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Case Report

Real-time 3D transesophageal echocardiography-guided closure of a complicated patent ductus arteriosus in a dog[☆]

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Received 3 February 2017; received in revised form 7 April 2017; accepted 17 April 2017

KEYWORDS

Canine;
Congenital heart disease;
Image guided;
Interventional

Abstract Advanced imaging modalities are becoming more widely available in veterinary cardiology, including the use of transesophageal echocardiography (TEE) during occlusion of patent ductus arteriosus (PDA) in dogs. The dog in this report had a complex history of attempted ligation and a large PDA that initially precluded device placement thereby limiting the options for PDA closure. Following a second thoracotomy and partial ligation, the morphology of the PDA was altered and device occlusion was an option. Angiographic assessment of the PDA was limited by the presence of hemoclips, and the direction of ductal flow related to the change in anatomy following ligature placement. Intra-operative TEE, in particular real-time three-dimensional imaging, was pivotal for assessing the PDA morphology, monitoring during the procedure, selecting the device size, and confirming device placement. The TEE images increased operator confidence that the size and location of the device

[☆] A unique aspect of the Journal of Veterinary Cardiology is the emphasis of additional web-based images permitting the detailing of procedures and diagnostics. These images can be viewed (by those readers with subscription access) by going to <http://www.sciencedirect.com/science/journal/17602734>. The issue to be viewed is clicked and the available PDF and image downloading is available via the Summary Plus link. The supplementary material for a given article appears at the end of the page. Downloading the videos may take several minutes. Readers will require at least Quicktime 7 (available free at <http://www.apple.com/quicktime/download/>) to enjoy the content. Another means to view the material is to go to <http://www.doi.org> and enter the doi number unique to this paper which is indicated at the end of the manuscript.

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<http://dx.doi.org/10.1016/j.jvc.2017.04.001>

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were appropriate before release despite the unusual position. This report highlights the benefit of intra-operative TEE, in particular real-time three-dimensional imaging, for successful PDA occlusion in a complicated case.

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Abbreviations

ACDO	Canine Duct (Occluder)
LA:Ao	left atrium to aorta ratio
LVIDd	left ventricular internal dimension in diastole
LVIDs	left ventricular internal dimension in systole
MDD	minimal ductal diameter
PDA	patent ductus arteriosus
TEE	transesophageal echocardiogram
2D	two-dimensional
3D	three-dimensional

Case report

An 11-month-old, 17.8 kg, female terrier mix breed was presented to the Texas A&M University Veterinary Medical Teaching Hospital for evaluation of a left-to-right shunting patent ductus arteriosus (PDA). Three months before presentation, the PDA had been diagnosed and a surgical ligation was attempted but not completed due to reported complications. The dog was prescribed pimobendan and enalapril, and evaluation by a cardiologist was recommended.

At the time of presentation, the owner reported the dog had a history of exercise intolerance. A grade 6/6 continuous left basilar murmur was noted on auscultation of the thorax, and femoral pulses were bounding consistent with a PDA. The previous thoracotomy site was completely healed. The remainder of the physical examination was unremarkable. Radiographic cardiomegaly included left atrial and ventricular enlargement with a vertebral heart size of 13.4. The pulmonary vessels were enlarged consistent with overcirculation, and there was not any evidence of pulmonary edema. Hemoclips were noted in the left cranial lung field. A complete two-dimensional (2D) transthoracic echocardiographic study was performed, which documented the left ventricular internal dimensions were increased in size in both diastole and systole (LVIDd, LVIDs). Moderate mitral regurgitation and left atrial enlargement based on 2D

short axis left atrium to aorta ratio (LA:Ao) were present [1]. Transaortic velocity was elevated (4.3 m/s), and aortic insufficiency was documented. The aortic valve appeared structurally normal, but there was a possible subvalvular ridge documented in the left ventricular outflow tract and thus subaortic stenosis could not be ruled out as a cause for the elevated outflow tract velocities in addition to increased volume secondary to ductal flow. A PDA was visualized entering the main pulmonary artery, and left-to-right shunting was confirmed with color and spectral Doppler. Acoustic shadowing artifact attributed to the hemoclips was noted at the base of the heart near the left atrium. The PDA gently tapered at the pulmonary ostium and the minimal ductal diameter (MDD) measured 8.4 mm with an ampulla diameter that was at least 21.1 mm (Fig. 1). These dimensions precluded transcatheter device closure with currently available devices, and surgical ligation was considered despite the previous attempt before presentation. Potential complications associated with a repeat thoracotomy and the development of intrathoracic adhesions since the last procedure was discussed with the owner. The following day, a left-sided thoracotomy was performed at the 4th intercostal space. Fibrous adhesions to the chest wall and the array of hemoclips

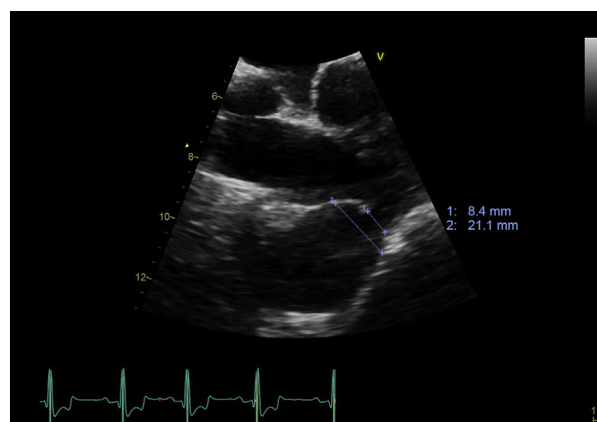


Figure 1 Transthoracic echocardiographic image of the patent ductus arteriosus from a right parasternal short axis basilar view before the second surgical ligation. The minimal ductal diameter measured 8.4 mm and the ampulla diameter measured 21.1 mm. MDD, minimal ductal diameter.

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