Morphological Study of the Horsehair Worm, *Chordodes koreensis* (Nematomorpha: Gordiida), Isolated in Canine Vomitus

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Abstract: This report deals with the morphology of the horsehair worm isolated in canine vomitus. We received a worm in living status. The worm was investigated by using light and scanning electron microscopy (SEM) for species determination. Grossly, the worm was blackish brown in color and 215 mm in length and 1.2 mm in maximum width. Microscopically, the worm was composed of epicuticle, cuticle, epidermis, muscle, mesenchyme, pseudocoeel, nerve cord and gut. But the genital organ was not developed. The SEM study revealed that the cuticle contains five types of elevated structures called areolae. The cuticular surface of the parasite is covered by an abundant type of areolae: simple areole, tubercle areole, bulging areole, crowned areole, circular cluster areole. The observed characteristics of the specimen in this study are same to those of genus *Chordodes*. And we concluded that it is a male of *Chordodes koreensis* belong to Gordiida. Only nine species of freshwater Nematomorpha are known from Korea, two of which belong to the genus *Chordodes*. But the case of parasitic horsehair worm in dogs do not recorded, and this is a first gordiosis of dog in Korea.

Key words: horsehair worm, *Chordodes koreensis*, Gordiida, dog.

Introduction

Horsehair worms (Nematomorpha), also known as Gordian worms, occur worldwide and represent a primitive group, with invertebrates, especially insects, serving as a developmental hosts. The worms include about 300 freshwater species in 22 genera (Gordiida) and 5 marine species in one marine genus (Neotomida) (16). The nematicorph fauna of Korea have been reported 9 species in 3 genera (1,2,12). The traditional classification includes 4 families: Gordiidae May 1919 including genera with a so-called postcloacal crescent (Gordius and Acutogordius), Spinocordoididae Kirjanova 1950 including the genus Spinocordodes, Lanochordoididae Kirjanova 1950 including the monotypic genus Lanochordodes, and Chordoididae May 1919 including all remaining genera (5). They are similar to nematodes but much longer and very thin. The genus *Chordodes* Creplin, 1874 is the largest genus of Nematomorpha with about 90 described species (18).

The worms are parasitic in their larval stages, while the adult worms are free living in fresh-water habitats. The hosts of hairworms are mantises and some carnivorous or omnivorous species of orthoptera and coleoptera, although a variety of other animals are known to serve as definitive hosts. The worms have been frequently reported in humans, but hardly ever in domestic animals. In most cases, the worms were passed per anum or vomited out. To date, a total of 9 species in 3 genera have been recorded in the gordioidea fauna in Korea (1,2,12). Of the genus *Chordodes*, two species have been reported in Korea: *C. japonensis* and *C. koreensis* (1). But the case of parasitic horsehair worm in dog does not recorded. This report deals with the morphology of the horsehair worm vomited by a domestic dog in Korea.

Materials and Methods

A 2-year-old 50 kg intact male domestic dog (Fig 1) was referred. The dog's body condition was good, but he had vomited two times. When vomiting, the owner discovered a living worm (Fig 2). So we performed a hematological examination, a fecal suspension & sedimentation test, and a modified Knott's test for heartworm. For light microscopic study, the worm was cleared in lactophenol. The worm was placed in lacto-phenol solution (glycerin 20 ml, lactic acid 10 ml, phenol 10 g, D.W. 10 ml) for 24 hrs to the transparency. The transparent worm was examined by light microscope. The mid part of worm was cut, fixed with neutral buffered formalin, conventional paraffin sectioned, and H-E stained for light microscopic study. The worm was previously washed with 0.1 M phosphate buffer pH 7.4 (PB) and fixed with 2.5% glutaraldehyde in PB at 4°C for 4 hrs. After washing with PB, the specimens were post-fixed with 1%
osmium tetroxide at 4°C for 4 hrs. Afterward, the specimens were dehydrated in a graded ethyl alcohol series, dried by CO₂ critical point, coated with gold and examined by scanning electron microscopy.

### Results

In hematological examination, the dog was normal with the exception of red blood cell (RBC), granulocyte count (GRA) and Red cell distribution width (RDW). In parasitological examination, *Toxocara canis, Angiostrongylus cantonensis, Trichuris vulpis*, and *Dirofilaria immitis* were positive (Table 1).

The worm is blackish brown in color, 215 mm in length, and 1.2 mm in maximum width (Fig 2). The light microscopic study revealed that the worm is composed of epicuticle, cuticle, epidermis, muscle, mesenchyme, pseudocoel, nerve cord and gut (Fig 3). But the genital organ is not developed. The Calotte (anterior end) is somewhat conical and the mouth is presented at the center (Fig 4).

The whole body is covered with protruding structures called areoles (Fig 5). The SEM study revealed that the cuticle contains five types of elevated structures. The first type areoles (simple areole) are the most abundant, they are slightly elevated and rounded. Tightly spaced areoles look like mulberry. Typically, these areoles do not contain bristles (Figs 6, 10). The second type areoles (tuberele areole) are further elevated and contains one finger-like projection on top and small bristles (Figs 7-11) that does not extended 10 μm in length. The third type areoles (bulging areole) are arranged among simple areoles, isolated or in groups of two or three areoles, they are similar to simple areoles in shape although taller than simple areoles (Fig 9). The fourth type areoles (crowned areole-short filament) occur in pairs with central tubercle, have moderately short filaments on top. These areoles are distributed all over the cuticle (Figs 8, 10, 11). The crowned areoles encircled fifth type areoles (circumcluster areole). The circumcluster areoles with small bristles were slightly elevated and composed of 12-14 areoles (Figs 10, 11).

The Cloacal aperture is situated ventrally at 3.7 mm from the anterior to posterior extremity. A very shallow groove is presented on the ventral surface from the cloacal aperture to the distal end (Figs 12, 13). The bristles of the male posterior end are laterally abundant (Figs 14, 15). The cloacal opening of the worm is surrounded by distinctly circumcloacal spines. The region posterior of the cloacal opening does not contain recognizable areoles. Male of *Chordodes* always have an undivided posterior end without tail lobes.

### Discussion

The identification of a species of *Chordodes* is not easy because they have the highest diversity in cuticular structures and the largest genus, comprising about 90 species among Nematomorpha (15). The *Chordodes* species are distributed mainly in tropical and subtropical regions (16). *Chordodes*