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## Letter to Editors

### *Gnathostoma turgidum* – still a mysterious parasite

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#### Summary

The recent publication entitled “Possible zoonotic implications of the discovery of the advanced third stage larva of *Gnathostoma turgidum* (Spirurida: Gnathostomatidae) in a Mexican fish species” by Mosqueda-Cabrera *et al.*, appeared in *Helminthologia*, 2023; 60(1): 112-116. was extremely interesting and informative showing potential zoonotic nature of *G. turgidum*. However, discovery of only one larva from one out of 17 fish rather indicate that this fish is an accidental host of *G. turgidum*. Whether this and other fish act as the second intermediate host in the life cycle of *G. turgidum* requires more field survey using both compression and digestion methods. Also, many biological events of *G. turgidum* such as intrahepatic maturation in the final hosts and the seasonal changes with self cure are remained unsolved. More extensive survey on intermediate and paratenic hosts for *G. turgidum* and biological research on unique features of *G. turgidum* is necessary.

**Keywords:** *Gnathostoma turgidum*; opossums; intermediate host; paratenic host; fish

Dear Editor,

We have read with extreme interest the recent publication entitled “Possible zoonotic implications of the discovery of the advanced third stage larva of *Gnathostoma turgidum* (Spirurida: Gnathostomatidae) in a Mexican fish species” by Mosqueda-Cabrera *et al.*, which was appeared in your journal, *Helminthologia*, 2023; 60(1): 112 – 116. They reported the discovery of one advanced 3<sup>rd</sup> stage larva (AL3) of *G. turgidum* from the muscles of one out of 17 wild fish, of which common name is a big mouth sleeper and the scientific name *Gobiomorus dormitor*, in Veracruz, Mexico. Since Cole *et al.* (2014) previously found 5 AL3 of *G. turgidum* in 3 (4.5 %) out of 67 wild-caught swamp eels *Monopterus albus* from Tampa, Florida, USA, discovery of *G. turgidum* AL3 in edible fish in Mexico by Mosqueda-Cabrera *et al.* (2023) strengthened the possibility of *G. turgidum* as the zoonotic pathogen in the Americas. By now, however, *G. binucleatum* is the only confirmed agent of indigenous human gnathostomiasis in Mexico (Díaz-Camacho *et*

*al.*, 2020) but actual infection in humans with *G. turgidum* has not been reported. In addition to *G. binucleatum* and *G. turgidum*, several other *Gnathostoma* species have been recorded in the wild life in Mexico (Pérez-Álvarez *et al.*, 2008). Combined morphological and molecular identification of the causative species of human gnathostomiasis is, thus, critically necessary in the endemic areas. In the present study, Mosqueda-Cabrera *et al.* (2023) could not detect *G. turgidum* AL3 by the compression of the sliced fish meat between 2 backlit glass plates, but eventually found one AL3 after artificial digestion in of the whole meat examined by compression, and put an emphasis on the advantage of digestion method. Nevertheless, the authors group previously found encysted *G. turgidum* AL3 in the musculatures of amphibians (4 larvae in a turtle *Kinosternon integrum*, and 8, 2 and 1 AL3 in 3 out of 5 frogs, *Lithobates zweifeli*) in Mexico (Mosqueda-Cabrera *et al.*, 2010) using the compression method. Thus, if *G. turgidum* AL3 were encysted in the musculatures of fish, it might be not so difficult to detect them by the compression method. Related to this, previ-

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ously Mosqueda-Cabrera *et al.* (2010) reported that *G. turgidum* AL3 were not encysted in experimentally infected fish hosts, such as guppies and Nile tilapia, and they disappeared from fish hosts rather quickly within 2 months post-infection. In Tecualilla, Sinaloa, Mexico, where practically 100 % of opossums, *D. virginiana*, were infected with *G. turgidum* AL3 (Díaz Camacho *et al.*, 2009). We examined a large number of fish, *Dormitator latifrons* and *Eleotris picta* (Díaz Camacho *et al.*, 2008) Although we found high infection rate of *G. binucleatum* AL3 in those two fish species, but were unable to detect any *G. turgidum* larvae from them. Thus, taking all those works together, fish in general might be not suitable intermediate hosts of *G. turgidum*. Further extensive survey for *G. turgidum* larvae in fish is required to elucidate this issue.

In terms of the size of *G. turgidum* AL3, the only one sample found from naturally infected fish by Mosqueda-Cabrera *et al.* (2023) was about 1.5 mm in length and 0.14 mm in width, which is compatible with those (average 1.7 x 0.14 mm) of *G. turgidum* AL3 found from the musculature of frogs by the same study group (Mosqueda-Cabrera *et al.*, 2010), but is much smaller compared with the AL3 of other *Gnathostoma* species, which are about 3 – 5 mm in length. As for the size of *G. turgidum* AL3, Díaz-Camacho *et al.* (2010) found much larger *G. turgidum* AL3 of almost 1 cm length including one worm just molting to adult stage from the liver of naturally infected opossums, *Didelphis virginiana*. Almeida-Artigas *et al.* (2010) also found two such extremely large *G. turgidum* AL3 in the liver of a naturally infected opossum, *Philander opossum pallidus*, which is now known as *Philander vossi* Gardner & Ramírez-Pulido, 2020. Mosqueda-Cabrera *et al.* (2010) as well described the extraction of two large *G. turgidum* AL3, one of which is of 8.2 x 0.5 mm size under molting to the adult, from the liver of an experimentally infected opossum. Thus, *G. turgidum* AL3 have a potential to grow up further to gigantic AL3 in the liver of the definitive host opossums. Since the molting to adult stage was consistently observed in those three different studies, biological significance of the intrahepatic growth of *G. turgidum* AL3 in the definitive hosts needs further clarification. Also, whether such an additional growth of *G. turgidum* AL3 would occur in non-susceptible mammalian hosts including humans is of extreme interest in relation to the pathogenesis.

Not only the low infection rate and the smaller size of AL3 in fish, *G. turgidum* has many unique features compared with other *Gnathostoma* species: They mature in the liver before establish in the stomach of opossums (Díaz-Camacho *et al.*, 2010) and the size of adults are extremely large (mature females are about 10 cm). Their host range seems to be extremely narrow, found only in opossums, with clear seasonality by spontaneous cure (Nawa *et al.*, 2009; Torres-Montoya *et al.*, 2014). Moreover, molecular phylogenetic study showed that *G. turgidum* is distinct from all other *Gnathostoma* species and is considered an oldest one (Nawa *et al.*, 2015). Thus, *G. turgidum* is fascinating not only as a potential zoonotic pathogen, but also as a biological research target because of its unique and mysterious features.

## Conflict of Interest

Authors state no conflict of interest.

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