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Case report

CLINICAL USE OF 3D COMPUTED TOMOGRAPHY IN DIAGNOSIS AND THERAPY OF TAIL NECROSIS IN A BALL PYTHON (*PYTHON REGIUS*)

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Summary

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The main musculoskeletal diseases in reptiles diagnosed through computed tomography (CT) are vertebral malformations and disorders. This diagnostic imaging technique is crucial for the outcome and prognosis of applied treatment. The presented clinical case describes the diagnosis, surgical treatment and antibacterial therapy of traumatic tail necrosis in a ball python (*Python regius*), referred to the Small Animal Clinic of the University Veterinary Hospital, Stara Zagora, Bulgaria. Osteolytic and osteosclerotic changes in coccygeal vertebrae were visualised by radiography and computed tomography. The surgical treatment comprised amputation, whose performance depended on three-dimensional CT reconstruction.

Key words: 3D CT, amputation, ball python, tail

In reptiles, the tail is an important anatomical structure, extension of the vertebral column. Its main functions consist in maintaining balance, social signalling, defense against predators, communication and interaction between two adult snakes, reproduction, role in swimming etc. (Zwart & Gröne, 2006). The deformities of coccygeal vertebrae may be due to congenital defects, trauma or infectious agents (Mader, 2006). Diagnostic imaging, in particular radiography and computed tomography, is a main diagnostic approach to these disorders (Di Girolamo *et al.*, 2014). Radiography is commonly used in clinical practice, whereas the application of conventional computed tomography has several limitations, including patient size (it is challenging to set the linear attenuation coefficient of each patient because of the great variability of size), patient movements causing streak artifacts and consequently, reduction of the image quality, animal specific anatomical features and last but not least, the cost of examination (Greco *et al.*, 2022).

The skeletal system of reptiles is less mineralised compared to mammalian skeleton (Zotti *et al.*, 2004), which requires correction of technical parameters of CT. Nevertheless, CT is used for diagnosis and monitoring of some skeletal diseases: fractures (Rahal *et al.*, 2011), luxations, arthritis, and bone inflammations (Pees, 2010).

The advantage of examination with modern multisectional CT scanners is the production of quality multiplanar and 3D reconstructions of the patient over a very short time period. Three-dimensional CT reconstruction is a valuable procedure, which is infrequently applied in veterinary medicine. The data collection requires multiple parallel thin sections, which are all obtained at the same gantry tilt. A significant advantage is the visualisation of the image in three dimensions. A properly selected convolution algorithm intensifies the reconstructed 3D image and improves image quality (Seeram, 2015).

At present, existing literature data are often limited to few reptile species with emphasis rather on radiography and ultrasonography than on computed tomography. The aim of the described case report was to complete existing knowledge in the field of CT diagnostics of skeletal diseases in snakes.

CASE DESCRIPTION

Patient's signalment and history

An eight year old male ball python (*Python regius*) weighing 32 kg was brought to the Small Animal Clinic at the Faculty of Veterinary Medicine, Stara Zagora, Bulgaria. The snake was kept as a single animal in a terrarium at Circus "Arlekino". The patient's diet included raw meat (rabbit), powdered with a calcium supplement.

The reason for the visit was a trauma. Two months prior to presentation the tail of the snake was crushed by a door but subsequently, no treatment was prescribed. As a result, the distal end of the tail began drying. A few days before reception, the python was treated with amikacin.

Evaluation and clinical findings

The mentation, respiration, and locomotion of this python were normal. The eyes were clear with no discharge. The nares were clear, free of discharge and retained shed. The oral cavity was normal. The mucous membranes were pale to pink and free of thick, ropey mucus. The glottis was free of discharge. The integument was normal excepted for the affected area. The epaxial muscle was well developed.

Fig. 1. Tail necrosis in a ball python (*Python regius*), referred to the Small Animal Clinic of the University Veterinary Hospital, Stara Zagora, Bulgaria.

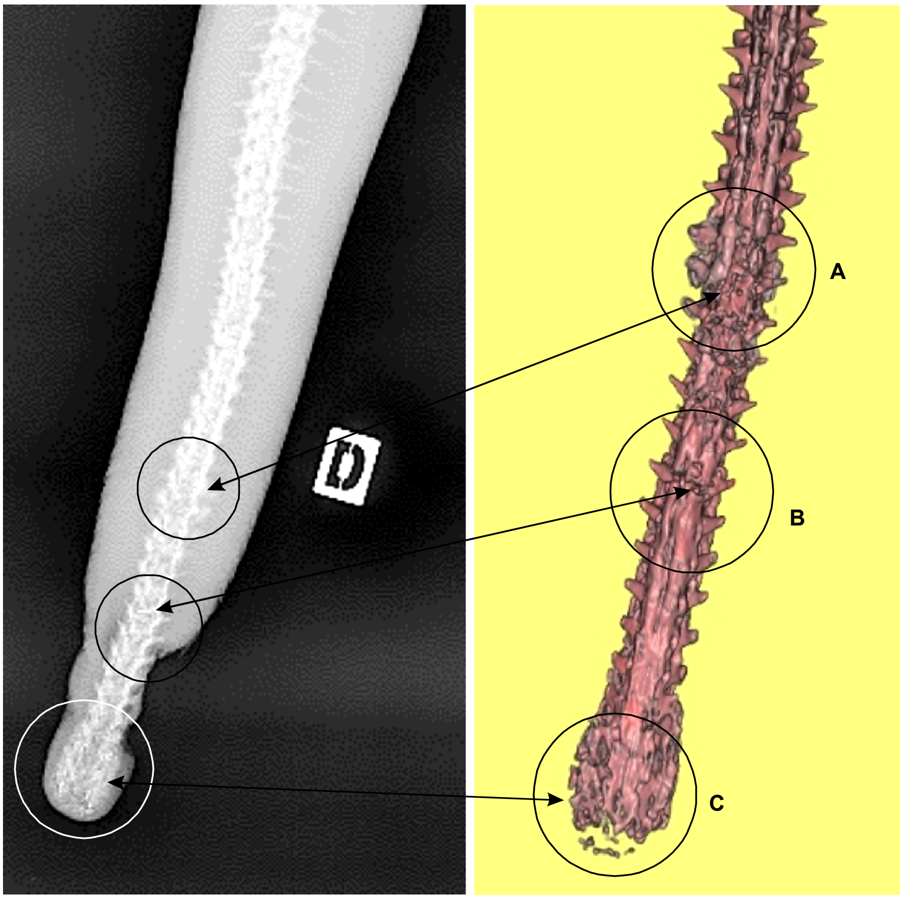

Fig. 2. Comparison of radiographic and 3D reconstructed computed tomographic views and pathological areas of the vertebral column – osteolysis (A), fracture (B), and new bone formation (C).

The inspection revealed absence of the caudal part of the tail, local tissue deformities along the entire anatomical region (sunken areas) (Fig. 1) and dry skin lesions of darker colour than normal. The affected area become inflexible, hard, dull, and brittle. Palpation showed no pain in aforementioned areas and irregularly distributed local skin temperature (lower in necrotic areas). The length of the changed area was about 15 cm.

Radiography

After the physical examination, radiographs of the patient were performed in lateral and dorsoventral views with a PHILIPS SUPER 50 CP-D (Hamburg, Germany) X-ray equipment and exposure data 50 kV and 10 mAs. Radiographic images were processed with iQ-VIEW/PRO version 2.7.0 INT EN003R software.

Lateral and dorsoventral views of the tail revealed areas of osteolysis and osteosclerosis with unclear margins on coccygeal and more cranial vertebrae (Fig. 2). The observed radiographic signs in reptiles are compatible with vertebral osteopathy, osteomyelitis, neoplastic and traumatic processes.

Computed tomography

CT scans were done with Fidex Animage 3825 Hopyard Road, Pleasanton, California 94588.925.416.1900 (Fig. 3) scanner with the following parameters: 110.0 kV, 0.08 mAs, 0.16 mm. Three-dimensional images for evaluation of coccygeal vertebrae content were reconstructed via the ANIMAGE (Animage, LLC, California, USA) software.

In snakes, crocodiles and large lizards, the scanning is on separate areas of the body. For tomography of the tail, it may be necessary to change the position of the patient on the table of the apparatus and conduct the scan in the posterior-anterior direction (from caudal to cranial part of the body).

The reconstructed 3D scans of the ball python tail demonstrated clearly differentiated areas of vertebral bone destruction and new bone formation. In caudal areas, osteosclerosis dominated over osteolysis. Fusion of adjacent vertebrae was also observed (Fig. 3).

Anaesthesia

Premedication was performed by intramuscular injection of tiletamine/zolazepam (Zoletil 50 mg/mL, 3 mg/kg, Virbac Santé Animale). For induction of anaesthesia, 3 vol% isoflurane and 2.5 L/min oxygen were delivered via an anaesthetic mask. Following intubation (endotracheal tube, uncuffed, 3 mm, Helmed, Bulgaria), the patient was maintained with 2 vol% isoflurane and 2.5 L/min oxygen with intermittent positive-pressure ventilation at a rate of three breaths/min.

Surgical distal tail amputation

In the operation room, the patient was placed on a warming pad (Temperature Controlled Heating Pad) for maintaining optimum body temperature, covered with

Fig. 3. Posterior-anterior computed tomography scanning of the ball python tail.

sterile cotton surgical drapes. After positioning in ventral recumbency, the tail was wiped twice with povidone-iodine. The operating field was isolated with polyethylene surgical drape. The affected part of the tail was isolated by an elastic bandage.

Symmetric arcuate incisions of the skin were made on the dorsal and ventral aspect, 3–4 cm cranially of the necrotic border end. The skin incision was made distal enough to allow for tension-free wound closure following amputation, but at the same time was proximal enough to avoid incomplete excision of diseased tissue. The soft tissue and bone were transected between vertebrae. Absorbable gelatin sponge was used for hemostasis (Surgispone, Aegis Lifesciences, India) (Fig. 4). Muscles were closed covering the last vertebra by means of single interrupted 3-0 absorbable polyfilament sutures (PGA) (DemeSORB ™, DemeTECH Corporation, Miami Lakes DR, USA).

Fig. 4. Definitive haemostasis after tail amputation by means of sterile gelatin haemostatic sponge.

Absorbable suture material (PGA) 2-0 (DemeSORB ™, DemeTECH Co., Miami Lakes DR, USA) and horizontal mattress sutures were used to close the skin edges (Fig. 5). The amputation site was bandaged for the first few days following surgery.

Fig. 5. Closure of skin edges with absorbable polyfilament horizontal mattress sutures.

Post operative period

Post operative antibacterial therapy consisted of intramuscular injection of 5 mg/kg/day enrofloxacin (Baytril, Bayer Healthcare LLC, Animal Health Division, Shawnee Mission, KS) administered over 7 days. At the same time, 10% povidone-iodine solution (Iodseptadon, Himax Farma Ltd, Sofia, Bulgaria) was locally applied to the incision site. Post operative analgesia included i.m. injection of meloxicam (Meloxidolor 5 mg/mL, Le Vet Beheer B.V., Netherlands) at 0.2 mg/kg/48 h (four applications in total).

Five weeks after the tail amputation the wound surface was significantly reduced (Fig. 6).

In reptiles, tail amputation should be done in all cases of traumatic injury with affection of coccygeal vertebrae, as well

Fig. 6. The amputation area five weeks following the surgical intervention.

as in burns, bites by rodents, mechanical injuries, vasoconstriction of cutaneous blood vessels, recurrent abscesses, tumours and pseudotumours (Alworth *et al.*, 2011). All pathologically altered areas should be removed. For their visualisation, computed tomography is the most accurate technique.

The application of computed tomography in veterinary practice is indicated for patients with thoracic and abdominal diseases, intra- and extracranial lesions and musculoskeletal affections of the appendicular skeleton and the vertebral column (da Costa & Samii, 2010; Ballegeer, 2016). Diseases of the skeletal system in reptiles diagnosed by CT include spine malformations and diseases, metabolic bone diseases, shell fractures in turtles, and abscesses of the limbs or head (Silverman, 2006). CT may be used for visualisation not only of major changes in bone structures, but also for identification of micro fractures and limited bone architecture abnormalities (Keane *et al.*, 2017). Furthermore, compared with conventional radiography, the digital image format of CT results in improved tissue contrast. Manipulation of the grayscale permits optimum visualisation of all tissues within the slice. Last-generation CT equipment gives fast imaging acquisition, body sections from different tomographic planes, fair anatomic resolution without superimposition, and excellent tissue-like differentiation (Banzato *et al.*, 2012; Arencibia *et al.*, 2021). The elimination of scales and soft tissues in this case facilitated the differentiation of the changes in the tail vertebrae.

Three-dimensional CT reconstruction techniques are of particular diagnostic value in fibrous osteodystrophy, fractures or osteolysis of the skeleton, skull and shell (Wyneken, 2014). This procedure can image the surface of bony structures with different degrees of rotation without the superimposition of soft tissues (Jaber *et al.,* 2018; Arencibia *et al.*, 2020). In this study, detailed diagnosis of traumatic vertebral injuries in snakes was achieved by three-dimensional reconstruction of the computed tomography image. The exact establishment of changes in bone structure is relevant for the final outcome and prognosis following the applied treatment. This diagnostic method allowed the proper decision-making about the surgical approach, the amputation site and the therapy in the postoperative period.

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