

***Macracanthorhynchus hirudinaceus*: the most common helminthic infection of wild boars in southwestern Iran**

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Abstract A pathological and epidemiological study on *Macracanthorhynchus hirudinaceus* infection on 25 wild boars *Sus scrofa* in southwestern Iran was done. Overall 24 helminthes (18 female and 6 male) were collected from the intestine of 13 infected wild boars. Thus, the prevalence of acanthocephalans among the 25 examined boars was 52 %. Pathological evaluation revealed damages caused by the acanthocephalans penetrated in the small intestine tissue. Helminthes caused severe necrosis with ulcer and inflammation in tunica sub mucosa layer. High prevalence of this helminthic infection may cause severe hazard for farmers, residents and also wild life animals.

Keywords *Macracanthorhynchus hirudinaceus* · Prevalence · Pathology · Wild boar · Iran

Introduction

Wild boars (*Sus scrofa*) are aboriginal animals in the most countries of the world. This population of wild boars freely lives in forests and farms. In addition to

environmental concern, which is caused farm damage, they are popular as infectious diseases reservoirs which are able to transfer diseases to human and animals (Meng et al. 2009). *Sus scrofa* is a widespread species all over the tropical Asia. Geographical distribution of *S. scrofa* in Iran is seen in north dense rainforests, north-west and west oak forests and south-west tropical forest (Solaymani-Mohammadi et al. 2003). Wild Boars are omnivorous animal that primarily feeds on plants. They feed on berries, leaves, grasses, fruits; unearth roots and bulbs from the ground with their hard snouts. They also eat worms, insect larva, beetles, bird and bird's eggs, mice, small amphibious, and reptiles. Previous studies have been done to determine the parasitic fauna of wild boars in Iran, where a relatively, and sometimes very high, prevalence of acanthocephalan (namely *Macracanthorhynchus hirudinaceus*) were reported. Prevalence rate of this parasite in Khuzestan wild boars was reported to be as high as 64 % in Mowlavi et al. (2006) study while a relatively lower prevalence rate (41.6 %) of this parasite has been reported from Lurestan (western) Iran (Solaymani-Mohammadi et al. 2003). *Macracanthorhynchus hirudinaceus* is an acanthocephalan helminth lives in small intestine of wild boars and can be transmitted to human by accidental ingestion of the intermediate host, arthropods, usually dung beetles. Boar's meat consumption in many parts of the world causes human to be in direct contact with this animal and consequently be a chance to transmit diseases between humans and animals. Recreational hunting of boars and consuming their meats by ethnic minority group (i.e. Christian and Armenian) is not uncommon in Iran. Apart from parasitic diseases, accumulating data suggests that eating wild boars meat is associated with a risk of acquiring hepatitis E virus infection (Masuda et al. 2005).

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The current study was conducted to find out the prevalence of *M. hirudinaceus* in wild boars in Bushehr province, south-western Iran. Moreover a pathological study was performed on infected animals to look at the severity and level of tissue damages caused by this parasite.

Materials and methods

Study area

This study was done in Deylam district of Bushehr province, located in south-western Iran lies on the geographical coordinates of 31° 46' 39" N, and 48° 51' 56" E. Deylam is 200 km far from Bushehr port and has border with Khuzestan, Kohgiluyeh and Boyer-Ahmad and a part of Fars states, with highland nature and dense forests, in northern part of this city, and also rivers which are originated from Khuzestan state. This unique environmental feature makes this province a suitable habitat for wild boars and other wild animals.

Collecting parasites

Twenty five adult wild boars including 14 females and 11 males were collected during authorized hunting program, with coordination to local hunters, from March up to October 2013. Gender and approximate age (according to teeth development) of hunted boars were recorded. Stool samples were collected from each boar and parasitic infectious were studied, using formalin-ether concentration technique and modified Telman method. Samples were then carefully examined under a light microscope for detection of helminth ova.

At necropsy, all parts of small and large intestine were removed. The intestine was opened longitudinally and its wall was carefully examined for the presence of any worms and lesions. All acanthocephalans were recovered and placed in containers with warm water (60 °C for about 6 h) for worm relaxing. After relaxation, helminthes were preserved in hot (63 °C) AFA (alcohol, formalin, acid acetic). After about 72 h, worms were transferred to 70 % alcohol solution contained 5 % glycerin and were fixed permanently. Size of helminthes, overall length and its width, and number and arrangement of the hooks on the proboscis were measured and analyzed to confirm the species of the acanthocephalan.

Collecting tissue samples

Diseased intestine tissues were cut from appropriate place and were fixed in 10 % buffered formalin for further histopathological evaluation. Intestinal damaged tissues in

which the proboscis was embedded in intestinal wall were selected for histopathological examinations. Following routine preparation of tissues, serial sections of paraffin embedded tissues of 5 µm thicknesses were cut using a microtome (Slee-Germany) and stained with hematoxylin and eosin and studied under light microscope.

Results

Overall 24 helminthes (18 female and 6 male) were collected from the intestine of 13 infected wild boars. Thus, the prevalence of acanthocephalans among the 25 examined boars was 52 %. Eggs of Acanthocephalan were detected in 6 out of 13 (46.2 %) infected boars by formalin-ether concentration and modified Telman methods. Overall, 24 acanthocephalans were collected from the 13 infected boars (mean worm burden = 1.85). The highest intensity of infection was six worms in one of the wild boars. Young acanthocephalans (measured 100–120 µm) were seen in few cases. Table 1 shows the features of adult worms recovered from the boars in this study. Males constituted 46 % (6 out of 13) and females 54 % (7 out of 13) of the infected animals. No significant statistical correlation was found between the acanthocephalan infection and age or gender of the animals. Damages caused by the acanthocephalans penetrated in the small intestine tissue were observable (Fig. 1a–d). Fibrotic nodules caused by the attachment of worm proboscis to the intestinal wall were visible. Moreover, trauma and hemorrhages around the site of the worm's head, invading the intestinal tissue were noticeable. Helminthes presence in tunica sub mucosa layer caused severe necrosis with ulcer and inflammation (Fig. 1e, f).

Discussion

M. hirudinaceus, the giant thorny headed worm, is a widely distributed helminth parasite of canine and suid including wild boars in many part of the world, including Iran (de-la-Muela et al. 2001; Eslami and Farsad-Hamdi 1992; Solaymani-Mohammadi et al. 2003; Mowlavi et al. 2006; Senlik et al. 2011). Cases of *M. hirudinaceus* human infection have been reported in Asian countries such as China (Leng et al. 1983; Zhong et al. 1983) and Thailand (Hemsrichart et al. 1983; Radomyos et al. 1989).

The current study designed to ascertain the prevalence of *M. hirudinaceus* in wild boars in southern Iran. The total prevalence of *M. hirudinaceus* was found to be 52 %. Although higher prevalence (64 %) of this acanthocephalan has been reported in previous study by Mowlavi and his colleagues, yet this rate of infection is

Table 1 Extreme values and mean measures of distinctive features (in mm) of 18 females and 6 males of *M. hirudinaceus* recovered from wild boars

Measurements	Females		Males	
	Min–max	Mean \pm SD	Min–max	Mean \pm SD
Total body length	56–351	205.5 \pm 84.1	52–89	68.16 \pm 14.46
Width at mid-body	3–6	4.62 \pm 1.13	2–3	2.83 \pm 0.4
Praesome length	0.8–3.52	1.67 \pm 0.66	0.83–1.90	1.36 \pm 0.34
Proboscis length	0.66–0.95	0.82 \pm 0.07	0.58–0.83	0.73 \pm 0.33
Row no. in proboscis	5–6	5.3 \pm 0.49	5–7	5.3 \pm 0.82
Hook no. per row	6–9	7.11 \pm 0.99	6–7	6.3 \pm 0.51
Hook length	0.125–0.225	0.175 \pm 0.08	0.130–0.212	0.152 \pm 0.04

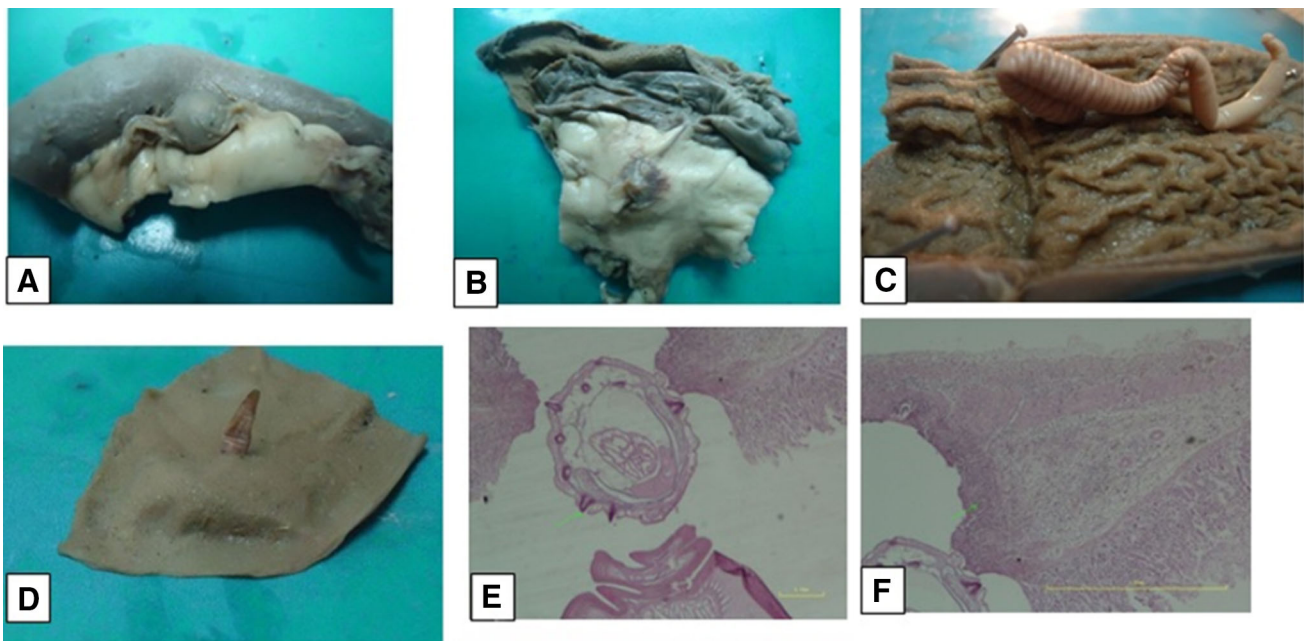


Fig. 1 Lesions induced by *M. hirudinaceus* in wild boar: **a** a fibrotic nodule caused by the attachment of worm proboscis to the intestinal wall, visible from serosal surface, **b** local trauma and hemorrhages around the site of the worm's head invading the intestinal tissue in the early stages; **c** adult worm embedded in the intestine wall, **d** head of

juvenile worm penetrated the tissue, **e** anterior of acanthocephalan embedded in the intestinal wall demonstrates the protractible proboscis with its hooks ($\times 40$, H&E), **f** parasite penetrates into the deep layers of the intestine, causes severe necrosis and ulcer with heavy inflammatory cell infiltrations ($\times 40$, H&E)

quite high. Other studies about the prevalence rate of this parasite reported a lower rate in other areas of Iran. Solaymani-Mohammadi reported a prevalence rate of 41.6 % in Lorestan province, western Iran. Eslami et al. found that 27 out of 57 (47 %) of wild boars collected from north, east and southwest of Iran are infected with *M. hirudinaceus* (Eslami and Farsad-Hamdi 1992). Gar-edaghi et al. (2014) reported a prevalence rate of 19 % for *M. hirudinaceus* in wild boars hunted in Talesh city in North of Iran.

Senlik et al. (2011) reported a lower (19 %) prevalence of *M. hirudinaceus* in Bursa province of Turkey. De-la-Muela et al. (2001) in Spain found that 21 % of forty seven studied boars are infected with this acanthocephalan.

In the current study no correlation were found between the Acanthocephalan infection and age or gender of the animals. However, in Mowlavi et al. (2006) study, adult's wild boars were more infected than young animals. Low sample size of the current study may be accounted for this dissimilarity.

Pathological studies showed severe necrosis and ulcer with inflammation in deep small intestine wall. Anterior part of the helminth with its hooks was penetrated into the sub mucosal layer of boar intestine and caused severe inflammation. Pathological findings of this study are in line with Mowlavi et al. (2006) study.

Taken together, although breeding and consumption of pork being prohibited in Iran, and yet no human cases of *M.*

hirudinaceus infection has been reported, nevertheless high prevalence of this helminth in wild boars in this region represent a human infection risk for the residents, namely farmers, who may accidentally ingest the intermediate host, dung beetles, of this helminth.

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Compliance with ethical standards

Conflict of interest None.

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