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Histopathological changes associated with hydatid cysts in sheep slaughtered in Al-Muthanna province, Iraq

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Abstract

Cystic echinococcosis, a prevalent zoonotic disease caused by the larval stage of *E. granulosus*, poses significant economic and public health challenges due to its predilection for the liver and lungs of various livestock, including sheep. Despite ongoing epidemiological studies, an in-depth exploration of the associated histopathological changes remains scarce. The present investigation sought to elucidate the microscopic lesions attributable to hydatid cysts in sheep. In this descriptive, cross-sectional necropsy study, a total of 100 ovine subjects were systematically inspected at a slaughterhouse. The study spanned an encompassing timeframe from August to October 2024. The overall prevalence of infections registered at approximately 31%. Thorough post-mortem examinations revealed a spectrum of cyst sizes, with the lungs and liver being the predominant infection sites. The cysts, which varied in diameter, were axenically filled with clear to slightly turbid, straw-colored, or brown liquids and were devoid of any protoscolices. All cysts were enveloped in fibrous capsule-membranes. Histopathological evaluations revealed significant immunological responses in the corresponding organs. Lung tissues exhibited extensive infiltration by lymphocytes and plasma cells, accompanied by pronounced interstitial edema, alveolar overdistention, and bronchiolar epithelial metaplasia. Similarly, liver tissues displayed a spectrum of lesions, including lobular disorganization, atrophy of hepatocyte cord, intralobular microabscesses due to neutrophilic infiltration, bile duct hyperplasia, portal mononuclear cell infiltration, sinusoidal dilatation, centrilobular hepatocyte hypertrophy, and dissemination of necrotic hepatocytes.

Keywords: Hydatidosis, histopathology, slaughterhouse, sheep, Iraq

Introduction

Like other domestic animals, sheep are also exposed to various pathogenic and infectious agents, such as parasites, which can negatively affect their growth and productivity (Al-Khalidi, 1998) ^[9]. Cystic echinococcosis is a cosmopolitan zoonotic parasitic disease caused by the larval stage of *E. granulosus*. It represents a major public health and veterinary concern in many developing countries, including Iraq (Jarjees and Al-Bakri., 2012) ^[15]. The parasite has a complex life cycle that involves dogs and other canids as definitive hosts, and a wide range of herbivorous animals, particularly sheep, goats, and cattle, as intermediate hosts (Romig *et al.*, 2017) ^[20]. Humans may also act as accidental intermediate hosts, acquiring infection through ingestion of eggs shed in dog feces (Eckert and Deplazes, 2004) ^[12]. In sheep, which serve as one of the most important intermediate hosts, hydatid cysts are commonly found in the liver and lungs, though other organs such as the spleen, kidneys, and heart may also be affected (Sharma *et al.*, 2013) ^[21]. The infection leads to severe economic losses due to organ condemnation at abattoirs, reduction in meat and milk production, decreased carcass weight, and negative impacts on leather quality (Al-Marsomy, 2021) ^[4]. In Iraq, hydatidosis is endemic and continues to pose a significant burden on both animal production and public health (Kadir and Rasheed, 2008) ^[16]. The pathology of hydatid cysts is characterized by a complex structure composed of three layers: the inner germinal layer, the laminated acellular layer, and the outer adventitial layer of host origin (Thompson, 2017) ^[22]. The surrounding host tissue usually exhibits marked histopathological alterations, including chronic granulomatous inflammation with macrophages, lymphocytes, eosinophils, plasma cells, fibrosis, calcification, and in some cases, necrosis (Dalimi *et al.*, 2002) ^[10]. Histopathological examination is therefore considered an essential tool to assess the viability of cysts and the degree of tissue damage, as well as to understand the host-parasite interaction (Dyab *et al.*, 2018) ^[11].

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Although hydatidosis has been extensively studied worldwide, there is limited published information on the histopathological changes associated with hydatid cysts in slaughtered sheep in Iraq, particularly in Al-Muthanna Province. Such data are crucial not only for documenting the disease burden but also for providing baseline information that can contribute to control strategies and risk assessment for zoonotic transmission. The aim of this study was to characterize the gross and histopathological alterations associated with hydatid cysts in sheep slaughtered at abattoirs in Al-Muthanna Province, Iraq, in order to provide baseline data on the pathological features of ovine hydatidosis in the region

Materials and Methods

Study area and animals

This cross-sectional study was carried out in the abattoirs of Samawah at Muthanna province, south of Iraq, between August to October 2024. The abattoirs was visited two days a week and the number of sheep slaughtered varied from 10 to 15 each day. A total of 100 sheep of different ages and sexes were examined during routine postmortem inspection. Information on age (estimated by dentition) and sex was recorded for each animal. Visceral organs infected with hydatid cysts were put in plastic bags and were brought to parasitology laboratory/College of science, University of Al-Muthanna for analysis. The study was designed to investigate the histopathological changes associated with hydatid cysts in slaughtered sheep.

Histopathological examinations

Liver and lung tissues collected from infected sheep were immediately fixed in 10% neutral-buffered formalin to preserve cellular architecture. Following fixation, the samples were thoroughly rinsed in distilled water to remove residual fixative, then subjected to dehydration through a graded ethanol series (50%, 70%, 90%, 95%, and 100%), with each step maintained for two hours. After complete dehydration, the tissues were embedded in paraffin wax to facilitate sectioning. Paraffin blocks were trimmed and sectioned at a thickness of 4 μ m using a rotary microtome. The sections were floated on a 50 °C water bath to eliminate wrinkles and mounted onto clean glass slides. For staining, the paraffin was removed from the sections using xylene, followed by rehydration through a descending series of ethanol concentrations (100%, 90%, and 70%) for two

minutes at each step. Tissue sections were stained with hematoxylin to enhance nuclear contrast, followed by aqueous rinsing and counterstaining with eosin to delineate cytoplasmic and extracellular matrix components. The sections were then subjected to graded ethanol dehydration, cleared in xylene, and permanently mounted using Canada balsam. Histopathological examination was subsequently performed using light microscopy (Mnati *et al.*, 2020)^[18].

Results

Post-mortem examinations conducted at the abattoir revealed that 31 (31%) out of 100 examined sheep were infected with hydatid cysts during the period from August to October 2024. Gross pathological examination revealed single or multiple hydatid cysts of varying sizes in the lungs, either completely or partially embedded in the tissue. Most cysts were soft and contained clear to slightly turbid fluid, while some were solid with condensed contents. The lungs appeared enlarged, congested, and edematous, with petechial hemorrhages on their surfaces. The liver was also enlarged and congested, with extensive ulcerative lesions and hemorrhages, as shown in figure (1).

Histopathological examination of the liver and lungs in sheep infected with echinococcosis revealed varying degrees of tissue degeneration associated with hydatid cyst development. In severe cases, sloughing of the epithelial mucosal layer was observed. The cysts exhibited characteristic architecture, comprising an inner germinal layer, laminated membrane, and fibrous outer capsule, often surrounded by inflammatory infiltrates including eosinophil, mononuclear cells, and scattered fibroblasts, as showed in figure (2). In the liver, pathological changes included mild focal hemorrhages, leukocyte infiltration, hepatocellular degeneration, biliary hyperplasia, and epithelial damage. Pressure from enlarging cysts led to hepatic tissue atrophy and lympho-mononuclear infiltration. Chronic cases demonstrated marked fibroplasia extending into portal triads, with disrupted hepatocytes embedded within fibrous tissue (Figures 3 and 4). Pulmonary hydatid cysts presented with similar histological features, including fibrous connective tissue proliferation and mononuclear cell infiltration (Figure 5). Lung parenchyma exhibited central necrosis, vacuolated mesenchymal cells, emphysema, vascular congestion, and hemorrhage. In many cases, lesions extended into adjacent terminal and small bronchioles, indicating extensive parenchymal damage (Figure 6).

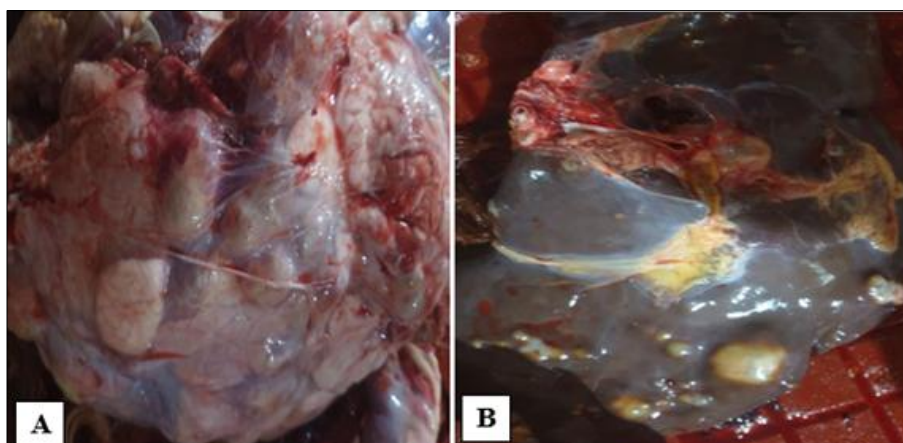


Fig 1: Hydatid cysts isolated from A-lung of the infected sheep; B-liver of the infected sheep

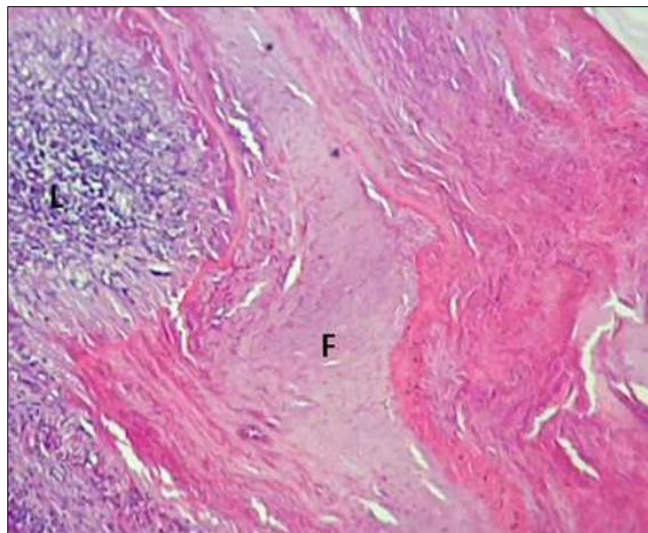


Fig 2: Histological section of liver tissue from a sheep infected with hydatid cyst, consist of capsule formation with fibrosis (F), and present of aggregation of lymphocytes (L), H&E. 10 X.

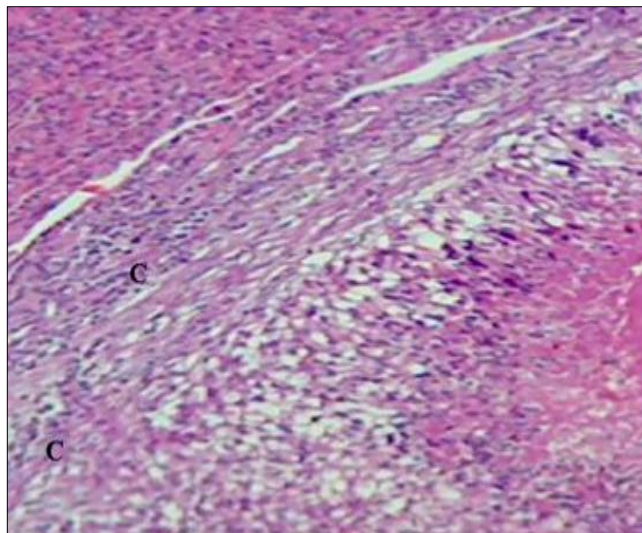


Fig 5: Histological section of lung tissue from a sheep infected with a hydatid cyst, showing area of inflammatory cells H&E. 20 X.

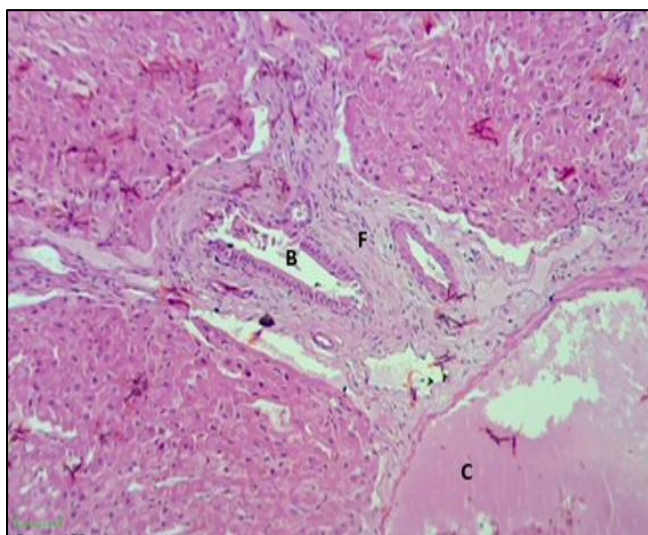


Fig 3: Histological section of liver tissue from a sheep infected with a hydatid cyst, showing periportal fibrosis(F) and bile duct proliferation(B) in adjacent the hydatid cyst(C), H&E. 10 X.

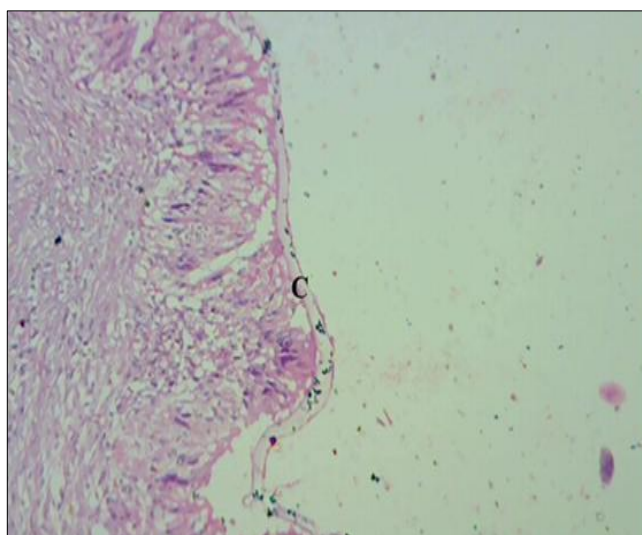


Fig 6: Histological section of lung tissue from a sheep infected with a hydatid cyst, showing dilatation of bronchiole (C) and proliferation of bronchiolar parenchyma with dense infiltration of inflammatory cells H&E. 10 X.

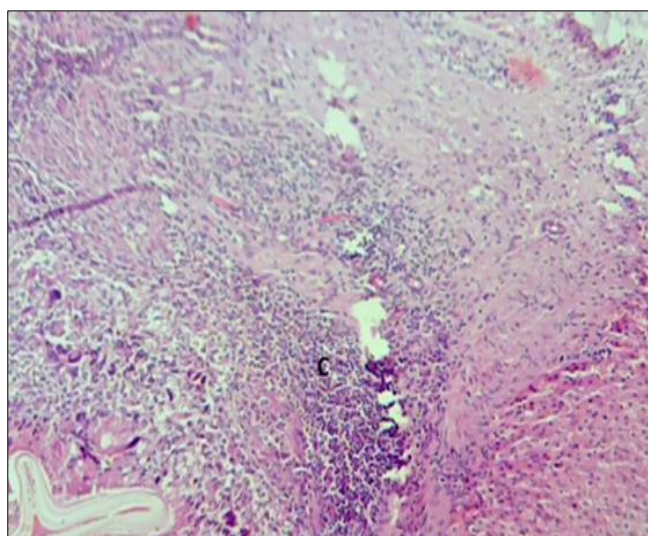


Fig 4: Histological section of liver tissue from a sheep infected with a hydatid cyst, showing dense infiltration of inflammatory cells (C) H&E. 10 X.

Discussion

The results of the current study revealed that 31% of the examined sheep (31 out of 100) were infected with hydatid cysts during the period from August to October 2024. This infection rate is notably higher compared to previous studies conducted in Iraq and neighboring regions. For instance, studies in Basrah and Sulaymaniyah reported lower prevalence rates of approximately 7.3% and 5.3%, respectively, during similar post-mortem examinations at abattoirs (Abdulhameed *et al.*, 2018; Aziz, *et al.*, 2022) [1, 8]. Such discrepancy in prevalence may be attributed to several factors including geographical differences, seasonal variation, management practices, or the program of control definitive hosts such as stray dogs (Al-Khalidi, 1998; El-Dakhla *et al.*, 2019) [9, 13]. Gross pathological examination in the present study revealed single to multiple hydatid cysts of variable sizes, predominantly located in the lungs, with some cases involving the liver. Most cysts were soft and contained clear to slightly turbid fluid, while others appeared firm and calcified or filled with condensed

material. The lungs were often enlarged, congested, and edematous with petechial hemorrhages. The findings of the present study are in concordance with previous reports that described comparable gross lesions in sheep naturally infected with Hydatid cysts were typically observed as fluid-filled structures, often exerting pressure on adjacent parenchymal tissues, which in some cases led to secondary bacterial infections (Khademvatan *et al.*, 2013; Ahmed *et al.*, 2024) [2, 17]. Histopathologically, liver and lung tissues showed features consistent with the established pathology of cystic echinococcosis. The cysts exhibited the characteristic trilaminar architecture—comprising an inner germinal layer, a laminated membrane, and an outer fibrous capsule surrounded by dense inflammatory infiltrates, including eosinophils, mononuclear cells, and scattered fibroblasts. These observations are consistent with those reported by Al-Bermani and Al-Dabhawi (2022) [3], who documented similar structural features and chronic inflammatory responses in lung tissues of infected sheep. In hepatic tissue, findings such as hepatocellular degeneration, biliary hyperplasia, focal hemorrhages, and leukocytic infiltration correspond with earlier studies from Punjab and Iraq, which highlighted progressive liver damage resulting from both mechanical pressure and immune-mediated responses (Ameen *et al.*, 2020; Alsaadawi *et al.*, 2022) [6, 5]. Notably, advanced fibrosis and architectural disruption, particularly around the portal triads, further reflect the chronic and immunomodulatory nature of the infection (Amer *et al.*, 2007; Hamad *et al.*, 2022) [7, 14]. Pulmonary lesions—such as emphysema, necrosis, bronchiolar epithelial damage, and vascular congestion—are also well-documented in the literature, reflecting the cysts' space-occupying effects and the host's inflammatory response (Mnati *et al.*, 2020; Obead, 2025) [18, 19]. Collectively, these degenerative and inflammatory changes underscore the intricate host-parasite interactions and the substantial pathological burden imposed by hydatid disease in livestock.

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Conflict of interest

No conflicts of interest were declared by the authors.

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