EFSUMB Course Book, 2nd Edition

Editor: Christoph F. Dietrich

Aorta, visceral arteries and inferior vena cava

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Doppler ultrasound of the aorta

CT angiography (CTA) and MR angiography (MRA) are commonly used imaging methods to evaluate diseases of the aorta. CTA is particularly useful to evaluate the abdominal aorta in acute aortic syndrome (AAS). In practice, the diagnosis of intramural haematoma can be reliably made using CT, and other manifestations of AAS can be reliably and relatively quickly evaluated with multidetector-row CT and CTA. To perform both CTA and MRA, intravenous injection of iodinated or gadolinium-based contrast media is required.

Ultrasound may also be useful, especially to detect the presence of an abdominal aortic aneurysm (AAA) and to follow-up its course. Ultrasound allows follow-up patients after surgery or endovascular aortic repair (EVAR) for AAA. For the evaluation of the abdominal aorta and inferior vena cava (IVC) convex low-frequency transducers are used with a frequency range of 2.5–5 MHz, depending on the patient's body volume. Ultrasound is useful to demonstrate atherosclerotic changes of the aortic wall and to measure aortic diameter. Iliac arteries can be visualised well, as well as the coeliac trunk and its branches and mesenteric arteries. These vessels are usually examined with the patient in a supine position [(1)].

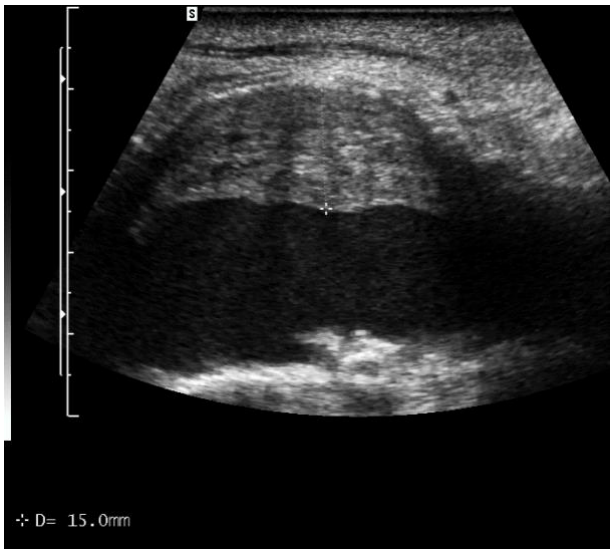
Aneurysm of the abdominal aorta and iliac artery are significant and potentially fatal conditions, which may remain clinically asymptomatic for years [(2-4)]. Acute aortic syndrome consists of aortic dissection, penetrating aortic ulcer and intramural haematoma. Ultrasound can demonstrate aneurysms that may be entirely asymptomatic. US can be used to follow-up enlargement of an aneurysm and to assess complications after surgery or endovascular treatment. If a patient is referred for ultrasound for AAA, one should measure the diameter and length of the aneurysm, evaluate the extension of the AAA to iliac arteries and try to determine the relation of the AAA to the renal arteries. The diameter of the normal aorta in adults is 2–2.5 cm, and a diameter above 3 cm is diagnostic of AAA. However, an aneurysm can be present even if the diameter is below 3 cm, if there is a focal dilatation of aorta. Normal iliac arteries have regular walls, with a maximum diameter of the common iliac artery of 1.5 cm [(2)].

AAAs of atherosclerotic origin are most commonly saccular or fusiform in shape and of infrarenal origin. They usually terminate at the aortic bifurcation but may extend into the iliac arteries. These are true aneurysms, containing all layers of the aortic wall. It is recommended

to briefly examine the aorta by ultrasound to rule out AAA in all patients who are referred to ultrasound for examination of peripheral arteries, because AAA is often asymptomatic. AAA usually enlarges 2 mm per year, and the dynamics of enlargement can be determined by ultrasound examinations [(1, 2, 5, 6)]. AAA is shown in Figure 1.

Figure 1 Saccular aneurysm of abdominal aorta in longitudinal (a) and transversal scan with mural (parietal) thrombi. Colour Doppler is also shown (c). The arrow shows microcalcifications.

a



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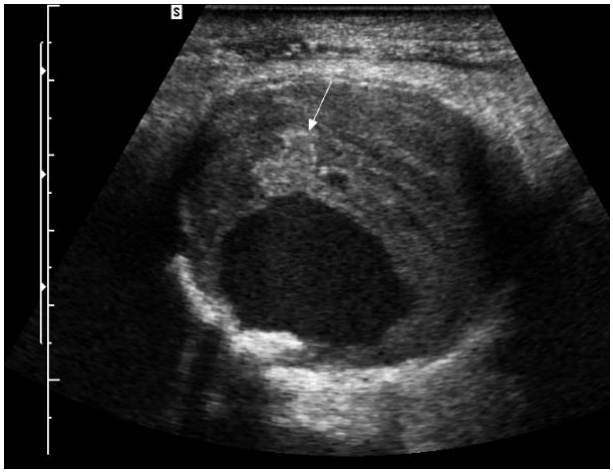

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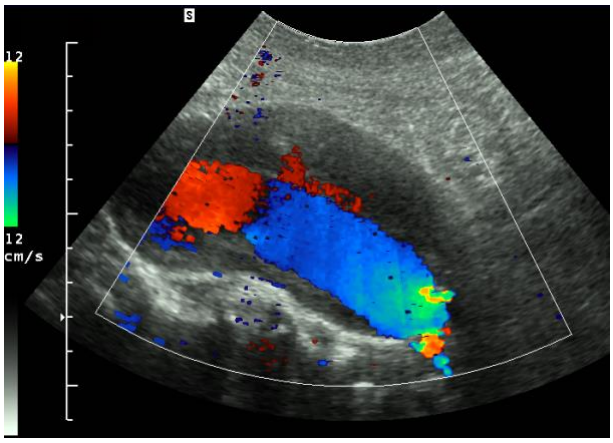
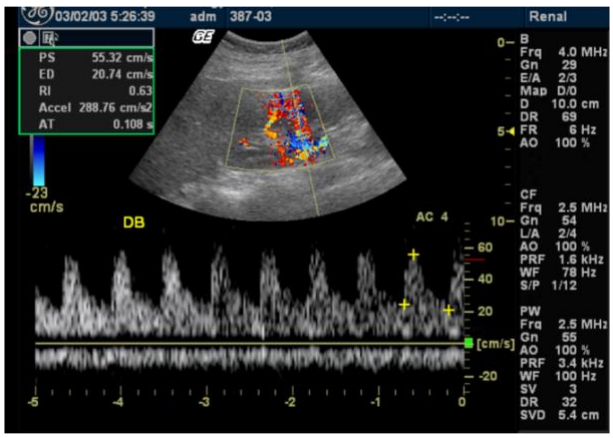


It is important to assess whether the aneurysm is infrarenal or if it affects renal arteries. If AAA is infrarenal it is relatively easy for the surgeon or radiologist to preserve the flow in kidneys during AAA surgery or EVAR placement. If AAA extends to the origin of renal arteries, surgery is more complicated and may require reimplantation of renal and/or mesenteric arteries of the use of fenestrated EVAR (FEVAR). [(2)]. It is useful to analyse features of intrarenal arterial flow during the evaluation of AAA. This topic is discussed elsewhere in this chapter. One should also always carefully examine the kidneys to identify hydronephrosis caused by AAA. Involvement of ureters is particularly common with inflammatory aneurysms causing periaortic retroperitoneal fibrosis [Figure 2].

Figure 2 Normal intrarenal arterial Doppler spectra, with normal velocities and normal vascular resistance in a patient with AAA.

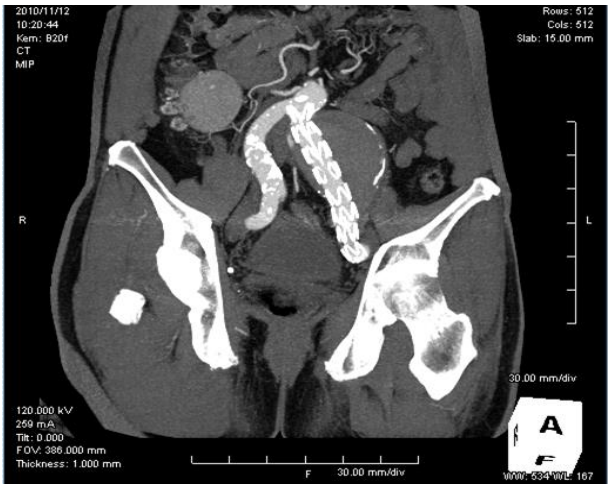


The distal end of AAA should be carefully evaluated to determine whether the iliac arteries are also affected. Most iliac artery aneurysms are related to AAA with the common iliac artery is most commonly affected. Isolated iliac artery aneurysms are seen less often. They are dangerous because they may not be palpated, may be large and may rupture with non-specific symptoms of abdominal or pelvic pain that are unrecognised, with associated high mortality and delayed surgery [(1)] [Figure 3].

Figure 3 **CT angiography of the large isolated left iliac artery aneurysm (a). CT angiography of the same patient after endovascular treatment of iliac artery aneurysm with the stent-graft (b). Colour Doppler image of the patent stent-graft and aneurismal sac excluded from the circulation (c). Normal, triphasic spectra within the stent graft in iliac artery (d).**

a

b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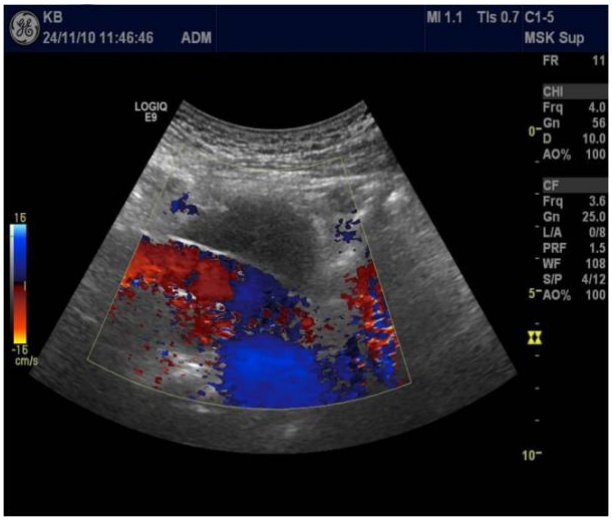
c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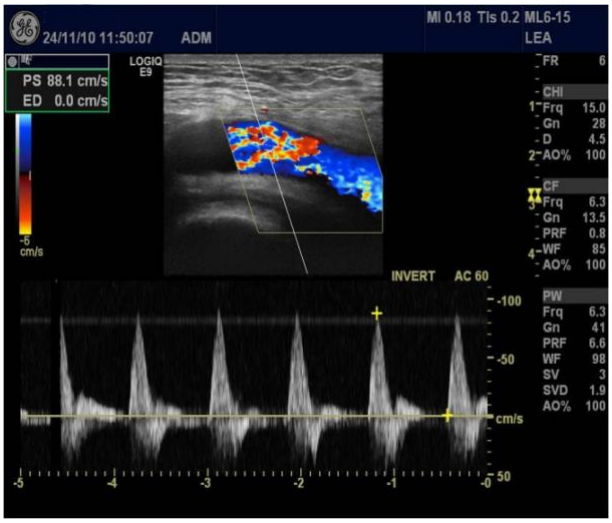
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50

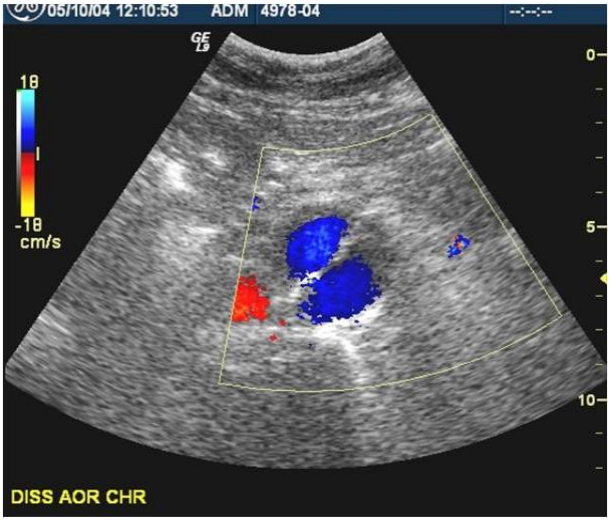
Colour Doppler may enable diagnosis of renal artery or superior mesenteric artery occlusion but CTA is more accurate than ultrasound. A combination of duplex Doppler and MRA has a similar accuracy to CTA for evaluating all features of aortic aneurysms. In the case of AAA rupture, CT should be performed as it provides the most accurate assessment.

Although CTA is superior to ultrasound in diagnosing aortic dissection and other conditions of acute aortic syndrome, ultrasound raise the initial suspicion of AAS. In cases of aortic dissection ultrasound may visualise the intimal flap and flow in a true or false lumen [Figure 4]. A pseudoaneurysm is shown in Figure 5.

Figure 4 **B-mode example of chronic dissection of abdominal aorta with the intimal flap clearly visible within the vessel lumen (a). Transverse scan of aorta of the same patient with the flow visible by colour Doppler in both lumina (b). Doppler spectrum demonstrating flow in the true lumen of dissected aorta (c). Doppler spectrum demonstrating flow in the false lumen of dissected aorta (d). A second example is shown with the flap clearly visible within the vessel lumen (e), panoramic imaging (f) and CEUS (g) with undulating ("WELLE") flow in the false lumen.**

a

b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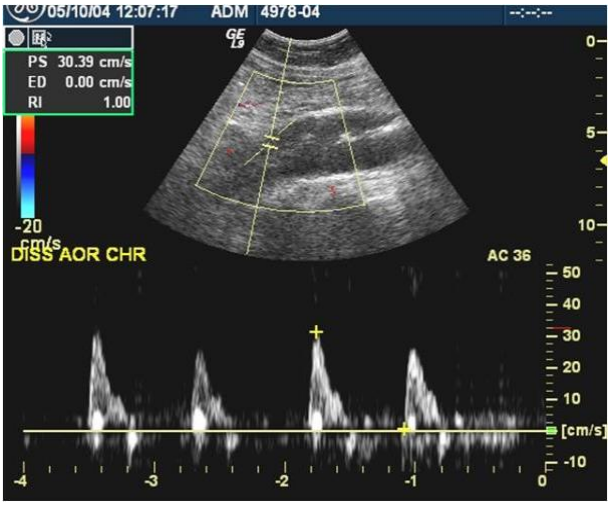
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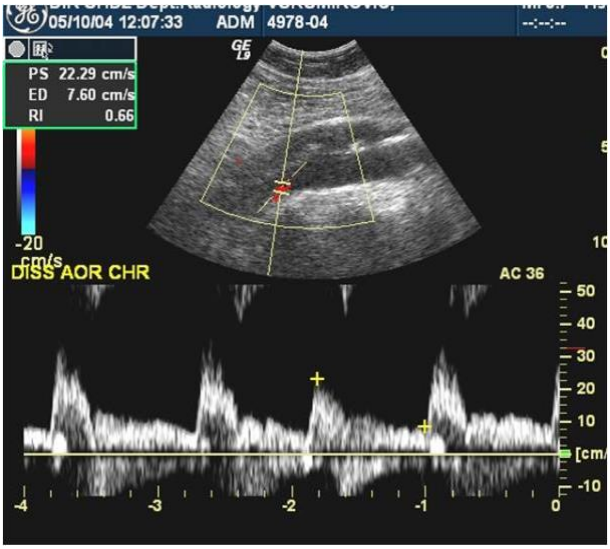
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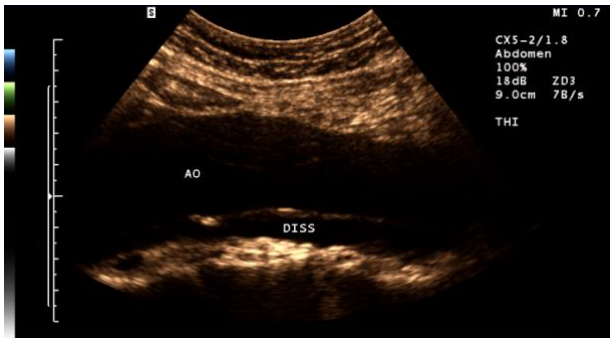
e



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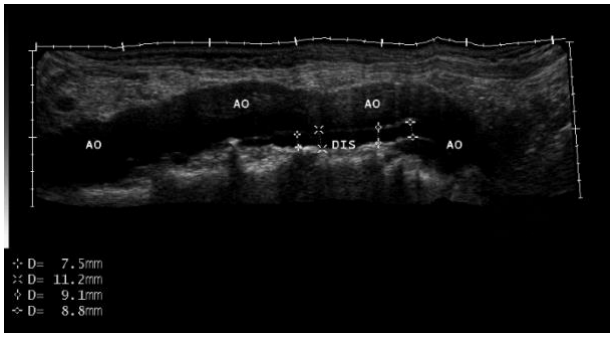

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