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Study of cystic echinococcosis in slaughtered animals in Al Baha region, Saudi Arabia: Interaction between some biotic and abiotic factors

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ABSTRACT

The variation in cystic echinococcosis (CE) prevalence and mean intensity was studied in relation to site, season and host age and sex. A total of 12,911 slaughtered animals, 140 camels, 2668 cattle, 6525 sheep and 3578 goats were inspected for hydatid cysts in Al Baha region, Saudi Arabia, in three study areas during four seasons from June 2008 to May 2009. The prevalence of infection was 32.85%, 8.28%, 12.61% and 6.56% in camels, cattle, sheep and goats respectively. The prevalence of the parasite varied significantly in relation to site, season and host age classes and sex in most host species. Spring showed the highest prevalence in camels, cattle and sheep. A significant association was found among host age classes and likelihood of infection in all examined hosts and the oldest age class was significantly more likely to be infected. The main effects in parasite intensity were host sex and age in most examined host species. A positive correlation was found between intensity of CE and host age class in all animal species examined. The most commonly infected organs were liver and lungs which constituted 48.75% and 32.83% respectively, of the total infected organs. There was a significant difference among host species in fertile cysts ($P < 0.0001$). The higher percentages of fertile cysts were in sheep (47.67%) and goats (23.99%) indicating that sheep and goats are the most important intermediate hosts for *Echinococcus granulosus*. Examined hydatid cysts of the liver had a higher fertility rate (38.79%) than those of the lungs (25.13%). Cysts size ranged from 1 to 8 cm in diameter. The mean cyst diameter was found in the lungs higher than that in the liver in all hosts. The range in the number of cysts was 1–33 in infected animals. The mean number of cysts was higher in lungs than that in liver in all examined animals. The viability rate of protoscoleces of liver fertile cysts (62.20%) was significantly higher than that of lung cysts (52.73%). In conclusion, these findings of infection, mean abundance and fertility rates of CE in slaughtered animals, prompt plans for further epidemiological studies and control programmes.

1. Introduction

Cystic echinococcosis (CE) is an important problem for public health and the economy in many parts of the world. It is one of the most important zoonotic diseases and it is of great social importance (Benito et al., 2006; Daryani et al., 2007; Garippa et al., 2004). It has been reported from all countries in the Middle East and Arabic North Africa (Battelli et al., 2002; Sadjjadi, 2006). Its high prevalence is closely connected to the following factors, which are linked to the social and economic conditions of the population: continued widespread use of traditional techniques when raising small ruminants (extensive or semiextensive grazing), illegal slaughtering of the animals, and the presence of high number of dogs (Garippa et al., 2004; Ibrahim et al., 2008).

The parasite's domestic life cycle is maintained through dogs (which harbour the adult tapeworm) and a range of domestic livestock intermediate host species, including goats, sheep, cattle and camels. Due to the high biotic potential of *Echinococcus granulosus*, infected dogs can excrete a large number of parasite's eggs with their faeces, contaminating wide range of soil, and spreading the disease (Gemmell, 1990).

The most common production practices that may increase the risk of exposure of sheep to hydatidosis were the improper disposal of dead animals, the access of farm dogs to the offal of slaughtered sheep, the carelessness of farmers to treat farm dogs with anthelmintics, and the grazing of flocks in fields where stray dogs have free access (Christodoulopoulos et al., 2008).

Cystic echinococcosis, though one of the most important helminth infections in man, has proved difficult to establish an accurate prevalence status in intermediate hosts in any continent. This is partly due to poor reliability of the available diagnostic tests and high costs of performing these tests under field conditions. Most of the prevalence studies have relied on slaughter

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data (Baldock et al., 1985; Macpherson et al., 1985; Njoroge et al., 2002). Slaughter survey has been recommended in studies of cystic echinococcosis for various reasons (Baldock et al., 1985; Njoroge et al., 2002). It is an economical way of gathering information on livestock diseases, particularly subclinical conditions. Also, no satisfactory test exists for cystic echinococcosis in living ruminants (Craig, 1997; Njoroge et al., 2002). In addition to this, lesions of cystic echinococcosis usually remain for the life of the animal, and therefore, at post-mortem it is possible to tell whether or not an animal was infected.

The aim of this study was to determine the prevalence and mean intensity of CE infection in slaughtered animals in Al Baha region in relation to abiotic and biotic factors. The site, size and fertility of cysts as well as viability of their protoscolices were also determined.

2. Materials and methods

The study was carried out in Al Baha region, western south Saudi Arabia (20°N, 41–42°E). Three sites were chosen in Al Baha region for this study namely Al Baha, Al Aqiq and Al Mekwah. The study sites are mainly hilly, with small areas of either mountains (Al Baha) or flat land (Al Aqiq and Al Mekwah) and extend from 500 to 2500 m a.s.l. The climate in Al Baha area is cold winter (10–22 °C) and mild summer (22–32 °C) with an average of annual rainfall between 229 and 581 mm (highland ranges from 1500 to 2500 a.s.l). Mild winters (20–37 °C) and hot summers (36–51 °C), with an average annual rainfall between 100 and 250 mm, prevail in Al Aqiq and Al Mekwah areas (lowland range from 500 to 1000 a.s.l).

A total of 140 camels, 2668 cattle, 6525 sheep and 3578 goats were examined for cystic echinococcosis during the four seasons from June 2008 to May 2009. All these animals were slaughtered in official abattoirs in Al Baha (20°N, 41°46′E) and Baljurshi (20°N, 41°50′E). The data collected for each animal (camels, cattle, sheep and goats) included: (a) host age class (<1 yr, 1–2 yrs and >2 yrs for camels, sheep and goats, <1–5 yrs, >1.5–3 yrs and >3 yrs for camels and <1 yr, 1–2 yrs and >3 yrs for cattle); (b) sex; (c) season and (d) site. The animals' ages were estimated by examining their teeth and asking the animals' owner especially in camels. The structure of the sampled host population by the season, host sex and site is shown in Table 1.

2.1. Examination of slaughtered animals

During the post-mortem examination, a thorough visual inspection, palpation and systematic incision of each visceral organ particularly the liver, lung, kidney, heart and spleen was carried out with the help of veterinarians according to procedures recommended by FAO/UNEP/WHO (1994). Infected organs were taken to the laboratory and all hydatid cysts found in the organs were collected to conduct cyst count, cyst size measurement, cyst fertility test and viability of protoscoleces.

2.2. Examination of cysts and viability of protoscoleces

Individual cysts were grossly examined for any evidence of degeneration and calcification. Some cysts were randomly selected by organs (liver and lung) per species for fertility studies. To reduce intracystic pressure, the cyst wall was penetrated with a needle and opened up with a scalpel and scissors. The contents were transferred into a sterile container and examined microscopically (40×) for the presence of protoscoleces. Similarly, the germinal layer was put in glycerin between two microscopic glass slides and examined for the presence of protoscoleces. Cysts which contained no protoscoleces as well as heavily supurative or calcified were considered unfertile. The viability of protoscoleces was assessed by the motility of flame cells together with staining with a 0.1% aqueous eosin solution. Living protoscoleces did not take up the stain, unlike the dead ones (Smyth and Barrett, 1980; Daryani et al., 2007). The viability of protoscoleces was carried out for each fertile cyst per animal species and organ.

2.3. Statistical analysis

Ecological terminology follows that is described by Bush et al. (1997). Prevalence is the proportion of infected hosts, and mean intensity is the mean number of parasites per infected host. To assess associations between the animal species, host sex, age and season on the CE infection, logistic regression was undertaken with each variable fitted separately and assessed in comparison with the null model using the likelihood ratio test. The odds ratio (OR) and 95% confidence interval (CI) were also calculated for each of these variables, other than the reference group, using the corresponding beta-coefficients and associated standard errors

Table 1
The structure of the sampled host populations by the season, host sex and site.

Animal species	Season	No. of examined	Sex		Al Baha	Al Aqiq	Al Mekwah
		Total	Male	Female			
Camels	Summer	71	62	9	37	21	13
	Autumn	19	15	4	8	6	5
	Winter	10	8	2	4	3	3
	Spring	40	35	5	19	13	8
	Total	*140*	*120*	*20*	*68*	*43*	*29*
Cattle	Summer	1023	790	233	513	323	190
	Autumn	522	347	175	240	152	130
	Winter	300	220	80	137	93	70
	Spring	823	615	208	421	277	125
	Total	*2668*	*1972*	*696*	*1311*	*842*	*515*
Sheep	Summer	2583	2133	450	1080	995	508
	Autumn	1250	1013	237	611	375	264
	Winter	800	630	170	417	220	163
	Spring	1892	1512	380	873	728	291
	Total	*6525*	*5288*	*1237*	*2981*	*2318*	*1226*
Goats	Summer	1630	1250	380	736	628	266
	Autumn	720	520	200	348	230	142
	Winter	428	310	118	230	118	80
	Spring	800	603	197	370	280	150
	Total	*3578*	*2683*	*895*	*1684*	*1256*	*638*