Successfull endovascular treatment of femoro-popliteal aneurysm and reliable sonographic control by B-Flow™ at follow-up – a case report

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Abstract

Introduction:
Treatment of dilatative arteriopathy, caused either genetically and/ or by classic atherosclerotic risk factors, is still challenging. In contrast to aneurysms of the abdominal aorta, endovascular treatment of femoro-popliteal located aneurysms is rarely performed, mostly because surgical treatment is seen as the only option in most patients. When treated endovascularly, follow-up (FU) control of endoleaks is done by Computed tomography angiography (CTA) or by contrast-enhanced ultrasound (CEUS). Other ultrasound assisted techniques are not used regularly.
Case Report:
77-year-old male patient with dilatative arteriopathy and femoro-popliteal aneurysms (Superficial Femoral Artery (SFA) and Popliteal Artery (PA)) in both legs underwent unsuccessful bypass surgery of the right leg 3 years ago with early re-occlusion and permanent occlusion within months with then chronic critical perfusion and postoperative lymphedema. Patient therefore did not agree to surgical treatment of the left SFA and PA aneurysms. We therefore performed an endovascular repair with two 10x150 mm endoprostheses (Gore Viabahn™). Angiographically a small endoleak after implantation was observed. At the 1st postinterventional FU after 24 h no endoleak neither by CEUS nor by B-Flow™ was detected. Similar results were observed at 3-, 12- and 24-months FU. CTA at 6 months revealed no endoleak and complete patency in the treated vessels in the left leg. The initial Fontaine 2b stadium was improved to a stadium 1. ABI and postinterventional pulse wave oscillography were consequently improved as well. Primary patency of the treated vessel reaches now 24 months.
Discussion:
Although usually treated by open surgery, peripheral aneurysms can be successfully treated endovascularly and easily controlled by ultrasound. Modern ultrasound systems offer alternative ultrasound modi to sufficiently detect or exclude endovascular leakage.
Conclusion:
Endovascular repair of femoro-popliteal aneurysms is a therapeutic option, which should be considered and offered to the patient, when technically possible. It is safe and allows for good results, when endovascular experience is sufficient. Control for endoleaks can adequately and safely be done by B-Flow™ or alternative ultrasound modi with less time and effort than by CEUS.

Keywords: endovascular aneurysm repair; peripheral vascular aneurysm; contrast enhanced ultrasound (CEUS); endoleak detection; B-Flow™; ultrasound surveillance.

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Introduction

Aneurysmatic dilatation of femoral and popliteal arteries is less common than of the abdominal aorta (1-3). However, the potential consequences are similarly severe, ranging from thrombosis and distal embolization to acute ischemia and limb loss (4, 5). They typically affect men over 60 years of age (95%) (6) and often occur alongside a variety of cardiovascular risk factors and comorbidities (7).

Thus, it is imperative to provide optimal treatment. Elective open surgical repair via interposition or bypass graft is considered to be the gold standard (1, 8, 9). However, given the predominantly elderly patient demographic and the complexity of associated risks, endovascular treatment is frequently used as an alternative to open surgery. Here, endoprostheses with precise delivery capability and structural stability are frequently used. However, despite growing use in aneurysm therapy, there remains limited comprehensive data on long-term performance on femoropopliteal aneurysm repair, which is of significant importance in order to provide evidence-based treatment decisions, particularly in regard to adverse events such as graft occlusion or endoleaks. Therefore, it is crucial to obtain robust data on the long-term course, especially in a real-world setting, when frequent controls are necessary.

The gold standard to follow up the results of any endovascular repair is still Computed tomography angiography (CTA). However, the frequent exposure to radiation or regular contrast medium can sometimes be harmful to these generally fragile patients (i.e. impaired renal fuction). Thus, the use of an intravascular contrast agent in conjunction with ultrasound (contrast enhanced ultrasound= CEUS) provides an alternative method to avoid side effects, known from regular radiology contrast medium, with a sufficient quality to rule out most endoleaks. The contrast agent consists of microbubbles, composed of a lipid or protein shell and a gaseous core, that are strong reflectors of the ultrasound signal (10). It provides information that cannot be obtained using B-mode ultrasound alone.

Nevertheless, CEUS also might cause side-effects, though rarely, like intolerance or allergic reactions. The intravenous application can further complicate the application of CEUS when superficial venous puncture is difficult or impossible. Therefore, alternative ultrasound modes, like the B-Flow™ offer a further, quick and reliable alternative ultrasound modus. Using this technique, tissue echoes are suppressed while blood signals are amplified, enhancing the actual blood flow allowing it to be visualized easier, thus making this technique ideal for detecting endoleaks.

Case Report

A 77-year old patient was referred to the medical practice for a second opinion regarding treatment opinion of the occluded peripheral venous bypass on his right leg. The bypass surgery had to be performed due to aneurysmatic dilated femoro-popliteal arteries and occluded within months after the operation. At presentation he suffered from a severe claudication (less than 50 m painfree walking distance) and of a severe postoperative lymphedema. Therefore, the suggestion by his surgeon of a re-operation was clearly rejected by the patient and an interventional approach was prefered. After successful endovascular recanalisation of the bypass, the patient asked for a treatment of the femoro-popliteal aneurysms of his left leg. Again, any surgical approach was rejected by him, so we agreed to an endovascular approach to repair the aneurysmatic segments of the left femoral and popliteal arteries.

In order to plan the intervention we performed a CTA (Fig. 1A) to measure the diameter and length of the segment to be treated. Here, the maximal diameter of the aneurysmatic segment was measured with 30mm over a length of approximately 258 mm. The diameter of the proximal and distal landing zone was 8 mm and 7 mm, respectively.

The intervention was then performed via an 8 French sheath from an antegrad access via the left common femoral artery (CFA). After the diagnostic angiography (Fig. 1B), we then implanted two 10 mm GORE Viabahn™ Endografts, a heparin-bonded stent graft, of 150 mm length each to cover the 258 mm long segment. After prolonged dilatation with a plain old balloon (POBA) the two endoprotheses covered the aneurysmatic segment completely with a tight sealing in the in- and outflow area of the femoro-popliteal segment. Only in the proximal treated segment an endoleak remained fed by one of the profound femoral sidebranches (Fig. 1C, arrow).

The first postinterventional control was performed on the following day, showing a regular peripheral arterial circulation in the segmental oszillography. In the ultrasound B-Flow™ modus no endoleak was seen, especially in the proximal stent segment, which was then confirmed by CEUS using SonoVue® as contrast medium (Fig. 2 A and B).

Similar results were obtained at 3 months follow-up (Fig 3 A). CTA was performed at 6 months with no evidence of an endoleak and complete patency of the endografts (Fig 3 B).

At 12 and 24 months postprocedure controls we performed a further comparison between B-Flow™ and CEUS (Fig. 4A and B). Again, the endografts showed a complete patency with no evidence of an endoleak and the former aneurysma diameter shrinked by 1 mm, approximately. During the whole observation period the patient was on apixaban 5 mg twice daily and clopidogrel 75 mg, due to a necessary reintervention of the femoro-crural bypass on his right leg, to optimize the secondary patency of the bypass.

Discussion

In the present case report, we want to demonstrate two aspects.

Firstly, peripheral aneurysms of femoro-popliteal arteries can be safely and sufficiently treated by an endovascular approach, especially when a surgical repair is not possible or the patient strictly denies any surgery, as in the present case. Since he suffered from a similar aneurysmatic alteration of the femoro-popliteal circulation on his right leg with an unsatisfactory surgical result with postoperative lymphedema and a premature bypass occlusion within months, the patient declined any surgical treatment, although being fit for surgery. A conservative treatment, i.e best medical treatment alone by intense platelet inhibition and/ or oral anticoagulation, would not have been a possible alternative, since these would not have prevented potential peripheral embolism, especially in an aneurysmatic diameter above 30 mm and already presenting with a mural thrombus (see Fig. 1 A). Notably, on his right leg, our patient had already encoutered the natural course of periperal aneurysms with peripheral embolism and a critical circulatory situation in the long run. Statistically, among asymptomatic patients with femoro-popliteal aneurysms up to 24% will become symptomatic within 1 to 2 years and up to 68% will develop complications during the patient's lifetime (11). Guidelines therefore recommend an aneurysma repair ≥ 20 mm, preferably by open surgery, especially when there is an adequate spahenous vein available (11). Only in cases with high perioperative risk, low life expectancy or lack of adequate graft material, endovascular repair is recommended (11). The preference for a surgical repair over an endovascular approach is justified by the better long term results regardig patency and complications (8, 12, 13). In the cases where surgical treatment is limited, endovascular treatment is recommended with claimed acceptable outcomes, especially when compared to alternative autogenous vein grafts (11, 14, 15). We do not know the reasons for the early bypass occlusion of the right leg in the present case. However, it is likely that the used graft material was not adequate. Like in the present case, endografts in femoro-popliteal aneurysms may show good long-term results regarding patency and complications, even when a reintervention becomes necessary, with secondary patency reported to be 100% within the observational period of 60 months (16). Regarding patency and periinterventional complications the present case is definitely in range (even better) with reported 100% patency at 12 months and 90% patency at 24 months (16).

Secondly, regular surveillance remains necessary and can safely be done by ultrasound. Duplex ultrasound is frequently available and helps to prevent complications like graft occlusion in a timely manner (17). Yet while CEUS is accepted as an alternative to CTA in current guidelines on abdominal aortic aneurysms management after endovascular repair (18), to observe endoleaks and prevent graft occlusion, its application in surveillance after femoro-popliteal aneurysms remains unclear. In the present case we present an alternative. Similar to

CEUS or a CTA, the B-Flow™ modus can safely and adequately exclude a remaining or developing endoleak. The advantages of an alternative ultrasound modus to CEUS or CTA are apparent. For CEUS or B-Flow™, patients are obviously not exposed to radiation. To avoid radiation, MRI as an alternative could be done. However, a MRI has higher costs and takes up more time to run and is less widely available. Furthermore, patients with claustrophobia or metal implants, like pacemakers or ICDs, may also not be suitable. Furthermore, stents or endografts cause artefacts, thus, making assessments more difficult.

Contrast medium is necessary for CTA, MRI or CEUS, though different for each application, but a vascular access is still necessary. This might pose problems in some patients with sensitive skin and/ or fragile, or even rarefied superficial veins. Allergic reactions are rare but possible and for contrast medium used in CTAs or MRIs, thyroid or renal conditions are necessary to assess before application. Therefore, the thought of a routinely use of an alternative ultrasound modus like B-Flow™ for surveillance after endovascular repair is appealing.

At present, only small patient cohort studies or single center observational studies are published regarding the use of B-Flow™ in vascular diagnostics in a broader sense (19). For endoleak detection two studies have been published so far, but only regarding the surveillance after aortic endovascular repair (20, 21). Here, the authors report of a comparable performance of B-Flow™ to CEUS or CTA, with slight advantages for the latter two regarding certain detection of endoleaks. This might very well explained by the challenging setting of abdominal ultrasound where intraabdominal fat and gas can sometimes render a reliable imaging to be impossible. Nevertheless, B-Flow™ and CEUS showed mostly similar results. Therefore, in a easier accessible region like the femoro-popliteal segment without unfavourable factors for ultrasound images, B-Flow™ is likely not to be inferior to CEUS. In contrast, its advantages (no vascular access, no contrast medium, less time) might therefore make it the preferable method for surveillance at least after peripheral endovascular repair. To our knowledge, this is the first report on using B-Flow™ for surveillance after femoro-popliteal endovascular repair over a period of 24 months. Whether B-Flow™ will have the potential to be used in a routinely manner in this field has to be established in further trials.

Conclusions

Endovascular repair of femoro-popliteal aneurysms is possible and poses a secure alternative to open repair in selected cases. For routine surveillance after endovascular repair of femoro-popliteal aneurysm, B-Flow™ is a promising candidate in general and for endoleak detection in specific.

Figures

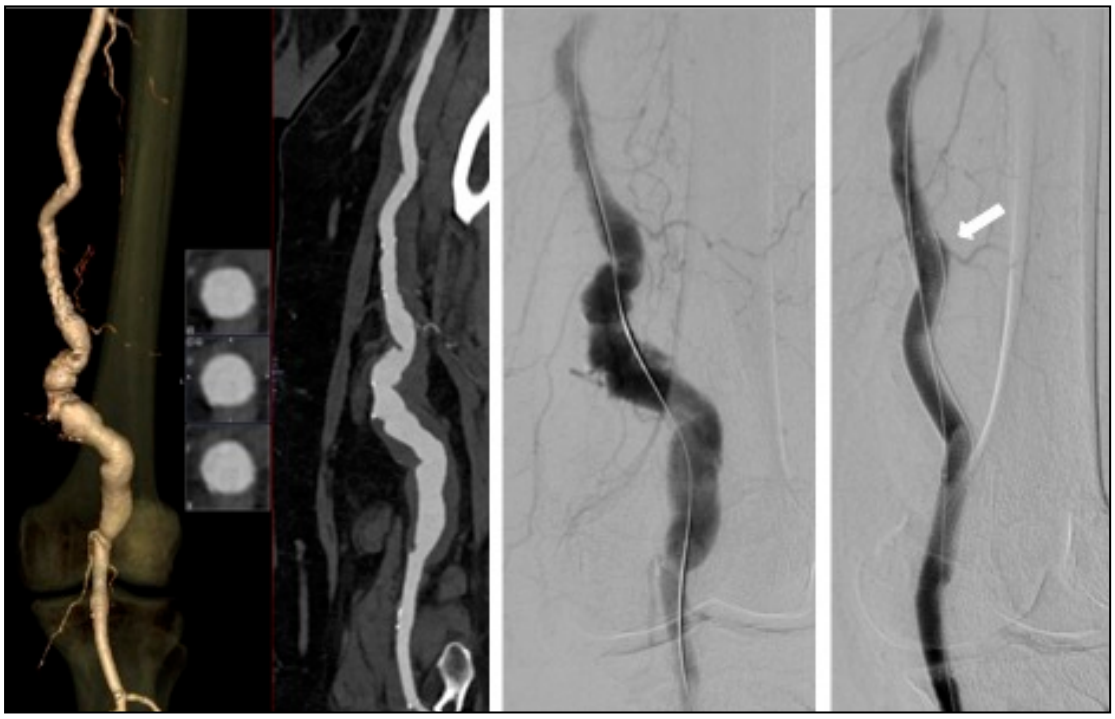


Fig. 1. Panels are labelled A–C from right to left.

A. CTA before intervention to analyze the feasibility of endovascular treatment in order to measure the landing zone of the stent-grafts as well as the maximal diameter and length of femoro-popliteal aneurysm intended for treatment.

B. DSA of the femoro-popliteal aneurysm before endovascular treatment and
C. after implantation of the Viabahn™ endoprostheses with a remaining small endoleak (arrow).

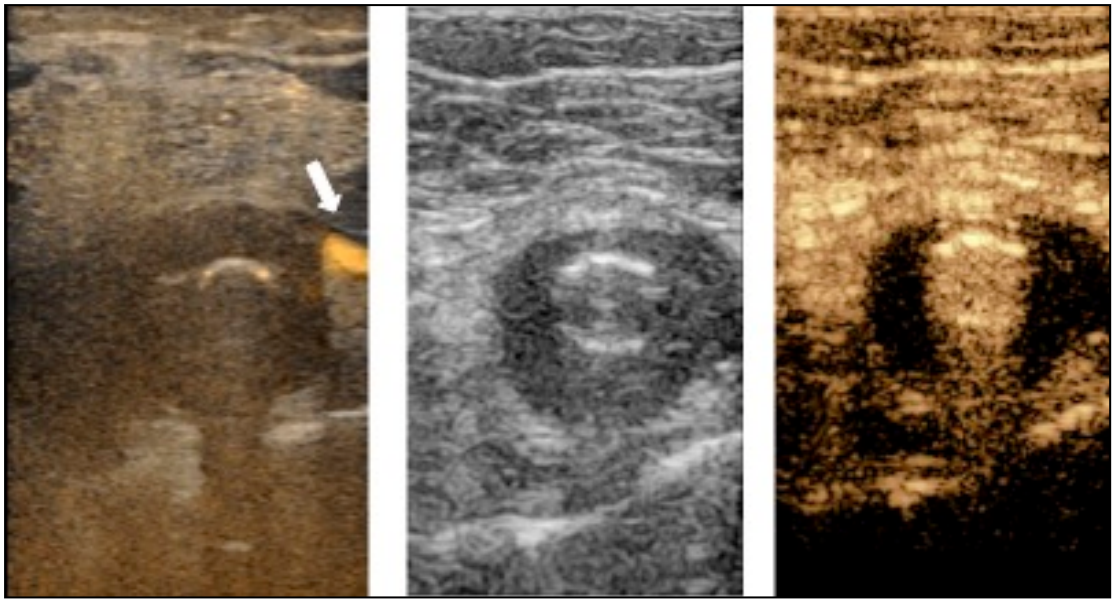


Fig. 2. Panels are labelled A–B from right to left.

A. B-Flow™ imaging of the proximal femoro-popliteal aneurysm. Note, the collateral (arrow) coming from lateral left without any sign of endoleakage, then

B. confirmed in CEUS images. The first ultrasound images after endograft implantation show a shadowing, thus hindering images of intravascular flow, clearly showing CEUS to be the method of choice in the first 24h after endovascular repair. However, endoleaks coming from outside the graft therefore (type 2) can be detected/ excluded by B-Flow™ modus.

Fig. 3

A 3-months Follow-up B 6-months Follow-up

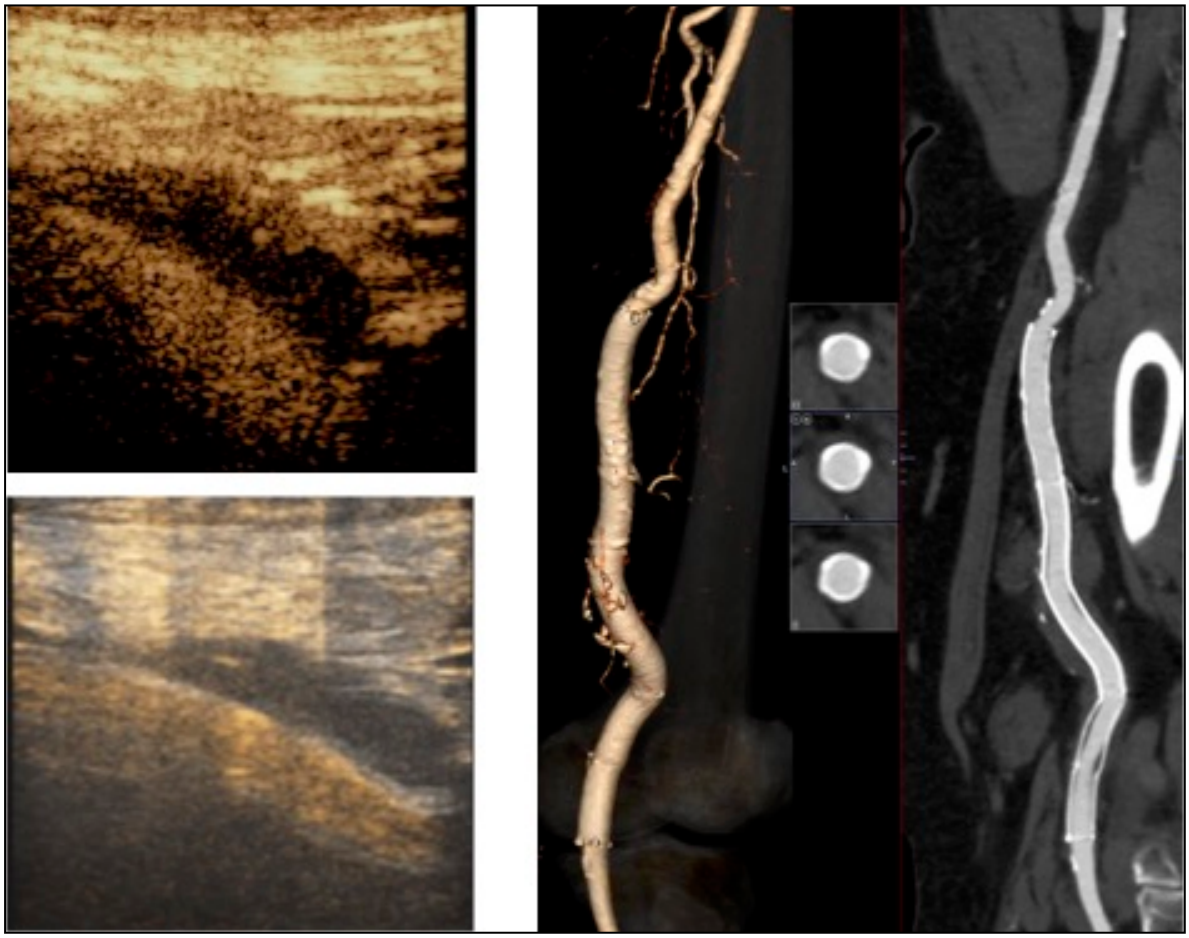


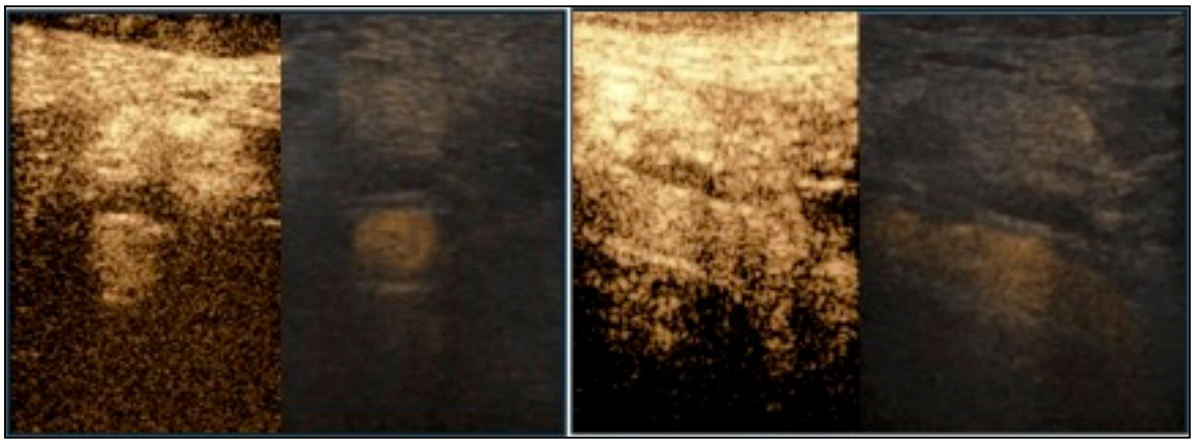
Fig. 3. Panels are labelled A–B from right to left.

A. at 3 months follow up no endoleak was observed, neither by CEUS (top panel) or in the B-Flow™ modus (bottom panel).

B. CTA revealed similar images with a complete open endograft and no sign of an endoleak.

Fig. 4

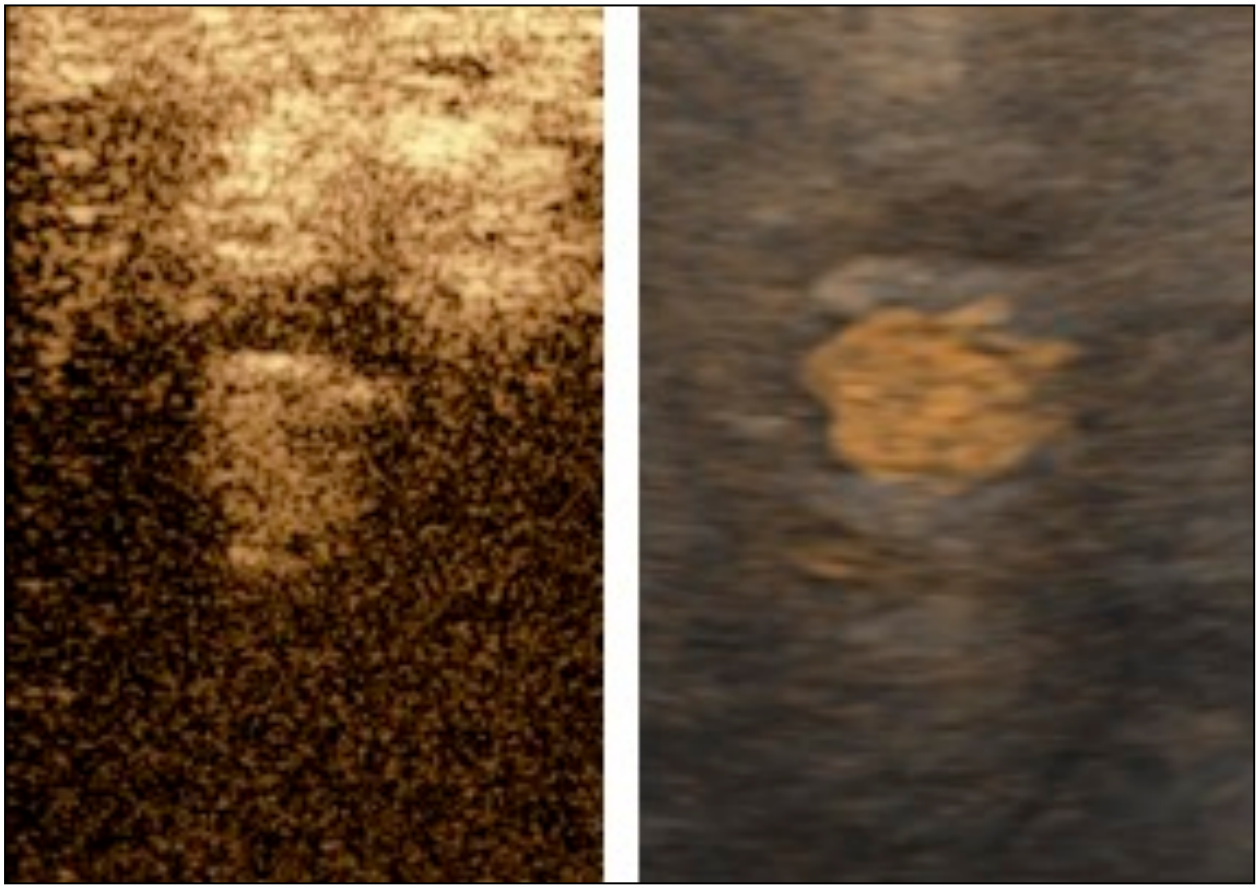
A 12-months Follow-up



cross-section longitudinal section

Fig. 4

B 24-months Follow-up



A. at 12 months follow up no endoleak was observed, neither by CEUS (right side) or in the B-Flow™ modus (left side), as well as at

B. 24-months follow up. The aneurysmatic dilatation shrinked significantly within the 24 months observation

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Declarations

Consent for publication: The author clarifies that written informed consent was obtained and the anonymity of the patient was ensured. This study submitted to Swiss J. Rad. Nucl. Med. has been conducted in accordance with the Declaration of Helsinki and according to requirements of all applicable local and international standards. All authors contributed to the conception and design of the manuscript, participated in drafting and revising the content critically for important intellectual input, and approved the final version for publication. Each author agrees to be accountable for all aspects of the work, ensuring its accuracy and integrity.

Conflict of interest:

The authors declare that there were no conflicts of interest within the meaning of the recommendations of the International Committee of Medical Journal Editors when the article was written.

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