Diagnosis and Therapeutic Management of Candidiasis

in Falcons in Saudi Arabia

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Abstract: From 1998 to 2001, a total of 3,760 falcons were presented at the Falcon Medical Research Hospital of the Fahad bin Sultan Falcon Center, for clinical examination. From this total, 11 (0.3%) adult (>1 year old) falcons, including eight saker falcons (*Falco cherrug*), two peregrine falcons (*Falco peregrinus*) and one lanner falcon (*Falco biarmicus*) were admitted for treatment of candidiasis. Affected falcons showed general clinical signs including reduced to total absence of appetite, the shredding and flicking of food, regurgitation and progressive weight loss. The diagnosis of clinical candidiasis was made through clinical signs, endoscopy examination of the upper digestive tract, the observation of typical *Candida albicans* blastospores on samples obtained from the crop and by mycology cultures. The primary therapy consisted on the use of a miconazole preparation applied q12h for five consecutive days. Miconazole proved to be an effective, fast and inexpensive antifungal agent suitable for the treatment of candidiasis in captive falcons.
Introduction

Candidiasis is a mycotic disease that affects mucocutaneous areas of the body, but in particular those of the gastrointestinal and genital tracts of animals and humans. The disease is produced by yeasts of the genus Candida. There are over 150 species of Candida, but only Candida albicans is the species most commonly associated with disease in animals. Candida albicans grows as a budding yeast cell, oval in shape and measuring 3.5-6.0 X 6.0-10.0 µm in size, on agar plates and in animal tissues.

In birds candidiasis, also referred to as thrush and moniliasis, is also commonly caused by C. albicans, but other species such as C. parapsilosis, C. krusei and C. tropicalis have also been implicated. C. albicans is an opportunistic yeast that is often found in the digestive tract of birds. In most cases, the infection is endogenous in origin and can be triggered by predisposing factors such as stress, immunosuppression, inadequate nutrition and prolonged antibiotic therapy. It has recently been observed that the disease can also be transmitted through the use of contaminated fomites and utensils used for force feeding and to administer medication (J. H. S., J. L. N., unpublished data, September 2001). C. albicans affects mainly the upper digestive tract of birds, but in particular the oro-pharynx, crop and esophagus.

Candidiasis is a common infection of captive birds of prey. However, this disease is very often misdiagnosed since other disorders affecting the mucosal membrane of the upper digestive tract could present similar clinical and pathological signs. This paper describes the diagnosis and a novel therapeutic management of clinical candidiasis in captive falcons presented at our hospital for treatment.
Material and Methods

From November 1, 1998 to September 1, 2001, a total of 3,760 falcons were presented at the Falcon Medical Research Hospital of the Fahad bin Sultan Falcon Center, Riyadh, Kingdom of Saudi Arabia for clinical examination. From this total, 11 (0.3%) adult (>1 year old) falcons, including eight saker falcons (*Falco cherrug*), two peregrine falcons (*Falco peregrinus*) and one lanner falcon (*Falco biarmicus*) were admitted for treatment of candidiasis. Affected falcons showed general clinical signs including reduced to total absence of appetite, the shredding and flicking of food, regurgitation and progressive weight loss. The falcons were used in the sport of falconry and were under intensive training at the time of admission.

All individuals were anesthetized with isoflurane (Rhône-Poulenc Chemicals Ltd., Avonmouth, Bristol, UK) in oxygen via a facemask and were subjected to a thorough clinical examination. Routine radiographs in the dorso-ventral and lateral positions were obtained using standard techniques. The upper digestive tract, including the oro-pharynx, crop, esophagus, proventriculus and ventriculus, were examined using a 0° 4 mm rigid endoscope (Olympus Keymed, Southern-on-Sea, Essex, UK).

Following endoscopic examination, two microbiology swabs were collected from affected area of the upper digestive tract of each individual. One swab was used to prepare smears, which were subsequently fixed and stained using a quick staining system (Rapid Romanosky Stain Pack, TAAB Laboratories Equipment Ltd, Aldermaston, Berkshire, UK). The smears were then examined at X400 and X1000 using light microscopy. The second swab was used for culturing using plates with a mycology medium (Mycological Agar with Cyclohexamide and Chloramphenicol, Saudi Prepared Media Laboratory Co, Riyadh, Saudi
Arabia) and incubated at 37°C for 24-48 hours. Identification of *C. albicans* was carried out using a commercially available kit (api Candida, bioMérieux sa, Lyon, France).

Individuals affected with candidiasis were admitted into the hospital for treatment. The primary therapy consisted on the use of a miconazole preparation (Daktarin Oral Gel, Janseen-Cilag Ltd, High Wycombe, Buckinghamshire, UK), a topical product widely used to treat vaginal and oral candidiasis in human medicine. The gel was liberally applied into the crop using cotton-tip applicators provided with a long (20 cm) wooden handle, q12h for five consecutive days. Additional treatment included the use of a multivitamin preparation (1 ml/kg IM; Multivitamin, Arnolds Veterinary Products, Harlescott, UK) and a vitamin B12 preparation (0.5 ml/kg IM; Anivit B12, Animalcare, Dunnington, UK). Supportive therapy included force feeding 40-50 ml/kg q12h with a mixture of minced whole quail (40%), minced beef liver (40%), whole egg (18%) and a multivitamin-mineral preparation (2%) (Soluvet, Vetafarm, Wagga Wagga, Australia) via a stomach tube for five days.
Results

At endoscopic examination, all 11 clinical cases showed amorphous diphtheritic membranes, from white-gray to gray-green in color (Fig 1) affecting only the crop. The mucosal membrane of affected areas had a typical “Turkish towel” appearance. It was estimated that in nine cases the diphtheritic membranes might have covered up to 50% of the total surface of the crop, while in the remaining two cases only 10% of the total mucosal surface might have been affected. On external examination, through palpation, these affected areas appeared thicker to the touch.

On light microscopic examination, blastospores of *C. albicans* appeared as thin-walled, oval budding yeast cells measuring 2-3 X 4-6 µm and in the form of elongated pseudohyphae. No significant bacteria could be observed in the stained preparations. After 48 hr of culture, *C. albicans* appeared as shiny and convex round colonies, measuring 3-5 mm in diameter, and pearl white to light cream in color with a characteristic smell of beer. The microorganism was positively identified as *C. albicans* using the api kit (bioMérieux sa).

Clinical candidiasis was successfully treated using the miconazole gel (Janssen-Cilag Ltd) topically. Daily follow up endoscopy examinations of individuals revealed a marked improvement on the appearance of the mucosal membrane as early as 12 hr after the initiation of therapy. All diphtheritic membranes had disappeared after three days of treatment. The inflammatory process of the crop was completely resolved by day fifth of treatment.
Discussion

The establishment of a correct diagnosis of disorders affecting the mucosal membrane of the upper digestive system is of the utmost importance before adequate therapy is instituted. Disorders that have to be taken into consideration in the differential diagnosis of candidiasis include, *Pseudomonas aeruginosa* stomatitis, trichomoniasis, hypovitaminosis A, and capillariosis. *Pseudomonas aeruginosa* stomatitis was recently described in saker falcons in Saudi Arabia. Affected falcons showed small nodular growths (0.5-5.0 mm) or larger amorphous diphtheritic membranes (10-15 mm) white or yellow in color on the oropharynx and tongue. All clinical cases of *P. aeruginosa* related stomatitis had been previously affected with trichomoniasis. The causal microorganism is easily cultured using standard bacteriology techniques. Trichomoniasis is a disorder that affects the upper respiratory and digestive tract of falcons. Falcon affected with this infection showed small to large nodular caseous growths or amorphous diphtheritic membranes pale yellow in color. *Trichomonas gallinae*, the protozoal parasite responsible for trichomoniasis, can easily be identified in wet preparations from thick mucous surrounding the caseous material. Capillariosis produces nodular caseous masses in the oropharynx, crop and esophagus of infected birds of prey. The diagnosis is usually made by identifying typical operculated *Capillaria* species ova in direct smears obtained from the masses. Hypovitaminosis A has been postulated as a cause of stomatitis in birds of prey. However, vitamin A deficiency in captive birds of prey is more often associated with ocular disorders and abnormalities of the integument.
Traditionally, the treatment for candidiasis infections in the upper digestive tract of birds include the use of nystatin (200,000-300,000 units/kg PO q12h for 7-10 days), ketoconazole (10-30 mg/kg PO q12h for 7 days), itraconazole (5-10 mg/kg PO q12h for 7-21 days), and fluconazole (2-5 mg/kg PO q24h for 7 days). The latter is being postulated as the most effective antifungal agent for the treatment of tissue-based yeast infections in birds. Nystatin (1 ml of a 100,000 units/kg), has also been used applied directly onto the mucosal membranes of the mouth of raptors (P. T. Redig, written communication, September 2001). The use of miconazole gel, as suggested in this paper, for the treatment of upper digestive tract candidiasis infections in falcons may prove useful for similar cases in other avian species.

It can be concluded that the differential diagnosis of disorders affecting the mucosal membrane of the upper digestive tract in birds is essential before a therapeutic management can be implemented. Miconazole proved to be an effective, fast and inexpensive antifungal agent suitable for the treatment of candidiasis in captive falcons.
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Figure legends

Fig. 1.- Endoscopic view of the crop of a saker falcon (*Falco cherrug*) affected with clinical candidiasis. The bird was presented with a history of reduced appetite, regurgitation and progressive weight loss. Note the gray-green "Turkish towel" appearance of the mucosal membrane.