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ECHINOCOCCOSIS IN KENYA: TRANSMISSION CHARACTERISTICS, INCIDENCE AND CONTROL MEASURES

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Kenya has the highest reported incidence of human hydatid disease in the world. Up to about 30 % of cattle, 15 % of goats and 13 % of sheep harbour the infection. The causative agent of the disease in Kenya is *Echinococcus granulosus* and a complex strain picture of this parasite has been postulated to occur. The domestic dog is the main definitive host of *E. granulosus* in Kenya but infection in wild carnivores has also been reported. Hydatid cysts have also been found in wild herbivores. Although the domestic cycle has been shown to be the most important mode of transmission of the disease, a sylvatic cycle is also known to exist. The etiology of hydatid disease, the strain differentiation of *E. granulosus* found in Kenya, and the role that wildlife plays in the transmission cycle is reviewed. The current trends in the incidence of hydatid disease in man and livestock, and the efforts being made to control the disease are also discussed.

Key words: *E. granulosus*, hosts, incidence, wildlife, control, kenya.

INTRODUCTION

Unilocular hydatid disease caused by the larval stages of *E. granulosus* (Bastch, 1876) is a zoonotic disease of major medical and economic significance in many parts of the world. This global distribution is partly due to the ability of the parasite to adapt to a wide variety of domestic and wild intermediate and definitive hosts (25). This fact is very well demonstrated by the diversity of hosts affected by the parasite in Kenya (14). The prevalence of hydatid disease varies from area to area and country to country but is most prevalent where the livestock industry is the main type of agriculture (25).

Kenya is mainly an agricultural country and about two-thirds its landmass is margianl to semi-arid. Pastoralism is the main economic activity (Fig. 1) in these

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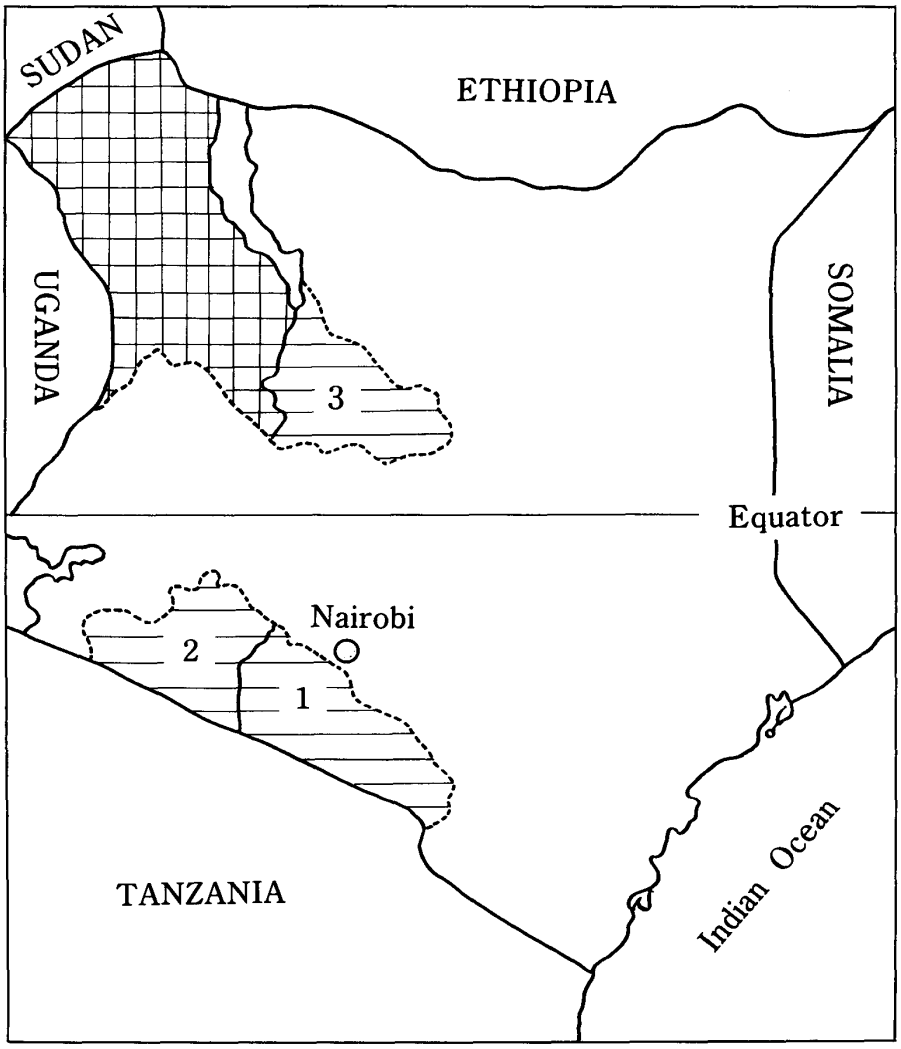

Fig. 1: Map or Kenya showing areas or human hydatid disease endemicity.

Turkana District

1. Kajiado District
2. Narok District
3. Samburu District

} Masailand

areas which are occupied by nomadic or seminomadic pastoralist groups such as the Turkana, the Maasai, the Boran, the Pokot and the Somali. Like pastoralists from other parts of the world, they will keep dogs to help in herding of their livestock and to guard the livestock at night from marauding wild carnivores such as jackals and hyenas. It is mainly in these groups, especially the Turkana and the Maasai, that human hydatid disease occurs (2). Hydatidosis has also been reported among other ethnic groups but the incidence is low (22).

The pastoralist people of Kenya will keep many forms of livestock. These include cattle, sheep, goats, camels, and even donkeys. Pigs are kept in the higher potential areas of the country. Hydatid infection has been reported from all forms of livestock and rates of up to 30 % have been reported in cattle, 13 % in sheep and 15 % in goats (6). Infection has also been reported in wild carnivores and herbivores but the actual role they play in the transmission of the disease to man, and to the perpetuation of the disease in nature has not yet been clarified (14).

The aim of this review is to discuss some of the factors leading to the high incidence of hydatid disease in man and livestock in Kenya. The strain differentiation and the current trends in the incidence of the disease are also discussed.

Etiology

Only *E. granulosus* has so far been identified as the causative agent of hydatidosis in Kenya and no hydatidosis in Kenya and no other species of the parasite has been reported. The etiology was first confirmed by the reports of Nelson and Rausch (20). However, a complex strain picture has been postulated to exist within this particular species leading to the presence of a unique strain with a particularly high virulence in man in Turkana district. Initially it was thought that this unique strain would most probably be harboured by the camel (18). The possibility of the existence of different strains is further supported by the wide range of definitive and intermediate hosts affected by echinococosis in Kenya. The strain differentiation of the Kenyan parasite has been the subject of numerous studies involving *in vitro* culture, biochemistry, isoenzyme analysis and DNA hybridization (10, 13, 19). Isoenzyme studies have revealed similar patterns for human, cattle and sheep isolates while different patterns were obtained for camel and goat materials (13). Recently, DNA hybridization studies (19) have confirmed the existence of a camel hybridization pattern different from that of cattle, sheep and human isolates. However, one goat isolate from Turkana showed a hybridization pattern similar to that of the camel material. All the human isolates that were examined by DNA hybrization from Turkana conform to the sheep strain and this has led to the conclusion that the sheep / dog strain may be the most important as far as human infection is concerned. The studies carried out so far have yielded no particular strain unique to Turkana and further work in this direction is therefore necessary.

DEFINITIVE HOSTS

The domestic dog (*Canis familiaris*) is the main definitive host of *E. granulosus* in Kenya (20). Several reports have been published on the prevalence of the parasite in dogs (Table 1). The dog is mainly infected by eating offal from livestock with hydatid cysts. Most of the surveys carried out are mainly from those areas like Turkana and Masailand where human hydatid disease has been reported. It is important to note that not only is the prevalence of *E. granulosus* in dogs in Turkana high but the worm counts in individual dogs is also very high. Macpherson *et al.* (16) estimated up to 4 -5×10^4 worms in some of the dogs autopsied.

Table 1 Reports of *Echinococcus granulosus* infection in dogs in Kenya.

Area of Survey	No. examined	No. infected	% infection	References
Turkana	27	19	70.4	(20)
Nairobi	43	27	62.7	(20)
Masailand	1165	318	27.3	(2)
Turkana	44	26	59.1	(9)
North Turkana	354	196	55.1	(16)
Central 〃	247	32	13.0	(16)
South 〃	94	46	48.9	(16)

Several wild carnivores have been shown to harbour *E. granulosus* (Table 2). The highest infection rates have been reported in wild hunting dogs (*Lycaon pictus*) but recently the population of these animals in Kenya has decreased considerably and may therefore not pose much danger as important definitive hosts of *E. granulosus*. Jackals also show high infection rates but it is the golden jackal (*Canis aureus*) that is thought to be the most important wild defitive host in that it has been shown to carry a higher number of worms (14).

INTERMEDIATE HOSTS

Several reports are available on the prevalence of hydatid cysts in livestock in Kenya (Table 3). Most of these reports however give different prevalance rates for various species with some suggesting infection rates as high as 30 % in cattle, sheep and goats (6). The highest infection rates have been reported in camels and this may be explained by the fact that camels are slaughtered at a later age and therefore have higher chances of picking up infective eggs.

Table 2 Echinococcus infection in wild carnivores in Kenya (After Nelson and Rausch, 1963; Eugster, 1978; Macpherson et al., 1985)

Definitive hosts	No. infected	% infection
Spotted hyena *(Crocuta crocuta)*	3 / 19	15.7
Silver-backed jackal *(Canis mesomelas)*	11 / 28	28.0
Golden-jackal *(Canis aureus)*	6 / 22	27.2
Lion *(Panthera leo)*	1 / 1	100.0
Wild hunting dog *(Lycaon pictus)*	3 / 4	75.0

Table 3 Hydatid cyst infection in livestock in Kenya.

% infection				References
Cattle	Sheep	Goat	Camel	
30	30.0	30.0	—	(8)
25.5	—	—	—	(6)
20.7	19.8	16.2	—	(17)
46.7	9.5	9.0	—	(2)
8.9	8.1	7.1	80	(12)
15.8	7.6	3.1	80	(7)

Slaughterhouse surveys for the whole country for the period 1977–1988 indicate that 4.1 % and 4.8 % of all cattle livers and lungs respectively were condemmed due to the presence of hydatid cysts while figures for smallstock were 2.6 % and 3.0 % for the liver and lungs respectively. For the same period the condemnation rates of pig liver and lungs were 0.4 % and 0.5 % (7). The low rates in pigs may be accounted for by the fact that pigs in Kenya are reared indoors and so have less chance of coming in contact with infective eggs. Donkeys are widely used as beasts of burden among the nomadic groups in Kenya. Unfortunately no proper studies have been carried out to determine the infection levels and examine the role that they may play in the hydatid disease cycle.

Hydatid cyst infection has been documented in several species of wild herbivores (Table 4). Studies on the infection in herbivores have mainly concentrated on Turkana District and Masailand. Reports are not available for the rest of the country.

HUMAN HYDATIDOSIS

The high incidence of human hydatid disease reported in Kenya is mainly confined to the Turkana District in the north-western part of the country. This was first

Table 4 Echinococcus infection in wild herbivores in Kenya (After Nelson and Rausch, 1963; Eugster, 1978; Macpherson et al., 1985),

Intermediate hosts	No. infected	% infection
Wildebeest *(Gorgon taurinus)*	70/574	12.3
Grants gazelle *(Gazella granti)*	2/26	7.6
Blue duiker *(Cephalophus monticola)*	1/1	100.0
Impala *(Aepyceros melampus)*	2/24	8.3
Kongoni *(Damaliscus korrigum)*	2/38	5.2
Buffalo *(Syncerus caffer)*	1/1	100.0

Table 5 Reports of human hydatid disease in Kenya.

Period	No. of cases	Incidence per 100,000 persons	References
1952—1955	119	—	(29)
1957—1961	122	—	(20)
1969	40	—	(26)
1968—1971	163	—	(24)
1971—1975	789	96.0	(21)
1976—1980	355	—	(3)
1979—1980	45	—	(22)
1976—1980	355	198.0 (Northern Turkana)	(4)
		17.0 (Southern Turkana)	(4)
1979—1988	833	0.5 (Whole country)	(7)
		60.5 (Turkana District)	(7)

confirmed by Schwabe (26) who estimated the incidence at 40 cases per 100,000 population. This incidence was three times that of Cyprus which had the highest reported incidence at the time. Numerous reports have ensued (Table 5). A survey carried out by French and Nelson (5) indicated that even within Turkana District there were differences in incidence. They reported an incidence of 198 cases per 100,000 persons population in the north while the incidence in the south was 17 cases per 100,000 persons population. It is interesting to note that infection in dogs in the north and south Turkana are almost the same, but it has recently been shown that the level of man / dog contact is higher in the north that in the south (28).

Another interesting feature of hydatid disease infection in Turkana is the age-sex distribution of the patients. French (3) studied the age-sex distribution of 355

Turkana hydatid patients and obtained a male : female ratio of approximately 1 : 2. He also observed that the majority of the patients were females of ages between 20 and 35 years. This he related to the colose contact of women and dogs during child rearing age when the dogs are used as nurse maids to clean the babies on defaecation or vomiting.

A recent survey based on hospital records for the years 1979–1988 revealed an average annual incidence of 0.46 cases per 100,000 persons population for the whole country and 60.5 cases per 100,000 persons in Turkana district (7). Average annual incidence rates of 2.4 and 1.8 cases per 100,000 persons were obtained for Kajiado and Narok districts which comprise Masailand. No significant changes with time were obtained in the incidence over the period of study. No cases were reported in the North-eastern and parts of the Coast Province which are mainly inhabited by Muslims. The fact that the Muslim religion considers the dog as 'unclean' and discourages the followers from keeping them may partly explain the apparent absence of the disease from this area.

Several hypotheses have been advanced to explain the high incidence of human hydatid disease in Turkana District. These include the presence of a wildlife cycle (14), eating of infected carnivores such as dogs, jackals, hyenas, etc. and the presence of a man / dog cycle where man acts as an intermadiate host due to lack of burial or burial in shallow graves where the corpses are easily out by dogs (11). A more important postulate is the close contact between the Turkana people and their dogs, and the use of dogs as nurse maids (5, 18). The contamination of waterholes by taeniidae eggs has also been suggested as a possible source of infection and with the recent development of tests to differentiate *E. granulsus* eggs from other taeniidae eggs, it will be possible to examine this mode of transmission with greater accuracy (1). Turkana is a hot and dry region and dust storms are a common phenomenon. This has led to speculation that dust-borne infections could also occur (18). The use of dog faeces in various traditional medicaments has also been suspected to play a role in the transmission (4).

Role of wildlife in the transmission

The existence of a hydatid sylvatic cycle has been clearly demonstrated in Masailand but in the Turkana district this has not been phown to occur (14). In Masailand both the wild carnivores and wild herbivores harbour the infection. In Turkana , however, infection has only been found in wild carnivores. The fact that the lion and its main prey, the wildbeest, both show infection suggests that this could be an important route of perpetuation of the hydatid disease cycle in the wild in Masailand will become infected scavenging on both infected livestock and wild herbivores while those in Turkana may be infected by scavenging on infected livestock especially during the numerous droughts that occur in this region. Although infection in wildlife has been

clearly demonstrated, the actual role they play in the transmission of the disease to man and to livestock has yet to be elucideted. Further research is therefore neccessary in this particular aspect of the disease, especially in Masailand.

CONTROL MEASURES

Several approaches are being used in a pilot control project started in the north-western part of Turkana district (15). These include an education campaign teaching of the life cycle of the parasite and dangers of keeping unwanted dogs. Songs composed in the local dialect are used as part of a community based health care programme. The education campaign is however hampered by the low literacy rate among the Turkana people. Dog registration and dosing using praziquantel are being carried out (15). These two measures are difficult to implement in that dog dosing is an expensive undertaking and the Turkana are a nomadic people and therefore not easy to follow-up. Recently, a slow release formulation of praziquantel has been tested for use in Turkana and has shown promising results (27). Stray dogs are eliminated by either shooting or baiting. Surveillance by the use of a portable ultrasound scanning machine and by serology are used identify patients who need treatment for the condition. Treatment in the past has mainly been surgical but lately albendazole has been used with promising results (23). Introduction of meat inspection services in more areas of the country is also helping to combat hydatid disease by ensuring that infected offal are properly disposed of.

The fact that Turkana district three international boundaries with Ethiopia, Sudan and Uganda (Fig. 1) complicates the control efforts further. The southern part of Ethiopia and the Karamoja district of Uganda are known endemic foci of hydatid disease (10). Cattle rustling among the tribes in this area is a common occurrence and international efforts may be neccessary to accomplish any meaningful control of the disease.

CONCLUSION

From the facts and figures presented here, it is obvious that hydatid disease has been and continues to be an important disease in both livestock and man in Kenya. It is therefore necessary that efforts should be made to make the general public aware of the problem even in those areas where the disease has not been reported. It is also imperative that dog owners should be warned of the dangers of feeding raw offals to dogs since home slaughter is a common feature of the Kenyan lifestyle. The necessity of regular deworming of dogs and the provision of meat inspection servises will no doubt greatly contribute to the fight against hydatid disease. Further strdies of the sociological aspects that may enhance transmissoin within the communities where high incidence occurs should be undertaken.

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