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Cystic Echinococcosis In Small Ruminants (Sheep & Goat)

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Abstract:

Cystic echinococcosis (CE), or hydatidosis, is a globally prevalent zoonotic disease caused by the larval stage of Echinococcus granulosus. Small ruminants like sheep and goats act as intermediate hosts, developing hydatid cysts mainly in the liver and lungs. The disease poses serious public health and economic risks, especially in areas with poor slaughter practices and uncontrolled dog populations. This review summarizes CE's etiology, transmission, epidemiology, diagnosis, and control in small ruminants. Ultrasound and necropsy are key diagnostic tools, while treatments include albendazole and EG95 vaccination. Preventive measures like proper offal disposal, farmer education, and One Health surveillance are essential to reduce CE prevalence and its zoonotic potential. The prevalence of hydatid cysts was significantly higher in sheep and goats of age equal to three years or less. In both sheep and goats, the rate infection of Hydatidosis was significantly higher in female than male.

Key Words: *CE, zoonotic, Hydatid cyst, Sheep and goats.*

Introduction:

- Cystic echinococcosis (CE), also referred to as hydatidosis, is a significant parasitic zoonosis caused by the larval form of cestodes belonging to the genus Echinococcus, predominantly Echinococcus granulosus (Eckert & Deplazes, 2004; Thompson, 2017). The parasite's lifecycle involves carnivores, particularly dogs, as definitive hosts, and various herbivorous and omnivorous animals as intermediate hosts, in which hydatid cysts typically develop in organs such as the liver, lungs, and occasionally others (Ould et al., 2010). The severity and clinical manifestation of the disease largely depend on the cyst's location and the extent of parasitic invasion (Kebede et al., 2009).
- In many developing nations, Cystic echinococcosis poses a dual threat to public health and the economy, affecting both human populations and livestock productivity (Yazar & Altıntaş, 2003). The

disease is prevalent in areas such as Australia, New Zealand, South Africa, and a vast majority of Asian countries, particularly where stray dog populations are high and animal husbandry is widespread (Doğru, 2008).

- Among the six Echinococcus species identified, four are known to be pathogenic to humans—E. granulosus, E. multilocularis, E. vogeli, and E. oligarthrus—while E. felidis and E. shiquicus have not been associated with human disease (Mine et al., 2020; Casulli et al., 2022). The two major clinical forms of human echinococcosis are cystic echinococcosis and alveolar echinococcosis, both of which are potentially fatal. However, CE has a much broader geographic range compared to AE (Hijjawi et al., 2018).
- Taxonomic studies have revealed considerable genetic diversity within E. granulosus sensu lato, leading to the identification of several genotypes (G1–G10). Some of these genotypes have been reclassified into distinct species, including E. granulosus sensu stricto (G1–G3), E. equinus (G4), E. ortleppi (G5), and E. canadensis (G6–G10) (Laurimäe et al., 2018).

These genetic variations influence host preference, pathogenic potential, and geographical occurrence, thereby complicating control strategies and emphasizing the need for localized epidemiological research (Kim et al., 2020).

Etiology & Life cycle:

- Cystic echinococcosis (CE), caused by the larval form of Echinococcus granulosus, is a globally distributed parasitic disease. According to WHO (2021), its prevalence exceeds that of alveolar echinococcosis, with notably high endemic rates in regions such as Russia, Eastern Europe, the Middle East, China, and South America, where incidence can reach up to 50 cases per 100,000 people annually.
- The life cycle of Echinococcus granulosus involves an indirect route requiring two host types: dogs and other canids serve as definitive hosts, while herbivorous animals like sheep and goats act as intermediate hosts. Humans may become accidental intermediate hosts by ingesting parasite eggs excreted in the feces of infected dogs.
- These eggs can contaminate the environment, including food, water, and grazing areas, and are ingested by intermediate hosts such as sheep, goats, cattle, or humans through contaminated sources (Romig et al., 2020).
- Following ingestion, the oncospheres penetrate the intestinal lining and are carried through the circulatory system, where they predominantly develop into hydatid cysts in the liver— accounting for about 70% of cases—while others localize in the lungs or various organs (McManus et al., 2024). The parasitic cycle is completed when a definitive host, such as a dog, consumes the infected organs of an intermediate host, often due to scavenging or inadequate slaughter practices. Inside the host's

intestine, the protoscoleces emerge, adhere to the mucosa, and mature into adult worms (WHO, 2021).

Risk Factor:

- In animals, several factors contribute to the transmission and maintenance of echinococcosis, particularly in endemic regions. Key predisposing factors include the presence of free-roaming or stray dogs, which serve as definitive hosts and often have access to infected offal due to illegal or unsupervised slaughtering practices (Torgerson et al., 2010). Improper disposal of infected viscera, especially in rural or pastoral areas, facilitates the continuation of the life cycle of Echinococcus granulosus.
- Additionally, close association between livestock and dogs, particularly in traditional farming systems, increases the risk of infection among intermediate hosts such as sheep, goats, and cattle (Eckert & Deplazes, 2004). Poor veterinary infrastructure, lack of regular deworming of dogs, and limited public awareness further exacerbate the spread of the parasite (Scala et al., 2006). Environmental factors such as pasture contamination with infective eggs and seasonal grazing also play significant roles in the epidemiology of the disease in animals (Otero-Abad & Torgerson, 2013).

Epidemiology:

- Cystic echinococcosis (Echinococcus granulosus) remains endemic across multiple global regions. According to the World Health Organization, this includes the Mediterranean basin (comprising Bulgaria, Cyprus, France, Greece, Italy, Portugal, Spain, former Yugoslavia, and southern Russia), North Africa (Algeria, Morocco, Tunisia), Eastern and Southern Europe, South America (especially Argentina, Brazil, Chile, Peru, Uruguay), Southwest Asia (Iraq, Turkey, Iran), China, and Australia (WHO, 2021).
- In South American hyperendemic zones, such as parts of Argentina, Peru, and Chile, up to 20–95% of livestock in slaughterhouses test positive for E. granulosus, primarily due to extensive animal slaughter and pastoral practices (WHO, 2021). In contrast, Africa exhibits markedly lower livestock prevalence, estimated at around 3%. In Australia, annual human diagnoses of cystic echinococcosis range between 80–100 cases per year (Periago, 2023).

Diagnostic Methods:

1. **Clinical Assessment:** Cystic echinococcosis is frequently identified by chance during routine examinations or post mortem inspections. A background of contact with dogs or grazing animals in known endemic areas increases the likelihood of suspicion.
2. **Ultrasound Assessment:** Liver ultrasonography, and occasionally lung scanning, serves as the principal diagnostic method for detecting cystic echinococcosis in live animals. In Turkana, Kenya, a study on goats found that 2.5% had cysts identifiable via ultrasound, with a positive predictive value

of 82% when confirmed through necropsy (Sage et al., 2017). A more detailed investigation conducted in Italy on sheep using targeted liver ultrasound demonstrated a sensitivity of 91% and specificity of 80%, a methodology that can also be effectively applied to goats (Borriello et al., 2020). This imaging technique allows visualization of key cyst features such as daughter cysts, floating membranes, and calcification, enabling disease staging similar to the WHO classification system used in human medicine (Govindasamy et al., 2023).

3. **Serologic Testing:** Serological tests such as ELISA and indirect hemagglutination (IHA) can complement imaging results. However, in small ruminants, these tests often show inconsistent reliability due to issues like cross-reactivity and fluctuating sensitivity. Consequently, while they may assist in broader herd-level surveillance, they are not regarded as conclusive diagnostic tools on an individual animal basis (Borriello et al., 2020).
4. **Confirmatory Diagnosis:** Definitive diagnosis is most reliably achieved through necropsy, which allows direct observation of hydatid cysts in the liver or lungs during slaughter or post-mortem examination. Goats that test positive via ultrasound are confirmed through necropsy in approximately 82% of cases, reinforcing the credibility and diagnostic value of ultrasound in live-animal assessments (Maxson et al., 1996).

Treatment in Small Ruminants:

1. Anthelmintic Medication:

• Albendazole is the most frequently used anthelmintic in goats, typically administered orally at 7.5–10 mg/kg daily, either continuously or intermittently across several weeks. Its effectiveness is greater on smaller or developing cysts and may be variable overall (Parasitipedia, 2022).

• Combination protocols, such as albendazole with praziquantel, and alternatives like oxfendazole (30 mg/kg twice weekly), have shown promise in naturally infected sheep and goats, achieving higher cost reduction rates than albendazole alone (Gavidia et al., 2011).

2. Surgical Intervention:

• Radical surgical methods including cystectomy, pericystectomy, lobectomy, or hepatectomy offer the best chance for complete cyst removal and reduced recurrence. However, these procedures carry a high risk of intraoperative complications and require skilled surgical expertise (WHO, 2024; Parasite Immunol, 2016).

3. Preventive Measures:

I. Proper Disposal of Offal: Avoid feeding raw or infected offal to dogs. Infected organs from slaughter should be buried or incinerated to break the transmission cycle (WHO, 2021).

II. Improved Slaughterhouse Practices: Encouraging use of licensed slaughterhouses ensures systematic inspection and safe discarding of infected tissues, reducing disease spread (WHO, 2021).

III. Livestock Management: Fence grazing areas and water sources to limit contact between dogs (definitive hosts) and livestock, and minimize environmental contamination (WHO, 2021).

4. Vaccination:

- The EG95 vaccine has been shown to significantly reduce CE prevalence in sheep and goats. In regions like Río Negro, Argentina, three-dose regimens have reduced infections in small ruminants by over 60% (Romig et al., 2024; Acuña et al., 2021; Poggio et al., 2016).
- Recommended vaccination schedule: initial dose in young stock (≥2 months), followed by boosters at 1 month and annually thereafter (Tecnovax, 2021).

5. Education & Surveillance:

- Training farmers on the Echinococcus life cycle, emphasizing hygiene protocols (e.g., hand-washing after handling dogs or livestock), and promoting proper feeding practices are essential complementary control measures (Romig et al., 2024; Poggio et al., 2016).
- Conduct regular assessments of livestock and dog populations in endemic areas and maintain records of case numbers to monitor program efficacy (Romig et al., 2024).

Conclusion and Future Perspective:

- Cystic echinococcosis (CE) is a significant zoonotic parasitic disease in small ruminants, mainly caused by the larval stage of Echinococcus granulosus. Sheep and goats act as intermediate hosts, with hydatid cysts predominantly forming in the liver and lungs. The disease is often asymptomatic in early stages, making diagnosis difficult; necropsy remains the most definitive method, though ultrasound offers good live-animal detection. CE causes considerable economic losses and poses a major public health risk.
- Future control efforts should focus on improved diagnostic tools, strategic vaccination (e.g., EG95), public education, and integrated One Health surveillance approaches to interrupt the parasite's life cycle and reduce transmission to both animals and humans.

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