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***Serratia marcescens* Infection in a Swallow-tailed Hummingbird**

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ABSTRACT: A swallow-tailed hummingbird (*Eupetomena macroura*) was presented with a history of prostration and inability to fly. After a 2-day hospitalization, the bird died and necropsy findings included diffuse hyperemia of the small intestine serosal and mucosal surfaces and the presence of a small quantity of clear ascitic fluid in the coelomic cavity. Intestinal contents and cardiac blood were collected for microbiologic exams yielding pure cultures of a pigmented strain of *Serratia marcescens*. This strain was susceptible to gentamicin, enrofloxacin, streptomycin, trimethoprim, and sulfamethoxazole and had intermediate susceptibility to chloramphenicol and resistance to cephalotin. The source of the infection could not be ascertained, but possible contamination of hummingbird feeders could be involved, because the infection seemed to originate from the digestive tract.

Key words: Bacterial infection, *Eupetomena macroura*, hummingbird, *Serratia marcescens*.

Serratia are gram-negative bacteria belonging to the *Enterobacteriaceae* family; they have been associated with nosocomial infections in immunosuppressed human patients and may cause serious infections such as septicemia, meningitis, conjunctivitis, cystitis, and osteomyelitis (Theccanat et al., 1991; Parment, 1997; Abejón et al., 2005; Shigemura et al., 2005; Shih et al., 2005). These bacteria are also capable of developing resistance to a large number of antimicrobial agents and antiseptics (Fox et al., 1981; Willingham et al., 1996).

In animals, there are reports of *Serratia* infections causing mastitis in dairy cows (Kamarudin et al., 1996), endocarditis and sepsis in horses (Colahan et al., 1984; Young et al., 1989; Ewart et al., 1992),

sepsis and osteomyelitis in dogs and cats (Armstrong, 1984), intracranial abscesses and/or purulent meningoencephalitis in deer (Baumann et al., 2001; Nettles et al., 2002), pneumonia in sea lions (Sweeney and Gilmartin, 1974), and localized articular and cutaneous infections in reptiles (Crawford et al., 1970; Ackerman et al., 1971). Procedures such as catheterization and prolonged antibiotic treatment tend to predispose domestic animal patients to *Serratia marcescens* infections (Fox et al., 1981).

Gram-negative microorganisms are not normal components of the microflora of the digestive tract of birds in the Trochiliformes (hummingbirds) family (Gerlach, 1994), and in avian species, *Serratia* spp. are uncommonly isolated from clinical specimens. Although *Serratia* can be pathogenic and may be significant in companion psittacine birds, even if isolated in small numbers (Flammer, 1998), there are reports of its isolation from apparently healthy birds such as houbara bustards (*Chlamydotis undulata macqueenii*) (Bailey et al., 2002), passeriformes (Radwan and Lampky, 1972), and raptors (Bangert et al., 1988). *Serratia marcescens* infection was described in parrots with chronic debilitating diseases in which predisposing factors seemed to include previous antibiotic treatment and immunosuppression (Gerlach, 1994). Another study describes bacteremia in stranded wedge-tailed shearwater chicks (*Puffinus pacificus*), in which *S. marcescens* was isolated among several other bacterial agents in mixed growth cultures (Work

and Rameyer, 1999). Clinical signs in birds can include regurgitation or vomiting, hepatitis, nephritis, and septicemia (Lumeij, 1994a, b, c). This case report describes the isolation of *S. marcescens* from a swallow-tailed hummingbird (*Eupetomena macroura*) in a Brazilian zoo and its significance as to cause of death.

An adult swallow-tailed hummingbird was brought to the Sorocaba Zoo (Sorocaba, São Paulo state, Brazil) by local birdwatchers the same day it was found prostrate on the ground and unable to maintain sustained flight. The bird was hospitalized and examined, and it had moderate atrophy of the pectoral muscles. It was force fed with a commercial nectar product used in hummingbird feeders. After a 2-day hospitalization, the bird's condition quickly deteriorated and it started to show increasing prostration, breast muscle atrophy, and inability to swallow the offered nectar. No antimicrobial therapy was done. The next day the bird was found dead and necropsy findings included diffuse hyperemia of the small intestine serosal and mucosal surfaces and a small quantity of clear ascitic fluid in the coelomic cavity. Intestinal contents and cardiac blood were collected for microbiologic examination.

The swab of the intestine contents and the collected cardiac blood sample were separately placed in tubes containing brain and heart infusion broth and incubated at 37 C for 24 hr. Broth was streaked on MacConkey agar (Difco™, Becton Dickinson and Company, Sparks, Maryland, USA) plates and incubated at 37 C for 24 hr. Both samples yielded pure cultures of negative lactose fermenter colonies, which produced a red pigment when incubated at room temperature and had gram-negative bacilli morphology in the Gram stain. These colonies were then selected for biochemistry identification (Isenberg et al., 1974).

Identification of genus and species was accomplished by the ability of the bacteria to catabolize carbohydrates such as D-

glucose, D-mannitol, maltose, D-mannose, salicin, sucrose, and trehalose; absence of production of gas, hydrogen sulfide, and hydrolysis of urea as well as negative indole production; incapacity to ferment L-rhamnose, cellobiose, melibiose, L-rhamnose, and D-xylose; presence of motility; decarboxylation of lysine; Voges-Proskauer positive reaction; and the production of the water-insoluble red compound prodigiosin (Holt et al., 1994). Kirby-Bauer diffusion test (Bauer et al., 1966) showed a susceptibility pattern to gentamicin, enrofloxacin, streptomycin, trimethoprim, and sulfamethoxazole; intermediate susceptibility to chloramphenicol; and resistance to cephalotin.

The most common problems in hummingbirds are of nutritional etiology, especially insufficient caloric intake and hypoproteinemia. However, infectious diseases such as candidiasis are common in captive hummingbirds, and other diseases such as aspergillosis, salmonellosis, and mycobacteriosis have been documented (Fowler, 2001). Gram-negative opportunistic bacterial infections can occur as in other avian species; beak abscesses are the usual lesion caused by these organisms (Fowler, 2001).

Quesenberry and Short (1983) previously reported chronic *S. marcescens* cutaneous and systemic infection in a blue and gold macaw (*Ara ararauna*); gross necropsy findings included emaciation, polyserositis, and alterations characteristic of septicemic lesions. The fact that this hummingbird had only a few distinguishable gross macroscopic alterations can be explained by the rapid onset of symptoms and death, which contrasted with the more chronic nature of the aforementioned macaw case.

Serratia marcescens infection in humans occurs as an opportunistic infection, typically in granulocytopenic patients and in those who are immunosuppressed by disease or therapy (Theccanat et al., 1991). Septicemic infections are also attributed to strains that are able to resist serum

bactericidal activity (Simberkoff et al., 1976). In the blue and gold macaw affected by *S. marcescens*, immunosuppression was thought to be present because chronic lymphoid atrophy was present in the spleen (Quesenberry and Short, 1983). In this swallow-tailed hummingbird, stress factors such as territorial fights, nutritional imbalances, and other undetected agents, as well as the subsequent stress of captivity could have played a negative role affecting the immune system and resulting in the observed bacteremia.

Multiple drug resistance of *S. marcescens* strains are frequently reported both in humans (Shigemura et al., 2005), as well as in animal patients (Fox et al., 1981). In this case, the strain isolated was resistant to cephalotin and had intermediate susceptibility to chloramphenicol.

The initial source for the bacterial infection was not ascertained, but as *S. marcescens* can survive at room temperature in areas of high humidity or in water containers (Fox et al., 1981), contamination of hummingbird feeders could be involved as the infection seemed to originate primarily from the digestive tract.

Serratia are ubiquitous in the environment (Holt et al., 1994), but the zoonotic potential of birds as carriers of *S. marcescens* cannot be disregarded and could be species dependent. In certain species (e.g. hummingbirds and parrots), the potential seems small because the highly pathogenic nature of this bacteria in these birds usually results in death of the affected animal, not allowing them to become a long-time reservoir. On the other hand, a low prevalence of *S. marcescens*, *S. odorifera*, and *S. liquefaciens* in the feces of apparently healthy captive raptors (Bangert et al., 1988), as well as *Serratia* spp. in the feces of free-ranging cowbirds (*Molothrus ater*) (Radwan and Lampky, 1972), and in cloacal swabs of houbara bustards (Bailey et al., 2002) suggests that some species have this microorganism in

their digestive system, which, even if transient, could be a source for zoonotic infections. Currently, very little is known about *S. marcescens* strains isolated from birds, and further virulence studies are required to determine if avian isolates of *S. marcescens* have the potential to cause disease in humans.

Although this pathogen is rarely isolated from avian species and usually is not included in the primary differential diagnosis of bacterial infections in birds, the findings in this report underscore the possibility of enterobacteria (including rare isolates) acting as opportunistic or primary pathogens and contributing to the cause of death in birds.

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