Contrast-enhanced tomographic ultrasound for endoleak detection and classification following endovascular aneurysm repair: case study

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Introduction

An endoleak is defined as persistent blood flow in the aneurysm sac following stent grafting. Endoleaks may cause pressurization of the aneurysm sac and can lead to aneurysm rupture after endovascular aneurysm repair (EVAR). Contrast-enhanced computed tomography (CTA) is considered the gold standard for the detection and classification of endoleaks. Nevertheless, cumulative radiation dose, cost, and increased demand for computed tomography aortography suggest that duplex ultrasonography (DU) may be an alternative to CTA-based surveillance after EVAR. Contrast-enhanced ultrasound (CEUS) involves the intravenous administration of a stable suspension of sulfur hexafluoride micro-bubbles surrounded by a phospholipid shell as an ultrasound contrast agent enhancing the visualization of flowing blood [1]. Although CEUS was first reported 19 years ago [2], studies demonstrating an improved sensitivity for endoleak to at least the level equivalent to CTA, have only recently been performed. Contrast-enhanced tomographic ultrasound (CEtUS) uses a magnetic position tracking system to convert a sequence of 2D ultrasound images into a 3D volume. It enables visualization of DU images in three dimensions with ultrasound contrast highlighting blood flow of endoleaks. It allows multiplanar reconstructions and image manipulation in any 3D plane. The case presented highlights the added benefit of CEtUS in endoleak detection and classification after EVAR.

Case description

In the case reported, CEtUS was useful in the diagnosis of type III endoleak and establishment of appropriate treatment. A 67-year-old male presented to surveillance after being treated with EVAR for an aortic abdominal aneurysm (diameter: 7,1 x 7,0 cm) in February 2018. He presented a history of inveterate smoking. His past medical history included hypertension currently treated with Losartan and adequately controlled. A CTA scan performed one month after treatment (March 2018) showed evidence of a type II endoleak evolving lombar artery and growth of the aneurysm sac (7,6 x 7,1 cm). In April 2018, the patient was submitted to a contrast-enhanced tomographic ultrasound that revealed a type III endoleak arising between stent graft components and flowing from inside the aneurysm sac into a lombar artery (Figures 1-3). It also showed a significant increase in the aneurysm sac diameter of 8,1 x 8,1 cm (Figure 4). Endovascular treatment was performed with angioplasty at the area of junction of the stent graft components. In June 2018, a new CEtUS was done and showed no longer evidence of endoleak.

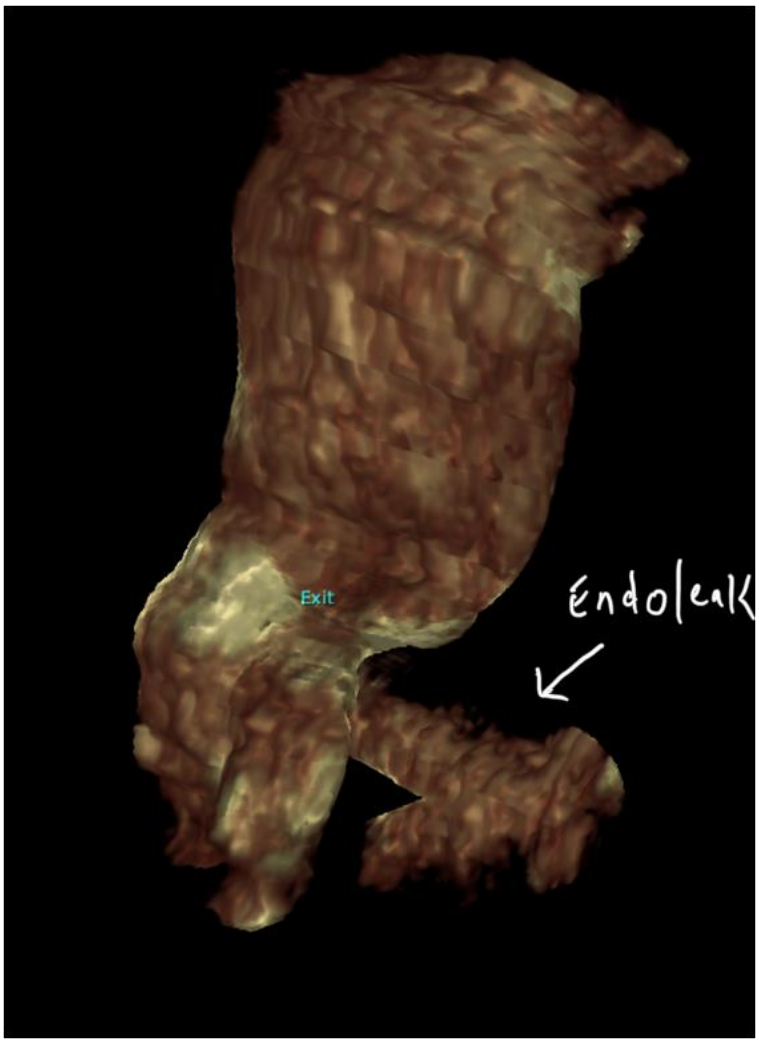

Figure 1: CEtUS Volume Rendering demonstrating endoleak.

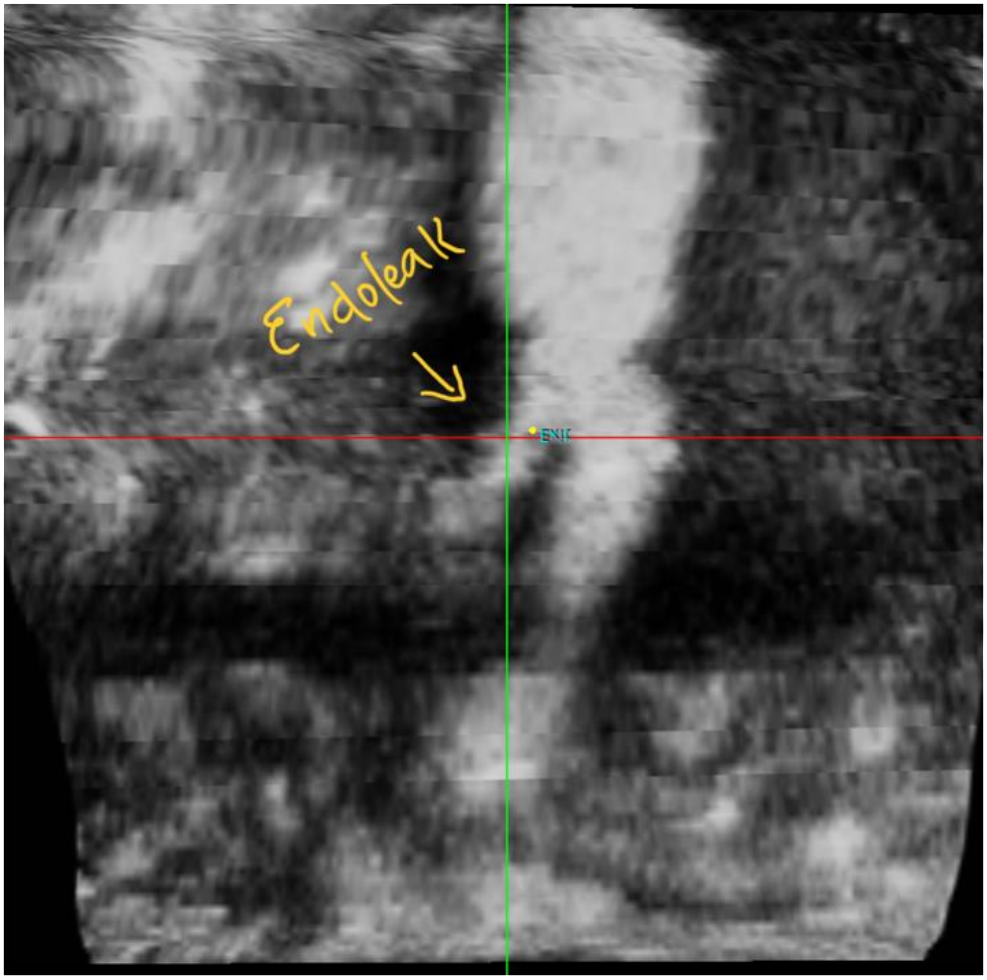

Figure 2: CEtUS multiplanar reconstruction demonstrating type III endoleak.

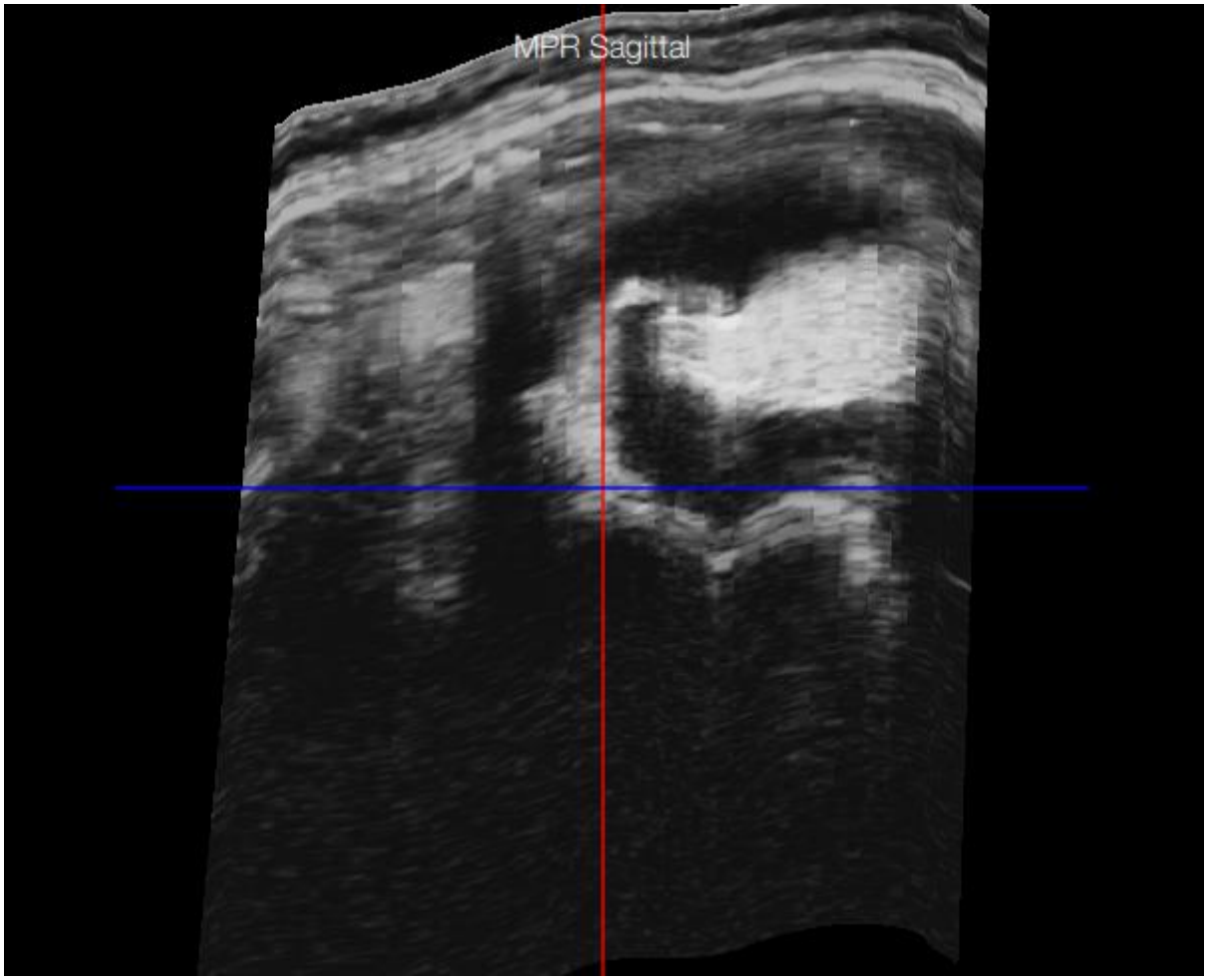

Figure 3: CEtUS demonstrating blood flow outside the stent graft.

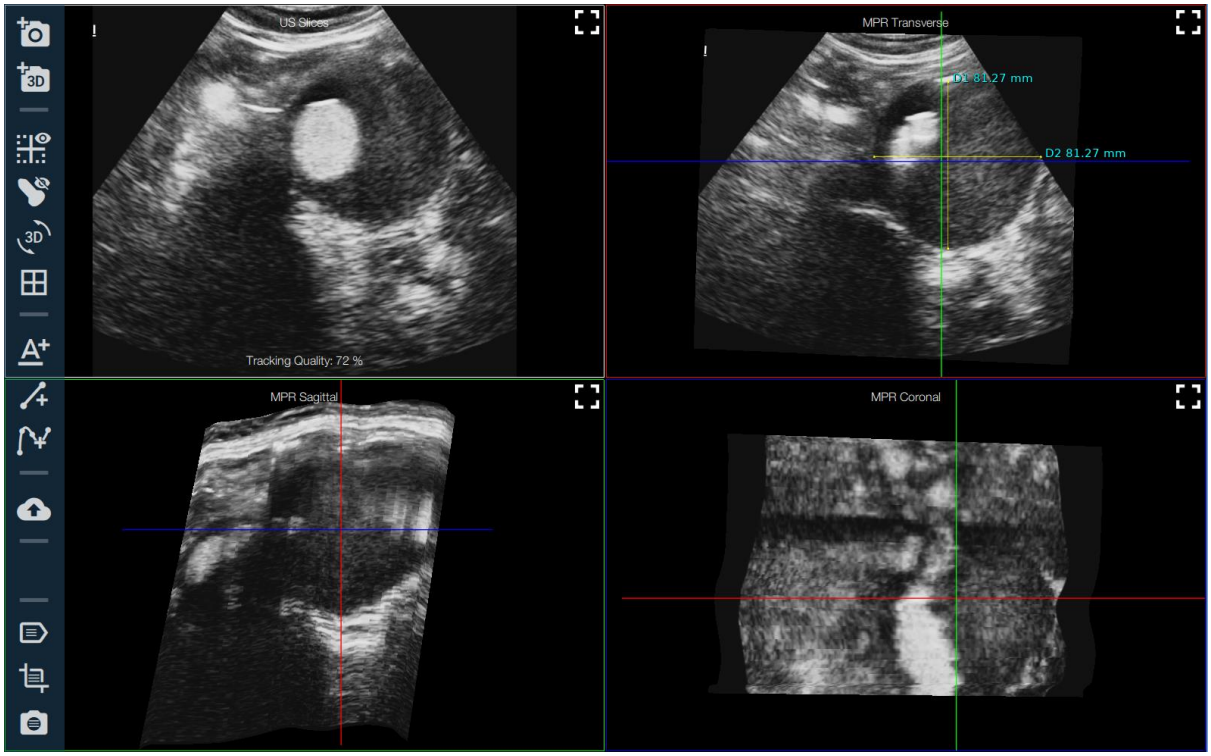

Figure 4: Angle-corrected maximum diameter measurement of the aneurysm sac based on CEtUS images.

Discussion

There has been much debate about the ideal surveillance program after EVAR, the frequency of imaging required, and the optimal imaging strategy. Most centers use a combination of CTA and DU scanning, at six-month or yearly intervals. However, concerns about the cumulative effects of radiation from repeated CTA, and the resources involved, have raised some questions whether DU could completely replace CTA surveillance scans [3,4]. Surveillance after EVAR could reasonably be based on standard DU imaging to measure AAA diameter, with CEUS required only if the AAA sac grows or if an endoleak is suspected [5]. A recent meta-analysis revealed a pooled sensitivity of 0.83 and a pooled specificity of 1.00 for DU detection of type I and type III endoleaks [6]. Data from a relatively large study revealed that although DU yielded only a sensitivity of 67% compared with CT scan, no type I endoleaks or endoleaks requiring intervention were missed [7]. A large study about three-dimensional contrast-enhanced ultrasound done in Manchester, UK, showed that compared with CTA, the sensitivity, specificity, positive predictive value, and negative predictive value of CEtUS to classify endoleak were 96%, 91%, 90%, and 96%, respectively [1]. In a pilot study on 30 paired CTA and CEtUS acquisitions, it has been reported that CEtUS appeared more accurate than CTA for the detection and classification of endoleaks [7]. A move from CTA towards ultrasound modalities for EVAR surveillance has been evolving for the past years. Further studies are still needed, but technological advances in the area of ultrasonography, including

the possibility of tomographic imaging, may replace CTA for standard post-EVAR surveillance with CTA being reserved for positive or inconclusive cases.

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