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Characterization of Hydatid cyst in cattle slaughtered at Adama Municipal Abattoir, Ethiopia

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Abstract

A cross-sectional study was conducted at Adama Municipal Abattoir from November 2011 to April 2012 with the aim to localize and characterize hydrated cysts based on their size, fertility and viability rate. Cysts were collected from the lung, liver, spleen, heart and kidney of 316 cattle infected with the diseases following slaughter fertility of the cysts was determined by examination of cyst fluid for the presence of brood capsules congaing the protoscolices or hydrated sands or freely existence of protoscolices resulted from the rupture of the cyst. Anatomically, the cysts were distributed with the proportion of 76.6% in the lungs, 22.92% in the liver 0.20% in the spleen, 0.125 in the heart and 0.08% in the kidney. The numbers of cysts obtained from a single lung ranges from 1-29 size assessment made on 2604 cysts indicated that 1266 (48.62%) were small, 1076 (41.41%) were medium and 262 (9.97%) were large sized cysts. Cyst fertility assessment yielded 201 (55.84%) sterile, 31 (8.61%) fertile, and the rest 128 (35.55%) were classified cysts. The fertility rates of hepatic cysts of cattle were 7 (1.94%) and that of pulmonary cysts were 24 (6.67%). This result indicates us that in cattle the fertility rate of cysts in the lung was higher than in liver. From the fertile cyst subject to viability test, 17 (54.84%) of viable cysts were recorded from the lung whereas 2 (6.45%) from the liver and the rest organs no viable cysts were found.

Keywords: Adama, Abattoir, Calcification, Fertility, Hydatid Cyst, Size, Sterility, Viability.

Introduction

Ethiopia possesses the largest livestock population in Africa, with an estimated population of 47.5 million heads of cattle, 7.8 million of equines, 1million of camels 39.6 million of chickens, 23.62 million of sheep and 23.33 million of goats [1]. However, this extensive livestock resource is not fully exploited. Because of many constraints of which poor animal production and management, improper evaluation of public health importance due to virus individual parasitic disease and adequate knowledge of the epidemiology of the diseases determine the type and scope of control measures of be applied [2].

Parasites in the tropics are responsible for greater losses to the meat industry than any other diseases that parasites disease are among the major factors responsible for the low productivity of the livestock in Ethiopia [3,4]. Hydatidosis/echinococcus is cosmopolitan zoonosis caused by larval stages of cestode belonging to the genus Echinococcus (family taeniidae). Larval infection/ hydatidosischaracterizzed by long term growth of metacestod (hydatid cysts) in the intermediate host [5].

Hydatidosis, constitutes public health problems worldwide, and causes a particularly heavy burden in developing countries [6]. Recently four species of the genus Echinococcus are regarded as valid taxonomically, *Echinococcus granulosus, Echinococcus multilocularis, Echinococcus oligarthrus* and *Echinococcusvogeli*. However, genus Echinococcus contains two species of special importance to veterinary medicine, *E. granulosus* and *E.multilocularis*, which are very small. Adult tape worm are having only four to five segments of which only the terminal segment is gravid [7].

The entire length of *E. granulosus* is only about 6.0 mm long, and is therefore difficult to detect/find in the freshly opened intestines. It consists of a scolex and three or four segments, the terminal gravid one occupying about half the length of the complete tapeworm. The scolex is typically taeniid and rostellum has two hooks, varying from 30-60 in numbers. Each segment has a single genital opening, with the penultimate segment sexually mature and the segment gravid. The genital pores altemate irregularly. The eggs are typically taeniid and measure 32-36 x 25-30 and the embrophore is radically striated with six-hooked oncosphere. The cyst capsule consists of an outer membrane and inner germinal epithelium from which, when cyst growth is almost complete, brood capsule each containing a number of scolices are budded off. Many of these capsules become detached and exist free in the hydtid fluid; collectively these and the scolices are often referred to as hydatid sand; Sometimes, complete daughter cysts are formed either inside the mother cyst or extremely; in the latter case they may can carried to other parts of the body to form new hydatids [8].

The distribution of *E. granulosus* is higher in developing countries especially in rural communities where there is close contact between the dog, definitive host, and various domestic animals, which may act as intermediate host [6, 9]. *Echinococcosis multilocularis* is a very small tapeworm (2-4 mm) and is generallly similar to *E. granulosus*, but usually with three to five segments, the terminal one measuring less than half the length of the whole worm. The scolex has four suckers and possesses a double row of large and small hooks. The third segment of the adult tapeworm is sexually mature and genital pores are in front of the middle of each segment. The uterus is sac-like with lateral calculations in the terminal proglottid. Gravid segments contain about 200-300 spherical eggs that are shade have a diameter of about 30-40 the structure of a germinative gelatinous matrix that forms multiple compartments [8].

At the anterior aend is a scolex or hed. The scolex usually posseses four suckers which sometimes are armed with hooks. It is joined to the rest of the body or strobila by short neck. The strobila consists of several segments or proglottids, each of which contains one or two sets of reproductive organs (male and female). These proglottids are formed from the neck and when gravid contains hundreds of eggs. The female organ consists of one or two ovaries, uterus, vagina, seminal receptacle and vitellaria or yolk gland. The male organs, which develop first, comprise a large number of tests, a vas deferens and a cirrus or penis female and male genital pores lie close together on the ventral or lateral side of the proglottids [10].

The eggs are ovoid (30-40 in diameter) , consisting of a hexa canth(oncosphere, first larval stage) surrounded by several envelops, the most noteable one being the highly resistant keratinized embrophore, which gives the egg a dark striated appearance. The outer capsule quickly disappears once the eggs are librated from the host. The eggs of Echinococcus are morphologically indistingushable to those of tape worms of the genus taenia [11]. Once the oncosphere has reached its final location, it develops into the metacestode stage. Time of development is variable and it may take several months before protoscoleses are produced (fertile Meta cestode). There may be several thousand protoscoleces within a single cyst of E. granulosus. Each single protoscolex is capable of developing in to a sexually mature adult worm. The Meta cestode (second larval stage) consists of a bladder with an outer a cellular laminated layer and an inner nucleatd germinal layer, which may give rise by asexual budding to brood capsules. The structure and development of the Meta cestode differs between the four species of Echinococcus. Not all Meta cestodes produce protoscoleces (sterile Meta Cestode) [12].

In the typical dog-life cycle, tape worm eggs are passed in the faeces of an infected dog and may subsequently be ingested by grazing animals; they hatch in to embryo in the intestine, penetrate the intestinal lining, and are picked up and carried by blood throughout the body to major filtering organs(mainly liver and lungs). protoscolices attach to the dog`s intestinal lining and, in approximately 40-50 days, grow and develop in to mature adult tapeworms, onces again capable of producing infective eggs to be passed in to the outside environment with the dog`s

feces. A hydatid cyst grows slowly and usually takes several years to develop to a size, where they may cause disease and symptoms in animals. Fertile cysts may occur within about 10-12 months in pigs, 2-4 years in sheep (but only 50% of E. granulosus cysts are fertile by 6.65 years). Cysts are rarely fertile in cattle in most countries, except where the cattle where the cattle strain is present [13].

There is great variation in size, shape and location of hydatid cyst in animals; this is not only because of host factors but also due to the strain of E. granulosus involved. In those cases where there is a good host parasite relationship, such as with the sheep and horse strains of the parasite in their respective intermediate hosts, the initial host cellular response is limited and quickly resolves in to a fibrous capsule. However, in `abnormal` intermediate hosts such as the sheep strain in cattle the cellular response may be quite severe resulting in degeneration of the parasite and/or calcification [14].

There is no simple and satisfactory technique available for ante mortem diagnosis of Echinococcusis in domeestic or wild animal such as immunodiagnostics. Hydatidosis in food animal is detected by post morten examination and inspection of visceral organs such as lungs, liver, and kidney [15]. A thorough meat inspection procedure requires two steps. Ante mortem and post mortem inspection. The importance of ante mortem inspection in the abattoir has long been recognized in an attempt to avoid the introduction of clinically diseased animals in to the slaughter house and should be done within 24hrs of slaughter and repeated if slaughter has been delayed over a day [16,17].

The purposes of meat inspection, comprising of ante mortem and post mortem examination, are to remove gross abnormally from meat and its products, prevention of distribution of contaminated meat that could result to diseases risk in man and animals and assisting in detecting and eradication of certain of certain disease of livestock [18]. As meat is the main source of protein to man, it should be clean and free from diseases of particular importance to the public such as tuberculosis, Hydatidossis, cysticercosis, and fasciolosis [19].

A proper ante mortem inspection of the animals makes the task of routine post mortem inspection simpler and straight forward procedure [10]. Post mortem inspection is the center around which meat hygiene revolves since it provides information of on indispensable for the scientific evaluation of clinical signs and pathological processes that affect the wholesomeness of meat [10, 20].

All gross lesion should be identified at least in a general way. A routine post mortem inspection of a carcass or an organ should be carried out as soon as possible after completion of dressing. The main purpose of post mortem examination is detect and eliminate abnormalities, including contamination, thus ensuring that only meat fit for human consumption is passed for food [10]. It is necessary to be aware of the extent to which the public is exposed to certain zoonotic diseases detected in abattoirs [21]. The objectives of this study were to Characterize hydatid cysts based on their size, fertility and viability rates and to asses localization of the cysts.

Materials and Methods

Study Area

The study was conducted at Adama municipal abattoir, which is situated in Adama town, East shoa zone of Oromia Regional state (central Ethiopia) from November 2011 to April 2012. Adama is located 99 km south East of Addis Ababa, at 39.17^0N latitudes and 8.31E longitudes with an altitude of1770 meters above sea level. It is situated in the well-known East Africa Rift Valley. It has an annual rain fall ranging between 400-800mm of which 84% fall in long rain season (June to September). The dry season extends from October to February. The mean annual minimum and maximum temperature is 13.9%c, and 27.7^0c, respectively [22].

Study Animals

The study animal consists, cattle of both sexes that were slaughtered during the study period. Most of the cattle slaughtered at the abattoir were adult males and few young males of local zebu type, which come from different parts of the country like Borena, Bale, Arsi, Hararghe and different locations of East Shoa, including AdamaWoreda.

Study Design

A cross- sectional study type was conducted from November, 2011 to April, 2012 at Adama Municipal Abattoir to collect data on events associated with hydatidosis in cattle using post mortem meat

inspection. Moreover, when hydatid cysts are encountered, they were recorded.

Sampling method and sample size determination

During post mortem examination all positive castles offal's for hydatidosis were examined purposively with an intention for characterization of the hydatid cysts.

Study Methodology

Post Mortem Examination

During each visit, visceral organs particularly from thoracic and abdominal cavity especially of the lung, liver, heart, kidney and spleen were systematically inspected for the presence of *hydatid cysts* and recorded after evisceration of the visceral organs. The infected organs from each positive animal were collected; the total number of hydatid cysts were counted per infected organ and recorded. The size of the diameter of collected hydatid cysts was measured using ruler and classified as small cyst (if the diameter of the cyst is less than 4cm), medium cyst (if the diameter of the cyst is between 4-8cm) and large cyst(if the diameter of the cyst is greater than 8cm in diameter) [23, 24].

Fertility and Viability Test

Fertility Test

Cysts collected and transported using ice box to the Addis Ababa University, Faculty of Veterinary Medicine, Debre-Zeit for laboratory examination. Soon on the arrival, it was incubated at 37^0c for 15-20 minutes to maintain the normal environment for the cyst or to prevent the death of the protoscolices. The fertility test for hydatid cyst was performed in three different ways. The flesh parts that remain on the cyst was carefully and thoroughly sliced-off using scaple blade and then placed on the petridish and observed under the stereo microscope for the presence of hydatid sands that appeared as glistening sands.

The fluid was aspirated by sterile syringe and poured in to the clear test tubes and were centrifuged at 1500 rpm for 3 minutes. The supernatants discarded and the sediments were placed on the center of clear slide, covered with slip and examined under 40x magnification power for the presence of protoscolices that appear as white dots. Lastly, the fluid of the cyst is discarded carefully by dissection and the sands on the germinal epithelium are appreciated by naked eye which resembled as whitish to yellow in color and felt fine solid when palpated in between the thumb and the 4^{th} finger of gloved hand.

Viability Test

Fertile cysts were subjected to viability test. A drop of sediment containing the protoscolices were placed on the microscope glass slide and covered with cover slip and observed for amoeboid like peristaltic movements (flame cell activity) with 40x objectives. for clear vision a drop of 0.1% aqueous eosin solution was added to equal volume of protoscolices in hydatid fluid on microscope slide with the principle that viable protoscolices should completely or partially exclude the dye while the dead once take it up [25].

Furthermore, infertile cysts were classified as sterile or calcified. Sterile hydatid cysts were characterized by their inner lining usually with slightly turbid fluid in its content. Typical calcified cysts produce a gritty sound feeling up on incision [7].

Data Analysis

The data collected were entered in to M-Excel 2007 and coded for analysis. The results were analyzed with STATA 2011 version and the numbers of infected organs by hydatid cysts were calculated. And in addition hydatid cysts based on their size and their relations with organ involvement and their proportion were determined and finally their fertility, sterility, classification and viability rate of cysts were assessed.

Results

A total of 316 cattle at Adama municipal Abattoir were found to harbour 2604 hydatid cysts and these cysts were found to localize in five different organs in various numbers and size during the study period. A total number of 445 organs were found to be infected by the cysts; of which 308 were lungs, 127 liver, 5 spleens, 3 Heart and 2 kidneys. This finding is illustrated as follows.

Table 1. Total number of infected organs recorded out of 316 affected cattle during the study period.

Examined Organs	Organs infected by the cyst	Total No of infected organs
316	Lung	308
	Liver	127
	Spleen	5
	Heart	3
	Kidney	2

It is not uncommon to see organs harbouring one or more hydatid cysts and one or more organ were also recorded to be involved simultaneously. Anatomically the cysts were located themselves in various organs and they are found in different size (as small cyst, medium cyst and large cyst). This finding is discussed as follow (table.2).

Table 2. Characterization of hydatid cysts based on their size and their relation with organ involvement.

Cyst location	Large cysts No (%)	Medium cysts No (%)	Small cysts No (%)	Total No(%)
Lung	229 (8.78)	841 (32.30)	927 (35.60)	1997 (76.68)
Liver	31 (1.19)	230 (8.71)	336 (12.9)	597 (22.92)
Spleen	2 (0.08)	3 (0.12)	0 (0.00)	5 (0.20)
Heart	0 (0.00)	1 (0.04)	2 (0.08)	3 (0.12)
kidney	0 (0.00)	1 (0.04)	1 (0.04)	2 (0.08)
Total	**262(9.97)**	**1076(41.41)**	**1266(48.62)**	**2604(100.00)**

Of the 2604 cysts recorded during the study period, only 360 cysts were subjected for characterization as sterile, fertile, and calcified. Following the study; the cysts were found to be fertile, sterile and calcified with 8.61%, 55.84% and 35.55% respectively. This result is indicted below in (table.3)

Table. 3. Characterization of cysts based on their fertility, sterility and calcification rate

Infected organs	fertile cysts No (%)	sterile cysts No (%)	Calcified cysts No (%)	Total No
Lung	24 (6.67)	174 (48.33)	13 (3.61)	211
Liver	7 (1.94)	18 (5.00)	114 (31.67)	139
Spleen	0 (0.00)	5 (1.39)	0 (0.00)	5
Heart	0 (0.00)	2 (0.56)	1 (0.28)	3
kidney	0 (0.00)	2 (0.56)	0 (0.00)	2
Total	**31 (8.61)**	**201 (55.84)**	**128 (35.55)**	**360**

During the study period, the statuses of the cysts were identified as viable cyst (active) and non-viable cyst (dead) up on fertility and viability (0.1%) Eosin exclusion) test. Following the test. 19 (61.29%) were found to be viable cyst and 12 (38.71%) were non-viable.

Table 4 Characterization of hydatid cysts on the basis of their viability rate.

Infected organs	viable cysts No (%)	Non viable cysts No (%)
Lung	17 (54.84)	7 (22.58)
Liver	2(6.45)	5(16.13)
Total	**19 (61.29)**	**12 (38.71)**

Discussion

Meat inspection is conducted in the abattoir for the purpose of screening and removing animal products with abnormal pathological lesions unsafe for human consumption and having poor aesthetic values. An important function of meat inspection is to assist in monitoring diseases in the national herd and flock by providing feedback information to the veterinary service to control or eradicate diseases and to produce wholesome products and protect the public from zoonosis hazards [19].

In this study, it has been estabilished that hydatid cysts occur predominantly in the lung and liver with the percentage of 76.68 and 22.92 respectively. This is explained by the fact that lungs and liver possesses the first greater capillaries sites encountered by the migration of Echinococcusoncosphere (hexacanth embryo) which adopt the portal vein route and primarily negotiate hepatic and pulmanary filtering system sequentially before any other peripheral organ is involved. However, developments of hydatid cysts occur occasionally in other organs tissues when oncosphere escape in to the general systemic circulation [26].

According to this study, hydatid cyst is higher in the lungs followed by liver, spleen, heart and kideny. It was also suggested that particularly the lung is the organ most affected by *hydatidosis*because at old age the liver capillaries are dilated and most cysts passed directly to the lung; secondary the cyst passes to the lung via the thoracic duct without involving the liver [10].

A maximum of 29 medium cysts were recorded from a single lung. A much superior results were previously reported by Tamene [27] which was 132 cysts per organ. Such variation in cyst abundance on an organ is explained as probably to the spatial distribution and infectivity of *Echinococcus oncosphere* [28] and to the susceptibility and defensive capabilities of the host (Macpherson, 1985). Of the total 2604 cysts recorded during the study time, 262(9.97%) were large, 1076 (41.41%) were medium and 1266 (48.62%) were small sized cysts. However, this result were disagree with the results of [29] with their result being 153 (78.46%), 41 (21.03%) and 1 (0.51%); large, medium and small cysts respectively from the total of 195 hydatid cysts; but, it slightly agree with the results of [30] to be 471 (69.26%), 140 (20.59%) and 69 (10.15%) small, medium and large cysts out 680 total hydatid cysts respectively. But it contradict with the report of [31]; who found out the result of 64 %(small), 11.4 % (medium) and 1.7% large cysts out of a total of 1479 hydatid cysts.

Higher numbers of small, medium and large cysts were found in the lungs than liver whereas the liver harbored higher number of calcified cysts. The reason for higher percentage of medium and large cysts in the lung is due to softer consistency of the lung while higher number of calcified cysts in the liver could be attributed to relatively higher reticulo-endothelial 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 host, which might preclude expansion of cyst size [32].

Out of the total 360 cysts examined, 201 (55.84%) were sterile, 128 (35.55%) were calcified and 31 (8.61%) were fertile cysts of which 19 (61.29%) were viable and 12(38.71%) none viable cysts. This result was somewhat concomitant with the report of other findings [30] in Ambo who found out 31.39%, 53.28% and 15.33% to be fertile, sterile and calcified cysts, respectively. Similarly it agrees with that of Zelalem *et al*. [31] in Addis Ababa with that of sterile cysts accounted for 55.4% but not in case of fertile and calcified cysts being 19.3%, 25.3%, fertile and calcified cysts respectively from 1479 total hydatid cysts. The finding of this study generally implied that most of the cysts recovered from cattle were sterile.
Evaluation of the condition of hydatid cysts revealed that the rates of sterility, fertility and viability of the cyst varied among different organs. The fertility and viability rate were higher among the cysts of the lung 24 (6.67%) and 17 (54.84%) respectively. This is attributed to the relatively softer consistence of the lung that allow easier development of the pre-sorted cyst and the frowsy of legated cysts may show a tendency to increase with advanced age, that may be related with reduced immunological compatibility of the hosts at their old age of infection. This may be associated with the relatively higher reticulo endothelial cell and abundant connective tissue reaction of the organ [28]..

Conclusion and Recommendations

The present study show much higher infection rate of hydatid cyst in the lungs of slaughtered cattle. In addition higher numbers of cysts in different organs

with different size were recorded. Among the different offal`s the lungs and liver consisted of the major proportion of the cyst counted. Most fertile cysts were also recorded from the lungs of slaughtered animals where by it is the inedible portion of the offal`s. All the above information suffice that lung is the most frequently disposed organs that may increase the chance of access by the dog. The fertility and viability rate of hydatid cyst is higher in the lungs than any other organs and hence infection may cycle from cattle to dog and vice versa. Finally; the disease is difficult to control due to back yard slaughtering, lack of adequate meat inspection and the habit of provision of raw offal`s especially the lung, which mostly harbours live/ viable protoscolices to their dogs.

In view of the present findings and available information, the following recommendations are suggested;

- Efficient meat inspection procedures with effective disposal of rejected meat and offal`s should be available
- Stray dogs should be controlled to prevent the risk of hydatidosis to farm animals
- Enforcement of legislation that will put an end to back yard and road side slaughter practice by giving efficient public education on its the adverse effect should be exercised
- Laboratory rooms with adequate equipment and instruments with appropriate reagents which are used to detect fertility and viability of the cyst should be fulfilled.

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