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Concurrent Infection of a Patas Monkey (*Erythrocebus patas*) by *Citrobacter freundii* and *Trichuris trichiura*

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ABSTRACT: Concurrent infection of *Citrobacter freundii* and *Trichuris trichiura* in a Patas monkey (*Erythrocebus patas*) is reported. A synergistic effect of both organisms contributing to host mortality in this case is suggested.

Key words: *Citrobacter freundii*, *Trichuris trichiura*, concurrent infection, Patas monkey, *Erythrocebus patas*, case history.

Citrobacter freundii, found in water, food, feces and urine, is recognized as an opportunistic pathogen, causing disease when other factors reduce host resistance to infection (Sedlak et al., 1971; Sedlak, 1974). It has been associated with various disease conditions in guinea pigs, rabbits and mice (Owens et al., 1975) but no information is available on its involvement in diseases of captive wild animals. *Trichuris trichiura* infection is apparently of little significance except in heavy infections but where it causes bloody diarrhea (Dunn, 1977). Previous reports have described synergistic effects of concurrent infections of helminths, protozoa and bacteria in animals (Wescott, 1970; Grieve et al., 1977; Hazen et al., 1978), but none of these involved free-living or captive primates. This report describes a concurrent infection of *Citrobacter freundii* and *Trichuris trichiura* in a captive monkey.

An adult female Patas monkey (*Erythrocebus patas*), one of the five Patas monkeys housed together in a wire enclosure set among trees in the Jos Zoo (Jos, Nigeria) had profuse diarrhea, weakness, inappetence and pyrexia with temperature of 41 C for about 3 days. Therapy with Bisol-M® (Pfizer, Inc; New York, New York 10017, USA) containing methscopolamine and neomycin at 5 mg/kg three times daily was begun, but the animal did not improve and suddenly died the following day. The carcass was submitted to our laboratory for necropsy 4 hr after it died. Samples of the lung, liver and intestine were cultured for bacteria aerobically and anaerobically at 37 C on blood and MacConkey agar (Carter, 1975). A fecal sample was examined for intestinal parasites by a modified Shaether's sugar flotation technique (Dunn, 1977). Mature and immature worms recovered from the intestine were identified as *T. trichiura* by morphological characteristics (Dunn, 1977).

At necropsy, the carcass was emaciated and had bloody feces. Numerous worms were found in the large intestine. Thickening of the intestinal wall and edema and petechiation of the intestinal mucosa also were seen. Gross lesions in other organs were suggestive of acute septicemia: (1) pneumonia and acute congestion of both lungs, (2) Petechial hemorrhages in the liver, spleen, kidney, epicardium and endocardium and (3) hydrothorax. Microscopically, there was thickening of the interalveolar septa in the lung which were congested and contained neutrophils, lymphocytes and numerous gram-negative bacilli. Septic thrombi were seen in the large vessels and capillaries of the liver and spleen. Significant changes in the intestine included loss of epithelium and fusion of villi.

Citrobacter freundii was isolated from the lung, liver, heart blood and intestines. Identification was based on the following biochemical reactions: catalase positive; fermented mannitol with production of gas; produced acid from lactose, raffinose, sucrose, xylose, trehalose and dulcitol; produced β-galactosidase; hydrolysed urea; decarboxylated orninthine; did not decarboxylate lysine; methyl-red tests were positive; Voges-Proskauer test was negative; produced hydrogen sulfide from TSI agar;

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grew on KCN media; and it was indole negative (Holmes and Roger, 1984). Fecal samples contained trichuroid eggs at 7,000/g of feces.

A survey for helminth parasites in animals in the zoo showed that all the other four Patas monkeys harbored *T. trichiura* but *C. freundii* was not isolated. Routine administration of suitable anthelmintics is important in the management of captive animals. Infection by either *T. trichiura* or *C. freundii* alone may not have been capable of causing the severe disease we observed in this case. However, it is conceivable that the heavy infection by *T. trichiura* might have resulted in debilitation, stress and physiologic conditions favourable for rapid proliferation of *C. freundii* with the subsequent invasion of tissues and resulting in death of the animal. Dual or multiple infections of this nature are common (Wescott, 1970; Salkin et al., 1975) and the relationship between infectious agents and the complications of such infections must be considered in the management of captive animals. *Citrobacter freundii* has not been reported as a cause of disease in captive wild animals, but its ability to cause mortality under certain predisposing conditions, or in association with other organisms as in the present case, should be appreciated.

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