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Short Communication

Magnetic resonance angiography of the normal canine heart and associated blood vessels

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Abstract

Magnetic resonance angiography (MRA) images of the normal canine heart and associated blood vessels were obtained from two mature Beagle dogs. Fast spin-echo sequence MRA images were taken with a 1.5 T magnet and a human thorax coil. Relevant vascular structures were identified and labelled on maximum intensity projection reconstructions of 3D gadolinium-enhanced MRA and anatomical dissections with vascular latex injection taken from the right and the left thoracic walls and the base of the heart. These images should provide useful reference material for clinical studies of the canine heart.

Keywords: Magnetic resonance angiography; Gadolinium; Heart; Blood vessels; Dog

Recent advances in magnetic resonance imaging (MRI) resulting from fast gradients and use of contrast agents have allowed magnetic resonance angiography (MRA) to make substantial advances in exploring the vascular system. In human medicine, MRA has become a useful non-invasive diagnostic imaging technique for the assessment of the heart and thoracic vasculature (Didier, 1999; Tsekos et al., 2002). Experimental studies using contrast-enhanced MRI have been made on animal models (Hernandez et al., 2001; Ren et al., 2006), and in veterinary medicine several studies have demonstrated the clinical value of MRA in diagnosing diseases of the vascular system (Drost et al., 1999; Seguin et al., 1999).

Congenital vascular anomalies are relatively common in dogs (House et al., 2005). An accurate MRA interpretation of the anatomy of the heart and great thoracic vessels would be useful in the evaluation and diagnosis of congenital diseases such as double aortic arch, aberrant left subclavian artery, persistent right aortic arch and patent ductus arteriosus. The objective of the present study was to examine the normal anatomy of the canine heart and associated blood vessels using maximum intensity projection (MIP) reconstructions of 3D gadolinium-enhanced and anatomical dissections.

The experimental work was approved by the Ethical Committee for Animal Experimentation of the Veterinary Faculty of Las Palmas University. Two mature, clinically healthy Beagles weighing 15–20 kg and belonging to the Las Palmas University Animal Resources Centre were used. After a clinical evaluation (physical examination and haematological and biochemical analysis), the dogs were sedated with a combination of 0.05 mg/kg acetylpromazine (Calmo Neosan, Pfizer) and 0.25 mg/kg butorphanol (Torbugesic, Fort Dodge). The animals were administered 4–6 mg/kg propofol (Lipuro, Braun) as inducing agent. Anaesthesia was maintained using 2.5% isoflurane (98 Forane, Abbott). The dogs were kept in

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dorsal recumbency through the investigation. A cardiorespiratory gating was applied to minimise the effects of cardiorespiratory and peristaltic movements.

MRA imaging was performed with a 1.5 T superconducting magnet (Genesis Sigma; General Electric Medical System) and a human thorax coil. Fast spin-echo sequence MRA images were acquired with a repetition time of 2526 ms, echo time of 37.9 ms, an acquisition matrix of 256×224 with 7 mm slice thickness. In our studies, we used intravenous gadolinium-DTPA (Manevist, Schering) as a paramagnetic contrast medium, at a dose of 0.2–0.3 mL/kg. To perform contrast enhanced MRA we used a test bolus with specific software to detect time of arrival of the bolus in the vessels of interest. MIP 3D reconstructions of the heart and associated blood vessels were obtained by post processing techniques. MIP images were compared with the corresponding anatomical dissections with vascular latex injection and an atlas of cross-sectional anatomy (Vázquez et al., 2000), to identify the canine heart and associated blood vessels.

Three figures corresponding to MIP images and anatomical dissections of the heart are presented. Fig. 1 was obtained from the right thoracic wall, Fig. 2 from the left thoracic wall and Fig. 3 was obtained from the base of the

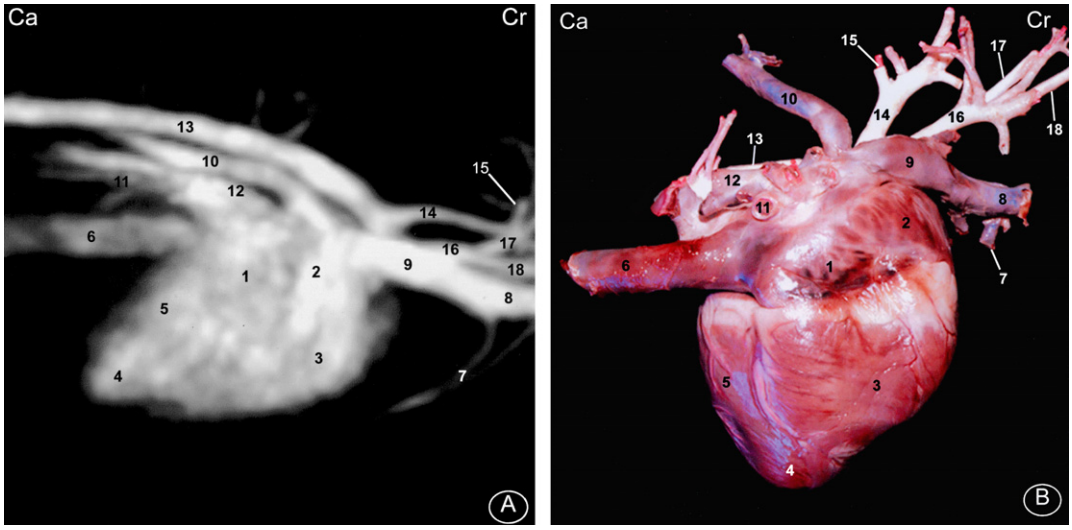

Fig. 1. (A) Maximum intensity projection (MIP) reconstruction of 3D gadolinium enhanced MRA and (B) anatomical dissection from the right thoracic wall. Lateral view. (1) Right atrium; (2) right auricle; (3) right ventricle; (4) heart apex; (5) left ventricle; (6) caudal cava vein; (7) internal thoracic vein; (8) right brachiocephalic vein; (9) cranial cava vein; (10) right azygous vein; (11) pulmonary veins; (12) right pulmonary artery; (13) descending aorta: thoracic aorta; (14) left subclavian artery; (15) left vertebral artery; (16) brachiocephalic trunk; (17) left common carotid artery; (18) right common carotid artery.

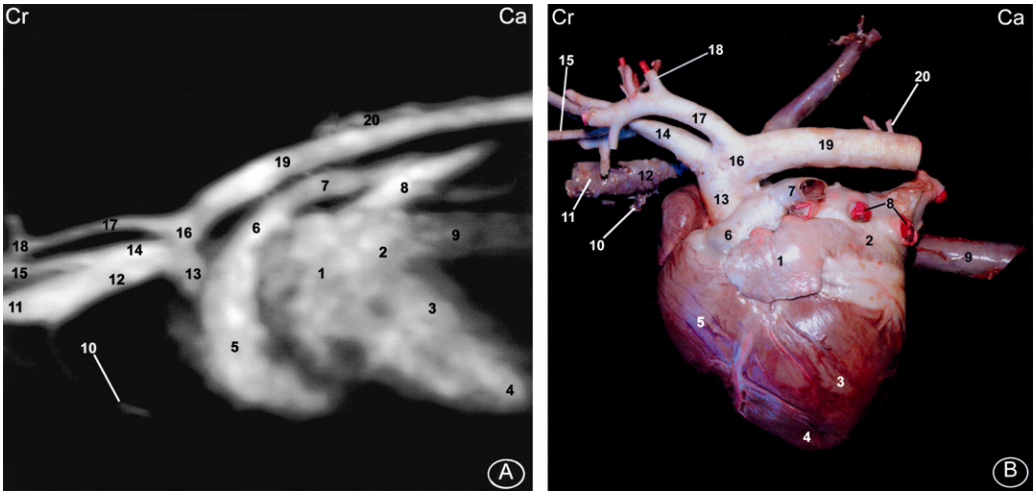

Fig. 2. (A) Maximum intensity projection (MIP) reconstruction of 3D gadolinium enhanced MRA and (B) anatomical dissection from the left thoracic wall. Lateral view. (1) Left auricle; (2) left atrium; (3) left ventricle; (4) heart apex; (5) right ventricle; (6) pulmonary trunk; (7) left pulmonary artery; (8) pulmonary veins; (9) caudal cava vein; (10) internal thoracic vein; (11) left brachiocephalic vein; (12) cranial cava vein; (13) ascending aorta; (14) brachiocephalic trunk; (15) left common carotid artery; (16) aortic arch; (17) left subclavian artery; (18) left vertebral artery; (19) descending aorta: thoracic aorta; (20) dorsal intercostal arteries.

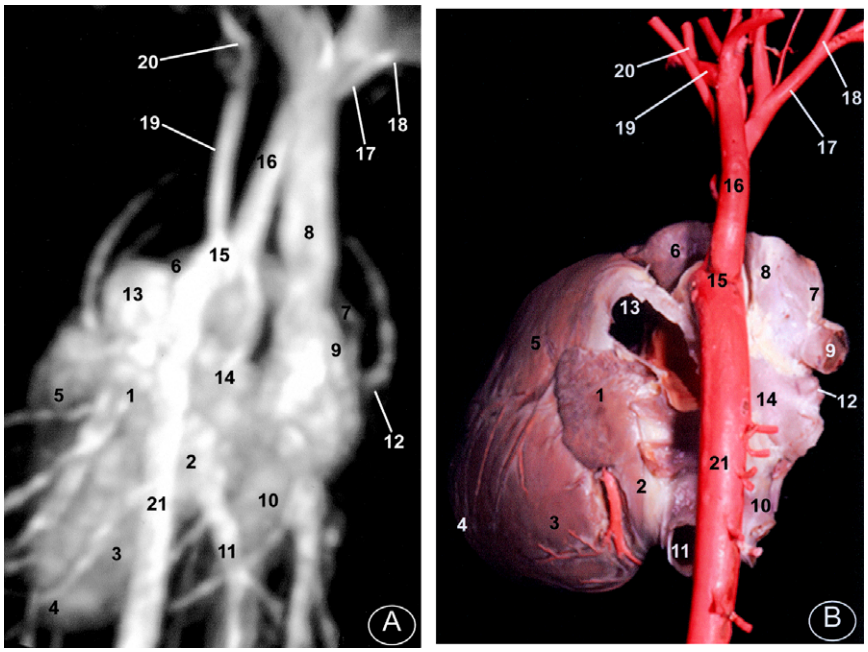

Fig. 3. (A) Maximum intensity projection (MIP) reconstruction of 3D gadolinium enhanced MRA and (B) anatomical dissection from the base of the heart. Dorsal view. (1) Left auricle; (2) left atrium; (3) left ventricle; (4) heart apex; (5) right ventricle; (6) right auricle; (7) right atrium; (8) cranial cava vein; (9) right azygous vein; (10) caudal cava vein; (11) left pulmonary vein; (12) right pulmonary vein; (13) pulmonary trunk; (14) right pulmonary artery; (15) aortic arch; (16) brachiocephalic trunk; (17) right subclavian artery; (18) right vertebral artery; (19) left subclavian artery; (20) left vertebral artery.

heart. Clinical vascular structures were identified and labelled. Visualisation was excellent for several structures of the heart and associated blood vessels, with a high signal hyper-intensity, due to the paramagnetic contrast medium.

MRA is a useful diagnostic tool for the evaluation and assessment of the human vascular system (Didier, 1999; Tsekos et al., 2002), not least because conventional angiography is more invasive, significantly more time consuming and more expensive (Didier, 1999). The advantages of MRA include minimally invasive diagnosis, multiplanar imaging, superior contrast resolution, a short imaging time and description of vascular segments that are not optimally visualised using other diagnostic techniques (Ose et al., 2005). Compared to computed tomography (CT), MRA offers an absence of ionizing radiation, the ability to acquire images in non-axial imaging planes, and the lack of toxicity of gadolinium (Neimatallah et al., 1999).

The use of contrast-enhanced 3D MRA in veterinary medicine at present remains limited because of lack of availability, high cost and logistical difficulties in acquiring MRA images. In the present study, MRA of the canine heart and associated blood vessels have provided some clinically relevant anatomical details and the work has demonstrated that MRA can provide good discrimination of vascular structures.

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