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COMPUTED TOMOGRAPHY STUDY OF THORACIC AORTA IN THE CAT

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Summary

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Computed tomography (CT) with contrast enhancement allows a detailed anatomical description of feline thoracic aorta. For this purpose, 14 sexually mature clinically healthy domestic cats weighing 2.9 to 4.0 kg were investigated. The animals were anaesthetized and fixed in dorsal recumbency on a CT table (Tomoscan, CX/Q, Siemens). Consequent transversal 5 mm cross-sections were made along the thoracic cavity, caudally to the thirds thoracic vertebra (Th3). The levels corresponding to the best representation of anatomical features of thoracic aorta were selected. The branches of the aortic arch (the brachycephalic trunk and the left subclavian artery) were observed from the first studied Th3 segment to Th4. The aortic arch was detected at the Th5 level. The ascending aorta was visualized almost centrally to the Th6 segment, surrounded by the left atrium, the right atrium and the right ventricle. The descending aorta was observed on the left ventrally to the body of Th6. In caudal direction, the descending aorta was positioned ventromedially to the vertebral column, that was the best visible at Th10. This placement of the descending aorta was preserved up to aortic hiatus.

In conclusion, CT is able to visualize *in vivo* thoracic aorta and allows a precise anatomical analysis for the needs of diagnostics.

Key words: cat, computed tomography (CT), thoracic aorta

INTRODUCTION

Being a sensitive indicator of cardiovascular and mediastinal diseases in men, computed tomography (CT) of the thorax is applied in cases where a detailed anatomical description is needed in order to obtain a more detailed information for diagnostics or for monitoring of therapeutical efficacy (Shin *et al.*, 1981; Solomon & Haaga, 1983; Woodring & West, 1989; Kurihara, 2001; Knollmann & Pfoh, 2003; Anderson *et al.*, 2004).

The contemporary interest to CT in veterinary medicine, cardiovascular pathology, the correct interpretation of images and the existence of data mainly for dogs, requires a precise CT imaging of thoracic aorta in domestic cats (Herrtage & Dennis, 1995; Samii *et al.*, 1998; Kara *et al.*, 2001; Schwarz *et al.*, 2002; De Rycke *et al.*, 2005). This is necessitated by the increased diagnostic needs of feline cardiology (Schwarz *et al.*, 2002; Hen-

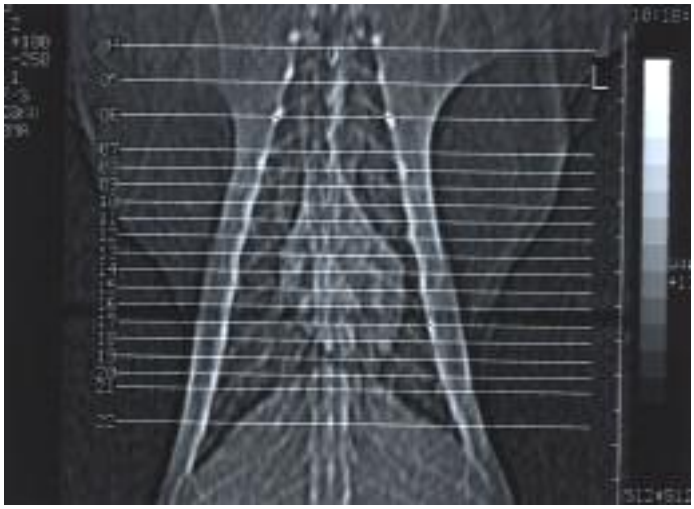

Fig. 1. Ventrodorsal view of the thorax in a clinically healthy cat with reference to levels (from 04 to 22), where the CT slices were obtained.

ninger, 2003). The reference data for aorta are few and inadequate. Samii *et al.* (1998) have studied the cardiac structures in corresponding anatomical and CT cross-sections along the thorax in the cat. The authors did not, however, follow up the course of aorta as well as its topographic interelationships. A comparative description of CT cross-sections and transverse gross specimens was reported by Shojaei *et al.* (2003), who highlighted that the slice thickness of 15 mm was not suitable for a precise investigation of cardiac and thoracic structures.

The insufficient data about the path of the thoracic aorta and its topographic relationships motivated the present study.

MATERIALS AND METHODS

Fourteen sexually mature, clinically healthy domestic cats (*Felis silvestris f. domestica*) weighing 2.9–4 kg were used. They were anaesthetized according to the following protocol: premedication with atropine sulfate at 0.02–0.045 mg/kg s.c. (Atropinum sulfuricum, 1 mg/mL, Sopharma®, Bulgaria), followed after 15 min by xylazine at 1–2 mg/kg i.m. (Xylazin 2%, Alfazan, Holland) and after another 15 min by ketamine hydrochloride at 10–15 mg/kg i.m. (Ketamin 10%, Alfazan, Holland) (Dinev & Aminkov, 1999). The cats were positioned in dorsal recumbency on the CT table (TOMOSCAN – CX/Q, Siemens). CT was accomplished using the following technical specifications: 120 kV, 110 mA, filter 1, CT index 1.5, high resolution mode, table height 149 cm.

Along the thorax, caudally to Th3, consequential transversal cuts with a thickness of 5 mm were performed (Fig. 1). CT was enhanced by a drop infusion of Omnipaque®, 350 mg I/mL (Nycomed, Ireland) into the cephalic vein at a rate of 3 mL/kg.

After the CT study, the animals recovered without complications.

RESULTS

CT images of the branches of the aortic arch – the brachycephalic trunk and the left subclavian artery were observed just at the first level of study – Th3. The brachycephalic trunk was observed on the left ventrally to the trachea whereas the left subclavian artery was situated dorsolaterally and on the left to the brachycephalic trunk (Fig. 2).

At the Th4 level, compared to the Th3 one, the brachycephalic trunk was placed rather ventrally to the trachea whereas the left subclavian artery was shifted dorsally to the brachycephalic trunk (Fig. 3).

The visualization of the aortic arch was possible at the Th5 level (Fig. 4). The anatomical image of this slice was with a rainbow shape and right contour, that was

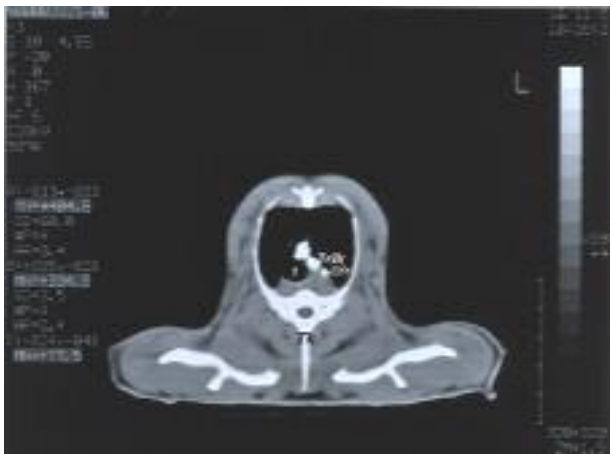

Fig. 2. Transverse CT scan at Th3 (level 06, Fig. 1); TrBr = brachycephalic trunk; ASs = left subclavian artery; t = trachea; Th = Th3.

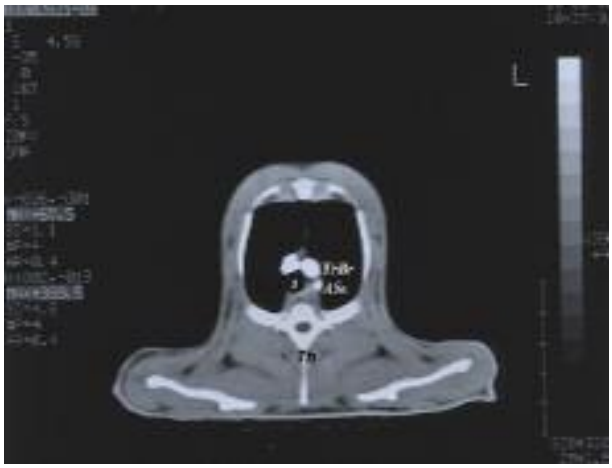

Fig. 3. Transverse CT scan at Th4 (level 08, Fig. 1); TrBr = brachycephalic trunk; ASs = left subclavian artery; t = trachea; Th = Th4.

Fig. 4. Transverse CT scan at Th5 (level 10, Fig. 1); ArAo = aortic arch; VCcr = cranial vena cava; t = trachea; Th = Th5.

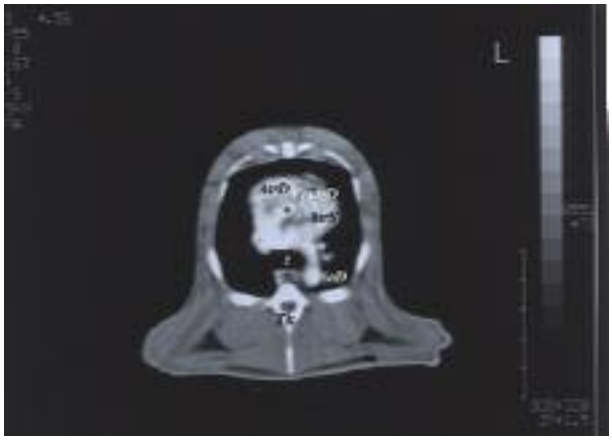

Fig. 5. Transverse CT scan at Th6 (level 12, Fig. 1); AtrD = right atrium; AtrS = left atrium; VentrD = rigth ventricle; ∗ = ascending aorta; AoD = descending aorta; t = trachea; Th = Th6.

approaching subsequently the trachea and the cranial vena cava in a dorsoventral direction..

At the Th6 level (Fig. 5), the descending aorta was observed as an oval surrounded by the left and right atria and the right ventricle. The descending aorta was detected ventrally to and on the left of the vertebral body and along its path in caudal direction, its position was gradually placed ventromedially to the vertebral column. This topographic feature was preserved up to the aortic hiatus, but was best visualized at the transition between Th9 and Th10 (Fig. 6), where the descending aorta was situated on the left dorsally to the oesophagus, under the vertebral bodies and sagittally to the right azygous vein.

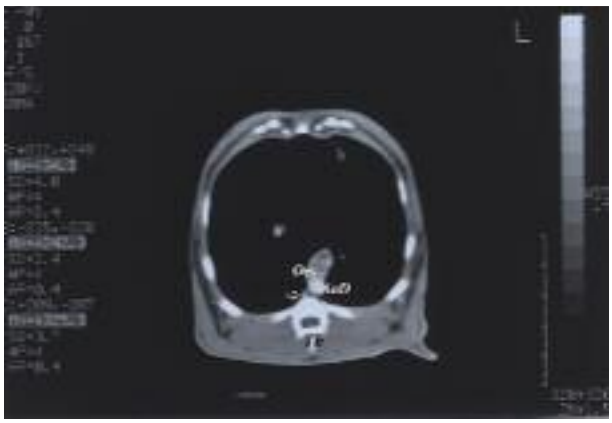

Fig. 6. Transverse CT scan between Th9 and T10 (level 19, Fig. 1); AoD= descending aorta; Oes = oesophagus. The arrow shows the right azygous vein; Th = Th9/Th10.

DISCUSSION

The CT study of thoracic aorta followed up its path with reference to vertebrae, thoracic organs, cardiac and vascular structures. The relativity in CT study of topographic relationships, present in both human and veterinary medicine, are resulting from the anatomical position of the body and the respective thoracic vertebrae. In this connection, Anderson *et al.* (2004) proposed a principal interpretation of CT images of cardiac structures for the different human body positions. The authors have briefly discussed the topographic relationships of the thoracic aorta predominantly with regard to the heart. Samii *et al.* (1998) have marked the anatomical locations of ascending and descending aorta in a comparative study of transverse frozen and CT cross-sections through various thoracic levels. The random slices were not related to any thoracic vertebra and did not give a detailed information about the situation of ascending and descending aorta. Our results confirmed partly the data of Shojaei *et al.* (2003) about the anatomical features of the aorta obtained on the base of thoracic vertebrae and at slice thickness of 15 mm. This distance however did not allow a precise analysis of the thoracic aorta, its branches and its path. Most probably, the big distance between slices resulted in an incomplete visualization not only of the brachycephalic trunk and the left subclavian artery, but also of the aortic arch that were well visible with slices of 5 mm. This is apparently a suitable distance for anatomically precise CT imaging of thoracic aorta. The necessity of such precision in the CT diagnostics of the thorax is outlined by Henninger (2003) via a comparative study of normal and pathological thoracic structures in cats.

CONCLUSION

The transverse CT with slice thickness of 5 mm enhanced the detection of the aortic arch at the Th5 level. Its branches – the brachycephalic trunk and the left subclavian artery were visualized between the Th3 and Th4 segments.

The transverse CT scans through Th6 with slice thickness of 5 mm allowed the

simultaneous study of both ascending and descending aorta.

At this level, the descending aorta was observed on the left and ventrally to the body of Th6. In caudal direction, the descending aorta was gradually positioned ventromedially to the vertebral column. This path was most clearly visible at Th10 and was preserved up to aortic hiatus.

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REFERENCES

Anderson, R., R. Razavi & A. Taylor, 2004. Cardiac anatomy revisited. *Jornal of Anatomy*, **205**, 159–177.

De Rycke, L., I. Gielen, P. Simoens & H. van Bree, 2005. Computed tomography and cross-sectional anatomy of the thorax in clinically normal dogs. *American Journal of Veterinary Research*, **66**, No 3, 512–524.

Dinev, D. & B. Aminkov, 1999. Veterinary Anaesthesiology, Trakia University, Stara Zagora, pp. 116–117.

Henninger, W., 2003. Use of computed tomography in the diseased feline thorax. *Journal of Small Animal Practice,* **44**, No 2, 56–64.

Herrtage, M. & R. Dennis, 1995. The Thorax. In: *Manual of Small Animal Diagnostic Imaging*, II edition, ed. R. Lee, BSAVA, Quedgeley, pp. 43–67.

Kara, M., Z. Karaman, I. Dabanoglu & M. Ocal, 2001. Computed tomographic measurements of the trachea in dog. *Deutsche Tierärztlische Wochenschrift*, **108**, No 4, 164–167.

Knollmann, F. & A. Pfoh, 2003. Image in cardiovascular medicine. Coronary artery imaging with flat-panel computed tomography. *Circulation,* **104**, No 8, 1209.

Kurihara, Y., 2001. Anatomic and radiologic considerations of varied appearances of thoracic structures. *Nippon Igaku Hoshasen Gakkai Zasshi,* **61**, No 12, 663–667.

Samii, V., D. Biller & P. Koblik, 1998. Normal cross-sectional anatomy of the feline thorax and abdomen: Comparison of computed tomography and cadaver anatomy. *Veterinary Radiology & Ultrasound*, **39**, No 6, 504–511.

Schwarz, T., M. Sullivan, C. Stork, R. Willis, R. Harley & D. Mellor, 2002. Aortic and cardiac mineralization in the dog. *Veterinary Radiology & Ultrasound*, **43**, No 5, 419–427.

Shin, M., K. Ho & D. Witten, 1981. Application of computed tomography in differential diagnosis of radiographic opacities in the lower thorax and upper abdomen. *Journal of Computed Tomography,* **5**, No 6, 519–528.

Shojaei, B., A. Rostami, A. Vajhi & M. Shafaee, 2003. Computed tomography anatomy of the thoracic region of the cat. *Veterinarski Arhiv*, **73**, No 5, 261–269.

Solomon, E. & J. Haaga, 1983. The Mediastinum. In: *Computed Tomography of the Whole body*, eds. J. Haaga & R. Alfidi, Mosby Company, Toronto, 430–493.

Woodring, J. & J. West, 1989. CT of aortic and mitral valve calcification. *Journal of the Kentucky Medical Association*, **87**, No 4, 177–180.

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