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Taeniasis: symptoms, diagnosis and treatment – a systematic review

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Abstract

Human taeniasis is caused by infection with one of three Taenia species: *Taenia saginata*, *Taenia solium*, and *Taenia asiatica*. It is a parasitic disease that remains a public health concern in endemic regions. This systematic review examines the clinical manifestations, diagnostic approaches, and methods of treatment for taeniasis. A comprehensive analysis of available literature highlights the diverse symptomatology, ranging from asymptomatic carriers to individuals with life-threatening complications. Advances in diagnostic techniques, including molecular methods, have improved detection rates, while pharmacological treatments like praziquantel and niclosamide remain the key elements of therapy. This review underscores the importance of integrated control strategies to reduce the burden of taeniasis, including sanitation improvements and public health education.

Keywords

taeniasis, Taenia saginata, Taenia solium, symptoms of taeniasis, taeniasis treatment, tapeworm infection

Introduction

Human taeniasis is a zoonotic parasitic infection caused by cestodes of the genus *Taenia*. The species causing human infections are *T. saginata* (beef tapeworm), *T. solium* (pork tapeworm), and *T. asiatica* (Asian tapeworm). These parasites are transmitted through the ingestion of raw or undercooked meat containing infective cysticerci, which develop into adult tapeworms in the

human intestine. [1] While taeniasis is often asymptomatic, [2] it can cause a range of gastrointestinal symptoms, including abdominal pain, nausea, and altered bowel habits. In cases involving *T. solium*, there is a concerning risk of cysticercosis, a dangerous systemic disease caused by larval stage migration. [2,3]

Taeniasis mostly affects populations in regions with inadequate sanitation and meat processing, limited access to healthcare, and high rates of livestock consumption. [4] The World Health Organization (WHO) classifies *T. solium* as a neglected tropical disease due to its significant health and socioeconomic impact, particularly in low- and middle-income countries. [5] Despite global efforts to control taeniasis, challenges such as diagnostic limitations, lack of awareness, and resistance to behavioral interventions persist. [6]

This systematic review aims to provide a comprehensive overview of the clinical presentation, diagnostic advancements, and therapeutic strategies for taeniasis. By synthesizing findings from recent studies, academic sources and newest guidelines this review seeks to inform evidence-based approaches for managing and controlling this parasitic infection.

Methods

Search Strategy

A systematic search of electronic databases, including PubMed, MEDLINE, Cochrane Library, and Embase, was conducted to identify relevant articles published between 1970 and 2024. Keywords used in the search included “taeniasis,” “Taenia saginata,” “Taenia solium,” “symptoms of taeniasis,” “taeniasis treatment,” and “tapeworm infection.”

Results

Signs and Symptoms

Taeniasis, caused by the parasitic tapeworms *Taenia saginata*, *Taenia solium*, and *Taenia asiatica*, presents a spectrum of clinical manifestations that range from asymptomatic infection to significant gastrointestinal and systemic symptoms. The clinical presentation depends on the species of *Taenia*, the location and burden of the parasites, the host’s age and immune response. [2,7]

Many individuals with taeniasis remain asymptomatic [8], particularly in cases of *Taenia saginata* infection, where the parasite resides in the intestinal lumen without causing significant mucosal damage. [9] However, symptomatic cases often manifest with abdominal pain (35,6%)[7], typically localized to the epigastric or periumbilical regions. The pain varies in intensity, ranging from mild cramping to severe colicky episodes, resulting from the irritation of the intestinal mucosa by the parasite’s suckers or hooks. [10] Intermittent nausea is reported in approximately 34,4% of infected individuals and its rarely (4%) accompanied by vomiting. [7]

Altered appetite is another common symptom, where patients report changes that range from anorexia to increased hunger. These alterations are likely due to the parasite’s competition for nutrients and its disruption of normal gastrointestinal signaling pathways. [3,7] Disruption in intestinal motility often results in diarrhea or constipation, which may alternate in the same individual due to the dynamic interaction between the host and the parasite. Unintentional weight loss is a hallmark of taeniasis, however it affects only 21% of symptomatic patients. [7]

Weight loss is more common in infections caused by *Taenia saginata*, where the parasite's significant nutrient consumption leads to nutritional deficiencies in the host. [11] Chronic infection may also lead to fatigue and weakness, largely attributable to malnutrition and the host's inflammatory response to the parasite. [7]

The clinical manifestations vary depending on the species of the causative agent. In infections caused by *Taenia saginata*, commonly referred to as the beef tapeworm, the majority of individuals experience mild gastrointestinal symptoms. A characteristic feature of *Taenia saginata* infection, reported in 98,3 % infected, is the spontaneous passage of motile proglottids through the anus. [7] Patients may report sensations of movement or observe visible segments in their undergarments or stool, which often leads to pruritus ani. [7,10] In severe cases *T. saginata* infection may even lead to bowel obstruction. [12,13]

Infections caused by *Taenia solium* pose a greater clinical risk due to their potential to cause cysticercosis. While intestinal *T. solium* infections share many symptoms with *T. saginata*, the extraintestinal migration of *T. solium* larvae results in severe complications. Neurocysticercosis, for instance, is a life-threatening condition characterized by neurological symptoms such as seizures, chronic headaches, focal neurological deficits, and signs of raised intracranial pressure. [14,15] The severity and nature of neurological symptoms depend on the number, location, and stage of cysts in the brain. Parenchymal cysts often result in seizures, while intraventricular cysts may cause hydrocephalus. [14] In addition to neurocysticercosis, ocular cysticercosis can lead to visual disturbances, ranging from blurry vision and floaters to significant visual impairment or blindness, depending on the cyst location. [16,17] Subcutaneous or muscular cysticercosis is characterized by the development of painless nodules that may either be detected incidentally or cause discomfort when compressing surrounding tissues. [18]

Infections caused by *Taenia asiatica*, which are geographically restricted to parts of Asia, are often asymptomatic or present with mild gastrointestinal disturbances. [19] Symptoms such as abdominal pain, diarrhea, and occasional proglottid passage are typically reported in cases of *T. asiatica* infection, mirroring those of *T. saginata* but with a lower frequency of severe complications. [20]

Complications of taeniasis, though rare, can occur in untreated or severe cases. Intestinal obstruction, caused by a high tapeworm burden, is more common in individuals with narrower intestinal lumens and can present with severe abdominal pain, vomiting, and the inability to pass stools or flatus. [21] Migration of proglottids or larval stages into the biliary or pancreatic ducts can lead to cholangitis or pancreatitis, respectively, manifesting as jaundice, right upper quadrant pain, and fever. [22–24] Similarly, the migration of proglottids into the appendix may induce appendicitis, mimicking acute inflammation that requires surgical intervention. [25,26]

Cysticercosis, primarily caused by the extraintestinal larval migration of *T. solium*, remains the most severe complication. The clinical presentation varies widely, from asymptomatic subcutaneous cysts to life-threatening neurocysticercosis with refractory seizures and progressive neurological deterioration. [14,15,27] Allergic reactions to antigenic components released during the degradation of the parasite or its cysts may provoke systemic hypersensitivity reactions. Such reactions, ranging from urticaria to anaphylaxis, are particularly concerning during antiparasitic treatment, which accelerates cyst breakdown. [28]

The pathophysiology underlying these symptoms is primarily driven by the lifecycle of the parasite and its interaction with the host immune system. Mechanical effects, such as irritation of the intestinal mucosa and obstruction of anatomical structures by large parasites or masses

of proglottids, contribute significantly to symptomatology. [7] Nutritional competition between the parasite and host can exacerbate deficiencies in essential vitamins and minerals, further impairing growth in children and contributing to systemic fatigue and weakness in adults. [3] The host's inflammatory response, particularly during larval migration or cysticercosis, results in both local and systemic inflammation. Cytokine release, including interleukin-1 (IL-1) and tumor necrosis factor-alpha (TNF-α), contributes to fever, malaise, and tissue damage, especially in neurocysticercosis where perilesional edema worsens neurological symptoms. [29]

In conclusion, understanding the signs and symptoms of taeniasis is pivotal for timely diagnosis and effective management. Although many cases present as asymptomatic or with mild gastrointestinal symptoms, the potential for severe complications, particularly neurocysticercosis, underscores the need for vigilance, especially in endemic regions.

Diagnosis

The diagnosis of taeniasis involves an intricate combination of clinical evaluation, laboratory techniques, and imaging studies to accurately detect and differentiate *Taenia* infections. The approach has been significantly advanced by integrating traditional and molecular methods, enhancing both sensitivity and specificity.

Microscopic examination of stool specimens remains a cornerstone in the diagnostic process. This conventional method involves identifying *Taenia* eggs or proglottids in fecal samples. However, the morphological similarities between eggs of *T. saginata* and *T. solium* often pose challenges in distinguishing these species using light microscopy alone. [30] While the presence of gravid proglottids can aid in differentiation, this requires a trained microscopist and optimal sample collection. [31,32]

To address these limitations, molecular diagnostics have emerged as pivotal tools. Polymerase chain reaction (PCR) techniques enable the precise detection of *Taenia* species by amplifying specific genomic sequences unique to each species. This method provides unparalleled accuracy and is particularly beneficial in research and surveillance settings. [33] Recent advancements have introduced loop-mediated isothermal amplification (LAMP) as a cost-effective alternative to PCR. [34] LAMP is highly sensitive and operates under simpler laboratory conditions, making it an ideal choice for resource-limited regions where taeniasis is endemic. [35]

Serological tests offer valuable adjuncts in diagnosing taeniasis, especially in co-endemic areas where distinguishing between intestinal taeniasis and cysticercosis is crucial. Techniques such as enzyme-linked immunosorbent assays (ELISA) and Western blot are commonly employed to detect parasite-specific antigens or host-derived antibodies. [36] ELISA is widely appreciated for its simplicity and cost-effectiveness, whereas Western blot is utilized for its superior specificity and capacity to confirm ambiguous results. The integration of antigen-detection ELISA has further improved diagnostic precision by directly identifying active infections. [36,37]

In cases where complications are suspected, imaging modalities provide critical insights. Although not routinely required for intestinal taeniasis, imaging studies become indispensable for diagnosing extraintestinal complications, such as cysticercosis [14] or obstruction. [21] Abdominal ultrasound and computed tomography (CT) are particularly effective in visualizing anatomical disruptions caused by parasitic masses or migrating proglottids. [13,38] For neurocysticercosis histological confirmation of the parasite is, in most cases, not possible. Diagnosis is based on neuroimagining and confirmed by serological tests. Magnetic resonance

imaging (MRI) is a fundamental tool in visualizing cystic lesions, inflammatory changes, and associated structural alterations within the central nervous system. In some rare cases, like calcification of cysticerci, CT can provide better medical imaging. [14]

The integration of advanced diagnostic approaches has significantly improved the detection and management of taeniasis. Combining traditional stool microscopy with molecular and serological tools enables accurate identification of species and stages of infection. This multidisciplinary approach ensures timely intervention and reduces the morbidity associated with taeniasis and its complications.

Treatment of Taeniasis

The treatment of taeniasis focuses on eradicating the intestinal tapeworm while addressing any complications or coexisting conditions, such as cysticercosis. Effective management requires the use of antiparasitic medications, nutritional support, and in some cases, surgical intervention. The therapeutic approach is tailored to the species of *Taenia*, the clinical presentation, and the patient's overall health.

Antiparasitic Medications

Antiparasitic drugs are highly effective in eliminating the adult tapeworm from the intestine. Praziquantel is one of the two first-line treatment for taeniasis caused by *T. saginata*, *T. solium*, and *T. asiatica*. [39] This anthelmintic agent that is hypothesized to work by disrupting the parasite's calcium homeostasis, leading to paralysis and detachment of the tapeworm from the intestinal mucosa. [40] A single oral dose of 5–10 mg/kg is typically sufficient to achieve complete eradication. [41] The cure rate is around 95%. [39] Praziquantel is well-tolerated, with mild side effects such as nausea, dizziness, or abdominal discomfort reported in a minority of cases. [42]

Niclosamide serves as an alternative treatment option with a cure rate of 85%. [39] A single dose regimen of 2 g for adults, followed by a laxative to aid in expelling the dead parasite, is commonly employed. [41] This drug acts by inhibiting the parasite's oxidative phosphorylation, leading to energy depletion and death. [43] Unlike praziquantel, niclosamide is not systemically absorbed, making it a good choice for treating intestinal infections. [44]

Albendazole, though not a first-line agent for taeniasis, is occasionally used, especially in areas where cysticercosis is co-endemic. Albendazole inhibits microtubule polymerization in the parasite, disrupting its nutrient uptake and leading to death. [45] Some studies prove that dose of 400mg per day for three consecutive day has a high cure rate in *T. solium*, [46] although there is not enough data for its effectiveness especially in *T.saginata* infestation. [47]

Management of Cysticercosis

For patients with *T. solium* infection, special consideration is required due to the potential for cysticercosis. Neurocysticercosis, the most severe form, necessitates a multidisciplinary approach involving neurologists, infectious disease specialists, and radiologists. Praziquantel and albendazole are the primary agents used for treating neurocysticercosis, often in combination with corticosteroids like dexamethasone to mitigate inflammatory reactions caused by cyst degradation. [48,49] Antiepileptic drugs are prescribed to manage seizures, while surgical interventions such as cyst removal or ventriculoperitoneal shunting may be necessary for cases with obstructive hydrocephalus. [41]

Supportive and Symptomatic Management

In addition to antiparasitic therapy, supportive care plays a crucial role in managing taeniasis. Nutritional supplementation may be required for individuals experiencing significant weight loss or nutrient deficiencies due to prolonged infection. Iron, vitamin B12, and protein-rich diets can help reverse anemia and malnutrition associated with chronic parasitic burdens. [50,51]

Hydration and electrolyte balance must be monitored, particularly in cases with severe diarrhea or vomiting. Symptomatic relief for abdominal pain and nausea can be provided with antispasmodics and antiemetics, respectively. In rare cases where obstruction occurs, decompressive procedures or surgical resection of the affected bowel segment may be required.

Prevention of Reinfection

To prevent reinfection and interrupt transmission cycles, public health measures are critical. Patients and their families must be educated about the importance of personal hygiene, including regular handwashing and proper food handling. [52,53] Treating all infected individuals in a household or community setting is crucial to reduce the risk of reinfection. [6] Regular follow-up stool examinations may be necessary to ensure the complete clearance of the parasite. [54]

Challenges in Treatment

Several challenges complicate the treatment of taeniasis, particularly in endemic regions. Limited access to healthcare facilities and diagnostic tools can delay treatment, increasing the risk of complications. [39] The emergence of drug-resistant parasites, though not yet a widespread issue, represents a potential threat to the effectiveness of current antiparasitic regimens. [55] Moreover, co-endemicity with other parasitic diseases, such as schistosomiasis or soil-transmitted helminthiasis, can complicate clinical management and increase the burden on healthcare systems. [56,57]

Future Directions

Advancements in pharmacological research and diagnostic technologies hold promise for improving taeniasis management. Novel drug formulations with enhanced efficacy and safety profiles are under investigation, as are vaccines targeting larval stages to prevent cysticercosis. Integrating molecular diagnostics and point-of-care testing in resource-limited settings could facilitate early detection and treatment, reducing the prevalence and associated morbidity of taeniasis.

In conclusion, the treatment of taeniasis is highly effective with appropriate antiparasitic medications, particularly praziquantel and niclosamide. A comprehensive approach that includes supportive care, prevention of reinfection, and management of complications is essential for optimal outcomes. Continued investment in research, healthcare infrastructure, and public health education will be pivotal in controlling and ultimately eradicating this parasitic disease.

Discussion

Taeniasis remains a persistent health challenge in regions where socioeconomic constraints hinder access to adequate sanitation, veterinary oversight, and public health infrastructure. The disease exemplifies a complex interplay of biological, environmental, and social factors, requiring a multifaceted approach for effective control and eventual eradication.

Pharmacological treatments like praziquantel and niclosamide have proven highly effective in eliminating the adult tapeworm, but barriers such as delayed diagnosis, reinfections, and treatment nonadherence compromise long-term outcomes. Moreover, the disease's asymptomatic nature in many cases allows it to go undetected, further propagating transmission cycles. The added risk of cysticercosis, particularly neurocysticercosis, associated with *Taenia solium* infections, significantly elevates the public health impact, with severe neurological consequences including seizures and hydrocephalus.

Advancements in diagnostic technologies, particularly molecular and antigen-detection assays, represent a critical step forward. These tools offer higher specificity and sensitivity, enabling accurate detection and differentiation of *Taenia* species. However, their accessibility in endemic, resource-limited regions remains a key hurdle.

Public health interventions aimed at improving awareness and sanitation practices have demonstrated measurable success. Studies highlight the value of community education initiatives in reducing the consumption of raw or undercooked meat and promoting proper food handling. Nevertheless, the implementation of such programs on a large scale is often hindered by financial and logistical constraints.

Future research should prioritize the development of vaccines targeting *Taenia* species, as these could provide a long-term, cost-effective solution for controlling both taeniasis and cysticercosis. Additionally, the exploration of novel therapeutic agents is crucial to preempt the potential emergence of drug resistance, which could undermine the efficacy of current treatments. Simultaneously, the integration of deworming campaigns within broader public health strategies, alongside the enforcement of meat inspection protocols, could significantly reduce disease prevalence.

Conclusion

Taeniasis exemplifies the challenges of combating parasitic diseases in resource-limited settings. While effective treatments exist, sustainable control necessitates addressing underlying determinants such as poverty, inadequate infrastructure, and lack of education. Integrated approaches combining pharmacological advances, diagnostic improvements, and public health initiatives are essential to breaking the transmission cycle.

Continued investment in research, community engagement, and international collaboration will be pivotal in mitigating the burden of taeniasis and associated complications like cysticercosis. Ultimately, achieving global control of this parasitic disease depends on aligning scientific innovation with practical, equitable public health solutions.

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