Histopathological changes in the upper digestive tract of pigeons infected with *Hadjelia truncata*

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Abstract Thirty-five pigeons from ten different farms in Fars area, southern Iran were submitted for post mortem inspection. Based on the clinical observations and gross pathological examinations, all the birds showed severe weight loss, diarrhea and to some extent ventricular enlargement. Furthermore, all the cases demonstrated large numbers of nematodes attached to the mucosa and submucosa of the ventriculus. Parasitological examinations revealed that the recovered parasites were *Hadjelia truncata*. The histopathological changes showed necrosis of the mucosal cells with moderate infiltration of lymphocytes, macrophages, *heterophils* and eosinophils in the lamina propria and muscularis mucosa in the infected animals. Based on the parasitological and pathological findings it can be concluded that the nematode *H. truncate* could be assigned as a pathogenic agent in the upper tract of pigeons.

Keywords *Hadjelia truncata* · Pigeon · Histopathological changes · Gizzard

Introduction

Hadjelia truncata (Spirurida: Habronematidae) is a nematode parasite which resides in the gizzard of several species of birds such as Coraciiformes and Columbiformes

(Anderson 2000). Infection with this parasite has been reported from different regions throughout Africa, Asia, and Europe (Tadros and Iskander 1975; Junker and Boomker 2007; Razmi et al. 2007; Shubber 2010).

The pathologic changes in gizzard of different avian species due to *H. truncata* infection have not yet been properly investigated. *Hadjelia truncata* has been reported to be pathogenic only in commercial pigeons from a few countries, including Egypt (Tadros and Iskander 1975), Saudi Arabia (Farah 1988), Cyprus (Appleby et al. 1995), Iraq (Al-Attar and Abdul-Aziz 1985) and Iran (Razmi et al. 2007). Clinical symptoms such as weight loss, diarrhea, weakness, and death have been observed in the infected pigeons (Geyhan 2004).

The previous studies have not reported clear gross and histopathological changes associated with *H. truncata* infection in the infected digestive tract of the avian species yet (Anderson 2000). Therefore, this study was designed for the first time in the pigeon flocks in Fars province, southern Iran to find out the infection with *H. truncata* and additionally to investigate the histopathological changes due to this nematode infection in the upper digestive tract of pigeons.

Materials and methods

Necropsy procedures and sample collection

Thirty-five pigeons from 10 pigeon farms in Fars Province were presented to Poultry Clinic for post-mortem inspection. In all farms, a number of pigeons suffered from a chronic disease with diarrhea, weakness and weight loss. The mucosa and submucosa of the gizzard, in all cases, were inspected carefully for nematode infection. In

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addition, the contents and washings of the mucosa were rinsed, using a set of sieves. After filtration of each segment, the material retained on the sieves was collected and examined under stereomicroscope at $\times 40$ magnification for worms. The nematode specimens were fixed in alcohol 70° and cleared in lactophenol and were then evaluated and measured by an optical microscope.

Appropriate tissue samples were also collected from the infected parts of the gizzard for histopathological studies. The samples were fixed in 10 % neutral buffered formalin, cleared with xylol, embedded in paraffin, sectioned at 5 μm in thickness, stained with Hematoxylin and Eosin and examined by an ordinary light microscope (Olympus, Tokyo, Japan).

Morphological identification of the parasites

Identification of the parasites was accomplished on the basis of the previously reported morphological descriptions for the genus *Hadjelia* in avians (Yamaguti 1961; Tadros and Iskander 1975; Appleby et al. 1995).

Results

All the cases, examined in the present study, were infected with nematodes. The morphological features of the recovered nematodes showed that the specimens were *H. truncata*. This nematode was easily recognizable, based on its main characteristics, described in the previous references. At the anterior end, the mouth part was surrounded by two large lateral lips, each was trilobed at each side. A relatively elongate and cylindrical pharynx was also observed beneath the mouth region in both males and females (Fig. 1).

The vulva of the female worms was located at the anterior end of the body. The uterus consisted of large number of thick-shelled embryonated oval-shaped eggs with average of 45.1 μm length and 31.5 μm width (Fig. 2). In males, the morphology of the caudal region was characteristic of the spirurid-type nematodes. As shown in Fig. 3, the posterior end was curved ventrally. In addition, the large caudal alae which were supported by 6 caudal papillae and two spicules with unequal size and dissimilar shape were evident at the caudal extremity of males. Both sexes were white in color and their bodies had spiraled cuticles. The bodies were straight, narrowing at the anterior end. As an average, the length of the females was 19.8 mm and the males were 7.5 mm.

All the pigeons suffered from a chronic disease with weight loss, diarrhoea and weakness. Histopathological examination of the infected gizzard showed the transverse section of the worm together with necrosis of the mucosal

Fig. 1 The anterior end of *Hadjelia truncata* showing two lateral lobed *L* lips surrounding the mouth part, a cylindrical *P* pharynx and *SC* spiraled cuticle ($\times 400$)

Fig. 2 *Hadjelia truncata* female (middle of the body): the uterus containing overlapped embryonated oval eggs ($\times 400$)

Fig. 3 *Hadjelia truncata* male (posterior end): two wide CA caudal alae, CP caudal papillae and two unequal SP spicules are seen in the posterior end of the nematode ($\times 400$)

cell and moderate infiltration of lymphocytes, macrophages, *heterophils* and eosinophils in the lamina propria and muscularis mucosa layer (Figs. 4, 5).

Discussion

The morphological characteristics of the nematodes recovered from the gizzard of pigeons were consistent with the key descriptions previously presented for *H. truncata*. This parasite belongs to the order Spirurida, family Habronematidae and affects wide range of birds from different families and orders, as well as vast geographical distribution throughout Africa, Asia and Europe (Al-Attar and Abdul-Aziz 1985; Appleby et al. 1995). Although *H.*

truncata has been known for a long time especially in pigeons (*Columbia livia*), few reports exist to show the prevalence of this parasite in different geographical regions of the world. This is probably related to the mildness of *H. truncata* infection and that this parasite has not been considered as a pathogen in pigeon flocks. Because the infection with this nematode could lead to some clinical symptoms such as weight loss, diarrhea, weakness and even death in pigeons (Appleby et al. 1995), it seems, more attention must be made for diagnosis and treatment of the disease in this host.

The severity of infection with *H. truncata* in pigeon flocks has not been clear so far in Iran (Razmi et al. 2007; Radfar et al. 2011; Nabavi et al. 2013). A comparison among the morphologic measurements made in the previous studies and our data revealed almost similar measurements in the main morphological features particularly in length of the worms and/or the spicules despite the length variability in the Habronematidae nematodes has been described before (Junker and Boomker 2007).

The main histopathological features in the pigeons infected with this parasite included necrosis of the mucosal cells of gizzard together with moderate infiltration of inflammatory cells in the lamina propria and muscularis layers accompanied with presence of numerous cross sections of the nematode parasites between the koilin and glandular layers. These findings were comparable to those reported previously (Razmi et al. 2007; Senties-Cué et al. 2011) who reported enlargement, distortion, and necrosis of the infected gizzards in cases of *Columba livia*. Senties-Cué et al. (2011) examined the gross and histopathologic changes in the alimentary tract in a number of worm-infected meat-type breeder rock pigeons in southern and central California. They reported

Fig. 4 Histopathological section from a ventriculus infected with *Hadjelia truncata*, exhibiting the transverse section of the nematodes located between the glandular and koilin layers (black arrows). The koilin layer is disrupted and fragmented (H&E, $\times 100$)

Fig. 5 Histopathological section from the gizzard's wall with transverse section of the adult female *Hadjelia truncata* (H&E, $\times 400$)

that the surface of the koilin layer of the cranial and caudal areas of the ventriculus had a moderate to severe irregular and rough appearance with either a greenish or dark brownish discoloration and multiple rounded cavities and erosions. They stated that the ventricular epithelium showed extensive cystic glandular hyperplasia with accumulation of a homogeneous eosinophilic proteinaceous material in the dilated epithelial glands, however, we did not observe cystic glandular hyperplasia in the infected gizzards probably due to the existence of a mild infection in our cases.

Moderate infiltration of inflammatory cells was observed in the lamina propria and muscularis layers of the gizzard, in the present study. In line with our results, Senties-Cué et al. (2011) stated that moderate lymphocytic and heterophilic infiltrations together with small numbers of lymphoid aggregates were evident in the lamina propria of the infected pigeons.

Taking together, our results showed that pigeons with clinical signs of chronic disease including weight loss, weakness and diarrhea had degrees of infection with nematodes. The morphological features of the recovered nematodes showed that the specimens were *H. truncata*. Histopathological examination of the infected gizzard revealed necrosis of the mucosal cells of the upper digestive tract and moderate infiltration of lymphocytes, macrophages, *heterophils* and eosinophils in the lamina propria and muscularis layer of gizzard, together with ventricular hypertrophy and severe damage of the koilin layer. Thus, it can be argued that the nematode *H. truncate* could be assigned as a pathogenic nematode for pigeons. This result can imply that strict control measures are needed to prevent the infection with this nematode in the pigeon flocks.

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