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Epidemiology and Economic Importance of Hydatidosis in Domestic Animal and Human in Ethiopia- A Review

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Abstract

Echinococcosis/hydatid disease is one of the most important of the helminth zoonoses and remains a significant problem worldwide. Based on recent report; five species of the genus *Echinococcus* are regarded as taxonomically valid. These are *Echinococcosis granulosus*, *Echinococcosis multilocularis, Echinococcosis oligarthrus, Echinococcosis vogeliand Echinococcosis shiquicus*. Among this the most widespread is *Echinococcosis granulosus* and *Echinococcosis multilocularis. Echinococcosis granulosus* is zoonotic parasite which occurs in Ethiopia and throughout the world. Hydatidosis prevail in all age group, there are no age and sex discrimination. Hydatidosis causes considerable economic loss due to condemnation of edible organs, decreased meat and milk Productions, reduced hide and fleece value and decrease in fecundity. The definitive host of the parasite, *Echinococcosis granulosus* is dogs which harbor the adult parasite and excrete the parasite eggs along with their feces, while livestock and human are the intermediate hosts. Humans can accidentally become intermediate hosts by ingesting the eggs of the tapeworm. While most cysts develop in the liver and lungs, other organs or tissues may become affected. The diagnosis in human conducted with X-rays or ultrasound machine. Whereas, in the other intermediate animal diagnosis of cyst will be conducted only during meat inspection in the abattoir and postmortem examination. In conclusion, basic hygiene such as washing hands with soap after gardening or touching the dog and washing vegetables that may have been contaminated by dog faeces, deworming of dogs with antihelmentic in every six months are important in prevention of this disease.

Keywords: Economic importance; Epidemiology; Hydatidosis; Zoonosis

Introduction

Hydatidosis is one of the important parasitic diseases of livestock that has both economic and public health significant [1]. According to Sewell [2] in hydatidosis two main species are recognized. Whereas Urquhart, et al. [3,4] reported four species of *Echinococcuses*, such as *Echinococcosis granulosus, Echinococcosis multilocularis, Echinococcosis oligarthus* and *Echinococcosis vogeli*. But at present, five species of the genus *Echinococcus* are regarded as taxonomically valid. These are *Echinococcosis granulosus, Echinococcosis multilocularis, Echinococcosis oligarth rus, Echinococcosis vogeli and Echinococcosis shiquicus* [5]. The most widespread is *Echinococcosis granulosus* and the other is *Echinococcosis multilocularis* [6]. Among this *Echinococcosis granulosus* is wide spread zoonotic parasite which occurs in Ethiopia and throughout the world [7]. The adult tapeworm is not more than 6 mm long with, usually, three proglottides in *Echinococcosis granulosus* and five in *Echinococcosis multilocularis* [2]. According to FAO [8] egg counts are not specific because of the similarity of eggs from other tapeworms of the Taenia family. Therefore, Hydatidosis cysts diagnoses will be performed during meat inspection and postmortem examination in abattoir and elsewhere in research centers.

The definitive host of the parasite, *Echinococcosis granulosus*, is dogs which harbor the adult parasite and excrete the parasite eggs along with their feces, while livestock and human are the intermediate hosts [9]. Humans can accidentally become intermediate hosts by ingesting the eggs of the *Echinococcus* species and most cysts develop in the liver and lungs, other organs may become affected [10].

Echinococcosis granulosus causes considerable economic loss and the public health problem by reducing livestock production and condemnation of cyst contains offal during meat inspection [7]. Similarly Polydorou, et al. [11,12] stated that in farm animals Hydatidosis causes considerable economic loss due to condemnation of edible organs, decreased meat and milk productions, reduced hide and fleece value and decrease in fecundity. The prevalence of hydatid cysts in harboring cattle, sheep, goats, camel were 35.15%, 11.78%, 4.9%, 16.79%, respectively [13]. In human case a prevalence of 0.5%-0.7% was reported in Hamar pastoralist tribes of southwest Ethiopia [12,14]. During a period of 1995 to 2005, 234 patients were operated for hydatid disease at Tikur Anbessa Hospital in Addis Ababa [15].

Therefore, the objective of this paper is to review the epidemiology and economic importance of hydatidosis in domestic animal and human.

Review

Epidemiology of hydatidosis

According to Putt [16], epidemiology is the study of disease in population. In the case of hydatidosis the disease distribution or the epidemiology cannot be differentiated by sex, age and breed, therefore regardless of sex and age all mammals will be infected by hydatidosis [7]. The global distribution of the parasite is due in part to its ability to adapt to wide variety domestic and wild intermediate hosts. The disease occurs throughout the year as long as inal hosts are available [17-24].

Worldwide distribution: *Echinococcosis*/hydatid disease is one of the most important of the helminth zoonoses and remains a significant problem worldwide (Table 1). Among the specious of hydatidosis the most widespread is *Echinococcosis granulosus* and the other is *Echinococcosis multilocularis* [6] (Figure 1).

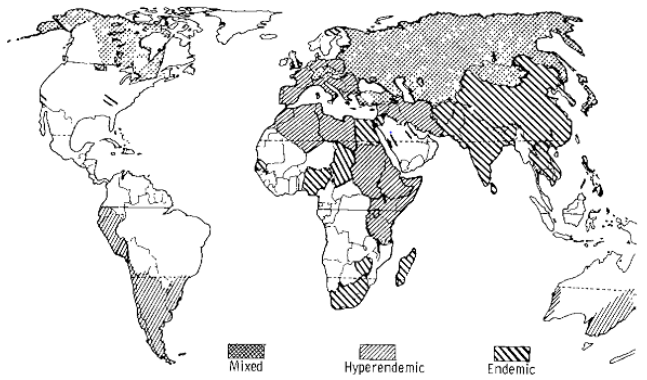

Figure 1: Global distribution of human and animal hydatidosis. Single lines represent *Echinococcosis granulosus* and crossed lines the coexistence of both *Echinococcosis granulosus* and *Echinococcosis multilocularis* infection [18].

This parasite occurs throughout the world in many agricultural-based countries which are listed as the following.

Countries	Source
Eastern Europe	[19]
India	[19]
Mediterranean region	[20]
North Jordan	[21]
Australia	[22]
North and South Americans	[2]
Tunisia	[25]
Greece	[26]
Middle East and Arabic North Africa	[27]
Iran	[28,29]
Thailand	[30]
Libya	[31]
Sub-Saharan Africa	[32]
South Africa andTurkey	[33-36]
Ethiopia	[37]

Table 1: worldwide distribution of hydatidosis.

Distribution in Ethiopia: As different authors reported, hydatidosis is wide spread zoonotic disease in Ethiopia. Varying prevalence rates were also reported by different authors from diverse countries in different intermediate hosts (Table 2).

Study area	Animal	Prevalence	Source
Oromia			
Arsi/asella	Cattle	50.29	[38]
Hararge	Goat Cattle	6.51 27.98	[39]
Nazareth	Cattle Sheep Goat	46.8 29.3 6.7	[40]
Wollega	Sheep	22.20	[41]
SNPP			
Sidamo	Cattle	34.3	[42]
Gamo Goffa	Sheep Cattle	18.8 25.7	[43]
Amahara			
Bahir Dar	Cattle Sheep	34.05 10.6	[44]
Wollo	Sheep Cattle	4.4 38.4	[45]
Tigray	Cattle Human	7.5 31.85	[1]

Table 2: Varying prevalence rates.

A retrospective survey of bovine hydatidosis conducted in Gondar, Injibara and Finote Selam municipal abattoirs during 2002 to 2007 revealed an increasing trend from year to year in prevalence of bovine hydatidosis that caused the condemnation of 79.5% organs [46]. This might be attributed to backyard slaughter practice, an increase in the population of stray dogs and the absence of control program [13].

In human case a prevalence of 0.5%-0.7% was reported in Hamar pastoralist tribes of southwest Ethiopia [12,14].

Host-agent-environment interaction

The clinical signs of any disease, whether endemic or epidemic, are the result of an intricate relationship between the infectious agents (parasite). The host's immune response, the management and environmental factors imposed on the host [47]. According to Noone

[48] agent, host and environmental factors provide an approach to elucidate the causes of incident outbreaks of infectious disease. They are less helpful in predicting when and why outbreaks arise.

Host: Hydatidosis hosts are divided in to final and intermediate host [7]. *Echinococcosis granulosus* is found in the small intestine of carnivores particularly the dog of the final host and the metacestode (hydatid cyst) is found in a wide variety of ungulates (sheep, cattle, pigs, goats, horse and camels) and man which are the intermediate hosts [49]. According to FAO [8] *Echinococcosis granulosus* has little host specificity with regard to intermediate hosts, hydatid cysts have been seen in a wide range of mammals, including domestic ruminants, camels, giraffes, pigs, equines, elephants, hippopotamuses, marsupials and different types of deer, as well as humans.

Agent: Hydatidosis is the larval stage of immature tapeworm and endemic disease to east and South Africa, eastern and central Europe, Middle East, china, central and South America [7]. *Echinococcus* species is the causal agent of hydatidosis. As Urquhart, et al. [3,50-55] previously reported four species of *Echinococcus* such as *Echinococcosis granulosus*, *Echinococcosis multilocularis*, *Echinococcosis oligarth* and *Echinococcosis vogeli* are clearly distinguishable using morphological, biological or molecular techniques (Table 3). But the present study indicates that five species of the genus *Echinococcus* are regarded as taxonomically valid. These are *Echinococcosis granulosus*, *Echinococcosis multilocularis*, *Echinococcosis oligarth rus*, *Echinococcosis vogeli* and *Echinococcosis shiquicus* [5]. The four specious of *Echinococcus* that are identified are *Echinococcosis granulosus*, *Echinococcosis multilocularis*, *Echinococcosis oligathes* and *Echinococcosis vogeil* (Table 2 and Figures 2-5).

Kingdom	**Animalia**
Phylum	*Platyhelminthes*
Order	*Cyclophillidae*
Family	*Taenidae*
Genus	*Echinococcus*
Species	*E.granulsus*
	Echinococcosis multilocularis
	Echinococcosis oligarthus
	Echinococcosis vogeli

Table 3: Taxonomy of the causative agent of *Echinococcosis*.

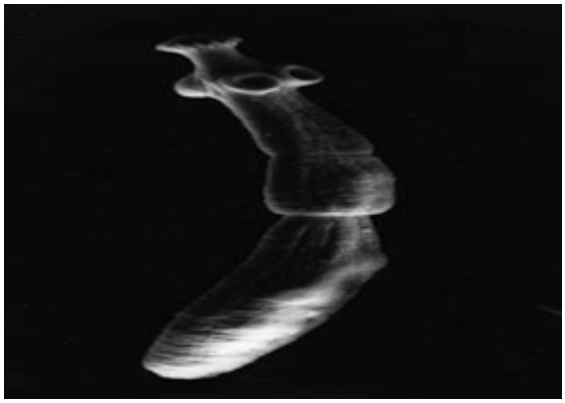

Figure 2: Adult *Echinococcosis multilocularis.*

Figure 3: Adult *Echinococcosis granulosus.*

Figure 4: Strobilar stage of *Echinococcosis oligarthrus.*

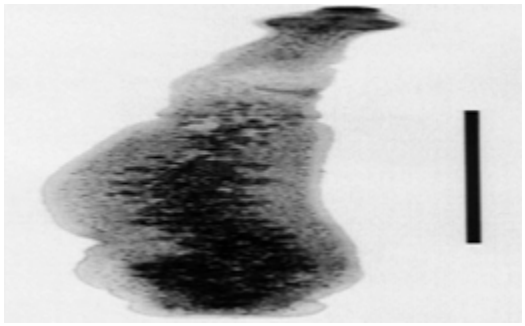

Figure 5: Adult *Echinococcosis vogeli*.

Environment: The survival of the infective egg is influenced by environmental factors, such as humidity and temperature. While eggs may survive for several months under moist conditions and moderate temperatures. Desiccation is detrimental and they will only survive a short time when they exposed to direct sunlight and dry conditions [56]. But according to Bowman [57] when hydatid tapeworm eggs passed by dogs, dingoes and foxes into the environment are quite resistant to harsh environmental conditions. Under favorable conditions (cool, moist, overcast), eggs may remain infective to susceptible intermediate hosts for several months.

Transmission

Animal: Animals host of hydatidosis are bovine, ovine, caprine, swine, human and dromedarius. Grazing animals become infected when they swallow eggs from contaminated pasture. When hydatid eggs are swallowed by an intermediate host (sheep, cattle, kangaroos or humans), they migrate through the stomach wall into the bloodstream. They are then carried to various internal organs, usually the liver and lungs, but sometimes the brain. Watery hydatid cyst then forms in these soft tissues [57]. Species vary in their suitability as intermediate host; hydatid cysts found in the sheep are usually fertile, whereas those in cattle are usually sterile [58]. Hence, the sheep play a very important role in the transmission of the disease to the definitive host. Since definitive hosts acquires the infection of the parasite by ingestion of the fertile hydatid cyst [59].

The establishment of a pastoral cycle may result from the feeding of uncooked offal from the infected domestic animals to the dogs [3,58]. According to Soulsby [58] when the hydatid cyst is ingested by a suitable definitive host, the eggs again appears in the feces in six to nine weeks. Each egg is capable of developing into an adult tapeworm in the intestine of a dog [57]. The parasites segment after excreted from the infected definitive hosts detached with the faeces may perform rhythmic contractions and relaxations that assist egg-expulsion and eggs may be dispersed over considerable distances away from the faeces [8]. Since sheep generally avoid grazing near areas contaminated with dog faeces, this dispersal mechanism enhances the chances of eggs being ingested by the grazing animals. This has important epidemiological implications since a single dog can thus infect many sheep over a wide area [60-65].

According to Oku [9] livestock and human are the intermediate hosts. Once the egg inter to the intermediate host, it will hatched in the intestine. Consequently the larva inter to the blood stream and latter travel to different circulatory system. The cysts invade and develop in different human organs like lung, liver, heart, spleen, kidney and other organs [2].

The life cycle of this organism outside of a human can be summed up in six stages (Figure 6):

1. The adult *Echinococcus granulosus*, which is about 3-6 mm in length, resides in the bowel of its definite host.

2. Gravid proglottids release eggs that are passed in the feces.

3. These eggs are then ingested by a suitable intermediate host, including sheep, goat, swine, cattle, horses and camels. The eggs then hatch in the bowels and release oncospheres that penetrate the intestinal wall. These oncospheres then migrate through the circulatory system to various organs of the host.

4. At the organ site, the oncosphere develops into a hydatid cyst. This cyst enlarges gradually, producing protoscolices and daughter cysts that fill the cyst interior.

5. These cyst-containing organs are then ingested by the definite host, causing infection. After ingestion, the protoscolices evaginate (Figure 8), producing protoscolexes.

6. The scolexes of the organisms attach to the intestine of the definite host and develop into adults in 32-80 days.

The life cycle then continues in humans (Figure 6):

1. Humans can become infected if they ingest substances infected with *Echinococcus* eggs.

2. The eggs then release oncospheres in the small intestine.

3. At these places, oncospheres migrate through the circulatory system and produce hydatidcysts.

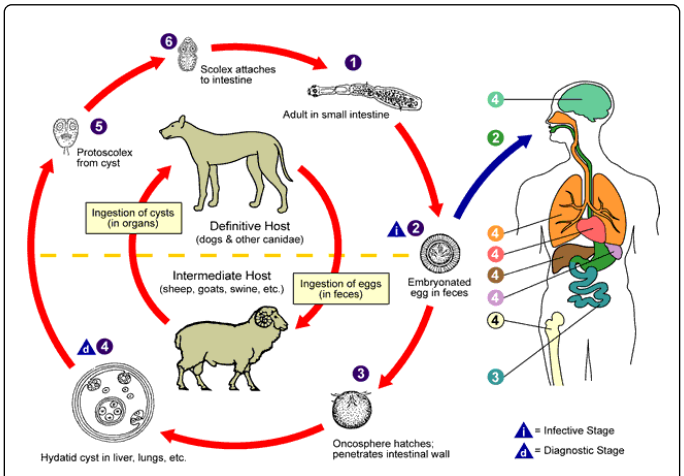

Figure 6: life cycle of Echinococcosis *granulosus*.

Human: Man is an accidental intermediate host. As Sewell [2] described human infection most commonly occurs when infected dogs are handled, because the sticky hydatid eggs are present on the dog's coat. Infection is also possible from eating home-grown raw vegetables, contaminated with the faeces of an infected dog.

In human one or both lungs may be affected causing respiratory symptoms (Figure 9), and if several hydatids are present in the liver there may be gross abdominal destersion. If the cycle would rupture,

this is a risk of death from anaphylaxis or if the person survives, released daughter cysts may resume developing other regions of the body [3].

Diagnosis

The presence of hydatids as a clinical entity is rarely suspected in domestic animals, and specific diagnosis is never called for. In man, the methods most commonly used are serological tests such as complement fixation or immune electrophoresis. Scanning techniques may be used to locate the cysts. Diagnosis of infection in dogs with adult tapeworms is difficult, because the segments are small and only shed sparsely [3]. The *Echinococcosis granulosus* infection in candies cannot be diagnosed by microscopic egg detection in faecal samples because these eggs are morphologically indistinguishable from those of the taenia species [8]. Egg can be detected in the faecal samples using routine flotation technique or on the perineal skin using clear adhesive tape, which is pressed to the skin, transferred to a microscopic slide and examined (Figure 7). Proglottids of *Echinococcosis granulosus* spontaneously discharged by dogs and detected mostly on the surface of faecal samples may allow a correct morphological diagnosis, if they are in a good condition [3].

The diagnosis in human conducted by confirmation by imaging through US, CT, X-RAYS and identification of the characteristic or suspicious cyst structure [62]. In addition to this, it can also confirmed by detection of specific antibodies with immunodiagnosis test such as ELISA, IFAT, Immuno blot Detection, ARE 5 antibodies and PCR [63]. Whereas, in the other intermediate animal diagnosis of cyst will be conducted only during meat inspection in the abattoir and postmortem exam [2].

Figure 7: *Echinococcus* Egg in Feces.

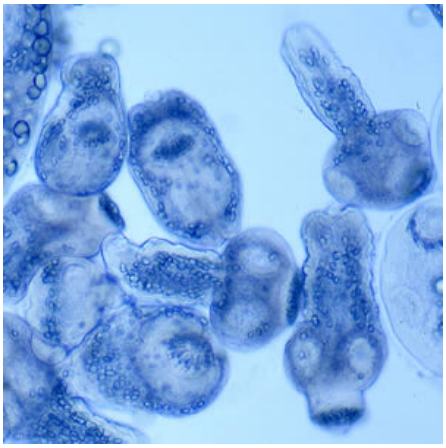

Figure 8: Protoscolices after releasing from hydatid.

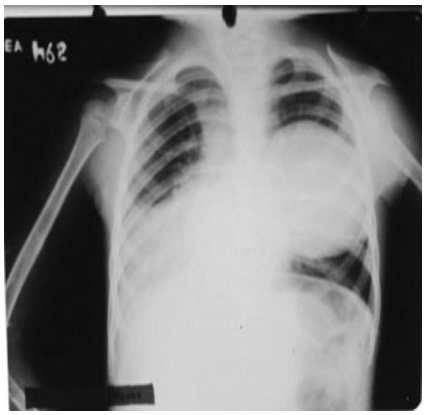

Figure 9: Chest radiograph of a 5-year old Peruvian girl with a hydatid cyst in the left lung field detected as part of an imaging survey in an endemic area.

Economic importance of hydatidosis

The impact of hydatidosis in livestock: Romazanov [66], stated that the effect of hydatidosis infection on host animal depends on the location of host organ. According to Sewell [2] hydatidosis cyst attack very important organs of meat animal like lung, spleen, liver, heart, kidney, and other organs. All organs affected by the cyst will not be consumed by humans as well as animals. In farm animals, hydatidosis causes considerable economic loss due to condemnation of edible organs, decreased meat and milk production, reduced hide and fleece value and decrease in fecundity [7,11,67]. Lungs and livers are highly infected organs and it cause's reduction in livestock production and condemnation of cyst contains offal during meat inspection [7] (Figure 10).

According to Endrias [6] in bovine hydatidosis survey at ambo municipal abattoir from 384 slaughtered cattle 114(29.69) was found positive for *Echinococcosis granulosus*. According to the author the direct economic loss was Ethiopian currency, birr 160032.23 annually. In each year hundreds of thousands organs condemned in the abattoir

during meat inspection due to whole or partial condemnation of the organ significant economical loss will be met. When this is estimated in terms of money, it can be recorded, hundred thousand of birr loss per year. It affects the country's economy in terms of local consumption meat quantity decrease and foreign trade income losses [68-69].

Figure 10: Photograph of fluid-filled hydatid cyst in bovine lung and hydatid cyst of liver [69,70].

Public impact of hydatidosis: The occurrence of the disease in humans in Ethiopia was described earlier by Graber. However, the situation of the disease in humans is not well documented and explored so far in the country. In the northern part of the country of the regional state of Tigray all the six hospitals pretending to this area had disclosed diagnosing one active clinical case in Mekelle hospital during the study period of 2008 [37]. Similarly in the southern part of Ethiopia, the existence of human hydatidosis was confirmed in south Omo region [71].

Echinococcosis creates problem and has greatest economic importance in Amhara region and in the tropics as a whole. According to Mwambete [4] the economic importance of hydatidosis estimated in terms of money recorded 492,600 birr loss annually during the study carried out for one year at Bahir Dar Abattior. The zoonotic character from public health aspects out of 36402 human patient admitted and examined in health centers with the help of ultrasound 24 (0.066%) of them were found positive for hydatidosis [68]. Direct loss estimate to be birr 3994.53 and indirect loss birr 264004.06 totally it would be birr 268035.59 [72].

The impact of hydatidosis varies with the location(s) of the cysts (Figure 11). When the cyst occurs in the liver, common symptoms include abdominal pain, nausea, vomiting and indigestion. If the cyst obstructs the biliary system, it can mimic gallstones and cause pain or cholestatic jaundice. Hepatomegaly, anemia, pleural pain, ascites and portal hypertension can also be seen. Cysts in the lungs are more likely to be clinically apparent while they are still small, compared to those in the liver. In the lungs, cysts can cause respiratory signs including chronic cough, chest pain, dyspnea and hemoptysis, particularly if they rupture. Abscess formation (from secondary bacterial infection of the cyst) and pneumothorax can also occur, and fragments of the capsule may cause arterial embolism. Neurologic signs, including blindness and seizures, may be seen if the brain or spinal cord is affected. Cysts in the bones can destroy the structure of the bone and result in spontaneous fractures. In the heart, a cyst can result in pericardial effusion, heart block or other arrhythmias, and sudden death. Cysts in any location may become secondarily infected by bacteria. *Echinococcosis granulosus* s. l. cysts can also be asymptomatic throughout the individual's life, and may be incidental findings at surgery or autopsy. Some cysts may die and not develop further [73].

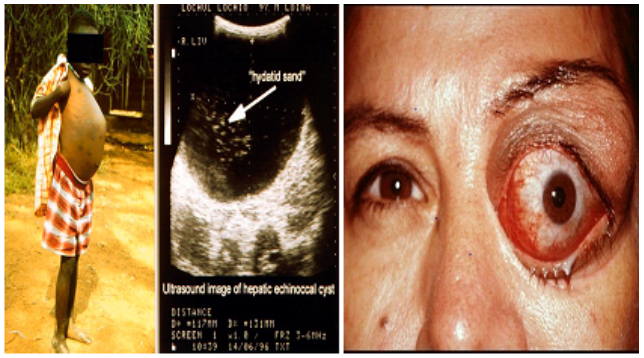

Figure 11: Boy with abdominal distention due to cystic *Echinococcosis* of the liver as shown by ultrasound imaging and a woman with exo ophalmos [74,75].

Prevention and control

There are no drug treatments available for intermediate hosts of animal and human. But human treatment can be conducted surgically and Careful removal of cyst can be conduct [76]. Cystic hydatidosis continues to be a substantial cause of morbidity and mortality in many parts of the world. Elimination is difficult to obtain and it is estimated that, using current control options, achieving such a goal will take substantial years of sustained efforts [35]. Dogs are essential in *E. granulosus* transmission to humans, and dog vaccination provides a very practical and cost-effective prevention strategy.

According to Bowman [57] there are different basic rules for prevention of hydatid like washing hands after handling dogs and before eating, smoking, restricting dogs to lick your own, or your children's faces. Applying and carrying strict meat inspection, restricting dogs to defecate near vegetables, gardens or children's play areas. Forbidding dogs to roam or gain access to carcasses of wild or farm animals through burying hydatid cyst infected organs. Treat the dogs at high risk with broad spectrum antihelmentic like Terazole or Niclosamide.

Conclusion and Recommendation

Hydatidosis is serious disease to mammals including man and also causes considerable economic loss in livestock due to condemnation of the organ, reduction in milk and meat productions, reduced hide and fleece value and decrease in fecundity. In human if one or both lungs affected, it will cause respiratory symptoms, and if several hydatid cysts are present in the liver there may be gross abdominal distention. If the cycle would rupture, this is a risk of death from anaphylaxis or if the person survives, released daughter cysts may resume developing other regions of the body. The risk of infection of humans by this parasite is high due to lack of hygiene in rural areas, the high infection rate of dogs, the high level of environmental, water and food contamination with *E.granulossus* eggs and the lesser awareness of the mode of transmission of the parasite by the community. Based on the above conclusion, the following recommendations are forwarded:

Deworming with antihelmentic in every six months should have to be practice and feeding with uncooked or untreated visceral offal's to dogs and canine specious should be stopped. Awareness about the parasitic character or treat and dissemination should have to be created to the community. Good personal hygienic practice with environmental hygiene protection through active community participation should be introduced and must be encouraged in all level. Backyard, open air and road side slaughtering practice should be prevented by implementing the law and regulation of meat inspection. All affected visceral offal's should be buried in a deep pit or destroyed by burning in order to prevent infection of farm animals and dogs. Detailed study should have to be done on the epidemiology and economic impact in Ethiopian condition.

Competing Interests

The authors declare that they have no competing interests.

References

1. Kebede W (2008) Echinococcusis/hydatidosis:its prevalence, economic and public health significance in Tigray region, North Ethiopia. Tigray Regional State Bureau of agriculture and rural development, Mekelle,Ethiopia. Faculity of veterinary medicine, Addis Ababa University, Ethiopia.
2. Sewell MMHB (1990) Hand book on animal disease in the tropics. 4th edn, Bailliere Tindal-London.
3. Urquhart GM, Armour J, Duncan JL, Dunn AM, Jennings FW, et al. (1996) Veterinary parasitology. 2nd edn, pp: 120-138.
4. Mwambete KD, Ponce GF, Cuesta BC (2004) Genetic identification and host range of the Spanish strains of Echinococcus granulosus. Acta Tropica 9: 87-93.
5. OIE (2008) Office International des Epizootics, OIE Terrestrial manual on diagnosis of hydatidosis/echinococcosis. France, pp: 175-186.
6. Endrias Z, Teshome Y, Wakwoya A (2010) Bovine hydatidosis in Ambo Municipality abattoir,West Shoa, Ethiopia. Ethiop Vet J 14: 1-14.
7. Mahedra P, Bulto G (2012) Echinococcosis: A Helminthic Zoonosis of Increasing Concern. Journal of Natural History, India 8: 25-28.
8. FAO (1982) Guideline for surveillance, prevention and control of echinococus/ hydatidosis. Food and Agriculture organization of the united nation Rome. J Production and health paper 29: 20-21.
9. Oku Y, Malgorb R, Benavidezb U, Carmonab C, Kamiyac H, et al. (2004) Control program against hydatidosis and the decreased prevalence in Uruguay. International Congress Series 1267: 98-104.
10. Soulsby CJC (1982) Helminthes, Arthropods and Protozoa of Domestic Animals. 7th edn, Philadelphia, Lea and Febiger, USA, p: 123.
11. Polydorou K (1981) Animal health and economics. Case study: echinococcosis withreference to Cyprus. Bul Int Epz 93: 981-992.
12. Macpherson CNL, Spoerry A, Zeyhle E, Romig T, Gorfe M, et al. (1989) Pastoralistsand hydatid disease: an ultrasound scanning prevalence survey in East Africa. Transact Royal Soc Trop Med Hyg 83: 243-247.
13. Abebe F, Yilma J (2011) A synthesis report of previous surveys in infection prevalence of hydatidosis (Echinococcus granulosus, Batsch, 1786) in domestic animals in Ethiopia. Ethiopian Vet J 15: 11-33.
14. Klungsoyr P, Courtright P, Hendrikson TH (1993) Hydatid disease in theHamar of Ethiopia: a public health problem for women. Transact. Royal Soc Trop Med Hyg 87: 254-255.
15. Minas M, Biluts H, Bekele A, Alemie M (2007) surgical management of 234 patients with hydatid disease: The Tikur Anbessa Hospital experience. Ethiop Med J 45: 257-65.
16. Putt SNH, Shaw APM, Tylar L, Jame AD (1987) Veterinary epidemiology and economics in Africa. International Livestock Center for Africa. Revue Elev Med Vet Pays Trop 1: 13-95.
17. Hagos Y (1997) Hydatidosis (Echinococcosis): Prevalence and Economic Impact in Bovine at Mekelle Municipal Abattoir; Zoonosis and infection in dogs Mekele-Tigray. DVM Thesis, Addis Ababa University Faculty of veterinary medicine, Debre Zeit, Ethiopia.
18. Matossian RM, Rickard MD, Smyth JD (1977) Hydatidosis: a global problem of increasing importance. Bulletin of the WHO, 55: 499-507.
19. Bhattacharya D, Bera BC, Maity A, Das SK (2006) Genotypic characterization of Indian cattle, buffalo and sheep isolates of Echinococcus Granulosus, Vet Parasitol.
20. Seimenis A (2003) Review article: Overview of the epidemiological situation on echinococcosis in the Mediterranean region. Acta Tropica 85: 191-195.
21. Mukbel RM, Torgerson PR, Abo Shehada MN (2000) Prevalence of hydatidosis among donkeys in northern Jordan. Veterinary Parasitology 88: 35-42.
22. Small LM, Pinch DS (2003) Survey for hydatidosis in cattle bred in the northern region of the territory of Australia. Aust Vet J 81: 355-358.
23. Moro P, Schantz PM (2006) Cystic echinococcosis in the Americas. Parasitology International 55: S181-S186.
24. Zanini F, Gonzalo R, Perez H, Aparici SX, Guerrero J, et al. (2006) Epidemiological surveillance of ovine hydatidosis in tierra del fuego, Patagonia Argentina, 1997-1999. Vet Parasitology 138: 377-381.
25. Lahmar S, Chehida FB, Petavy AF, Hammou A, Lahmar J, et al. (2006) Ultrasonographic screening for cystic echinococcosis in sheep in Tunisia, Veterinary Parasitology.
26. Sotiraki S, Himonas KP (2003) Hydatidosi-echinococcosis in Greece. Acta Tropica 85: 197-201.
27. Sadjjadi SM (2006) Present situation of echinococcosis in the Middle East and Arabic North Africa. Parasitology International 55: S197-S202.
28. Sharbatkhori M, Mirhendi H, Fasihi HM, Rezaeian M, Mohebali M, et al. (2009) Echinococcus granulosus genotypes in livestock of Iran indicating high frequency of G1 genotype in camels. Experimental parasitology.
29. Ansari Lari ML (2005) A retrospective survey of hydatidosis in livestock in Shiraz, Iran, based on abattoir data during 1999-2004.Veterinary Parasitology 133: 119-123.
30. Waikagul J, Dekumyoy P, Malinee TA (2005) Taeniasis, cysticercosis and Echinococcus in Thailand. Parasitology, pp: 1-6.
31. Shaafie IA, Khan AH, Rambabu K (1999) Biochemical profiles of hydatid cyst fluids of Echinococcus granulosus of human and animal origin in Libya. Journal Helminthology 73: 255-258.
32. Magambo J, Njoroge E, Zeyhle E (2006) Epidemiology and control of echinococcosis in sub-saharan Africa. Parasitology International 55: S193-S195.
33. Andrson FF (1997) Compendium on cystic echinococcosis in Africa and Middle eastern countries with special reference to morocco, 1st edn. Brigham Young University, USA.
34. Simsek S, Koroglu E, Dumanli N, Aktas M, Cmel SCE, et al. (2005) Seroprevalence of cattle hydatidosis in some districts in the East Anatolian Region of Turkey. Turkey J Vet Anim Sci 29: 1305-310.
35. Craig PS, McManus DP, Lightowlers MW, Chabalgoity JA, Garcia HH, et al. (2007) Prevention and control of cystic echinococcosis. Lancet Infectiou Disease 7: 385-394.
36. Cringoli G, Rinaldi L, Musella V, Veneziano V, Maurelli MP, et al. (2007) Georeferencing livestock farms as tool for studying cystic echinococcosis epidemiology in cattle and water buffaloesfrom southern Italy. Geospatial Health 2: 105-111.
37. Kebede N, Abuhay A, Tilahun G, Wossene A (2009) Financial loss estimation,prevalence and characterization of hydatidosis of cattle slaughtered at DebreMarkos Municipality abattoir, Ethiopia. Trop Anim Health Prod 41: 1787-1789.
38. Dasie SH (1992) Economical significance of bovine hydatidosis, faciolasis and cysticercosis at Asela Abattoir. AAU, FVM, DVM Thesis. Debre ziet, Ethiopia.
39. Woubet M (1988) A Preminary study on Echinococcusis in Harage region and the efficacy of Glinus lotidus seeds against Echinococcosis

granulosus in pups infected experimentally with hydatid material.AAU, FVM, DVM Thesis Debre Zeit, Ethiopia.

40. Getaw A, Beyene D, Ayana D, Megersa B, Abunna F, et al. (2010) Hydatidosis: Prevalence and its economic importance in ruminants slaughtered at price of organs and mean annual slaughter rate in Adama municipal abattoir, Central Oromia, Ethiopia. Acta. Trop 113: 221-225.
41. Bersissa K (1994) Hydatidosis in Nekemte: Prevalence in slaughtered cattle and sheep, estimated economic loss and incidence in stray dogs. AAU, FVM, DVM Thesis. Debre Zeit, Ethiopia.
42. Getachew J (1991) The prevalence of hydatidosis in cattle at Awassa abattoir. AAU, FVM, DVM Thesis Debre Zeit, Ethiopia.
43. Fikre L (1994) An assessment trail of its prevalence, economic, and public health importance. Echinococcosis/Hydatidosis in Konso (Southern Ethiopia), AAU, FVM, DVM Thesis. Debre Zeit, Ethiopia.
44. Nigatu K, Abebe M, Getachew T (2009) Hydatidosis of slaughtered animals in Bahir Dar abattoir, North Western Ethiopia. Trop Anim Health Prod 41: 42-50.
45. Yilkal A (1989) Hydatidosis in cattle, sheep and pigs; Cysticercus Tenuicollis in sheep around Dessie and the efficacy of Hgenia abyssinyca (Kosso) on Taenia hydatigenia. AAU, FVM, DVM Thesis. Debre Zeit, Ethiopia.
46. Kebede N (2010) A retrospective survey of bovine hydatidosis in three abattoirs of Amhara National Regional State, northwestern Ethiopia. Trop Anim Health Prod 42: 323-325.
47. Harding C (2005) Clinical Signs are an Interaction of Host, Agent and the Environment. Swine Production Medicine.
48. Noone P (2008) Agent, host and environmental interactions. Oxford Journals 58: 158.
49. Thompson RCA, Lumbory AJ, Thomson RCA, Lymbeny AJ (1995) Biology and systematic of echinococcus, Echinococcus and hydatid disease. CAB international Wallingford, UK, pp: 1-20.
50. Eckert J, Deplazes P (2004) Biologicalpidemiological and cinical aspects of Echinococcusis a zoonoses of increasing concern. Clin Microbio Rev 17: 117-465.
51. Heinz Sager (2001) The little dangerous fox tapeworm and how he came to the dog. Institute of Parasitology University of Bern, Switzerland.
52. Mike Breunig (2009) Echinococcus granulosus A Parasitic Tapeworm.
53. D Alessandro A, Rausch RL. (2008). New Aspects of Neotropical Polycystic (Echinococcus vogeli) and Unicystic (Echinococcus oligarthrus) Echinococcosis. Clinical Microbiology Reviews 21: 380-401.
54. Moro P, Schantz PM (2008) Echinococcosis: a review. International Society for Infectious Diseases.
55. Thompson RCA, Allsopp CE (1988) Hydatidosis: veterinary perspectives and annotated bibliography.
56. Harkin J (2009) Published and Authorised by: Department of Environment and Primary Industries. Melbourne, Victoria.
57. Bowman DD (1995) Georgis Parasitology for Veternarians. 6th edn / Dwigh D Bowman, with a chapter on ant parasitic drug by Randy Carl Lynn pp: 129-150.
58. Soulsby EJL (1986) Helminths, Arthropods and Protozoa of Domesticated Animals (M'o'nnig) 7th edn. Bailliere Tinidall, London, pp: 119-124.
59. Gemmell MA, Lawson JR (1986) The epidemiology and control of hydatid disease. The biology of Echinococcus and hydatid disease. Allen and Unwin, London 1: 9-216.
60. DPDx (2016) Echinococcosis Global Health Division of Parasitic Diseases and Malaria Notice.
61. Pal M (2007) Zoonosis. 2nd edn. Satyam Publishers, Jaipur, India, pp: 234-235.
62. Bernthaler P, Epping K, Schmitz G, Deplazes P, Brehm K, et al. (2009) Molecular Characterization of EmABP, an Apolipoprotein A-I Binding protein secreted by the Echinococcus multilocularis Metacestode. Infection and Immunity, pp: 5564-5571.
63. Zhang W, Li J, McManus DP (2003) Concepts in Immunology and Diagnosis of Hydatid Disease. Clinical Microbiology Reviews 16: 18-36.
64. Moro PJ, McDonald RH, Gilman B, Silva M, Verastegui V, et al. (1997) Epidemiology of Echinococcus granulosus infection in the central Peruvian Andes. Bulletin of the WHO.
65. Payne WJA (1990) An introduction to animal husbandry in the tropics. 4th.edn, Rib.
66. Romazanov VT (1983) Evaluation of economic losses due to echinococcosis. In: Zoonosis control: collection of teaching aids for international trainingcourse. Centre of International Projects GKNT, Moscow 2: 283-85.
67. Abebe MA (2007) Prevalence of economic and public health significance of hydatidosis /Echonicoccus at Bahir Dar. Msc thesis, Aklilu Lema Institute of Pathology, Addis Abeba University, Ethiopia.
68. Gareth (2007) Helminth and Helminthiasis of domestic and wild animals in Ethiopia.
69. Science photo library. Hydatid cyst of liver. http://www.sciencephoto.com/media/257630/view.
70. Jobere Y, Labag F, Tirone R, Abebe G, Dorchies P, et al. (1996) An assessment trial on prevalence, economic and public health importance of hydatidosis in three selected regions of Ethiopia. Med Vet 147: 797-804.
71. Teketay W, Asmare M, Muluken M, Mingistu M (2009) Prevalence of economic and public health importance of Echinococcus hydatidosis in Bahir Dar slaughter house. Ethiopia.
72. Iowa state university (2011) Echinococcosis. The center for food security and public health. New York, USA.
73. Moro Pedro M Schantz Peter (2008) Echinococcosis: A Review. International Journal of Infectious Diseases 13: 125-33.
74. Trivedi A, Garg AK, Hiran S (2015) Partial thickness autologus calvarial bone orbitocranioplasty for a sphenorbital encephalocele presenting as pulsatile exophthalmos. Asian J Neurosurg.
75. Rue J, Donald RM (1974) Disease of feedlot cattle. 2th edn. Lea and Febiger Filadelphia, USA.