Case Report

Use of Contrast-Enhanced Ultrasound for the Diagnosis of Endoleak After EVAR: A Case Report

Uso do Ultrassom com Contraste para Diagnóstico de Endoleak após Reparo Endovascular de Aneurisma em Ruptura

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Introduction

Abdominal aortic aneurysm (AAA), with an estimated prevalence of 4–8% and a higher incidence in men, older people, hypertensive patients, and smokers,[1] can be treated with surgical or endovascular aneurysm repair (EVAR). When well-indicated, EVAR is primarily used since it is less invasive and has lower morbidity and mortality rates.[2] However, due to possible complications, routine clinical and imaging surveillance is necessary to identify or prevent periprosthetic leaks (endoleaks) associated with aneurysmal disease progression.[3]

Accordingly, computed tomography angiography (CTA) has always been considered the gold standard for endoleak surveillance due to its high image quality and usefulness for two- and three-dimensional reconstruction; however, its use of iodinated contrast and exposure to ionizing radiation are disadvantages. Therefore, other post-EVAR control imaging methods such as contrast-enhanced ultrasound (CEUS) have been studied as an endoleak dynamic and high-quality assessment method.[4,5]

The present case report highlights the importance of CEUS as a diagnostic method for detecting endoleak after EVAR, showing its advantages and disadvantages versus those of the current gold standard method.

Case report

A 65-year-old hypertensive and diabetic man had a family history of cerebral aneurysm and AAA. In June 2014, he was diagnosed with an infrarenal AAA up to the aortoiliac bifurcation with a transverse diameter of 8.7 × 8.3 cm and a left common iliac artery (LCIA) aneurysm with a diameter of 2.1 cm.

In July 2014, he underwent infrarenal abdominal aorta EVAR with aortoiliac endoprosthesis placement and left hypogastric artery (HA) embolization (Figure 1).

Keywords

Aortic aneurysm, abdominal, Endoleak.

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In October 2019, a follow-up CTA showed an AAA measuring 9.5 × 9.1 cm without evidence of an endoleak. A CEUS type II endoleak was diagnosed and corrected with inferior mesenteric artery (IMA) embolization (Figure 2).

The aneurysmal sac diameter transversely increased to 9.8 cm over 2020 and 2021, but no evidence of an endoleak was seen on CTA. In January 2022, spectral B-mode Doppler CEUS recorded a large infrarenal fusiform aneurysmal dilatation of 9.5 cm × 9.0 cm in transverse and anteroposteriorly, pulsatile flow inside the aneurysm sac on spectral Doppler, and, after the injection of 2.5 mL of microbubble contrast (SonoVue-Bracco), signs of leakage in a peripheral vein inside the aneurysmal sac originating from a lumbar artery (LA) from the right lateral wall and the right branch of the endoprosthesis, which aided the diagnosis of type II and III endoleaks, respectively (Figure 3).

CTA initially performed during the EVAR procedure in April 2022 (Figure 4 A) simultaneously with angiography detected an AAA with a transverse diameter of 9.58 cm, no sign of a type III endoleak, and only LA retrograde flow. Regardless, considering the CEUS findings (Figure 3), we proceeded with the therapeutic strategy, bilaterally implanting iliac endoprostheses to cover the previous endoprostheses (Figure 4B). At the end of the procedure, CTA showed correct endoprosthesis positioning with no signs of endoleak (Figure 4C, Video 1).

The patient recovered well with no recurrence and was discharged on the second postoperative day.

Discussion

Due to increasingly advanced techniques and devices for AAA treatment, most current cases can be endovascularly treated using fenestrated, branched, or even parallel stents. Constantly progressing treatments require intensified surveillance due to the possibility of several complications.[2]

Endoleak, the most frequent complication after EVAR with an incidence of 20–25% among treated patients, is defined as persistent blood flow inside the aneurysm but outside the endoprosthesis, perpetuating aneurysmal sac pressurization and all related risks.[6] Endoleaks can be anatomically classified into five types. Type I endoleaks involve a leak related to lack of endoprosthesis apposition to the healthy wall of the proximal (Ia) or distal (Ib) neck or due to lack of occlusion plug sealing in the iliac branch associated with blood flow from the crossed graft (Ic). Type II endoleaks involve aneurysmal

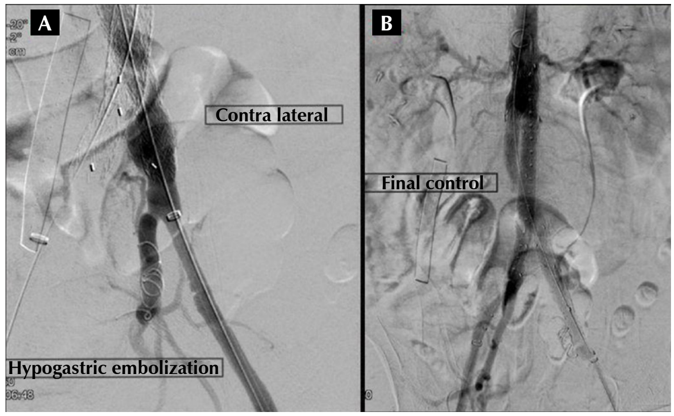

Figure 1 – *Infrarenal and left common iliac artery endovascular aneurysm repair with aortoiliac endoprosthesis placement and left hypogastric artery embolization.*

Figure 2 – *(A) B-mode ultrasound image used to take the transverse diameter measurement. (B) Color Doppler anechoic images inside the aneurysmal sac, mainly on the posterior wall, where pulsatile flow was recorded on spectral Doppler suggestive of the presence of a type II endoleak. (C) Contrast-enhanced ultrasound (SonoVue, Bracco) image showing low-pressure leakage in the anterior wall of the aneurysmal sac at the height of the proximal segment of the endoprosthesis, probably from the inferior mesenteric artery suggestive of a type II endoleak.*

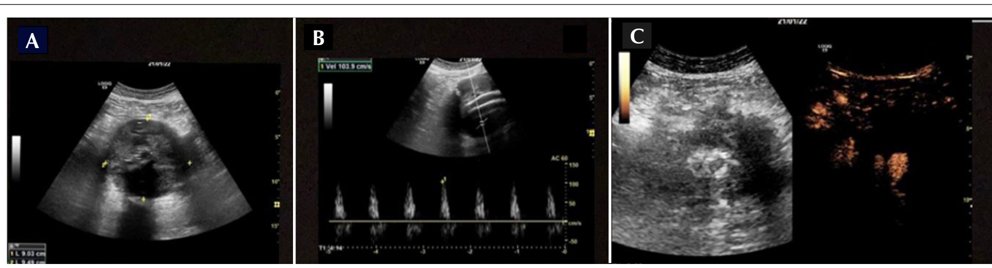

Figure 3 – *(A) B-mode ultrasound image used to take anteroposterior and transverse diameter measurements.(B) Spectral Doppler image showing high-velocity flow inside the aneurysmal sac. (C) Contrast-enhanced ultrasound (SonoVue, Bracco) image showing leakage through the right branch of the endoprosthesis.*

sac perfusion by flow from the collateral arteries such as the LA, IMA, and HA. In type III endoleaks, leakage results from the disconnection or structural failure of the endoprosthesis components. In type IV endoleaks, tissue porosity leads to leakage. Finally, type V endoleaks present as aneurysmal sac pressurization without evidence of blood flow on imaging tests, known as endotension.[2,6] Type I and III endoleaks carry an increased risk of rupture due to pressurizing more quickly and should be treated as soon as possible. Thus, frequent monitoring is imperative as this classification defines a care and action algorithm.[7]

CTA is the standard after EVAR imaging surveillance tests at 1-, 6-, and 12-month follow-up and annually thereafter. This test is fast, is reproducible, has excellent spatial resolution, and uses iodinated contrast with image acquisition through the emission of ionizing radiation.[8]

CTA disadvantages include its use of iodinated contrast, which is nephrotoxic, a limiting factor for non-dialysis-dependent kidney disease patients, and the use of ionizing radiation, which can have deleterious and cumulative effects, such as the development of cancer. An important limitation is not assessing hemodynamics or the flow direction that resulted in leakage in cases of type II endoleaks.[3]

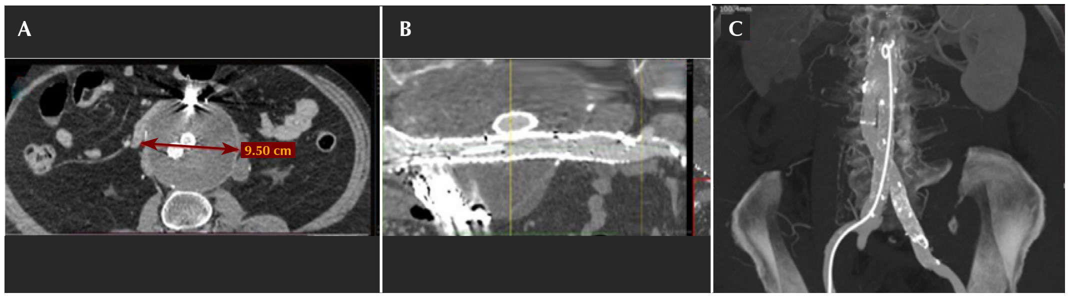

Figure 4 – *(A) Computed tomography angiography (CTA) image taken in the sagittal plane demonstrating the anteroposterior diameter of the aneurysmal sac.(B) CTA image taken in the coronal plane. (C) CTA image taken in the sagittal plane.*

Other imaging methods, such as CEUS, have been highlighted after EVAR surveillance. CEUS uses contrast agents with gas microbubbles (perfluorocarbon or sulfur hexafluoride) surrounded by a phospholipid that are injected into the bloodstream and work as intravascular reflectors of ultrasound waves. Consensus is still lacking on the ideal dose, but recommendations state 1–2.4 mL administered as a peripheral intravenous (IV) bolus. Low-frequency probe scanning is performed for about 5 min after the IV injection. The test assesses the presence of contrast in the aneurysmal sac and endoprosthesis and the perfusion time in relation to inflow and outflow vessels in addition to wave speed and shape in spectral mode.[3] This type of contrast is quickly absorbed into the bloodstream and eliminated by the respiratory system, making it safe for patients with compromised kidney function; it also has the advantage of no radiation exposure.[9]

Recent studies showed that this method has high diagnostic value and is suitable for following this complication.[7] CEUS also has higher sensitivity for detecting endoleaks than CTA, mainly due to detecting flow velocity and direction despite a lack in significant specificity differences between the two imaging modalities.[9] Another CEUS benefit reported in the literature is lower follow-up cost than CTA with high sensitivity.[7–9]

The specific analysis of CEUS for type II endoleaks can stratify cases at greatest need of additional intervention according to endoleak flow velocity and width, parameters that indicate treatment need when >80 cm/s and >4 mm, respectively. Test sensitivity and specificity were 0.62–0.83 and 0.90–0.97 for all types, respectively, and 0.40–0.97 and 0.97–1.00 for types I and III, respectively, thus demonstrating that CEUS is accurate and effective.[10]

However, despite having these advantages, CEUS is limited by being an operator-dependent technique that requires specific training and equipment and can be affected by patient-related factors such as a high body mass index, intestinal gas, aortic wall calcifications, or ascites, and the acquisition of CTA images may be necessary to better characterize the detected leaks and complete the surgical planning.[9]

In the reported case, CTA identified aneurysmal sac dilation but did not visualize the leak (Figure 4) However, CEUS classified the endoleak as type III (Figure 3), enabling safe intervention and repair due to the risk of aneurysmal sac rupture and corroborating the data in the literature about its greater sensitivity.

Therefore, the case described here highlights the importance of CEUS as an alternative to the current gold standard for following up and monitoring endoleaks after EVAR. Despite its limitations, this US method improves the detection of this complication, leading to early diagnosis and favorable outcomes.

Authors' contributions

Case introduction and presentation: Djaló ACN; literature review: Fonseca Filho IS Marques MO; discussion: Pires GLO; manuscript review: Ferraz A, Abath CG.

Conflict of interest

The authors have declared that they have no conflict of interest.

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