Prevalence and pathology of *Gongylonema pulchrum* in cattle slaughtered in Rudsar, northern Iran

Reza Kheirandish¹², Mohammad Hossein Radfar¹, Hamid Sharifi², Naser Mohammadyari³, Soodeh Alidadi³

1 – Shahid Bahonar University of Kerman, School of Veterinary Medicine, Department of Pathobiology, Kerman, Iran.
2 – Shahid Bahonar University of Kerman, School of Veterinary Medicine, Department of Food Hygiene and Public Health, Kerman, Iran.
3 – Shahid Bahonar University of Kerman, School of Veterinary Medicine, Kerman, Iran.

**Abstract.** The gullet worm, *Gongylonema pulchrum* Molin, 1857, is a thread-like nematode that occurs in a large variety of animals worldwide. The present study was conducted to investigate the prevalence and histopathology of *G. pulchrum* in cattle slaughtered in Rudsar slaughterhouse, Gilan Province, northern Iran. During four seasons of 2011, a total of 680 esophagi of native and hybrid breed cattle at Rudsar abattoir were examined parasitologically and pathologically for gongylonemiasis. Cattle were considered in three age groups including less than 2, 2-5 and over 5 years old. Results of our study showed that the prevalence of *G. pulchrum* in cattle was 16.2%. Prevalence was significantly highest in native cattle and in summer (P<0.05). The highest prevalence was in cattle over 5 years old and males were more infected than females. The age and sex of the cattle had not significant effects on the prevalence of the parasite (P>0.05). No gross lesions was noticed in the infected esophagi but histopathological observations revealed the presence of the sections of parasites in the esophageal epithelium causing moderate to severe eosinophilic esophagitis in a few cases of them. Parasitological, gross and microscopic findings revealed *Gongylonema* infection was relatively common in cattle of Rudsar, northern Iran.

**Keywords:** *Gongylonema pulchrum*; Cattle; Iran.

**Introduction**

*Gongylonema pulchrum* Molin, 1857, belonging to the superfamily Spiruroidea, with about 25 species in domestic and wild mammals and 10 species in birds, is a long, slender whitish spirurid nematode found throughout the world (Jelinek and Loscher, 1994; Eberhard and Busillo, 1999). This parasite infects a large variety of animals...
including cattle, sheep, goats, buffaloes, camels, deers, wild boars, donkeys, pigs, horses, rodents, non-human primates and humans (Waid et al., 1985; Islam et al., 1992; Kia et al., 2001; Kudo et al., 2005; Sato et al., 2005; Farooq et al., 2012; Ryan et al., 2012).

These thread-like worms burrow in the mucosa of the upper alimentary tract, including the tongue and especially esophagus producing white or red blood-filled zigzag tracks in the mucosa. They can be 10 to 15 cm in length and are easily visible (Jubb et al., 2007). The life cycle of gullet worm is obviously indirect. Embryonated eggs are passed in the feces of the definitive host and ingested by intermediate hosts, such as coprophagous beetles and cockroaches. The larvae perform two molts towards the infective third stage (L₃) in about 4 weeks. Animals acquire the infection by feeding on these insects or ingestion of them accidentally with their forage (Taylor et al., 2007). Humans also are infected by accidental ingestion of the insect host or by drinking contaminated water (Wilson et al., 2001). The adult worms spirally embedded in the esophageal mucosa or submucosa by protruding of their anterior ends within the lumen. The prepatent period is about 8 weeks (Taylor et al., 2007). Their presence is inconsequential to the host and of no clinical significance. Nevertheless, infection may be associated with a mild to moderate lymphocytic and eosinophilic esophagitis (Jubb et al., 2007).

In some areas of Iran, this worm has been demonstrated in cattle (Anwar et al., 1979; Halajian et al., 2010), sheep (Esrami et al., 2010), goats, buffaloes, wild boars (Esrami and Farsad-Hamdi, 1992), donkeys (Movassaghi and Razmi, 2008), and humans (Molavi et al., 2006). Anwar et al. (1979) recorded that the infection rate with *G. pulchrum* has been 49.7% among 555 cattle slaughtered at the central Tehran abattoir in the 1970s. Halajian et al. (2010) reported that the incidence of *G. pulchrum* was approximately 26% of 138 cattle collected at four local abattoirs in Mazandaran Province, northern Iran.

The aim of this study was to determine the prevalence of *Gongylonema pulchrum* and pathology of gongylonemiasis in cattle slaughtered at Rudsar slaughterhouse, North of Iran, and to obtain information about the effects of some factors such as season, breed, age and gender on this parasitic infection. Rudsar city is located at the southern coast of the Caspian Sea and has a warm and humid climate. The maximum and minimum air temperatures are in the August and January, respectively. The air temperature reaches up to 26°C in summer (Jamshidi and Abu-Bakar, 2010).

**Materials and methods**

**Animals and sampling**

A total of 680 esophagi of cattle (335 native and 345 hybrid breed) were examined for gongylonemiasis at meat inspection in an abattoir in Rudsar County, Gilan Province, northern Iran, During four seasons of 2011 (spring = 144, summer = 189, autumn = 230, winter = 117). Data related to sex, breed, age, as well as date of slaughter were recorded for each animal. The worms embedded in zigzag tracks were carefully removed from the esophageal epithelium using fine forceps, preserved and fixed in 70% ethanol containing 5% glycerin solution. The collected worms and infected esophagi were transported to the laboratories of the department of pathobiology, Faculty of Veterinary Medicine, Shahid-Bahonar University of Kerman, Kerman, Iran for parasitological and pathological investigations.

These worms were directly observed under a light microscope, and the figures were drawn with the aid of a camera lucida. Measurements were made using these drawn figures. For histopathological observations, tissue samples of affected esophagi were taken and fixed in 10% neutral buffered formalin and processed according to the routine of histopathologic technique. Paraffin sections at 5μm thickness were cut and stained with hematoxylin and eosin (HE) and examined under ordinary light microscope. Prevalence of the disease during four seasons was investigated according to the sex, breed and age groups including less than 2, 2-5 and over 5 years old.
Statistical analysis

Statistical analysis of the distribution of the infection according to season, breed, sex and age groups was performed by the univariate chi-square test and logistic regression using the Stata10.1 statistical software. Differences were considered statistically significant if the null hypothesis could be rejected with N 95% confidence (P<0.05).

Results

The collected nematodes were identified as *G. pulchrum* based on their morphological and parasitological characteristics according to Soulsby (1982). Out of 680 esophagi examined 96 (prevalence = 16.2%) were found to be infected with *G. pulchrum*. Obtained data about relation between the prevalence of *G. pulchrum* with season, breed, age groups and sex of cattle are illustrated in tables 1, 2, 3, and 4, respectively. The highest and lowest prevalence were detected in summer and winter seasons, respectively. The prevalence of the gullet worm was significantly (P<0.05) higher in summer season, as well as in native breed in comparison with hybrid breed. In relation to age and sex, the cattle over 5 years old had higher infection rate than those less than 2 and 2-5 years old; meanwhile, *G. pulchrum* infection was more prevalent in males as compared to females. However, no significant differences between any of these parameters and prevalence were observed (P>0.05). Careful gross examination of the esophagi revealed that the sections of the parasite were lodged in the esophageal epithelium. They oriented in the longitudinal axis of esophagi as white to pink zigzag tracks in the mucosa of the esophagi. The tracks were composed of white thread-like worms embedded in the mucosa. Nearly all tracks were the same color as the surrounding esophageal mucosa (figure 1).

Histopathologically, the parasites lodged in burrowed tunnels in the stratum spinosum and stratum corneum of the esophageal epithelium. The walls of these tunnels were composed of flattened keratinocytes without any fibrous tissue (figure 2). In severe cases, after cases mild acanthosis and hyperkeratosis were observed. In most cases, no inflammatory reaction was occurred around the parasites, and in the submucosa. In a few cases, eosinophilic esophagitis was observed that characterized by moderate to severe infiltration of eosinophils into the epithelium (eosinophilic pustulosis), and in the submucoa (figures 3 and 4).

Figure 1. Esophagus. The parasite is located in the esophageal mucosa as white to pink zigzag tracks

Table 1. Seasonal prevalence of gongylonemiasis in slaughtered cattle in Rudsar slaughterhouse

<table>
<thead>
<tr>
<th>Season</th>
<th>No. of examined</th>
<th>No. of infected</th>
<th>Infection (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring</td>
<td>144</td>
<td>24</td>
<td>16.66</td>
</tr>
<tr>
<td>Summer</td>
<td>189</td>
<td>36</td>
<td>19.04</td>
</tr>
<tr>
<td>Autumn</td>
<td>230</td>
<td>26</td>
<td>11.30</td>
</tr>
<tr>
<td>Winter</td>
<td>117</td>
<td>10</td>
<td>8.54</td>
</tr>
<tr>
<td>Total</td>
<td>680</td>
<td>96</td>
<td>-</td>
</tr>
</tbody>
</table>

Table 2. The prevalence of gongylonemiasis related to breed of slaughtered cattle in Rudsar slaughterhouse

<table>
<thead>
<tr>
<th>Breed</th>
<th>No. of examined</th>
<th>No. of infected</th>
<th>Infection (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Native</td>
<td>335</td>
<td>78</td>
<td>23.28</td>
</tr>
<tr>
<td>Hybrid</td>
<td>345</td>
<td>18</td>
<td>5.21</td>
</tr>
<tr>
<td>Total</td>
<td>680</td>
<td>96</td>
<td>-</td>
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</tbody>
</table>

Table 3. The prevalence of gongylonemiasis related to age of slaughtered cattle in Rudsar slaughterhouse

<table>
<thead>
<tr>
<th>Age group</th>
<th>No. of examined</th>
<th>No. of infected</th>
<th>Infection (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤2</td>
<td>43</td>
<td>6</td>
<td>13.95</td>
</tr>
<tr>
<td>2-5</td>
<td>545</td>
<td>77</td>
<td>14.12</td>
</tr>
<tr>
<td>&gt;5</td>
<td>92</td>
<td>13</td>
<td>14.13</td>
</tr>
<tr>
<td>Total</td>
<td>680</td>
<td>96</td>
<td>-</td>
</tr>
</tbody>
</table>
Table 4. The prevalence of gongylonemiasis on the basis of sex of slaughtered cattle in Rudsar slaughterhouse

<table>
<thead>
<tr>
<th>Sex</th>
<th>No. of examined</th>
<th>No. of infected</th>
<th>Infection (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>110</td>
<td>10</td>
<td>9.09</td>
</tr>
<tr>
<td>Female</td>
<td>570</td>
<td>86</td>
<td>15.08</td>
</tr>
<tr>
<td>Total</td>
<td>680</td>
<td>96</td>
<td>-</td>
</tr>
</tbody>
</table>

Discussion

Although this nematode is primarily a parasite of ruminants, there are several reports of human infections with Gongylonema in various areas of the world including Europe, Asia and the United States (Jelinek and Loscher, 1994; Eberhard and Busillo, 1999; Wilson et al., 2001; Urch et al., 2005).

In Iran, the first human case of gongylonemiasis has been reported in a 35-year-old woman with sensation of a moving organism in the neck region and the upper part of the digestive tract for duration of one year (Molavi et al., 2006). Its route of transmission to animals appears to be through usual grazing; however, in humans the factors that may put some people at high risk of infection with this parasite are not clearly known (Mowlavi et al., 2009). The parasite seems to be non-pathogenic for animals as well as humans; nevertheless, Bleier et al. (2005) reported development of an esophageal squamous cell carcinoma (SCC) attributed in a 17-year-old, female vari (Lemur macaco variegates). The morphological features of the collected worms are similar to G. pulchrum described in previous reports (Soulsby, 1982; Kudo et al., 1992; Eslami et al., 2010; Halajian et al., 2010).

As have been previously demonstrated in a variety of domestic and wild mammals in Iran (Anwar et al., 1979; Eslami and Farsad-Hamdi, 1992; Movassaghi and Razmi, 2008), the present study has also confirmed a rather high prevalence of G. pulchrum infection. The prevalence rate of infection among ruminants in Iran has been indicated as 49.7% and 25.36% in cattle (Anwar et al., 1979; Halajian et al., 2010, respectively) as well as 4.56% and 2% in sheep (Eslami et al., 2010; Naem and Gorgani, 2011, respectively). Contrary to this survey, in reports from Japan and Iran, the age of examined cattle significantly affected the incidence of G. pulchrum infection (Kudo et al.,...
In agreement with the previous investigations, our study showed that the prevalence was significantly higher in native cattle, which graze freely in the pasture, compared with hybrid cattle (Halajian et al., 2010). It is likely that in comparison with hybrid breed cattle, the freely grazing native cattle have more chances for contact with dung beetles and cockroaches and consequently for becoming infected with *G. pulchrum*. Therefore, a possible explanation for the higher incidence of *G. pulchrum* in the survey of Halajian et al. (2010) is that the number of the selected native cattle (97/138) has been higher than that of ours.

In the current study, we have demonstrated that the prevalence rate of *G. pulchrum* was significantly highest in summer season, but Halajian et al. (2010) have a vice versa belief. They observed that the prevalence in cattle was not different by season. At high temperatures, larval development and survival are faster and longer, but as the temperature reduces, these processes will become slower and shorter. Hence, a warm and moist summer (like the summer in Rudsar) is well favorable for the development and survival of the free-living stages of this nematode (Taylor et al., 2007). Low prevalence of *G. pulchrum* during winter and autumn seasons seems to be due to low temperatures and reduced resistance of the larvae of this parasite to quick varying weather conditions, which were not conducive for the propagation of infective larvae. Since this nematode has an indirect life cycle; hence, it is probable that the intermediated hosts such as dung beetles and cockroaches be more abundant in summer, which could be an explanation for the higher prevalence in this season (Taylor et al., 2007). Transmission of infection to animals could result from an accidental or intentional ingestion of contaminated forages through grazing in pasture surfaces (Mowlavi et al., 2009). In accordance with Halajian et al. (2010), this research work indicated that the incidence of the gullet worms in cattle was not different by sex; however, it was higher in males.

In veterinary literatures, there are various reports that have confirmed a mild local inflammation around the worm in the epithelial layer and the lamina propria, as well as mild acanthosis, with hydropic changes in acanthocytes and parakeratosis in the mucosa of the esophagi of sheep and cattle, respectively (Halajian et al., 2010; Eslami et al., 2010). In consistent with our work, Stromberg and Schwinghammer (1988) reported the histopathological features of *Gongylonema* infection different from those have been previously reported in ruminants. There was a mild inflammatory response in the submucosa consisted predominantly of eosinophils with a few lymphocytes. These differences may be due to differences in strains of parasite, or age and breed of cattle (Stromberg and Schwinghammer, 1988). The prevalence and pathology of *Gongylonema pulchrum* in cattle in Rudsar have not been reported previously. In this study, we demonstrated that the gullet worm is relatively widespread in cattle in Rudsar County, Gilan, Iran.

**References**


