



Original article

Prevalence and characterization of hydatidosis in Najdi sheep slaughtered in Riyadh city, Saudi Arabia

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ABSTRACT

Hydatidosis is considered to be one of the important zoonotic diseases and has a significant public health importance due to the difficulties of the diagnosis. Domestic animals act as intermediate hosts and the main reservoir for the disease in humans. The main purpose of this work therefore was to determine the prevalence of hydatidosis in Najdi sheep slaughtered in Riyadh city, Saudi Arabia. Cyst location and cyst fertility and viability were also estimated, together with effect of seasons, age and sex on the prevalence of the infection. The prevalence of hydatidosis was evaluated by post-mortem examination, with intensive inspection of the visceral organs of 2785 Najdi sheep. The infection was found to prevail throughout the year in both sex, with an overall prevalence of 2.33%. The highest prevalence was recorded in winter (6.48%) while the lowest was encountered in summer (1.36%). Females were proved to be more prone to infection (70.7%) than males (29.3%). In the present study, younger sheep tended to have a higher prevalence of infection than older ones. The most commonly infected organ was the liver, with a prevalence of 81.5%. The recorded cysts showed a fertility rate of 75.4%, and a high viability rate of 61.2%. Hepatic cysts were the most fertile and viable ones (46%), while calcified cysts were not recorded during the study. Measurements of recorded cysts in all organs ranged from 2 to 6 cm in diameter.

In conclusion, the high fertility and viability rate of the recorded cysts suggest that sheep are a potential source of hydatidosis transmission to dogs and the continuation of its life cycle in this region. Consequently, authorities are recommended to instigate stricter regulation of the slaughtering process, including the secure disposal of infected offal so as to minimise the transmission of cysts from slaughter houses, along with treatment of stray dogs.

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1. Introduction

Hydatidosis is an important zoonotic disease in many parts of the world, including Saudi Arabia. The disease is caused by the larval stages of a taeniid-type tapeworm of the genus *Echinococcus* and poses a great threat to human health and livestock, with the latter especially causing great economic loss (Thompson and

McManus, 2002; Eckert and Deplazes, 2004). *Echinococcus* taeniid-worm has a two-host life cycle in which canines serve as final hosts, while domestic livestock and wild ungulates act as intermediate hosts (Abdel-Baki et al., 2016; Eslami et al., 2016). Domestic livestock act as intermediate hosts which are the major reservoir for the disease in humans (Eckert and Deplazes, 2004). Accordingly, domestic livestock in rural communities are the main reservoir for the disease in humans as there is a greater contact between dogs and domestic animals in this environment (Almalki et al., 2017).

Careful diagnosis of hydatidosis in livestock is essential for the identification of the most important source of the spread of the disease (Cadavid Restrepo et al., 2016). Unfortunately, hydatidosis in the intermediate hosts (sheep, goat, camels, cattle, etc.) is normally asymptomatic and not apparent to farmers (Elham et al., 2014). In addition, there are normally no trustworthy techniques for the routine diagnosis of the hydatidosis infection in living animals, with

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only ultrasound and radiography able to detect the presence of the hydatid cysts (Eckert and Deplazes, 2004; Hayajneh et al., 2014). Meat inspection or post-mortem investigation is therefore essential in diagnosing hydatidosis and in determining its prevalence in various species of slaughtered animals, and therefore abattoirs are the best places to survey hydatidosis in livestock (Almalki et al., 2017). There is currently little data regarding the prevalence of hydatidosis in livestock in Middle Eastern countries including Saudi Arabia (Almalki et al., 2017), and information on the epidemiology of hydatidosis in the livestock in different regions of Saudi Arabia is particularly limited. The Najdi sheep is the principle breed of domestic sheep from Saudi Arabia. It is indigenous to the Najd region of Saudi Arabia where it possibly given its name. They are greatly appreciated for their meat, milk and also long and straight wool (Ali and Al-Noaim, 1992). According to the available literature, no studies have been carried out to assess the hydatidosis in Najdi sheep slaughtered in Riyadh city thus far. The present survey was therefore undertaken to determine the prevalence of hydatidosis in Najdi sheep in Riyadh city. Cyst location and cyst fertility and viability were also estimated, together with effect of seasons, age and sex on the prevalence of the infection.

2. Materials and methods

The present survey was carried out on 2785 Najdi sheep in an animal slaughterhouse in Riyadh, Saudi Arabia, between November 2015 to October 2016.

2.1. Examination of the slaughtered sheep

During the post-mortem examination, an intensive inspection of the visceral organs, notably the liver, lung, spleen, kidney and heart, was undertaken with the assistance of veterinarians in keeping with procedures counselled by WHO/FAO/UNEP (1994). Infected organs were immediately transported in ice boxes to the Laboratory of Parasitology, Zoology Department, College of Science, King Saud University. In the laboratory, all cysts were measured and cyst fertility and protoscolices viability were determined.

2.2. Assessment of cyst fertility and protoscolices viability

The hydatid cyst fluid was aspirated by means of a sterile syringe with a large-sized needle and then transferred into a sterile container. To determine the cyst fertility, the cyst fluid was examined microscopically for the presence or absence of the protoscolices. If protoscolices were not present, the cyst was considered to be infertile. The viability of protoscolices was determined by staining with a 0.1% aqueous eosin solution. Usually, the viable protoscolices do not take up the stain, whereas the non-viable ones do (Fig. 1) (Moazeni and Nazer, 2010).

2.3. Statistical analysis

Data were analysed using a statistical package program (Sigma Plot version 11.0) and one-way ANOVA was performed to determine the statistically significant differences. Data were expressed as the means \pm standard deviations from the means (SD) and $P \leq 0.005$ was considered to be statistically significant.

3. Results

The present study surveyed the hydatidosis in Najdi sheep slaughtered in an animal slaughterhouse in Riyadh city, Saudi Arabia. Cases of infection were found throughout the year, with an overall infection prevalence of 2.33% (65/2785). The highest

prevalence was reported in winter 6.48% (25/385), followed by spring 2.29% (14/594) and autumn 1.47% (14/951), while the lowest was recorded in summer 1.36% (12/855). Statistical analyses showed no significant differences in the prevalence of infections among seasons during the period of this study ($P = 0.30$) (Fig. 2).

The statistical evaluation did however reveal that the prevalence of infection differed significantly by host sex ($P = 0.001$). Females were found to have the highest prevalence of infection at 70.7% (46/65) compared to 29.2% (19/65) for males (Fig. 3). The study also revealed that infection varied according to the sheep's age, with the highest prevalence of infection in sheep of 6–12 months' age (47.7%, 31/65) followed by sheep aged more than 2 years (35.3%, 23/65), while sheep aged 13–24 months recorded the lowest prevalence of 17% (11/65). The statistical analysis, however, confirmed that these differences were not statistically significant ($P = 0.232$) (Fig. 4).

Regarding the location of cysts, the liver was reported to have the highest prevalence of infection (81.5%, 53/65), followed by the lungs, with a prevalence of 10.8% (7/65), while synchronous infection of both liver and lungs together with other visceral organs showed the lowest prevalence of 7.7% (5/65). There were significant statistical differences in infection prevalence between liver and lung infection ($P < 0.001$), liver and concurrent infection of both liver and lung together with other visceral other visceral organs ($P < 0.001$), while there were no significant differences between lung and synchronous infection of both liver and lung together with other visceral organs ($P = 0.760$) (Fig. 5).

The fertility rate of the recorded cysts was 75.4% (49/65) with a viability rate of 61.2% (30/49). Hepatic cysts were the most fertile 71.4% (35/49) and viable 66.6% (20/30), while calcified cysts were not recorded during the study. Measurements of recorded cysts in all organs ranged from 2 to 6 cm in diameter.

4. Discussion

Hydatidosis has a cosmopolitan distribution from the Arctic circle in the North to as far South as Tierra del Fuego, Argentina, occurring in all major climates, in a wide variety of hosts and at various levels of prevalence (WHO/OIE, 2002). Infections with hydatid cysts occur in a broad spectrum of natural intermediate host species and cysts are found most frequently in the liver and lungs, although they can also occur in other internal organs including the nervous system, the skeletal muscles and in the bone marrow cavity (Thompson and McManus, 2002; Cadavid Restrepo et al., 2016). Domestic intermediate hosts (goat, sheep, cattle, camels, etc.) are the main reservoirs of hydatidosis for subsequent human infection (Ibrahim, 2010). Consequently, WHO/OIE (2002) has confirmed the necropsy of intermediate hosts for hydatid cysts as an essential for baseline surveys as well as for the surveillance of control programmes. The objective of this study was therefore to assess the prevalence of hydatidosis infection in Najdi sheep slaughtered in Riyadh city. The location of cysts, their size and fertility, as well as the viability of their protoscolices were also determined. In the present study, the hydatidosis infection revealed marked fluctuation during the study period, with a maximum prevalence in winter (6.48%) which then progressively decreased to a minimum prevalence in summer (1.36%). Similarly, Daryani et al. (2007) and Almalki et al. (2017) found seasonal variation in infection prevalence, with the highest prevalence in winter and the lowest in summer. The seasonal variation in infection prevalence may related differences in the environmental conditions that are responsible for the spreading the parasite, the availability of infected final hosts, and the nature of the pasture among seasons (Ernest et al., 2009, Ibrahim, 2010).

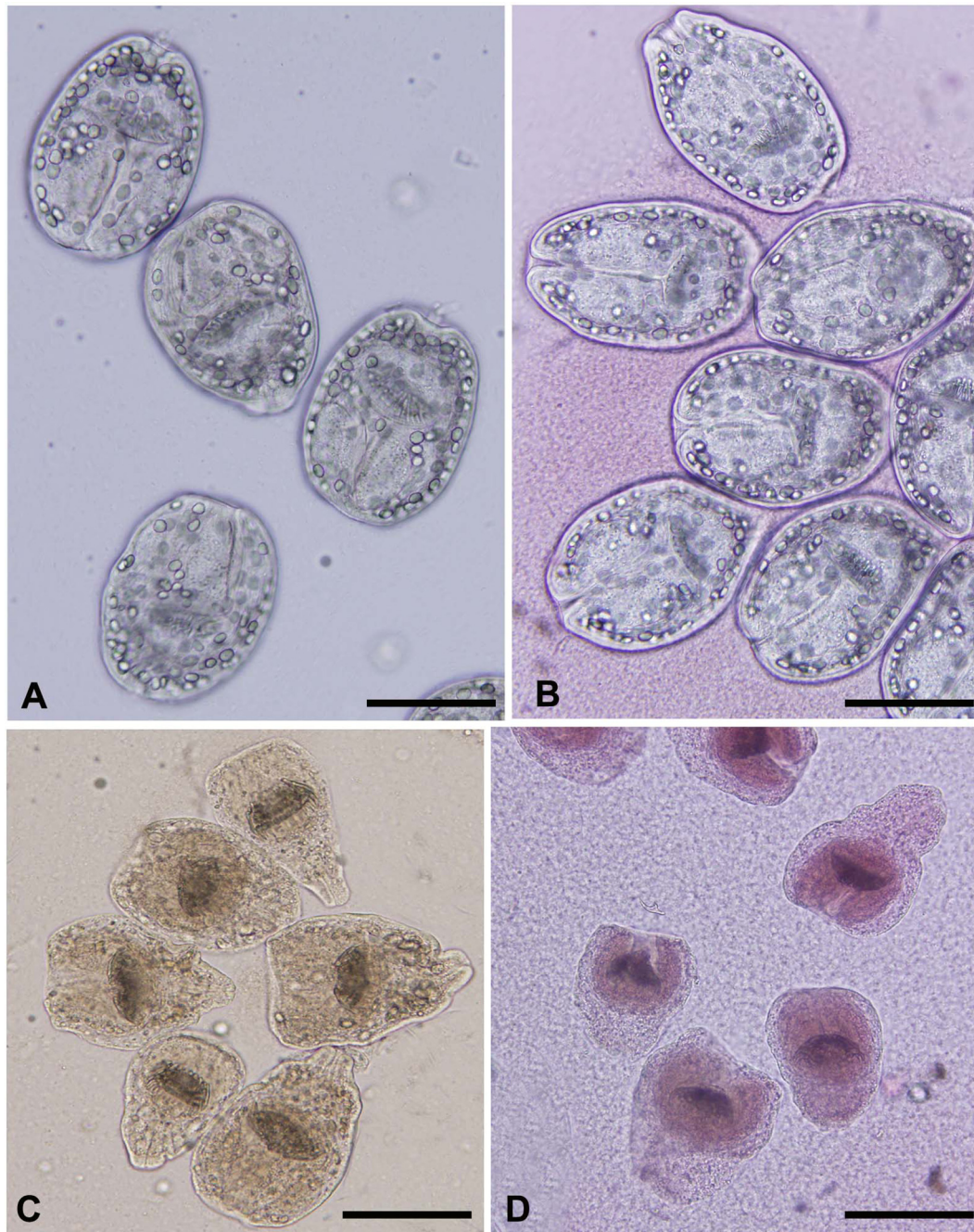


Fig. 1. Representative photos for the viability test; (A) viable protoscolices without staining (B) Viable protoscolices after staining with 0.1% eosin, (C) Dead protoscolices without staining, (D) Dead protoscolices after staining with 0.1% eosin. Scale-bar = 100 μ m.

Previous studies in other regions of Saudi Arabia, have revealed a rather higher prevalence of hydatidosis infection than the 2.33% found in this study: 12.61% in Al Baha (Ibrahim, 2010), 69.6% in Jeddah (Toulah et al., 2012) and 13.5% in Al Taif (Hayajneh et al., 2014), possibly indicating different factors affecting the transmission of this disease among the farm animals in these regions. Almalki et al. (2017), however, have recently reported a rather lower prevalence of infection (1.06%) in Sawakny sheep in Riyadh city. They attributed this lower prevalence to the fact that Riyadh is an urban region while the other areas are rural to semi-urban, incorporating Bedouin herds that often have dogs for keeping watch and hunting, meaning that dogs are in close contact with domestic animals and humans, potentially promoting transmission of the disease in these areas. Improvements in living conditions

and a better awareness of the risk of zoonotic diseases has also been argued to contribute to the lower incidence in Riyadh (Almalki et al., 2017).

The results also showed that hydatidosis is markedly more prevalent in females (70.7%) than in males (29.3%). This may have related to a combination of factors such as hormonal differences, genetic composition and the host-parasite interaction (Blancas Mosqueda et al., 2007; Roostaei et al., 2017). These results are in agreement with previous studies carried out in Saudi Arabia (Ibrahim, 2010) and other countries (Esatgil and Tuzer, 2007; Azami et al., 2013; Nyero et al., 2015).

The current study elucidated that younger sheep had a higher prevalence of infection than older ones, which is in accordance with the results of Hayajneh et al. (2014) and Almalki et al.

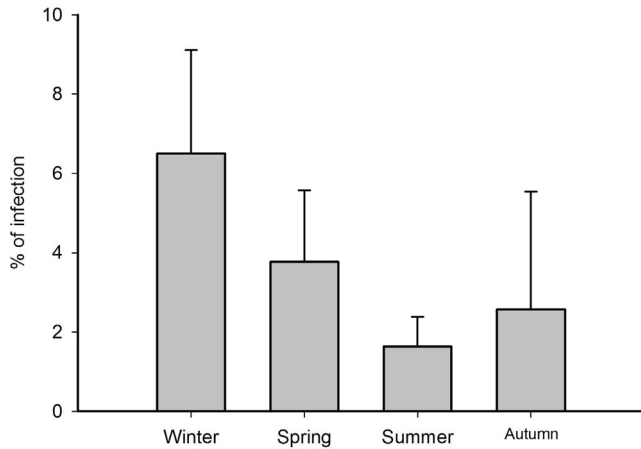


Fig. 2. The mean seasonal prevalence (% ± SD) of hydatidosis in slaughtered Najdi sheep.

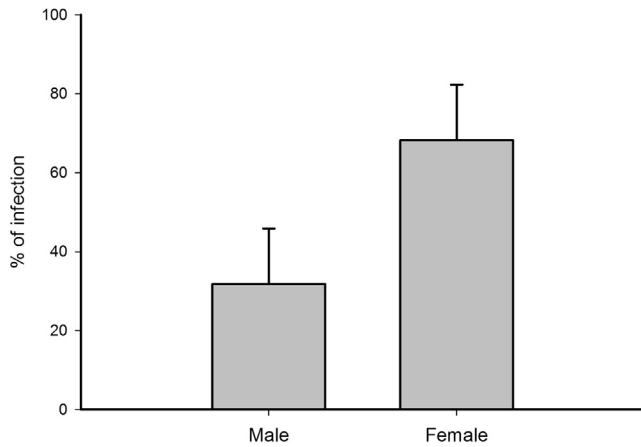


Fig. 3. The mean prevalence (% ± SD) of hydatidosis in male and female of slaughtered Najdi sheep.

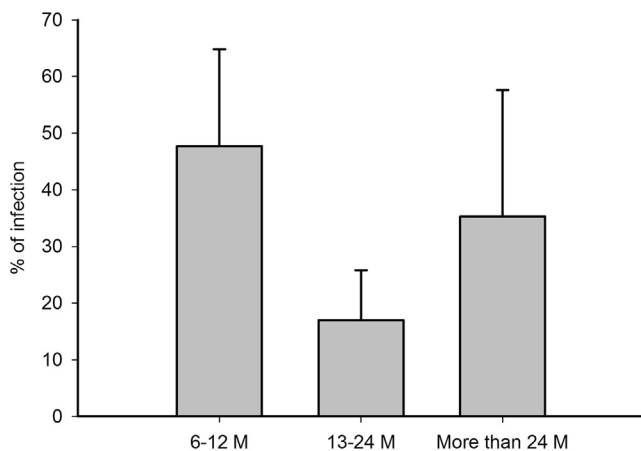


Fig. 4. The mean prevalence (% ± SD) of hydatidosis based on the age of slaughtered Najdi sheep.

(2017). This finding may be explained by the fact that the inhabitants of Riyadh prefer to slaughter younger sheep rather than older ones and consequently most of the sheep slaughtered in Riyadh abattoirs are young (Al-Qureishy, 2008). In contrast to this finding, most of the previous studies (e.g. Ibrahim, 2010; Al-Qurashi and

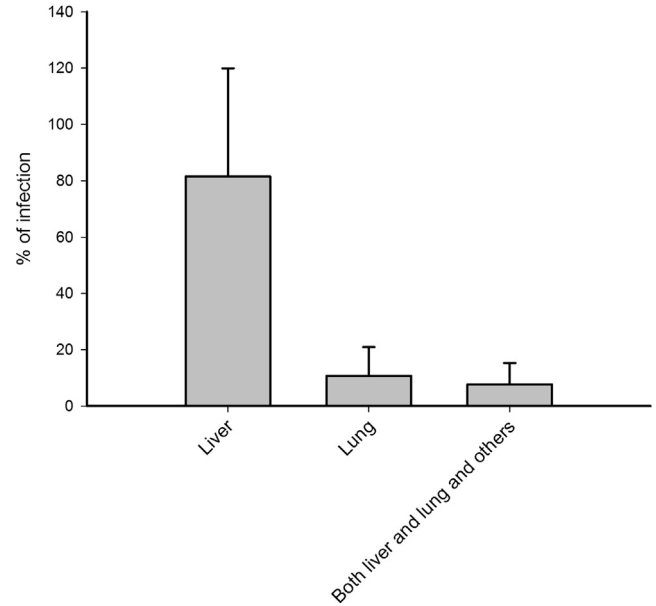


Fig. 5. The mean prevalence (% ± SD) of hydatid cyst according to the infected organs of slaughtered Najdi sheep.

Bahnass, 2012; Elmajdoub and Rahman, 2015) have suggested a higher rate of infection among older animals than younger ones.

In the present study, the livers were found to be more frequently infected with hydatid cysts than the lungs and other organs, which is compatible with several previous studies (e.g. Azlaf and Dakkak, 2006; Haridy et al., 2006; Ibrahim, 2010; Toulah et al., 2012; Almalki et al., 2017). This may be due to the fact that oncosphere penetrates the intestinal wall and enters the portal blood/lymph where they are transported passively throughout the body to the major filtering organs, mainly the liver, where they are localized and develop into larval hydatid cysts. Only those that are not removed in the liver can move to develop in the other organs (Al-Khalidi, 1998).

Data on the fertility and viability of the hydatid cysts in specific domesticated animals is crucial to provide an indication of the importance of each kind of livestock as a manageable wellspring of final hosts infection, particularly dogs. Usually, the hydatid cysts have diverse rates of fertility according to their measurements, host type and site of infection (Dalimi et al., 2002). In the current study, it was noticed that the liver cysts were more fertile than those of the lungs, which is similar to those reported by Ibrahim (2010), Elmajdoub and Rahman (2015) and Almalki et al. (2017).

In conclusion, this study has revealed a considerably lower infection rate in Riyadh compared to those reported in other locations in Saudi Arabia, probably reflecting a variation in infection rates according to the rural or urban status of each location. The high fertility and viability rates of the reported cysts have an epidemiological significance since they suggest an increased potential for transmission to dogs and thus the continuation of the hydatidosis life cycle in this region. Consequently, more action is recommended to control hydatidosis in Riyadh. To attain this goal, stronger tracking of the slaughtering process is recommended together with the treatment of stray dogs. More efforts also need to be made to control the transmission of cysts from slaughter houses by way of the secure disposal of infected offal.

Conflict of interest statement

We declare there is no conflict of interest.

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