sciendo

DOI 10.2478/helm-2022-0020

HELMINTHOLOGIA, 59, 2: 200 – 203, 2022

Research Note

Human encounter with a horsehair worm (Nematomorpha): Is there a reason to worry?

N. MILADINOVIĆ-TASIĆ[1], A. SCHMIDT-RHAESA[2]*, V. PETROVIĆ[3]

[1]University of Niš, Faculty of Medicine, Department of Microbiology and Immunology, Serbia; Public Health Institute Niš, Serbia; [2]Zoological Museum Hamburg, Leibniz Institute fort the Analysis of Biodiversity Change (LIB) and University Hamburg, Martin-Luther-King-Platz 3, 20146 Hamburg, Germany, *E-mail: *andreas.schmidt-rhaesa@uni-hamburg.de*; [3]University of Niš, Faculty of Medicine, Institute of Histology and Embriology, Serbia

Article info

Received February 2, 2022
Accepted June 1, 2022

Summary

We report here a specimen of the horsehair worm (Gordiida, Nematomorpha) *Spinochordodes bacescui* (Căpuşe, 1965) found in a patient´s urine. This is the first record of this species from Serbia and the sixth gordiid species known in Serbia. It is discussed that there is no evidence that gordiids are parasites of humans. Instead, gordiids parasitize terrestrial insects, which release their mature gordiid parasite into water and may thereby also use containers in human surroundings. Pseudoparasites, such as *Spinochordodes bacescui*, do not pose a threat to human health nor are they a serious public health issue.
Keywords: Nematomorpha; Gordiida; *Spinochordodes*; Scanning electron microscopy; human encounter

Introduction

Horsehair worms (Nematomorpha) have a life cycle which consists of a parasitic and a free-living phase (Hanelt *et al*., 2005). In freshwater/terrestrial species (taxon Gordiida), which make up most of Nematomorpha, most species parasitize terrestrial hosts such as crickets, beetles or praying mantids and influence their behavior to move towards water (Thomas *et al*., 2002). There the gordiid worm emerges; its reproduction and early larval development take place in freshwater. Apart from this life cycle, gordiids were several times found close to humans, raising the questions whether they are able to parasitize humans and whether they are dangerous to humans. The reported cases were reviewed by Schmidt-Rhaesa (Schmidt-Rhaesa, 2013), who came to the conclusion that, with the exception of very few unexplained cases, there was no true parasitism and the association between humans and gordiids was accidental. People with certain health complaints may assume that they have expelled the worms from their own body, which they bring to their doctor's office for the confirmation that the worm has been the cause of their complaints. We report here a new record of a *Spinochordodes bacescui* (Căpuşe, 1965). As this specimen was found after urination, we discuss the often misinterpreted association with gordiids and humans.

Material and Methods

The patient, a 73 years old man, reported seeing a hairworm whilst urinating in a container which had stayed during the day in the open air. The event took place at end of August 2020 in Eastern Serbia, in the rural settlement Vrbovac (43° 41' 11" N; 21° 44' 31" E). The worm was brought to the Public Health Institute of the University of Niš, Serbia, where macroscopic and microscopic analysis of the parasite´s morphometric characteristics was performed. The sample was sent to the Institute of Histology and Embryology of the University of Niš, Serbia, for histological analysis.
The worm tissue samples were fixed in 10 % buffered formalin and

* – corresponding author

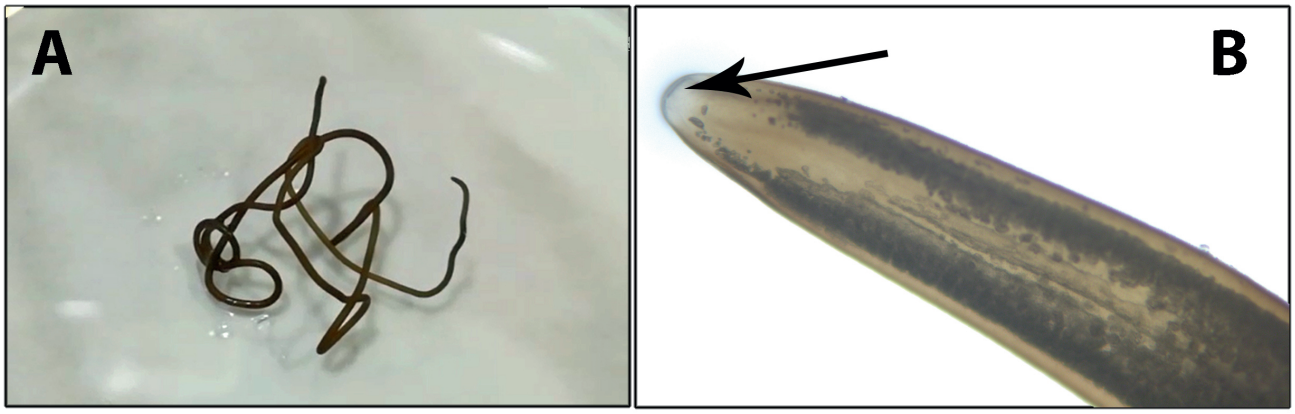

Fig. 1. A. Macroscopic view of the worm in the Petri dish; B. Anterior portion of the worm, arrow pointing at the calotte, x40.

routinely processed to paraffin blocks. The paraffin blocks were cut on the Leica microtome in order to obtain 5 µm thick tissue sections. The obtained paraffin sections were deparaffinized (in the thermostat at 64°C and xylene) and rehydrated in a series of descending concentrations of alcohol (100 %, 96 %, and 75 %) and distilled water. The sections were then stained with hematoxylin and eosin (HE), dehydrated in the ascending concentrations of alcohol (75 %, 96 % and 100 %), cleared in xylene and mounted with cover slips by using Canada balsam. The photo documentation, used for microscopic analysis, was obtained using an Olympus BX50 light microscope equipped with a Leica DFC295 digital camera (Leica Microsystems, Germany).

Pieces of the worm were prepared for scanning electron microscopy (SEM). They were dehydrated in an increasing ethanol series, critically point dried and coated with gold in a sputter coater. The observation took place using a JEOL JSM 5300 SEM at 20 kV and digital images were taken. The worm was not deposited in the collection.

Ethical Approval and/or Informed Consent

For this study formal consent was not required. The article does not contain any studies with human participants.

Results and Discussion

The worm was 12 cm long and 0.3 cm wide along the entire length. The body was dark brown, cylindrical and with uniform diameter along the entire length (Fig. 1A). Individual parts of the worm were observed under a light microscope. A calotte was observed at the anterior end (Fig. 1B). Notable is the absence of a dark, ring-like pigmentation which is present in gordiids of several other genera. The histological analysis revealed the presence of the cuticle, muscular layer, parenchyma and ventral nerve cord, which corresponded to the microscopic structure of horsehair worms (Nematomorpha) (Fig. 2A, B). Paired dorsolateral cavities within the parenchyma, the testes (Fig. 2B); are absent in anterior sec-

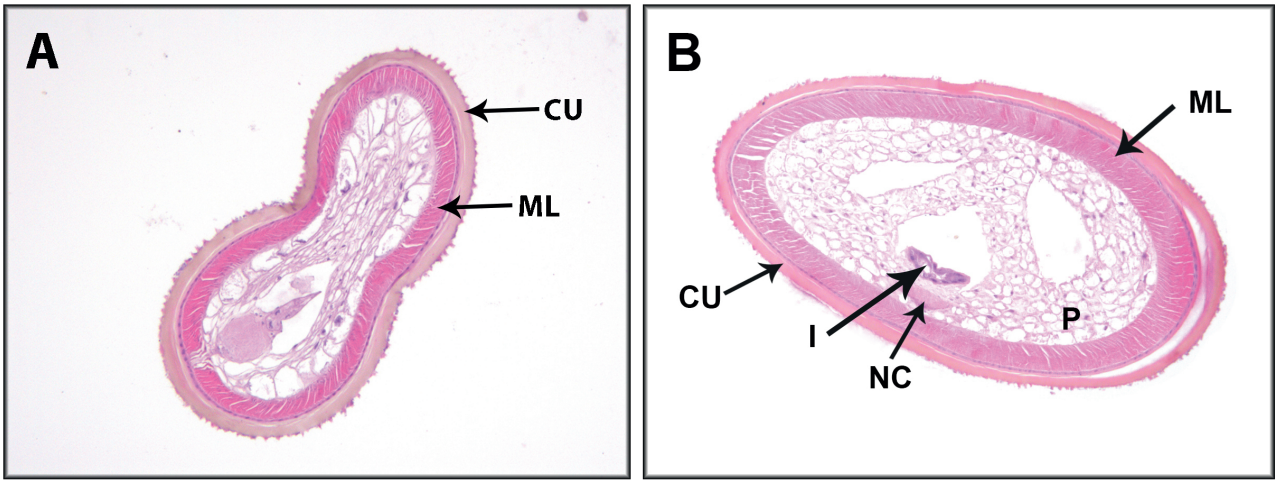

Fig. 2. A. Section trough anterior portion of the worm, CU - cuticle, ML - muscle layer, x160; B. Section trough medium part of the worm body. CU - cuticle, ML - muscle layer, NC - nerve cord, I – intestine, P - parenchyma, x160.

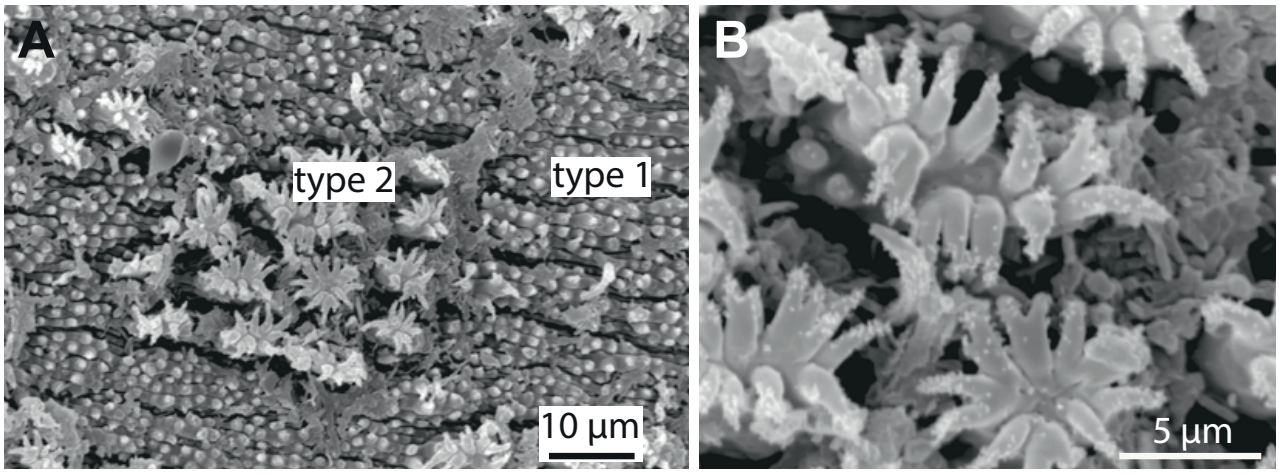

Fig. 3. Scanning electron microscopical images of the cuticular surface of *Spinochordodes bacescui*.
A. Two types of areoles are present in patches on the cuticle. B. Magnification of the elevated type of areoles.

tions (Fig. 2A). The analysis of the digital SEM images established that the specimen belongs to *Spinochordodes bacescui* (Căpuşe, 1965) (formerly *Dacochordodes bacescui*) (Fig. 3A, B).

SEM is the standard technique for gordiid identification. PCR and molecular barcoding is potentially very helpful in identification, but as the COI gene of no *Spinochordodes* species has been sequenced before, there is no basis for comparison right now.
The characteristic of the genus *Spinochordodes* is that the cuticular surface contains two types of structures (Schmidt-Rhaesa, 2013). The cuticular substructures are in general called areoles. One type of areole is flat, the other is more elevated and almost flower-shaped with a basic stem and apical diverging short branches. In the species *S. bacescui* the flat areoles look polygonal from a distance. At larger magnification, they consist of strings of cuticular material, onto which hemispherical "knobs" are sitting (Fig. 3A). The elevated areoles resemble little palm trees, and the apical branches arise as single or double structures from the basic stem (Fig. 3B). The elevated areoles form clusters of 12 – 15 areoles surrounded by flat areoles (Fig. 3A) (compare Căpuşe, 1965, 1966; Spiridonov *et al*., 1992; Zanca & Schmidt-Rhaesa, 2006).
Currently, nine species of *Spinochordodes* are known. Two of these were reported from the Balcan region. *Spinochordodes bacescui*, after being described in Romania (Căpuşe, 1965), was also reported in Bosnia and Herzegovina and Montenegro (Pešić & Ćurčić, 2006; Pikula *et al*., 1996; Spiridonov *et al*., 1992, Zanca & Schmidt-Rhaesa, 2006). The second species, *S. tellinii* (Camerano, 1888) occurs mainly in the North-Western Mediterranean, but was also recorded in Macedonia (Dorier, 1931). The specimens recorded in Serbia were assigned to *S.* cf. *tellinii* (Schmidt-Rhaesa 2012). Therefore, two species of *Spinochordodes* seem to be present in Serbia, with *S. bacescui* being a new record. Four other species of Gordiida were recorded in Serbia: *Gordius aquaticus*, *Gordius balcanicus*, *Gordius isohypsatus* and *Gordionus violaceus* (Pešić & Schmidt-Rhaesa, 2008; Schmidt-Rhaesa 2012). A lower number of different species in the fauna of Serbia was probably due to the scarcity of studies and lack of publishing of the data.
During the life cycle of gordiids, the parasites influence the behavior of the host, compelling it to approach water (Thomas *et al*., 2002, Hanelt *et al*., 2005). The nature of this behavioral impact is still not completely understood, but the effect is that hosts search for water and even enter water, which is beyond their natural behavior. This behavior can transport gordiid worms to nearly any accumulation of water, including cattle troughs, drinking pots for pets, toilets and more. The host often survives the emergence of the parasite (Schmidt-Rhaesa 2013). Therefore, the most likely explanation for the occurrence of gordiids in toilets or equivalent containers after urinating is that they were released there from their host and did not emerge from the human urinary system.
In the past decade, the Parasitology Laboratory of the Public Health Institute in Niš received three samples (author's unpublished data) found in a toilet, water tank and glass for water of a patient with pulmonary complaints, but these cases were not identified further.
There are several published case reports in which gordiids were found in patients urin immediately after urination (Schmidt-Rhaesa, 2003; Burger, 1972). Clinical manifestations in humans were reported as well (in the form of vague pain in the lower abdomen) immediately before the release of parasites via urin (Burger, 1972; Carvalho, 1942). However, the potential symptoms and signs of infection have to be taken with caution, because unrelated health complaints and diseases might have been present. In order to establish the possible source of parasites, it is essential to obtain detailed anamnestic and socioepidemiological data, as well as the information about hygienic situation in the patient's living environment. Health of the people, individuals and population, should be

considered against the interaction of animal-human (and vice versa) occurring in the common living environment.

Spinochordodes bacescui was already reported in an association with humans. Spiridonov *et al*. (1992) described three different cases. In the first case, around 12 worms were found in the vomitus, the first time about a dozen parasites and 20 days later another two. In the second case, one parasite was found in the stool, and in the third case, in the same location as the second case, a worm was found in a bath tub (Pikula *et al*., 1996 described the first two cases in more detail). Besides assumed infections of the urinary system (which are likely misinterpretations, see above), the records of worms found in the vomitus or stool make up most of the records of human-gordiid encounters (see Schmidt-Rhaesa, 2013). These cases are best explained by accidental swallowing of a gordiid with drinking water originating from natural sources. The movement of the gordiid worm may cause irritation, leading to vomiting. Gordiids may pass through the intestinal tract which were then found in the feces. The cuticle of mature gordiids is extremely rigid and probably withstands the passage through the human intestinal tract. There are few unconvincing reports of gordiids present within human tissue, see Schmidt-Rhaesa (2013) for detailed discussion. In summary, there is no evidence for a parasitation of humans by gordiid worms. Both the patient and his physician should be informed that horsehair worms do not pose a health risk for humans and the environment. Detection and identification of these pseudoparasites necessitate multidisciplinary collaboration, i.e. professional and scientific evidence relevant for the health of individual people and for the general population. Human encounters with horsehair worm do not threaten human health and do not pose a public health issue.

Conflicts of Interest

The authors declare no conflict of interest.

Acknowledgments

I should express my gratitude to the physicians Zdravković Dragan, Janković Tatjana, Milena Potić, Mihajlo Lazerević and Dragan Ilić for their assistance and cooperation in the preparation of this paper.

References

Burger, R. (1972): *Paragordius esavianus* passed per urethram. *J. Urol*., 108(3): 469. DOI: 10.1016/s0022-5347(17)60774-2

Căpuşe, I. (1965): Un Gordiid nou pentru ştiinţă *Dacochordodes bacescui* gen. n., sp. n. (Ord. Chordodida, fam. Chordodidae) [A gordiid new to science *Dacochordodes bacescui* gen. n., sp. n. (Ord. Chordodida, fam. Chordodidae)]. *Revista Muzeelor*, 2: 134 – 136 (In Romanian with Russian and French summary)

Căpuşe, I. (1966): Sur le *Dacochordodes bacescui* Căpuşe (Ord. Chordodida, Fam. Chordodidae) [On *Dacochordodes bacescui* Căpuşe (Ord. Chordodida, Fam. Chordodidae)]. *Trav. Mus. Hist. Nat. Grigore Antipa*, 6: 17 – 23 (In French)

Carvalho, J.C.M. (1942): Studies on Some Gordiacea of North and South America. *J. Parasitol.*, 28(3): 213 – 222. DOI: 10.2307/3272775

Dorier, A. (1931): Sur la présence de *Chordodes tellinii* (Camerano) en Macédoine [On the presence of *Chordodes tellinii* (Camerano) in Macedonia]. *Bull. Soc. Zool. France*, 56: 533 – 541 (In French)

Hanelt, B., Thomas, F., Schmidt-Rhaesa, A. (2005): Biology of the phylum Nematomorpha. *Adv. Parasitol*., 59: 243 – 305. DOI: 10.1016/S0065-308X(05)59004-3

Patra, G., Kumar Borthakur, S., Ghosh, S., Sahanawaz Alam, S., Lilliankimi, H., Lalrinkima, H. (2017): Morphological and molecular characterization of *Gordius*, a horse hairworm recovered from cricket. *Asian Pac J Trop Dis*., 7(7): 422 – 425. DOI: 10.12980/APJTD.7.2017D7-47

Pešić, V.M., Ćurčić, S.B. (2006): New records of hairworms (Nematomorpha) from Montenegro (SE Europe). *Arch. Biol. Sci. (Belgrade)*, 58: 5P – 6P. DOI: 10.2298/ABS0601001P

Pešić, V., Schmidt-Rhaesa, A. (2008): First data on Serbian hairworms (Nematomorpha). In: Pavićević, D., Perreau, M. (Eds.) *Advances in the studies of the fauna of the Balkan Peninsula*. Institute for Nature Conservation of Serbia, Monograph No. 22, Belgrade, pp. 337 – 340

Pikula, Z.P., Spiridonov, S.E., Drljevic, E.T. (1996): *Dacochordodes bacescui* Capuse, 1966: report of the first two isolations from humans. *Can. J. Infect. Dis.*, 7: 144 – 146. DOI: 10.1155/1996/818016

Schmidt-Rhaesa, A. (2012): The Nematomorpha of the Balkan Peninsula. In: Pavićević, D., Perreau, M. (Eds) *Fauna Balkana*, Vol. 1. University of Novi Sad, pp. 1 – 12

Schmidt-Rhaesa, A. (2013): Nematomorpha. In: Schmidt-Rhaesa, A. (Ed) *Handbook of Zoology. Gastrotricha, Cycloneuralia and Gnathifera*. Volume 1: *Nematomorpha, Priapulida, Kinorhyncha and Loricifera*. Berlin: De Gruyter, pp. 29 – 145

Schmidt-Rhaesa, A., Chung, S. (2003): *Parachordodes megareolatus*, a new species of horsehair worm (Nematomorpha: Gordioida: Gordea) from Korea. *Kor. J. Syst. Zool.*, 19: 160 – 166

Spiridonov, S.E., Pikula, Z.P., Drljevic, E.T. (1992): Redescription of *Dacochordodes bacescui* Capuse, 1966 (Nematomorpha: Chordodidae). *Helminthologia*, 29: 193 – 196

Thomas, F., Schmidt-Rhaesa, A., Martin, G., Manu, C., Durand, P. & Renaud, F. (2002): Do hairworms (Nematomorpha) manipulate the water-seeking behaviour of their terrestrial hosts? *J. Evol. Biol.*, 15: 356 – 361. DOI: 10.1046/j.1420-9101.2002.00410.x

Zanca, F., Schmidt-Rhaesa, A. (2006): Reinvestigation and new evaluation of representatives from the genera *Semigordionus*, *Euchordodes*, *Pantachordodes*, *Dacochordodes* and *Spinochordodes* (Nematomorpha). *Mitt. Mus. Naturkd. Berlin, Zool. Reihe*, 82: 170 – 178. DOI: 10.1002/mmnz.200600003