Bovine Hydatidosis in Ambo Municipality Abattoir, West Shoa, Ethiopia

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Abstract

A cross-sectional study on bovine hydatidosis was conducted in Ambo municipality abattoir from November 2007 to March 2008 with the aim of investigating the prevalence, intensity, fertility and economic losses in cattle slaughtered for human consumption. Stray dogs killed with strychnine baited meat piece were also examined for the presence of adult *Echinococcus granulosus*. Out of the total 384 cattle examined 114 (29.69%) were found infected with hydatidosis. From the examined animals 61 (15.89%), 19 (4.95%) and 26 (6.77.3%) contained hydatid cyst in their lungs, livers, and in both lung and liver, respectively. Age related infection was significant in that older animals were more infected (P<0.05, x^2 = 15.64, df =1). In the sphere of size determination there were 471 (69.26%) small, 140 (20.59%) medium and 69 (10.15%) large sized cysts. Concerning the fertility test, 31.39%, 53.28% and 15.33% were fertile, sterile and calcified cysts respectively. About 58.14% of fertile cysts were viable. Five (25%) out of the 20 stray dogs were infected with *E.granulosus* and the range of parasitic burden and mean was 3-57 and 27 respectively. The total annual economic loss due to direct and indirect loss was estimated to be 160,032.23 Ethiopian Birr. Therefore, hydatidosis has considerable economic and veterinary importance in the study area.

Keywords: Ambo/ Bovine/ Economic significance// Fertility/ Hydatidosis/ Prevalence/

Introduction

Hydatidosis (Cystic echinococcosis) caused by the larval stage (metacestode) of *Echinococcus granulosus* is the most widespread parasitic zoonoses. Dogs are the usual definitive hosts whilst a large number of mammalian species can be intermediate hosts, including domestic ungulates and man (Soulsby, 1982; Torgerson and Budke, 2003; Eckert and Deplazes, 2004). The disease occurs throughout the world and causes considerable economic losses and public

health problems in many countries (Torgerson, 2003; Ansari-Lari, 2005; Majorowski *et al*. 2005). Hydatidosis causes decreased livestock production and condemnation of offal containing hydatid cysts in slaughterhouses (Eckert and Deplazes, 2004; Azlaf and Dakkak, 2006).

Despite the large efforts that have been put into the research and control of echinococcosis, it still remains a disease of worldwide significance. In some areas of the world, Cystic echinococcosis caused by *E. granulosus* is a re-emerging disease in places where it was previously at low levels (Torgerson and Budke, 2003).

Echinococcus granulosus infection is endemic in East and South Africa Central and South America, South Eastern and Central Europe, Middle East, Russia and China. The highest incidence is reported mainly from sheep and cattle rearing areas (Subhash, 2004). Several reports from different parts of Ethiopia indicate that hydatid cyst is prevalent in livestock (Fikre Lobago, 1994; Mussie Haylemelekot, 1995; Fekadu Olika, 1997; Hagos Yihdego, 1997; Kebede Weldegiorgis *et al.*, 2008). However, the status of the problem is not known in Ambo. Therefore, this study was undertaken to elucidate the prevalence, intensity, fertility and economic significance of hydatidosis in cattle slaughtered at Ambo municipality abattoir and also to determine the prevalence and worm burden of *Echinococcus granulosus* in dogs of Ambo.

Material and Methods

Study Area

The study was undertaken in Ambo town, Western Shoa zone of Oromia regional state, located 115 km West of Addis Ababa. The area is found at a longitude of 370 32' to 380 3' E, and latitude of 80 47' to 90 20' N and the altitude range is from 1900 to 2275 meters above sea level. The climatic condition of the area is 23% highland, 60% mid altitude, and 17% lowland. It has an annual rainfall and temperature ranging from 800 – 1000 mm and 20 – 29 o C respectively. The rainfall is bi-modal with the short rainy season from February to May and long rainy season from June to September (AARDB, 2006). Agriculture is the main occupation of the population of the area. The agricultural activities are mainly mixed type with cattle rearing and crop production under taken side by side. Extensive system of livestock management predominate the area and dogs are commonly used for control and guarding of herds of cattle and flocks of sheep and goats.

Study Animals

A total of 384 indigenous zebu cattle slaughtered at Ambo municipality abattoir were included in the study. During ante-mortem examination each study animal was given an identification number; and age was determined. Estimation of age was done by the examination of the teeth eruption (De Launta and Habel, 1986). Two age groups were considered: above 5 years and below 5 years. It was difficult to precisely indicate the geographical origin of all animals slaughtered at the abattoir and relate the findings on hydatidosis to a particular locality. Nevertheless, the attempts made in this regards have disclosed that the majority of them were drawn from market oriented areas (Guder market). Since, almost all the cattle presented for slaughtering in the study area were males; infection rate regarding sex variation was not included. A total of 20 stray dogs of Ambo town were also included in the study.

Sample Size and Sampling Method

Average annual slaughter rate of cattle in Ambo municipality abattoir was estimated based on retrospective analysis of data recorded for three years which gave 2675 cattle The sample size was calculated according to Thrusfield (1995) by considering 72.44% expected prevalence from previous studies (Fekadu Olika, 1997) and 5% accepted error at 95 % confidence interval using this formula:-. N= 1.96^{2} * Pexp (1 - Pexp) / d^{2}; where,   N = required sample; Pexp = expected prevalence; d = desired absolute precision. A total of 306 bovine would have sufficed; however, in this study 384 cattle were selected by simple random sampling method.

Study Design and Methodology

A cross sectional study design was used to examine the prevalence of bovine hydatidosis at Ambo municipality abattoir, from November 2007 to March 2008. Additionally, post- mortem examination of dogs was also included.

To study the prevalence of bovine hydatidosis post-mortem examination through inspection, palpation and incision of internal organs such as lung, liver, heart, spleen and kidney was made and the organ distribution and rate of infection of hydatidosis were recorded.

The total numbers of mature cysts obtained per organ were counted in different organs. The minimum and maximum cyst burden per organ was also recorded. Counting was difficult in very close cysts particularly in liver. After

all cysts in an organ were counted, they were subjected to systematic size measurement (diameter) using a ruler and classified as small cyst (<3cm), medium cyst (3-5 cm) and large cyst (>5cm).

The fertility and sterility of hydatid cyst was recorded in order to investigate the viability of the cyst. Fertile cysts were subjected to viability test. Fertility or sterility of hydatid cyst was determined by the method described by Calero et al., (1978).

To asses the status of human hydatidosis in the study area retrospective data from Ambo hospital case books was collected and physicians working at this hospital were interviewed.

Post mortem examination of dogs

Prevalence of *E. granulosus* in dogs was assessed by post-mortem examination of 20 stray dogs in Ambo town. The dogs were killed for the purpose of rabies control using strychnine baited meat pieces. To avoid autolysis immediately after death, each dog's abdominal cavity was opened and the small intestine legated at both ends and removed. It was then taken to the laboratory, opened along its length and immersed each intestinal content into a jar. The intestinal wall was scraped with spatula. The intestinal content and scraped part of the intestine was boiled and washed by sieving to eliminate the particulate colored material. The washed content was placed on a black tray and the worms counted with the aid of a hand lens in those that were positive. The mean and range values were calculated.

Economic Analysis

To study the economic losses due to hydatidosis in cattle, both direct and indirect losses were considered. The calculation of the direct losses is based on condemned organs (lung, liver, heart, spleen and kidney) and the indirect losses were assessed on the basis of live weight reduction due to hydatidosis. In calculating cost of condemned edible organs and carcass weight loss, ten different meat sellers were interrogated randomly to establish the price per unit organ and the collective price of lung, liver, heart, spleen, and kidney was determined. Average price was drawn out from that data and this price index was later used to calculate the meat loss in terms of Ethiopian birr (ETB).

Average annual slaughter rate of cattle in Ambo municipality abattoir was estimated based on retrospective analysis of data recorded from three years. A 5% estimated carcass weight loss due to bovine hydatidosis described by Poly-

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dorou (1981) was taken into account to determine the carcass weight loss. Average carcass weight of an Ethiopian zebu was taken as 126 kg, as estimated by International Livestock Center for Africa (Hagos Yihdego, 1997).

Direct loss from organ condemnation

Annual economic loss = $(PI_1 \times T_k \times C_1) + (PI_2 \times T_k \times C_2) + (PI_3 \times T_k \times C_3) + (PI_4 \times Tk \times C_4)$ (Ogunrinade and Ogunrinade, 1980).

Where PI_1 = Percent involvement of lung out of the total examined
PI_2 = Percent involvement of liver out of the total examined
PI_3 = Percent involvement of spleen out of the total examined
PI_4 = Percent involvement of heart out of the total examined
C_1 = Average market price of liver
C_2 = Average market price of lung
C_3 = Average market price of heart
C_4 = Average market price of spleen
T_k = Average annual kill of bovines

Indirect loss from carcass weight loss

Annual economic losses due to carcass weight loss=Ns x Ci x Pa (Polydorou, 1981).

Where Ns=Total number of animals slaughtered and positive for hydatidosis

Ci= Carcass weight lost in individual animals
Pa=Average market price of a kg of beef in Ambo

Annual economic losses were calculated by adding both direct and in direct losses.

Data analysis

Data obtained from the study were coded and stored in Microsoft Excel, and then subjected to descriptive statistics and chi-square in order to assess the magnitude of the difference of comparable variables using stata version 7 (STATA, 2001) soft ware.

Result

Prevalence

Out of a total of 384 heads of indigenous zebu cattle slaughtered at Ambo municipal abattoir 114 (29.69%) were found infected with one or more hydatid cysts involving different organs. Rate of infection of hydatidosis in different age groups (>5 and <5 years) was statistically significant (P<0.05, df =1) (Table 1).

Table-1: Prevalence in different age groups

Age groups(yrs)	No animal examined	infected	Prevalence	X2	P
Group 1 (>5)	244	88	22.91		
Group 2 (<5)	140	26	6.78	15.6378	0.000
Total	384	114	29.69		

Out of 114 cattle infected, 61 (15.89 %) have hydatid cyst in their lungs, 19 (4.95%) in livers, 3 (2.63%) in spleen and 1(0.88%) in heart and the other was mixed infections (Table 2).

Table 2: Distribution of hydatid cyst in different organs

Organs	No. infected	Prevalence from infected animals	Prevalence from total examined animals
Lung	61	53.51	15.89
Liver	19	16.67	4.95
Lung & liver	26	22.81	6.77
Spleen	3	2.63	1
Lung, liver & spleen	2	1.75	0.52
Lung and spleen	2	1.75	0.52
Heart	1	0.88	0.26
Kidney	0	0	0
Total	114		29.69

Cyst characterization

The number of cysts found range from 1 - 35 in different organs. Higher numbers of large and medium sized cysts were found in lungs, while higher numbers of small and calcified cysts were found in liver (Table 3 and 4).

Table 3: Total and average number of hydatid cysts

Organ	Total No. of organ examined	Positive	Percent-age	Number of cyst			
				Min.	Max.	Mean	Total
Lung	384	91	23.69	1	25	4.64	422
Liver	384	46	11.98	1	35	5.24	241
Spleen	384	8	2.08	1	6	2.13	17
Heart	384	1	0.26	1	-	1	1
Kidneys	384	0	0	0	0	0	0
Total	1920	146	38.01	4	66	11.52	681

Table 4: Distribution of cysts based on size

Organ	Small cyst		Medium cyst		Large cyst		Total	
	No.	%	No.	%	No.	%	No.	%
Lung	258	61.14	107	25.36	57	13.51	422	62.05
Liver	201	83.40	30	12.45	10	4.15	241	35.44
Spleen	12	70.51	3	17.65	2	11.76	17	2.50
Total	471	69.26	140	20.59	69	10.15	680	100

A total of 91 infected lungs and 46 infected livers were examined by opening and inspecting them with the naked eye and hand lens. The examination indicated that 30 hydatid cysts (32.97%) in lungs and 13 (28.26%) in liver had protoscolices, either attached to the germinal layer or in its fluid. This suggests fertility of the cysts. The rest of the cyst were sterile and calcified (Table 5).

Table 5. Cyst fertility and viability in lung and liver

Organ	Fertile cyst						Sterile cyst		Calcified cyst		Total	
	Motile		Non motile		Sub total							
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Lung	17	56.67	13	43.33	30	32.97	51	56.04	10	10.99	91	66.42
Liver	8	61.54	5	38.46	13	28.26	22	47.83	11	23.91	46	33.58
Total	25	58.14	18	41.86	43	31.39	73	53.28	21	15.33	137	100

Fertile cyst protoscolices was showing the amoeboid-like peristaltic movement (flame cell activity) with 10x magnification power. Up on staining with 0.1% aqueous eosin solution viable protoscolices partially excluded the dye while the dead once take it up.

Prevalence of *Echinococcus. granulosus* in dog

Out of the 20 stray dogs killed and examined, the adult parasite, *E. granulosus,* were found in 5 (25%) of dogs. Apart from *E.granulosus*, *Dipilidium Caninum* and *Ancylostoma caninum* were encountered. The maximum and minimum

number as well as the mean and range of *E. granulosus* per killed dog was 57, 3, 27 and 3 -57, respectively.

Human hydatidosis

According to information obtained from physicians and retrospective study of Ambo hospital case books, there was no human hydatidosis clinically diagnosed in spite of a greater likelihood for its being a significant problem. Lack of modern diagnostic facilities was the main draw back according to the physicians which hampered the clinical diagnosis of hydatidosis in humans in the study area.

Economic Loss

Economic loss due to organ condemnation

A total of 91 lungs, 46 livers, a heart and 8 spleens were condemned due to hydatidosis with an economic loss of 2528.8, 2616, 14.17 and 10.9 ETB respectively. This was calculated from average market price of cattle liver (20 birr), cattle lung (8 birr), cattle heart (5 birr) and cattle spleen (0.50 birr) and the total number of organ condemned during the study period. On the other hand, annual economic loss was determined by considering annual slaughter rate of cattle and prevalence of hydatidosis per liver, lung, heart and spleen. And it is calculated to be 11065.96 ETB annually.

Economic loss due to carcass weight

A 5 % carcass weight loss due to hydatidosis (Polydorous, 1981) was considered as the information given previously to estimate the economic loss. The computed result showed a loss of 148966.27 ETB per annum. Therefore, the total estimated economic loss in cattle at Ambo municipality abattoir due to hydatidosis was estimated to be 160,000 ETB which is equivalent to 18,000 USD at the exchange rate of ETB 8.8 to USD.

Discussion

Hydatidosis is known to be important in livestock and public health in different parts of the world and its prevalence and economic significance has been reported by different workers in different geographical areas. The prevalence may however vary from country to country or even within a country.

The prevalence of the disease in cattle (29.69%) slaughtered at Ambo municipal abattoir is comparable to those cattle slaughtered at Tigray region (22.1%) (Kebede Weldegiorgis *et al.,* 2008), central Sudan 3% (Elmahdi *et al.*, 2004) and Morocco 22.98% (Azlaf and Dakkak, 2006).

A higher prevalence of hydatidosis (48.7%) has been reported from Ngorongoro district of Arusha region, Tanzania (Ernest *et al.*, 2008). A lower prevalence rate was also reported from Burdur (Turkey) 13.5% (Umur, 2003) and from Thrace (Turkey) 11.6% (Esatgil and Tuzer, 2007). The variation in prevalence between different countries and regions may be attributed mainly to strains difference in *E. granulosus* that exist in different geographical situations (Arene, 1985). Other factors like difference in culture, social activity and attitude to dog in different regions might have contributed to this variation (Macpherson, 1985).

The prevalence rate of 29.69% in the study area was high. This might be due to the abundance and frequent contact between the infected intermediate and final hosts. It could also be associated to slaughtering of aged cattle which have had considerable chance of exposure to the parasitic ova, backyard slaughtering of small ruminants and provision of infected offal's to pet animals around homesteads. Moreover, poor public awareness about the disease and presence of few slaughter houses could have contributed to such a higher prevalence rate.

With regards to rate of infection of hydatidosis in different age groups of cattle, significant difference ($P<0.005$) was observed. Animals with more than 5 years of age were highly affected. The difference in infection rate could be mainly due to longer exposure time to *E. granulosus*. This finding is similar to the finding of Fikre Lobago (1994), Hagos Yihdego (1997), Umur (2003), Azlaf and Dakkak (2006) and (Esatgil and Tuzer, 2007).

From the organ prevalence study, lung is found to be the most commonly affected organ. This might be due to the fact that cattle are slaughtered at older age. During this period the liver capillaries are dilated and most cysts directly pass to the lungs. Additionally, it is possible for the hexacanth embryo to enter the lymphatic circulation and be carried via the thoracic duct to the heart and lungs in such away that the lung may be infected before the liver and / or instead of the liver (Arene 1985). Similar findings were reported by Hagos Yihdego (1997), and Fekadu Olika (1997). But, this result contradicts with Soulsby (1982) and Fikre Lobago (1994).

Out of the total 680 hydatid cysts 471 (69.26%), 140 (20.59%) and 69 (10.15) were small, medium and large sized cysts respectively. The high proportion of small cysts may indicate infection of animals as a result of heavy rain fall and continuous grazing in the past rainy seasons or due to immunological response of the hosts which might have reduced the expansion of cyst size. Moisture and rainfall favor the survival of eggs of *E.granulosus* species and at the same time eggs may get chance to be disseminated by flood (Hagos Yihdego, 1997).

Lung harbored higher number of large and medium sized cysts, while liver was found to harbor higher number of small and calcified cysts. The high number of large and medium sized cysts in lung may be due to relatively softer consistency (Symth, 1974). The higher number of calcified cysts in the liver could be attributed to the reticulo-endothelial and connective tissue of the organ (George and Diame, 1981). This finding is similar to the findings of Hagos Yihdego (1997).

The result of the present study revealed that lung is the most common organ which harbored fertile cysts followed by liver. This result is similar to other workers such as Himones (1987) and Hagos Yihdego (1997). It has been stated that relatively softer consistency of lungs allow earlier development of cyst; and fertility of hydatid cysts may show a tendency to increase in advanced age of the host. This may also be related to reduction in immunological compatibility of the host at their older ages of infection (Hubbert 1975).

Information about prevalence and fertility of hydatid cysts in various organs of cattle are important indicators of potential source of infection to perpetuate the disease to dogs. In our study the percentage of fertile cysts recovered was 31.39 %.This is low compared to 70% in the Great Britain, 96.9% in South Africa and 94% in Belgium (Arene, 1985) but comparable to Elmahdi *et al.* (2004) and Ernest *et al.* (2008) who reported 22% and 21.3% fertile hydatid cysts from central Sudan and Ngorongoro district of Arusha region, Tanzania, respectively. Elmahdi *et al.* (2004) also reported low (3%) prevalence from Central Sudan.

Hydatid cyst condition tends to follow size dependent pattern in that most of the small cysts were calcified. This can be due to the host defense mechanisms of killing more efficiently with parasitic larvae at the early stage of development (Himones, 1987).

The high prevalence rate of *E. granulosus* in stray dogs (25%), with parasitic burden ranging from 3 – 57 and the mean being 27, of the study area is one of

the important findings of this study. High prevalence of dog *Echinococcus* in the area could be due to slaughtering of small ruminants in backyard without inspection, provision of infected offal's and dead animals to dogs; that may harbor fertile cysts.

The complete absence of reported human hydatid cases from Ambo hospital may not suggest that the study region is free of this disease. The lack of modern diagnostic facilities, clinical similarities with other disease and its asymptomatic appearance and extended incubation period added to the inability to afford medical treatment by the most vulnerable section of the society could have contributed to the obtained result. Moreover, further study in this regard is necessary

The annual economic loss due to bovine hydatidosis at Ambo municipality abattoir from direct and indirect losses was estimated to be 160,032.23 ETB. In addition to losses incurred in the abattoir, hydatidosis could have economic impact due to invisible losses like impaired productivity; for example, reduced traction power of oxen which results in reduced crop production. Moreover, cost of control, loss of life, productivity and treatment cost in humans magnifies the economic losses. Our finding of annual economic losses is much higher than the report of Kebede Weldegiorgis *et al.* (2008) who reported annual economic loss of 25, 608 Ethiopian Birr in their study in Tigray region of Northern Ethiopia. Torgerson (2003) and Majorowski *et al.* (2005) reported significant total economic losses in monetary terms due to cystic echinococcosis both in the public health and livestock sector.

In conclusion, the prevalence rate in bovine and dogs observed in the present study were high and undoubtedly reflect the potential hazard to public health in the area. Hydatidosis also causes substantial visible economic losses due to condemnation of the organs in the study area. In terms of frequency, size and fertility of the cyst the lung was found to be the most preferred predilection site for larval stage of *E. granulosus* in cattle.

Acknowledgments

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