EPIDEMIOLOGICAL STUDY OF CYSTIC ECHINOCOCCOSIS IN SHEEP, CATTLE AND GOATS IN ERBIL PROVINCE

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(Accepted for publication: May 27, 2016)

Abstract:

Cystic echinococcosis (CE) or hydatid cyst (HC) caused by the larval stage of the tapeworm *Echinococcus granulosus* continues to be a substantial cause of morbidity and mortality in many parts of the world. Since Kurdistan region is considered as endemic area, an epidemiological study was conducted to investigate the occurrence of CE isolated from sheep, cattle and goats from July 2013 to June 2014. The total rate of infection was 11.17(457/4092), with the highest rate (9.07%) in sheep and the lowest (0.54%) in goats. Regarding the sex of the infected animals, female showed slightly a higher rate than males (5.99% versus 5.18%) which statistically non-significant (P>0.05). Among the three intermediate host sheep showed the highest rate of infection (14.51%) regarding the sex females of sheep and cattle showed higher rate of infection versus males (27.36 and 20.35 versus 9.37 and 3.86). Furthermore, the highest incidence of CE in sheep, cattle and goats were found among the age group over three years (18.75, 5.41 and 1.69%, respectively), while the lowest rate was noted in the age groups less than one year (3.96 and 0.25%, o.33, respectively). On the other hand, sheep showed high rate of infection throughout the year with peaks during May to July which were 19.44%, 17.59 and 18.14%,respectively. This was followed by cattle and goats (11.67% and 5.26%) in April and December, respectively. Regarding the size, the higher numbers of small sized cysts were found in the liver (98/175), while the highest numbers of large sized cysts were found in both liver and lung which were 69/165. The liver and lungs appeared to be the site of predilection, since highest rate of infection was reported in these organs. Regarding the fertility of CE, the highest was in sheep (87.6%), followed by goats (77.27%) and then the cattle (40.63%).

Keywords: *Cystic echinococcosis; epidemiology; slaughtered animals, age, gender, location and fertility.*

Introduction

Cystic echinococcosis (CE) is a cosmopolitan zoonosis caused by the larval stages of a tapeworm belonging to genus *Echinococcus* (Class Cestoidea, family Taeniidae) (Ibrahim *et al*., 2011; Grosso *et al*., 2012 and Umhang *et al*., 2014). The life cycle of *Echinococcus* species includes two mammalian hosts (Definitive hosts which are mainly canids and some felids, and Intermediate hosts which are usually ungulates and rodents, which act as prey for the definitive hosts). The infection of intermediate hosts is a result of ingestion of the parasite eggs which shed in the feces of definitive hosts, and the definitive host is infected by ingesting intermediate hosts harboring *Echinococcus* spp. metacestodes (Konyaev *et al*., 2012).

Actually, six species of *Echinococcus* have been recognized, but the most important members in this genus to public health and to the geographical distribution are *Echinococcus granulosus* (which causes cystic echinococcosis) and *E. multilocularis* (which causes alveolar echinococcosis) (Grosso *et al*., 2012). The first is considered to be one of the most important global parasitic infectious diseases of humans and animals and has a widespread distribution around the world. The adult worms inhabit the small intestine of carnivores, while intermediate hosts harbor the metacestodes (hydatid cysts) (Harandi *et al*., 2012 and Rajabloo *et al*., 2012) which develop in internal organs (mainly liver and lung) as unilocular fluid-filled bladders (Ibrahim *et al*., 2011; Jing *et al*., 2011 and Nakao *et al*., 2013). The pathology of the disease is mainly due to the physical pressure exerted on visceral organs by the developing cyst (Khoo *et al*., 1997). The distribution and prevalence of CE in any country depends on the presence of large numbers of nomadic or semi-nomadic sheep and goat flocks that represent the intermediate host of the parasite, and their close contact with the final host, the dog, which mostly provides the transmission of infection to humans (Grosso *et al*., 2012).

In Kurdistan region sheep are more desirable for rearing due to their consumption preference and they are more adapted to live with dogs than cattle and goats in addition to their grazing

habits as they eat the whole grass unlike goats which eat only the upper layer, all these factors have impact on the rate of infection. Limited epidemiological studies have been performed in Kurdistan region and variable rates of CE in sheep, goats and cattle have been reported ranged from 9.92 to 12.7% ,4.8 to 6.25 % and 4.3 to 6.25%, for sheep, goats and cattle, respectively (Saida and Nouraddin, 2011; Meerkhan and Abdullah, 2012; Hama, 2013 and Sargali and Mero, 2013).

The present study was conducted in Erbil province, Kurdistan region of Iraq where the conditions are different from those of other Kurdistan province, since all epidemiological conditions for autochthonous transmission of *Echinococcus* are given: sheep as important hosts are frequent, there are large numbers of dogs, traditional methods of animal husbandry, unsupervised home slaughtering of livestock, and frequent absence of appropriate control program which favors the transmission of *Echinococcus spp*.. The aim of this study was to determine the prevalence of CE infection in slaughtered animals at Erbil abattoirs (Erbil center, Shaqlawa, Koya and Soran), in addition to the determination of organ predilection for the cyst development and the fertility of cysts as well as the viability of their protoscolices.

Materials and methods

Abattoirsurvey:

This study was undertaken for 12 months from June 2013 to July 2014. The capacity of the abattoirs depend on the number of animals slaughtered per month and the variety of animals slaughtered (sheep, cattle and goats) with main objective to determine the prevalence of CE. The data collected for each animals included: (a) sex; (b) host age (<1 yr, 1–3 yrs and >3 yrs for sheep, cattle and goats); (c) month of slaughtering and (d) site. The animal ages were estimated by examining their teeth because both adults and young animals were slaughtered. A total number of 4092 animals (2556 sheep, 924 cattle and 612 goats) were examined for the presence of CE in their visceral organs.

Examination of slaughtered animals:

During inspection with regular visits to the local abattoirs in Erbil province throughout the study, carcasses and their respective organs (liver, lungs, spleen, kidneys, heart and peritoneum) were carefully examined by visual inspection, palpation and systematic incision of each organ to detect and collect hydatid cysts. All infected organs were recorded, removed and separately kept in a clean container and transport to the laboratory. The cysts were carefully removed from organs with scalpel and then transported in clean tray containig crushed ice, the size of the cysts was measured in diameter and classified as small (1-3 cm), medium (4-7 cm) and large (above 8 cm) and the location of each cyst was recorded. Individual cyst was carefully incised and examined for protoscolices which look like white dots on the germinal layers.

Fertility and viability of Hydatid Cysts:

Individual cysts (fig. 1) were grossly examined for degeneration and calcification. The later one produce slightly turbid fluid and the hydatid fluid from each cyst was aspirated by a large-sized, sterile syringe and then transferred to a sterile petri dish or test tube. The collected fluid was left to sediment or centrifuged at 8000 rpm for 5 min, to determine their fertility, as indicated by the presence of protoscolices. The viability of each cyst was determined by placing a drop of the centerifuged sample on a slide together with a drop of 0.1% aqueous eosin solution(v/v) and covered with a cover slip and examined under 40X(flame cell activity, peristaltic motility together with staining 0.1% aqueous eosin solution). Living protoscoleces did not take up the stain, unlike the dead ones, then the viability was determined by counting living protoscolices.

Statistical analysis:

Data collected from antemortem, postmortem, and laboratory finding were entered into MS Excel and SPSS such as graph pad prism version 6. 01 to analyze the results, $P < 0.05$ considered significant.

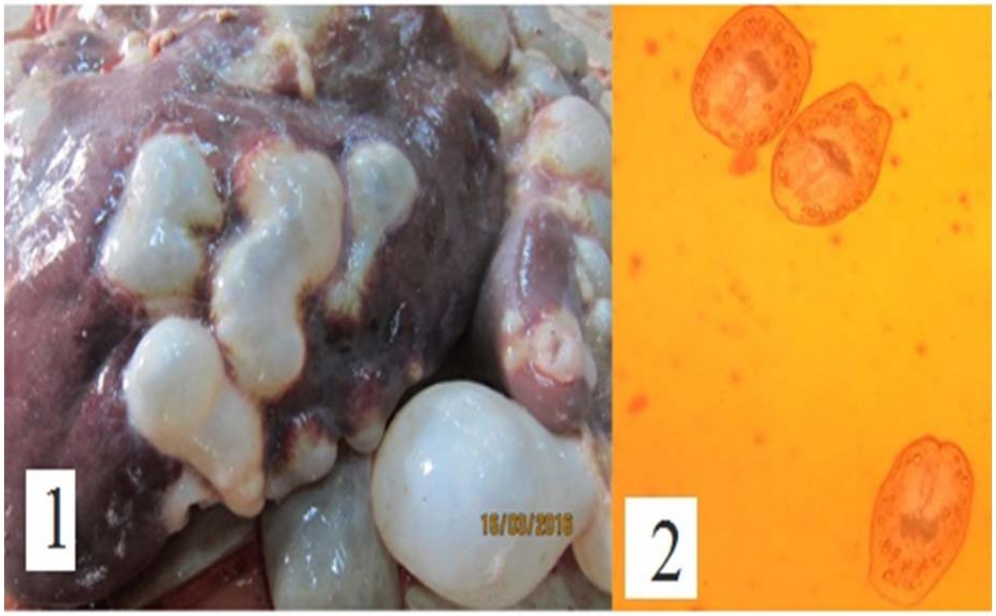

Figure (1): Shows 1- Liver of sheep infected with CE: The fluid in deep cyst aspirated for detecting the protoscolices, 2-Viable scolices

Results

The results of the prevalence of hydatid cysts in sheep, cattle and goats during this study are shown in Table (1). The total rate of infection was 11.17% (457/4092) in animals from both sexes slaughtered at Erbil abattoirs, with the highest rate of infection among sheep as 371/4092(9.07%), whereas, the rate of infection in both cattle and goats was low (1.56 and 0.54%, respectively) (table.1).

Regarding the gender, the rate in female sheep was higher than that of female cattle or goats, but the overall rate of infection in females versus males was slightly higher but statistically non-significant (P>0.05%) among all studied intermediate hosts. If results were analysed according to the rate of infection among males and females of each intermediate host separately, also slight differences were observed between both sexes (table.1) which were statistically non-significant (P>0.05%).

Table 1: The Prevalence of hydatid cyst among all slaughtered animals of both sexes

Species	No. of inspected animals			No. of Infected with percentage				Total No. of infected with percentage	
	Male	Female	Total	Male	(%)	Female	(%)	No.	(%)
Sheep	1825	731	2556	171	4.18	200	4.89	371	9.07
Cattle	752	172	924	29	0.71	35	0.86	64	1.56
Goats	375	237	612	12	0.29	10	0.24	22	0.54
Total	2952	1140	4092	212	5.18	245	5.99	457	11.17

When the results were analysed between the three intermediate hosts (table.2), the picture differ in some aspects, such as the highest rate (14.51%) of sheep infection in contrast to other hosts, in addition to the higher rate of infection in females of sheep and cattle versus males (27.36 and 20.35 versus 9.37 and 3.86). While in goats the rate in females was slightly higher than males (4.22 versus 3.20).

Table 2: The Prevalence of hydatid cyst among both sexes of infected animals (No=457)

Species	No. of inspected animals			No. of infected with percentage				Total No. infected with percentage	
	Male (2952)	Female (1140)	Total (4092)	Male (212)	(%)	Female (245)	(%)	No. (457)	(%)
Sheep	1825	731	2556	171	9.37	200	27.36	371	14.51
Cattle	752	172	924	29	3.86	35	20.35	64	6.93
Goats	375	237	612	12	3.20	10	4.22	22	3.59

The rate of infection increased proportionally with the age of the animal as shown in table 3. In sheep, cattle and goats, the highest rate of infection was among the ages over three years (18.75, 5.41 and 1.69%, respectively). The lowest rate was noted in the age groups less than one year (3.96 and 0.25%, o.33 respectively), and these rates were statistically significant ($p<0.0068$).

Table 3: Prevalence rate of hydatid cyst among different ages from total number infected

Species	Total No. of Inspected Animals				No. of Infected Animals			Total Number	
	Less than one year	1-3 years	Over 3 years	Total	Less than one year	1-3 years	Over 3 years	No.	(%)
Sheep	885	1308	363	2556	48(3.96)	212(9.26)	111(18.75)	371	9.07
Cattle	79	693	152	924	3(0.25)	29(1.27)	32(5.41)	64	1.56
Goats	248	287	77	612	4(0.33)	8(0.35)	10(1.69)	22	0.54
Total	1212	2288	592	4092	55(4.54)	249(10.88)	153(25.84)	457	11.17

The monthly infection rates are shown in table (4), in which sheep showed high rate of infection throughout the year with peaks during May to July which were 19.44, 17.59 and 18.14%, respectively, on the other hand, the rates of infection in cattle and goats were low throughout the year, with the highest percentage in cattle (11.67%) in April and for goats (5.26%) in December, but these differences were statistically non-significant ($P>0.05$)

Table 4: The monthly distribution of hydatid cysts in cattle, sheep and goats from July 2013 to June 2014

	Month	Species of Animal					
		Sheep		Cattle		Goats	
		No. of examined animals (2556)	No. of infected (%) (371)	No. of examined animals (924)	No. of infected (%) (64)	No. of examined animals (612)	No. of infected (%) (22)
2013	July	204	37(18.14)	84	4(4.76)	41	2(4.88)
	August	192	28(14.58)	84	4(4.76)	61	3(4.92)
	September	216	33(15.28)	96	5(5.21)	49	1(2.04)
	October	204	32(15.69)	72	4(5.56)	37	1(2.7)
	November	228	34(14.91)	72	5(6.94)	73	3(4.1)
	December	240	29(12.08)	84	5(5.95)	57	3(5.26)
2014	January	240	25(10.42)	72	3(4.17)	49	2(4.08)
	February	204	24(11.76)	84	7(8.33)	27	1(3.7)
	March	204	23(11.27)	72	8(11.1)	61	1(1.64)
	April	192	26(13.54)	60	7(11.67)	49	1(2.04)
	May	216	42(19.44)	72	6(8.33)	61	2(3.28)
	June	216	38(17.59)	72	6(8.33)	47	2(4.26)
	Total	2556	371(14.51)	924	64(6.93)	612	22(3.59)

Regarding the size, the higher numbers of small sized cysts (1-3cm in diameter) were found in the liver (98/175), while the highest numbers of large sized cysts (above 8cm in diameter) were found in mixed infection (liver and lungs) which were 69/165. In spleen most of cysts were small sized (11/15), with no large sized cysts (table 5). The variation in cyst size in different organs was statistically significant ($p < 0.0001$).

Table 5: The size categories of the cysts

Organs	Small (1-3cm) (173)	(%)	Medium (4-7cm) (145)	(%)	Large (above 8cm) (139)	(%)	Total (457)	(%)
Liver	98	21.44	55	12.04	22	4.81	175	38.29
Lungs	23	5.03	31	6.78	48	10.50	102	22.32
Mixed	41	8.97	55	12.04	69	15.10	165	36.11
Spleen	11	2.41	4	0.88	0	0.00	15	3.28

The distribution of CE in different organs of infected animals is shown in table 6. It's obvious from the results that the highest rate of infection in sheep was in both liver and lungs and liver alone (39.62% and 39.08%, respectively) while in cattle the highest rate of infection (45.31%) was in lungs. On the other hand, the highest rate (50%) in goats was in liver.

In terms of the fertility rate for hydatid cysts, cysts were selected from different slaughtered animal species, the fertility of the liver cysts in sheep and goats was higher (34.23 and 45.45%) than that of cattle cysts (15.63%) as shown in table (7). Statistically the differences in fertility rate among different intermediate hosts was significant ($p < 0.05$). On the other hand, the rate of sterile cysts was higher in lungs than in liver of cattle accounting for 28.13 and 12.5%, respectively. With respect to calcified cysts, the highest rate (4.69, 4.55%) was found in cattle and goats lungs, respectively.

Table 6: Prevalence and organ predilection of hydatid cysts in slaughtered animals

Infected Organs	Species of animals							
	Sheep (371)		Cattle (64)		Goat (22)		Total infected Organs	
	Infected number	(%)	Infected number	(%)	Infected number	(%)	No.	(%)
Liver	145	39.08	19	29.69	11	50.00	175	38.29
Lung	65	17.52	29	45.31	8	36.36	102	22.32
Spleen	12	3.23	2	3.13	1	4.55	15	3.28
Liver and Lungs	147	39.62	14	21.88	2	9.09	163	35.67
Liver, Lung and Spleen	2	0.54	0	0.00	0	0.00	2	0.44
Total	371	81.18	64	14.00	22	4.81	457	11.17

Table 7: The types of hydatid cysts recovered from infected slaughtered animals in different abattoirs of Erbil province

Species	Type of Cysts	No. of infected animals with Percentage											
		Liver		Lungs		Spleen		Liver and Lungs		Liver, Lungs and Spleen		Total No. of infected animals	
		No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	%
Sheep	Fertile	127	34.23	53	14.29	9	2.43	134	36.12	2	0.54	325	87.6
	Sterile	13	3.50	5	1.35	2	0.54	10	2.70	0	0	30	8.09
	Calcified	5	1.35	7	1.89	1	0.27	3	0.81	0	0	16	4.31
	Total	145	39.08	65	17.52	12	3.23	147	39.62	2	0.54	371	81.18
Cattle	Fertile	10	15.63	8	12.50	1	1.56	7	10.94	0	0	26	40.63
	Sterile	8	12.50	18	28.13	1	1.56	7	10.94	0	0	34	53.13
	Calcified	1	1.56	3	4.69	0	0.00	0	0.00	0	0	4	6.25
	Total	19	29.69	29	45.31	2	3.13	14	21.88	0	0	64	14.00
Goats	Fertile	10	45.45	4	18.18	1	4.55	2	9.09	0	0	17	77.27
	Sterile	1	4.55	3	13.64	0	0.00	0	0.00	0	0	4	18.18
	Calcified	0	0.00	1	4.55	0	0.00	0	0.00	0	0	1	4.55
	Total	11	50.00	8	36.36	1	4.55	2	9.09	0	0	22	4.81

The viability of the protoscolices of fertile cyst was determined by flame cell activity, peristaltic motility together with staining 0.1% aqueous eosin solution. A total of 65 HCs from sheep, cattle and goats were tested as indicated in Table (8). The rate of viability in sheep was higher (86.73%) than goats and cattle which were (74.31% and 57.13%), respectively. The highest percentage of stained protoscolices were found in cattle (42.87%), followed by goats and sheep which were 25.69% and 13.27%, respectively.

Table 8: Viability rate of Protoscolices of hydatid cysts in slaughtered animals (n=65 examined)

Species of Animals	No. of Cyst Examined	Unstained Protoscolices (%)	Stained Protoscolices (%)
Sheep	37	86.73	13.27
Cattle	15	57.13	42.87
Goats	13	74.31	25.69

Discussion

Epidemiological study in Erbil province, showed that 11.17% of the slaughtered sheep, cattle and goats were infected with CE, with the highest prevalence rate among sheep followed by cattle and then goats which were 9.07, 1.56 and 0.54%. From total number slaughtered, the rate among infected slaughtered animals were 14.51, 6.92 and 3.59 % respectively; also with the peak in sheep. This is in agreement with the results of Meerkhan and Abdullah (2012); Saida and Nouraddin (2011), Al-Berwari, 2012; Al-Bosely (2014) and Hama (2013). In all these studies the highest rate of infection was in sheep although the rates were fluctuating, but in all these studies the highest rate of CE was reported from sheep. This indicate the high susceptibility of sheep to this parasite, furthermore, the molecular studies performed in Kurdistan proved that the sheep strain is the most prevalent strain in this area (Ahmad *et al*., 2013 and Hama *et al*., 2013). On the other hand, the lowest rate was seen in goats, this finding is in agreement with Bajalan (2006) in Kalar; Kadir and Rashid (2008) in Kurkuk and Mero *et al*., 2014 in Slemania due to feeding habit of this animal, as they eat the higher parts of herbage that are exposed to the sunlight which decrease the viability of the eggs or difficulty for dogs to uphill to these area for the defecation. In cattle, the low rate may be due to rearing them in cowshed with better care which relatively has no contact with the source of infection (Thompson and McManus, 2002).

The infection in sheep was reported at high rates, this is of great epidemiological importance as CEs are responsible for progression of the life cycle and therefore, acting as a reservoir for human CE (Dyab *et al*., 2005; Daryani *et al*., 2007; Saida and Nouraddin, 2011; Meerkhan and Abdullah, 2012; Adwan *et al*., 2013; Ezatpour *et al*., 2013 and Hanifian *et al*., 2013). Livestock CE is widespread through many regions of Middle East and other Arab countries (Sadjjadi, 2006 and Torgerson *et al*., 2006) and these regions are considered as endemic areas for *E. granulosus.* Epidemiological data were varying between, Syria (5%-17%); Israel (4.56%-10%), Palestine (9%); Saudi Arabia (8.28%-12.61%) and Aden Governorate-Yemen (0.5%-2.6%) (Ibrahim, 2010; Grosso *et al*., 2012; Muqbil *et al*., 2012 and Adwan *et al*., 2013). These differences in the rates may be attributed to the variability in the origin of animals, mode of grazing and other environmental factors and to pertaining to the dog definitive host. Al-Abbassy *et al*., (1980) in Baghdad abattoir (Iraq) stated that low rates of infection are related to different factors such as periodical killing of dogs, improved standards of meat inspection and overall improvement in socioeconomic conditions.

In the present study, female sheep and cattle showed slightly higher rate of infection than males (27.36 and 20.35% versus 9.37 and 3.86%), while in goats slight difference was found between both sex (4.22 versus 3.20%). Regarding the sex of slaughtered animals, similarly, Hama (2013); Sargali and Mero (2013) in Iraq; and Muqbil *et al*., (2012) in Yemen, stated that female animals showed higher infection rates than males. This could be attributed to the rearing of females for longer period of times than males in order to give offspring. In contrast, most males are slaughtered at young ages of 6 months to less

than 18 months. In younger animals, either hydatid cysts have not developed to detectable size so are too small and easy to miss. Females were also reported showing higher prevalence than males in Saudi Arabia (Ibrahim, 2010), Jordan (Kamhawi *et al*., 2009), Iran (Daryani *et al*., 2007) and Pakistan (Iqbal *et al*., 2012). While Mero *et al*., 2014 in Slemani province, found that the sex of the slaughtered animals has no significant effect on the distribution of CE, as the rate of CE in males (13.04, 4.8 and 4.42%) and female (12.57, 4.9 and 4%) in sheep, goats and cattle, respectively, were very close; and stated that both sexes has the same chance to get infection which usually depend on the contact with the source of infection and habit of grazing.

The prevalence of CE increase with the age, and usually animals are slaughtered at ages varies with countries and cultures, therefore, prevalence will typically be over-estimated if older animals are slaughtered and under estimated if younger animals are slaughtered (Barnes *et al*., 2012, Qingling *et al*., 2014 and Al Kitani *et al*., 2015). Adult animals were more likely to have CE than younger ones. Such an age-dependent increase in infection rate is to be expected given the shorter time of exposure of young animals or presumably related to the length of period required for the development of a detectable cyst. The age of the host has been largely recognized as an infection determinant for many farm species. Numerous studies have recorded higher prevalence of hydatidosis in old animals compared to young ones. Small ruminants (sheep and goats) three years or older were also found to be 1.6 times more at risk as compared to the younger groups. Additionally, an increase of cyst abundance has been reported in older age groups of farm animals (Al-Abbassy *et al.*, 1980; Kamhawi *et al*., 2009 Ibrahim, 2010; Ibrahim *et al*., 2011; Andresiuka *et al*., 2013 and Qingling *et al*., 2014).

When the result were analysed on monthly basis (table 4), sheep showed high rate of infection throughout the year with peaks during May to July which were 19.44, 17.59 and 18.13%, respectively. On the other hand, the rates of infection in cattle and goats was low throughout the year, with the highest percentage in cattle (11.67%) in April and for goats (5.26 %) in December, this is partly in agreement with Meerkhan and Abdullah (2012), as they stated that sheep showed the highest hydatidosis prevalence (13.305%) in July, and the lowest percentage(7.883%) in June While in goats and cattle, the highest percent of infection was shown in Jan. and June which was 9.091% and 13.24%, and the lowest percent of infection was found in August and February which was 3.984% and 7.46%, respectively. Also Sargali and Mero (2013) found that sheep and goats showed the highest percentage (22.8% and 11.05%) during July and October, whereas, the lowest percentage (8.1% and 2.53%) was observed during April and December, respectively. It is obvious from these results that the rate of CE in sheep was higher than that of goats; this may be due to the management type and outdoor rearing of sheep which is in a wider scale than that of goats.

Regarding the size of the cysts, the higher numbers of large sized cysts were found in both liver and lungs, followed by lungs and liver, which were 15.1%, 10.5% and 4.81% respectively, this coincide with Al-Shaibani *et al*., (2015) who stated that the higher numbers of small, medium and large sized cysts were found in lungs than liver. The reason for higher percentage of small, medium and large cysts in the lung and liver may be due to soft consistency of the tissues of these organs.

Predilection seat of *Echinococcus* metacestodes in different organs revealed that among infected slaughtered animals, the liver and both the liver and lungs were found to be the most commonly infected organs. Low rate of mixed infection (liver, lungs and spleen) was recorded. The higher rate of liver and both (liver and lungs) involvement because liver act as the first filter for larval infection and the lungs act as the second filter, furthermore the liver possess the first great capillaries sites encountered by migrating the *Echinococcus* oncosphere (hexacanth embryo) which adopt the portal vein route and primarily negotiate hepatic and pulmonary filtering system sequentially before any other peripheral organ is involved (Kebede *et al*., 2009; Khalf *et al*., 2014; Mero *et al*., 2014 and Qingling *et al*., 2014). The liver of sheep and goats were found to be more commonly infected with hydatid cysts than the lungs is in agreement with the previous findings of Saeed *et al*.(2000); Yildiz and Gurcan (2003); Haridy *et al*.(2006); Kamhawi *et al*.(2009); Saida and Nouraddin (2011); Jarjees and Al-Bakri(2012), and Khalf *et al*.(2014). In contrast Sargali and Mero (2013) found 56.1% of HC in lungs and 36.25% and 7.66% in liver alone and both liver and lungs, and in goats, 67.31, 25.5 and 7.2% of HC were

found in lungs, liver and both liver and lungs, respectively.

In cattle the lungs were the predominant site for CE (45.31%), followed by the liver (29.69%), while the least (3.13%) was for spleen. Similarly AL.Bosely (2014) in Duhok city showed that in cattle, the rate of infection in lungs was 50%, followed by both liver and lungs (38.88%), while the least (11.11%) was for liver alone, also Jarjees and Al-Bakri (2012) in Mosul found the predominant site of cyst in cattle was the lungs (50%) and concurrent infections of both of the liver and lung were 25%. There are two ways through which the infection can be transferred to the lungs, the most common route is alimentary tract of intermediate host, when hatched oncosphere penetrate intestinal wall to enter blood vessels then transported to liver and lungs via blood. The second route, the larvae may be liberated from eggs during rumination which may gain direct access to the lungs through trachea. The present results disagree with Köse and Sevimli, (2008) Mero *et al*. (2014) and El Berbri *et al*. (2015) who found that the co-infection of the liver and lungs was the predominant, than that of lungs and liver separately.

The presence of protoscolices attached to the germinal layer in the form of brood capsule or the presence of the daughter cysts was indicative of the fertility of the hydatid cysts, since fertile cysts were considered to propagate the infection. Irrespective of the animal sex, cysts in liver showed the highest fertility rate (34.23%, 45.45% and 15.63) in slaughtered, sheep, goats and cattle which were higher than for other organs (Table 7). These observations are in agreement with Saeed *et al*. (2000); Azlaf and Dakkak (2006); Daryani *et a*l.(2007) and Jarjees and Al-Bakri(2012). Liver was the common organ which harbored fertile cysts followed by the lungs and spleen. AL.Bosely (2014) observed higher rates of fertile cysts in sheep and goats (81% and 39.06) than the sterile (13% and 35.93%) and calcified (6% and 25%), respectively. In contrast also Chaligiannis *et al*.(2015) reported that cyst fertility was constantly higher in lungs than liver in both sheep and goats (4% and 2.7%; 2.4% and 0.45%, respectively). while in cattle; the number of sterile cyst was higher (79.03%) than the fertile and calcified cysts (17.74% and 3.22%), respectively. Contrarily, a study carried out in Romania reported that most fertile cysts were found in the lungs of sheep (58.7%; 182/310), while in cattle only 3 cysts were fertile (1%) in lungs, the fertility rate of the cyst was not influenced by sex (Mitrea *et al*., 2014). Also Costin *et al*., (2015) stated that cattle harbor predominant sterile cysts and play no significant role in the parasite transmission cycle. However, they could serve as indicators for CE infection pressure in endemic areas and Al Kitani *et al*. (2015) in Sultanate of Oman isolated the highest number of the fertile cysts from camels (52%) followed by cattle (14.1%) and goats (9.7%). No fertile cyst was identified from sheep. On the other hand, the rate of protoscolices viability in sheep was higher (86.73%) than goats and cattle (74.31% and 57.13%), respectively. This is in agreement with AL.Bosely (2014) who found the highest percentage of protoscolices viability in sheep and goats (87.21% and 76.13), also Dalimi *et al*. (2002) in western Iran also reported higher viability (82%) in sheep than that in cattle (75%), while Elmajdoub and Rahman (2015) stated that the viability rate of protoscolices that were recovered from all slaughtered livestock was 75.6%. The differences in viability rate using 1% eosin stain, it might be necessary to estimate the time to absorb the stain, because the viable protoscolices did not absorb the stain until they were dead, but if the Protoscolex is dead or not viable, the stain would enter into the Protoscolex after 5 - 8 min. Usually, the variation in the viability of protoscolices might be related to the difference in the immunological response of each host and calcareous corpuscles in the protoscolices.

Conclusion

In conclusion sheep play an important role in spreading of the disease due to their high susceptibility rates and fertility of the developed cysts. The high number of stray dogs, the contamination of water, food and environment with *E. granulosus* eggs, in addition to the large number of slaughtered animals outside slaughterhouses which their organs were not inspected by veterinarian, and if found infected were fed to stray dogs or cats acts as a positive source of infection. All these factors have a positive impact on the epidemiology of the disease.

Acknowledgments

The authors thanks the, the Dept. of Biology, Faculty of Science, University of Zakho for providing research facilities and financial support

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پوختە:

نەخۆشی تورەگەی ئاوی یان تورەگەی ئاوی رووەدات بە هۆی قۆناغی لارڤی کرمی *Echinococcus granulosus* کە بەردەوام دەبیت و هۆکاری بنچینەی توش بوون و لەناوچوونە لە زۆربەی بەشەکانی جیهان. هەرێمی کوردستان ناوچەیەکی توشبوە بەم نەخۆشیە. ئەم تویژینەوەیە ئەنجام درا بۆ پشکنین و رووداون و جیاکردنەوەی تورەگەی ئاوی لە مەرو ڕەشە ولاخ و بزن لە ماوەی تەموزی 2013 تا حوزەیرانی 2014. ڕێژەی گشتی توش بوون بریتیە لە 11.17٪ (457/4092) لەگەل بەرزترین ڕێژە 9.07٪ لە مەر و نزمترینیان 0.54٪ لەبزن.سەرەرای رەگەزی ئاژەلە توش بووەکان، میەکان دەریان خست کە ڕێژە توش بوون کەمیك بەرزترە لە نێرەکان (5.99٪ پیچەوانەی 5.18٪) کە کاریگەری بایەخداری نەبوو (P>0.05). لە نیوان هەرسێ خانە خۆیی، مەر دەرکەوت بەرزترین ڕێژەی توش بوونی هەیە(14.51٪). سەرەرای رەگەزی میەی مەر و ڕەشە ولاخ پیشانیاندا ڕێژە توش بوون بەرزترە پیچەوانەی نێرەکان (27.36، 20.35 پیچەوانەی9.37، 3.86). لەوەش زیاتر و بەرزترین رووداونی تورەگەی ئاوی لە مەر و ڕەشە ولاخ و بزن بیندرا لە تەمەنی سەروو سێ سالی (18.75، 5.41، 1.69٪) یەك بەدوای یەك. بەلام نزمترین ڕێژە بەدی کرا لە تەمەنی کەمتر لە یەك سالّ (3.96، 5.25، 5.33٪) یەك بەدوای یەك. لە لایەکی ترەوە لە مەر بەرزترین ڕێژەی توش بوونی تۆمار کرد لە هەموو سالەکە لەگەل بەرزترین ڕێژە لە مانگی ئایار و تەمۆز کە بریتیبو 19.44٪ و 18.14٪ یەك بەدوای یەك، لە دوای ئەویش چێل و بزن (11.67٪و 5.26٪) لە مانگی نیسان و کانونی یەکەم یەك بەدوای یەك، سەرەرای قەبارەکەی، زۆرترین ژمارەی قەبارەی بچوکی تورەگەی ئاوی بیندرا لە جگەر (175/98) ،لە هەمان کاتدا زۆرترین ژمارەی قەبارەی گەورەی کیس بیندرا لە جگەرو سیەکان کە بریتیە لە (165/69). جگەر و جگە و سیەکان بەدیار دەکەون وەك شوینی ئارەزوکردن لە مەر، سیەکان لە چێل و جگەر لە بزن. هەر لەبەر ئەوەش بەرزترین ڕێژەی توش بوون تۆمار کراوە لەم ئەندامانە. سەرەرای ڕێژەی چالاکی(fertility) تورەکە ئاویەکان، بەرزترینیان لە مەڕدا 87.6٪ لە دوای ئەو بزن 77.27٪ و پاشان چێل 40.63٪.

دراسه وبائيه حول الاكياس العدريه او المائيه في الاغنام والماعز والابقار في محافظة اربيل– اقليم كردستان– العراق

الملخص:

يعتبر داء الاكياس العدرية او المائية الذي تسببه الاطوار اليرقية لدودة الكلاب الشريطية (*Echinococcus granulosus*) كمسبب رئيسي لامراضية وهلاك المواشي في عدة مناطق من العالم. يعتبر اقليم كردستان كمنطقة متوطنة لهذا المرض.

اجريت هذه الدراسة الوبائية للاغنام والماعز والابقار خلال الفترة من تموز 2013 لغاية حزيران 2014 للتحري عن مدى حدوث المرض في هذه الحيوانات. اظهرت الدراسة نسبة اصابة كلية بلغت 11.17٪ في جميع الحيوانات التي شملتها، وكانت اعلى نسبة (9.07٪) في الاغنام واقلها (0.54٪) في الماعز. بالنسبة للجنس اظهرت الاناث نوعا ما نسبة اعلى مقارنة بالذكور (5.99مقارنة ب5.18٪) ولكن هذا الاختلاف لم يكن معنويا ($P < 0.05$). من بين الحيوانات المصابة، اظهرت الاغنام اعلى نسبة اصابة (14.51٪) و بالنسبة لجنس الحيوان كانت الاصابة في اناث الاغنام والابقاراعلى مقارنة بذكورها (27.36 و 20.35 مقارنة ب 9.37 و 3.86٪ على التوالي). بالنسبة للعمر، كانت نسبة الاصابة اعلى في الفئات العمرية التي تزيد اعمارها عن 3 سنوات من الاغنام والابقار والماعز (18.75و 5.41 و1.69٪ على التوالي). بينما سجلت اقل نسبة للاصابة في الفئة العمرية الاقل من سنة (3.96 و 0.33 و 0.25٪ على التوالي). من الناحية الاخرى كانت نسبة الاصابة عالية في الاغنام على مدار السنة وبلغت ذروتها في ايار وتموز حيث كانت 19.44 و 18.14٪ على التوالي. تلتها الابقار وثم الماعز (11.67 و 5.26٪) في الاشهر نيسان وكانون الاول.

بالنسبة لحجم الاكياس عزلت اعلى نسبة (98\175) من الاكياس الصغيرة من الكبد بينما عزلت اعلى نسبة من الاكياس الكبيرة (69\165) من كل من الكبد والرئة معا ، واتضح ان افضل الاعضاء المصابة هي كل من الكبد والكبد والرئتين في الاغنام والرئتين في الابقار والكبد في الماعز. فيما يخص خصوبة الاكياس، كانت اعلاها في الاغنام (87.6٪) تلاها الماعز (77.27٪) واقلها في الابقار (40.63٪).