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Case Report

The Recent Human Case of *Taenia saginata* in Iran: Could Be a Sign of Re-Emerging Scenario?

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Received 13 Mar 2025
Accepted 10 Jun 2025

Keywords:
Taenia saginata;
Beef tape worm;
Case report;
Iran

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Abstract
Beef tape worm a zoonotic helminth of platyhelminth phylum, is reported here in a 28-year-old female patient from Tehran, Iran taking advantage of microscopic and molecular techniques. The occurrence of this infection has been recorded high in previous decades in Iran while its record nowadays looks rare in the country. Two 18s and Cox1 fragments were amplified and sequenced successfully using specific primers. This case underscores the potential for *Taenia saginata* transmission in the region, warranting rigorous slaughterhouse inspections and enhanced public awareness efforts.

Introduction

Human taeniasis is a worldwide parasitic infection caused by *Taenia saginata, T. solium*, and *T. asiatica*. Each of these species requires its specific intermediate host, like cattle and pigs, to develop their own parasitic larval stages called cysticercus within their muscles and viscera that might be eaten raw or undercooked by humans. Although not highly prevalent nowadays in many parts of the world, but this tapeworm infection due to *T. saginata* is still current, specifically in some countries in Africa, South America and in Asia (1).

This foodborne zoonotic taeniasis has also been very prevalent in Iran until four decades

ago (2, 3) which was declined dramatically over the years, nevertheless the present status of this infection will mention in the following.

This is epidemiologically worth mentioning how a prevalent disease in the past in a certain geographical region can be witnessed as an astonishing case report in some decades later? Improved general hygiene and advancements in veterinary practices are key factors contributing to the decline in taeniasis cases and other similar parasitic infections.

Meanwhile, accurate and continuous inspection for cysticerci in slaughtered animals remains a fundamental control measure in countries that have previously faced similar parasitic diseases. It should also be noted that certain parasitic infections, in both developed and developing countries, cannot be considered biologically eradicated; rather, terms such as 'elimination' and 'control' are more realistic and achievable goals. Reminding of the facts of global warming and climate change is a supportive issue in this concern. In parallel with this understanding, the clinicians and laboratory technicians should be up-to-date through interval retraining courses aiming to face suspected patients.

Case Report

The present case was confirmed when a 28-year-old female patient from Tehran, Iran suffering from intermittent abdominal discomfort and repelling of proglottids, was referred to our laboratory of Helminthology at the School of Public Health, Tehran University of Medical sciences, Tehran, Iran with expelled samples in her hand. Following this observation stool examination was performed in which the taeniid eggs were also observed (Fig. 1.b).

Apart from feeling a light abdominal discomfort the patient did not complain of any specific clinical symptoms. The rest of the laboratory tests for the patient were in a normal range and not indicating of any other pathological evidence. Moreover, like her other family members, she did not exhibit any other clinical signs or symptoms either. In addition, frequent consumption of fast-food and undercooked meat product, and a history of traveling to the northern and central regions of Iran within one year ago, were mentioned by the patient.

The macroscopic examination of proglottids showed the characteristic features of the taeniid gravid segment, morphologically very close to *T. saginata* (Fig. 1.a). The size of proglottids was measured and one of the latest segments was crushed, aiming to observe the eggs. The patient successfully treated with multiple 2-gram dose regimen of Niclosamide, and during the one-year follow-up period, the sign and symptoms did not recur.

Polymerase chain reaction (PCR)

For molecular diagnosis of the species, DNA was extracted using the SinaPure DNA kit. The concentration of extracted DNA was measured using nanodrope of about 102 and PCR was carried out to detect the 18 small subunit ribosomal DNA of *T. saginata* and the cytochrome c oxidase subunit 1 (*Cox1*) mitochondrial gene of taeniid helminth. The PCR product was subjected to safe stain and run on 1.5% agarose gel. After confirmation of product length, ten micro liters of PCR product of both genes were sent for sequencing using Applied Biosystems 3130xl genetic analyzers. All PCR reactions were carried out in a final volume of 25 µl, consisting of 12.5 µl of master mix (2× Master Mix RED; Ampliqon, Odense, Denmark; 1.25 U Taq DNA polymerase, 0.5 µM of dNTPs and 2 mM MgCl2), 20 pmol of each primer and 2 µl of DNA template. The forward and reverse primers used in the PCRs were as follows: JB3 (5'-TTT TTT GGG CAT CCTGAG GTT TAT-3') and JB4.5 (5'-TAA AGA AAG AACATA ATG AAA ATG-3') for the *Cox*1 gene (4) and (5'-CACGTGGCGATGTTGCTGCTG-3') and (5'-TGATCCACCGCACACAGTTACTTG-3') for *18s* gene. The PCR program for *Cox1* began with one cycle at 94 °C for 5 min (primary

denaturation), followed by 35 cycles at 94 °C for 30 sec (denaturation), 55 °C for 45 sec (annealing) and 72 °C for 35 sec (extension), followed by a final extension step at 72 °C for 10 min. The PCR program for *18s* began with one cycle at 95 °C for 5 min (primary denaturation), followed by 35 cycles at 95 °C for 35 sec (denaturation), 60 °C for 45 sec (annealing) and 72 °C for 45 sec (extension), followed by a final extension step at 72 °C for 10 min. Accession numbers: PQ535567 (*18s*) & PQ660936 (*Cox1*) (Table 1).

Table 1: The primers used for amplification of *Cox1* and *18s* genes of *T. saginata*

Target gene	Forward primer	Reverse primer	Product length (base pair)
18s* ribosomal DNA of *T. saginata	CAC GTG GCG ATG TTG CTG CTG	TGA TCC ACC GCA CAC AGT TAC TTG	140
***Cox1* mitochondrial gene of Taeniid helminth**	TTT TTT GGG CAT CCT GAG GTT TAT	TAA AGA AAG AAC ATA ATG AAA ATG	430

Results

The apparent morphology and microscopic examination of the proglottids were characteristic of classical identification of a gravid segment of *T. saginata,* while the morphometric measures were found within the range as well. Meanwhile the genital pores were randomly on either side. The eggs inside the uterus were about 40 micrometers in diameter and the taeniid embryophore layer was seen, obviously. For the molecular detection, both *Cox1* and *18s* ribosomal genes were detected using their characteristic bands in electrophoresis. The sequencing results of the *18s* rRNA and *Cox1* genes showed 100% and 99.75% identity with *T. saginata* genome using BLAST in NCBI (Figs. 2,3).

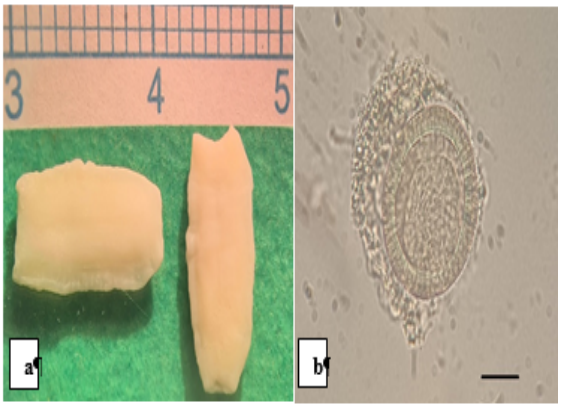

Fig. 1: a: *Taenia* sp. egg recovered from patient. **b:** the proglottids repelled from patient. The scale bar is 20 micrometers

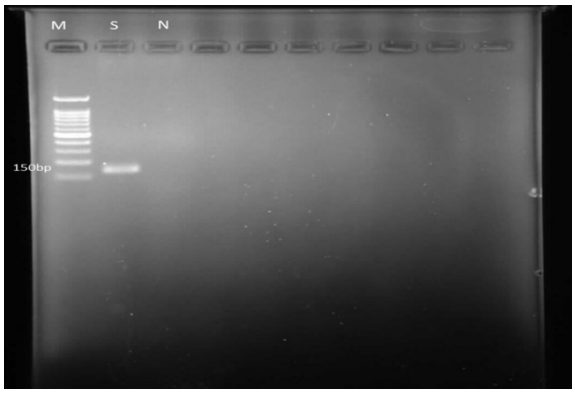

Fig. 2: Electrophoresis of a *18s* gene (150bp) amplified fragment using PCR. M: 100 bp DNA Marker (Gene Ruler™, Fermentas); S: amplicon related to proglottids expelled from patient N: negative control

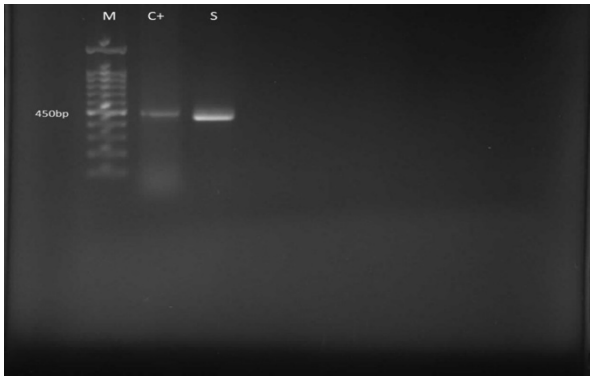

Fig. 3: Electrophoresis of a *Cox1* gene (450bp) amplified fragment using PCR. M: 100 bp DNA Marker (Gene Ruler™, Fermentas); C+: Positive control, S: amplicon related to proglottids expelled from patient

Discussion

T. saginata is a widespread infection, reported in 21 countries across the Americas (5), 18 in the MENA (Middle East and North Africa) region (1), and 14 in Europe (6). Surveys investigating the presence of *T. saginata* in East, Southeast, and South Asia found that nearly all countries were affected except for Japan (7).

After decades of rare reports of human infectivity with *T. saginata* in Iran, in 2023, a case of taeniasis was revealed by the surgeons during an acute abdomen operation in a 34-year-old man; whom a car-pedestrian accident had led to intestinal perforation and a live tapeworm was found in the peritoneal cavity accidentally (8). Since this case was an incidental diagnosis of *T. saginata* infection, it did drag the minds of those who assumed that human intestinal helminthiasis in the country is far from expectations to possible realities.

T. saginata infection is witnessed in most parts of the world, with high humidity in climate conditions, like in rural areas in northern Iran, specifically where human and animal close contact exists. It is important to note that its transmission almost shows inadequate hygiene and lack of sewage systems in human communities, since humans can serve as the only definitive host, passing the eggs to cattle as intermediate hosts. Despite the mild clinical symptoms that are exhibited in most patients and has grouped *T. saginata* infection among non-serious diseases, this parasite is however known as a cause of significant economic losses in the livestock industry. The preva-

lence of bovine cysticercosis can indirectly indicate the incidence of human taeniasis. Iran and neighboring countries report numerous cases of bovine cysticercosis, making the region more susceptible to human infection, particularly since most *T. saginata* infections are asymptomatic. This asymptomatic nature can reduce the number of reported human cases, as the lack of symptoms often prevents individuals from seeking medical attention.

As cysticerci should be detected precisely in slaughterhouses, neglect in this way can be a serious cause of infection transmission to human communities.

Concerning the other two human taeniid species, *T. solium* and *T. asiatica*, which may expect to occur potentially everywhere in the world, human infection of these two in Iran is not regarded as an important issue from the perspective of public health since swine meat consumption is prohibited according to Islamic beliefs. It is worth mentioning that paleo parasitological evidence has revealed the existence of *T. asiatica* in the pre-Islamic period in this country in ancient times (9).

Regarding the dramatic decline of human taeniasis, the observation of two positive cases (0.5%) among 417 randomly examined stool samples in rural areas in Mazanderan Province, northern Iran, where it has been highlighted for taeniasis many decades ago, is highly attractive epidemiologically (10). Parallel to this epidemiological scenario, tracking of the existence of *T. saginata* segments and eggs in two cases out of 2379 appendectomies in Isfahan should not be neglected (11). Reports in 2009 show that in Karaj, 50 km western of Tehran, the capital city of Iran and a multicultural residing area, in a total of 13,915 human stools, *Taenia sp.* proglottids have been observed in about 0.028% (12, 13)

A glance at the ectopic forms of *T. saginata* in human internal organs recorded in Iran exhibits the neglected side of its clinical problems, although this meat-borne helminth infection has not been known as a serious and risky pathogenic agent clinically. Findings of a long worm during endoscopy in two female patients of 40 and 55 years old, in the northeast and in Gilan at the Caspian Sea littoral area, in 2013 and 2015, respectively are important reports in recent years (14, 15). Other examples, such as peritonitis due to this taeniid parasite, in the Gorgan region in the north in 2017 (16) and expelling the worm during defecation in a patient following the consumption of undercooked beef in 2016 should be also taken into account. Other examples, such as peritonitis due to this taeniid parasite, in the Gorgan region in the north in 2017 (16) and expelling the worm during defecation in a patient following the consumption of undercooked beef in 2016 should be also taken into account. Although very rare but there are still similar reports however in recent years indicating the possible occasional occurrence of Beef Tapeworm infection in the country (17-20).

Meanwhile, the situation in neighboring countries is different to the scenario that we see in Iran. In Iraq, for instance, the number of human cases is remarkable within the same period of time (21). In Turkey, a bordering country in the northwest, the prevalence of taeniasis is reported to be up to 5.3% in 2019, while *T. solium* infection should moreover be taken into account, although a large proportion of the population are Muslim (22, 23). The reported epidemiological situation in Russia in the north narrates the existence of *T. solium* much more than what we can observe in our other neighboring countries (24).

For future actions, more sensitive methods for the detection of cysticercosis in abattoirs and public education about the risk of consumption of un-inspected meats are helpful in preventing human taeniasis. Awareness of clinicians about the possible misdiagnosis of human cases which may have complications like ectopic infections and perforation of the bowel is necessary.

Acknowledgements

The authors thank Dr. Zahedin Kheyri, Gastroenterology and Hepatology subspecialist, for his close collaboration and precise observation of the patient during the clinical and diagnostic steps.

Conflict of interest

There is no conflict of interest.

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