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# Prevalence and Fertility Survey of Hydatid Cyst in Slaughtered Livestock in Hamadan Abattoir, Western Iran, 2015 - 2016

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## Abstract

**Background:** Cystic echinococcosis (CE) is a cosmopolitan zoonotic infection which is considered as a significant public health and economic concern. Livestock is the main intermediate host for *Echinococcus granulosus*.
**Objectives:** This study was conducted to evaluate the prevalence and fertility rate of hydatid cyst among livestock in Hamadan area, western Iran.
**Methods:** A total of 10626 livestock carcasses were examined through visual inspection in order to detect hydatid cyst in Hamadan industrial slaughterhouse, during 2015 - 2016. The viability and fertility of hydatid cyst were determined microscopically by flame cell activity and eosin dye uptake.
**Results:** The carcasses, including 8684 sheep, 1110 goats and 832 cattle were inspected in order to detect hydatid cyst. An overall CE was detected in 3% of the inspected carcasses with a prevalence rate of 5.3% in cattle, 3% in sheep and 1% in goats ($P < 0.001$). The prevalence rate of infection in the females (2.7%) was more than males (0.3%) ($P < 0.001$). All of the infected animals were aged one year or more. The highest rate of infection in internal organs was found in the lungs (47.2%). The highest and the lowest fertility rate of hydatid cyst were observed in sheep (69.3%) and cattle (6.8%), respectively. The most of hydatid cysts which obtained from cattle (79.6%) were suppurative or calcified.
**Conclusions:** This study shows that the prevalence rate of CE is considerable in the area and sheep appear to be the most important intermediate hosts for *E. granulosus* tapeworm.

*Keywords:* Echinococcosis, Iran, Livestock, Prevalence, *Echinococcus granulosus*

## 1. Background

Cystic echinococcosis (CE) is one of the most important helminth zoonotic diseases caused by the larval stage of *Echinococcus granulosus*, a taeniid tapeworm, with worldwide distribution. The life cycle of *E. granulosus* involves two mammalian hosts which are included carnivorous and herbivorous animals. In domestic life cycle of the parasite, dog and livestock was involved as definitive and intermediate host, respectively. Larval stage, hydatid cyst, is formed in inner organs of the intermediate host after ingestion of the parasite egg (1). Hydatid cyst slowly develops and mostly observed in liver (> 65%) and secondly in lungs (25%) although other organs such as spleen, heart, kidneys, bone, eyes and central nervous system can be involved (2).

CE has an extensive distribution and a broad range of hosts in the world. The cosmopolitan zoonotic infection is an important concern for public health and economiclosses in the highly endemic areas including Southern America, Northern and Eastern Africa, Western and Central Asia, in the Mediterranean region, China and Australia (2). The global burden of CE including health and socioeconomic problems and monetary cost of the given disease is considerable for society. It is assessed 1,009,662 disability-adjusted life years (DALYs) or at least 763.98 million U.S. dollars is expended, for human financial burden of disease, and approximately 190.13 million U.S. dollars costs in order to reduce the livestock production, annually (3).

This zoonosis is endemic and prevalent in the most parts of Iran where several species of livestock (sheep, cattle, goat, buffalo and camel) act as intermediate host. Also up to 49% of dogs harboring is adult parasite. The incidence rate of human CE is estimated 1.18-3 cases per 100,000 people, according to surgical reports from various parts of the country, and approximately 1% of surgical operations are related to hydatid cyst surgery (4, 5). Also, CE burden in Iran is significant which includes 635,232 asymptomatic individuals, 93.39 and 132 million U.S. dollars cost for human disease and livestock production loss, respec-

tively (6).

## 2. Objectives

According to the previous reports (7, 8) Hamadan district is endemic for CE, therefore, necessity to renew information about the situation of infection and better understanding of epidemiological disease factors, this study was designed in order to evaluate the prevalence and fertility of hydatid cyst in livestock slaughtered animals in Hamadan abattoir.

## 3. Methods

### 3.1. Sample collection

In this descriptive cross sectional study, a total of 10626 slaughtered animals including 8684 sheep, 1110 goats and 832 cattle were investigated in Hamadan industrial slaughterhouse from March 2015 to April 2016. Visit of the slaughterhouse was performed periodically and hydatid cyst survey of livestock was conducted with post mortem inspection. After killing livestock, some features such as type of animal, age, gender, contamination, infected organ, number of cysts and etc. were recorded for each animal in a separate checklist. Carcasses were inspected with visual and physical examination. Furthermore, livers and lungs were investigated by making some incisions.

### 3.2. Cyst Examination for Fertility, Protoscoleces Viability and Bacterial Infectivity

All hydatid cysts were grossly inspected for degeneration and calcification. Intact cysts were transferred to the parasitology research laboratory of Hamadan University of Medical Sciences. Before opening, the cyst fluid was aspirated in clean container. Then, the germinal layer of cyst was removed and dipping and washing in the cyst's liquid several times. After contents deposition, the sediment was microscopically examined in order to evaluate fertility and bacterial infection. The viability of protoscoleces was determined by motility of flame cells and protoscoleces activity, as well as dye-uptake, dead cells stained with eosin 0.1%.

### 3.3. Statistical Analysis

Descriptive statistics and Chi-square test were applied in order to analyze the data with significance level of less than 0.05 using SPSS 16 software.

## 4. Results

A total of 10626 livestock carcasses were examined of which 316 cases (3%) were positive for CE (Figure 1). Prevalence rates of hydatid cyst were 5.3% in cattle, 3% in sheep and 1% in goats ($P < 0.001$). Both male and female of animals were found infected by CE with frequencies of 0.3% and 2.7%, respectively ($P < 0.001$) (Table 1). All of the infected animals were aged one year or more and none of the animals with less than one year age were positive ($P < 0.001$) (Table 2).

High number, > 10 cysts, and low number, ≤ 10 cysts, of hydatid cysts were detected in 1.4% and 1.6% of the slaughtered animals, respectively. Hydatid cysts were detected in liver and lungs of slaughtered sheep, cattle and goats, however infected hearts were observed only in sheep. In all types of carcasses, most of hydatid cysts were found in lungs (Table 3).

The results of hydatid cyst fertility and protoscolices viability were shown in Table 4. The highest and the lowest fertility rate of hydatid cyst were observed in sheep and cattle, respectively. The viability rate of protoscolices recovered from the fertile hydatid cyst was significantly different in three types of slaughtered animals ($P < 0.001$). The most of examined hydatid cyst recovered from cattle were suppurative or calcified (Table 4).

## 5. Discussion

Echinococcosis/hydatidosis is a significant animal health and economic problem in many areas of the world. One of the important biological ability of the parasite, *E. granulosus*, is infectivity and adaptation to a wide range of intermediate and definitive host species under various environments. It is necessary in order to monitor and renew the epidemiological and economic data sets for endemic regions of echinococcosis/hydatidosis. Post-mortem examination, necroscopy, is a routine and standard method in order to detect CE in slaughtered animals. This way is often used for investigation of hydatidosis prevalence in livestock. Although abattoir surveys have limitations, false positives and bias, However this approach is economic and can be very useful for estimating the prevalence of some zoonotic helminth infections such as fascioliasis, dicrocoeliasis and particularly hydatidosis (2, 9).

By reason of different epidemiological conditions, there are various reports about the prevalence rate of livestock CE worldwide. Areas in North and Sub-Saharan Africa are highly endemic for hydatidosis. The high average prevalence rates were reported from Tanzania, Ethiopia and Libya with the prevalence of 35%, 32% and 20%, respectively (2).

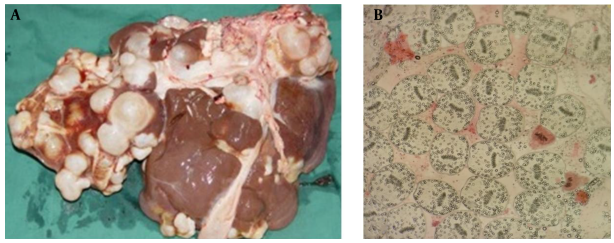

**Figure 1.** A, Hydatid Cysts in Sheep Liver and B, Isolated Protoscolices from Fertile Hydatid Cyst

**Table 1.** Prevalence Rate of hydatid Cyst in Slaughtered Livestock in Hamadan Abattoir [a]

| Animal Type | Infected | | Uninfected | | Examined | Infected |
|---|---|---|---|---|---|---|
| | Male | Female | Male | Female | | |
| **Sheep** | 19 (0.7) | 242 (4.1) | 2710 (99.3) | 5713 (95.9) | 8684 | 261 (3) |
| **Cattle** | 5 (2.1) | 39 (6.5) | 228 (97.9) | 560 (93.5) | 832 | 44 (5.3) |
| **Goats** | 2 (0.4) | 9 (1.4) | 466 (99.6) | 633 (98.6) | 1110 | 11 (1) |
| **Total** | 26 (0.8) | 290 (4) | 3404 (99.2) | 6906 (96) | 10626 | 316 (3) |

[a]Values are expressed as No. (%).

**Table 2.** Prevalence Rate of Hydatid Cyst in Different Age Groups of Slaughtered Livestock in Hamadan Abattoir[a]

| Animal Type | Age Groups (Infected), y | | Age Groups (Uninfected), y | | Examined |
|---|---|---|---|---|---|
| | < 1 | ≥ 1 | < 1 | ≥ 1 | |
| **Sheep** | 0 | 261 (4) | 2146 (100) | 6277 (96) | 8684 |
| **Cattle** | 0 | 44 (5.4) | 10 (100) | 778 (94.6) | 832 |
| **Goats** | 0 | 11 (1.1) | 66 (100) | 1033 (98.9) | 1110 |
| **Total** | 0 | 316 (3.8) | 2222 (100) | 8088 (96.2) | 10626 |

[a]Values are expressed as No. (%).

**Table 3.** Organ Distribution and Multiplicity of Hydatid Cyst in Slaughtered Livestock in Hamadan Abattoir[a]

| Animal Type | Infected Organ | | | | Multiplicity, Cysts | | Total |
|---|---|---|---|---|---|---|---|
| | Liver | Lungs | Both | Heart | ≤ 10 | > 10 | |
| **Sheep** | 115 (44.1) | 122 (46.8) | 21 (8) | 3 (1.1) | 129 (49.4) | 132 (50.6) | 261 |
| **Cattle** | 18 (40.9) | 21(47.7) | 5 (11.4) | - | 30 (68.2) | 14 (31.8) | 44 |
| **Goats** | 5 (45.5) | 6 (54.5) | - | - | 6 (54.5) | 5 (45.5) | 11 |
| **Total** | 138 (43.7) | 149 (47.2) | 26 (8.2) | 3 (0.9) | 165 (52.2) | 151 (47.8) | 316 |

[a]Values are expressed as No. (%).

CE is still considered as a zoonotic helminth infection that causes public health concern in many regions of Europe, with more impact in Mediterranean regions (Greece, Spain, Italy, and Turkey) and Southeastern countries of Europe including Romania and Bulgaria. The high average of ovine hydatidosis was reported from Greece, Italy and Turkey with ranging of 20% to 54% (2). In South America, some areas have been affected more intensely by CE. The average of hydatidosis prevalence in sheep was estimated 9% in Argentina, 13.6% in Brazil and 75% in Peru (2).

**Table 4.** Characteristics of Hydatid Cysts Recovered from Slaughtered Livestock in Hamadan Abattoir

| Animals Type | Characteristics of Hydatid Cysts [a] | | | Cyst Examined [b] | Viability of Protoscolices [c] |
|---|---|---|---|---|---|
| | Fertile | Sterile | Suppurative or Calcified | | |
| **Sheep** | 181 (69.3) | 76 (29.1) | 4 (1.6) | 261 | 82.2 ± 13.4 |
| **Cattle** | 3 (6.8) | 6 (13.6) | 35 (79.6) | 44 | 36.7 ± 11.5 |
| **Goats** | 2 (18.2) | 8 (72.7) | 1 (9.1) | 11 | 45 ± 7.1 |
| **Total** | 186 (58.8) | 90 (28.5) | 40 (12.7) | 316 | 81.1 ± 14.9 |

[a] Values are expressed as No. (%).
[b] Values are expressed as No.
[c] Values are expressed as mean ± standard deviation.

In similar to many regions of the world, animal CE is extensive in Asia from South Asian countries: China, Japan and India to West Asia: Middle East (Iran, Iraq, Saudi Arabia and Pakistan) and Central Asia (Kazakhstan, Kyrgyzstan, Uzbekistan, Tajikistan, and Turkmenistan). High frequency of ovine hydatidosis was documented from China, some regions of Iran, Kazakhstan, Turkmenistan and Uzbekistan with average prevalence rates ranging from 50% to 83% (2, 10).

In present study, the prevalence of livestock CE was 3% which is relatively lower than the reports from neighboring regions of the country such as Middle East and Central Asian countries (2). According to the available reports from different parts of Iran, frequency of ovine hydatidosis was estimated from 1% to 27.5% with an average of 8.1%. Although a high prevalence of sheep hydatidosis (74.4%) has been documented from Ardabil province (9, 10). Other reports for echinococcosis in sheep are 9.2% in Kerman, 20.6% in North Khorasan, 51.9% in Kurdistan and 9.3% in Qom (5). The results of our study revealed that 3% of sheep were infected with hydatid cyst. In most studies, the frequency of hydatidosis in goat was lower than other livestock intermediate host species, probably because of the feeding of goats through browsing rather than grazing (6, 8, 9, 11-13). In accordance with reports, the infection rate of goats in this study was significantly lower than sheep and cattle with frequency of 1%. The average of hydatidosis rate in Iranian goats has been reported 6.5% with minimum and maximum rate of 0.5% and 20%, respectively (9). Another finding in this study showed that 5.3% of the slaughtered cattle were infected with CE, more than sheep and goats. In Iran, CE in cattle has ranging from 1% to 28% with the mean of 12% based on some previous investigations (8, 9, 11, 12). However, there is a report of high prevalence on cattle hydatidosis (38%) in Ardabil province (10). Fertility of hydatid cyst is an essential factor in order to affect the stability of *E. granulosus* life cycle in the environment. According to the many conducted studies in Asia, averages of cyst fertility rate of livestock species are 80% in camels (from 65% to 95%), 59% in sheep (from 25% to 97%), 36% in goats (from 20% to 79%), 29% in cattle (from 10% to 75%) and 26% in buffaloes (from 3% to 84%) (2).

In this study, cyst fertility rates were 69.3%, 18.2% and 6.8% in infected sheep, goats and cattle, respectively. The mean of viability rate of protoscolices was 82.2% in sheep, 45% in goats and 36.7% in cattle. Interestingly, the most of cyst recovered from inspected cattle were multilocular form and nearly 80% of them were found suppurative or calcified. This result was confirmed with previous study which is conducted in the region that reported 88% suppuration or calcification rate of cattle cysts (14).

The hydatid cysts were found in liver, heart, and mostly in the lungs. On inspection of inner organs, higher frequency of hydatid cyst (51.3%) was found in the lungs of slaughtered animals, probably due to detect easier than liver cysts. Also the results show hydatidosis in the female livestock was significantly more prevalent than male. This matter can be supported by the relationship between increasing age and risk of hydatidosis, since the most of older slaughtered livestock are often female. These results are compatible with the previous study which is conducted in Hamadan (8) and other reports area (10, 11, 15). In contrast to our study, the frequency of hydatid cyst in liver was higher than lungs in slaughtered animals that inspected in Yemen in 2012 (16).

CE in Iran, like most endemic areas in the world, is transmitted principally through domestic cycles, dogs as definitive host and livestock species as intermediate hosts (17). In Hamadan region, two surveys of canine echinococcosis, using necropsy technique, were conducted by Fallah et al. in 1995 (7) and 2015 (article in press) that showed 48.3% and 37.9% of examined stray dogs infected with *E. granulosus*, respectively. Another study in the area was performed by Sardarian in 2012, with fecal sample analysis, revealed 2.9% of dogs were positive for *Taenia/Echinococcus* spp. (18). Also in 2010, other previous study on slaughtered animals

in this area are demonstrated livestock hydatidosis with a frequency of 12.3% (8). The present study and the previous investigations confirm echinococcosis/hydatidosis is mainly maintained through a domestic sheep-dog cycle in this region.

In conclusion in the endemic areas, there is a need for regular periodic surveys and monitoring systems in order to improve epidemiological knowledge about hydatidosis. A comprehensive strategy requires for monitoring of echinococcosis/hydatidosis. The multifaceted control program can be consisting of some measures against definitive and intermediate host in wild and domesticated animals. The main measures including regular treatment of dogs with anthelmintic drugs; avoid feeding dogs with raw offal; management of the wild definitive host via anthelmintic baiting; standardization of recording and reporting systems for hydatidosis in slaughtered livestock and control of home-slaughter practices. A promising new tool for echinococcosis/hydatidosis control, a recombinant antigen vaccine (EG95), would increase the effectiveness of the other controlling measures (19, 20). Finally, it will be completed by informing the community about potential public health risk caused by parasite infection.

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## Footnotes

**Authors' Contribution:** Malihe Roostaei contributed to sample collection and experiments; Mohammad Fallah, Amir Hossein Maghsood and Masoud Saidijam contributed to study design and article Proofreading; Mohammad Matini contributed to study design, experiments and article writing.

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