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Prevalence of Hydatidosis of Sheep Slaughtered at Abergelle Export Abattoir, Mekelle, Northern Ethiopia

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Abstract: A cross sectional study was conducted from November, 2010 up to March, 2011, to determine prevalence of hydatidosis, to compare liver and lung involvement with hydatid cyst and to assess fertility and viability of the recovered cysts in sheep slaughtered at Abergelle export slaughter house of Mekelle, northern Ethiopia. Systematic sampling was used to select a total of 1152 sheep among those presented to the abattoir during the study period. Meticulous investigation of the visceral organs, particularly the lungs and the livers was undertaken by visual inspection, palpation and incision to detect the presence of hydatid cyst. Parasitological examination was carried out to characterize the size, fertility as well as viability. Consequently, the overall prevalence was found to be 11.6% which was significantly higher ($P<0.005$) in relatively older sheep that were observed to shelter small, medium and large cysts compared to younger ones which were found to be harbouring only small cysts. Considerably higher infection ($P<0.005$) was observed in liver than in the lung with higher number of cysts per liver than lung. Larger proportion of the cysts recovered from the lung was fertile and viable as compared to liver where most of the recovered cysts were either sterile or calcified. In conclusion, the results of our study underscores that ovine hydatidosis is one of the impediments of livestock production and lingering public health hazard in the area. Hence, appropriate control method is necessary to be undertaken to insure sufficient and safe product to the concerned consumers.

Key words: Abattoir · Hydatid Cyst · Mekelle · Prevalence · Sheep

INTRODUCTION

Echinococcosis / Hydatidosis is a term used to describe infection of animals and human with adult Echinococcosis tapeworm or larval/metacestode stage of Echinococcosis species hydatid cyst [1-2]. *Echinococcus granulosus* and its metacestode in herbivores and humans have been recognized as the most important helminthes zoonoses with a great economic and public health significance in developing countries [3].

At present, there are four species of the genus Echinococcosis morphologically distinct both in their adult and larval stages namely: *Echinococcus granulosus* (cystic hydatidosis), *Echinococcus multilocularis* (multivesicular hydatidosis), *Echinococcus vogeli* (polycystic hydatidosis) and *Echinococcus oligarthrus* [4]. The adult tapeworm is found in the small intestine of carnivores, particularly the dog and the metacestode (hydatid cyst) is found in a wide variety of ungulates and man [5-6]. Dogs are primary definitive hosts for the parasite with livestock acting as aberrant intermediate host. The outcome of infection in livestock and humans is hydatid cyst development predominantly in liver, lung or other organs. Hydatid cyst causes severe disease and death in humans and also results an economic loss for treatment costs, lost wages and livestock annual production loss [7].

Even though hydatidosis in animals has been studied in several regions of Ethiopia, it has not been studied in Abergelle export slaughter house of Mekelle where animals of different origins are presented to be slaughtered. In connection, inedible offal's of these animals are usually thrown to dogs which play a great role to maintain the life cycle of *Echinococcus granulosus*. The existence of sylvatic cycles perpetuates the disease and creates obstacles for control and eradication programs. Moreover, at the moment, the feeding habits and hygienic status of the people in the area is poor.

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Data about the prevalence in general, comparative level of the involvement of liver and lung with fertility and viability of hydatid cysts in the two main organs expected to be primarily infected in particular are the key indicators of the impending source of infection. Thus, it is imperative to obtain such baseline information before planning disease control programs so as to insure sufficient and safe product to the concerned consumers. Therefore, objectives of this study were to determine prevalence of hydatidosis, to compare liver and lung involvement with hydatid cyst and to assess fertility and viability of the recovered cysts in sheep slaughtered at Abergelle export slaughter house of Mekelle, northern Ethiopia.

MATERIALS AND METHODS

Study Area: The study was carried at Abergelle export slaughterhouse in Mekelle, the capital city of Tigray Regional State of Ethiopia, where thousands of cattle, sheep and goats are accessible from different districts of the region and from neighbouring regions of the country for slaughter. Mekelle is found at 39° 29[1] East and 13° 30[1] North of the equator which is 783 kilometres away from Addis Ababa which is the capital city of Ethiopia. The altitude of the area ranges from 2000-2200 meters above sea level. The mean annual rainfall of the study area is 579-650 mm. The annual minimum and maximum temperature is 11.8°C and 24.9°C respectively. According to CSA [8], the livestock population of the region are 3,103,468 Cattle; 1,376,961 Sheep; 3,107,994 Goats; 5,427 Horses; 463,492 Donkeys; 7,694 Mules; 32,552 Camels; 3,829,788 Poultry and 255,607 Beehives.

Study Animals: As most of the animals presented to the abattoir for the slaughter were male, the survey was carried out on male indigenous sheep less than three years of age. Since the movement of animals was from different directions where even the suppliers themselves didn't know, tracing back the exact geographical origins of all animals slaughtered and relate the findings to a particular locality was difficult.

Study Design: A cross sectional study was conducted from November, 2010 up to March, 2011, to determine prevalence of hydatidosis, to compare liver and lung involvement with hydatid cyst and to assess fertility and viability of the recovered cysts in sheep slaughtered at Abergelle export slaughter house of Mekelle, northern Ethiopia.

Sample Size Determination and Sampling Technique: The required sample size was computed according to the formula given by Thrusfield [9] as follows:

$$n = \frac{1.96^2 . P_{exp} (1 - P_{exp})}{d^2}$$

where:

n = Required sample size
p_{exp} = Expected prevalence
d^2 = Desired absolute precision

Since no previous abattoir study has been undertaken in the area, 50% expected prevalence was considered. Accordingly, with 95% confidence level and 5% precision, the sample size was calculated to be 384. However, to increase precision, three times the calculated sample size (1152 sheep) was taken. Then systematic sampling was used to select individual animals among those presented to the abattoir.

Estimation of the Age of Sheep: The age of every sampled sheep was estimated based on dentition as indicated by Vatta *et al.* [10] and were conveniently categorized as young (less than two years old) and adults (two to three years old).

Post Mortem Examination and Sample Collection: Systematic investigation of the visceral organs, particularly the lungs and the liver were undertaken by visual inspection, palpation and incision to see the presence of hydatid cyst. Whenever they are accessible, cysts were carefully removed and separately collected in ice box and were transported to Mekelle Rgional Veterinary Laboratory. Parasitological examination was immediately carried out on all collected specimens to characterize the cysts in terms of their size, fertility and viability.

Classification of Cyst Size: The size of the cysts was measured by ordinary ruler and were suitably classified as small cyst (<2cm), medium cyst (2-4 cm) and large cyst (>4cm) in diameter according to Dalami *et al.* [11].

Cyst Fertility and Viability Study: Fertility status was defined by the presence or absence of proctoscolices whereas the viability was determined by the principle that viable proctoscolices should completely or partially exclude the eosin dye while the dead ones take it up.

Furthermore, sterile cysts were characterized by their smooth inner lining usually with slightly turbid fluid in its content. Typical calcified cysts produce a gritty sound feeling upon incision [5].

Data Management and Statistical Analysis: Raw data entry and handling was done using Microsoft Excel spread sheets program and then were transferred to SPSS version 16 for analysis. Descriptive statistics were computed. The prevalence of was calculated as the number of positive samples divided by the total number of examined samples. Pearson's chi-square (χ^2) was used to evaluate the association of age categories with the overall prevalence of hydatidosis. Fisher's exact test was employed to see relationship between overall result and infection of liver or lung. At 5% level of significance, P-value less than 0.05 were considered significant in all analysis.

RESULTS

Overall Prevalence: Out of 1152 sheep examined at Abergelle export slaughter house, 11.6% were found to be harbouring hydatid cyst. The prevalence was significantly higher (P<0.005) in adult sheep than young ones (Table 1).

Comparison of Liver and Lung Infection with Hydatid Cysts: Generally liver was found to be predominantly involved than lung, though few concomitant infections of liver and lung were observed. Statistically significant difference (P<0.005) was observed in the infection between these two organs. The maximum number of cysts recovered per organ was 5 cysts in liver which is higher than 2 cysts in the lung. In sheep of younger age group, cysts were recovered only from liver and not from lung (Table 2).

Cyst Size Characterization: Out of the total 208 hydatid cysts recovered from all positive animals, the largest proportion of cysts constituted cysts of small size while larger cysts were comparatively few in number (Figure 1). Based on the age animals from which cysts were recovered, virtually all of the relatively younger sheep that were positive for hydatidosis harboured small sized cysts. However, the entire large cysts, nearly all of the medium sized cysts and more than 75% of the small sized cysts were recovered form sheep of relatively higher age categories (Figure 2).

Characterization of Cysts in Relation to Fertility: Larger proportion (81.3%) of the identified cysts in general was sterile and calcified whereas 18.8% were fertile.

Table 1: Prevalence of hydatidosis based on age group of sheep

Age	No examined	No positive	Prevalence (%)	95% confidence interval	df	χ^2 (P-value)
Young	711	23	3.2	1.9-4.5	1	127.4 (0.000)
Adult	441	111	25.2	21.1-29.2		
Total	1152	134	11.6	9.8-13.5		

Table 2: Comparison of liver and lung infection with hydatid cyst in sheep

Infected organ	No of examined	No of positives	% of positives	95% confidence interval	χ^2 (P-value)
Liver	1152	109	9.5	7.8-11.2	814.1 (0.000)
Lung	1152	21	1.8	1.2-2.6	
*LI &LU	1152	4	0.4	0.01-0.69	

*LI &LU= liver and lung concurrent infection

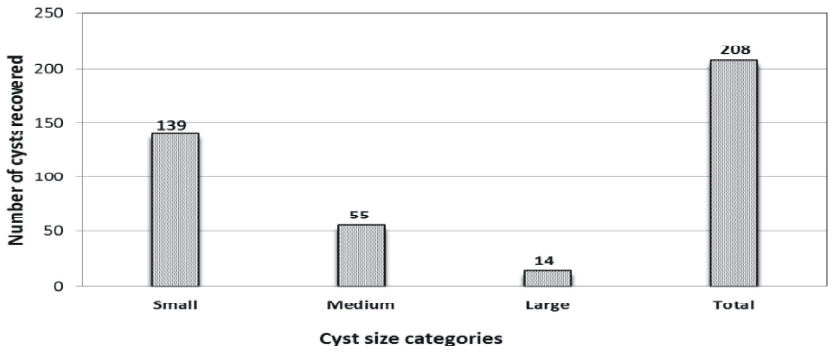

Fig. 1: Classification of all recovered cysts according to their sizes

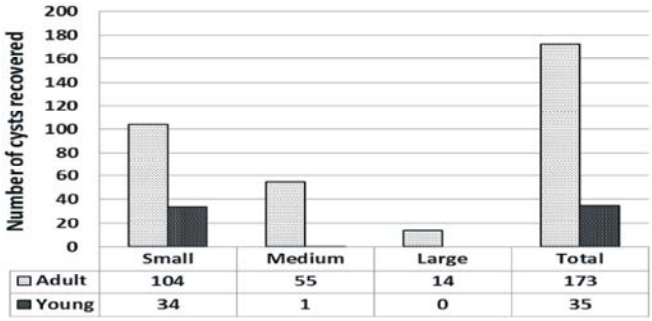

Fig. 2: Cyst size categories vs. age of the animals

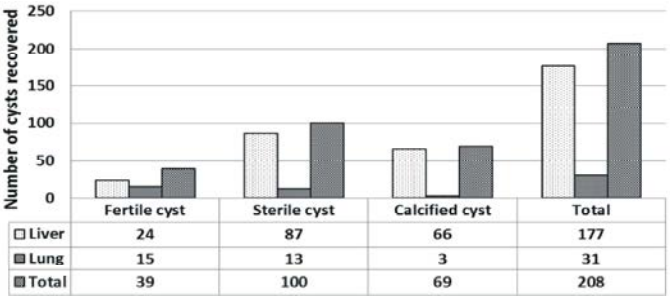

Fig. 3: Cyst fertility characterization

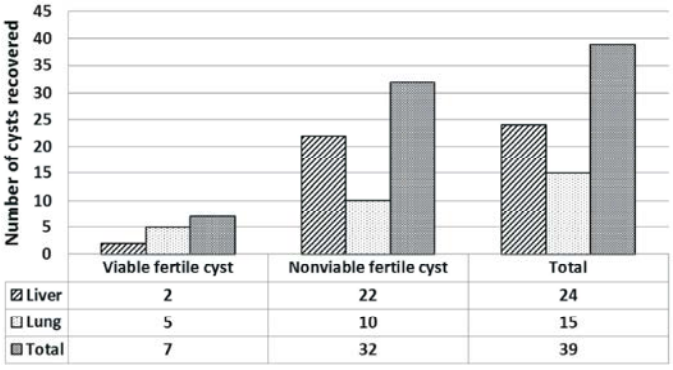

Fig. 4: Analysis of fertile cysts in relation to viability

Higher percentage of the cysts recovered from the lung was fertile as compared to liver where most of the recovered cysts were either sterile or calcified (Figure 3).

Description of Fertile Cysts Pertaining to Viability: More than one fifth of the fertile cysts were found to viable. With regard to organ distribution, higher number of viable cysts was recovered from lung than liver (Figure 4).

DISCUSSION

Hydatidosis is an important parasitic disease that causes considerable economic losses in livestock production and has huge public health significance in different parts of the world that necessitates virtuous study for the application of its control measures. An abattoir based study was conducted in Abergelle export slaughter house, Mekelle. In view of that, the overall prevalence (11.6%) recorded in this study was comparable with similar studies carried out in Addis Ababa Abattoir (13.5%) by Zelalem *et al.* [12] and in Morroco (10.6%) by Azlaf and Dakkak [13], but was higher than other studies done in Addis Ababa abattoir (8.6%) by Helina *et al.* [14]; in Luna export abattoir, central Ethiopia (7.7%) by Daniel *et al.* [15]; from Turkey sheep in New Taif abattoir Saudi Arebia (7.2%) by Ismail M. Shalaby *et al.* [16]; in Chennai abattoir (5.6%) by Sangaran and Lalitha, [17]. However, it was lower than studies undertaken in Ambo municipal abattoir (26.7%), western part of Oromia Regional State of Ethiopia, by

Endrias *et al.* [18] and in Addis Ababa Abattoir (19.9%) by Erbeto *et al.* [19]. Much higher prevalence (83%) was reported by Ripoche *et al.* [20] in Sardinia.

The discrepancy and similarity in the prevalence between the various areas might be attributed principally to strains difference and relationship in *E. granulosus* that exist in different geographical situations [21]. Moreover, additional reasons could be the difference in the level of awareness of the community with regard to methods of its transmission as people used to slaughter small ruminants at home and throw the offal's to the dogs around their villages. Furthermore, difference in culture, social activity and attitude to dog in different regions might have contributed to such inconsistency [22].

Age related magnitude of hydatidosis infection and cyst size was evident in our study. Hence, the infection was significantly higher ($P<0.005$) in older animals than in younger ones. Older animals were more infected with more number and larger size of cysts (Figure 2) as compared to younger ones. This is in accord with series of previous reports by Zelalem *et al.* [12], Azlaf and Dakkak [13], Helina *et al.* [14], Daniel *et al.* [15], Endrias *et al.* [18], Erbeto *et al.* [19], Ripoche *et al.* [20], Jehad Hammed El-Ibrahim [23] and Muskin *et al.* [24]. Furthermore, in support of our finding, a study conducted in Kazakhstan also strongly suggested that cyst were seen in all age groups of sheep, but prevalence is increasing with age. Thus, in lambs of 1 year age, the prevalence was approximately 25% and 20%, rising to 57% and 49% in 3 years old animals and over 80% and 74% in animals 6 years or over [25]. Obviously, as animals get aged, the risk of infection increases due to prolonged period of exposure. In addition, most old animals have higher odds of acquiring infection due to their low immunity to combat infection. Besides, the likelihoods of detecting cysts during post mortem examination are higher in older animals owing to the larger size of the cysts.

Moreover, on one hand, the explanation for the predominance of medium and large cysts in a relatively adult sheep observed in our study (Figure 2) could be as a result of fairly higher reticuloendothelial cells and abundant connective tissue reaction of the liver [26]. On the other hand, however, the higher amount of small cyst in relatively younger sheep might show late infection of the animals due to immunological response of the host which might preclude expansion cyst size [25]. Despite the observed results, a question could arise about the sensitivity of the methods employed for the detection of the cysts. Evidently, the use of more sensitive techniques of detection with more advanced diagnostic procedures as attempted elsewhere [27-31] could have changed the outcomes to some extent particularly in terms of the smaller sized cysts that could not be detected visually.

With regard to comparison of infection between the two organs in terms of overall infection and recovery of cysts per organ, our study disclosed that the infection was significantly higher ($P<0.005$) in liver than in the lung with higher number of cysts per liver than lung. Consistent with our work, Zelalem *et al.* [12], Azlaf and Dakkak [13], Ripoche *et al.* [20] and Jehad Hammed El-Ibrahim, [23] also reported higher infection in liver than lung. This could mainly be attributable to the point that blood flows directly to the liver through portal circulation after leaving the gastro-intestinal tract. Hence, most of the oncospheres that were hatched in the intestine are trapped in the liver, just the remaining few are passed to the lungs and then to other organs. Another explanation might be due to the fact that, in most cases, sheep are slaughtered at a relatively younger age when the liver capillaries are not sufficiently dilated and thus accounts for most of the cysts to be trapped in the liver instead of allowing some to directly pass to the lungs.

Nevertheless, in contrast to our observations, Helina *et al.* [14], Daniel *et al.* [15], Sangaran and Lalitha, [17], Endrias *et al.* [18], Islam *et al.* [32] and Abebe and Yilma [33] reported that lung was more infected organ as compared to liver. The possible explanation for this could be that majority of sheep slaughtered might be older in age. Clearly, the liver capillaries in older sheep are relatively wider, so that it can allow the the embryos to pass through it and reach the lungs. Besides, the embryos may go into the hepatic circulation and be passed via the thoracic duct and heart to the lungs so that lungs will be infected before or instead of the liver [34]. Notwithstanding, few concomitant infections detected in our study were in line with Sangaran and Lalitha, [17] and Jehad Hammed El-Ibrahim, [23].

Even though higher percentage among the overall detected cysts was sterile and calcified in relation to fertility, the total proportion of fertile cysts and nearly one fifth of the viable fertile cysts (Figure 4) were substantial enough to warrant a biological significance. The higher recovery rate of fertile and viable cysts from the lung in this study might suggest the variation in tissue resistance between the affected organs as softer consistency of the lung tissue might allow the unperturbed growth of the cysts [21]. Moreover, comparatively stronger host reaction in the liver may limit fertility and viability rate of hydatid cysts in this organ [26]. Consistent with our observation, Zelalem *et al.* [12], Daniel *et al.* [15],

Endrias *et al.* [18], Muskin *et al.* [24] and Alemian *et al.* [35] also reported that fertile and viable cysts were higher in lung than in liver. Conversely, Saeed *et al.* [36] and Dalimi *et al.* [11] reported that hepatic cysts of sheep were more fertile than those in the lungs.

CONCLUSSIONS AND RECOMMENDATIONS

Finally, the results of our study underscores that ovine hydatidosis is one of the impediments of livestock production and lingering public health hazard in the area. Hence, appropriate control method is necessary to be undertaken to insure sufficient and safe product to the concerned consumers.

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