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ANATOMICAL COMPUTED TOMOGRAPHIC STUDY OF THE HEART AND SOME MEDIASTINAL VESSELS OF THE RABBIT (*ORYCTOLAGUS CUNICULUS*)

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Abstract

DIMITROV, R., D. VLADOVA, K. STAMATOVA, D. KOSTOV and M. STEFANOV, 2012. Anatomical computed tomographic study of the heart and some mediastinal vessels of the rabbit (*Oryctolagus cuniculus*). *Bulg. J. Agric. Sci.,* 18: 784-788

The aim of the study is to utilize the computed tomography the anatomical study of the rabbit heart and some of its mediastinal vessels.

We investigated seven sexually mature, healthy male white New Zealand rabbits, aged 12 months. The animals were anesthetized. The bodies of the thoracic vertebrae were used as bone markers when performing the imaging.

At the level of the third and fourth thoracic segment were found only vascular structures. At the fifth thoracic vertebrae a partial heart silhouette was observed, and the complete one – at the seventh. At the third, fourth and fifth thoracic vertebrae an image of the ascending aorta was found, at the third and fourth one – aortic arch, at the fifth segment – the beginning of the descending aorta.

The results confirm the thesis, that the rabbit is a suitable biological model for morphological and functional studies of the heart.

Key words: imaging anatomy, computed tomography, rabbit heart

Introduction

The rabbit heart is a relatively small organ toward its body weight, compared to the other animals. Its small size permits to be covered entirely by the lung lobes. The heart shape is ovoid. The apex is more rounded, than that of the carnivores. The heart topography is with cranial position, compared to the rest of the animals. It is situated from the second to the fifth rib. The descending aorta begins under the level of the fifth thoracic vertebra. Two cranial venae cava and one caudal are observed in the rabbit. The right azygos vein fuses into the right vena cava at the level of the third rib. The pulmonary veins are two – left and right (Barone, 1996; McCracken et al., 2008).

Recently the rabbit is used more frequently as an animal model in cardiological imaging investigation of the human ischemic disease, contrary to distant past when swine and dog s were used for such investigations (Laarse and Wall, 2009).

Many authors use computed tomography on the rabbit heart to determine thrombotic masses in the heart

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cavities and atherosclerotic plates in its vessels. The researchers use the rabbit as an animal model for studying the human atherosclerosis (Zhao et al., 2011).

An imaging anatomical research of the rabbit heart is carried out in connection with the fat depositioning processes. The authors propose the use of the obtained results for interpretation of the human adipose lesions (Yonkova et al., 2010a, b).

The rabbit heart is studied by magnetic resonance tomography MRI. The obtained results present the rabbit as a model for the imaging anatomical and functional investigation of the human heart (Price et al., 2009; Goodyer et al., 2011).

In some studies done with correlation to our investigational goals, the feline heart is being researched via computed tomography. The authors use some thoracic vertebrae, toward which they describe the corresponding vascular and heart structures. At the levels of the third, fourth and fifth thoracic vertebrae, they found only vessels (brachiocephalic trunk, left subclavian artery and arch of the aorta). At the level of the sixth thoracic vertebra are visualized heart structures as the left and right atria and ventricles. The descending aorta appears here (Vladova et al., 2005a, b; Vladova, 2006).

Different computed tomographic anatomical study of the dog thoracic cavity proves the authenticity and precision of the method (De Rycke et al., 2005).

The lack of data about computed tomographic anatomical investigation of the rabbit heart and some close vessels motivated our study.

Our aim is to apply the computed tomography in the anatomical research of the rabbit heart and some mediastinal vessels. The obtained results could be significant regarding the cardiological imaging diagnosis in the mammals.

Materials and Methods

Subject

Seven sexually mature and healthy male white New Zealand rabbits, aged 12 months, and weighed from 2.8 kg to 3.2 kg were studied. The animals were anesthetized with 15 mg/kg i m Zoletil® 50 (tiletamine hydrochloride 125 mg and zolazepam hydrochloride 125 mg in 5 mL sterile isotonic solution) Virbac, France.

Computed tomographic examination

The body of the third thoracic vertebra (cranially) and that of the seventh one (caudally) were used as bone markers. The experimented animals were positioned in a dorsal recumbency. For the contrasting of the vascular structures was used OPTIRAY® 350 (ioversol 741 mg/mL), Healthcare Ltd., UK, applied parenterally (i v 1 mL/kg) in the cephalic vein. The study was performed by axial computed tomograph SIEMENS SOMATOM, ARTX (Germany) with table height 125 cm, FOV = 250, filter 1, anode current 70 mA, anode tension 110 kV and scanning time 3 s. We worked in a high resolution (512) and gentry (GT) - 0°. A window (W) 280 and centre (C) + 33 were used. The scans of the thoracic cavity were done at 3 mm intervals.

Ethical protocol

The experiments were done in strict compliance with European convention for vertebrate animals' protection, used for experimental and other scientific purposes (Starsbourg /16th May 1986), European convention for companion animals' protection (Starsbourg /13th November 1987) and animal protection's law in Republic of Bulgaria (section IV-Experiments with animals, art. 26, 27 and 28, received on 24th January 2008 and published in Official gazette, № 13, 2008).

Results

In the middle part from the dorsoventral diameter of the cranial mediastinum the left and right cranial vena cava were visualized. The contrasted ascending aorta was scanned between them. Dorsally and right to the aorta, the hypodense trachea and the situated above hyperdense azygos vein (to the right) and oesophage (to the left) were imaged. On the left dorsal wall of the hyperdense ascending aorta, the pulmonal trunk and the arch of the aorta above were seen (Figure 1).

In the ventral part of the cardial mediastinum, the heart silhouette was visualized partially with the right and left atria and the hyperdense ascending aorta, localized between them. Ventrally and on the right was a part of the right ventricle and interventricular septum. Laterally were visualized the apical lobes of the lungs. The trachea was dorsally between them (with hypodense lumen and hyperdense wall). The arch of the azygos vein and oe-

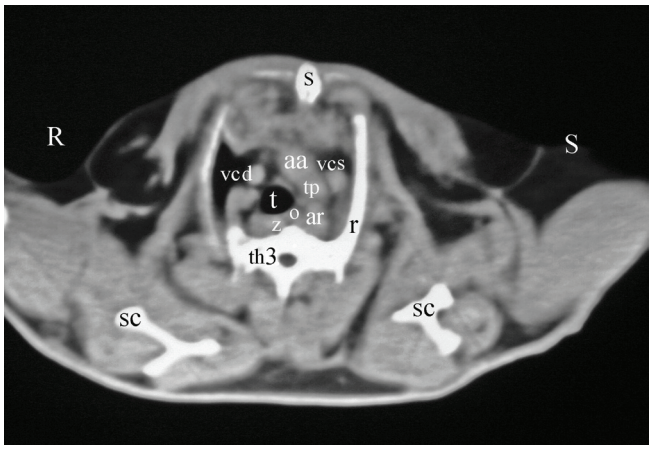

Fig. 1. Transversal computed tomographic image of the rabbit chest through the third thoracic vertebra (th3) (right side - R, left side - S): sternum (s), rib (r), scapula (sc), right cranial vena cava (vcd), left cranial vena cava (vcs), azygos vein (z), ascending aorta (aa), arch of the aorta (ar), pulmonal trunk (tr), trachea (t), oesophage (o)

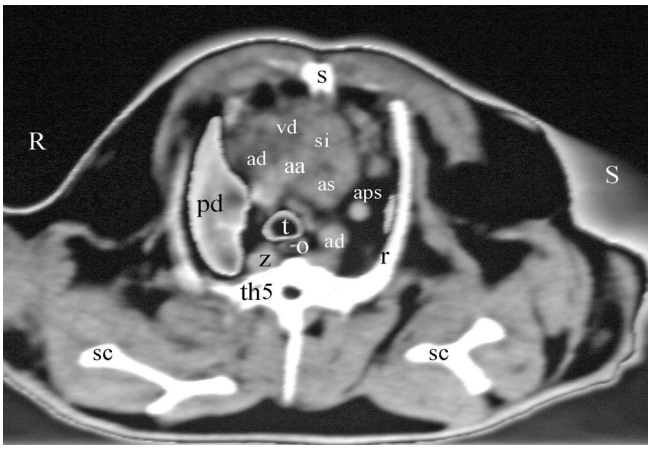

Fig. 2. Transversal computed tomographic image of the rabbit chest through the fifth thoracic vertebra (th5) (right side - R, left side - S): sternum (s), rib (r), scapula (sc), right ventricle (vd), right atria (ad), left atria (as), interventricular septum (si), azygos vein (z), ascending aorta (aa), descending aorta (ad), left pulmonary artery (aps), right lung (pd), trachea (t), esophage (o)

sophage were situated dorsally toward trachea. Left and ventrally to the fifth thoracic segment, the hyperdense image of the descending aorta appeared, and bellow and left to it – the left pulmonary artery (Figure 2).

At the level of the sixth thoracic vertebra was visualized almost the whole heart silhouette. The atrioventricular septum was imaged as a hypodense structure. The atria and ventricles were seen. The descending aorta, oesophage and trachea were visible at this level, and the hyperdense left pulmonary artery was found ventrally (Figure 3).

At the level of the seventh thoracic segment, the whole heart silhouette was seen and the interventricular septum was distinguished. Dorsally to the atria were seen the tracheal bifurcation with oesophage, hyperdense azygos vein and descending aorta. The left and right pulmonary arteries were visualized above the atria. The four heart cavities were presented (atria and ventricles). Laterally to the heart silhouette were the left and right lungs (Figure 4).

Discussion

In comparison to other studies that demonstrate the adipose pericardial tissue of the heart, our results are focused on the heart and some vascular structures, their positioning and full discruption (Yonkova et al., 2010a, b). Unlike some investigation regarding investigation of atherosclerotic alterations in the rabbit heart, we looked at computed tomography features of this organ in healthy animals (Zhao et al., 2011).

Our researches confirmed that the rabbit heart is a relatively small organ, covered entirely by the lungs. It is with cranial position, compared to the rest of the domestic mammals (Baron, 2006). Similarly, to the conventional anatomical investigations of other authors, we find the appearance of the thoracic part of the descending aorta bellow the level of the fifth thoracic vertebra (Baron, 2006; McCracken et al., 2008). Both cranial venae cava were seen at the level of the third thoracic segment (Baron, 2006; McCracken et al., 2008). The appearance of the right azygos vein is observed to the right at the level of the third thoracic vertebra. Both pulmonary veins were found at the level of the fifth and sixth thoracic vertebra, which corresponds to the comparative anatomical data (Baron, 2006).

Like to the studies of some authors we used the thoracic vertebra as a bone marker for the topographic definition of the studied heart and the vascular elements

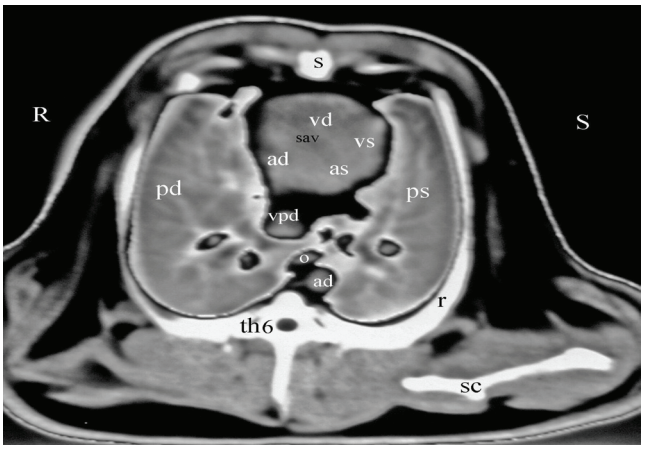

Fig. 3. Transversal computed tomographic image of the rabbit chest through the sixth thoracic vertebra (th6) (right side - R, left side - S): sternum (s), rib (r), scapula (sc), right ventricle (vd), left ventricle (vs), right atria (ad), left atria (as), atrioventricular septum (sav), descending aorta (ad), right pulmonary vein (vpd), right lung (pd), left lung (ps), oesophage (o)

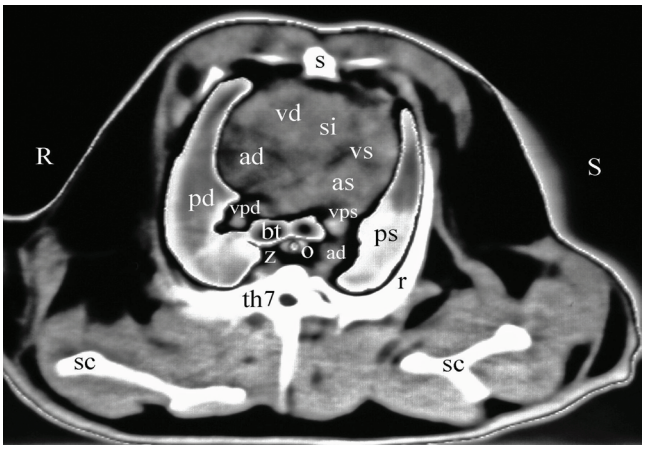

Fig. 4. Transversal computed tomographic image of the rabbit chest through the seventh thoracic vertebra (th7) (right side - R, left side - S): sternum (s), rib (r), scapula (sc), right ventricle (vd), left ventricle (vs), right atria (ad), left atria (as), interventricular septum (si), descending aorta (ad), right pulmonary vein (vpd), left pulmonary vein (vps), azygos vein (z), right lung (pd), left lung (ps), tracheal bifurcation (bt), oesophage (o)

(Vladova et al., 2005a, b; Vladova, 2006). We proved that at the level of the second and third thoracic segment are visualized only vascular structures, contrary to the attitude of the same author for the feline heart (Vladova, 2006). The heart silhouette and the descending aorta appeared at the level of the fifth thoracic vertebra. That is a prove for the cranial position of the rabbit heart, compared to the cat (Vladova, 2006). In contrast with the cat, that a complete heart silhouette is observed at the sixth thoracic vertebra, in the rabbit it was visualized at the seventh thoracic segment (Vladova, 2006).

Our data motivated us draw conclusions, that the rabbit is a good biological model for the morphological and functional investigation of the heart and the interpretation of the cardiovascular lesions in the animals and humans with agreement to the studies of many researchers (Laarse and Wall, 2009; Price et al., 2010; Goodyer et al., 2011).

Conclusions

At the level of the third and fourth thoracic segment, there were only vascular structures.

At the fifth thoracic segment a partial heart silhouette was observed, and a complete one – at the seventh.

At the third, fourth and fifth thoracic segment an image of the ascending aorta was scanned, at the third and fourth – arch of the aorta, and at the fifth segment – the beginning of the desending aorta.

An image of the right and left cranial vena cava with the pulmonary trunk was visualized at the level of the third thoracic vertebra.

An image of the right and left pulmonary arteries were found at the level of the seventh thoracic segment.

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