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PARTIAL ADACTYLY AND TOTAL POSTAXIAL ULNAR HEMIMELIA IN A DOG

UN CAZ DE ADACTILIE PARȚIALĂ ȘI HEMIMELIE ULNARĂ TOTALĂ POSTAXIALĂ LA CÂINE

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ABSTRACT | REZUMAT

We describe multiple congenital malformations in a 6-month-old male mixed-breed dog that presented with neurological signs and limb deformity. The left forelimb was shorter and smaller than the right, characterised by partial adactyly and postaxial ulnar hemimelia, a combination that has not been reported previously in the dog, to our knowledge. Radiographic, pathological, and anatomical findings illustrate other osseous, muscle, and brain malformations, emphasising the scarcity of reported cases with this combination. The study introduces a novel case and underscores the need for further research on the causes and implications of these unique congenital malformations in canines.

Keywords: canine, developmental anomalies, limb malformation, ulna, digits

Prezentul caz descrie multiple malformații congenitale la un câine mascul, rasă mixtă, cu vârsta de 6 luni care a prezentat semne neurologice și deformare a membrelor. Membrul toracic stâng a fost mai scurt și subdezvoltat fata de cel drept, caracterizat prin adactilie parțială și hemimelie cubitală/ulnară postaxială, o combinație care din cunoștințele noastre nu a fost raportată anterior la câine. Constatările radiografice, patologice și anatomice ilustrează alte malformații osoase, musculare și cerebrale, subliniind raritatea cazurilor raportate cu această combinație. Studiul introduce un caz nou și subliniază necesitatea unor cercetări suplimentare asupra cauzelor și implicațiilor acestor malformații congenitale unice la canide.

Cuvinte cheie: canide, anomalii de dezvoltare, malformații ale membrelor, ulna, degete

Congenital malformations of the distal end of the thoracic limb are not often described in veterinary medicine. Terms such as ectrodactyly, adactyly, syndactyly, and brachydactyly define the most common malformations reported to date (7, 6). Congenital skeletal deformities or dysostoses are reported in dogs, characterised as aberrant development of some bones or unusual development of a bony segment (8).

Ectrodactyly is described as an uncommon bone congenital malformation, reported in dogs and cats. The lobster claw, hypodactyly, and oligodactyly are other terms with the same meaning. This term describes the presence of a soft tissue and boney split, located at the level of the metacarpal bones and between the antebrachial bones. Also, carpal deformities have been reported (10). Ectrodactyly has been reported in pure breed dogs such as the West Highland White Terrier, Cocker Spaniel, Irish Setter, Labrador Retriever, toy poodle, Siberian Husky, Kangal, and German Shepherd (26) as well as in mixed breeds (2).

Adactyly is a congenital malformation representing a total absence of the toes (18). The same congenital malformation has been reported in literature as terminal transverse hemimelia (18).

Syndactyly can be described as a congenital malformation of the distal end of a limb that involves an abnormal interconnection between neighbouring digits (21).

In veterinary medicine, the term brachydactyly is used as a general term that describes the shortening of the digits. More specific diagnostic terms such as brachyphalangia (short phalanges), brachymetacarpalia (short metacarpal bones), and brachymetatarsia (short metatarsal bones) have all been reported previously (7, 11, 27). Hemimelia is a congenital malformation characterised by the total or partial lack of one or more bones (28, 17). This report describes and enriches the limb malformation terminologies and literature in dogs and in veterinary medicine.

MATERIALS AND METHODS

Case history

A 5.6 kg, approximately 6-month-old male intact mixed breed dog was presented to the Ross University Veterinary Clinic (RUVC) for unwillingness to move and failure to thrive. The dog was rescued as a stray 24 hours prior due to its condition and had an otherwise unknown history.

RESULTS AND DISCUSSION

Clinical examination

On presentation, the dog's vital signs were all within normal range with a temperature of 38.4ºC (101.2ºF) (RR 37º-39ºC), a heart rate of 104 beats/minute (RR 80-120 beats/min) and the dog was pan-

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ting. On clinical examination, the dog appeared obtunded and could not stand or ambulate on its own.

A neurological exam was performed, and the cranial nerves appeared intact. A direct ophthalmic exam was performed, and retinal haemorrhage was suspected. The dog's conscious proprioception, although present, was sluggish and delayed in all four limbs. A left forelimb deformity was apparent, and the limb appeared grossly smaller and shorter with less muscle mass than the right forelimb. Due to the condition of the dog and the unknown cause for the neurologic abnormalities, euthanasia was elected, and an autopsy was conducted.

Autopsy results

The external examination revealed mild post-mortem decomposition (following a period of refrigeration post-euthanasia) and a low body condition score (2/5). The left thoracic limb was approximately 20-25% shorter than the right one (micromelia), with smaller visible muscle mass (Fig. 1).

Fig. 1. Gross appearance of smaller, shorter, and deformed left forelimb with reduced muscle mass, compared to right forelimb

Grossly,the bones identified were scapula, humerus, and radius (presumed) with absence of ulna. The distal part of the leg appeared to have some carpal bones, one metacarpal bone, and one digit ending with a claw. The rest of the bones of the distal limb appeared absent. The upper jaw appeared shorter, resulting in an underbite, with some incisor deciduous teeth still present while some permanent incisors were erupted. A larger left temporal muscle (compared with the contralateral muscle) was also observed. Generalised lymphadenopathy and bilateral symmetrical hydrocephalus at the level of the lateral ventricles were observed.

Radiological results

The radiographic investigations, which were performed post-mortem, revealed that the left thoracic limb showed osseous malformations at the level of the distal third of the humeral bone.

including at the level of the humeral trochlea and capitulum (Fig. 2). In the same area, the ulnar bone was observed to be absent. Due to the ulnar absence, subluxation of the elbow joint was observed. The carpal region revealed the existence of two carpal bones. In the manus area, one metacarpal bone and three phalanges were observed.

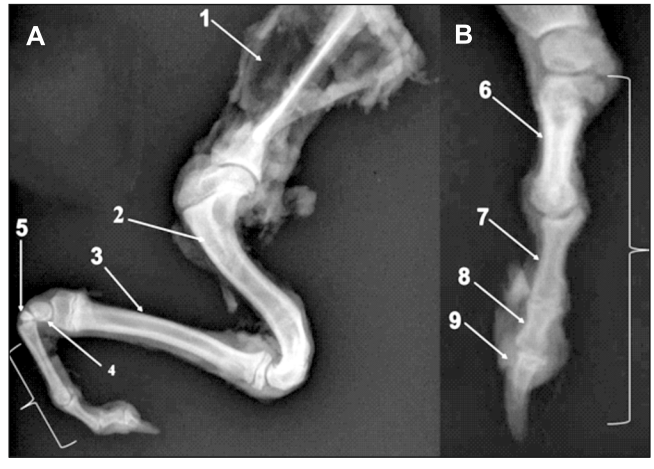

Fig. 2. A. Lateral radiograph of the left thoracic limb 1. Scapula, 2. Humerus, 3. Radius, 4. Proximal carpal bone, 5. Distal carpal bone.
B. Dorsoventral radiograph of the distal part of the left thoracic limb. 6. Metacarpal bone, 7. First phalanx, 8. Middle phalanx 9. Distal phalanx

Anatomical report

Skin and muscles were dissected from both thoracic limbs (Fig. 3), and morphological investigation revealed that the left scapula was smaller than the right, and on the lateral surface of the scapula, the ratio between the supraspinous fossa and the infraspinous fossa was approximately 2:1. The left humerus showed a cranial curved distal extremity, thus resulting in an "S-like" shape of the humerus of the affected limb. The left ulna was absent, which led to an abnormal insertion of the triceps muscle. Two bones were present in the carpal region. The proximal bone was well developed and in contact with the distal aspect of the radius, and the distal bone was smaller and in contact with the metacarpal bone. We could not identify the carpal canal due to the absence of the accessory carpal bone. The manus region showed only one well-developed metacarpal bone. According to the location and the aspect, in our opinion, this appeared to be the third metacarpal bone (MC III). Also, the proximal, middle, and distal phalanges of the third digit were present and well developed.

Discussion

The embryological development of the thoracic limb in the dog occurs with the thoracic limb-bud and starts on day 23, during week 4 of gestation. On day 35 of ge-

station, the forelimb joints become visible with well-constructed digits and well-developed claws (9, 8).

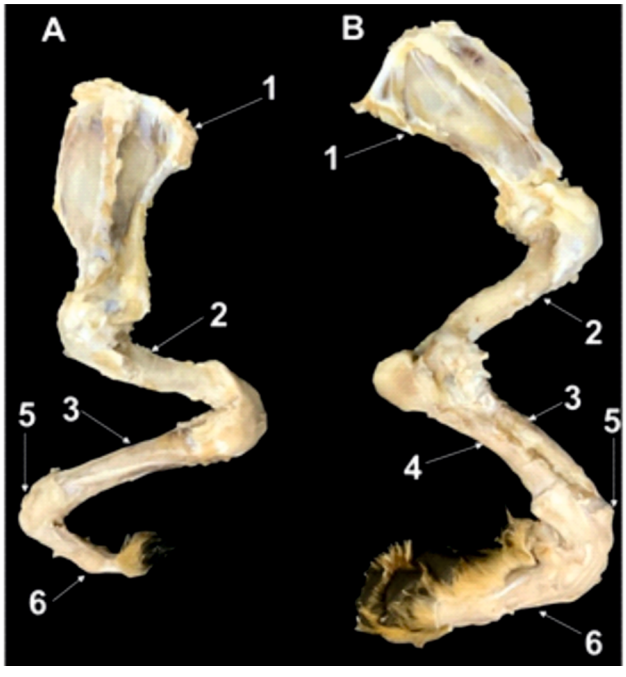

Fig. 3. Macroscopic aspects of the left (A) and right (B) forelimb. 1.Scapula, 2. Humerus, 3. Radius, 4. Right ulna, 5. Carpal region, 6. Digits region

After data corroboration, we can say that this dog had two significant congenital malformations: partial adactyly and postaxial ulnar hemimelia. The classification of osseus congenital malformations is difficult to define. The most important resource for this area is the Nomina Embryologica Veterinaria which allows us to identify and classify the congenital malformations in the veterinary field (8).

We retrieved no cases of partial adactyly and ulnar hemimelia on the same limb in the dog in a search of Google, PubMed, CAB Direct, Web of Science, and Scopus, using the search terms "canine ulnar hemimelia" and "canine partial adactyly", suggesting that this condition has not been reported in dogs. According to other studies, the adactyly is an osseous congenital malformation reported in both humans and animals. Although, this congenital malformation was reported more often in carnivora species (5,3, 18, 24), other species like horses, camels, donkeys, and sheep have also been shown to be affected (15, 14, 12).

The causes of these types of anomalies are not clearly understood. Causes like gene mutations, chemotherapeutics, corticosteroids administration, lack of vitamin B2 (riboflavin), transplacental viral infections, and radiographical exposures are very often reported (22).

This case of total postaxial ulnar hemimelia is the first reported case in dogs to the authors' knowledge. In the literature, Di Pietro (2021) described a case of partial postaxial ulnar hemimelia in one dog (23).

The most common cases of hemimelia involved the absence of the radius bone. This type of malformation was reported in dogs (1, 19), cats (16), polar bears (13), rabbits (29), goats (4), and monkeys (25).

The aetiology of postaxial ulnar hemimelia or paraxial radial hemimelia is not very well known, but a few common causes have been hypothesised: traumatic factors that involve the mother's embryo or the placenta, inbreeding, or irradiations. Also, some drugs like tetracycline, griseofulvin, and some vaccines administered during gestation can lead to these types of malformations. Other reported data suggests the heritability of radial hemimelia in Chihuahuas, and Siamese and domestic shorthair cats (20). Similar to our results, in radial hemimelia, malformations of carpal and digital bones were reported (29). The animal in our case was a stray dog that was rescued by a good Samaritan and ultimately euthanised with little knowledge of its past prior to the 24 hours before presentation. Limited historical information relating to this dog's foetal and parturition conditions and environmental exposures makes the cause of these malformations impossible to be determined.

CONCLUSIONS

The present case presents a novel and unique presentation of total postaxial ulnar hemimelia in a dog. Although unclear as to the cause of the malformations, this case represents a valuable addition to the literature and nomenclature in being the first of its kind presented to researchers and practitioners. More information and research are needed about these specific malformations to hypothesise possible causes.

Data Sharing and Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Conflict of Interest Statement

The authors declare no conflicts of interest.

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