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# Technique and Imaging for Transthoracic Echocardiography of the Laboratory Pig

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Transthoracic echocardiography (TTE) of the laboratory pig is technically challenging for several reasons. The ribs are in close proximity necessitating a small transducer footprint. The thorax is more "oval" in the anterior–posterior direction and the long axis of the heart follows an anterior–posterior direction (Fig. 1). These differences between human and pig are related to a basic difference in body orientation, as

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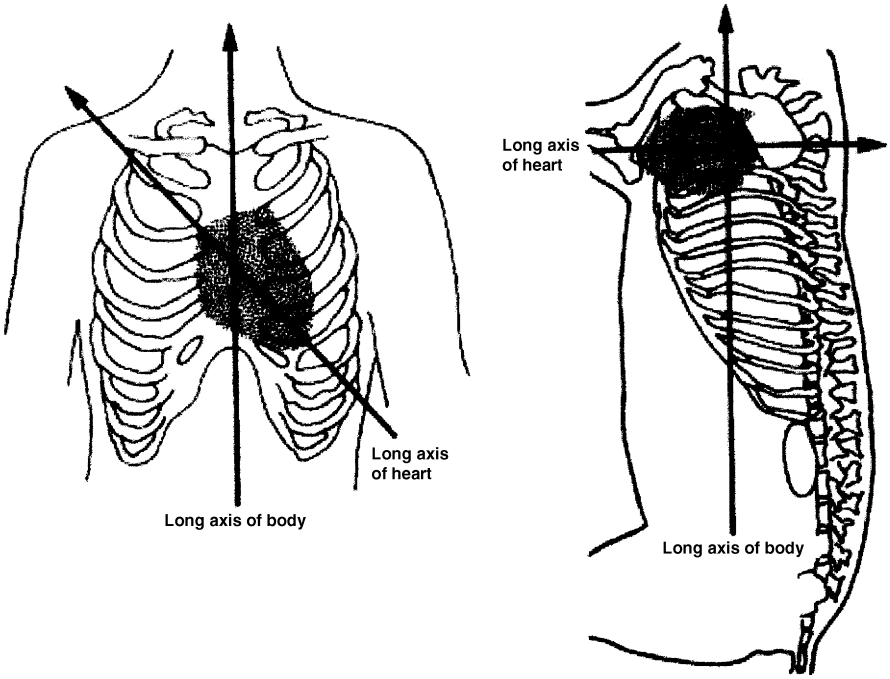


**Figure 1.** *Schematic drawings of the human (left panel) from an anterior projection, and a pig (right panel) from the left lateral direction. Compared to the human, the pig heart long axis is anterior–posterior. (Modified with permission from: Crick SJ, Sheppard MN, Ho SY, Gebstein L, Anderson RH. Anatomy of the pig heart: Comparisons with normal human cardiac structure. J Anat 1998; 193; Figure 1c and d).*

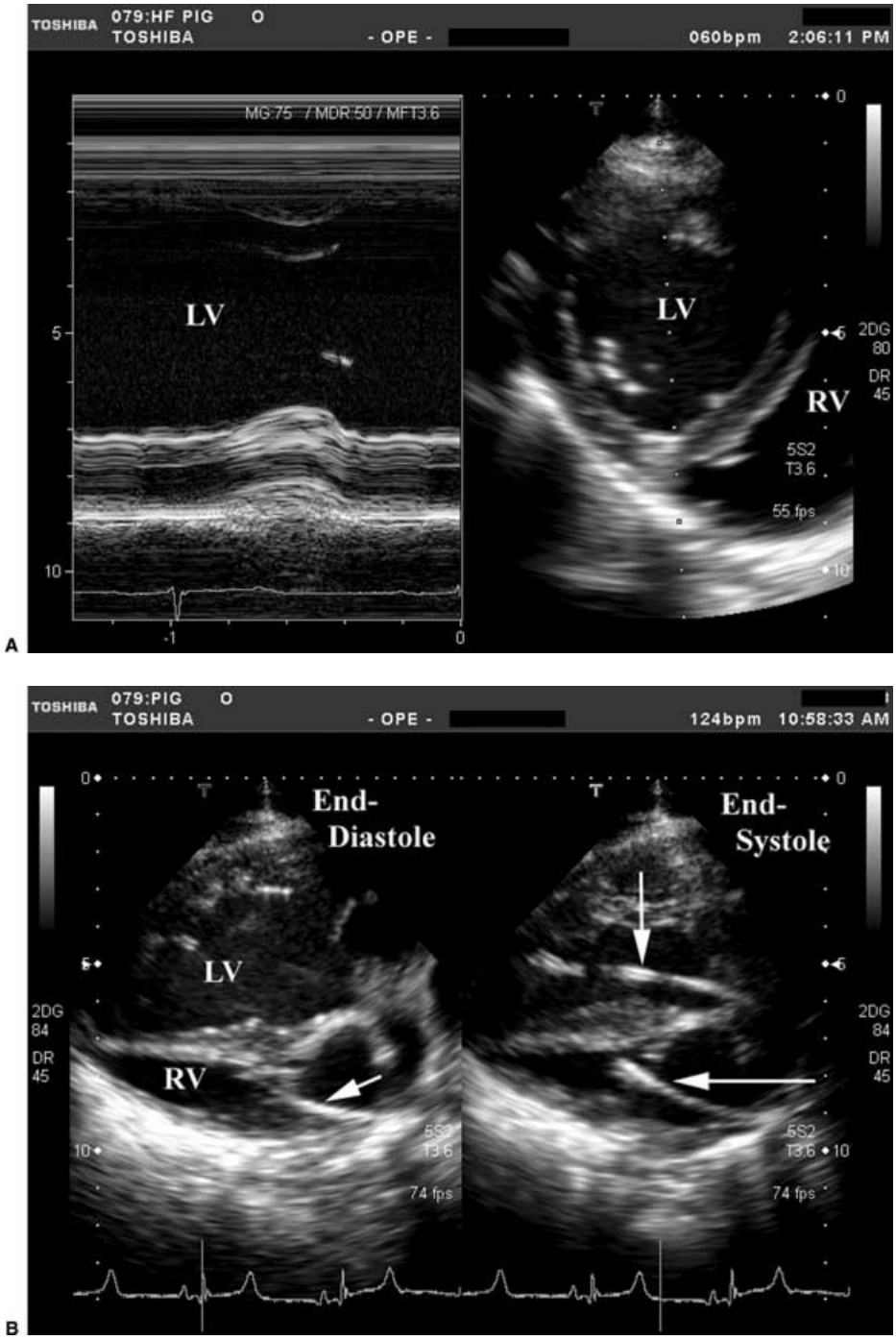


**Figure 2.** *Parasternal* **(A)** *short-axis and* **(B)** *long-axis images of the pig (38.6 kg female). Note that the LV is anterior to the RV in the thorax.* **A.** *LV two-dimensional and M-mode images are noted (3.6 MHz pulse subtraction harmonic imaging, two-dimensional frame rate 55/sec, 10-cm depth, 6-cm focus). This view allows the investigator to assess the LV function by M-mode and two-dimensional measurements. This view is suitable for the assessment of the LV function using tissue Doppler echocardiography modalities.* **B.** *End-diastolic (left panel) and end-systolic (right panel) frames (3.6 MHz pulse subtraction harmonic imaging, frame rate 74/sec, 10-cm depth, 6-cm focus) are illustrated. A right heart Swan-Ganz catheter is noted in the left panel (arrow) and right panel (horizontal arrow), and a pigtail catheter in the right panel (vertical arrow) enters the LV retrograde from the aorta and across the aortic valve.*

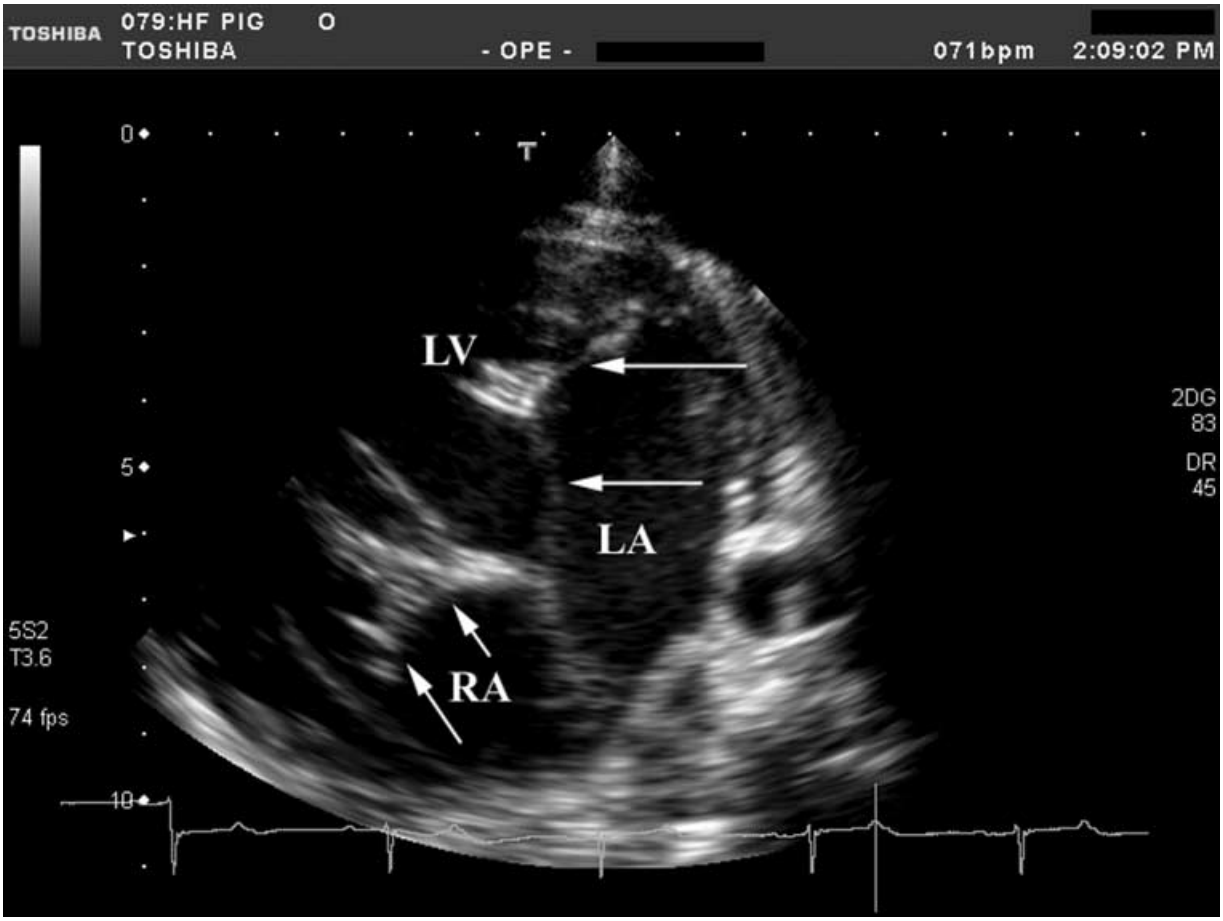


**Figure 3.** *End-systolic frame in a long-axis view (3.6 MHz pulse subtraction harmonic imaging, frame rate 74/sec, 10-cm depth, 6-cm focus), highlighting the left atrium (LA), right atrium (RA), mitral valve (horizontal arrows), and tricuspid valve (diagonal arrows).*

the pig has an unguligrade stance and the human an upright posture.[1] Finally, the animal is usually mechanically ventilated under general anesthesia, making TTE imaging difficult.

Investigators have performed echocardiography in pigs in an open chest model[2,3] and by transesophageal echocardiography (personal experience), but there are few reports of TTE of the laboratory pig.[4–7] Evaluation of the right ventricle (RV), by the assessment of RV free wall motion,[4] and left ventricular (LV) function from a parasternal view[6] has been described. Parasternal short-axis views have been described as requiring the two-dimensional short-axis image to be "visually approximated by closest fitting ellipse at end-diastole and end-systole."[7] Apical views have been reported as being not obtainable.[6]

Our laboratory performs TTE (Toshiba Aplio; Toshiba America Medical Systems, Tustin, CA) on the large laboratory pig while under general anesthesia and mechanical ventilation. As compared to the human or small laboratory animal (rat, mouse), the pig heart long axis is "rotated" posteriorly in the thorax; hence the RV appears posterior to the LV (Fig. 2). Parasternal short- and long-axis views are generally obtained readily. While imaging from a long-axis view, one will image the atrioventricular valves (Fig. 3), and also the LV outflow tract to obtain flow measurements through the aortic valve (Fig. 4).

In conclusion, we have demonstrated that TTE imaging of the large laboratory pig is possible, and is of potential utility for laboratory investigators. In particular, parasternal

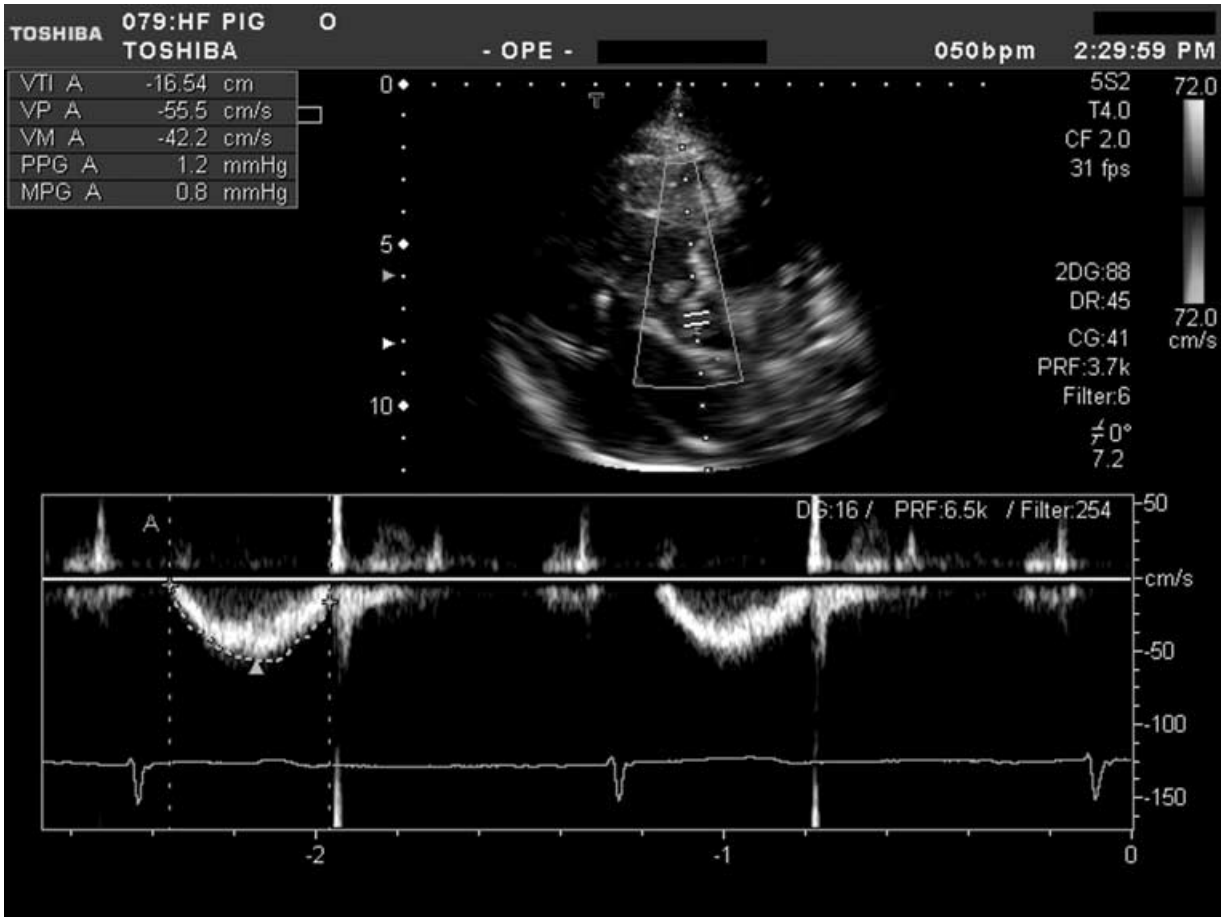


**Figure 4.** *Imaging of the left ventricular outflow tract with pulsed-wave Doppler at the level of the aortic valve. This study animal had LV systolic dysfunction with a reduced LV stroke volume.*

imaging for the assessment of the LV function, atria and atrioventricular valves, and also flow measurements through the LV outflow tract are all readily obtainable.

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