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Microdose computed tomographic cardiac angiography in normal cats

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KEYWORDS

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Abstract Objectives: To determine if microdose contrast-enhanced multi-detector computed tomographic angiography (MDCTA) allows characterization of cardiac chambers in lightly sedated normal cats.

Animals: Seven healthy domestic cats.

Methods: Lightly sedated normal cats were imaged pre-contrast and with microdose (0.22 ml/kg of non-ionic iodinated contrast medium, 300 mg I/ml) triple-phase MDCTA in a motion restriction device.

Results: On pre-contrast images, the aorta (median: 52.43 Hounsfield units [HU], range 27.35–76.74 HU) was outlined by significantly ($p = 0.015$) lower attenuating periaortic fat (–66.16 HU, –42.62 to –92.77 HU). On post-contrast images, median peak contrast enhancement in the right ventricle (111.77 HU, 36.09–141.60 HU) was achieved in 3.1 s (range 2.9–7.3 s), in the aorta (149.30 HU, 99.43–319.60 HU) and left atrium (180.83 HU, 88.53–266.84 HU) in 6.4 s (range 5.6–7.7 s) and in the left ventricle (147.89 HU, 57.23–245.77 HU) in 7.10 s (range 6.2–11.2 s). Significantly higher attenuation was measured between all chambers and walls, the right ventricular lumen and interventricular septum (median ratio 53.78 HU, range 0.21–83.20 HU), left ventricular lumen and left ventricular free wall (89.32 HU, 38.81–185.95 HU) and aorta and periaortic fat (190.43 HU, 143.22–425.44 HU) on post-contrast images.

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Conclusions: Sufficient biological contrast is available on survey CT to discriminate between the aorta and the left atrium, and microdose MDCTA provides sufficient contrast enhancement for adequate visualization of the heart chambers in normal cats.

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Introduction

Cats in congestive heart failure typically present on emergency basis due to respiratory distress. In the acute setting, differentiation between cardiac and non-cardiac causes of respiratory signs often requires thoracic radiographs.^{1,2} Once a working diagnosis of heart failure is made, suggested by cardiomegaly and concurrent pulmonary edema and/or pleural effusion, an echocardiogram is the gold standard method for confirmation and characterization of primary cardiac disease.^{1,3} However, because symptomatic cats require time for stabilization prior to imaging, radiographic detection of congestive heart failure and echocardiographic confirmation of a cardiac etiology may be delayed.

Multi-detector CT (MDCT) allows fast, high-resolution imaging and, using a motion-limiting device,¹ can be used in awake cats with minimal to no motion artifact.⁴ The motion-limiting device has previously been used to evaluate thoracic pathology in a population of cats presenting in respiratory distress. In that study of cats with thoracic disease, 9 of 54 cats were diagnosed with cardiomegaly and congestive heart failure.⁵ The use of CT in awake cats has been shown to reduce morbidity, provide superior imaging, distinguish cardiac from primary respiratory causes of respiratory distress, and be performed earlier in the

treatment course than thoracic radiographs or echocardiography.⁴ In order to evaluate clinical cases of cats presenting in respiratory distress, it must first be determined that contrast-enhanced CT provides adequate visualization of the cardiac structures in healthy cats.

The standard dose of non-ionic iodinated contrast medium for contrast-enhanced CT in cats currently is 2.2 ml/kg (660 mg I/kg) of body weight. Although non-ionic iodinated contrast agents have fewer adverse effects than ionic iodinated contrast agents, there is still potential for adverse hemodynamic effects and nephrotoxicity.⁶ In humans, the risk of contrast-induced nephropathy is low but does increase with certain disease states including heart disease.^{7,8} To the authors' knowledge, no veterinary study to date has shown an association between non-ionic contrast agents and nephrotoxicity in clinical patients. This report represents the first phase of a study evaluating feline hearts using contrast-enhanced MDCT. The aims of this study were to determine if, in lightly sedated normal cats, 1) diagnostic quality MDCT images of the heart, both pre- and post-contrast, could be obtained using a motion-restricting device,^c 2) inherent biological contrast allows evaluation of the aorta and left atrium on survey CT, and 3) microdose iodinated contrast (0.22 ml/kg, 66 mg I/kg) would be sufficient to allow accurate characterization of cardiac chambers and walls.

Abbreviations

Ao	aorta
CT	computed tomography
CTA	computed tomography angiography
DFOV	display field of view
HD	Hounsfield difference
HU	Hounsfield unit
IVS	interventricular septum
LA	left atrium
LV	left ventricle
LVFW	left ventricular free wall
MDCT	multi-detector computed tomography
ROI	region of interest
RV	right ventricle

Animals, materials and methods

Seven apparently healthy client-owned cats were utilized for the project. Included cats were healthy per the owner and without history of cardiac or respiratory disease. Cats were excluded if a heart murmur or arrhythmia was detected during a physical examination. Other screening tests included complete blood count, serum biochemistries, urinalysis, T4, systolic Doppler blood pressure measurement, echocardiogram, and a three-view thoracic radiographic series. The age of the cats

^c VetMousetrap™, University of Illinois, Illinois, USA.

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