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Morphological characterization of *Moniliformis moniliformis* isolated from an Iraqi patient

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Abstract Infection with *Moniliformis moniliformis* is rare in Iraq since it has been recorded only twice by Ministry of Health. In the current study, the morphology of the parasite is evaluated to explain the basic structure of the parasite parasitizing a human body in Iraq, including the adult worm and the egg stage which is considered the diagnostic stage for the detection of the intestinal parasite in the stool sample. The assessment of the adult worm showed that it was white in color and had a pseudo-segmented shape, lacked the digestive system or alimentary canal, and was 133 mm in length. The anterior end bore the cylindrical-shaped proboscis armed with 13 rows of hooks, each with 7–8 hooks and measured 0.42×0.21 mm. The egg was oval-shaped, covered with three envelopes, contained hooks, and was 0.083 to 0.116 mm in length. The current study was performed on a single specimen that was revealed to be female during the examination.

Keywords *Moniliformis moniliformis* · Morphology · Acanthocephalan · Iraq

Introduction

Moniliformis moniliformis, which is commonly known as the thorny-headed worm, is the causative agent of acanthocephaliasis in humans (Meyers et al. 2000). It is an acanthocephalan that normally infects hamsters, white mice, cats, rats, and dogs in most parts of the world. It has a complex life cycle, in which humans, rats, mice, or dogs act as a definitive host, while the intermediate host is either beetles or cockroaches, which must be eaten by the definitive host (Gibson 2010). According to Schmidt (1971), *M. moniliformis* is accidentally found in humans. It is an endoparasite that is found in the intestine of its definitive host in most parts of the world (Roberts and Janovy 2005).

The shape of the parasite seems to be segmented and the alimentary canal is absent. The sex of the parasite is separate and fertilization occurs between the male and female to release the oval-shaped eggs which contain internal hooks (Marty 1998; Sahar et al. 2006).

Beetles and cockroaches are the intermediate hosts for the parasites. The eggs of the parasites are ingested by the intermediate host, in which they develop into the acanthor (the first larval stage), morphing into the second larval stage, namely the acanthella. Then, the acanthella becomes a cystacanth in the tissue of the intermediate host. The development of the parasite into the adult worm is completed in the definitive host when the intermediate host which contains the larval stage or the infective stage is ingested. Finally, the adult worm develops and mates in the small intestine of the definitive host, in which the eggs which are produced from the sexual mating are resealed with the stool (Crompton 1985). The aim of the current study was to describe the morphology of *M. moniliformis* which is present in Iraq.

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Materials and methods

Source of the sample

In the current study, the *M. moniliformis* parasite was examined which, as explained in the following images, was acquired from a 10-year-old child living in rural region of Thiqr province, southern Iraq who referred to a teaching hospital in Nasiriyah city in the south of Iraq with diarrhea and vomiting. The stool sample was examined microscopically for the eggs and macroscopically for the adult worms by the technical staff at the hospital where it was reported.

Fixation and drawing of sample

Moniliformis moniliformis were relaxed in saline and fixed in alcohol formalin acetic acid (A.F.A) over night and kept in (70%) alcohol and glycerin. specimen was permanently mounted in a pure glycerin for the purpose of clarification (Abdullah 1988). The drawing was made with help of camera Lucida and identified according to Yamaguti (1963). All measurements are recorded in millimeter.

Results

Description of the morphology of *M. moniliformis*

The adult worm had white color and its length was 133 mm. The body consisted of a spiny head that appeared as the proboscis, located at the anterior end of the worm along with the neck and trunk. The digestive system was absent in the worm and it was reported as female based on its straight posterior end.

The proboscis was cylindrical in shape, measured 0.42×0.21 mm, and was armed with 13 rows of curved hooks with 7–8 hooks per row. The trunk's surface had regular horizontal lines and appeared to be segmented. The egg had an oval shape, was covered with three envelopes, had clear hooks, and the length varied from 0.083 to 0.116 mm.

Discussion

Human infection with *M. moniliformis* occurs due to many factors that may be related to human activities or the presence of the intermediate host of *M. moniliformis*. Personal hygiene, poor health, low socio-economic status, rural habitat or environment, and clay houses that harbor the insect are the most common risk factors for the

infection with *M. moniliformis* (Berenji et al. 2007; Messina et al. 2011; Marachi et al. 2014). Prevention strategies include cleaning of the house from insects such as beetles and cockroaches and avoiding direct contact with dogs and cats since their fur is the best harbor for insects (Marachi et al. 2014).

The morphology of *M. moniliformis* in Iraq was evaluated in the current study and it was found that the parasite had white color and segmented appearance, which was in agreement with the findings of the studies by Marty (1998) and Marachi et al. (2014). Some studies have reported that the length of the parasite varies between 60 and 180 mm (Marachi et al. 2014), which was in agreement with the results of the current study in Iraq, reporting the length of the parasite to be 133 mm. In the study conducted by Sahar et al. (2006), the morphology of a female parasite in a 20-month old child in Saudi Arabia was examined and the length of the female parasite was also reported to be 133 mm. However, Salehabadi et al. (2008) reported that the length of the female parasite in Iran was 125 mm. The pseudo-segmented shape of the *M. moniliformis* parasite was similar to the shape reported by Sahar et al. (2006), Salehabadi et al. (2008), and Marachi et al. (2014).

A cylindrical proboscis which measured 0.42×0.21 mm was located at the anterior end of *M. moniliformis* and was armed with 13 rows of hooks, with 7–8 hooks in each row. This result was not in agreement with the findings of the study by Salehabadi et al. (2008), reporting a different morphology for the parasite in Iran. Salehabadi et al. reported that the proboscis was armed with 14 rows of hooks, each with 6–8 hooks. However, this study on the morphology of *M. moniliformis* was in agreement with the results of the study by Sahar et al. (2006), which reported the same morphology for the parasite in Saudi Arabia and explained the role of the proboscis in the attachment of the parasite to the intestinal wall of the host during parasitism.

The oval shape of the ova of *M. moniliformis*, the three envelopes, the presence of hooks, and the size varying from 0.083 to 0.116 mm were all described as the main characteristics of the eggs or ova of the acanthocephalan parasite *M. moniliformis* in this study since the egg is the diagnostic stage for the parasite that can be seen in the stool sample microscopically. These results indicated that the shape of the *M. moniliformis* eggs was similar to the shape reported by Sahar et al. (2006) and Marachi et al. (2014). Sahar et al. (2006) reported that, during the examination of the stool, at first, the worm was confused with *Ascaris lumbricoides*; but, typical microscopic stool examination for detecting the characteristics of the eggs and macroscopic stool examination for the adult worm is advised to achieve a definitive result.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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