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Occurrence, Zoonosis, Risk Factors and Effect of Swine Hydatidosis in Pigs Slaughtered at Addis Ababa Municipal Abattoir (AAMA)

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Abstract: A cross sectional study was conducted from November 2011 to April 2012 to determine the prevalence of swine hydatidosis in pigs slaughtered at Addis Ababa municipal abattoir (AAMA), in central part of Ethiopia.. A total of 384 pigs were randomly sampled and examined after slaughter for the presence of hydatid cysts in the visceral organs (lung, liver and heart) and on muscles of the animals using the standard meat inspection procedures, where 65 (16.9 %) were positive. The positive samples were taken to the laboratory for the cyst identification where fertility and viability test were performed during the study periods. Analysis of risk factors for occurrence of the disease revealed that there was statistically significant variation ($p < 0.05$) in animals from different origins and age groups. However, significant variation was not observed ($p > 0.05$) in the difference of sex and body condition scores. The proportions of organ infected were 10.68 %, 4.94 %, 0.78 % and 0.52 % in the liver, lung, heart and muscle, respectively. From the total 65 examined cysts for fertility and viability tests, they were7.3 % calcified, 6 % sterile and 3.6 % fertile cysts. With regard to the size of cysts, mean cyst size were 1.74 ± 1.20cm, 3.28 ± 1.88cm, 1.2 ± 0.72cm and 1.4 ± 0.70cm in diameter for liver, lung, heart and muscle, respectively. In the study area, swine hydatidosis is indicated as the potential hazard to the human population and the intermediate hosts.

Key words: Hydatidosis · Prevalence · Pigs · Postmortem · Cyst Size · AAMA

INTRODUCTION

The raising of livestock is an important and often the main source of income for millions of small holders' farmers in Africa. The role of livestock in food security and food self-sufficiency in the highland production system; hundreds of millions of people depend on animal power for cultivation, planting, weeding, threshing and transporting. In Ethiopia, the contribution of livestock and livestock products to the agriculture is about 30 % and to export earnings about 19 % [1].

Although the Pig population is greater in Asia and Tropical America than Africa and Europe, it is certain that pig meat constitutes a very important source of protein. In Africa the human population is increasing yet the traditional source of meat is stagnant; thus, other animal production systems must be developed to meet the meat requirements of the growing population [2]. The primary purpose of pig farming all over the world is the production of meat, including pork, bacon or fat and secondary considerations are; the production of pigs'skin bristles and manure. In tropics; fresh pork has always been and continues to be the most important types of pig's meat but elsewhere processed meat is produced in large quantities; probably because pigs flesh can be more effectively preserved with salt than other type of meat. Processed pork is now finding a ready acceptance among many consumers in tropical countries and consumer preferences are slowly changing everywhere as industrialization advances [3].

One of the major problems confronting pig producers in the tropics particularly in humid region is due to the presence of high mortality rate; for example: it has been reported from the Philippines that the mortality rate from birth to maturity is approximately 50 % [3]. Disease and parasite problems cause millions of dollars in losses each

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year in the US swine industry [4]. In developing countries including Ethiopia; swine production has little benefit due to under developed infrastructure coupled with poor genetic performance, inadequate nutrition, poor managements, poor husbandry, shortage of trained man power, cultural and religious taboo and wide spread diseases [5].

Hydatidosis in Ethiopia is known to be an important in animals and public health in different parts of the country. Due to that, many researchers have done about hydatidosis in different animal species; but there is no any report or research about swine hydatidosis in our country. It is a cosmopolitan zoonosis caused by the larval stage of cestode belongs to the genus echinococcus (family taenidae). Larval infection (hydatidosis) is characterized by long-term growth of metacestode (hydatid cysts) in the intermediate host [6].

The public health and economic significance of hydatidosis lies on the cost of hospitalization, medical and surgical fees, loss of income and productivity, permanent or temporary incapacity to work social consequence hydatidosis of disability and mortality [7]. In food animals like swine hydatidosis has an adverse effect on production causing decreased production of meat, reduction in growth rate and predisposition to other diseases [8].

Effective control of hydatid disease is based on presentation by breaking the cycle between definitive and intermediate hosts. This has been demonstrated in a number of well-documented control campaigns concerned with *Echinococcus* (E) *granulosus* maintained in domesticate life cycle patterns [9]. Therefore, the objectives of this study were to determine the current prevalence of hydatidosis in pigs slaughtered at AAMA and to assess the associated risk factors with the prevalence of swine hydatidosis and indicate its zoonotic importance in the area.

MATERIALS AND METHODS

Study Area: The study was conducted from November 2011 to April 2012 in Addis Ababa municipal abattoir (AAMA). Addis Ababa is located at 9°3' north, latitude and 38°43' east longitude. It lies in the central highlands of Ethiopia at an altitude of 2500 m above sea level. It has an average rainfall of 1800 mm per annum. The annual average maximum and minimum temperature is 26° c and 11°C, respectively with an overall average of 18.7°C. Highest temperature is reached in May and the main rainy season extends from June to September. Addis Ababa has a relative humidity ranging from 70-80% during rainy season and 40-50% during dry season. The human population is estimated at about 3 million inhabitants [10].

Study Animals: The study population comprises an indigenous breeds of swine brought for slaughter from various parts of the country to AAMA. These sources of pigs in this study were from Addis Ababa, Bahir Dar,Tatek, Gondar, DebreZeitand Nazareth.

Study Design: Across-sectional study was conducted to determine the prevalence of swine hydatidosis by using post mortem examination (PME) of animals slaughtered at AAMA. In this abattoir ante mortem and post mortem, examination was done by giving a special identification code.

Sampling Method and Sample Size Determination: By using simple random sampling methods and 95%, confidence interval the sample size was determined according to the formula given by Thrusfield [11].

Since there was no information about swine hydatidosis, the expected prevalence of the disease in pigs slaughtered at Addis Ababa municipal abattoir was taken as 50%. As stated above the confidence interval is chosen 95% and d = 5%. By substituting the value in the formula, the sample size (n) taken was 384.

Investigation Procedure: The inspection procedure used during the post mortem examination consisted of primary and secondary examinations. The primary examination involved visual inspection and palpation of organs and viscera. The secondary examination involved further incisions into each organ if a single or more cysts found. Liver, lungs, heart, spleen, mesentery and omentum of each animal were examined grossly. Each organ was also incised once or twice with a knife. Cysts were removed, put in polythene bags separately, labeled and then taken to the laboratory for further studies. Identification of cysts was carried out based on the morphological criteria (described by microscopic examination of the cyst fluid) was conducted to look for the characteristic protoscolices. The content of the cyst was poured into a petridish and examined with 40X magnifications for assessment of the condition of the cyst. If the protoscolices were present, they were seen as white dots on the germinal epithelium or brood capsule (hydatid sands) within the suspension and the cysts were categorized as fertile. Fertile cysts were further subjected to viability test. A drop of fluid from cyst containing the protoscolices were placed on the microscope glass slide,

covered with cover slip and observed for amoeboid like peristaltic movements with 40 X objective. 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 ones take it up. Sterile hydatid cysts are characterized by their smooth inner lining usually with a slight turbidity of the contained fluid and typical calcified cyst produced a gritty sound feeling upon incision [11]. Data collection: Data was recorded and collected including origin of animals, estimated age, body condition, sex and lesion distribution and nature of the cyst at postmortem examination by using a data collection format. Age o pigs was considered as young for = 11 months and adults if their age is > 11 months and body condition were categorized as good, medium and poor.

Data Management and Statistical Analysis: Data obtained from record format and detail postmortem and microscopic examination of organs and cysts were recorded on Microsoft excel. Descriptive and analytical statistics such as Chi square test and F-test were used with SPSS 18.0 statistical package. Prevalence was calculated as percentage value and the possible association of infection with hypothesized risk factors was analyzed.

RESULTS

The Overall Prevalence of Hydatidosis: The prevalence of hydatidosis in pigs slaughtered at AAMA was found to be 16.9 % during the study period from a total of 384 pigs examined. Assessment of swine hydatidosis with different hypothesized risk factors was made. Pigs with poor body condition scoring have the highest prevalence of hydatidosis (28.57 %) followed by medium body condition scoring (18.79 %) and the least prevalence were observed in good body condition scoring pigs (13.04 %). However, there was no statistically significant difference (P>0.05) between body condition and hydatidosis prevalence. The sex specific prevalence was 14.13 % for females and 17.80 % for males though it was not statistically significant (P>0.05).

The prevalence of age specific hydatidosis was 3.2 % and 23.55 % for young and adult pigs, respectively and the difference was statistically significant (P<0.05). The prevalence of hydatidosis in different areas from where animals brought to the abattoir were described. The highest prevalence being observed from pigs of Tatek (34.25 %), followed by Bahir Dar (22.5 %), Debre Zeit and Nazareth (12.5 %), Addis Ababa (11.54%) and 0% from Gondar showing a statistical significant difference with source/origin (P< 0.05) (Table 1).

Table 1: Prevalence of hydatidosis in swine by different risk factors tested in this study

Factors tested examined	N0.	Positive	Prevalence (%)	P- value
Body condition				
Poor	35	10	28.57	
Medium	165	31	18.79	0.136
Good	184	24	13.04	
Sex				
Female	92	13	14.13	0.150
Male	292	52	17.80	
Age				
Young (≤ 11months)	125	4	3.2	0.000
Adult (> 11months)	259	61	23.55	
Origin				
Tatek73	25	34.25		
D/Zeit and Nazareth	152	19	12.5	
Addis Ababa	104	12	11.54	0.000
Bahir Dar	40	9	22.5	
Gondar	15	0	0	

Table 2: The relative comparison of cyst size with organs/tissues in this study

Organs	Cyst size(M±SD)	No. of condemned organs
Lungs	3.28 ± 1.88	19
Liver	1.74 ± 1.20	41
Heart	1.2 ±0.72	3
Muscle	1.4 + 0.70	2
Total	2.16 ± 1.57	65

Distribution of Hydatid Cysts in Different Body Organs: In this study, the proportion of hydatid cyst distribution in various internal organs was determined and liver was found to be the commonly affected organ. Out of the total number of organs/tissues affected with hydatid cysts (65), the relative proportion of organs affected was 19 (4.94 %) for the lungs, 41 (10.68 %) for liver, 3 (0.78 %) for heart and 2 (0.52%)in muscles.

Cyst Characterization: For cyst characterization, 65 samples were taken from different internal organs/tissues of positive animals. These samples were subjected to laboratory test for cyst condition/nature and size determination. The minimum size of cysts was 0.4cm in diameter, the maximum size was 6 cm and the mean cyst size was 2.16 ± 1.573 cm (Table 2).

Table 3: Cyst condition and organs/tissues affected in the study

	Cyst condition			
Organs	Calcified n (%)	Sterile n (%)	Fertile n (%)	Total n (%)
Lung	3(15.79)	5(26.32)	11(57.89)	19(29.23)
Liver	24(58.54)	15(36.59)	2(4.88)	41(63.08)
Heart	1(33.33)	2(66.67)	0(0)	3(4.62)
Muscle	0(0)	1(50)	1(50)	2(3.08)
Total	28(43.08)	23(35.38)	14(21.54)	65(100)

From the total of cyst count (65), the proportion of cyst condition was described and the highest one was calcified cysts with the proportion of 28 (7.3 %), followed by the sterile cysts 23 (6%) and the least was fertile cysts 14 (3.6%) from the total positive animals for hydatidosis.

The proportion of calcified cysts was highest (58.54%) on the liver than in any other organ/tissue but the fertile ones were highly encountered on the lungs (57.89%)(Table 3).

DISCUSSION

Many investigators have tried to report about hydatidosis in animals other than swine. Despite there is almost no information about the disease in our country, the occurrence of swine hydatidosis in the present study was found to be high (16.9%) which shows that the disease is highly important for consideration in the area/country.

In the rest of the world, there are different reports of this disease on swine. This finding (16.9%) is lower with that of Thompson *et al.* [12], Hutchinson and Copeman [13] and Lidetu and Hutchinson [14] which reported 45.8 % in western Australia, 27 % of north Queensland and 31.1 % in north Queensland, respectively. All these researches have done on the feral pigs. The result in this study might indicate that the prevalence of hydatidosis in pigs slaughtered at this abattoir (AAMA) has a low chance of sharing the disease from dogs' compared to those of feral pigs. This is due to the use of dogs for pig hunting and the way of these dogs being fed during the hunting season; thus may contribute to the maintenance of hydatid disease in feral pigs. However, there is the chance of getting the disease from dogs to the different abattoirs and swine farms though the degree of infection is less than compared to feral pigs.

The disease of *E. granulosus* shows considerable geographical variation. Factors that contribute to this variation in prevalence include difference in culture, social activities and attitude towards dogs [15]. Daryani *et al.* [16] reported high prevalence of hydatidosis in domesticated farm animals was likely to be related to the presence of an abundance of animals, traditional animal husbandry and the presence of stray dogs which are infected with *E. granulosus.*

In this study, the assessment was made to establish a relationship between hypothesized risk factors and disease status. This finding indicated that there is no statistical significant association ($p > 0.05$) between the body condition and hydatidosis. This study disagrees with that of Polydorous[17]who reported a significant association and explained that in moderate to severe infection, the parasite may cause retarded performance and growth thus reduced quality and yield of meat as well as live weight loss. He estimated a 5 % and 16 % weight loss in Yugoslavia and Bulgaria, respectively. Such differences in prevalence in relation with body condition scoring might be due to the difference in origin of slaughtered animals, environmental and social factors, as well as epidemiological factors, which could affects the rate of transmission of hydatidosis. Although it was not statistically significant, the prevalence of the disease for different body condition scores was 28.57 %, 18.79 % and 13.04 % for poor, medium and good body condition pigs, respectively.

Analysis of sex of animals had no significant association with the occurrence of the disease ($p > 0.05$) but the prevalence was lower in females (14.13 %) than their male counter parts (17.80 %). This finding was in agreement with Lidetuand Hutchinson [14] who reported that there was no significant difference ($p > 0.05$) in sex between infected and non-infected feral pigs.

A significant variation ($p < 0.05$) was observed in the rates of hydatid infection between age groups where adult pigs were highly infected with the prevalence of 23.55 % and young pigs have 3.2 % prevalence. The reason behind this might be due to adult pigs may gain access of infection with longer exposure than those of young pigs. Thompson *et al*. [12] described that the level of contamination and infectivity of the eggs determine the number of infected eggs ingested by intermediate host.

In this study, the prevalence of infection with regard to place of origin was analyzed and a significant variation was observed ($p < 0.05$). The prevalence of hydatidosis in animals originated from Tatek (34.25 %) was the highest, followed by BahirDar (22.5 %), DebreZeit and Nazareth (12.5 %), Addis Ababa (11.54 %) and the least infection for those pigs coming from Gondar (0%). This significance difference between places of origin might be due to the difference in the presence of definitive hosts (dogs and other canids), agro-climatic locations and livestock management in the places of origin of pigs. Similar factors were responsible for the variation in prevalence in feral pigs between Queensland and Western Australia [14].

The reason behind the high prevalence of pig hydatidosis in Tatek and BahirDar areas may be due to cultural taboo, which favors the keeping of dogs in close association with their family and farm animals. The presence of large number of dogs and hyenas, high range of rainfall, the wide spread tradition of offering uncooked infected offal to swine around different farms, poor public awareness about the disease, the absence of proper housing and fencing for pig farms (where dogs and other carnivores get an easy access) and the habit of disposing dead wild or domestic animal unburied and left open for scavenging carnivores also creates favorable condition for environmental contamination by maintaining the life cycle of *E. granulosus* in dogs and wild carnivores [18]. The reason for absences of infection in pigs from Gondar district may be due to the presence of small sample size taken as a source.

The result obtained from this study indicates that the lung and liver were the most predominantly affected organs with a proportion of 4.94 % and 10.68 %, respectively. This finding is in agreement with the literature that revealed hydatid cyst is most commonly found in liver and lung of ungulates [8]. The lungs and livers were the favored sites for hydatid cyst development in feral pigs as it has been shown to be the case with other studies in pigs or other species. About 13.5 % percent of the total feral pigs sampled had cysts in both organs, but no cysts were found in any other organ except for a single cyst in a kidney [14]. In the present study, there is a small occurrence of hydatidcysts in organs like heart (0.78 %) and muscle (0.52 %). This could be justified by the fact that lung and liver posses the first great capillaries sites encountered by the migrating echinococcus onchosphere (hexacanth embryo), which adopt the portal vein route and primarily negotiate hepatic and pulmonary filtering system sequentially before any other peripheral organ is involved [19]. However, Banks [20] found three infected feral pigs of which two harbor single hepatic cysts, one of which was fertile and the third had disseminated infection with some fertile cysts in the liver, lung, spleen and kidney.

In this study, the liver was the highest infected organ (10.68%) than any other organs/tissues. The liver being the most commonly affected organ is due to the reflection of the route of parasite entry and seem to support the hypothesis of hepatic portal distribution of onchosphere leading firstly to liver infection [21]. This also might be justified by the fact that pigs are not slaughtered at older age in AAMA. During older ages, the liver capillaries were dilated and most onchosphere pass directly and used for hexacanth embryo to enter the lymphatic circulation at last that can be carried through the thoracic duct to the lungs [21,22]. This may decrease the prevalence of the occurrence of hydatid cysts on swine lungs and other organs/tissues. In pigs, the liver is often involved alone or in combination with the spleen and kidney [23].

In the present study, large sized cysts were found in the lung with the size of 3.28±1.88 cm diameter. This observation is in agreement with the findings of Tamene [24], Asrat [25], Hagos and Alemayehu [26] who confirmed that larger size of cysts in the lungs might be due to relatively softer constancy [27-29]. Compared with the lungs, the liver havehigher number of small sized cysts and the mean size of the cyst in the liver was 1.74±1.20 cm in diameter.

The highest prevalence of fertile cysts was found in the lung with the proportion of 26.32% than in any other organs/tissues. This is similar with the result of other workers and it has been stated that the relatively softer consistency of lung allows easier development due to the pressure of cysts [30]. While the higher number of calcified cysts were found in the liver with the proportion of 58.54%. This could be attributed to the relatively higher reticuloendothelial cells and abundant connective tissue reaction of organs [31]. The high proportion of small cysts in the liver compared to lungs may be due to immunological response of the host, which might preclude expansion of cystic size [32].

During examination for cyst condition, the finding of 7.35% calcified, 6 % sterile and 3.6 % fertile cysts were described. It may generally imply that most of the cysts in pigs are calcified. This is due to the high occurrence of pig hydatidosis on the liver. This study disagrees with that of Lidetuand Hutchinson [32] who reported that from all cysts counted in feral pigs in either organs (lung and liver) only a very few cysts shown calcification and necrosis.

CONCLUSION

This study indicated that the prevalence of hydatidosis in pigs slaughtered at Addis Ababa municipal abattoir (AAMA) at present study was high (16.9 %). This study revealed that hydatidosis is an important disease not only in other animals but also in swine. This intern indicates that there is a potential hazard to the human population and pig production in different farms/areas. In this study, being old in age exposes animals for the disease due to their long life time infection and origin of pigs also showed a significant difference in the prevalence of swine hydatidosis. Among the different organs affected, the liver was found to be the most commonly affected organ, followed by the lungs whereas the heart and muscles were the least infected ones in swine hydatidosis.

CONCLUSION

Promoting the establishment of intensive swine farms should be encouraged and prevention of stray dogs' access to slaughter house and pig farms (especially in areas of Tatek and Bahir Dar) helps to reduce exposure of pigs for the disease. Proper disposal or burring of infected organs and dead animals rather than living them outside should be implemented. There should be creating of awareness about the disease and disadvantage of cultural taboo's of swine to people in order to participate them in prevention and control of swine hydatid disease throughout the country. Further research in different areas of Ethiopia about pig hydatidosis should be conducted to know the prevalence, public health implication and its economic significance.

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