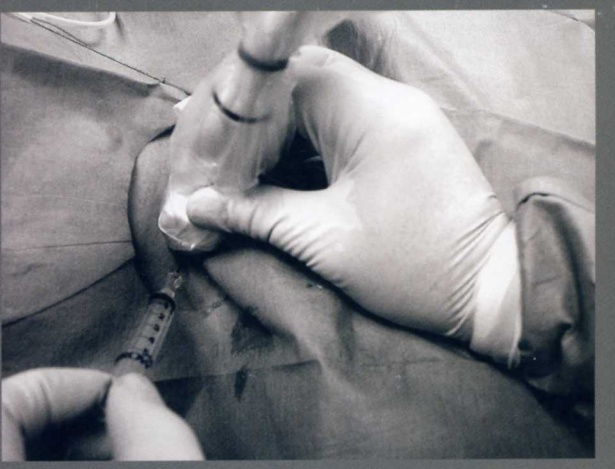

The Handbook of *Ultrasound* in Trauma and Critical Illness

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ADVANCED TRAUMA SCAN

SEE CHAPTER 6

AAA EXAM

Introduction

Leaking or ruptured AAAs are associated with a very high mortality rate. Unfortunately, only about 50% of patients with leaking or ruptured AAAs will have the classic triad of back pain, hypotension, and a pulsatile mass. Up to about one-third of patients with leaking or ruptured AAAs are misdiagnosed. Prompt recognition and emergent surgical management are the key factors in reducing morbidity and mortality. The use of bedside US can rapidly diagnosis the presence of an AAA and provide more rapid patient disposition.[2] The use of bedside ultrasound to detect the presence of a AAA can be accurately performed by ED physicians with limited training.[3]

Sonographic Technique

The patient should be in the supine position and a 2.5-5.0 MHz curvilinear transducer is recommended.

The examination is begun by placing the transducer perpendicular to the anterior abdominal wall in the subcostal region using the left-lobe of the liver as a window. The image depth should be enough that the relationship of the aorta to the vertebral body can be noted. The aorta is first located in long-axis with the transducer indicator directed toward the patient's head (Figures 107A and 107B). The aorta is then scanned in the long-axis using a "rock and glide" technique down to the bifurcation (Figures 108A and 108B). Increased pressure of the transducer may be needed during the examination to displace bowel gas.

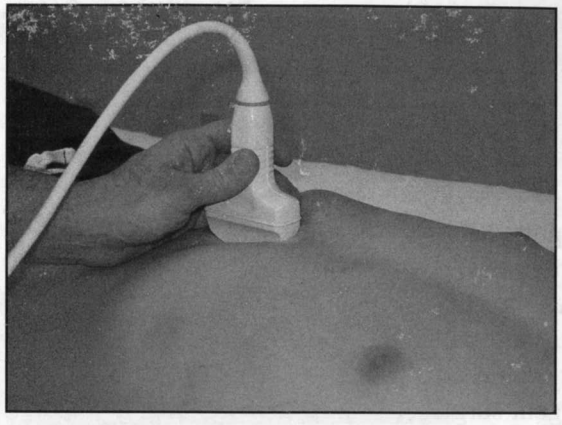

Figure 107A. Transducer placement for beginning long-axis scan of the aorta. Transducer indicator is directed toward patient's head.

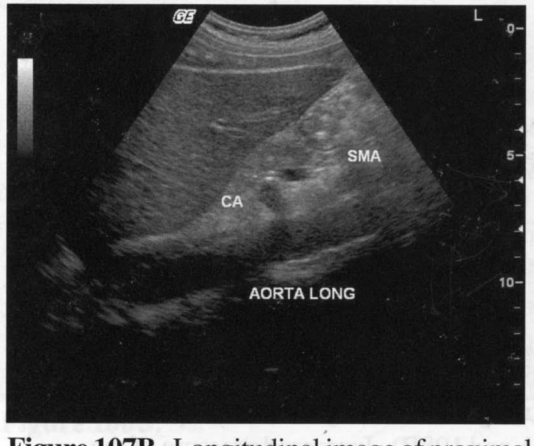

Figure 107B. Longitudinal image of proximal aorta with celiac artery (CA) and superior mesenteric (SMA) artery take-offs noted.

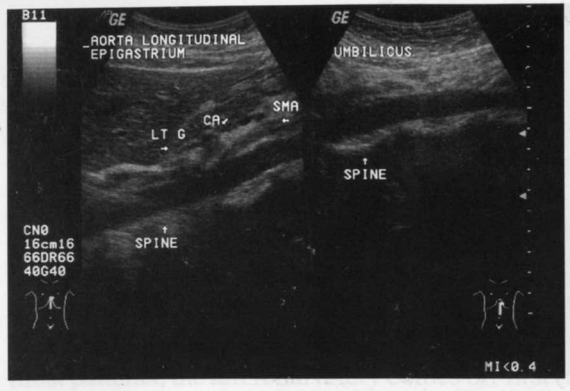

Figure 108A. Longitudinal images (split-screen) showing proximal through distal aorta (Courtesy of GE).

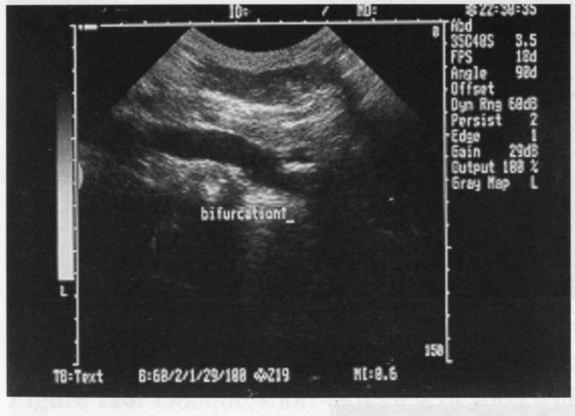

Figure 108B. Longitudinal image of distal aorta at bifurcation.

The transducer is then placed in the transverse plane with the transducer indicator directed toward the patient's right in the subcostal space (Figure 109A). The aorta is then scanned in the short-axis down to the bifurcation (Figures 109B and 109C). Increased pressure on the transducer may once again be needed during the examination to displace bowel gas. Measurements of the aorta are taken in the transverse plane in an anterior-posterior plane (Figure 109B).

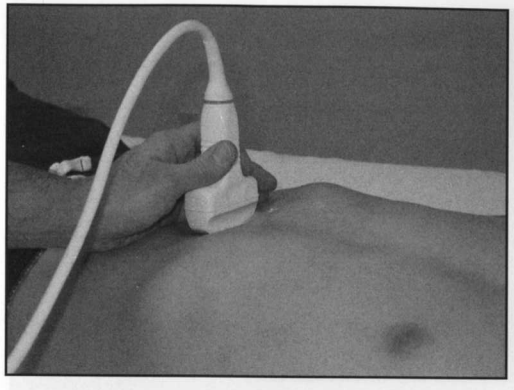

Figure 109A. Transducer placement for beginning the short-axis scan of the aorta. Transducer indicator is directed toward patient's right.

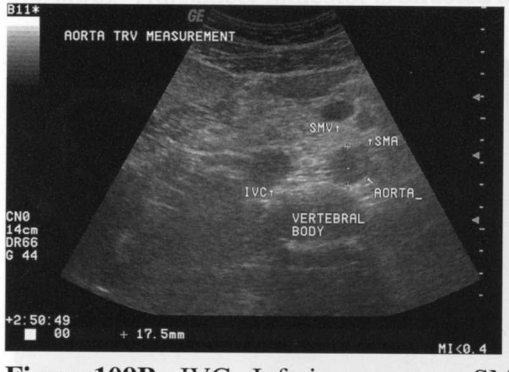

Figure 109B. IVC= Inferior vena cava, SMV=Superior mesenteric vein, SMA= Superior mesenteric artery.

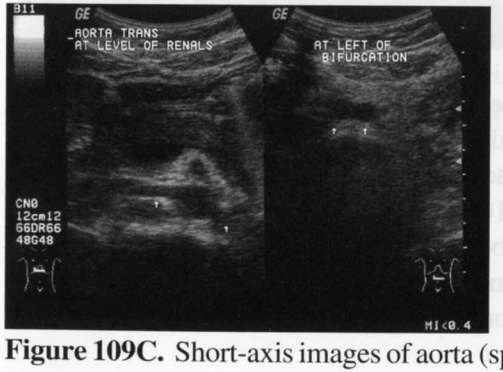

Figure 109C. Short-axis images of aorta (split-screen) at levels of the renal arteries (arrows) and the bifurcation (arrows).

Visualization of the renal arteries and assessing their relationship to the aorta is useful information for the operating surgeon. The renal arteries can be visualized with the patient in the supine position or in the left lateral decubitus position. For visualization with the patient in the supine position, place the transducer in the subcostal region with the transducer in the transverse plane. Gently turn the transducer into an oblique plane with the transducer indicator at the 8 o'clock position and angle the transducer slowly in the caudal direction. The renal arteries are attached to the aorta on the sides and can only be visualized in either the coronal or transverse planes of the aorta (Figure 110). In most patients, the left renal artery comes off first (more cephalad position). Having the patient take in a slow deep breath may aid in visualizing the renal arteries.

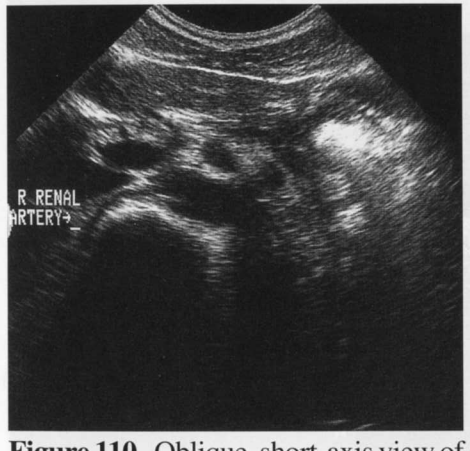

Figure 110. Oblique, short-axis view of aorta with takeoff of right renal artery noted.

Visualizing the renal arteries in the coronal plane is done by having the patient lie in a left-lateral decubitus position. The transducer is placed on the right side of the anterior abdominal wall with the transducer in a coronal plane (Figure 111). The liver can be used as a sonographic window if bowel gas is present. The coronal view will provide takeoff points of both renal arteries (Figure 112).

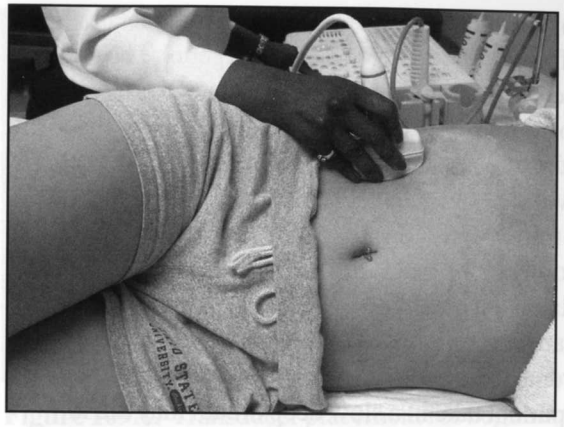

Figure 111. Transducer placement/patient position for coronal scan of renal artery takeoff.

Figure 112. Coronal view of aorta with both left and right renal artery takeoffs noted (arrows).

If bowel gas prevents visualization of the aorta, the patient can be placed in a right lateral decubitus position and the aorta scanned in a coronal plane through the inferior aspect of the left kidney (Figure 113). The aorta will be visualized in a coronal plane and can be followed by sliding the transducer in a caudal direction to the bifurcation (Figure 114).

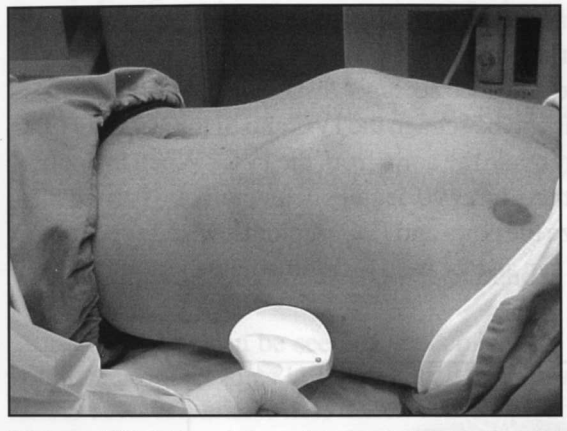

Figure 113. Transducer placement/patient position for coronal scan of aorta, using the spleen/left kidney as a sonographic window.

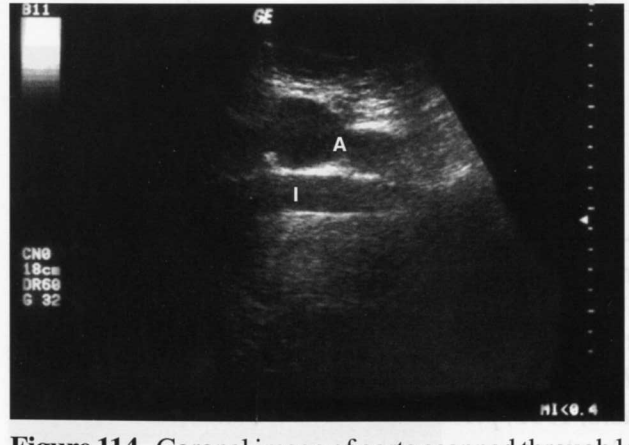

Figure 114. Coronal image of aorta scanned through left kidney demonstrating a dumbbell-shaped AAA.I=IVC, A=AAA.

Sonographic Findings

The aorta enters the abdominal cavity through the aortic hiatus of the diaphragm and is a retroperitoneal structure. The abdominal aorta gives off the following branches (in order) prior to its bifurcation: celiac trunk, superior mesenteric artery, left and right renal arteries, and inferior mesenteric artery (Figure 115). The aorta is normally no larger than 3cm in diameter at any point. The aorta tapers distally as it approaches its bifurcation. The maximum diameter of the common iliac artery in men is 1.5 cm and in women is 1.2 cm. The inferior vena cava (IVC) is thinner walled and does not taper distally like the aorta. Transmitted pulsations can be seen in the IVC and SHOULD NOT be used as a way to differentiate the aorta from the IVC. When in doubt on long-axis, turn the transducer 90 degrees counterclockwise into the short-axis and visualize the aorta and IVC. Color flow and spectral Doppler interrogation can also be used to differentiate the aorta from IVC.

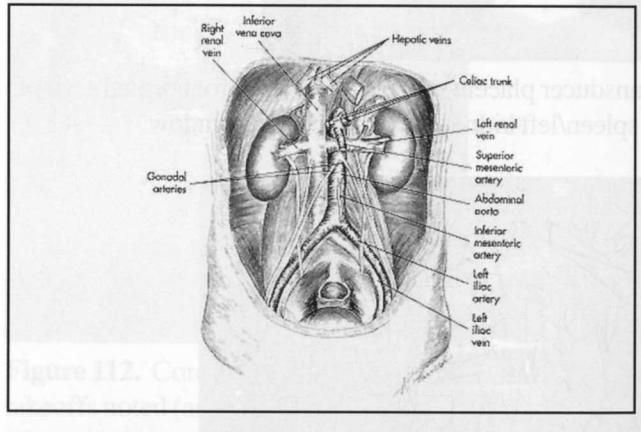

Figure 115. Normal anatomy of abdominal aorta.

(From Frazee BW. The Abdominal Aorta. In Snoey ER, Simon BC, eds: Ultrasound in Emergency and Ambulatory Medicine, Philadelphia: WB Saunders, 1995, p.191. Copyright WB Saunders 1995 Used by permission.)

An AAA is defined as an abdominal aorta with an AP diameter greater than 3cm (Figures 116A and 116B). Most aneurysms are infrarenal so it is essential that the entire aorta be scanned to the bifurcation. True aneurysms involve all three layers of the wall (intima, media and adventitia) while pseudoaneurysms only involve the adventitia. Aneurysms can be described in the following manner:

Fusiform (most common)- gradual transition between normal and abnormal

Bulbous- sharp junction between normal and abnormal

Saccular- sharp, sudden transition between normal and abnormal

Dumbbell- figure of eight appearance

Mural thrombus can be seen as areas of low to medium echoes within the wall (Figures 117A and 117B). Dissections may occur with AAAs but is essential to note that an aortic dissection is most commonly of thoracic aortic origin and is not interchangeable with the term leaking/ruptured AAA. Dissections will sonographically appear as an intimal flap noted within the vessel lumen (Figures 118A and 118B).

Figure 116A. Takeoff of right renal artery noted. Note absence of AAA at this level.

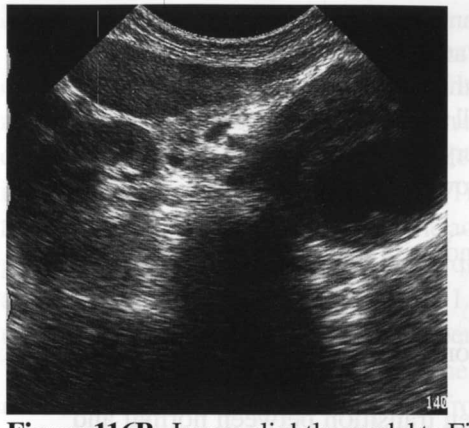

Figure 116B. Image slightly caudal to Figure 116 A revealing presence of AAA.

Figure 117A. Transverse image of AAA with mural thrombus noted.

Figure 117B. Longitudinal image of AAA with mural thrombus noted.

The relationship of the renal arteries to the AAA is noted, if possible, since this information is useful to the operating surgeon (Figures 116A and 116B). If the renal arteries cannot be visualized from the subcostal view or coronal view, its location can be estimated based on its known relationship to the superior mesenteric artery. In most people, the renal arteries takeoff about 1 cm distal to the takeoff of the superior mesenteric artery. The superior mesenteric artery is much easier to locate and a conservative measurement of 2 cm distal to the superior mesenteric artery takeoff made and the relationship of the AAA to that point noted.

Figure 118A. Short-axis view of aorta revealing echogenic intimal flap (arrow).

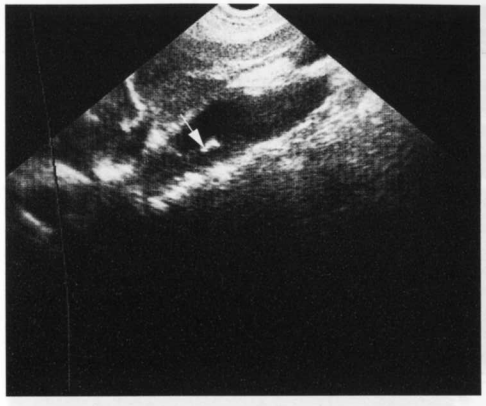

Figure 118B. Long-axis view of aorta revealing echogenic intimal flap (arrow).

Clinical Application

Bedside US is essentially 100% sensitive in the detection of AAA. US can be used to quickly include or exclude the diagnosis of AAA. However, the diagnose of aortic rupture is made only 4% of the time with US and is usually based on the presence of a complex fluid collection in the retroperitoneum (Figures 119A and 119B).[2]

Figure 119A. Aortic rupture. Longitudinal image of proximal abdominal aorta (arrowheads) in an elderly male with a known thoracoabdominal aortic aneurysm who presented in extremis and was found sonographically to have a complex fluid collection anterior to the abdominal aorta which represented retroperitoneal hemorrhage. Patient was found in the operating room to have a large retroperitoneal hematoma.

Figure 119B. Aortic rupture. Transverse view of aorta (arrowheads) in same patient with echogenic fluid surrounding the superior mesenteric artery (arrows).

Pitfalls

1. Failing to scan all the way to the bifurcation.
2. Misdiagnosing the IVC as the aorta due to the presence of pulsations.
3. Not scanning the aorta in both long and short-axis.