Cystic echinococcosis in cattle slaughtered at Gondar Elfora export Abattoir, northwest Ethiopia

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Received: 1 November 2012 / Accepted: 30 January 2013 / Published online: 23 February 2013
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Abstract A cross sectional and retrospective studies were conducted from November 2010 to April 2011 to determine the prevalence and characteristics of hydatid cysts in cattle slaughtered at Gondar Elfora Abattoir in northern Ethiopia. Out of the 308 cattle examined for the presence of hydatid cysts, 63 (20.5 %) of them were found harboring hydatid cysts in one or more of their internal organs. Results of the study showed higher ($P < 0.05$) prevalence of cystic echinococcosis in adult (22.4 %; 49/219) than in young (15.7 %; 14/89) cattle. Lowest prevalence of hydatid cysts was observed in cattle from Debark (7.7 %; 2/26) whereas highest prevalence of cystic echinococcosis was recorded in cattle from Fogera (28.2 %; 11/39). The lungs (69.3 %; 61/88) were the most affected organs followed by the livers (28.4 %; 25/88). A total of 230 hydatid cysts from different internal organs of 63 infected cattle were differentiated into 60.4 % calcified, 30 % fertile and 9.6 % sterile cysts. Likewise, a total of 13 % (30/230) small, 15.6 % (36/230) medium, and 10.9 % (25/230) large hydatid cysts were recorded. Lung harbored the highest overall count (76.9 %; 177/230) and greatest proportion of large size cysts (13.5 %; 103/177) than all the other organs. Liver harbored the highest proportion of calcified cysts

(68 %; 34/50). An overall proportion of 30 % (69/230) fertile cysts were recorded. The greatest proportion of fertile cysts (33.3 %; 59/177) was recorded in lungs followed by the livers (20 %; 10/50). A retrospective data of 5 years (2004/5–2009/10) revealed an overall prevalence of 30.4 % (9,106/29,951) and highest overall prevalence of 65.5 % hydatid cysts in the lungs followed by livers (33.5 %) and least in spleen (0.04 %). In conclusion the findings reported herein show that cystic echinococcosis is widespread in cattle slaughtered in Gondar export Abattoir and suggests that the lung is the most important source of hydatid cysts for definitive hosts in the area.

Keywords Cattle · Hydatid cysts · Prevalence · Retrospective survey · Gondar Elfora Abattoir

Introduction

Cystic echinococcosis, mainly caused by the metacestode of *Echinococcus granulosus*, is one of the most common zoonotic diseases associated with huge economic losses and great public health significance worldwide (Romig et al. 2011). The adult tapeworm in the definitive dog host is harmless unlike the hydatid cyst in the intermediate host animals that is responsible for immense economic and medical importance in infected hosts (Azlaf and Dakkak 2006; Fakhra and Sadjaji 2007; Battelli 2009; Ibrahim 2010).

In humans, cystic echinococcosis is responsible for direct monetary costs of diagnosis, hospitalisation, surgical or percutaneous treatments, therapy, post-treatment care, travel for both patient and family members as well as indirect costs including mortality, suffering and social consequences of disability, loss of working days or

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“production”, abandonment of farming or agricultural activities by affected or at-risk persons (Battelli 2009; Dakkak 2010; Rahimi et al. 2011). The prevalence, economic and public health impact of cystic echinococcosis is higher in rural communities of developing countries where there is close contact between dogs, intermediate host species and man (Ibrahim 2010; Romig et al. 2011).

In Ethiopia, where home slaughtering of cattle, sheep, goats and camels is still predominant and uncooked offal and carcass wastes are normally given for dogs and cats, cystic echinococcosis is an endemic disease and poses great public health and economic importance. Previous investigations show that cystic echinococcosis is one of the major causes of organ condemnation in the country (Kumsa 1994; Kebebe et al. 2010; Kumsa and Mohammedzein 2012). Cystic echinococcosis in cattle has been reported from some parts of the country (Kumsa 1994; Hailemariam et al. 2012). However, there is lack of information on cystic echinococcosis of cattle in Gondar and its Surroundings. Therefore, the present study reports the prevalence, organ distribution and fertility of hydatid cysts in cattle slaughtered at Gondar Elfora export Abattoir in north Ethiopia.

Materials and methods

Study area

The study was conducted from November 2010 through April 2011 in north Gondar zone (Fig. 1) located in the northwestern part of Ethiopia. Gondar is located 727 km north western of Addis Ababa in Amhara Regional State. The altitude of the study area ranges from 550 meters in the west to 4,620 meters in the high Mountain highlands in the north. The rainfall varies from 880 mm to 1,772 mm with a monomodal distribution, while the minimum and maximum temperatures are -10°C and 44.5°C , respectively. The rainy season of the area is from June to September while the dry season is from October to May. The area comprises livestock population of 1,936,514 cattle, 524,083 sheep, 682,264 goats, 2,124,000 poultry, 223,124 donkeys, 12,473 mules, 36,828 horses and 606 camels (CSA 2009). The farming system of the study area is characterized by a mixed crop-livestock production system.

Study design and sample size

A cross sectional study on a total of 308 indigenous cattle and retrospective study were carried out to determine the prevalence, organ distribution and fertility of hydatid cysts in cattle slaughtered at Gondar Elfora export Abattoir. The sample size was determined as described in Thrushfield

(1995) using 50 % expected prevalence at 95 % confidence level and 5 % desired absolute precision.

Ante-mortem examination

During ante-mortem examination of a total of 308 cattle of the present study, regular visits were made to obtain data on breed, sex, age, origin and body condition of each individual animal. The body condition of each study animal was rated into poor, medium or good as has been used previously (Kumsa 1994). Each study animal was clearly identified based on enumerated marks on the body by using ink and this marking was transferred to all corresponding carcasses and visceral organs after slaughtering.

Post-mortem examination

During the study period, a total of 308 slaughtered cattle were examined for the presence of hydatid cysts in visceral organs including lungs, liver, heart, spleen and kidneys. Visual inspection and palpation followed by multiple incisions in the livers, kidneys, lungs, hearts and spleens, were made to detect hydatid cysts which were carefully removed and collected into clean containers to determine their number and characteristics in the Parasitology Laboratory of the School of Veterinary Medicine of Gondar University.

Hydatid cyst count and fertility

The number of hydatid cysts on each positive organ were counted and recorded. The diameters of collected hydatid cysts were measured and classified as small (diameter less than 5 cm), medium (diameter between 5 and 10 cm) and large (diameter greater than 10 cm) as described by Kumsa 1994; Kumsa and Mohammedzein 2012). Each hydatid cyst was carefully incised and examined for the presence of protoscoleces, resembling white dots, on the germinal epithelium. Cysts with protoscoleces were characterized as fertile cysts. Furthermore, non fertile cysts were further classified as sterile or calcified. Sterile hydatid cysts were characterized by their smooth inner lining usually with slightly turbid fluid content. Whereas typical calcified cysts produce a gritty sound feeling upon incision (Taylor et al. 2007; Daryani et al. 2007).

Retrospective study

An attempt was made to compile previously recorded data on cystic echinococcosis in cattle slaughtered at Gondar Elfora export Abattoir during the years from 2004/5 to 2009/10.

Fig. 1 Map of Ethiopia show the study area (eight spoked asterisk)

Data analysis

Data obtained from ante-mortem and post-mortem findings were entered into Microsoft excel 2003 computer program. Then data were analysed using SPSS version 15 windows software. Chi square test was used to compare the prevalence of cystic echinococcosis among cattle of different age, body conditions scores and origins. A statistically significant association among variables was considered to exist if P value was less than 0.05.

Results

Out of the total 308 slaughtered cattle examined for the presence of hydatid cysts 63 (20.5 %) of them were found harboring hydatid cysts in one or more of their internal organs (Table 1). Results of our study showed higher prevalence of cystic echinococcosis in adult (22.4 %; 49/219) than in young (15.7 %; 14/89) cattle (Table 1). Lowest prevalence of hydatid cysts was observed in cattle

Table 1 Prevalence of hydatid cysts in cattle slaughtered at Gondar Elfora Abattoir by age

Age	No examined	Positive	Prevalence	95 % CI
Young	89	14	15.7	8.875–24.982
Old	219	49	22.4	17.035–28.478
Total	308	63	20.4	

Pearson χ^2 1.717, $df = 1$; $P = 0.190$

from Debark (7.7 %; 2/26) and Azizo (10.7 %; 3/28) whereas highest prevalence of cystic echinococcosis was recorded in cattle from Fogera (28.2 %; 11/39) (Table 2).

Our data showed that out of the total 88 different organs harboring hydatid cysts, the lungs 69.3 % (61/88) were the most affected organs followed by the livers 28.4 % (25/88) whereas hydatid cysts were not found in any of the inspected hearts of cattle in the Abattoir. Out of the total 63 cattle found harboring hydatid cysts in their different organs, 60.3 % (38/63) had hydatid cysts only in their

Table 2 Prevalence of hydatid cysts in cattle slaughtered at Gondar Elfora Abattoir by origin

Origin	No. examined	Positive	Prevalence (%)
Chilga	36	9	25
Gondar zuria	33	9	27.3
Fogera	39	11	28.2
Gondar town	57	13	22.8
Dembia	55	12	21.8
Alefa	34	4	11.8
Debark	26	2	7.7
Azizo	28	3	10.7
Total	308	63	20.4

lungs, 3.2 % (2/63) only in their livers, 33.3 % (21/63) in their both lungs and livers, 1.6 % (1/63) had in their lungs, livers and spleen and the rest (1.6 %; 1/63) had in their lungs, livers and kidney.

During the study period an overall number of 230 hydatid cysts were collected from a total of 63 cattle harbouring one or more hydatid cysts in a total of 88 internal organs (Tables 2 and 3). From infected organs of positive cattle a total of 13 % (30/230), 15.6 % (36/230) and 10.9 % (25/230) were recorded as small, medium and large, respectively, and 60.4 % (139/230) were found as calcified hydatid cysts (Table 3). The lungs harbored the highest overall count (76.9 %; 177/230) and greatest proportion of large size cysts (13.5 %; 103/177) than all the other organs followed by the livers (21.7 %; 50/230). The livers harbored the highest proportion (68 %; 34/50) of calcified cysts (Table 3). An overall proportion of 30 % (69/230) fertile and 9.6 % (22/230) sterile cysts were recorded (Table 3). The lungs harbored the greatest proportion of fertile cysts (33.3 %; 59/177) followed by the livers (20 %; 10/50). A retrospective data of 5 years (2004/5–2009/10) collected on cystic echinococcosis of cattle slaughtered at Gondar export Elfora Abattoir revealed an overall prevalence of 30.4 % (9,106/29,951) and a total of 12,579 organs rejected during these years. Interestingly, this retrospective data showed highest overall prevalence

of 65.5 % in the lungs followed by livers 33.5 % and least in spleen (0.04 %).

Discussion

Findings of our study showed the occurrence of high overall prevalence cystic echinococcosis in cattle slaughtered at Gondar Elfora Abattoir. This finding is in line with previous observations in Nekemte in west Oromia (Kumsa (1994) and 31.44 % in Jimma in south western Oromia (Tolosa et al. (2009) and 19.4 % in Kenya (Njoroge et al. 2002) and 22.98 % in Morocco (Azlaf and Dakkak 2006). This high prevalence of hydatid cysts in cattle is most probably linked to the presence of high number of stray dogs in the current study areas and presumably the low level of awareness of cattle owners. On the other hand, the prevalence of cystic echinococcosis in cattle of this study is higher than the findings of previous reports elsewhere: (4.2 % in Arusha Tanzania (Nonga and Karimuribo 2009), 6 % in Sudan (Omer et al. 2010), 7.4 % in Turkey (Sariozkan and Yalcin 2009), 8.28 % in Saudi Arabia (Ibrahim 2010), 10.4 % in Italy (Rinaldi et al. 2008) and 16.4 % in Iran (Dalimi et al. 2002). However, our current finding is lower than the previous report of 29.7 % from Ambo in central Oromia (Zewdu et al. 2010), 38.3 % in northern Iran (Daryani et al. 2007) and 48.7 % in Ngorongoro district of Arusha region in Tanzania (Ernest et al. 2009). These variations in prevalence of cystic echinococcosis among cattle of different study areas could be attributed to differences in agroecology, time of study, stocking rates and movements of animals, animal husbandry systems, awareness, culture and religion of the community, attitude of people to dogs in different regions of the countries (Ibrahim 2010; Cardona and Carmena 2012).

The higher prevalence of cystic echinococcosis in adult than young cattle in our study strengthen the previous findings in Ethiopia (Kumsa 1994; Zewdu et al. 2010) and elsewhere (Adinehbeigi et al. 2012; Cardona and Carmena 2012). It is most probably attributed to the greater chance

Table 3 Number, size and characteristics of hydatid cysts in infected organs of positive cattle ($n = 63$) slaughtered at Gondar Elfora Abattoir

Organs	Size of cysts				Cyst condition		
	Small no. (%)	Medium no. (%)	Large no. (%)	Calcified no. (%)	Sterile (%)	Fertile (%)	Total no. (%)
Lung	20 (11.3)	30 (16.9)	24 (13.5)	103 (58.2)	15 (8.5)	59 (33.3)	177 (76.9)
Liver	9 (18)	6 (12)	1 (2)	34 (68)	6 (12)	10 (20)	50 (21.7)
Kidney	0	0	0	2 (100)	0	0	2 (0.9)
Spleen	1 (100)	0	0	0	1 (100)	0	1 (0.4)
Total	30 (13.04)	36 (15.6)	25 (10.9)	139 (60.4)	22 (9.6)	59 (33.3)	230 (100)

of exposure to more number of infective stages over longer duration of time in adult than young cattle and partially related to the longer period is required for cyst to develop.

The findings of highest prevalence and largest number of hydatid cysts in the lungs than all the other organs followed by livers in our study are in agreement with several earlier reports (Kumsa 1994; Dalimi et al. 2002; Bardonnet et al. 2003; Daryani et al. 2007; Zewdu et al. 2010; Omer et al. 2010;). This finding could be explained by the fact that livers and lungs possess the first great capillary sites encountered by the migrating oncospheres of this parasite during their portal vein route that are primarily subjected to hepatic and pulmonary filtering system before the involvement of any other peripheral organ (Kumsa and Mohammedzein 2012). Furthermore, it is possible for the hexacanth embryo to enter the heart and lungs so that the lungs may be infected before or instead of liver as has been proposed earlier (Ibrahim 2010; Cardona and Carmena 2012).

The observation of highest proportion and numbers of both medium and large size hydatid cysts in the lungs than all the other organs could be associated to the softer consistency of the lung tissue whereas the finding of highest percentage of calcified cysts in liver is attributed to the previous argument (Kumsa and Mohammedzein 2012) related to the relatively higher reticuloendothelial cells and abundance of connective tissue reaction in the liver than all the other organs.

The overall rate of 60.4 % calcified, 9.6 % sterile and 30 % fertile hydatid cysts reported in the present study generally suggests that the majority of hydatid cysts in cattle are not infective to the final host. This finding supports the previous arguments of several investigators in Ethiopia who have proposed that sheep play the greatest role as the intermediate host of cystic echinococcosis than cattle (Kumsa and Mohammedzein 2012). However, when considering the high prevalence of 20.5 % and fertility of 30 % of cysts in cattle slaughtered at Gondar Elfora export Abattoir reported in this study imply that cattle still play an important role as potential source of infection to dogs and other definitive hosts of this parasite. This observation agrees with the previous findings (Kumsa 1994).

In the present study, the greater prevalence and the higher proportion (33.3 %) fertility of hydatid cysts in lungs than in the liver (20 %) and all the other organs recorded provides reliable indicators of the importance of lungs as a potential source of infection to dogs than all the other organs. Fertility of cysts could be affected by differences in strain of *E. granulosus* (Njoroge et al. 2002; Romig et al. 2011). Cysts, depending on the geographical situation, host, site, size and type of cyst may have different rates of fertility (Ibrahim 2010). Moreover, the fertility of hydatid cysts in the intermediate hosts may be also genotype dependent, but unfortunately genotype studies are

not available for any host in Ethiopia including Gondar. In view of the highest prevalence and fertility of pulmonary hydatid cysts than all the other organs in our current study and the practices of feeding uncooked lungs to dogs and cats in Ethiopia strengthen the great role of lungs in cystic echinococcosis than any other organ in the country.

Results of our retrospective study of highest overall prevalence of 65.5 % in the lungs followed by livers 33.5 % and least in spleen (0.04 %) at Gondar Elfora Abattoir supported the findings of our cross-sectional study.

In conclusion, the findings reported herein show that cystic echinococcosis is widespread in cattle in Gondar and its surroundings. The documentation of fertile cysts in examined organs suggests that cattle may play important role in the life cycle of this serious zoonosis and the presence of potential risks of transmission to other intermediate hosts and human population of the study area. Hence, safe disposal of infected offal and community education about cystic echinococcosis in the area will help reduce the transmission from slaughterhouses to potential hosts of the area. In detail epidemiological studies on the role of other intermediate host species, definitive hosts, genotypes of strains from different host species, zoonotic impact and economic significance of cystic echinococcosis are urgently needed in different parts of Ethiopia.

References

- Adinehbeigi K, Radfar MH, Rahmani M (2012) The role of cattle in the epidemiology of *Echinococcus granulosus* in Kerman area, southeast of Iran. *Comp Clin Pathol*. doi:10.1007/s00580-011-1391-4
- Azlaf R, Dakkak A (2006) Epidemiological study of the cystic *Echinococcus* in Morocco. *Vet Parasitol* 137:83–93
- Bardonnet K, Benchikh-Elfegoun MC, Bart JM, Harraga S, Hannache N, Haddad S, Dumon H, Vuitton DA, Piarroux R (2003) Cystic echinococcosis in Algeria: cattle act as reservoirs of a sheep strain and may contribute to human contamination. *Vet Parasitol* 116:35–44
- Battelli G (2009) *Echinococcosis*: costs, losses and social consequences of a neglected zoonosis. *Vet Res Commun* 33(Suppl 1): S47–S52
- Cardona GA, Carmena D, Rahmani M (2012) A review of the global prevalence, molecular epidemiology and economics of cystic echinococcosis in production animals. *Vet Parasitol*. doi:org/10.1016/j.vetpar.2012.09.027
- CSA (2009) Central statistical Authority Federal Democratic Republic of Ethiopia Agricultural sample enumeration statistical abstract
- Dakkak A (2010) Echinococcosis/hydatidosis: a severe threat in Mediterranean countries. *Vet Parasitol* 174:2–11
- Dalimi A, Motamedi Gh, Hosseini M, Mohammadian B, Malaki H, Ghamari Z, Ghaffari Far F (2002) Echinococcosis/hydatidosis in western Iran. *Vet Parasitol* 105:161–171
- Daryani A, Alaei R, Arab R, Sharif M, Dehghan MH, Ziaei H (2007) The prevalence, intensity and viability of hydatid cysts in slaughtered animals in the Ardabil province of Northwest Iran. *J Helminthol* 81:13–17

- Ernest E, Nonga HE, Kassuku AA, Kawala RR (2009) Hydatidosis of slaughtered animals in Ngorongoro district of Arusha region, Tanzania. *Trop Anim Health Prod* 41:1179–1185
- Fakhar F, Sadjjadi SM (2007) Prevalence of hydatidosis in slaughtered herbivores in Qom province, central part of Iran. *Vet Res Commun* 31:993–997
- Hailemariam Z, Nakao M, Menkir S, Lavikainen A, Yanagida T, Okamoto M, Ito A (2012) Molecular identification of unilocular hydatid cysts from domestic ungulates in Ethiopia: implications for human infections. *Parasitol Int* 61(2):375–377
- Ibrahim MM (2010) Study of cystic echinococcosis in slaughtered animals in Al Baha region, Saudi Arabia: interaction between some biotic and abiotic factors. *Acta Trop* 113:26–33
- Kebebe E, Girma Z, Kumsa B (2010) Hydatidosis of sheep and goats slaughtered at Addis Ababa Abattoir: prevalence and risk factors. *Trop Anim Health Prod* 42(5):803–805
- Kumsa B (1994) Hydatidosis in Nekemet: prevalence in slaughtered cattle and sheep estimated economic loss and incidence in stray dog. DVM Thesis, Addis Ababa University, Faculty of Veterinary Medicine, Debre Zeit, Ethiopia
- Kumsa B, Mohammedzein A (2012) Prevalence, organ distribution, risk factors, and financial losses of hydatid cysts in sheep and goats slaughtered in restaurants in Jimma, south western Oromia. *Comp Clin Pathol*. doi:[10.1007/s00580-012-1619-y](https://doi.org/10.1007/s00580-012-1619-y)
- Njoroge EM, Mbithi PMF, Gathuma JM, Wachira TM, Gathura PB, Magambo JK, Zeyhle E (2002) A study of cystic echinococcosis in slaughter animals in three selected areas of northern Turkana, Kenya. *Vet Parasitol* 104:85–91
- Nonga HE, Karimuribo ED (2009) A retrospective survey of hydatidosis in livestock in Arusha, Tanzania, based on abattoir data during 2005–2007. *Trop Anim Health Prod* 41:1253–1257
- Omer RA, Dinkel A, Romig T, Mackenstedt U, Elnahas AA, Aradaib IE, Ahmed ME, Elmalik KH, Adam A (2010) A molecular survey of cystic echinococcosis in Sudan. *Vet Parasitol* 169:340–346
- Rahimi MT, Sharifdini M, Ahmadi A, Laktarashi B, Mahdavi SA, Kia EB (2011) Hydatidosis in human and slaughtered herbivores in Mazandaran province, northern Iran. *Asian Pacific J Trop Dis* 1(3):212–215
- Rinaldi L, Maurelli MP, Veneziano P, Capuano F, Perugini AG, Cringoli S (2008) The role of cattle in the epidemiology of *Echinococcus granulosus* in an endemic area of southern Italy. *Parasitol Res* 103:175–179
- Romig T, Omer RA, Zeyhle E, Hüttner M, Dinkel A, Siefert L, Elmahdi IE, Magambo J, Ocaido M, Menezes CN, Ahmed ME, Mbae C, Grobusch MP, Kern P (2011) Echinococcosis in sub-Saharan Africa: emerging complexity. *Vet Parasitol* 181:43–47
- Sariozkan S, Yalcin C (2009) Estimating the production losses due to cystic echinococcosis in ruminants in Turkey. *Vet Parasitol* 163:330–334
- Taylor M, Coop R, Wall R (2007) Veterinary parasitology, 3rd edn. Blackwell publishing, London, p 52
- Thrushfield M (1995) Veterinary epidemiology, 3rd edn. Blackwell Science, London, pp 154–165
- Tolosa T, Tigre W, Teka G, Dorny P (2009) Prevalence of bovine cysticercosis and hydatidosis in Jimma municipal abattoir, southwest Ethiopia. *Onderstepoort J Vet Res* 76:323–326
- Zewdu E, Teshome Y, Makwoya A (2010) Bovine hydatidosis in Ambo Municipal Abattoir. *Ethiopian Vet J* 14(1):1–14