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Case Report—

Mucor ramosissimus Associated with Feather Loss in Canaries (*Serinus canarius*)

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SUMMARY. Three canaries showing feather loss on legs, dorsum, neck, and head, and hyperkeratosis on the feet were sacrificed because of their poor corporal condition and submitted to the Unit of Histology and Anatomic Pathology at the Veterinary School of Las Palmas de Gran Canaria. Histologically, skin revealed pronounced epidermal and follicular infundibular hyperplasia associated with orthokeratotic hyperkeratosis. Numerous fungal spores were observed on the stratum corneum of the epidermis and within feather follicles, associated with destruction of the feathers. This fungus was identified as *Mucor ramosissimus*. To the best of authors' knowledge, this is the first report of dermatitis and feather loss associated with *Mucor ramosissimus*, not only in canaries but also in birds.

RESUMEN. *Reporte de Caso* —Asociación del *Mucor ramosissimus* con la pérdida del plumaje en canarios (*Serinus canarius*). Se sacrificaron tres canarios que mostraban pérdida del plumaje en las patas, dorso, cuello y cabeza, e hiperqueratosis de las patas. Los canarios mostraban muy malas condiciones corporales y fueron enviados a la unidad de Histología y Anatomía Patológica de la Facultad de Medicina Veterinaria de Las Palmas de Gran Canaria, España. Histológicamente, la piel mostró una pronunciada e hiperplasia epidermica y del infundibular folicular asociada con una hiperqueratosis ortoqueratótica. Se observaron numerosas esporas de hongos en el estrato córneo de la epidermis y dentro de los folículos de las plumas, asociados con la destrucción de las plumas. El hongo fue identificado como *Mucor ramosissimus*. Hasta donde los autores conocen, este es el primer reporte de dermatitis y pérdida del plumaje producido por *Mucor ramosissimus*, no sólo en canarios sino en otras aves.

Key words: birds, canaries, skin, *Mucor ramosissimus*, feather loss

Abbreviations: GMS = Grocott methenamine silver stain; H&E = hematoxylin and eosin; PAS = periodic acid-Schiff

Mycotic dermatitis in birds is relatively rare. Sporadic cases have been reported in a number of species such as pigeons, psittacine birds (13), wild turkeys (5), bullfinches, canaries, budgerigars, wild passerine birds, and ostriches (4). The most frequently isolated agents have been pathogenic dermatophytes belonging to the genera *Trichophyton* and *Microsporum*, but *Aspergillus* spp., *Candida* spp., *Mucor* spp., *Rhizopus* spp., *Streptomyces* spp., and others species have also been found on skin and in feather follicles of clinically affected birds. Because symptoms and gross lesions of avian mycosis are fairly nonspecific (i.e., feather loss constitutes a nonspecific clinical sign produced by numerous infectious and noninfectious causes), the diagnosis is usually not established until a histopathologic examination is performed (2).

This report describes dermatitis and feather loss in three canaries (*Serinus canarius*) associated with follicular invasion by *Mucor ramosissimus*, which, to the best of authors' knowledge, is the first report not only in canaries but also in birds.

CASE REPORT

In an aviary of 80 canaries, 12 animals (15%), both young and adult, showed feather loss on legs, extending to the dorsum, neck, and head and hyperkeratosis on the feet (Fig. 1). Skin scrapings and examination of parted feathers were negative for parasites. No other gross lesions were observed. There was no evidence of mechanical damage and feather-picking was ruled out because of feather loss distribution and lack of gross skin damage. Three affected animals were sacrificed because of their poor corporal condition after some days of illness. Samples of affected skin were submitted for bacteriological and mycological culture. The carcasses of the canaries were fixed in 10% buffered formalin and sent to the Department of Comparative Pathology at the Veterinary School of Las Palmas de Gran Canaria. Tissues were embedded in paraffin wax, sectioned at 4 μm, and stained with hematoxylin and eosin (H&E), periodic acid-Schiff (PAS), and Grocott methenamine silver (GMS) stains.

Histopathology. Microscopic examination of the skin revealed pronounced epidermal and follicular infundibular hyperplasia associated with orthokeratotic hyperkeratosis. Numerous round to oval fungal spores were observed on the stratum corneum of the epidermis and within the feather follicles (Fig. 2). In numerous feather follicles, the presence of fungal spores was associated with mononuclear exocitosis and destruction of the feather. These fungal elements were positive for PAS and GMS histochemical techniques (Fig. 3). In the underlying dermis, a discrete mononuclear inflammatory cell infiltration was observed. No significant lesions were observed in other organs.

Microbiology. Skin cultures were carried out on Columbia agar with 5% sheep blood (blood agar), MacConkey agar, and Sabouraud dextrosa agar (Biomerieux, Madrid, Spain) and incubated at 37 C. Bacterial cultures yielded no growth, so gram-positive and gram-negative bacteria were ruled out. A grey colony rapidly grew on Sabouraud dextrose agar. The subcultures on Czapek agar (Remel Laboratories, Lenexa, KS) were incubated for 7 days at 30 C, and examined and identified by microscopic examination with lactophenol cotton blue stain. The sporangiophores were hyaline to light brown colored, globoid shaped, smooth to slightly roughened, short, erect, and sympodially branched. Sporangia were globoid, blackish,

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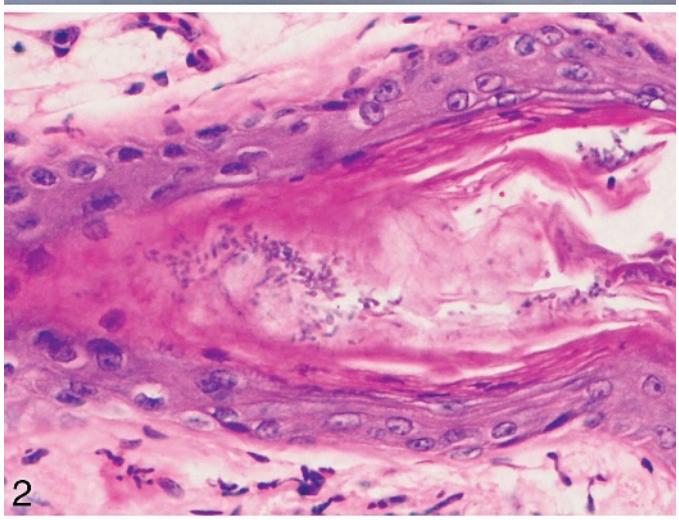

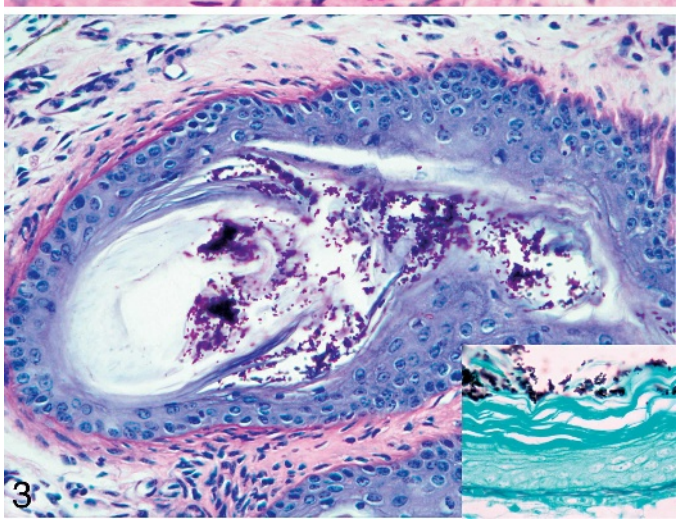

Fig. 1. Affected canary showing feather loss in head, neck, dorsum, and legs.

Fig. 2. Skin of affected bird showing round to oval fungal spores within feather follicle. H&E, 400×.

often intact with walls frequently persistent and with numerous spores. Columellae were smooth, hyaline, and applanate and were not observable in small sporangia. According to these morphologic characteristics, the fungus was identified as *Mucor ramosissimus* (8).

Aviaries were cleaned and disinfected with chlorhexidine digluconate (Hibimax 5%; SSL International PLC, London, England), and the canaries were housed separately in order to prevent overcrowding and treated with ketoconazole (Panfungol; Esteve, Barcelona, Spain) in the drinking water. A few days following the onset of antifungal treatment, the condition of the plumage had markedly improved.

Based on the clinical findings, the histopathologic demonstration of fungus invading the superficial stratum of the epidermis and colonizing the feather follicles, and the identification of the etiologic agent as *Mucor ramosissimus*, a diagnosis of cutaneous zygomycosis in canaries was made.

DISCUSSION

Zygomycosis is a wide term encompassing all mycotic diseases caused by fungi of the class Zygomycetes, which comprises 12 different genera, including the genus *Mucor* (14). Some authors prefer the term mucormycosis, because most of the fungi pathogenic are included in the order Mucorales (14), so zygomycosis and mucormycosis have been used interchangeably despite lack of culture confirmation (11).

In this case, a superficial fungal dermatitis caused by *Mucor ramosissimus* associated with feather loss in canaries is reported. In contrast with zygomycosis in humans, which is well documented, there are only few references to zygomycosis or mucormycosis in birds. Most cases of mucormycosis have been described in chickens, but mucormycosis has also been described in exotic birds such as penguins, African grey parrots, flamingos, Australian parakeets (6), lovebirds (2), Amazon parakeets (3), ducks, and ostriches (12). In canaries, a case of alimentary and disseminated mucormycosis has been described, but the skin was not affected (10). Infections have been reported affecting the gastrointestinal (10) and respiratory tracts (4,10), kidneys, heart (6), liver (10,12), spleen, and skin (12).

Zygomycosis has been reported to cause five clinical forms in humans, namely rhinocerebral, pulmonar, gastrointestinal, cutaneous, and disseminated zygomycosis (9,14). The mode of infection is usually by inhalation or ingestion of spores or by tissue invasion through injured skin (9,12). The most common clinical forms of zygomycosis are frequently devastating processes characterized by fungal vascular invasion resulting in thrombosis and tissue necrosis. If not recognized early in its course and aggressively treated, this disease is frequently fatal (1). The fact that in this case lesions were confined to the skin and no significant lesions were observed in others organs supports the idea of superficial cutaneous invasion.

The frequent exposure to these molds and the relative infrequency of resultant disease indicates that these microorganisms are not primary pathogens (1), but in compromised hosts the Mucorales are capable of causing acute, rapidly developing, and often fulminant infections. Members of the genus *Mucor* are saprophytes ubiquitous

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Fig. 3. Skin of affected bird showing round to oval fungal spores within feather follicle, with destruction of the feather. Fungal elements are positive for PAS technique, 200×. Inset: fungal elements positive for GMS, 400×.

in nature (9). Diseases caused by the Mucorales are designated as ''opportunistic infections.'' They occur mainly in immunocompromised patients (11), but a minority of cases can also be found in immunocompetent patients (9,11). Diabetes, ketoacidosis, neutropenia, immunosuppressive therapy, trauma, malnutrition, and iron overload may represent predisposing factors (14). Although agents affecting the general condition of our animals and their immune status, such as viral infections or nutritional deficiencies, were not demonstrated, these factors cannot be excluded as being the predisposing causes. According to the improvement of the plumage condition following antifungal treatment and the reduction of density of animals in the aviary, overcrowding could be considered as an important predisposing factor in this case, because of stress and effects on the immune status that it causes in birds.

Several fungi have been isolated from feathers of apparently healthy birds (4), but only few cases of feather damage due to mycotic infection, in wild turkeys and a glossy starling, have been reported, and none of them because of Mucorales (5,7). In this case, *M. ramosissimus* was isolated from the skin lesions. Superficial mycoses are normally confined to the keratinized layer of the skin and its appendages. In our three animals, the skin lesions consisted of pronounced epidermal and follicular hyperplasia associated with hyperkeratosis and follicular mononuclear exocitosis. Fungi were restricted to feather follicles with no evidence of dermal invasion. Deep invasion and destruction of feathers would explain the feather loss observed, and given that the lesions observed are according to the previous definition, a diagnosis of superficial mycosis was made. As far as the authors know, no cases of superficial mycosis because of *M. ramosissimus* in birds have been reported before. Thus, the Mucorales in general and *Mucor* spp. in particular should be taken into account in differential diagnosis in birds with superficial dermatitis when immunocompromised conditions, such as stressing factors, could be involved.

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