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Review Article

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Fascioliasis: A Zoonotic Disease and Diagnostic Capture Using Radiological Imaging

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ABSTRACT

Fascioliasis, also known as hepatic distomatosis or fasciolosis, is a zoonotic infection caused by the trematodes of *Fasciola*. The usual reservoir for this parasitic disease is herbivorous mammals, including humans, sheep, goats, and cattle. However, humans can contract this zoonosis infection by ingesting metacercaria, a juvenile trematode stage, which adheres to aquatic vegetation. Fascioliasis is typically present asymptomatically. However, human fascioliasis may have symptoms such as eosinophilia, abdominal discomfort, and various corroborative findings covering multiple diagnostic modalities. This review article aims to characterize fascioliasis in terms of zoonotic occurrence, outline the available diagnostic modalities, and highlight the specific significance of radiological imaging. These diagnostic options include parasitological fecal examination, which observes the parasite in the feces; radiological imaging techniques, which envision the anatomical abnormalities created by the invasion; and serological studies, which could detect the immune response system to the infestation of the parasite. This may contribute to the timely and adequate identification of the condition. This review article may contribute to forming the professional dialogue concerning fascioliasis, including its epidemiology, clinical presentation, and differential diagnostics.

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INTRODUCTION

Fascioliasis, commonly called liver fluke disease, is a foodborne parasitic infection that can infect humans and animals (Keiser and Utzinger, 2005; Tenorio and Molina, 2021). Fascioliasis is caused by the parasitic liver fluke or trematodes of genus *Fasciola* sp., with the main causative agents being *Fasciola hepatica* and *F. gigantica* (Lalor *et al.*, 2021; Prasetyo *et al.*, 2023). The two trematodes are transmissible to humans, a condition referred to as zoonosis, with the liver being the most commonly affected organ.

This disease significantly impacts public health and livestock productivity, particularly in regions where it is endemic. Human infection typically occurs through the ingestion of metacercaria, the infective stage of the parasite, which is attached to aquatic vegetation (Nyindo and Lukambagire, 2015). The disease often presents asymptomatically, making early and accurate diagnosis challenging. This underscores the necessity for effective diagnostic techniques to facilitate timely treatment (Mas-Coma *et al.*, 2014). Furthermore, WHO has launched a worldwide

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initiative against fascioliasis, which focuses on the need for diagnostic techniques to be more accurate (Mas-Coma *et al*., 2014; WHO, 2008).

Traditionally, Fasciola infection can be detected through fecal tests or indirectly by serological tests (Aftab *et al*., 2024). The present study review posed by the new worldwide scenario complements radiological imaging examination for diagnostic techniques (Mas-Coma *et al*., 2014). It enhances the accuracy of diagnosis when serological and fecal examinations are inconclusive. Radiological techniques, such as ultrasound, computed tomography (CT), and magnetic resonance imaging (MRI), are essential for visualizing the anatomical abnormalities caused by the parasite (Dusak *et al*., 2012).

The purposes of this review are mainly (i) to characterize fascioliasis in terms of zoonotic occurrence, (ii) to outline the available diagnostic modalities in the detection of the Fascioliasis infection, (iii) to highlight the specific significance of imaging radiology as a diagnostic technique.

MATERIALS AND METHODS

The review was conducted using literature sources from recent journals in the last 10 years. The focus of the review is on morphology, life cycle, pathogenesis, clinical manifestations of zoonotic nature, and diagnostic capture using radiological imaging in *Fasciola* sp. The discussion is descriptive by describing the focuses taken without changing the essence of the literature sources used.

RESULTS AND DISCUSSION

Morphology of adults *Fasciola* sp.

The morphology evaluation of the eyeball shows the leaf-like worms that are big enough for a human to see without a microscope: 20 – 30 mm in length, 25 – 75 mm wide for adult *F. hepatica* and *F. gigantica,* respectively (Farrar *et al*., 2013). The morphology of *F. hepatica*, the leaf-like shape of adult flukes, is distinctive, with a broader front end and a distinctive conical shape that separates it from the body. The flukes are usually gray-brown and measure 2.5-3.5 cm in length and 1.0 cm in width. Meanwhile, *F. gigantica is* larger than *F. hepatica*, measuring up to 7.5 cm in length and 1.5 cm in width, with a more transparent and distinctly leaf-like body. Its conically shaped anterior end is shorter, and the shoulders are less noticeable. Figure 1 depicts the morphology of. *F. gigantica* and *F. hepatica were* described previously by (Taylor *et al*., 2016).

Figure 1. (a) *Fasciola hepatica* (b) *F. gigantica* (Taylor *et al*., 2016)

Life Cycle of *Fasciola* sp.

The life cycle of *Fasciola* sp. involves intermediate hosts, such as freshwater snails, and definitive hosts, including various livestock species and humans (Fang *et al*., 2022). The life cycle of *Fasciola* sp. begins with an egg seeded in cattle feces. The eggs will survive in a watery area and hatch into a miracidium. Miracidium seeks an intermediate host within the *Lymnaea* snail, which then penetrates and develops the parasitic form of sporocyst-redia-cercaria. Cercaria is released from the *Lymnaea* body and develops into metacercaria, which attaches to aquatic vegetation before being ingested by animals or humans. In the stomach of the definitive host, the metacercaria discharge from their cysts develop into metacestodes before they go to the liver duct, become adults, and lay eggs, and the life cycle starts over again. The life cycle of *Fasciola* is presented in Figure 2, as previously described by (Bogitsh *et al*., 2012)

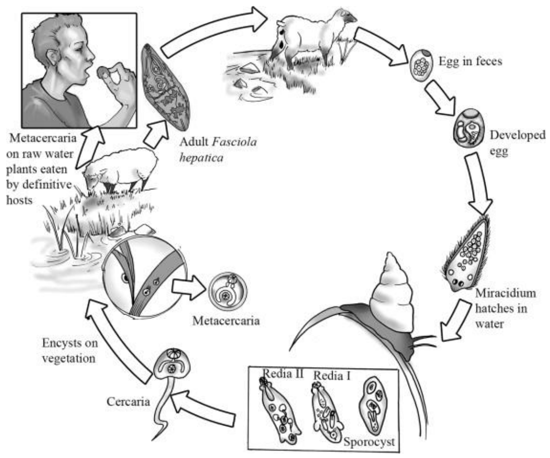

Figure 2. Life cycle of *Fasciola* sp. (Bogitsh *et al.*, 2012)

Pathogenesis

The presence of liver flukes in the bile ducts and their feeding activity can cause anemia, inflammation, obstructions, and cholangitis, which is the inflammation of the bile ducts. *Fasciola* species exhibit genetic diversity, especially regarding non-synonymous polymorphisms, allowing them to infect a wide range of hosts. Their ability to invade is aided by releasing excretory-secretory (ES) molecules, which prompt physiological changes that help them establish themselves within the host (Lalor *et al*., 2021).

Clinical Manifestations of Zoonotic Fascioliasis

In general, fascioliasis can occur with or without symptoms in humans and animals. However, clinical manifestations can occur in animals or humans with symptoms in various organs, such as the gastrointestinal, liver, or bile ducts. The pathogenesis of zoonotic fascioliasis involves the migration of immature flukes through the liver and bile ducts, leading to tissue damage, inflammation, and potential complications, such as biliary obstruction and secondary bacterial infections even eosinophilic pneumonia (Bayhan *et al.*, 2016; Mas-Coma *et al.*, 2018). Chronic fasciolosis is characterized by weakness, decreased appetite, enlarged stomach, diarrhea, anemia, and hypoalbuminemia. Rough and dull hair is also a symptom of an acute migration of metacestode-damaging liver tissue. There is also a chronic form in cattle where anemia, pale mucous membranes, edema (commonly referred to as a Bottle jaw when placed at the top and the other can be under the abdomen), and jaundice are observed (Taylor *et al.*, 2016).

Basically, human fascioliasis is divided into two phases according to its infection sites. The infection in the liver is known as the hepatic phase, which occurs from 3 to 11 weeks after the first infection. In the first phase, acute symptoms include a fever, liver enlargement, pain in the right upper quadrant, nausea, vomiting, and muscle soreness. The invasion of the parasites to the biliary tract marks the onset of the second phase (biliary phase), which will show chronic symptoms such as epigastric pain, prolonged malaise, muscle wasting, and jaundice. Right upper quadrant pain and hepatomegaly persist as an acute symptom (Preza *et al.*, 2019). Furthermore, complications may arise, such as cholangitis, cholecystitis, and liver abscesses, particularly in cases of heavy infestation or delayed diagnosis and treatment.

Ectopic parasitic infection can occur in sporadic cases involving juvenile fluke, which can easily deviate from the gastrointestinal tract to the liver and end up entering other organs. The most common organs are the gastrointestinal tract and subcutaneous tissue; however, the infection can be detected even in distant organs such as the lung, heart, brain, dorsal spine, skeletal muscle, eye, and epididymis. Various symptoms may arise from pleural effusion, pericardiac inflammation, cardiac conduction abnormalities, and neurologic disturbance due to immunologic and allergic processes (Mas-Coma *et al.*, 2014; Preza *et al.*, 2019).

Diagnostic Capture Using Radiological Imaging

There are many diagnostic options to detect Fasciola infection. However, three primary methods are used to diagnose: direct parasitological, indirect immunological, and imaging. The standard method of direct parasitic infection is parasitological fecal examination, which observes the parasite in the feces (Rinca *et al.*, 2019). On the other hand, indirect immunological methods rely on serological principles that detect any antigen in stool, serum, or intradermal. Both methods have proved to be useful as detection and monitoring tools. However, some of them need invasive procedures to collect the sample, which is relatively complicated (Preza *et al.*, 2019).

The other way is the use of radiological imaging techniques, which envision the anatomical abnormalities by non-invasive modalities such as ultrasound (US), computerized tomography (CT) scan, and magnetic resonance imaging (MRI) (Mas-Coma *et al.*, 2014; Behar *et al.*, 2009). In this review article, we would like to focus on diagnosing fasciolosis using a radiology approach to differentiate between the parenchymal and ductal phases.

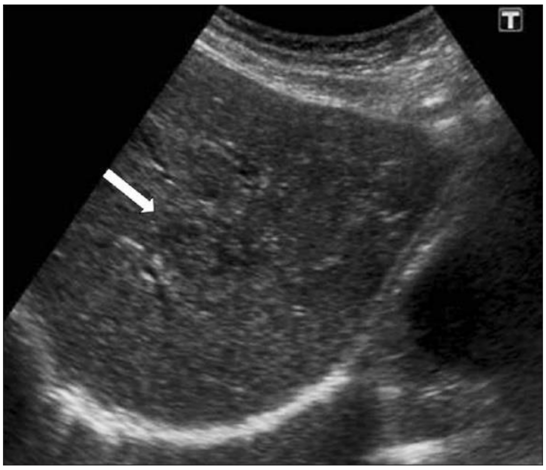

Figure 3. Ultrasound shows a parenchymal focal lesion with a halo around it within the liver (Dusak *et al*. 2012).

Ultrasound (US) shows a more significant image after 8 weeks of the Fasciola infection. Even though the US findings are non-specific in the early phase, according to Dusak *et al*. (2012), it can give visualization of focal hypoechoic or hyperechoic lesions with diffuse involvement of the liver (Figure 3). During the ductal phase, ductal ectasia (widening of liver duct) and duct wall thickening can be detected. Ductal dilatation, which is characterized by thin hypoechoic lines parallel to the portal areas, can be spotted, followed by biliary dilatation (Dusak *et al*. (2012); Preza *et al*., 2019)

Figure 4. Ultrasound shows a dead Fasciola hepatica represented by a linear echogenic substance (arrow) inside the dilated common hepatic duct (Dusak *et al*. 2012).

Computed tomography (CT) scan findings in the parenchymal phase show multiple small hypodense lesions with various shapes, including round or oval. The contrast agent helps to visualize the lesion better, producing clustered hypodense lesions with peripheral contrast enhancement. Subcapsular regions in the liver with attenuation can be detected. While in the ductal phase, a CT scan demonstrates dilated biliary ducts with periportal tracking (Dusak *et al*. (2012); Preza *et al*., 2019).

A study from Behar *et al.* (2009) reported a case report of a 21-year-old woman from Bangladesh who was admitted on a surgical take where the differential diagnoses included acute cholecystitis and hepatitis.

Figure 5. CT scan from a 21-year-old woman showed multiloculated septated lesions in the right lobe of the liver (Behar *et al.*, 2009)

Magnetic Resonance Imaging (MRI) is an established tool to diagnose the parenchymal phase in liver fascioliasis. T2 weighted sequence produces capsular hyperintensity with peripheral enhancement after contrast administration in high signal intensity. Meanwhile, the T1 weighted sequence shows parenchymal clustered lesions with mild low signal intensity. During the ductal phase, mild bile duct dilatation appears on T2 weighted. Irregular heterogeneity is indicated as a fibrotic scar in the capsular and subcapsular area (Dusak *et al*. (2012); Preza *et al*., 2019).

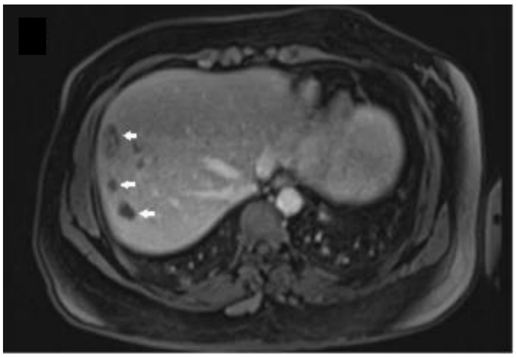

Figure 6. A case report of a 35-year-old patient shows her liver T1W MR image, which displays multiple spherical, clustered hypointense parenchymal lesions with mild peripheral contrast enhancement (arrows) (Salahshour and Tajmalzai, 2021)

Challenges and Future Research Directions

One of the significant challenges in diagnosing Hans is its often-asymptomatic presentation, which can lead to underdiagnosis and delayed treatment. Besides, most endemic countries have limited access to advanced diagnostic tools. The variability in the effectiveness of different diagnostic methods, such as fecal examination, radiological imaging, and serological tests, complicates establishing a standardized approach for accurate and timely diagnosis. Additionally, the zoonotic nature of fascioliasis complicates its control and prevention, requiring coordinated efforts between veterinary and human healthcare sectors.

Future research should focus on developing and refining more sensitive and specific diagnostic methods to address these challenges that can be easily implemented in resource-limited settings. Comprehensive epidemiological studies are needed to better understand the prevalence, distribution, and transmission dynamics of fascioliasis in various regions. Exploring integrated control strategies that involve both veterinary and public health approaches is essential for reducing the burden of fascioliasis.

CONCLUSION

Fascioliasis is a zoonotic infection that often presents asymptomatically but can manifest various clinical symptoms in both humans and animals. Reported common clinical symptoms of zoonotic fascioliasis include abdominal pain, fever, hepatomegaly, and jaundice. Various diagnostic options appear to enhance the timely and accurate diagnosis of fascioliasis. Radiological imaging emerges as a combined modality to detect its infection, which can produce an image of the anatomical abnormalities. Additionally, CT scans and MRI as advanced radiology imaging can demonstrate the exact phase of Fasciola infection and may help to guide toward ectopic lesions.

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