Calcified cyst		Total
	No.	%	No	%	No	%	No	%	
Lung	371	39.6	364	38.9	79	8.4	122	13.1	936
Liver	118	27.3	53	12.1	27	6.2	236	54.4	434
Spleen	3	33.3	4	44.4	2	22.2	-	-	9
Kidney	66	77.4	13	14.5	-	-	7	8.1	86
Heart	7	50.0	7	50.0	-	-	-	-	14
Total	565	38.2	441	29.8	108	7.3	365	24.7	1479

Table 5. Cyst size and counts in relation with organ involvement in sheep slaughtered in Addis Ababa abattoir.

Organ	Small cyst		Medium cyst		Large cyst		Calcified cyst		Total
	No.	%	No.	%	No.	%	No.	%	
Liver	43	54.2	3	3.4	-	-	34	42.2	80
Lung	67	72.3	17	18.7	3	3.2	6	5.8	93
Spleen	1	100	-	-	-	-	-	-	1
Kidney	1	100	-	-	-	-	-	-	1
Total	112	64	20	11.4	3	1.7	40	22.9	175

Table 6. Type of hydatid cyst (sterile, fertile and calcified) in different organs of cattle slaughtered in Addis Ababa abattoir.

Organ	Sterile cyst		Fertile cyst						Calcified cyst		Total
			Motile		Non motile		Subtotal				
	No.	%	No.	%	No.	%	No.	%	No.	%	
Lung	580	62.0	150	-	84	-	234	25	122	13.0	936
Liver	154	35.5	23	-	18	-	41	9.5	239	55.1	434
Spleen	9	100	-	-	-	-	-	-	-	-	9
Kidney	63	73.3	-	-	-	-	10	11.1	13	15.6	86
Heart	13	98	-	-	-	-	1	2	-	-	14
Total	819	55.4	173	60.5	113	39.5	286	19.3	374	25.3	1479

Table 7. Cyst fertility, viability and sterility in sheep slaughtered in Addis Ababa abattoir.

Organ	Sterile cyst		Fertile cyst						Calcified cyst		Total
			Motile		Non motile		Subtotal				
	No.	%	No.	%	No.	%	No.	%	No.	%	
Liver	16	20	21	-	11	-	32	40	32	40	80
Lung	21	22.6	60	-	12	-	72	77.4	-	-	93
Spleen	1	100	-	-	-	-	-	-	-	-	1
Kidney	1	100	-	-	-	-	-	-	-	-	1
Total	39	22.5	81	78.3	23	21.7	104	59.1	32	18.5	175

DISCUSSION

The infection of hydatidosis in cattle was found to be 19.7% during the study period. In general terms, there had been different magnitude records of hydatidosis in cattle with low, medium and high rates of infections. The prevalence of hydatidosis in sheep in this study was 13.5%. Generally, the difference in prevalence between the two species of animals and among the different geographical locations could be ascribed to strain

difference of *Echinococcus granulosus* (Arene, 1985). The sheep strain of *E. granulosus* is the most widely distributed strain around the world. It has been found to be a dominant strain both in human and animals (Ahmadi and Dalimi, 2006; Garippa, 2006). Additionally, variability could be related with age. Other factors like different in culture, social activities and attitudes to dogs in different region may contribute to this variation (Macphenson et al., 1985).

Most of the slaughtered animals were old probably culled due to less productiveness and hence they were exposed to the disease (parasitic ova) over a long period with an increased possibility of acquiring the infections. Studies conducted elsewhere also strongly suggest that prevalence is heavily influenced by age (Torgerson et al., 2002). In an attempt to trace back the geographical origins of animals slaughtered and relate the findings to a particular locality, most of them were brought from Harar, northern Shewa, Arsi, Nazareth and other places surrounding Addis Ababa with a prevalence rate of 76 (36%), 59 (28%), 46 (22%), 21 (10%) and 9 (4%), respectively.

In this study, an assessment was made to establish relationship between body condition scores and hydatid cyst count. Animals with poor body condition were found to have higher hydatid cyst count and the poor condition among animals is probably a reflection of the effect of relatively high cyst burden. Polydorou (1981) explained that in moderate to sever infection, the parasite may cause retarded performance and growth, reduced quality of meat and milk, as well as live weight loss.

In the present study, it has been established that hydatid cysts occur predominantly in lung and liver with prevalence rate of 79.6 and 91.7% in cattle and sheep, respectively. This is explained by the fact that lungs and liver possesses the first great capillaries sites encountered by the migration of Echinococcus oncosphere (hexacanth embryo) which adopt the portal vein route and primarily negotiate hepatic and pulmonary filtering system sequentially before any other peripheral organ is involved. In addition, the lungs were mostly affected than any other organs and this might be due to the fact that ruminants are slaughtered at older age.

A maximum of 51 cysts were encountered from a single lung of cattle. Such variation in cyst abundance is due to the spatial distribution and the infectivity (biotic potential) of *E. granulosus* eggs and to the susceptibility and defensive capabilities of the host (Macphenson et al., 1985). Hydatid cyst count is highest in the lungs followed by liver, kidney, spleen and heart. This finding is similar with previous studies conducted (Kebede et al., 2009).

Higher numbers of medium and large sized cysts were found in lungs than liver, whereas the liver harbored higher number of small sized and calcified cyst. The reason for high percentage of medium and large cysts in the lung is due to softer consistency of the lung while the higher number of calcified cysts in the liver could be attributed to relatively higher reticuloendotelial cells and abundant connective tissue reaction of the organ. The higher proportion of small cysts may indicate late infection of the animals and due to immunological response of the host which might preclude expansion of cyst size (Torgerson et al., 2002).

In examining the condition of cyst fertility and viability, the fertility rate was higher in sheep (59.1%) than cattle (19.3%). The findings of 55.4% sterile, 60.5% fertile and 25.3% calcified cysts in cattle may generally imply that most of the cysts in cattle are infertile. Similar findings are reported in Turkey by Yildiz and Gurcan (2003). The variation in fertility rate among different species and in different geographical zone could be due to the difference in strain of *E. granulosus* (Arene, 1985). Genotype of infecting strain affects the fertility rate of the cysts in the intermediate hosts and thereby the infectivity of strain for the subsequent hosts (Mwambete et al., 2004). Gemmel et al. (2002), furthermore, suggested that strains of parasites and hosts can modify the infective pattern of the parasite. Furthermore, Saeed et al. (2000) noted that fertility of hydatid cysts varies depending on intermediate host species and geographical areas. In comparison to the fertility rate among the organs, it was higher in lungs than liver for both cattle and sheep. It has been stated that the relatively softer consistency of lung tissue allows the easier development of the cyst and the fertility rate of hydatid cyst may show a tendency to increase with advancing age of the hosts (Himonas, 1987). This may be attributed probably due to reduced immunological compatibility of animals at their old age of infection. The variation between tissue resistances of the affected organs may also influence the fertility rate of cysts; for instance, in the liver, host reaction may limit fertility rate of hyadtid cysts.

Generally, the greater number of fertile and viable cysts detected in sheep than in cattle suggests that sheep act as the main reservoir of infection (important intermediate host) in maintaining and perpetuation of the domestic life cycle of *E. granuosus* in the region. In the study area sheep are raised by most livestock owner for cash, and the off take rate of sheep is higher than cattle and most frequently slaughtered at back yard or home stead. The contribution of cattle as intermediate host in maintaining the infection is also significant as there is higher infection rate in cattle than sheep. Similar findings are reported in the other part of the world (Yildiz and Gurcan, 2003).

Questionnaire surveys conducted on different categories of the society revealed that their awareness on hydatidosis is generally varied. 50 households from different sub-cities who owned an average of 2 livestock and 1 dog per household were interviewed and only 3 (8%) of the respondents has awareness about the disease. The owners kept animals as a source of food and income. The questionnaire survey revealed the difference in the awareness about zoonotic Hydatidosis, that is, 8, 100 and 16% in household, abattoir workers

and butchers, respectively. During holidays, ceremonies and other feasts, the community mostly practiced homestead (backyard) slaughter. It is a common practice that meat inspection is not conducted and the offal is often given to pets or disposed at back yard. No treatment of dogs with modern taenicidal drugs is practiced. These and other socioeconomic realities in the area are considered to best suit the maintenance and propagation of hydatid disease; in addition, the numbers of stray dogs is considerable and are not dewormed at all. Dogs can be infected by eating scavenged dead animals. This is may be due to poor awareness of the people about the disease and due to absence of proper fencing for their dogs and disposal pits for slaughterhouses where dogs and related carnivores can get an easy access to the infected organs.

It is therefore concluded that owing to the presence of socio-economic conditions favorable for hydatidosis and maintenance of high level of infection in cattle and sheep, hydatidosis is one of the most important diseases in the study area. The findings of the present study reflect the economic and zoonotic impact of hydatidosis which deserves serious attention by the various stakeholders in order to reduce losses and safe guard the public health. Hence, establishment of policy on dog keeping and handling including registration, treatment and elimination of stray dogs, promoting construction of abattoirs with their appropriate disposal pits in different sub-cities in Addis Ababa with an obligatory meat inspection services are highly essential. Furthermore, detailed investigation into the basic local epidemiological factors governing the spread of hydatidosis in the region is recommended.

ACKNOWLEDGEMENTS

The authors are grateful to Ato Nega Nigussie and Ato Hailu Getu for their technical assistance. Fund was obtained from Addis Ababa University, Research and Graduate studies.

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