

CASE REPORT

Diagnostic Colour Duplex Ultrasound for Type IIIb Endoleak

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Introduction: This report presents the treatment of an aortic endovascular aneurysm repair (EVAR) device failure, focusing on the use of colour duplex ultrasound (CDUS) to diagnose and confirm effective treatment of a type IIIb endoleak.

Report: An 89 year old man with a history of EVAR was transferred to the authors' centre with complaints of abdominal pain and a pressure sensation behind the umbilicus. A previously stable 11 cm aneurysm sac was visualised on computed tomography angiography in addition to a newly suspected type IIIb endoleak, which was confirmed via CDUS. He underwent successful endovascular repair with a stent across the limb defect. The patient was discharged uneventfully and was followed for surveillance.

Discussion: Type IIIb endoleak is an underreported complication after EVAR. CDUS of type IIIb endoleak aided in localisation and characterisation of the graft failure, and confirmed successful endovascular treatment of the endoleak defect in the side limb. Locating the point of graft failure using CDUS preceding endovascular repair of type IIIb endoleaks guides interventions and repair outcomes. It is a rare opportunity to report a case of acute type IIIb endoleak with CDUS that definitively localised an endograft defect.

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INTRODUCTION

Endoleaks, defined by persistent perigraft flow within the aneurysm sac, are the most common complications of endovascular aneurysm repair (EVAR), with an incidence ranging from 2% to 45%.¹ Specifically, type III endoleaks result from a disconnection in the graft (IIIa) or defect in the graft material (IIIb). The incidence of type III endoleaks is 2.6%–3.5% and is the lowest of all endoleak types.² However, the importance of type III endoleak surveillance should not be undermined, especially in light of the most recent Food and Drug Administration Class I recall of Endologix (Irvine, CA, USA) AFX Endovascular AAA System, and the fact that these dangerous endoleaks increase risk of aortic rupture.^{2,3}

Ultrasound is one of the accepted methods of EVAR surveillance and can be followed by computed tomography angiography (CTA) if there is an obvious endoleak or sac expansion. CTA, although highly sensitive for endoleak detection, introduces risk from cumulative radiation dose and inflicts a significant cost burden compared with ultrasound. In contrast, colour duplex ultrasound (CDUS) is the

least sensitive method of endoleak detection, with sensitivity reported in a meta-analysis as 74% (95% confidence interval of 62%–83%).⁴ The variability is attributed to the technical skills and experience of the operator as well as body habitus and cooperation of the patient. Despite the wide ultrasound confidence interval, a large study revealed that no necessary interventions were missed based on ultrasound diagnostics.⁵ Additionally, CDUS is non-invasive, does not require exposure to radiation or contrast medium, is widely available, and is easy to perform. This report describes the application of CDUS as a diagnostic tool for confirmation of a type IIIb endoleak.

REPORT

An 89 year old man was admitted with complaints of abdominal pain. He had a history of abdominal aortic aneurysm (AAA) repair (EVAR) with a Medtronic Talent (Santa Rosa, CA, USA) device 15 years prior to presentation. The original repair was notably complicated by a series of various endoleaks and interventions. Specifically, he had a history of persistent type I endoleaks that required conversion to aorto-uni-iliac with a Medtronic Endurant (Santa Rosa, CA, USA) device followed by a femorofemoral cross-over bypass and a subsequent infrarenal aortic wrap to correct. In addition to his complicated AAA repair history and endoleak interventions, he had a history of coronary artery disease status post stent placement and atrial fibrillation on warfarin. He had a 50 pack year smoking history

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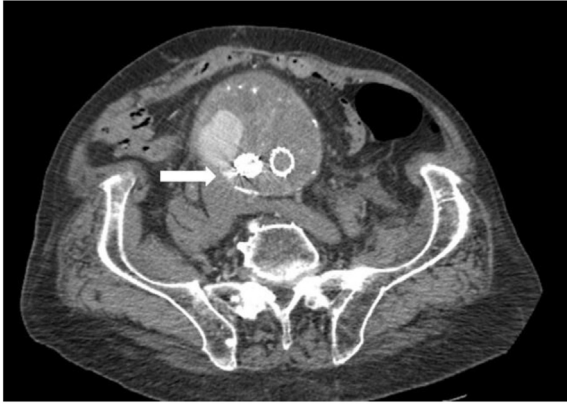


Figure 1. Computed tomography angiography at patient presentation demonstrating contrast extravasation (white arrow) in the right limb of the endovascular aneurysm repair device, representing concern for new type IIIb endoleak.

but had quit 30 years ago. Additionally, he had a history of obstructive sleep apnoea.

On admission, he was normotensive, non-tachycardic, and afebrile. He did not have leucocytosis and his basic metabolic work up was within normal limits. Physical

examination was significant for a pulsatile midline mass. CTA demonstrated a stable 11 cm aneurysm with contrast extravasation and possible concern for a new endoleak that was presumed to be a type III (Fig. 1). Of note, he had been followed on a routine basis with a stable aneurysm sac and no evidence of an endoleak. This endoleak finding was new since his last imaging study just a few months prior to this presentation. Aorto-iliac CDUS was performed which confirmed an obvious type IIIb endoleak (Fig. 2). CDUS metrics described the nature of the endoleak: the velocity of flow in the aneurysm sac was 63 cm/sec, and the source of the endoleak was a flow jet from the body of the right limb of the EVAR device, with a systolic velocity peak of 450 cm/sec. An aortogram confirmed a type IIIb endoleak in the right limb, with evidence of device disruption (Fig. 3A, the red arrow pointing to contrast smear demonstrating endoleak). Owing to significant tortuosity, a Viabahn VBX graft (WL Gore and Associates, Flagstaff, AZ) was placed over the leak site, and a subsequent aortogram demonstrated endoleak resolution (Fig. 3B). Of note, the uni-iliac limb was 16 mm in diameter. An 8 mm × 79 mm (large) VBX graft was selected which was dilated to 16 mm to match the limb diameter. The following day, a repeat colour duplex was performed. A final CDUS confirmed no evidence

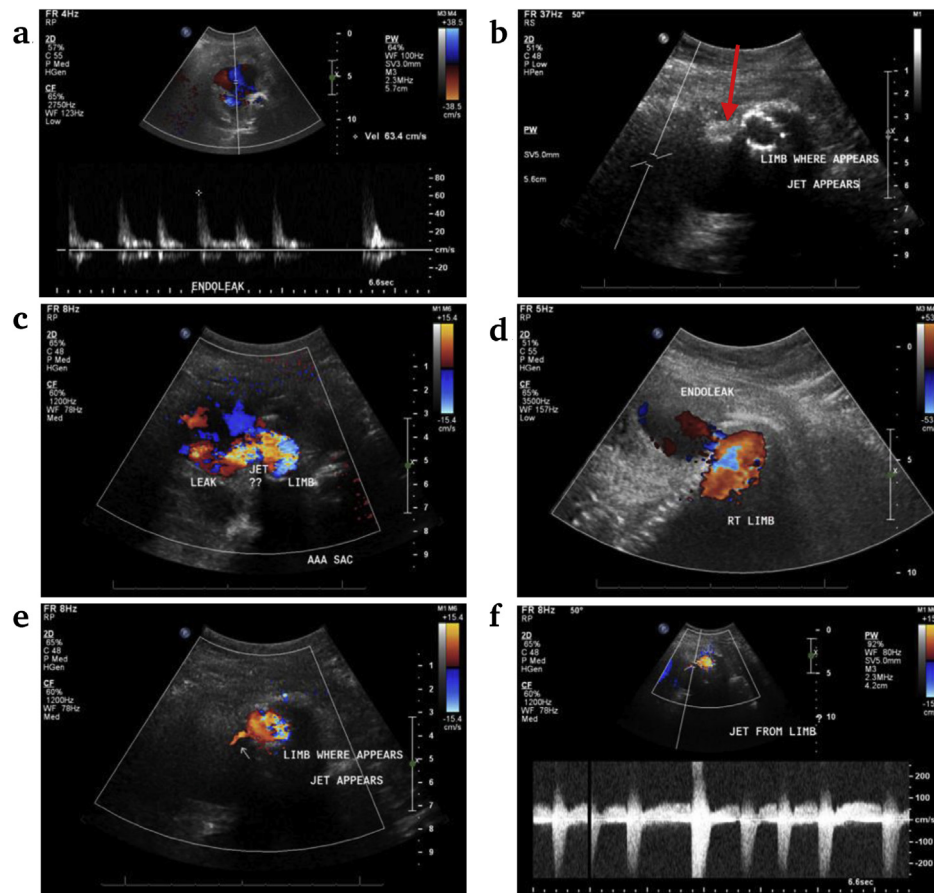


Figure 2. Turbulent flow (63 cm/sec) in the aneurysm sac suspicious of endoleak (A). Type III endoleak with flow jet in right limb of endovascular aneurysm repair device (arrow, B). Colour flow demonstrates positive velocity through endoleak (C–E). Peak velocity of flow jet from right limb is 450 cm/sec (F).

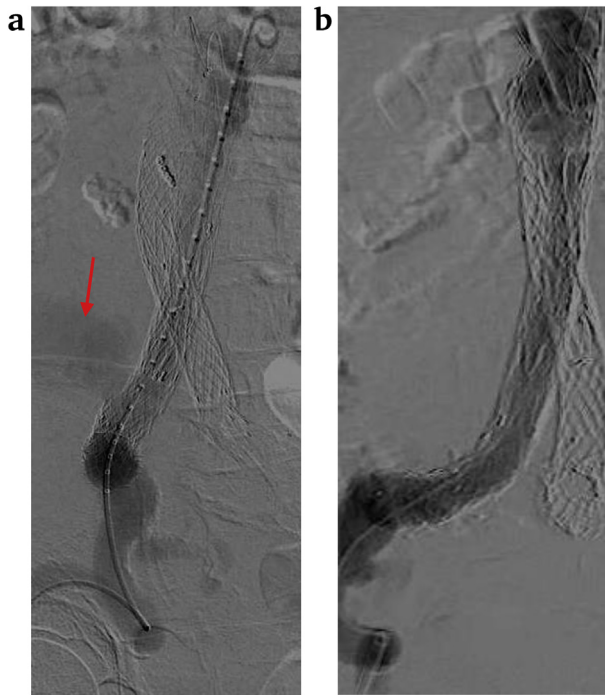


Figure 3. Endoleak extravasation from right limb of endovascular aneurysm repair device confirmed on angiogram (arrow, A). No endoleak extravasation from right limb after stent graft placement (B).

of flow in the revised aneurysm sac (Fig. 4). Additionally, there was no evidence of increased velocities throughout the right limb as noted in the colour duplex prior to stent placement. The patient has since presented for one month

follow up and there remains no evidence of endoleak on duplex.

DISCUSSION

The early survival advantage from EVAR of AAAs is supported by large, randomised control trials including EVAR I, DREAM, ACE, and OVER.⁶ Subsequently, population based outcomes from state wide inpatient databases confirm the mortality benefits generated from these large, randomised trials.⁷ The 2019 European Society for Vascular Surgery (ESVS) guideline describes a Class IIa, Level B recommendation in favour of EVAR for patients with suitable anatomy and reasonable life expectancy, but open repair for patients with long life expectancy.⁸ Although EVAR decreases morbidity and mortality rates compared with open repair in the short term, long term failures related to endovascular graft durability may occur. Lifelong endograft surveillance via CTA at least every five years is the most common and recommended modality of endograft surveillance.⁸ Endoleaks are the most frequent complications of EVAR, with a significantly increased risk of AAA rupture. The incidence of type IIIb endoleaks has challenged post-market modifications, specifically Endologix’s update of the AFX endograft to the AFX2 in 2014.⁹ Thus, identifying IIIb endoleaks is imperative to endograft surveillance and pre-operative planning.

The ESVS proposed an example algorithm for EVAR surveillance that includes a 30 day post-repair CTA, followed by patient stratification and use of multimodal imaging (DUS) based on initial imaging.⁸ However, a publication review of

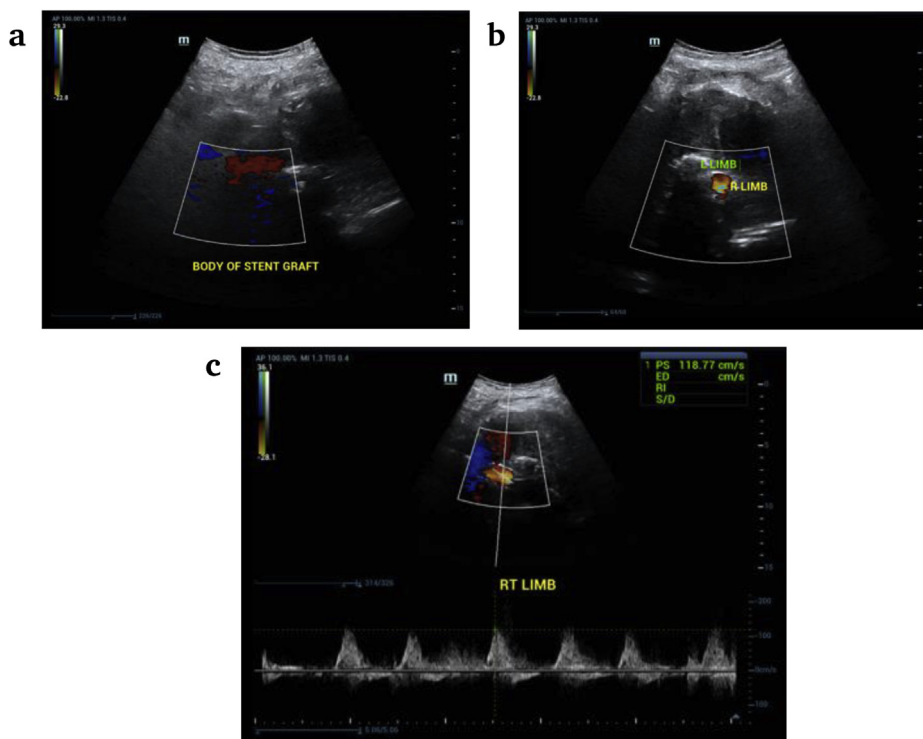


Figure 4. Absence of turbulent flow around body of stent graft confirms treatment of endoleak (A). Unidirectional laminar flow within the right limb borders with no evidence of flow jet wave outside the limb confirms successful treatment of type III endoleak (B, C).

all type IIIb endoleaks demonstrated that definitive diagnosis is challenging even with multimodal imaging due to the dynamic nature of failure detection.⁹ According to a systematic review of all type IIIb endoleaks from 1998 to 2017, only 20% were definitively diagnosed on CTA.¹⁰ In addition to CTA, contrast enhanced ultrasound (CEUS) offers additional specialised blood flow and tissue perfusion information. CDUS is the least sensitive method of endoleak detection compared with CTA and CEUS. Like CEUS, CDUS is non-invasive, and does not require exposure to radiation or contrast medium. Additionally, CDUS is widely available and is relatively easy to perform. It is a rare opportunity to report a case of acute type IIIb endoleak whereby CDUS definitively localised the defect and quantified directional flow velocity through the defect.

In the presented case, a type IIIb endoleak of the right limb of the EVAR device was clearly identified by CDUS. This allowed for excellent correction of the endoleak by placing a stent graft at the point of graft fracture. Following the intervention, CDUS confirmed adequate treatment of the type IIIb endoleak. Currently, ultrasound serves as a surveillance modality following EVAR for AAA. The laboratory performs hundreds of CDUS studies each year for endograft surveillance. The laboratory technicians are trained to identify the source of an endoleak, including a type IIIb. If CDUS does not demonstrate a clear endoleak in a symptomatic patient, then a CTA followed by an angiogram will be carried out. In this case, the initial CTA imaging did not clearly define the location of the endoleak. Although a type IIIb was suspected, this suspicion was confirmed on duplex imaging. Additionally, CDUS was used to verify location and flow characteristics of the suspected endoleak. CDUS provides real time data in multiple planes and across circumferential sites. CDUS allows for precise, exact isolation of endoleak and flow direction, even in the presence of coils or onyx obscuring the aneurysm sac. The benefit of meticulous diagnostics while minimizing negative side effects and healthcare costs cannot be over emphasised.

CONCLUSION

If endoleak is suspected, a colour duplex before and after endoleak treatment may determine the flow velocity, direction, and defect location and confirm adequate endovascular treatment of type IIIb endoleaks. Multimodal imaging, including CDUS, for surveillance of and detection of endovascular complications may improve risk management of graft complications.

CONFLICTS OF INTEREST

None.

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