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# Follow-up of aortic dissection with CEUS, Smart Fusion and Fly Thru – A case report

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## Introduction

Independent of the pathogenesis, extent and type of primary treatment of acute aortic dissection, the chronic form of the disease requires continuous monitoring and permanent long-term therapy. This is to ensure that subsequent vascular complications, such as progression of the dissection, the development of aneurysms or ruptures are avoided. According to Weigang et al., one third of patients who have survived acute aortic dissection suffer from progression of the dissection or from an aortic rupture within five years [1]. Follow-up examinations (CTA or MRA) conducted at regular intervals provide an insight into the course of the disease. The recommended intervals for examination are three and six months, followed by annual examinations [1]. During this process, the risks associated with exposure to radiation and to the contrast agents containing iodine or gadolinium must not be neglected, such as contrast agent-induced nephropathy, nephrogenic systemic fibrosis and thyreotoxicosis. Instead of CTA and MRA a follow-up procedure that is associated with significantly lower risks and is much cheaper could be used in such patients: contrast-enhanced ultrasound (CEUS) combined with image fusion techniques and 3D reconstruction.

## Case description

A 63-year-old male patient presented for an examination of a type B aortic dissection that had been known to be present for 12 years, accompanied by a stage I arterial hypertension, peripheral arterial occlusive disease (Fontaine Stage IIB) and coronary heart disease. The acute event in 08/2000 was also associated with renal ischaemia, which required interventional fenestration of the dissection membrane and the implantation of a stent in the left renal artery. After the intervention and in spite of the insertion of the stent the patient suffered acute renal failure. Kidney function improved over the course of time, but stable stage II chronic renal insufficiency has still been present for years.

Follow-up CTA is performed once a year. Over many years, the extent of the dissection and the aortic diameter have remained constant under adequate antihypertensive therapy. The patient was examined with a high-end ultrasound system (Aplio 500, Toshiba, Ottawa, Japan) using a 3.5 MHz 2D convex transducer with attached position sensor. Contrast enhancement was achieved through i.v. administration of a 1.6 ml SonoVue (Bracco, Constance, Germany) bolus and contrast harmonic imaging (CHI).

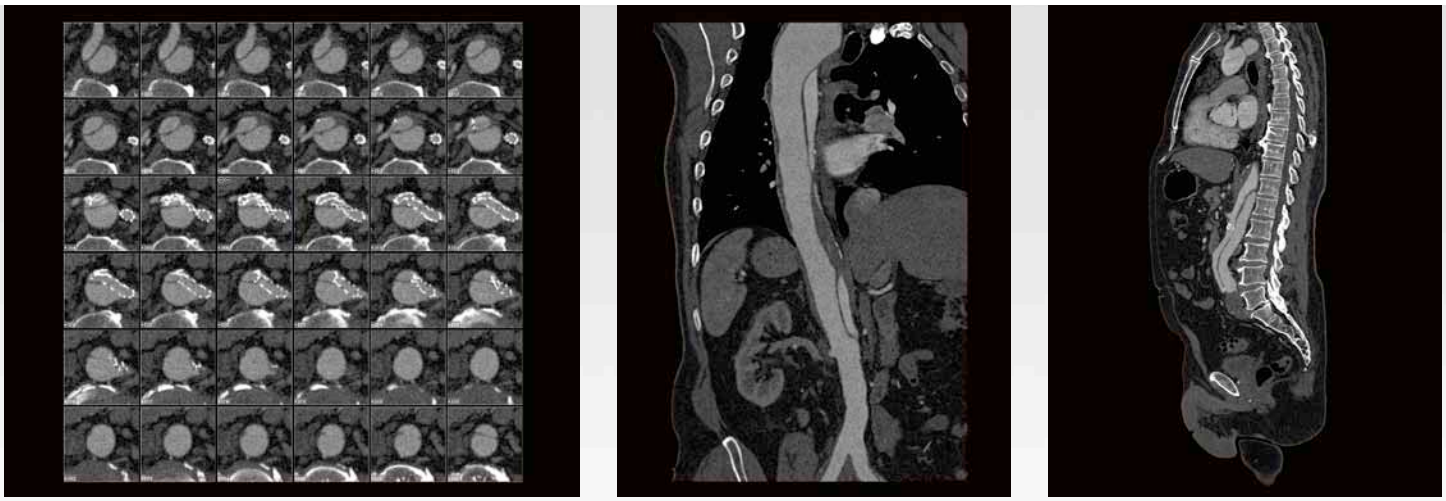

Figure 1 (A, B, C): An extensive dissection of the thoracic and abdominal aortas is visible on the axial, coronal and sagittal CTA images (reconstructed using MIP), also involving the pelvic axis (partially depicted). The visceral vessels and the renal arteries originate from the more narrow true lumen. Two stents were implanted in the left renal artery.

In a first step, the DICOM datasets from 3D CTA were called up on the ultrasound system using the Smart Fusion software. With the aid of this technology, the US plane and corresponding CT plane can be displayed on the monitor in real-time using dual imaging mode. Transducer navigation was supported by EMTS, an electromagnetic tracking system that is part of the Smart Fusion package. Thus any morphological changes compared with the previous CTA examination can be clearly captured on the ultrasound image. Finally, ultrasound 3D volume acquisition was carried out using a 3D volume transducer and the ultrasound volume dataset was reconstructed using the Fly Thru mode, a novel sonographic 3D rendering technique.

CEUS combined with the fusion technique also revealed constant findings for the aortic dissection and no further complications over the course of time. The visceral vessels and the renal arteries emerge from the substantially smaller true lumen, which was depicted in CEUS. The left renal artery has a stent implanted close to its origin (CT image and CEUS), which projects into the aortic lumen, where turbulent flow is detected sonographically. In addition, no further significant renal artery stenosis was detected and bilaterally equal, homogenous perfusion of the kidneys was present. A previously known aneurysm in the left common iliac artery is also unchanged when compared with the previous CT examination.

## Discussion

While patient status post acute aortic dissections requires adequate long-term monitoring, follow-up examinations should be as non-invasive as possible with such patients, especially given the high incidence of renal insufficiency. The probability of a contrast agent-induced nephropathy in this patient collective lies between 5 and 10 %[2] and increases substantially above an intravenous quantity of approx. 100 ml contrast agent, independent of its chemical structure[3]. The routine CTA protocols for the aorta still involve the administration of 120 ml of a contrast agent containing iodine, although depending on the CT equipment, a reduction of the CA volume to 40 ml is possible.

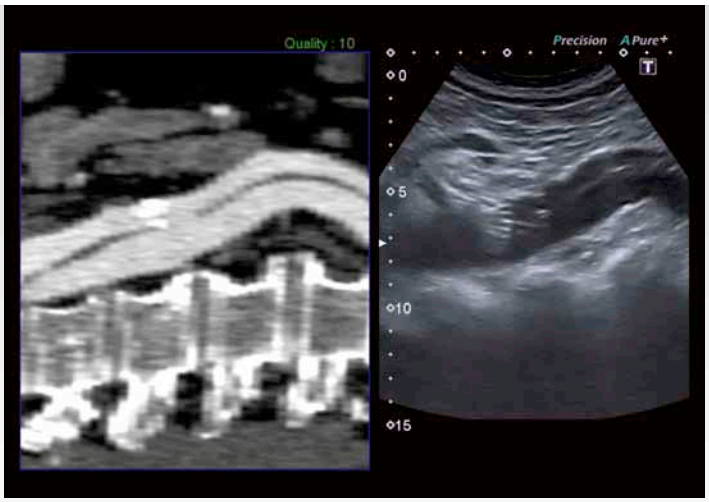


Figure 2: Smart Fusion, B-mode: The left side of the dual screen monitor shows the sagittal image of the CTA dataset stored on the US system. The corresponding B-mode image is shown on the right. The end of the stent that projects into the true lumen is visible as an echo-rich artefact. The dissection membrane is visible as a thin, echo-rich strip in the aortic lumen.

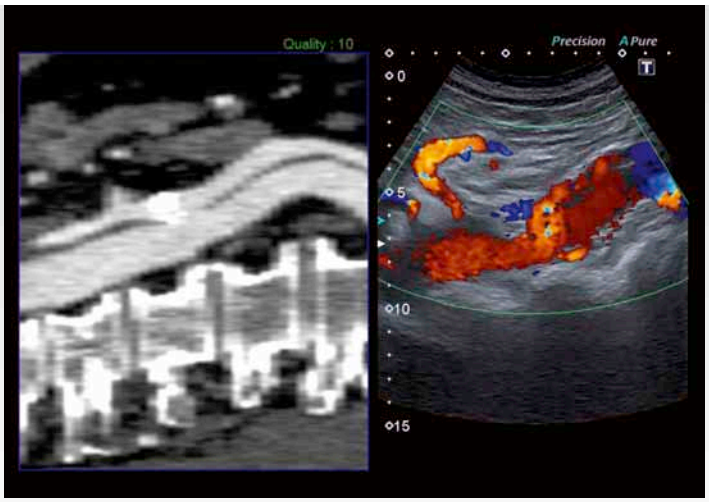


Figure 3: Smart Fusion, color mode: In the color Doppler image, the turbulent flow around the aortic end of the stent can be seen on the right side of the dual screen monitor, the corresponding sagittal plane of the CTA dataset is shown on the left.

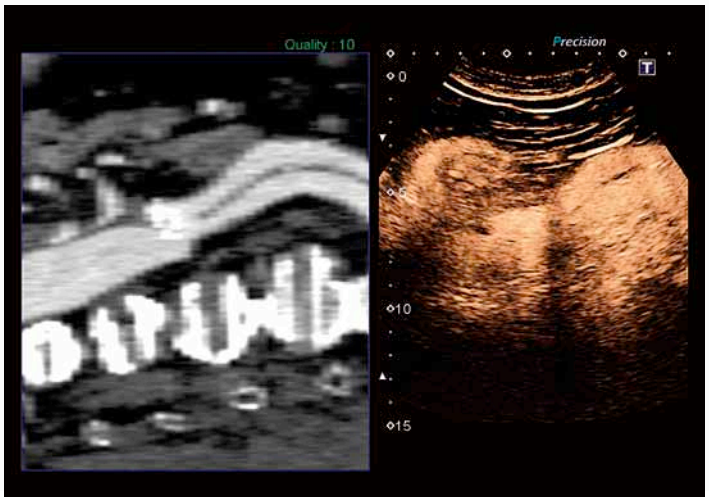


Figure 4: Smart Fusion, CEUS: Illustration on the right of the image of the arterial wash-in phase after administration of a contrast agent. The contrast between the true and false lumens is homogenous.

CEUS in combination with fusion technology is a viable alternative to this. A recent study has already demonstrated consensus with other data published to date, showing the advantages of ultrasound over CTA[4]. CTA images and multiplanar reconstruction of the 3D CA dataset allow precise differentiation of the pathology, such as endoleaks, and facilitate correlation with the morphologically more precise CTA/MRA data collected originally, which remain indispensable due to the better morphological overview that they provide.

## Key statements

- The new technique involving CEUS with 3D reconstruction and image fusion with the 3D CTA dataset provides an elegant alternative to CTA and MRA of the aorta that is less invasive and more patient-friendly.

- CTA should be used to document the initial condition and only if the sonographic findings are ambiguous, if there are signs of a complication or in case of unfavorable anatomy.

- A potential positive side effect of CEUS with fusion technology to be underlined is the possible cost efficiency when used as long-term follow-up on patients with aortic dissection.

## References

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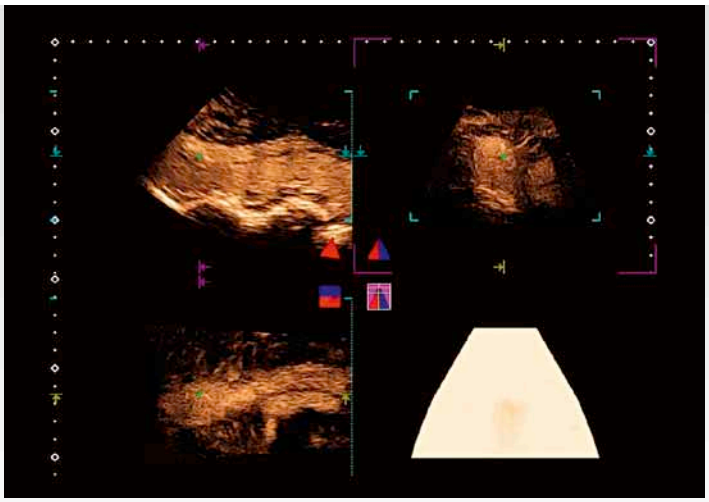

Figure 5: MPR of the 3D dataset of the dissected aorta. For Fly Thru the dataset is first presented in three orthogonal planes. The direction of navigation is entered or corrected using the green crosshair.

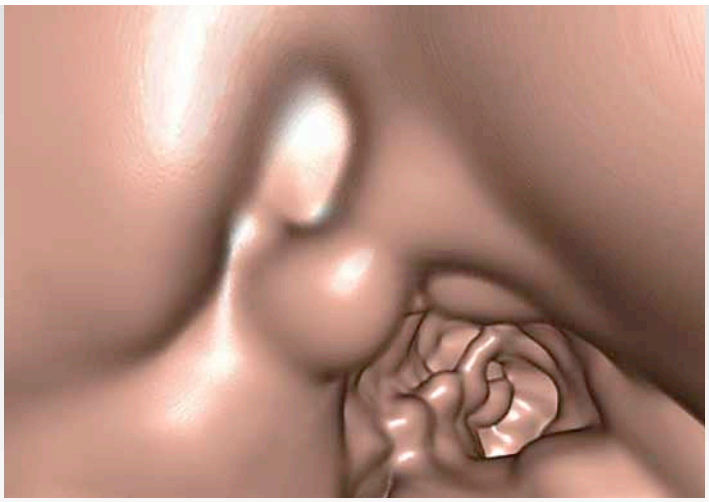

Figure 6: Static Fly Thru reconstruction: View from inside the aorta of the distal aortic lumen in cranial direction. This clearly reveals the dissection membrane and the false and true lumens.

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