

Hematological and blood chemistry alterations in coatis (*Nasua nasua*) naturally infected by *Trypanosoma evansi* in the Pantanal, Brazil

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Key words

Nasua nasua - *Trypanosoma evansi* - Blood - Biochemistry - Pantanal - Brazil.

Summary

During a study on the wildlife reservoir of *Trypanosoma evansi*, 40 coatis (*Nasua nasua*) were caught in the Pantanal of Nhecolândia subregion, Brazil. The values observed in infected coatis (16/40) were $4.21 \times 10^6/\text{mm}^3$ for red blood cell count, $12.68 \times 10^3/\text{mm}^3$ for white blood cell count, 28.19% for hematocrit, 9.51 mg/dl for hemoglobin, 73.60 mg/dl for glucose and 1.18 g/dl for albumin. The infected coatis presented anemia, hypoglycemia and low albumin values. These data are indications of the importance of coatis as a wild reservoir and of *T. evansi* as a disease-causing parasite in coatis. The nature of the blood and chemistry alterations needs to be elucidated. This is the first report of a disease caused by *T. evansi* in coatis.

INTRODUCTION

The Pantanal is a seasonal floodplain of about 140,000 km², located in the center of South America, between 16° and 21° S and 55° and 58° W (figure 1). The Pantanal is divided into 11 subregions differing in terms of watercourses, soil types and historical occupation (17, 19). The Pantanal has the greatest fauna density of the Americas. There are 235 fish species, 650 bird species, 50 reptile species and 80 mammal species. Man has introduced some animals in the Pantanal, including cattle, mules, donkeys, horses, pigs and dogs (10). Extensive cattle ranches varying from 10,000 to 200,000 ha occupy most of this wetland. It is populated by 3,996,000 cattle, 4966 buffaloes, and 49,000 horses (2, 14). The Pantanal is considered one of the most important livestock regions of Brazil.

Coatis are found mainly in wooded areas. They forage in trees, as well as on the ground, using the tail as balancing and as a semi-

prehensile organ. While moving along the ground, these animals usually carry the tail erect except for the curled tip. Adult males are often active at night, but coatis are primarily diurnal. They move about 1500 to 2000 m a day in search of food, and usually sleep at night (7). Coatis are highly opportunistic omnivores (5).

Trypanosoma evansi has the widest distribution of all trypanosome species and the greatest range of mammalian hosts. This parasite has a broad geographical distribution in a wide variety of mammals (10). A trypanosome survey carried out on domestic and wild animals in the Pantanal by Nunes and Oshiro (8) identified *T. evansi* in dogs, coatis (*Nasua nasua*) and capybaras (*Hydrochaeris hydrochaeris*). The role of wild mammals as reservoirs in the Pantanal is still unknown. The goal of this study was to evaluate the hematological and some blood chemistry parameters of infected animals.

MATERIALS AND METHODS

Animals

This study was conducted from September to December 1994. Forty coatis (*Nasua nasua*) were caught in the Pantanal of Nhecolândia subregion, Brazil. The coatis were physically restrained and injected intramuscularly with 0.01 ml/kg of acepromazine (Acepran 1%, Univet SA, São Paulo, Brazil).

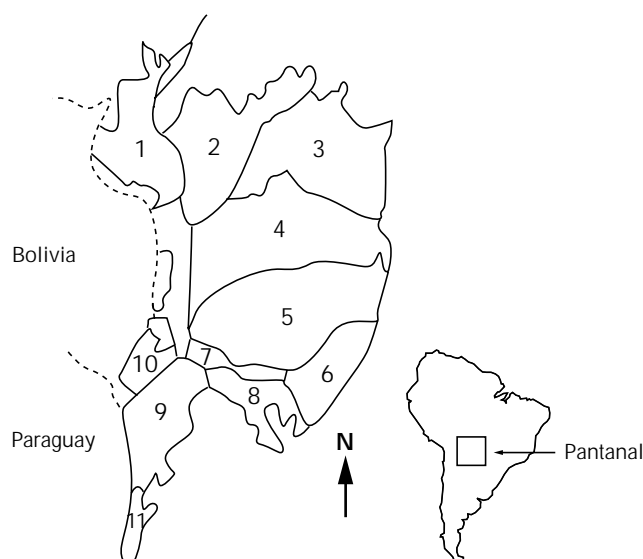
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- Pantanal subregions
1. Pantanal of Cáceres
 2. Pantanal of Poconé
 3. Pantanal of Barão de Melgaço
 4. Pantanal of Paiaguás
 5. Pantanal of Nhecolândia
 6. Pantanal of Aquidauana
 7. Pantanal of Abobral
 8. Pantanal of Miranda
 9. Pantanal of Nabileque
 10. Pantanal of Paraguay
 11. Pantanal of Porto Murtinho

Figure 1: Location of the Pantanal and its subregions.

Blood sample collection

The coatis were bled by cardiac puncture for determination of hematological data using a vacuum system (Vacuum II, Labnew, Campinas, Brazil) in tubes containing ethylenediaminetetraacetic acid as anticoagulant. The packed red cell volume (PCV) was measured using the standard microhematocrit method, and the red blood cell count (RBC) and total white blood cell count (WBC) were obtained using the Neubauer chamber. Differential leukocyte count was made using thin film blood smears and stained with Wright-Giemsa stain. The hemoglobin (Hb) concentration was determined colorimetrically (Micronal digital spectrophotometer, São Paulo, SP, Brazil) after its conversion to cyanomethemoglobin.

Blood chemistry

The serum concentrations of glucose and albumin were determined by spectrophotometric methods (Labtest sistemas para diagnósticos, São Paulo, SP, Brazil).

Trypanosome diagnosis

The diagnosis of trypanosomosis was done using the hematocrit centrifuge technique, inoculation in rats and mice, and Giemsa-stained smears. Blood from each sample and the concentrated parasites in the buffy coat of microhematocrit tubes were also used to prepare thin smears. The isolates were identified based on morphological and biometrical data (table I).

■ RESULTS

Infected coatis (16/40) presented anemia, hypoglycemia and low albumin values. One of the infected animals presented a parasitemia as high as 106.35×10^6 parasites/ml. The same animal had anemia characterized by low erythrocyte count (2.75×10^6 /ml) and decreased hematocrit (22%). The hematological and blood chemistry values of the infected coatis are presented in table II.

Table I

Measurements of *T. evansi* isolates of coatis (*Nasua nasua*) from the Pantanal, Brazil; means \pm SD (μm) (n=100)

PK	KN	PN	NA	F	T	PN/NA
n/a	n/a	9.19 ± 2.21	7.48 ± 1.82	8.01 ± 2.30	24.69 ± 3.64	1.29 ± 0.45

PK: distance from posterior end to kinetoplast; KN: from kinetoplast to middle of nucleus; PN: from posterior end to middle of nucleus; NA: from nucleus to anterior end; F: free flagellum length; T: total length including free flagellum

Table II

Hematological and blood chemistry values of coatis (*Nasua nasua*) naturally infected by *Trypanosoma evansi* in the Pantanal, Brazil, and non-infected coatis

	RBC count $\times 10^6/\text{mm}^3$	WBC count $\times 10^3/\text{mm}^3$	Ht (%)	Hb (mg/dl)	Glucose (mg/dl)	Albumin (g/dl)
Infected coatis	4.21 ± 1.13^a	12.68 ± 4.68^a	28.19 ± 5.27^a	9.51 ± 1.290^a	73.60 ± 44.53^a	1.18 ± 0.80^a
Captive coatis ⁺	7.50 ± 2.00^b	13.40 ± 4.50^a	40.90 ± 6.20^b	12.20 ± 3.30^a	176.20 ± 38.40^b	4.50 ± 1.20^{bc}

RBC: red blood cell; WBC: white blood cell; Ht: hematocrit; Hb: hemoglobin; ⁺ according to Pimentel, ABRAVAS, 1994
^{a, b, c} Values on the same row with different letters are significantly different ($P < 0.0005$)

■ DISCUSSION

Equine trypanosomosis caused by *Trypanosoma evansi* is known in the Pantanal and subtropical areas of Argentina as "Mal de Caderas" (6). Spanish settlers probably introduced it in South America during the sixteenth century (3, 12). Apparently, the disease entered in the Pantanal region in the 1850s (19). Since 1894, Mal de Caderas has been reported in horses in the Nhecolândia subregion of Pantanal (1). The most serious epidemics followed extensive flooding and this disease became a significant barrier to the expansion of cattle industry in the Pantanal (19). Outbreaks in horses are related to the vector season. Studies showed that the vector season occurs in the first half of the rainy season, from September/October to December/January. This study was conducted during the high vector season. Outbreaks of horse trypanosomosis have been reported that year (1994) as well (15, 16, 17). This season represents the period of major risk of trypanosome transmission to horses by vector insects due to their abundance and the population peak of species with high vector

potential, notably *Tabanus importunus* (16). After this season no cases are observed in horses. Nothing is known about *T. evansi* transmission from horses to wild mammals and between wild animals.

This study demonstrated that coatis presented anemia as reported in other mammal species infected by salivarian trypanosomes (17, 18). The lower values of albumin and glucose in *T. evansi* infected coatis have also been reported in other animal species infected by trypanosomes (4, 11, 13).

■ CONCLUSION

These data are indications of the importance of coatis as a wild reservoir and of *T. evansi* as a disease-causing parasite in coatis. The nature of the blood and chemistry alteration needs to be elucidated and mechanisms proposed. This is the first report of *T. evansi* causing diseases in coatis. More studies will be necessary to clarify whether there is a relationship between outbreaks of equine trypanosomosis and the infection of coatis.

REFERENCES

1. BARROS J., 1959. Lembranças para os meus filhos e descendentes. São Paulo, Brasil, Empresa Gráfica Carioca, 92 p.
2. CADAVID GARCIA E.A., 1986. Estudo técnico econômico da pecuária bovina de corte do Pantanal Mato-Grossense. Corumba, MS, Brazil, EMBRAPA/CPAP, p. 126-127. (documento 4)
3. HOARE C.A., 1972. The trypanosomes of mammals. A zoological monograph. Oxford, Edinburgh, UK, Blackwell Scientific Publications, 749 p.
4. KATUNGUKA-RWAKISHYA E., MURRAY M., HOLMES P.H., 1992. The pathophysiology of ovine trypanosomosis: haematological and blood chemistry changes. *Vet. Parasitol.*, **45**: 17-32.
5. KAUFMANN J.H., LANNING D.V., POOLE S.E., 1976. Current status and distribution of the coati in the United States. *J. Mammal.*, **57**: 621-637.
6. MONZON C.M., MANCEBO O.A., ROUX J.P., 1990. Comparison between six parasitological methods for diagnosis of *Trypanosoma evansi* in the subtropical area of Argentina. *Vet. Parasitol.*, **36**: 141-146.
7. NOWAK R.M., PARADISO J.L., 1983. Walker's mammals of the world, vol. 2, 4th ed. Baltimore, MD, USA, John Hopkins University, 1362 p.
8. NUNES V.L.B., OSHIRO E.T., 1990. *Trypanosoma (Trypanozoon) evansi* in the coati from the Pantanal region of Mato Grosso do Sul State, Brazil. *Trans. R. Soc. trop. Med. Hyg.*, **84**: 692.
9. PIMENTEL A.L.G., 1994. Análise comparativa entre valores hematológicos e séricos de quatis (*Nasua nasua*) mantidos em cativeiro e de quatis mantidos em regime de semi-liberdade. *Informativo ABRAVAS*, **2**: 1.
10. RAMIREZ L., DAVILA A.M.R., VICTORIO A.M., SILVA R.A.M.S., TRAJANO V., JANSEN A.M., 1997. Measurements of *Trypanosoma evansi* from the Pantanal. *Mem Inst Oswaldo Cruz*, **92**: 483-484.
11. RUE M. DE LA, 1996. Alterações hematológicas e bioquímicas em cães infectados com *Trypanosoma evansi* (Steel, 1885) Balbiani, 1888. PhD thesis, Fundação Faculdade Federal de Ciências Médicas de Porto Alegre, Rio Grande do Sul State, Brazil, 128 p.
12. SANTOS S.A., SERENO J.R.B., MAZZA M.C.M., MAZZA C.A., 1992. Origin of Pantaneiro horse in Brazil. *Arch. Zootec.*, **41** (extra): 371-381.
13. SEED J.R., HALL J.E., 1985. Pathophysiology of African trypanosomosis in: Tizard I., Immunology and pathogenesis of trypanosomosis. Boca Raton, FL, USA, CRC Press, p. 1-11.
14. SEIDL A., MORAES A.S., SILVA R.A.M.S., 1998. A financial analysis of alternative strategies for treatment of *Trypanosoma evansi* in the Brazilian Pantanal. *Prev. vet. Med.*, **33**: 219-234.
15. SILVA R.A.M.S., AROSEMENA N.A.E., HERRERA H.M., SAHIB C.A., FERREIRA M.S.J., 1995. Outbreak of trypanosomosis due to *Trypanosoma evansi* in horses of Pantanal Mato-grossense, Brazil. *Vet. Parasitol.*, **60**: 167-171.
16. SILVA R.A.M.S., BARROS A.T.M., HERRERA H.M., 1995. Trypanosomosis outbreaks due to *Trypanosoma evansi* in the Pantanal, Brazil. A preliminary approach on risk factors. *Revue Elev. Méd. vét. Pays trop.*, **48**: 315-319.
17. SILVA R.A.M.S., HERRERA H.M., DOMINGOS L.B.S., XIMENES F.A., DÁVILA A.M.R., 1995. Pathogenesis of *Trypanosoma evansi* infection in dogs and horses: Hematological and clinical aspects. *Ciência Rural*, **25**: 233-238.
18. SILVA R.A.M.S., SAHIB C.A., RUE M. DE LA, HERRERA H.M., FERREIRA M.S.J., DÁVILA A.M.R., 1996. Coagulopathy due to *Trypanosoma evansi* acute infection in a dog. *Arq. Bras. Med. vet. zootec.*, **48**: 485-489.
19. WILCOX R., 1992. Cattle and environment in the Pantanal of Mato-Grosso, Brazil, 1870-1970. *Agric. Hist.*, **66**: 232-256.

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Résumé

Silva R.A.M.S., Victorio A.M., Ramirez L., Davila A.M.R., Trajano V., Jansen A.M. Modifications sanguines et biochimiques chez des coatis (*Nasua nasua*) infectés naturellement par *Trypanosoma evansi* dans le Pantanal, Brésil

Lors d'une étude sur le réservoir animal sauvage de *Trypanosoma evansi*, 40 coatis (*Nasua nasua*) ont été capturés dans le Pantanal, district de Nhecolândia. Les valeurs observées chez les coatis infectés (16/40) étaient de $4,21 \times 10^6/\text{mm}^3$ pour les globules rouges, de $12,68 \times 10^3/\text{mm}^3$ pour les globules blancs, de 28,19% pour l'hématocrite, de 9,51 mg/dl pour l'hémoglobine, de 73,60 mg/dl pour le glucose et de 1,18 g/dl pour l'albumine. Les coatis infectés ont présenté de l'anémie, de l'hypoglycémie et de faibles valeurs d'albumine. Ces données signalent l'importance du coati en tant qu'animal réservoir de *T. evansi*, ainsi que du pouvoir pathogène de ce parasite chez le coati. La nature des modifications sanguines et chimiques doit être élucidée. Cette communication met en évidence, pour la première fois, *T. evansi* comme cause de maladie chez le coati.

Mots-clés : *Nasua nasua* - *Trypanosoma evansi* - Sang - Biochimie - Pantanal - Brésil.

Resumen

Silva R.A.M.S., Victorio A.M., Ramirez L., Davila A.M.R., Trajano V., Jansen A.M. Alteraciones hematológicas y de la química sanguínea del coatí (*Nasua nasua*), infectado en forma natural por *Trypanosoma evansi* en Pantanal, Brasil

Durante un estudio del reservorio silvestre de *Trypanosoma evansi*, se capturaron 40 coatíes (*Nasua nasua*) en Pantanal, subregión de Nhecolândia, Brasil. Los valores observados en los coatíes infectados (16/40) fueron de $4,21 \times 10^6/\text{mm}^3$ para el conteo de glóbulos rojos, $12,68 \times 10^3/\text{mm}^3$ para el conteo de glóbulos blancos, 28,19% para el hematocrito, 9,51 mg/dl para la hemoglobina, 73,60 mg/dl para la glucosa y 1,18 g/dl para la albúmina. Los coatíes infectados presentaron anemia, hipoglucemia y bajos niveles de albúmina. Estos datos indican la importancia de los coatíes como reservorios silvestres, así como la importancia de este parásito como causa de enfermedad en los coatíes. Debe elucidarse la naturaleza de las alteraciones químicas y sanguíneas. Este es el primer reporte de enfermedad en coatíes causada por *T. evansi*.

Palabras clave: *Nasua nasua* - *Trypanosoma evansi* - Sangre - Bioquímica - Pantanal - Brasil.