Ulcerative and granulomatous enteritis associated with Molineus torulosus parasitism in neotropical primates

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This paper reports eleven cases of ulcerative and granulomatous enteritis associated with Molineus torulosus parasitism in different species of neotropical primates of the Sapajus genus. All of the affected monkeys had been apprehended by the environmental police and were being treated in a rehabilitation center for wild animals. The clinical history was weight loss and debility. During the necropsy, several nodules were found on the duodenum and proximal jejunum wall, with ulcers on the adjacent intestinal mucosa, including the nodules in the pancreas of four monkeys. Histologically, eosinophilic granulomas were observed in the small intestine, associated with fibrosis, eggs and adult models of Trichostrongylidae, etiology consistent with Molineus torulosus. This study describes the first cases of parasitism in Sapajus flavius, a species previously considered extinct, but recently rediscovered, and presents the occurrence of M. torulosus in two other species, Sapajus libidinosus and Sapajus apella.

INDEX TERMS: Enteritis, parasitism, Molineus torulosus, neotropical primates, Sapajus flavius, new world monkeys, parasite, pathology.

RESumo.- [Enterite ulcerativa e granulomatosa com parasitismo de Molineus torulosus em primatas neotropicais.] São relatados 11 casos de enterite ulcerativa e granulomatosa associada ao parasitismo por Molineus torulosus em diferentes espécies de primatas neotropicais do gênero Sapajus. Todos os macacos afetados haviam sido apreendidos pela polícia ambiental e estavam sendo tratados em um centro de reabilitação de animais silvestres. O histórico clínico era de emagrecimento e debilidade. Durante a necropsia, foram constatados diversos nódulos na parede do duodeno e jejuno proximal, com úlceras na mucosa intestinal adjacente, além de nódulos no pâncreas de quatro macacos. Histologicamente, observou-se no intestino delgado, associado com fibrose, ovos e exemplares adultos de Trichostrongylidae, etiologia consistente com Molineus torulosus. O presente trabalho descreve os primeiros casos de parasitismo em Sapajus flavius, uma espécie antes considerada extinta, mas recentemente redescoberta, e apresenta a ocorrência de M. torulosus em duas outras espécies, Sapajus libidinosus e Sapajus apella.

TERMOS DE INDEXAÇÃO: Enterite, parasitismo, Molineus torulosus, primatas neotropicais, Sapajus flavius, macacos do Novo Mundo, parasita, patologia.

INTRODUCTION

The genus Sapajus comprehends neotropical primates, from the Cebidae family, subdivided into different species,
found in a large portion of the Brazilian territory (Lynch Al- 
farol et al. 2012). Some species of primates of this genus are in- 
cluded on the list of the critically threatened of extinction (INCN 2012), such as the case of the Macgrave’s capuchin 
monkey (Sapajus flavius), a species endemic of Northeast 
Brazil, for a long time considered extinct and recently re- 
discovered in parts of the Atlantic Rainforest (Oliveira & 
Langguth 2006).

Knowledge of the helminthic fauna pertinent to the 
Brazilian neotropical primates, including the Sapajus ge- 

tus, is insufficient. Few studies refer to the description of 
parasites in the wild New World primates (Toft 1982), and 

studies that correlate the parasitism with the clinical and 
pathological aspects in these animals are even more rare 
(Strait et al. 2012). The parasite Molineus torulosus (Nema-
toda, Trichostrongylidae) has been described in neotropical 
primates, such as Sapajus apella (previously Cebus apella), 
Aotus sp. and Saimiri sp., in some areas of South America 
2001), but there are still few descriptions of this parasite in 
primates in Brazil (Miguelt. et al. 2013). To the authors’ kno-
wledge, there is no description of this parasitism in Sapajus 
lbidinosus. As a result of the few models of wild Sapajus 
flavius or kept in captivity, there is no description of the oc-
currence of the parasites in this species.

The present study has the purpose of describing the oc-
currence of M. torulosus in different species of primates of 
the Sapajus genus kept in a center of rehabilitation in the 

northeast of Brazil, including the first description of this 
parasite in S. flavius and S. libidinosus, and evaluating the 
clinical and pathological aspects associated to the infection 
by this parasite.

**MATERIALS AND METHODS**

Eleven capuchin monkeys with nodules in the intestinal serosa 
were identified in a study involving 20 necroses of capuchins 
of three different species, performed in the Histology Labora-
tory and Veterinary Pathology of the Universidade Federal da 
Paraíba. The capuchin monkeys with intestinal lesions were 
classified and identified as four of the Sapajus flavius species, five S. libidinosus and two S. apella, originated from a center for rehabilitation of wild animals in the State of Paraíba, northeast of Brazil (CETAS/ 
PB). The monkeys were seized from illegal trafficking in the 
metropolitan area of João Pessoa.

The primates were submitted to necropsy after natural death, 
after a history of progressive weight loss and weakness. A com-
plete necropsy was performed on all the animals. All of the lesions 
and fragments of all the internal organs were identified and de-
scribed, including samples of skin and brain, and then they 
were placed in 10% neutral buffered formalin. The sample was em-
bded in paraffin, sectioned at 3μm-thicknesses and stained with 
haematoxylin and eosin (HE). The histopathological lesions were 
described, including a detailed identification and a description of 
the structures of the parasites associated with the lesion.

**RESULTS**

The necropsy findings on all of the primates included 
emaciation and multiple grayish-tan nodules of 0.5-2 cm 
in diameter; at times coalescent, forming masses in the 
small intestine serosa, predominately duodenum, the first 
third of the jejunum, and also in the pancreas of four pri-
mates (Fig.1A). Some nodules were noted in the intestinal 
mucosa and submucosa, with contiguity to the intestine’s 
lumen in the form of ulcers of up to 5mm in diameter, co-
vered with fibrin and hemorrhage. In the cut, the nodule-
us presented thick and firm walls, with a necrotic friable 
center, at times mineralized. In two cases it was possible 
to observe the presence of numerous adult worms, with 
approximately 1cm in length. The mesenteric lymph no-
des were enlarged and reddish. Microscopic examination 
of the small intestine revealed markedly expansion and 
compression of the tunica muscularis and elevation of the 
overlying serosa in the granulomas. The granulomas are 
composed of numerous epitheliod macrophages, eo-
sinophils, degenerate and viable neutrophils surrounding 
multiple cross and tangential sections of adult nematos 
and eggs (Fig.1B,C). The granulomas are surrounded by a 
discontinuous fibrous capsule which is subtended by nu-
merous lymphocytes and plasma cells. Multifocally, there 
are bands of collagen throughout the granuloma. The ne-
matodes are up to 120μm; have a 5μm thick cuticle with 
evenly spaced longitudinal cuticular ridges; a pseudoco-
elom; platymyarian/coelomyarian musculature; and a 
prominent digestive tract lined by few multinucleate cells 
with a low brush border. Eggs are 30-50 μm in diameter and thin shelled. Previously described inflammatory cells 
extend into the overlying serosa and superficial submucosa 
and mildly expand the lamina propria (Fig.1D). Ulcer-
ted areas of the intestine contained numerous viable and 
degenerate polymorphs and granulation tissue. The small 
intestine of all monkeys showed deep ulcers, accompanied 
with extensive areas of necrosis, involving all coats, in-
cluding the serosa (Fig.1C,D). Diffusely, there is mild follicular hyperplasia of the gut-associated lymphoid tissue. In two 
monkeys, the large mesenteric blood vessels and vessels 
at the periphery of the granulomas were infiltrated by 
some worms and Molineus eggs. In the pancreas of the four 
hosts, neutrophilic and lymphocytic periductal pancreati-
tis with intraductal nematodes and eggs were observed, 
associated with mild desquamation of epithelium. Five 
hosts also had mild, subacute lymphoplasmacytic mesen-
teric lymphadenitis. Invasion of the host’s vascular system 
(mesenteric) induced fibrin thrombi associated with Mo-
lineus eggs.

In the other evaluated organs, no lesions associated with 
Molineus eggs parasitism were observed. Other inter-
current lesions included traumatic lacerations on the skin, 
pneumonia, pleuritis and pulmonary abscess.

**DISCUSSION**

To the authors’ knowledge, this manuscript described the 
first cases of the parasitism by Molineus torulosus in blond 
capuchin (Sapajus flavius). A species of non-human neoto-

drical primates until recently considered extinct in nature, 
rediscovered and currently included in the red list of the 
species with high risk of extinction (INCN 2012). Although 
the primates of the present study presented other intercur-
rent lesions, non-related to the parasitism by M. torulosus, 
the high parasitic infestation, associated to severe ulcers.
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...in the small intestine certainly contributed to stress, weight loss and cachexia, resulting in severe debilitation. The knowledge of any illness that affects animals threatened by extinction is fundamental so that the programs of rehabilitation and conservation of the species can succeed. Ne-matode morphology, size, tissue location, and host, in the present case, were consistent with an identification key of *M. torulosus* (Durette-Desset et al. 2001).

*M. torulosus* is a small parasite from the Secernentea class, Strongylida order and Trichostrongylidae suborder, that affects the upper digestive system, including pylorus, the small intestine and occasionally the pancreas, but it never affects the terminal portion of the jejunum or the ileum (Toft 1982). In the present study, the pancreatic lesions were moderate or discrete from subacute to chronic in character. However the intestinal lesions were severe, characterized by accentuated inflammation, ulceration and hemorrhage. Different from the lesions caused by other *Trichostrongylus* that basically resulted in peeling and subsequently inflammation of the gastrointestinal epithelium, parasitism by *M. torulosus* in primates causes profound lesions on the intestinal wall, resulting in the perforation of the epithelium, as well as of the mucosae and muscularis mucosae (Brack et al. 1973). The cycle of life of these parasites is still not fully known. It is known that the infective larvae (L3) penetrates the epithelium and burrows into the submucosa, with subsequent larval maturation, and then deposits eggs, causing the formation of the submu- cosal granulomas. The eggs are expelled through channels from the granuloma into the intestinal lumen. Invasion of the host’s vascular system results in the formation of fibrin thrombus. Alternatively, the extraintestinal migration by the hematogenous route (via portal vein) or by direct tissue penetration has, as consequence, chronic pancreatitis. Due to the major severity of the lesions when compared to the parasitism by other trichostrongylus, the capuchin monkeys possibly represent unnatural hosts of *M. torulo-sus* (Brack et al. 1973). In our study, the lesions had similar severity in different species of capuchin evaluated, suggesting that *Sapajus* genus presents similar susceptibility to the infection by *M. torulosus*.

**CONCLUSIONS**

This study represents the first description of the parasitism of *Molineus torulosus* in blond monkeys and demonstrates that the infection by parasite can causes severe debility in these primates, compromising their quality of life and predisposition to the infection by other pathogens. Consequently, the parasitism by *M. torulosussis* has to be considered and investigated in *Sapajus* sp. with a his-
tory of progressive weight loss and debility, since different species of primates of this genus show similar signs and lesions as caused by this parasite.

REFERENCES


