***Cyathostomum catinatum* infection in a mule of Palam Valley, India: a case report**

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Abstract The small strongyles also called as cyathostomes, cyathostomins or trichonemes, affect the health status of equines, leading to morbidity and mortality in heavily infested individuals. The present study was carried out with the aim to identify the cause of colic in a mule of Palam valley, Himachal Pradesh, India. The detailed faecal sample examination revealed heavy intensity of strongyle eggs with an egg per gram value of 2300. The collected faecal sample also exhibited presence of adult worms. The morphological observations after clearing the retrieved parasites revealed the presence of adults of *Cyathostomum catinatum* species. The haematological and serum biochemical studies revealed alterations related to parasitic invasion. Fenbendazole used for the treatment proved completely effective. To the best of our knowledge and thorough literature search this is the first report of *C. catinatum* infestation in equines of India.

Keywords Clinico-parasitological observations · *Cyathostomum catinatum* · India · Palam valley

Introduction

The livelihood of the residents of hilly terrains of Himachal Pradesh, India depends more or less on hilly equines, especially ponies and donkeys, as being used as pack and draught animals (Kashyap et al. 2014). Any disease condition to the equines reared effect the economy of the residents adversely.

Colic is a major problem encountered by the equine owners and practitioners throughout the world. Parasites are considered to be one of the major contributors of colic in equines (Enbavelan et al. 2015). Earlier, large strongyles were incriminated behind the condition (Gay and Speirs 1978), but, recently small strongyles or cyathostomes of the equines were determined to be the main cause of increased colic incidences (White 2006).

Around 57 species of cyathostomes have been reported throughout the world (Eslami and Kiai 2007), which prove detrimental to the hosts either directly or indirectly by paving the way to other diseases to flourish by lowering down the immunity of the host. *Cyathostomum catinatum* inhabits large intestines of the equines and could be held responsible for morbidity and even mortality in heavily infested animals (Roumen et al. 2004).

The identification of the cyathostomes is very difficult as it requires long term experience, patience and access to proper keys (Eslami and Kiai 2007). The present study puts forward the first report of *Cyathostomum catinatum* infection in hilly mule of India, responsible for colic condition in the infested host. Further correlation of haemato-biochemical alterations with cyathostomin infection was made.

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Materials and methods

Clinical observations

A hilly mule of age 5 years was presented to Veterinary Clinical Complex, Dr. G. C. Negi College of Veterinary and Animal Science, Palampur, Himachal Pradesh (India) from the valley. The animal was exhibiting the signs of restlessness and pain by rolling on the ground and kicking the abdomen, indicating colic condition. The clinical examination of the animal was carried out by making observation of mucus membrane, capillary refill time, rectal temperature and heart, lung and abdominal auscultations.

Parasitological observation

The faecal sample was collected per rectally and qualitative evaluation was carried out by direct smear examination, floatation and sedimentation technique (Gupta and Singla 2012). The quantitative analysis was performed by McMaster egg counting technique to know the magnitude of infection, which was expressed as eggs per gram (EPG) values (Gupta and Singla 2012). The adult parasites were also observed in the faecal samples, while collection of samples per rectally. The adult parasites observed in the faeces were collected, washed with normal saline and then cleared with lactophenol containing glycerine, lactic acid, phenol and distilled water (1:1:1:1). The identification of the parasite was carried out as per the keys of Soulsby (1982) and Taylor et al. (2015).

Haemato-biochemical observation

The haematological analysis of the whole blood of all the animals including haemoglobin level (Hb), total erythrocyte count (TEC), total leukocyte count (TLC), packed cell volume (PCV) and differential leukocyte count (DLC) was carried out on fully automated analyzer, ADVIA 2120 Haematology system (Siemens Health Care Diagnostic Inc. Deerfield, IL, US). Biochemical parameters including aspartate aminotransferase (AST), alkaline phosphatase (ALP), total protein (TP), and gamma-glutamyl transferase (GGT) were assessed by using commercial kits of Siemens Ltd.

Treatment

The treatment of the mule was carried out by using fenbendazole (Bolus Fentas[®]—3 g *per os* once daily for 3 days) (Corning 2009).

Statistical analysis

The body lengths of male and female adult parasites was measured and expressed as mean $\pm$ standard deviation.

Results and discussion

The clinical observations were as follows: mucous membrane—pink, capillary refill time—2 s, rectal temperature—100.2 °F, which were within normal range. The physiological parameters involving rectal temperature and capillary refill time do not alter in equine exhibiting the signs of colic (Hubert et al. 2004). Heart and lung auscultations revealed no abnormalities. The abdominal auscultation revealed intestinal hypermotility, which is a common finding in spasmodic colic of equine (Abutarbush et al. 2005).

The direct smear examination and floatation concentration technique revealed presence of strongyle eggs. The egg per gram value was found to be 2300. The adult parasites were identified as *Cyathostomum catinatum* based on morphological features (Figs. 1, 2). The length of adult male and female parasites (n = 10) was 7.1 ± 1.37 and 11.5 ± 1.08 μ m, respectively. The observations were in concordance with the findings of Soulsby (1982), Eslami and Kiai (2007) and Taylor et al. (2015).

The distinctive morphological features observed in case of adult worms involved presence of internal leaf crown

Fig. 1 Anterior end of *Cyathostomum catinatum* depicting external leaf crown (1), internal leaf crown (2), cuticular lining inside the buccal capsule (3) and oesophagus (4)

Fig. 2 Posterior ends of adult *C. catinatum* male (a) and female (b) with prominent ventral bulge (arrow), giving an appearance of ‘fat foot’

elements, up to one-half of the depth of buccal capsule (Fig. 1). There was presence of high mouth collar. The buccal capsule was short, cylindrical and thick walled, with cuticular lining and without any tooth (Fig. 1). The male bursa was symmetrical with a moderately long dorsal ray which slightly curved back ventrally (Fig. 2a). On the other hand, the female was having a thick, short and blunt tail, with prominent ventral bulge, just anterior to vulva, giving an appearance of little fat foot (Fig. 2b). The observations of the present study were in line with the findings of Eslami and Kiai (2007) and Taylor et al. (2015).

The haematological observations revealed haemoglobin concentration to be 9 g %, packed cell volume—44 %, total erythrocyte count— 5.1×10^6 /cubic mm, total leukocyte count—9200/cubic mm and differential leukocyte count as neutrophils—54 %, lymphocytes—30 % and eosinophils—16 %. The haemoglobin concentration and total erythrocyte count was observed low, which could be attributed to parasitism (Saleem et al. 2000). Packed cell volume and total leukocyte count was within normal range, but towards the higher side. Neutrophilia and eosinophilia indicated inflammation in a response to parasitic invasion due to migration of larval stages of the parasites encountered (Dennis et al. 1992).

The biochemical values observed in the present case were: AST—515 U/L, ALP—649 U/L, TP—3.5 g/dL and GGT—17 U/L. The values of AST and GGT were within normal range, but the increased value of ALP represented intestinal damage due to parasitic invasion of mucosal cells and gastrointestinal inflammation (Kumar et al. 2015). Hypoproteinemia was observed in the infected individual in the present study, which could be further attributed to hypoalbuminemia in the parasitized horses due to increased

permeability of the intestines (Khan et al. 2015). The other explanation for hypoproteinemia in infected equines could be a marked reduction of serum fructose amines (glycated serum proteins), which has earlier been reported from horses with experimental cyathostomin infection (Dowdall et al. 2004).

Fenbendazole used for the treatment proved completely effective and EPG values recorded after days 15 and 21 post treatments were found to be zero. The results were in line with the discussion of Corning (2009).

Conclusion

Based on thorough literature search and available information, this is the first report of *C. catinatum* infection in equines of India. Similar to large strongyles of equines, primarily *Strongylus vulgaris*, which is considered to be the main cause of verminous colic, small strongyles (cyathostomes) could also be incriminated to cause the same condition in heavily infested animals. Further detailed studies on this aspect are warranted.

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