



DIAGNOSTIC PROTOCOLS FOR CYSTICERCOSIS IN SWINE: FROM FIELD TECHNIQUES TO ADVANCED SEROLOGICAL APPROACHES

PROTOCOLOS DE DIAGNÓSTICO DA CISTICERCOSE EM SUÍNOS: DAS TÉCNICAS DE CAMPO ÀS ABORDAGENS SOROLÓGICAS AVANÇADAS

PROTOCOLOS DE DIAGNÓSTICO DE LA CISTICERCOSIS EN CERDOS: DE LAS TÉCNICAS DE CAMPO A LOS ENFOQUES SEROLÓGICOS AVANZADOS

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ABSTRACT

Porcine cysticercosis, a zoonosis caused by *Taenia solium*, represents a serious public health and economic problem, perpetuated by poor sanitary conditions. In vivo diagnosis remains challenging due to the clinical nonspecificity of the infection. This study aimed to compare the effectiveness of field diagnostic protocols with advanced serological approaches. A narrative literature review was conducted using the PubMed database, including articles published within the last five years. The results demonstrated the low sensitivity of traditional techniques, such as tongue palpation and carcass inspection, which often underestimate the actual prevalence, detecting significantly lower rates compared to laboratory methods. In contrast, immunodiagnostic methods, particularly Ag-ELISA and Western Blot, showed greater accuracy, enabling the identification of circulating antigens and mild infections not visually detectable. It was observed that the choice of diagnostic method directly impacts epidemiological mapping and the identification of risk factors. It is concluded that the implementation of more sensitive serological diagnostics, integrated with vaccination and sanitation strategies, is essential for the effective control of the taeniasis–cysticercosis complex.

Keywords: Porcine Cysticercosis. Diagnosis. ELISA. Public Health. *Taenia solium*.

RESUMO

A cisticercose suína, zoonose causada pela *Taenia solium*, representa um grave problema de saúde pública e econômico, perpetuado por condições sanitárias precárias. O diagnóstico in vivo é desafiador, dada a inespecificidade clínica da infecção. O objetivo deste estudo foi comparar a eficácia dos protocolos de diagnóstico de campo frente às abordagens sorológicas avançadas. Realizou-se uma revisão bibliográfica narrativa na base PubMed, abrangendo artigos dos últimos cinco anos. Os resultados demonstraram a baixa sensibilidade das técnicas tradicionais, como a palpação lingual e a inspeção de carcaças, que frequentemente subestimam a prevalência real, detectando taxas significativamente menores em comparação aos métodos laboratoriais. Em contraste,

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métodos imunodiagnósticos, notadamente o Ag-ELISA e o Western Blot, apresentaram maior acurácia, sendo capazes de identificar antígenos circulantes e infecções leves não detectáveis visualmente. Observou-se que a escolha do método impacta diretamente o mapeamento epidemiológico e a identificação de fatores de risco. Conclui-se que a implementação de diagnósticos sorológicos mais sensíveis, integrados a estratégias de vacinação e saneamento, é crucial para o controle efetivo da teníase-cisticercose.

Palavras-chave: Cisticercose Suína. Diagnóstico. ELISA. Saúde Pública. *Taenia solium*.

RESUMEN

La cisticercosis porcina, una zoonosis causada por *Taenia solium*, representa un grave problema de salud pública y económico, perpetuado por condiciones sanitarias deficientes. El diagnóstico in vivo es desafiante debido a la inespecificidad clínica de la infección. El objetivo de este estudio fue comparar la eficacia de los protocolos diagnósticos de campo frente a los enfoques serológicos avanzados. Se realizó una revisión bibliográfica narrativa en la base de datos PubMed, incluyendo artículos publicados en los últimos cinco años. Los resultados demostraron la baja sensibilidad de las técnicas tradicionales, como la palpación lingual y la inspección de canales, que con frecuencia subestiman la prevalencia real, detectando tasas significativamente menores en comparación con los métodos de laboratorio. En contraste, los métodos inmunodiagnósticos, especialmente el Ag-ELISA y el Western Blot, presentaron mayor precisión, permitiendo identificar antígenos circulantes e infecciones leves no detectables visualmente. Se observó que la elección del método diagnóstico impacta directamente el mapeo epidemiológico y la identificación de factores de riesgo. Se concluye que la implementación de diagnósticos serológicos más sensibles, integrados con estrategias de vacunación y saneamiento, es fundamental para el control efectivo del complejo teniasis–cisticercosis.

Palabras clave: Cisticercosis Porcina. Diagnóstico. ELISA. Salud Pública. *Taenia solium*.



1 INTRODUCTION

Porcine cysticercosis, caused by the larval stage of *Taenia solium*, represents one of the main parasitic zoonoses in developing countries, exerting a substantial impact on both public health and the agricultural economy (Gulelat et al., 2022; Chege et al., 2023). The persistence of this disease is intrinsically linked to failures in basic sanitation, the habit of open defecation, and the management of pigs in extensive or semi-confined farming, which facilitates the animals' access to contaminated human feces (Detha et al., 2022; Koffi et al., 2023). In this epidemiological scenario, the transmission of the parasite is complex, since experimental models indicate that low infectious doses of eggs are already sufficient for the development of cysts (Andrade-Mogrovejo et al., 2022).

It is worth noting that this disease is often pointed out as the main cause of acquired epilepsy in humans globally, although cross-sectional studies in areas of high porcine prevalence are not always able to establish a direct and immediate serological correlation between epileptic patients and neurocysticercosis (Diaz et al., 2022).

Accurate diagnosis in pigs is a critical component for the control of the taeniasis-cysticercosis complex, since the animal acts as an essential intermediate host in the biological cycle of the parasite. However, the identification of infection in the live animal presents significant challenges, as clinical manifestations are often absent or nonspecific (Andrade-Mogrovejo et al., 2022). Traditionally, diagnosis is based on the inspection of carcasses in slaughterhouses and the examination of tongue palpation under field conditions, techniques that, despite being accessible, have low sensitivity (Gulelat et al., 2022). Recently, the improvement of immunodiagnostic methods, such as ELISA for the detection of circulating antigens (Ag-ELISA) and Western Blot, has provided a more reliable assessment of the actual prevalence and parasite load in swine populations (Diaz et al., 2022; Koffi et al., 2023).

This sensitivity discrepancy between the techniques becomes evident in quantitative data. In a meta-analysis covering Eastern and Southern Africa, Gulelat et al. (2022) demonstrated that while carcass dissection identified 27% positivity and ELISA tests 23%, visual inspection of meats and lingual examination detected only 12% and 9%, respectively. Corroborating this limitation, Chege et al. (2023) found visible cysts on the tongue in only 3.8% of animals in a field study, showing that relying only on visual inspection can drastically underestimate the circulation of the agent.



On the other hand, the practical application of advanced serological approaches allows the identification of more subtle risk factors. On Timor Island, the use of ELISA revealed a seroprevalence of 29%, allowing us to statistically conclude that pigs in extensive systems are five times more likely to be infected than those in intensive systems (Detha et al., 2022). In addition to detection, accurate diagnosis is key to monitoring interventions: the absence of sanitation facilities was identified as a critical factor (OR 4.5), while improvements in sanitation have been shown to reduce the prevalence of the disease over time (Chege et al., 2023).

Thus, the present study aimed to review and compare the efficacy of diagnostic protocols for porcine cysticercosis, contrasting the limitations of field techniques with the sensitivity of advanced serological approaches.

2 METHODOLOGY

The present study is characterized as a narrative literature review, developed with the objective of synthesizing and analyzing the most recent scientific evidence related to the diagnostic protocols of cysticercosis in pigs. The search was carried out in the PubMed database, using the descriptors "Cysticercosis", "Swine", "Diagnosis" and "Treatment", combined by means of the Boolean operators AND and OR, according to the terminology of the Medical Subject Headings (MeSH). Articles published in the last five years, available in full and written in Portuguese or English, that directly addressed the topic, were included. Studies that did not have a direct relationship with the central theme, duplicate publications, narrative reviews with low methodological rigor, and articles not indexed in the database used were excluded. The selection of studies was conducted in two stages: screening of titles and abstracts, followed by the evaluation of full texts to confirm relevance. The information extracted was organized in a descriptive way.

3 RESULTS AND DISCUSSION

The analysis of the diagnostic protocols reveals a marked discrepancy between the efficacy of traditional techniques and contemporary laboratory methods.

- **Field Techniques and Carcass Inspection:** Lingual palpation continues to be widely used in endemic areas due to its low cost and immediate execution. However, its sensitivity is limited, predominantly detecting massive infections



(Gulelat et al., 2022; Chege et al., 2023). Similarly, visual inspection of carcasses in slaughterhouses, while the regulatory standard in many regions, often underestimates the prevalence of the disease in cases of mild infections, where cysticerci may be located in tissues not routinely examined (Koffi et al., 2023; Gulelat et al., 2022).

- **Immunodiagnosis (Ag-ELISA and Ab-ELISA):**

Enzyme-linked immunosorbent assays represent the most significant advance in population screening. Ag-ELISA (especially using the B158/B60 or HP10 monoclonal antibodies) demonstrates superiority in detecting viable cysticercus antigens, which allows differentiating active infections from past exposures (Koffi et al., 2023; Diaz et al., 2022). In meta-analyses conducted in regions of Africa, the prevalence detected by Ag-ELISA was significantly higher (23%) than that obtained by meat inspection (12%) or tongue palpation (9%), evidencing the high rate of false negatives in conventional methods (Gulelat et al., 2022). The use of antibody tests (Ab-ELISA) and Western Blot (WB) confirmation are recommended for epidemiological mapping, although they may cross-react with other helminths (Koffi et al., 2023).

- **Risk Factors and Diagnostic Modeling:** The identification of risk factors, such as free access of pigs to untreated water sources and contact with human waste, is essential to guide screening protocols (Detha et al., 2022). Dose-response studies indicate that the final parasite load in the pig is directly related to the level of environmental exposure to *T. solium* eggs, which reinforces the need for more sensitive diagnostics to detect animals with low parasite loads that can still transmit taeniasis to humans (Andrade-Mogrovejo et al., 2022).

- **Control and Treatment Strategies:** Integration of diagnosis with intervention measures is essential. The use of the dewormer oxfendazole and the implementation of the TSOL18 vaccine have been shown to be effective in reducing the burden of cysticerci in infected pigs (Gulelat et al., 2022). In addition, improved latrine coverage and health education to reduce open defecation have been shown to decrease infection pressure in the pig herd, although complete eradication depends on systematic diagnostics and continuous surveillance (Chege et al., 2023; Diaz et al., 2022).



4 CONCLUSION

The present literature review study demonstrated a marked disparity in the efficacy of diagnostic protocols for porcine cysticercosis. Traditional field techniques, such as tongue palpation and carcass inspection, prove to be of low sensitivity, significantly underestimating the actual prevalence of infection and predominantly detecting only cases of massive infection.

On the other hand, advanced immunodiagnostic methods, notably **Ag-ELISA** (especially B158/B60 or HP10 monoclonal antibodies) and **Western Blot**, offer greater diagnostic accuracy. These are crucial for reliable epidemiological mapping, allowing the detection of circulating antigens and mild infections that are invisible to conventional methods.

It is concluded that the effective control of the taeniasis-cysticercosis complex requires the implementation of more sensitive serological diagnoses. Such approaches must be integrated into a comprehensive intervention program that includes the use of effective treatments, such as the dewormer oxfendazole and the TSOL vaccine¹⁸, and, crucially, continuous improvements in basic sanitation and health education to break the cycle of transmission of *Taenia solium*.

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