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Case Report

Osteochondromatosis in lovebirds *(Agapornis fischeri)*

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Abstract

The present work describes the radiographic and anatomopathological findings of osteochondromatosis in the skeleton of a female lovebird (*Agapornis fischeri*), approximately three years old, with a history of apathy, difficulty in breathing and feeding, and inability to fly. Macroscopically, expansive multinodular enlargements of varying sizes and degrees of hardness were observed in the sternum, skull, right radiocarpal joint, ulna, humerus, ribs, and vertebrae. On post-mortem radiographic examination, the nodules showed varying degrees of radiopacity. Microscopically, the neoplastic nodules were almost always located on the cortical surface of the affected bones and were composed of a layer of chondrocytes in different phases of differentiation, predominantly hypertrophic and well differentiated. Adjacent to the neoplastic cartilaginous tissue was the osteoid matrix or mature, mineralized trabecular bone tissue formed by endochondral ossification. Within the neoplasm, hematopoietic tissue and adipose tissue were observed among the trabecular bone tissue. Based on radiographic, macro, and microscopic characteristics, the diagnosis of osteochondromatosis was made.

Keywords: avian, bone neoplasms, captive birds, osteochondroma.

Introduction

Osteochondroma is a benign primary bone neoplasm surrounded by a layer of hyaline cartilage that arises from the surface of a bone formed by endochondral ossification (21). Osteochondromas can develop in single or multiple forms. In the single form, there is monostotic development, that is, tumor growth in just one bone, classified as solitary osteochondroma. In the multiple form, there is polyostotic development where multiple bones are affected, classified as osteochondromatosis or multiple cartilaginous exostosis (21). In domestic animal species, there is no breed predisposition or sex predilection (1, 23).

The etiopathogenesis of the disease is unknown, but the neoplasm can develop in any bone that is formed by endochondral ossification from its physis or subarticular cartilage (13). However, the presence of osteochondromas in intramembranous ossified bones, such as the skull, has already been described in humans (9), cats (5), and white-tailed deer (24).

Although osteochondromatosis has already been described in several species, including humans (17), horses (19), canines (13), rodents (14), and felines (7), reports of the disease in birds are rare (6,10). To the authors' knowledge, there is only one case described in lovebirds with involvement of several bones, all arising from endochondral ossification (6). Therefore, the aim of this report is to describe the radiographic, macroscopic, and microscopic characteristics of a rare case of osteochondromatosis in lovebirds (*Agapornis fischeri*) with involvement of bones arising from the endochondral and intramembranous ossification processes.

Case description

A female lovebird (*Agapornis fischeri*), approximately three years old, was sent to the Pathology Department of the Escola de Veterinária, Universidade Federal de Minas Gerais, Belo Horizonte, MG, Brazil, for necropsy examination. The animal lived with 11 other lovebirds in a large aviary where it was possible to move around widely and take flights. The food consisted of a seed mix for parrots. In March 2023, the bird did not lay eggs as it usually did and began to show apathetic behavior, remaining in the nest for longer periods, with breathing and feeding difficulties, and an inability to fly.

On clinical examination, several swellings were observed in the bones of the limbs, sternum, and skull. On radiographic examination, in addition to the nodules previously observed during the physical examination, radiopaque nodules were also diagnosed on the ribs and vertebrae. Gabapentin (10 mg/mL) and enrofloxacin oral suspension (25 mg/mL) were prescribed, in addition to a vitamin supplement. There was a slight improvement in apathy, but the bird did not regain its ability to fly, remained in respiratory distress, and ultimately died.

At necropsy, white, well-defined, hard nodules were visualized, ranging from a few millimeters to 0.3 cm in diameter in the right radiocarpal joint, middle third of the left ulna, distal region of the right humerus, middle and distal thirds of the ribs, in addition to cervical vertebrae C6 and C7, thoracic vertebrae T3 and T6, and lumbar L1 (Fig. 1A). A nodule with the same characteristics was visualized in the skull, in the center of the parietal bone (Fig. 1B and C), compressing the brain. In the sternum, there was a significant increase in volume, with an expansive, irregular, hard growth and a multinodular appearance that projected toward the keel, compromising its anatomical shape and concavity (Fig. 1D).

The skeleton was dissected, and post-mortem radiographic examination was performed. All volume increases observed in the skeleton showed variable radiopacity, depending on the affected bone site (Fig. 2). The skeleton and soft tissue samples were fixed in 10% neutral buffered formalin, decalcified in 10% EDTA solution, and processed by the routine paraffin embedding technique. 4µm histological sections were stained with hematoxylin and eosin (HE) for microscopic analysis.

Microscopically, neoplastic proliferations were observed most often on the cortical surface of the affected bones. The neoplasms were expansive, encapsulated, and well-defined. The proliferation was delimited by a connective tissue capsule, and underlying the capsule was a thick layer of well-differentiated and hypertrophic chondrocytes that were irregularly arranged. Over this cartilaginous tissue, there was a large amount of osteoid matrix or trabeculae of mature and mineralized bone tissue formed from endochondral ossification. In the neoplasia, the mature trabecular bone tissue presented gaps with central osteocytes, and between the bone trabeculae, there was hematopoietic and adipose tissue (Fig. 3 and 4). The amount of bone and cartilaginous tissue inside the neoplasms varied depending on the location, with some nodules being more ossified. Based on radiographic, macro, and microscopic characteristics, the diagnosis of osteochondromatosis was made.

Figure 1. Macroscopic appearance of osteochondromatosis in *Agapornis fischeri*. A- Multiple neoplastic bone formations (osteochondroma) located in the right radiocarpal joint, in the middle third of the left radius and ulna, and in the right and left ribs and cervical vertebrae (arrows). B- Neoplastic formation in the skull (arrow), lateral view. C- Neoplastic formation in the skull (arrow), dorsal view. D) Neoplastic formation on the sternum, right lateral view (arrow).

Discussion

Primary bone tumors in birds are rare (4, 18), with osteosarcoma and chondroma being the most diagnosed (4), followed by osteoma and chondrosarcoma (4, 22). To the authors' knowledge, only two cases of osteochondroma and osteochondromatosis in birds have been described, the first being of extra-skeletal origin (6,10). However, this appears to be the first report of osteochondromatosis in lovebirds with

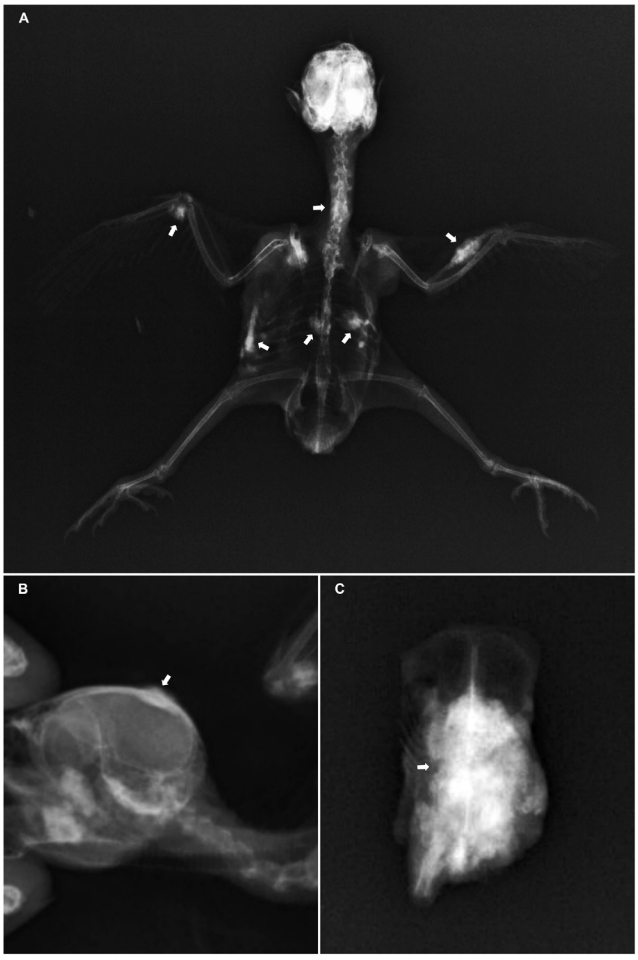

Figure 2. Radiographic appearance of osteochondromatosis in *Agapornis fischeri*. A- Ventrodorsal projection, showing multiple radiopaque bone neoformations with imprecise limits, located in the right radiocarpal joint, the middle third of the left radius and ulna, the right and left ribs and cervical and lumbar vertebrae (arrows). B- Left laterolateral projection, showing radiopaque neoplastic neoformation in the skull (arrow). C- Ventrodorsal projection of the sternum, showing a marked increase in radiopacity (arrow).

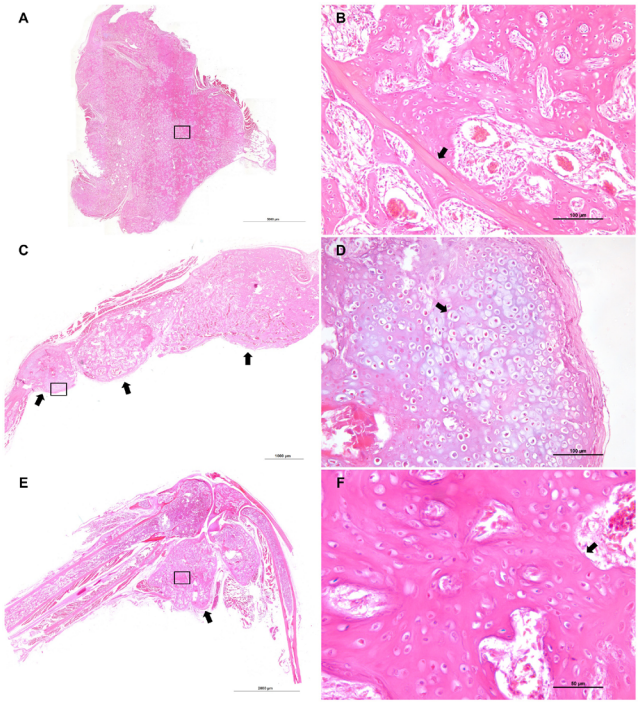

Figure 3. Microscopic appearance of osteochondromatosis in *Agapornis fischeri*. A- Fragment of the sternum showing well-differentiated and expansive new bone formation. (HE, bar = 5 mm). B- Enlargement of the region shown in A, demonstrating neoplastic bone formation from the periosteum, with maintenance of pre-existing bone tissue (arrow). (HE, bar = 100 µm). C- Rib fragment showing multinodular, well-differentiated and expansive bone formation (arrows). (HE, bar = 1 mm). D- Enlargement of the area shown in C, demonstrating an external layer of well-differentiated cartilaginous tissue (arrow). (HE, bar = 100 µm). E- Fragment of the radiocarpal joint region showing well-differentiated and expansive bone formation (arrow). (HE, bar = 2 mm). F- Enlargement of the area shown in E, showing thick and confluent bone trabeculae (arrow). (HE, bar = 50 µm).

involvement not only of the bones arising from endochondral ossification but also with involvement of the skull, of intramembranous origin.

The etiopathogenesis of osteochondroma/osteochondromatosis is unknown; however, some hypotheses are suggested based on the similarity between the cartilaginous layer of the osteochondroma and the growth cartilage of the bone. In cats, the disease appears to be related to feline leukemia virus infections. In humans, dogs, and horses, the polyostotic form of the disease has an autosomal dominant hereditary nature (2). In humans, this form is the result of mutations in the *EXT1* and *EXT2* genes that lead to a decrease in heparan sulfate, resulting in increased responsiveness to bone morphogenetic proteins and subsequent excessive chondrogenesis in the perichondrial ring (8). It is known that the avian leukosis/sarcoma virus (ALSV) is associated with sarcomas in chickens, including chondromas, osteomas, and osteosarcomas (15); however, no inference is made about the involvement of this virus in osteochondroma.

It is believed that the creation and maintenance of parrots in captivity, as companion animals, may predispose them to a greater occurrence of neoplasms due to factors such as inbreeding, exposure to carcinogenic agents, infectious diseases, mainly viral, inadequate dietary management, and greater longevity than in free life (11).

The bird in this report was the only one on the farm to present the disease, and the fact that it was diagnosed in adulthood suggests slow tumor growth, different from what has been observed in mammals, whose manifestation is more frequent in childhood before the closure of the epiphyseal plates (13). Furthermore, some osteochondromas present

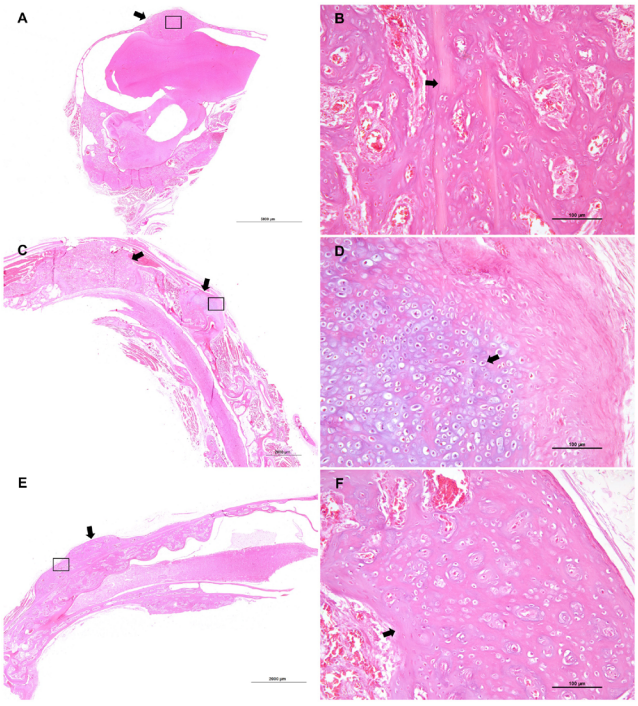

Figure 4. Microscopic appearance of osteochondromatosis in *Agapornis fischeri*. A- Skull fragment showing expansive new bone formation (arrow). (HE, bar = 5 mm). B- Enlargement of the region shown in A, demonstrating neoplastic bone formation from the periosteum, with maintenance of pre-existing bone tissue (arrow). (HE, bar = 100 µm). C- Fragment of cervical vertebrae showing multinodular, well-differentiated and expansive new bone formation (arrows). (HE, bar = 2 mm). D- Enlargement of the area shown in C, demonstrating an area of well-differentiated cartilaginous tissue (arrow). (HE, bar = 100 µm). E- Fragment of lumbar vertebrae showing multinodular, well-differentiated and expansive bone formation (arrow). (HE, bar = 2 mm). F- Enlargement of the area shown in E, showing thick and confluent bone trabeculae (arrow). (HE, bar = 100 µm).

in the bird were more ossified compared to others. In some nodules, there were only remnants of cartilaginous tissue. This occurs because, in the tumor expansion phase, the lesion is made up of a layer of external hyaline cartilage similar to a growth plate but without the same organization, and adjacent there are bone trabeculae that are formed by endochondral ossification, similar to what was observed in some nodules. However, in maturing lesions, the cartilaginous tissue between the bone tissue is less evident due to the ossification process, and in some cases, the nodule may be completely ossified (21).

The sites most affected by osteochondroma in dogs and horses are the metaphyses of long bones, ribs, scapulae, vertebrae, and pelvic bone (12, 16, 20), with reports of trachea involvement in dogs (2). Osteochondromas in the skull have only been reported in humans (9), cats (5), and white-tailed deer (24). In birds, the wing is reported to be the site most affected by primary bone tumors in general (6, 10, 21), with the skull being the second most common site. The vertebrae, sternum, and ribs are uncommon locations (6, 10).

However, with regard to osteochondroma, this appears to be the first report in a bird where the skull is affected. Although osteochondromatosis, in many cases, is not clinically important, the location of the lesion can mechanically interfere with the action of tendons and ligaments, and when located in the vertebrae and skull, it can compress the spinal cord or brain (3). Therefore, clinical signs depend on the location and size of the tumor. The respiratory and feeding difficulties observed in the lovebird may have occurred due to the increase in neoplastic volume in the sternum region, compromising thoracic expansion, and due to the nodule in the cervical vertebra, in addition to the difficulty in flying, which probably occurred due to the involvement of the wing bones. Despite being a rare neoplasm in birds, osteochondroma should be included in the differential diagnoses of primary bone neoplasms, especially in captive birds.

Conflict of Interest

The authors declare no competing interests.

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