VISUALSONICS
FUJIFILM

Imaging Guide

Guide to Small Animal **Kidney and Adrenal Glands Imaging** using the Vevo® Imaging Systems

System Compatibility: This guide contains instructions and suggestions for work on the Vevo2100, VevoLAZR, Vevo 3100 systems and transducers from the MS, MZ and MX series.

Objective

This guide is designed to aid the user to:

- Select the appropriate transducer and position for imaging of the renal system and adrenal glands
- Recognize organs of the renal system and the adrenal glands and associated structures in typical views of various imaging modes available on the Vevo systems
- List available measurements and calculations in the respective imaging modes

Overview of the Research Areas and Anatomy of the Renal System

The mammalian renal system is fundamental for the homeostatic regulation of bodily fluids and plasma pH, the re-absorption of water and various nutrients including glucose, the secretion of erythropoietin, Vitamin D, and renin, and the formation of urine by the excretion of metabolic bi-products and access water. Among the important physiological implications of these functions is the regulation of blood pressure, glucose metabolism, calcium absorption, and erythropoiesis. Using high frequency ultrasound to investigate the kidney allows research into normal renal physiology and renal pathophysiology, and nephropathies including quantification of focal lesions and hydronephrosis which are common in murine models of diabetes.

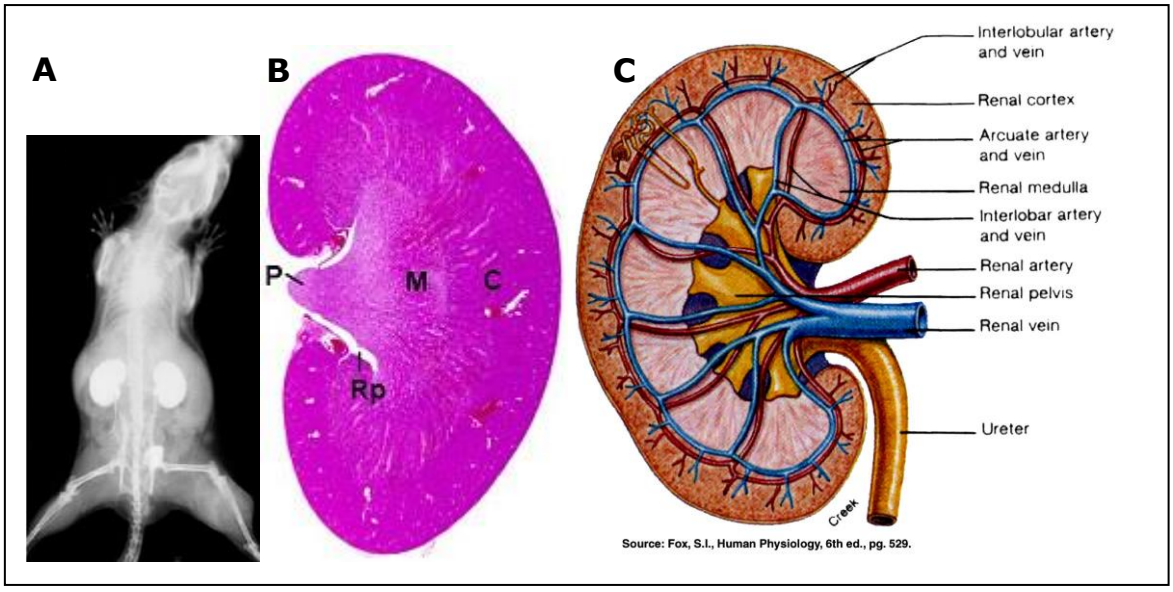

Figure 1- Location and structure of the kidney and renal vasculature: A) Using AuroVist X-ray contrast agent, the position of both right and left kidneys can be appreciated by CT imaging. www.nanoprobes.com/Images/Vol8_Iss5_Fig2.jpg

B) A longitudinal histological section enables visualization of a large area of the kidney tissue: both poles, papilla (P), medulla (M), cortex (C), and renal pelvis (Rp)
http://www.item.fraunhofer.de/reni/trimming/img1/kidney_s1.jpg
C) The vasculature and excretory structures of the kidney are shown in longitudinal section.

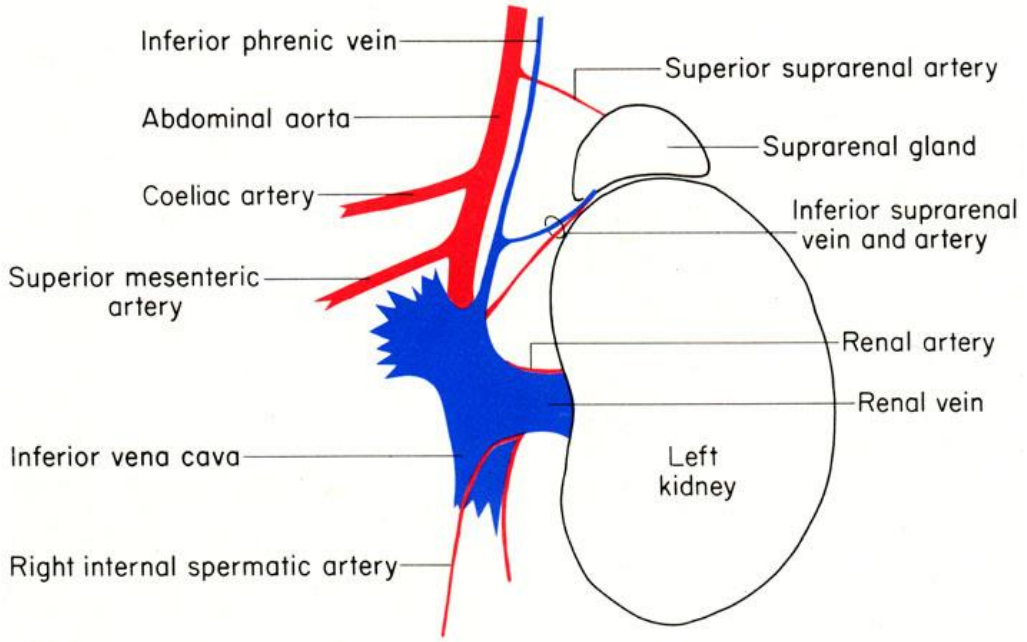

Figure 2 - Location of the adrenal gland.
http://www.informatics.jax.org/cookbook/figures/figure112.shtml

Selecting the Appropriate Transducer
The main criteria in selecting the correct transducer are:
- age of the animal
- target tissue
- pathology

For normal adult mice the 400 and 550D, 30 and 40MHz, models are all well suited for most types of tissue.

For young and very young mice the 550D and 550S models, 40MHz and deep and shallow depth, are the best option.

Animal Preparation

The animal preparation shall adhere with the Institution's Animal Care Committee approved SOP.

Transducer Positioning

Position the animal in the supine position and place the transducer in the transvers position on the lateral side of the animal, applying slight pressure for optimal imaging.

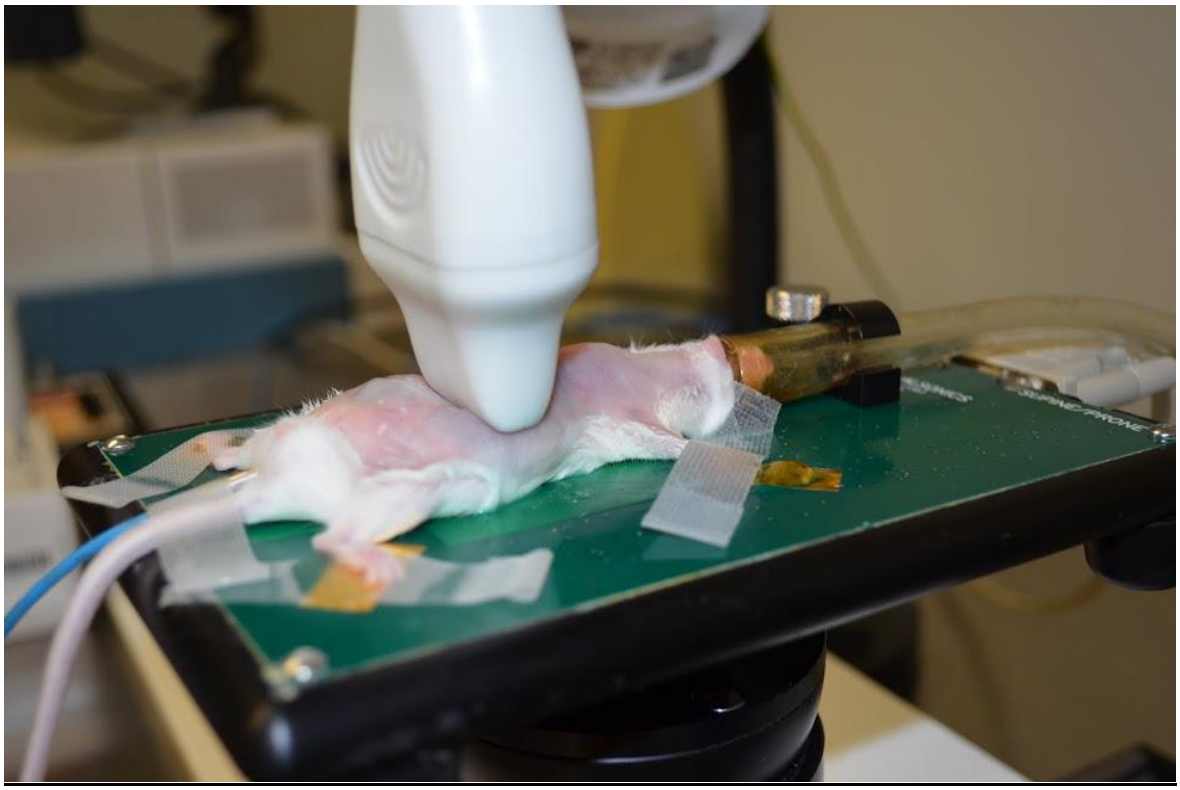

Figure 3 – Transducer position for left kidney imaging in the transverse plane.

Kidney B-Mode Imaging

The structure of the kidney can be generally divided into inner layer medulla and outer layer cortex. The medulla includes the renal pyramids while the cortex comprises the functional unit of the kidney, the nephron.
When viewed using ultrasound, the right kidney is positioned slightly anterior in the thoracic cavity with respect to the left kidney, the medulla is darker than the cortex and it is in the medial portion of the kidney. The cortex is the outer layer where tumors and cysts will generally appear. Surrounding the cortex, the kidney capsule appears as a bright thin line.

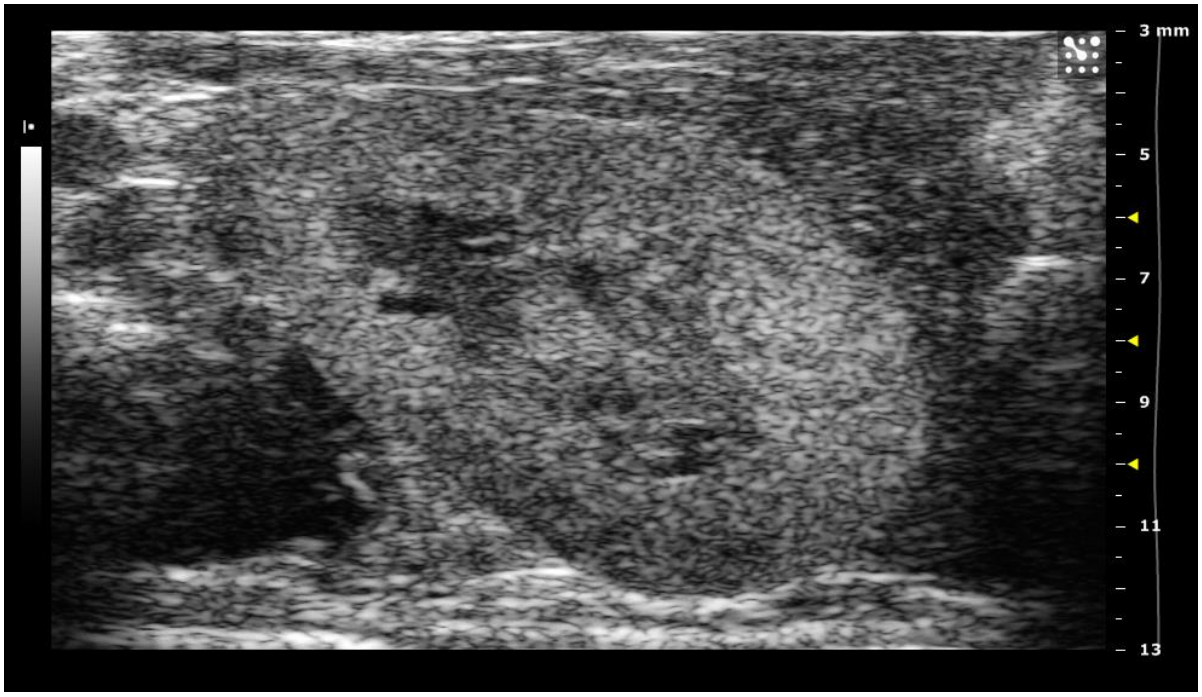

Figure 4 - Left kidney displayed in the transverse plane.

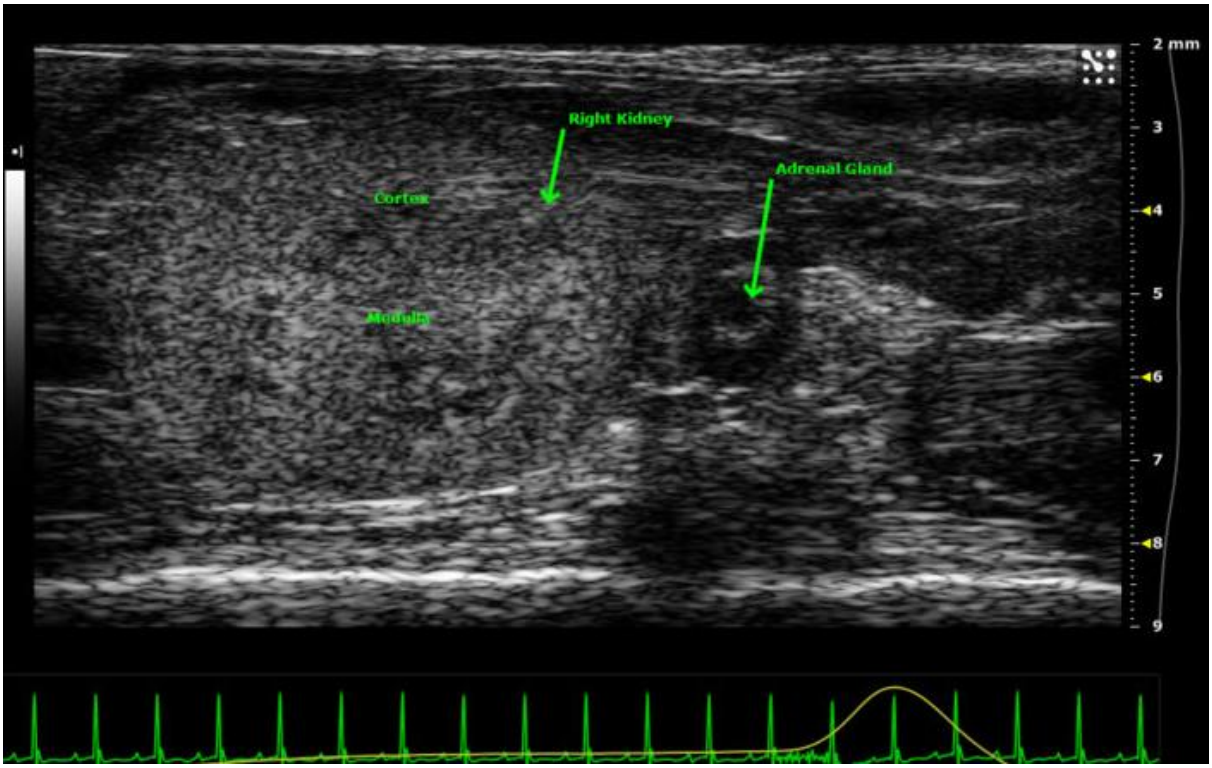

Figure 5 – Right kidney and adrenal gland displayed in the transverse plane

Measurements and Calculations for Kidneys and Adrenal Glands in B-Mode

Measurements	Calculations
Kidney	
L, R Kidney Sag	N/A
L, R Kidney Trans	N/A
L, R RA Diam	N/A
L,R RV Diam	N/A
Adrenal Glands	
RAG, LAG Sag	N/A
RAG, LAG Trans	N/A
RAA, LAA Diam	N/A
RAV, LAV Diam	N/A

Kidney and Adrenal Glands in Color and Power Doppler Modes

Color Doppler Mode and Power Doppler Mode imaging helps with identification of renal flow intensity and directionality and also helps identify the best points of interrogation in PW Doppler Mode for the blood flow of significant velocity. Also, Color Doppler Mode imaging could be very helpful in identification of flow pattern change for various pathologies.

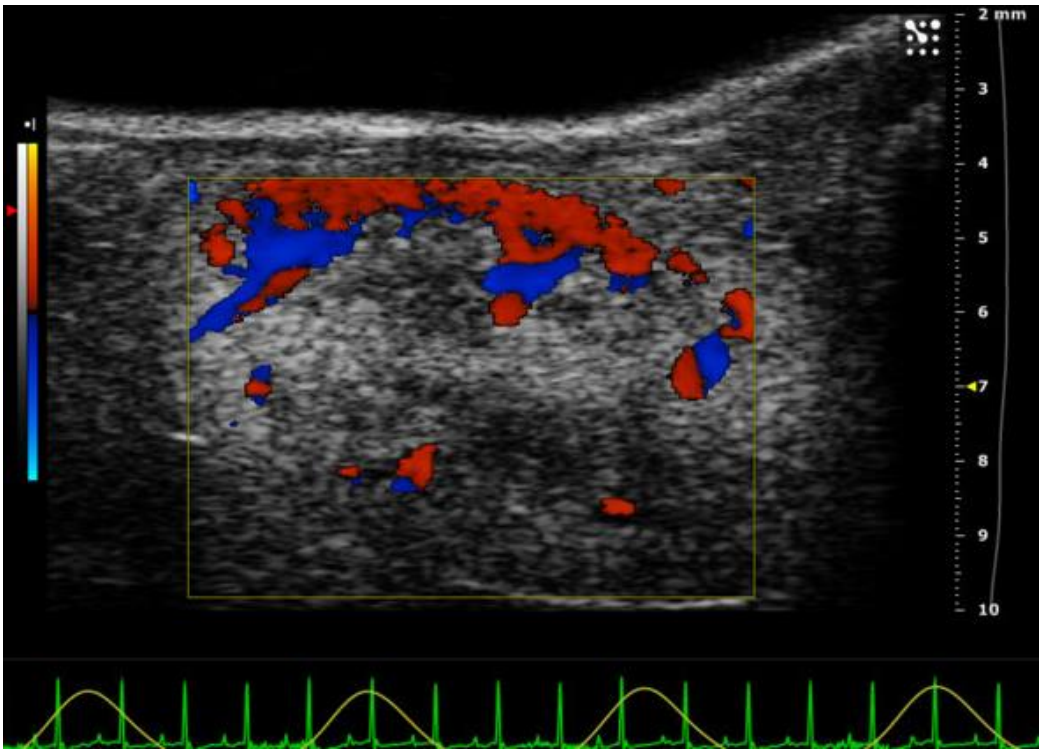

Figure 6 – Directional blood flow visualized in the medulla and cortex of the right kidney, displayed in transverse plane.

Figure 7 – Blood flow visualization of the right renal artery (Blue) and right renal vein (Red).

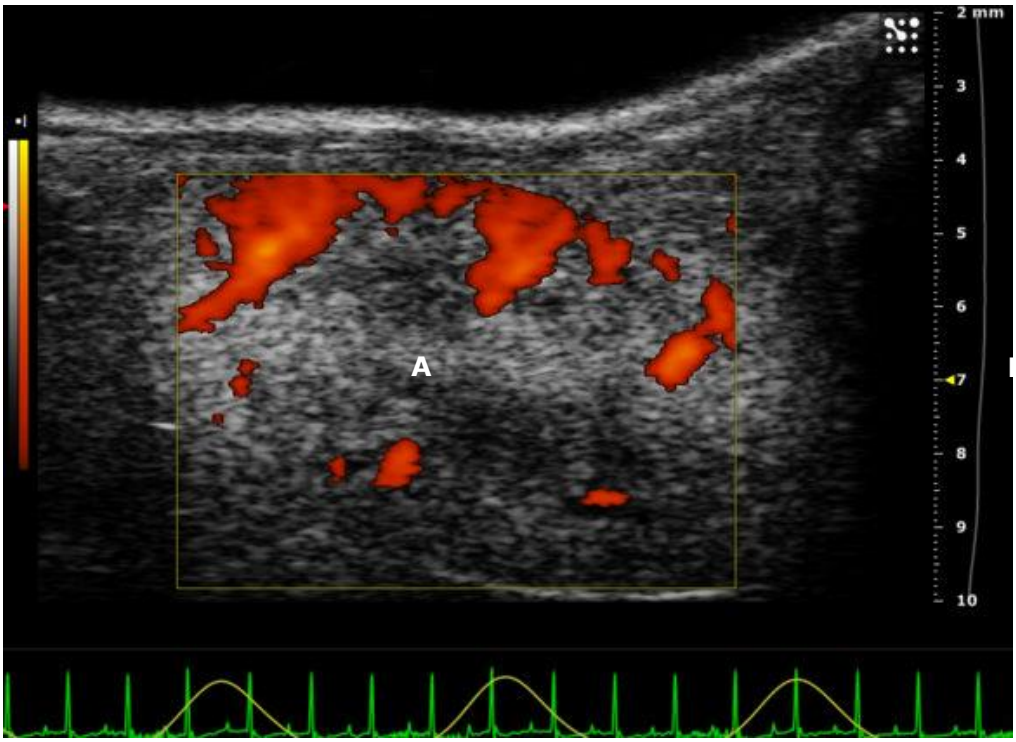

Figure 8 - Blood flow visualized in the medulla and cortex of the right kidney, displayed in transverse plane.

Figure 9 - Blood flow visualized from the right renal artery and right renal vein, leading into the medulla and cortex.

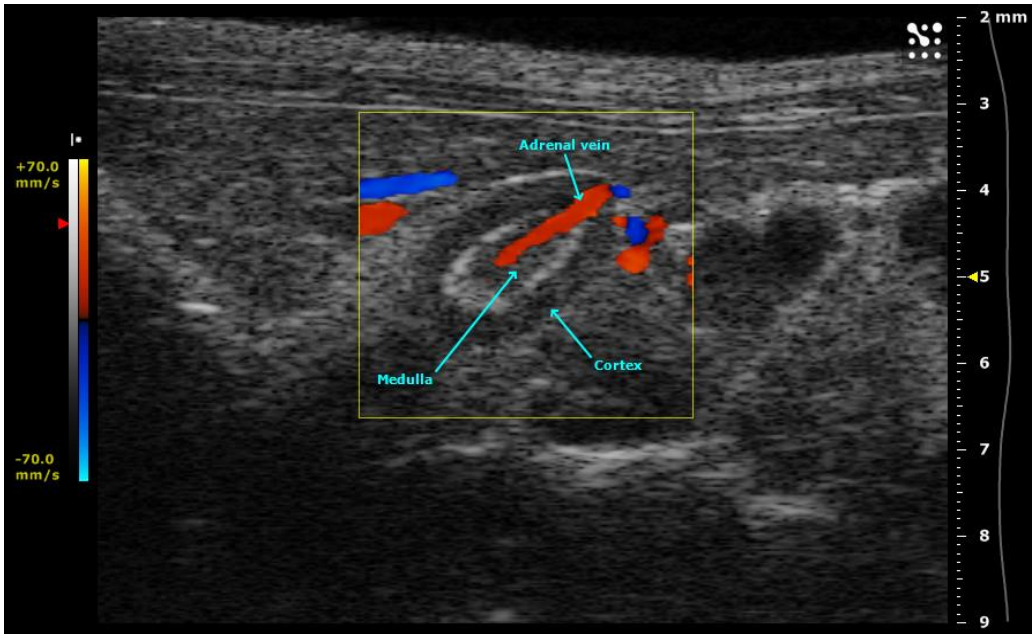

Figure 10 – Flow directionality visualized from the right adrenal vein and the medulla and cortex.

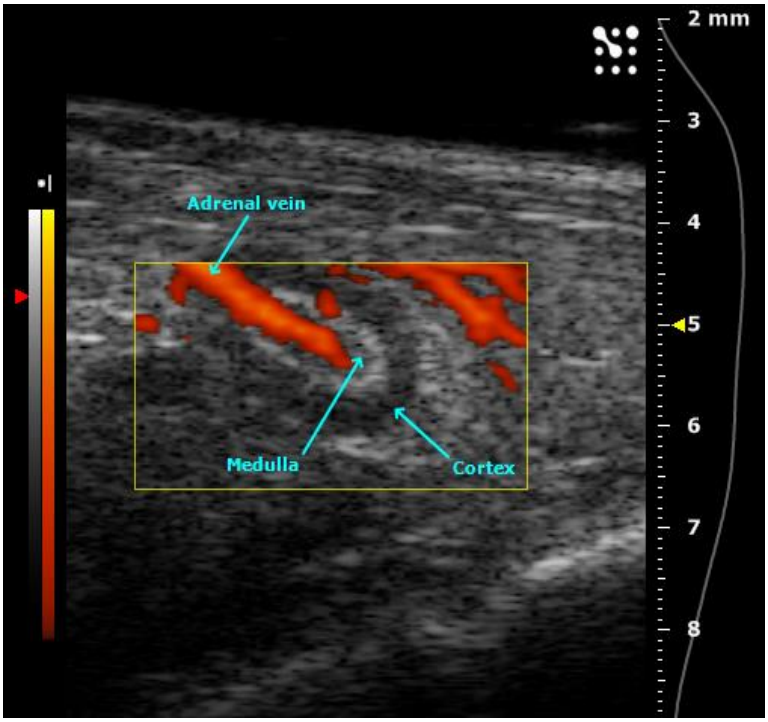

Figure 11 – Flow intensity visualized from the left adrenal vein

Kidney and Adrenal Glands in PW Doppler Mode

Investigation renal flow velocity using PW Doppler plays an important role in various types of studies such as research of kidney diseases, cardiovascular conditions or toxicity studies. The optimum imaging plane to analyze renal velocities is obtained from the transverse position.

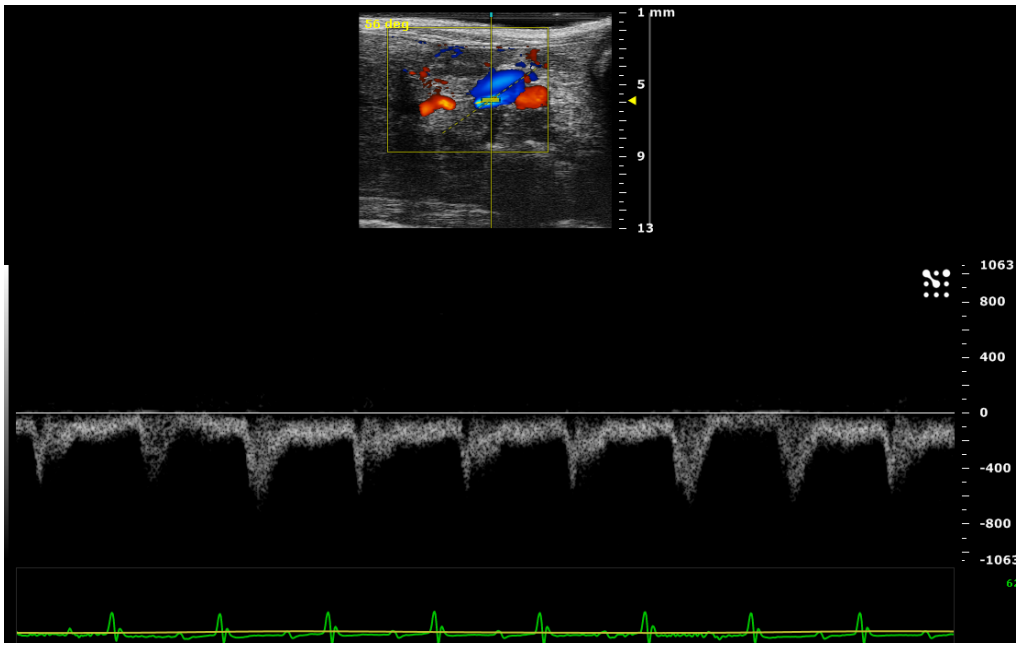

Figure 12 – Flow intensity visualized from the left adrenal vein

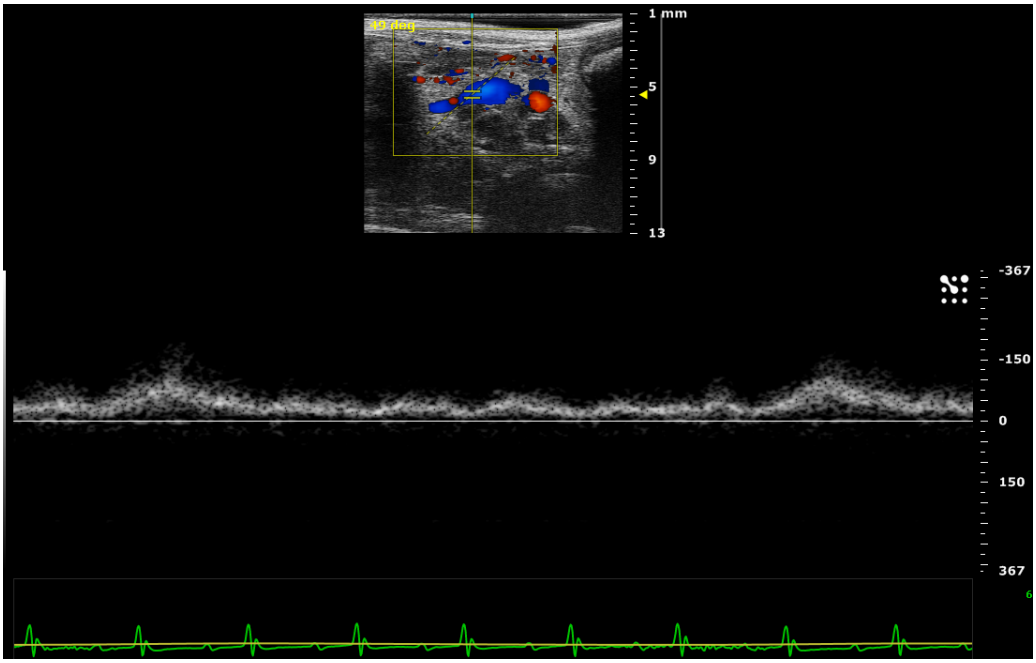

Figure 13 – Flow intensity visualized from the left adrenal vein

Measurements and Calculations for Kidneys and Adrenal Glands in PW Doppler Mode

Measurements	Calculations
Kidney	
L, R RA VTI	L, R RA RI
	L, R RA PI
Adrenal Glands	
RAA, LAA VTI	RAA, LAA RI
	RAA, LAA PI

Kidney 3D-Mode Imaging

3D-Mode imaging can be done to quantify the volume of the kidney. To perform 3D-Mode imaging, using the micromanipulator, scan across the kidney while noting the size by reading the ruler located on the micromanipulator. Reposition the transducer to the center of the region of interest, enter the **Range** of the motor travel, the desired **Step Size** (slice thickness) and click on "Start 3D" to begin 3D-Mode imaging.

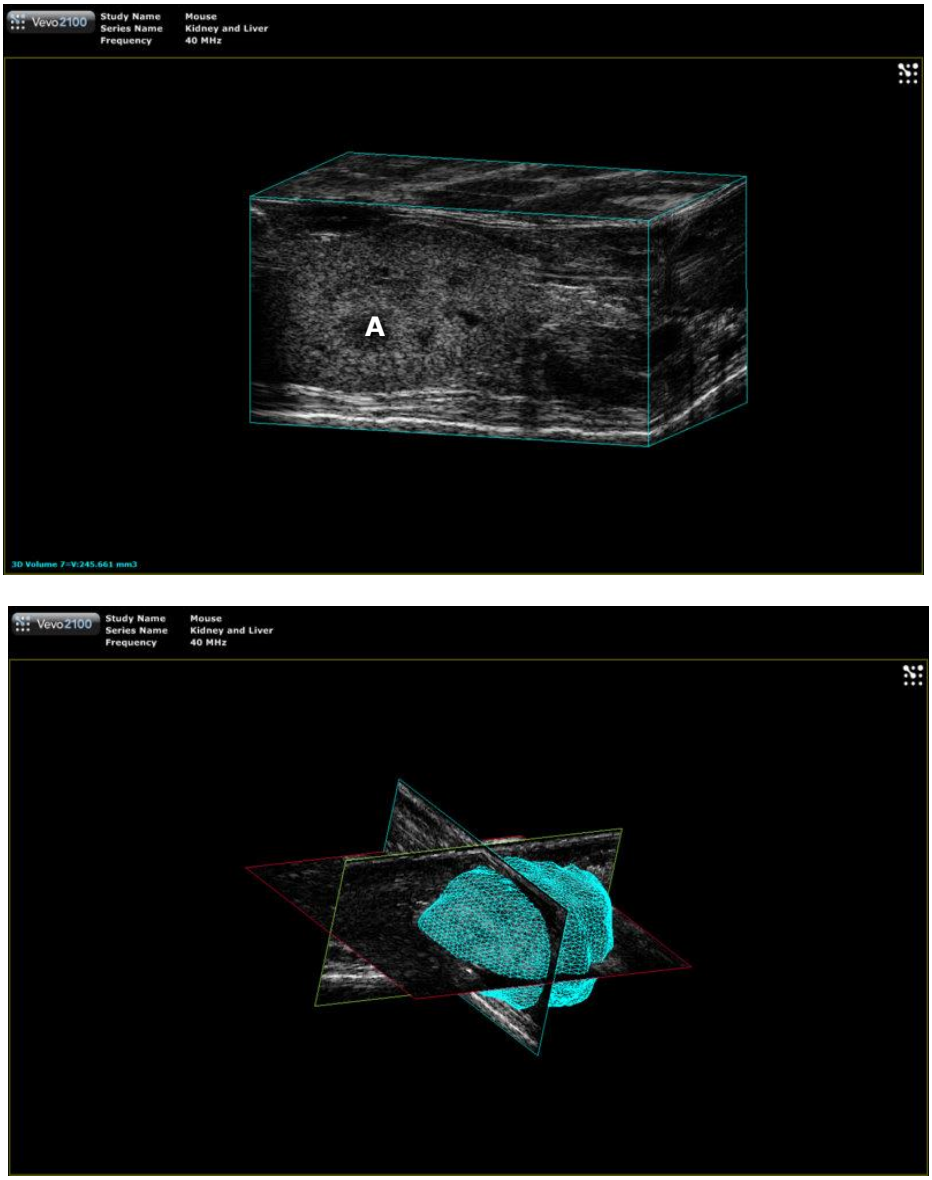

Figure 14 – The kidney displayed in the cube view (A) and the rendered volume for a 3D surface view of the kidney (B).

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