

MYCOBACTERIUM AVIUM-INTRACELLULARE INFECTION IN A WHITE-FACED SAKI (*PITHECIA PITHECIA*)

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Abstract: Physical examination of an adult female white-faced saki (*Pithecia pithecia*) revealed midabdominal multiple cystic structures. The animal developed a grade 3/4 reaction to old mammalian tuberculin injected into the right eyelid. Significant clinicopathologic findings included marked hyperproteinemia (9.2 g/dl), hyperglobulinemia (6.1 g/dl), and hypoalbuminemia (3.1 g/dl). Ultrasonography revealed multiple abdominal masses of varying echogenicity. The animal was euthanized and necropsied. Significant histopathologic findings included multifocal lymphadenitis with cystic degeneration of multiple visceral lymph nodes. *Mycobacterium avium-intracellulare* was cultured from a mesenteric lymph node.

Key words: *Mycobacterium avium-intracellulare*, saki, *Pithecia pithecia*, mycobacteriosis.

INTRODUCTION

Mycobacterial infections in New World primates are rarely reported,⁵ with most reports describing disease caused by *Mycobacterium tuberculosis*.^{1,4,7,8,10,13} Avian mycobacteriosis (*Mycobacterium avium-intracellulare* complex) has been described less frequently, with one report in a common marmoset (*Callithrix jacchus*).¹⁰ Infection with a Runyon group II mycobacterium (*M. gordonae*), without clinical evidence of disease, was reported as a probable cause of positive tuberculin reactions in two squirrel monkeys (*Saimiri sciureus*).¹⁴ *Mycobacterium avium-intracellulare* is a significant pathogen in primates and may interfere with test specificity for *M. tuberculosis*.^{3,11,12}

CASE REPORT

An adult 1.5-kg female white-faced saki monkey (*Pithecia pithecia*) was immobilized with diazepam (Elkins-Sinn, Cherry Hill, New Jersey 08003, USA), 1 mg i.m., and ketamine hydrochloride (Ketaset, Fort Dodge Laboratories, Fort Dodge, Iowa 50501, USA), 12 mg i.m., for examination shortly after importation from a private zoo in England. The animal was transported and subsequently housed with a male saki at the Lube Foundation, a private breeding and research facility in north-central Florida. Another pair of sakis, two douracoulis (*Aotus* sp.), and three dusky titi monkeys (*Callicebus moloch*) were housed in adjoining cages. All animals had been quarantined for 6 wk at an import facility in Miami and were reported to have received tuberculin injections twice during

that period. The white-faced saki presumably had no reaction to the tuberculin, but there were no written records.

Physical examination of the saki revealed a distended uterus consistent with pregnancy and multiple cystic midabdominal structures (2-3 cm diameter). Blood samples and a rectal swab were collected for complete blood counts, plasma chemistry, and aerobic fecal bacterial culture. Significant findings included moderately low cholesterol (100 mg/dl), marked hyperproteinemia (9.2 g/dl), hyperglobulinemia (6.1 g/dl), and hypoalbuminemia (3.1 g/dl), and an albumin/globulin ratio of 0.5. No pathogenic bacteria were identified. Mammalian tuberculin (Coopers Animal Health, Topeka, Kansas 66103, USA) was injected intradermally (0.1 ml) in the left eyelid, and tetanus toxoid (Tetnogen, Solvay Animal Health, Mendota Heights, Minnesota 55120-1139, USA; 0.1 ml i.m.), ivermectin (Ivomec, MSDAGVET, Rahway, New Jersey 07065, USA; 0.03 ml 1% solution s.c.), and metronidazole (Flagyl, GD Searle & Co., Skokie, Illinois 60077, USA; 75 mg p.o.) were also administered.

At 72 hr after examination, the left eyelid showed a grade 3 of 4 tuberculin reaction.⁹ A mid-term fetus and placenta were also found in the bottom of the saki's cage and were submitted for gross and histopathologic examination. The only significant finding was acute placental thrombosis with no evidence of infectious disease. The saki was quarantined pending further examination at the Veterinary Medical Teaching Hospital, University of Florida.

Anesthesia was induced by mask, and the saki was intubated and maintained with isoflurane (AER-rane, Anaquest, Madison, Wisconsin 53713-2318, USA) in oxygen for thoracic and abdominal radiography and ultrasonography and a transtracheal wash. Radiographs revealed an ovoid structure of

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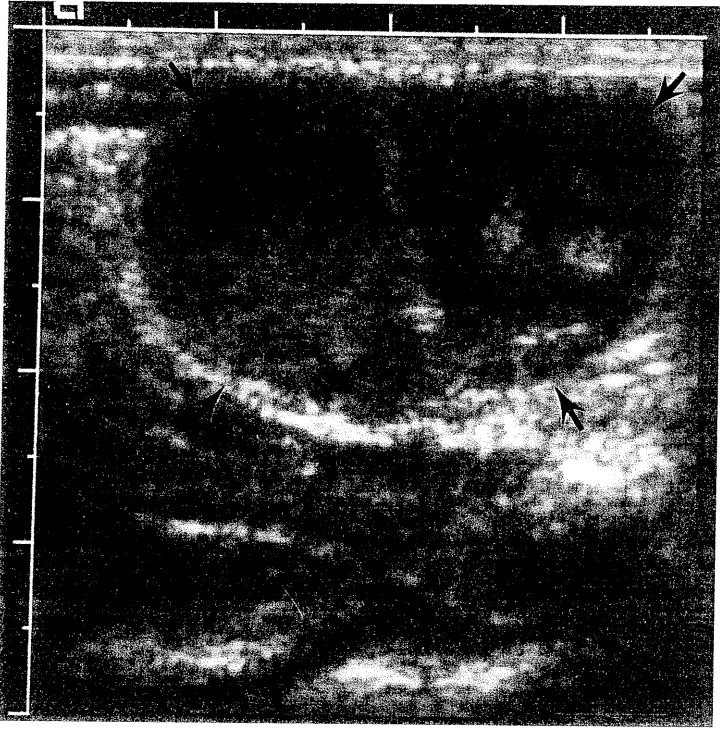


Figure 1. Abdominal ultrasonogram of abscessed mesenteric lymph node (margins delineated by arrows) from a white-faced saki (*Pithecia pithecia*) infected with *Mycobacterium avium-intracellulare* complex.

soft-tissue density in the caudal abdomen, which was the bladder, the uterus, or an abdominal mass. Additionally, there was a poorly defined central mass displacing the bowel. The remainder of the abdominal viscera were difficult to evaluate. Ultrasonography revealed multiple abdominal masses that varied in echogenicity; some had central hyperechoic regions and others were either uniformly hypoechoic or had septa (Fig. 1). These masses did not appear to be associated with any abdominal organs and were consistent in appearance with either intra-abdominal abscesses or abscessed lymph nodes. Cytologic examination of the tracheal wash showed no evidence of inflammation. Culture of the tracheal wash for aerobic bacteria and mycobacteria (2 mo, Lowenstein-Jensen slant, Remel, Lenexa, Kansas 66215, USA) revealed only normal flora.

An abdominal mass was aseptically aspirated, and the sample was submitted for cytologic examination, aerobic bacterial and mycobacterial culture, and staining for acid-fast organisms. The aspirate consisted of a viscous white, opaque fluid. Cytologic examination showed a moderate number of erythrocytes and neutrophils that contained discrete, often numerous vacuoles and abundant basophilic granules. Occasional large mononuclear cells and lymphocytes were seen, with a few lym-

phocytes containing several discrete vacuoles. Clumps of protein were scattered throughout the preparation. Fungi and bacteria were not observed. The white, opaque nature of the fluid and discrete cytoplasmic vacuoles of the leukocytes suggested the presence of lipid. This finding may have resulted from intestinal lymphangiectasia or another condition leading to impedance of flow of chyle or back leakage of chyle or from lysis of cells with release of intracellular cholesterol. The animal was returned to quarantine, and the tuberculin test was repeated 10 days later in the opposite eyelid with the same result.

The saki was reanesthetized with isoflurane in oxygen, intubated, and maintained on a non-rebreathing system. An exploratory laparotomy showed that the abdominal masses were adherent to portions of the intestinal tract and were not resectable. The animal was euthanized and submitted for necropsy. Significant histopathologic findings included multifocal granulomatous lymphadenitis with cystic degeneration of multiple visceral lymph nodes. One lymph node had large numbers of multinucleated giant cells often containing round crystals with concentric lamellations, which were identified as calcium salts using Von Kossa stain. Additionally, the saki had moderate to severe, chronic

segmental plasmacytic enteritis, mild to moderate numbers of eosinophils within the lamina propria of the small and large intestines, and severe multifocal nonsuppurative chronic hepatitis. Special stains for mycobacteria (Fites) and other organisms (periodic acid-Schiff, Brown and Brenn, Gömöri's methenamine silver) in the mesenteric lymph nodes and liver were negative. Aerobic bacterial and fungal culture of a cystic lymph node were negative. A mycobacterial species was cultured from a mesenteric lymph node and identified at the National Veterinary Services Laboratories (Ames, Iowa, USA) using a polymerase chain reaction probe (Accuprobe, Genprobe, San Diego, California 92112, USA) as belonging to the *M. avium-intracellulare* complex.

DISCUSSION

An antemortem diagnosis of mycobacteriosis was strongly suggested in this saki by the severe and repeatable tuberculin reaction, by the presence of intra-abdominal cystic structures consistent with either enlarged lymph nodes or abscesses, and by the hyperglobulinemia. However, it was impossible to identify the infective organism until necropsy, and even then it was present in such low numbers that it was not observed microscopically.

Pathologic features of *M. avium-intracellulare* infection in nonhuman primates that are useful in distinguishing it from tuberculous forms of mycobacteriosis include its extensive intestinal involvement, a massive number of acid-fast bacilli within infiltrating histiocytes, and the lack of tubercle formation and caseous necrosis.⁶ The first two features are not consistent with the lesions observed in this saki, which were predominantly confined to the mesenteric lymph nodes.

Unlike avian mycobacteriosis in Old World primates and immune-compromised humans, there was no evidence of diarrhea in this saki.^{2,11} Mycobacteriosis-associated diarrhea is usually due to granulomatous enterocolitis.^{5,11} Although there was a plasmacytic enterocolitis in this animal, there was no evidence of intestinal mycobacteriosis. The intestinal lesions were not typical of mycobacteriosis, and no acid-fast organisms were identified during histologic examination of the bowel. The presence of infected abdominal lymph nodes in this saki was, however, consistent with avian mycobacteriosis in Old World primates.¹

Hyperglobulinemia, as observed in this saki, has been described in two of three rhesus macaques (*Macaca mulatta*) infected with *M. avium*.¹¹ Conversely, hypoglobulinemia and hypoalbuminemia have been described in one of two rhesus monkeys

infected with *M. intracellulare*;² these conditions probably were due to chronic protein loss, malabsorption, and negative nitrogen balance associated with a diffuse enteropathy.²

This animal did not show a tuberculin reaction during quarantine in Miami, either because of poor monitoring for postinjection tuberculin reactions or because reactivity occurred after the animal left the facility. Rhesus monkeys infected with *M. avium-intracellulare* complex have shown either strong positive³ or equivocal^{2,11} skin responses to mammalian old tuberculin. This case reemphasizes the susceptibility of New World primates to nontuberculous mycobacteriosis and demonstrates the difficulty of antemortem identification of the causative organism.

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LITERATURE CITED

1. Chrisp, C. E., B. J. Cohen, D. H. Ringler, and G. D. Abrams. 1968. Tuberculosis in a squirrel monkey (*Saimiri sciureus*). *J. Am. Vet. Med. Assoc.* 153: 918-922.
2. Fleischman, R. W., G. C. Du Moulin, H. J. Esber, V. Ilievski, and A. E. Bogden. 1982. Nontuberculous mycobacterial infection attributable to *Mycobacterium intracellulare* serotype 10 in two rhesus monkeys. *J. Am. Vet. Med. Assoc.* 181: 1358-1362.
3. Goodwin, B. T., C. P. Jerome, and B. C. Bullock. 1988. Unusual lesion morphology and skin test reaction for *Mycobacterium avium* complex in macaques. *Lab. Anim. Sci.* 38: 20-24.
4. Hessler, J. R., and A. F. Moreland. 1968. Pulmonary tuberculosis in a squirrel monkey (*Saimiri sciureus*). *J. Am. Vet. Med. Assoc.* 153: 923-927.
5. Hines, M. E., J. M. Kreeger, and A. J. Herron. 1995. Mycobacterial infections of animals: pathology and pathogenesis. *Lab. Anim. Sci.* 45: 334-351.
6. King, N. W. 1993. *Mycobacterium avium-intracellulare* infection. In: Jones, T. C., U. Mohr, and R. D. Hunt (eds.). *Monographs in Pathology of Laboratory Animals. Nonhuman Primates I*. Springer-Verlag, New York, New York. Pp. 57-63.
7. Leathers, C. W., and T. E. Hamm. 1976. Naturally occurring tuberculosis in a squirrel monkey and a *Cebus* monkey. *J. Am. Vet. Med. Assoc.* 169: 909-911.
8. Mayhall, C. G., V. A. Lamb, and P. H. Coleman. 1981. Infection in rhesus (*Macaca mulatta*) and squirrel (*Saimiri sciureus*) monkeys due to *Mycobacterium tuberculosis* phage type B. *J. Med. Primatol.* 10: 302-311.
9. McLaughlin, R. M., and G. E. Marrs. 1978. Tuberculin testing in nonhuman primates: OT vs PPD. In: Montali, R. J. (ed.). *Mycobacterial Infections of Zoo Animals*. Smithsonian Institution Press, Washington, D.C. Pp. 123-128.
10. Moreland, A. F. 1970. Tuberculosis in New World primates. *Lab. Anim. Care* 20: 262-264.
11. Sesline, D. H., L. W. Schwartz, B. I. Osborn, C. O.

- Tohen, T. Terrell, C. Holmberg, J. H. Anderson, and R. V. Henrickson. 1975. *Mycobacterium avium* infection in three rhesus monkeys. J. Am. Vet. Med. Assoc. 167: 639-645.
12. Smith, E. K., R. D. Hunt, F. G. Garcia, C. E. O. Fraser, R. S. Merkal, and A. G. Karlson. 1973. Avian tuberculosis in monkeys. Am. Rev. Respir. Dis. 107: 469-471.
13. Snyder, S., T. Peace, O. Soave, and J. Lund. 1970. Tuberculosis in an owl monkey (*Aotus trivirgatus*). J. Am. Vet. Med. Assoc. 157: 712-713.
14. Soave, O., S. Jackson, J. S. Ghumman. 1981. Atypical mycobacteria as the probable cause of positive tuberculin reactions in squirrel monkeys, *Saimiri sciureus*. Lab. Anim. Sci. 31: 295-296.

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