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Authors: CALLE, PAUL P., MONTALI, RICHARD J., and JANSSEN, DONALD L.

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## DISTAL EXTREMITY NECROSIS IN CAPTIVE BIRDS<sup>□</sup>

PAUL P. CALLE, RICHARD J. MONTALI and DONALD L. JANSSEN, National Zoological Park, Smithsonian Institution, Washington, D.C. 20008, USA.

MICHAEL K. STOSKOPF,<sup>□</sup> Baltimore Zoological Society, Druid Hill Park, Baltimore, Maryland 21217, USA.

JOHN D. STRANDBERG, Division of Comparative Medicine, Johns Hopkins University School of Medicine, Baltimore, Maryland 21205, USA.

**Abstract:** The necropsy files of the National Zoological Park and Baltimore Zoological Society were reviewed for cases of distal extremity necrosis (DEN) in birds. Nineteen cases of DEN occurred following either trauma or frostbite. Six birds developed an apparently primary type of DEN in which no predisposing factors were obvious clinically. The toes and feet were most commonly involved, and in several cases the beak was also affected. Some pathologic evidence is provided that certain cardiovascular lesions may predispose birds to DEN by compromising circulation of the extremities.

### INTRODUCTION

Gangrene of the extremities usually occurs following some interference with the peripheral blood supply (Smith et al., 1972). Human cases have been reported in diabetics with arteriosclerosis (Lacy and Kissane, 1977), and in domestic mammals due to the chronic ingestion of the mycotoxin, ergot (Smith et al., 1972). The "ringtail" syndrome in laboratory rodents, in which the distal portion of the tail becomes gangrenous, has been attributed to low ambient humidity, dietary deficiencies of fatty acids and vitamin B<sub>12</sub>, and tail biting due to overcrowded conditions (Hume and Smith, 1931; McElroy and Gross, 1940; Njaa et al., 1957). Elephant shrews (*Elephantulus rufescens*) develop a similar syndrome, apparently associated with cagemate aggression (Hoopes and Montali, 1980).

This paper describes the clinical and pathological aspects of a gangrenous condition in birds characterized by distal

extremity necrosis (DEN) of the feet, digits, and beak, and classifies it either primary, of uncertain etiology, or secondary to frostbite or trauma. Evidence is also provided that certain cardiovascular conditions may predispose birds to DEN by causing deficiencies in the peripheral circulation.

### MATERIALS AND METHODS

Necropsy and clinical records of all birds from the National Zoological Park and the Baltimore Zoological Society were reviewed for reports of gangrene of the extremities. The records of the National Zoo were examined for the years 1975-1981, and those of the Baltimore Zoo from 1967-1981. Cases were classified as secondary if the gangrene was clearly a sequela to either frostbite or trauma, and primary if there was no plausible explanation as to the cause.

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<sup>□</sup> Present address: National Aquarium, Baltimore, Maryland 21201, USA.

## HISTORY

### Secondary DEN

There were 19 cases of secondary DEN in nine avian orders<sup>□</sup> which were considered to be sequelae to frostbite or trauma.

Seventeen birds, representing seven orders, developed DEN following frostbite. The gangrene affected mainly the toes, feet, legs, or a combination of these areas. In one case, the beak was involved. Birds least affected had only involvement of the toes on both feet, while the severe cases had extensive involvement of both distal limbs. Treatment consisted of parenteral or topical antibiotics and supportive therapy. Eight birds died, eight were euthanatized due to the severity and bilateral involvement of the DEN, and one bird is still alive with several toes missing.

Following death or euthanasia, all birds were examined at necropsy and histologic examinations were performed on 10 of the 16. The nutritional condition of the birds was generally good, although several were poorly nourished with minimal subcutaneous and cavity fat stores. Dry gangrenous necrosis of the feet was present in all cases, with proximal extension of the gangrene to the tarsometatarsal bone in 10 cases. Toes had actually sloughed in only three cases.

Common findings in seven of 10 birds studied histologically were chronic myocardial, valvular, or vascular lesions. These consisted of vegetative endocarditis, coronary arterial amyloidosis, chronic myocarditis, myocardial fibrosis, aortic atherosclerosis, myocardial degeneration, cardiac microinfarcts, a cardiac mural thrombus, and an unusual endothelial hyperplasia of the atrioventricular valve.

Incidental histologic findings included anthracosilicosis, periportal hepatitis, peribronchiolar lymphoid infiltration, and chronic enteritis. Amyloidosis was present in two cases.

Two birds with secondary DEN, representing two orders, developed DEN following trauma to the leg. Gross and histopathological examination of these birds was unremarkable.

### Primary DEN

Six birds, representing four orders,<sup>□</sup> developed spontaneous, or primary, DEN. Of these six cases, two were euthanatized due to the extent of the gangrene; one died, and the remaining three are still alive, with missing toes and in some cases, beaks.

Five birds exhibited a strikingly similar clinical course consisting of progressive DEN and sloughing of multiple toes, and loss of distal segments of the beak. In some cases there was repeated involvement of the beak.

The first case, a 3-yr-old female Marabou stork (*Leptoptilus crumeniferous*), completely fractured the lower beak. The fracture site was symmetrical, essentially avascular, and apparently the result of DEN (Fig. 1). The sloughed portion was surgically reunited with bone plates and acrylic. Two wks later, the bird was reported lame, and showed DEN of the toes on both feet. This occurred in June. The lameness worsened, the necrotic toes began separating from the viable tissue, and were surgically removed (Figs. 2A & 2B). One mo later the upper beak sloughed in a similar way to the lower beak. The upper beak was repaired and the bird given parenteral antibiotics. The total clinical course for this stork was 3 mo. Two mo later, while anesthetized to check the beak prosthesis, the bird died.

<sup>□</sup> Orders affected were Anseriformes, Casuariiformes, Charadriiformes, Ciconiiformes, Falconiformes, Gruiformes, Passeriformes, Piciformes, and Psittaciformes.

<sup>□</sup> Orders affected are Charadriiformes, Ciconiiformes, Coraciiformes, and Galliformes.

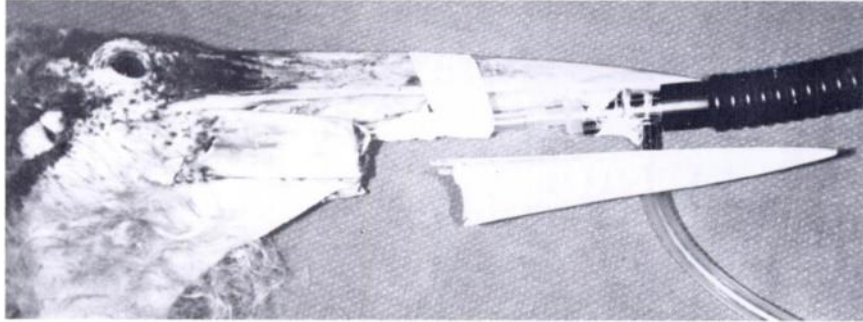


FIGURE 1. Female Marabou stork with sloughed lower beak due to primary DEN.

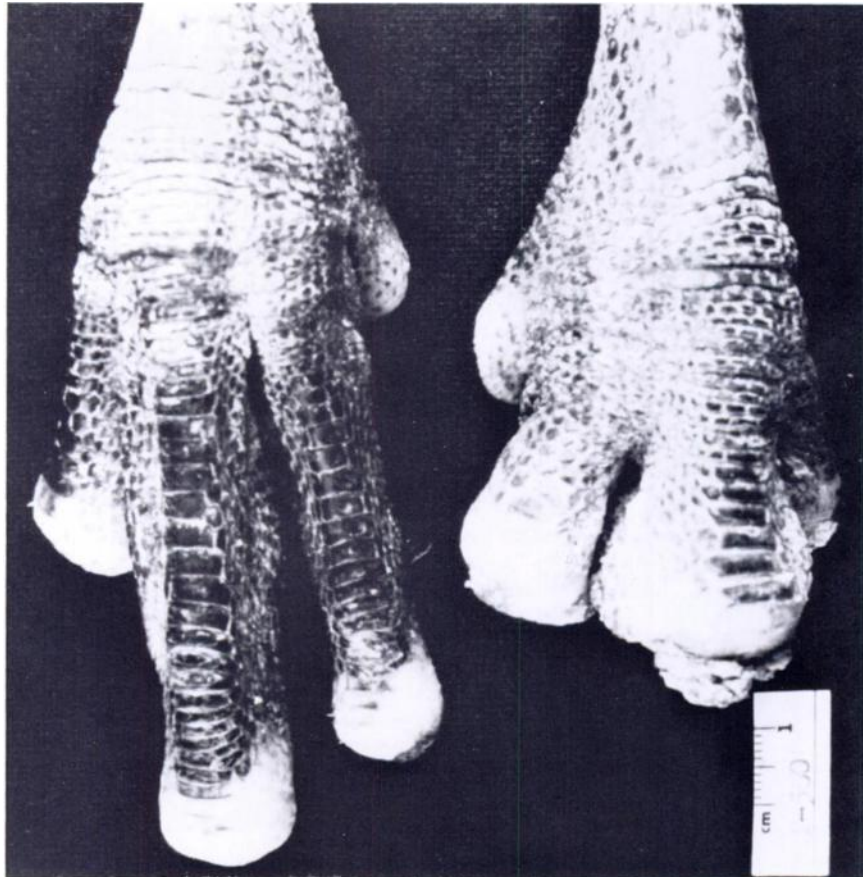


FIGURE 2A. Male Marabou stork with advanced case of primary DEN of toes. Acute stage.

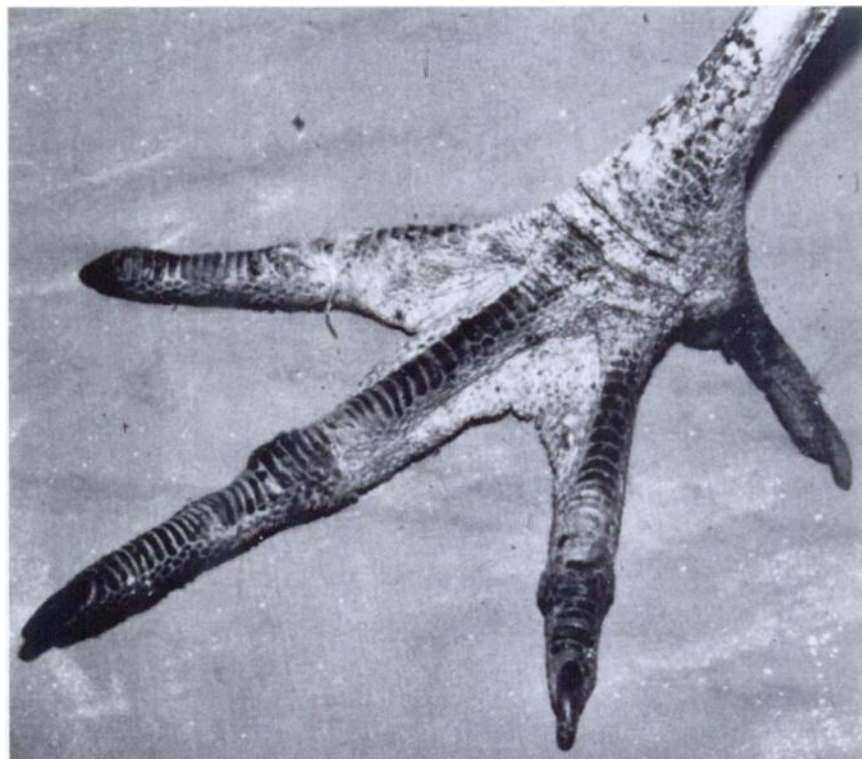


FIGURE 2B. Male Marabou stork with advanced case of primary DEN of toes. Healed stage.

Another Marabou stork, a 3-yr-old male, developed DEN of the toes of both feet at the same time as its cagemate. The necrotic portions were surgically amputated and the bird was given antibiotics intramuscularly, and at the time of this writing (2 mo post surgery), has developed no further DEN.

A male lesser adjutant stork (*Leptoptilos javanicus*), less than 3 yr old, lost the distal portion of its upper beak which was replaced by a prosthesis. One yr later, some of the toes on both feet became gangrenous and sloughed within 18 days.

A female Abyssinian ground hornbill (*Bucorvus abyssinicus*), less than 7 yr old, developed DEN and sloughed a seg-

ment of the upper beak. The proximal portion was trimmed back to viable tissue and the distal portion surgically united. The DEN progressed and 12 days later, the upper beak fractured again, proximal to the attachment site. The lower beak was also lost at this time and was trimmed to approximately the same length as the stump of the upper beak. The toes were observed to be avascular. The bird was given parenteral antibiotics, and within 2 wk, all toes had sloughed. To date, 2 yr after the initial episode, the bird has adapted well to the loss of toes and beak and has not developed further DEN.

The fifth case of primary DEN occurred in a male argus pheasant

(*Argusianus argus grayi*) less than 4 yr old. The bird was presented with bilateral DEN of the toes, which became progressively worse and necessitated destruction of the bird.

The sixth case of primary DEN did not resemble the preceding five. It affected a female wild-hatched killdeer chick (*Charadrius vociferous*), less than 1 yr old, that was hand-reared. During the 7 mo it lived, the chick developed abnormal wing posture ("Airplane wing"), and rickets due to dietary imbalances. The joints of both feet became swollen and firm and DEN of the toes developed. Over the 6 mo clinical course, the bird lost all toes on both feet. The bird was euthanatized due to the gangrene and rachitic deformities, although the rickets had become inactive as a result of vitamin and mineral supplementation.

The three birds which died were examined at necropsy. The Marabou stork had a mild, focal, chronic interstitial myocarditis. The vessels in the digits were unremarkable, as were all other tissues with the exception of the gangrenous extremities. The argus pheasant had coronary arteriosclerosis, myocardial perivascular lymphocytic infiltration, and splenic reticuloendothelial hyperplasia. Lesions found in the killdeer included healed rickets, chronic focal interstitial nephritis, and chronic peribronchiolitis.

## DISCUSSION

The secondary cases of DEN occurred following either trauma or frostbite. Gangrene and sloughing of toes secondary to trauma have been reported in both captive exotic birds (Petra, 1969) and in domestic poultry (Peckham, 1978b).

The majority of secondary DEN cases occurred as sequelae to frostbite. Among tropical birds kept as pets, the most common cause of arteritis leading to

gangrene of the feet and loss of one or more toes is frostbite (Petra, 1969). Domestic poultry (Peckham, 1978b) and captive birds (Wallach and Fleig, 1969) also develop gangrene and sloughing of extremities following frostbite.

The clinical signs and course of five of the six cases of primary DEN were similar to that seen in cases of chronic ergotism in domestic mammals (Smith et al., 1972) and poultry (Peckham, 1978a). Avian ergotism is characterized by gangrenous necrosis of the tongue, comb (Peckham, 1978a), and beak (Smith et al., 1972). With the exception of the pheasant, however, our birds were either carnivorous or carrion feeders. In captivity, they were fed mice, chicks, fish, mineral supplements, and a commercial carnivorous food diet.□ This diet did not contain grain and therefore it is unlikely that ergot was responsible, although another vasoactive substance may have been involved.

The primary DEN cases also resemble an idiopathic syndrome seen in budgerigars (Petra, 1969), in which spontaneous gangrene of one or more toes and feet develops and progresses to the tibiotarsal-tarsometatarsal joint with loss of the digits. The condition may be self-limiting, although it is usually fatal. Experimental attempts to reproduce the lesions by feeding ergot were unsuccessful (Petra, 1969). Frostbite was ruled out as the initiating factor for the cases of primary DEN. Only one case, that of the pheasant, occurred in the winter and the bird was housed in a heated indoor enclosure. The remaining cases occurred from April through September.

As with the "ringtail" syndrome in laboratory rodents, it is possible that a dietary deficiency contributed to the clinical course in the killdeer and perhaps in other cases.

□ Bird of Prey Diet, Central Nebraska Packing, Inc., North Platte, Nebraska 69101, USA.

Eight of 15 birds with DEN studied histologically had evidence of chronic cardiovascular lesions despite their relatively young ages. These eight cases included one bird from the primary group and seven from the secondary group. Lesions such as these might result in a degree of cardiovascular compromise. The resulting poor peripheral circulation may have rendered the affected birds incapable of responding normally to cold or trauma, with DEN of the extremities ensuing. The avian leg may be more susceptible to insults such as these, due to the lack of insulating feathers or significant muscle or fat in these regions.

In a review of twenty-six birds dying from cold injuries at the St. Louis Zoological Park, ten birds died with cardiovascular lesions and dry gangrene of the extremities (Wallach and Fleig, 1969). These lesions consisted of vegetative valvular endocarditis in seven cases and three additional birds had myocardial infarctions. The authors

felt that these cardiovascular lesions developed as sequelae to frostbite injuries. An alternative interpretation is that the cardiovascular lesions occurred first and resulted in compromised peripheral perfusion, subsequent "frostbite", and DEN.

In the case of primary DEN, a vasoactive substance cannot be ruled out; however, cardiovascular lesions as noted in many of the birds with secondary DEN, might play a major role in the pathogenesis of the condition. This is particularly likely in view of the fact that most of the affected birds have long legs, and therefore are more susceptible to the effects of compromise of the cardiovascular system.

DEN of the interdigital web and leg has been reported in free-ranging mute swans (*Sygnus olor*) (Yates et al., 1969), although the cause was not determined. These birds may represent cases of primary DEN, or they may be survivors of previous frostbite injuries.

#### LITERATURE CITED

- HUME, E.M. and H.H. SMITH. 1931. The relation of the fat-free diet to the scaly tail condition in rats. *Biochem. J.* 25: 300-306.
- HOOPES, P.J. and R.J. MONTALI. 1980. Tail lesions in captive elephant shrews. In: *The Comparative Pathology of Zoo Animals*. R.J. Montali and G. Migaki (eds.). Smithsonian Institution Press, Washington, D.C. pp. 425-430.
- LACY, P.E. and J.M. KISSANE. 1977. Pancreas and diabetes mellitus. In: *Pathology*. W.A.D. Anderson and J.M. Kissane (eds.). 7th ed., Vol. 2. C.V. Mosby Co., St. Louis, Missouri. pp. 1457-1482.
- McELROY, L.W. and H. GROSS. 1940. Development and cure of "ringtailed" condition in rats on Vitamin B<sub>6</sub> deficient diets. *Proc. Soc. Exp. Biol. Med.* 45: 717-719.
- NJAA, L.R., F. UTNE and O.R. BRUEKKAN. 1957. Effect of relative humidity on rat breeding and ringtail. *Nature*. 180: 290-291.
- PECKHAM, M.C. 1978a. Posions and toxins. In: *Diseases of Poultry*. M.S. Hofstad (ed.). 7th ed. Iowa State University Press, Ames, Iowa. pp. 895-933.
- . 1978b. Vices and miscellaneous diseases. In: *Diseases of Poultry*. M.S. Hofstad (ed.). 7th ed. Iowa State University Press, Ames, Iowa. pp. 850-851.
- PETRAK, M.L. 1969. *Diseases of Cage and Aviary Birds*. Lea and Febiger. Philadelphia, Pennsylvania. 528 pp.
- SMITH, H.A., T.C. JONES and R.D. HUNT. 1972. *Veterinary Pathology*. Lea and Febiger, Philadelphia, Pennsylvania. 1,521 pp.

- WALLACH, J.D. and G.M. FLEIG. 1969. Frostbite and its sequelae in captive exotic birds. *J. Am. Vet. Med. Assoc.* 155: 1035-1038.
- YATES, V.J., L.T. MILLER, V. JATSY, C.H. WILLEY and M. HOLTZINGER. 1969. Web necrosis in mute swans: a report of an outbreak. *Bull. Wildl. Dis. Assoc.* 5: 33-34.

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