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CASE REPORT
Cardiovascular imaging

Entirely zero-contrast diagnosis and revascularization for bilateral stenotic iliac disease with advanced chronic kidney disease: a case report

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Background Peripheral artery disease (PAD) is usually diagnosed with non-invasive arterial testing methods such as Doppler ultrasound or computed tomography angiography and treated with revascularization using contrast media, which increases the risk of contrast nephropathy and the need for subsequent renal replacement therapy, especially in patients with advanced chronic kidney disease (CKD). Therefore, it is important to identify a worthy alternative strategy for use in high-risk patients.

Case summary We present the case of a 79-year-old man with bilateral claudication and advanced CKD. The patient had a high risk of sustained reduction in renal function and requirement of renal replacement therapy in the event that contrast media was used. Therefore, we planned a zero-contrast strategy for diagnosis and treatment. The case was diagnosed as bilateral stenotic iliac disease with non-contrast magnetic resonance angiography. Zero-contrast intervention was conducted successfully under magnetic resonance angiography and intra-vascular ultrasound guidance, resulting in an excellent clinical outcome and avoidance of worsening renal function.

Discussion This zero-contrast strategy appears to be a viable alternative to angiography using contrast for diagnosis and treatment in patients with PAD and advanced CKD where contrast use is relatively contraindicated.

Keywords Case report • Chronic kidney disease • Peripheral artery disease • Contrast media • Magnetic resonance imaging • Intra-vascular ultrasound

ESC curriculum 9.3 Peripheral artery disease • 2.1 Imaging modalities

Learning points

- Given the high prevalence of chronic kidney disease in patients with peripheral artery disease, the use of contrast medium puts many patients at risk of worsening renal function or precipitating haemodialysis.
- Magnetic resonance angiography and intra-vascular ultrasound may facilitate entirely contrast-free diagnosis and revascularization of peripheral artery disease.
- A zero-contrast strategy can be used to safely diagnose and treat this high-risk patient population, which may help to avoid or delay the need for future renal replacement therapy.

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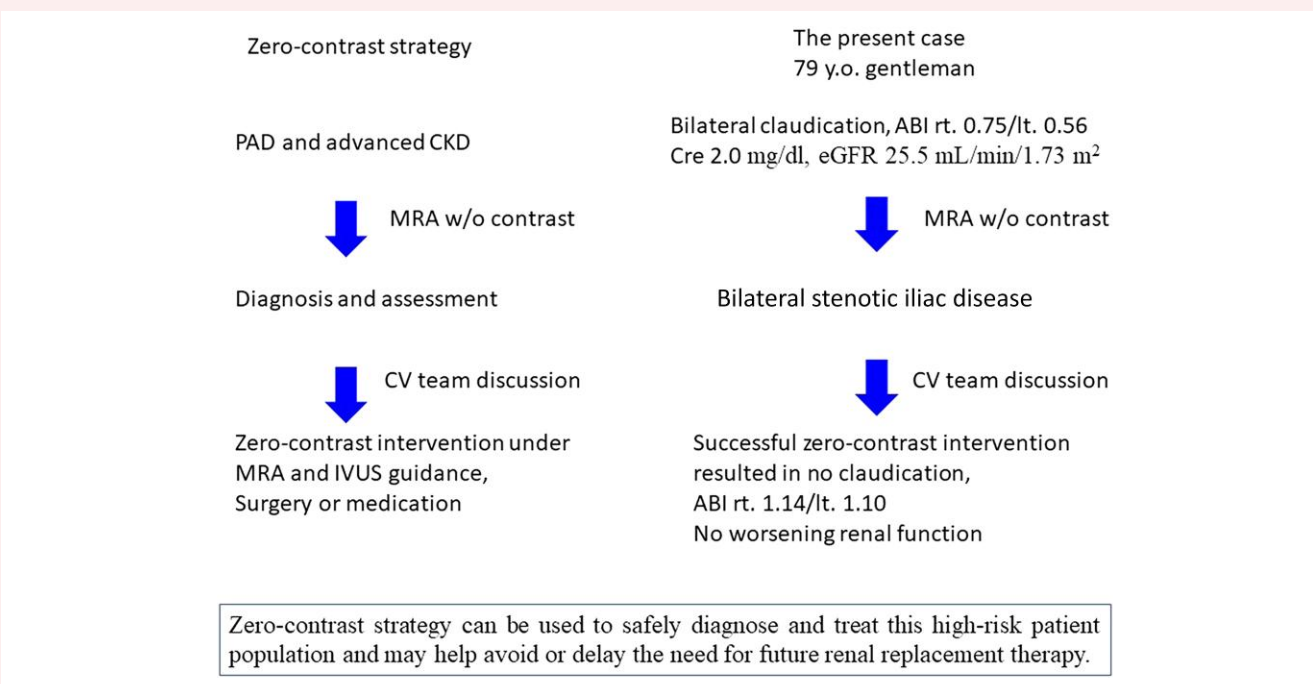
Introduction

Invasive angiography or non-invasive imaging such as computed tomography with iodinated contrast medium is the gold standard for diagnosis and assessment of peripheral artery disease (PAD).[1,2] However, given the high prevalence of chronic kidney disease (CKD) in patients with PAD,[3] many patients have a risk of worsening renal function or precipitating haemodialysis. Contrast-enhanced magnetic resonance angiography (MRA) with gadolinium-based contrast is not a suitable alternative examination because it may cause nephrogenic systemic fibrosis in patients with CKD.[4] Recently, non-contrast MRA has been improved with pulse sequences combined with instrumentation and provides a high spatial resolution to assess PAD.[5]

Endovascular therapy (EVT) requires the use of iodinated contrast medium. Intra-vascular ultrasound (IVUS) guidance may facilitate EVT without contrast if zero-contrast technique of percutaneous coronary intervention (PCI) is used, as it is safe and feasible.[6–9]

Here, we present the case of a patient with bilateral stenotic iliac disease and advanced CKD, which contraindicates the use of contrast medium.

Summary figure



Case presentation

A 79-year-old man with advanced CKD, Stage 4, a baseline serum creatinine level of 2.04 mg/dL (normal range 0.65–1.09) and an estimated glomerular filtration rate (eGFR) of 25.5 mL/min/1.73 m^2 (normal range > 90), presented with claudication. Other medical history included diabetes mellitus and hypertension. Bilateral claudication appeared 24 months prior and later worsened, on walking 10 m (Rutherford Category 3). The patient's ankle brachial index (ABI) was 0.75 and 0.56 on the right side and left side, respectively. To avoid contrast medium administration, non-contrast MRA and vascular ultrasound were chosen for the diagnosis.

Severe stenosis was detected at the bilateral common iliac artery (CIA) to the external iliac artery (EIA) on MRA (*Figure 1*). Doppler echo on vascular ultrasound indicated that the culprit lesion was on the CIA and/or EIA on both sides (*Figure 2*). Endovascular therapy was recommended in our multidisciplinary cardiovascular team. After discussion, the patient opted to proceed with zero-contrast EVT, with the concurrent preparation for contrast administration.

Non-contrast magnetic resonance angiography protocol

The fresh blood imaging (FBI) technique was used on the Vantage Titan, 1.5 T MRI instrument (Canon Medical Systems, Otawara, Tochigi, Japan). The patient was placed in the supine position with his knees and ankles fixed to prevent motion artefacts. The Octave SPEEDER Spine, Atlas SPEEDER Body coil, and 3D electrocardiogram-gated fast advanced spin echo sequence were used. The black blood images of arteries and the bright-blood images of veins were collected during the systolic period. An image of the lower artery was retrieved after subtraction.

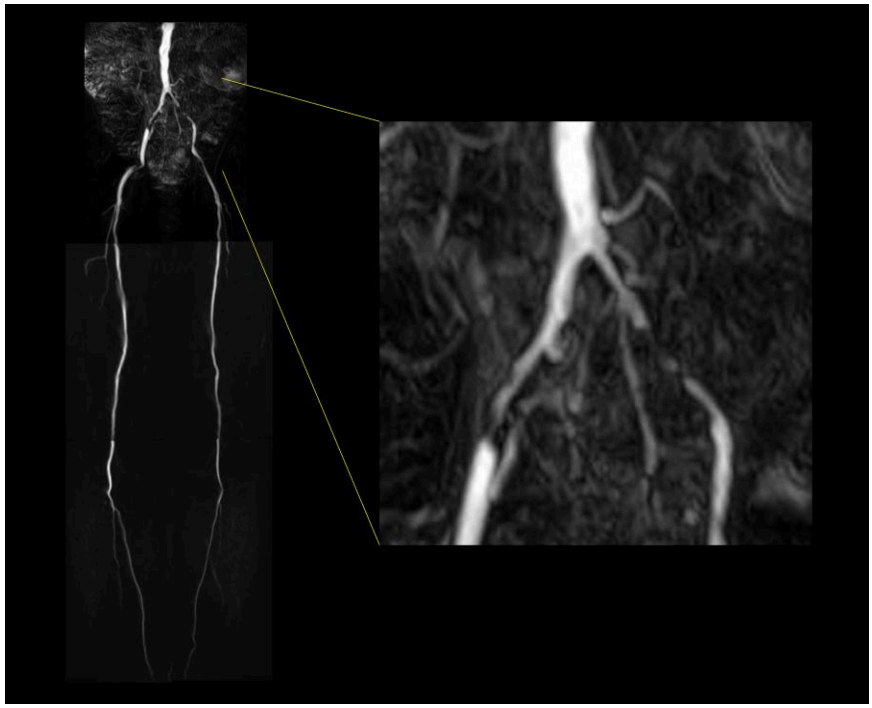


Figure 1 Non-contrast magnetic resonance angiography with the fresh blood imaging technique detected severe stenosis at the bilateral common iliac artery to the external iliac artery, with no other significant lesions.

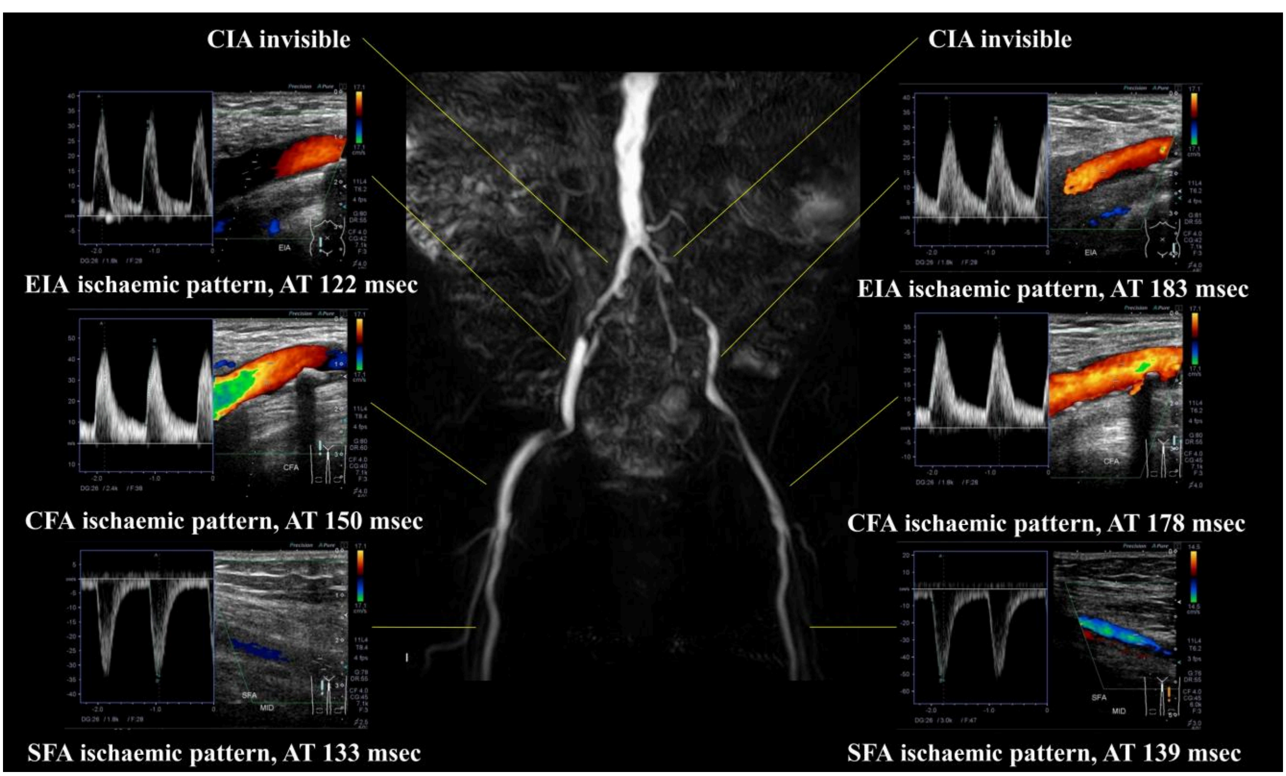


Figure 2 Both sides of the common iliac artery were invisible on vascular ultrasound. The blood flow of external iliac artery had an ischaemic pattern, indicating that the culprit lesion of lower limb ischaemia was on the common iliac artery and/or external iliac artery on both sides. AT, acceleration time; CFA, common femoral artery; CIA, common iliac artery; EIA, external iliac artery; SFA, superficial femoral artery.

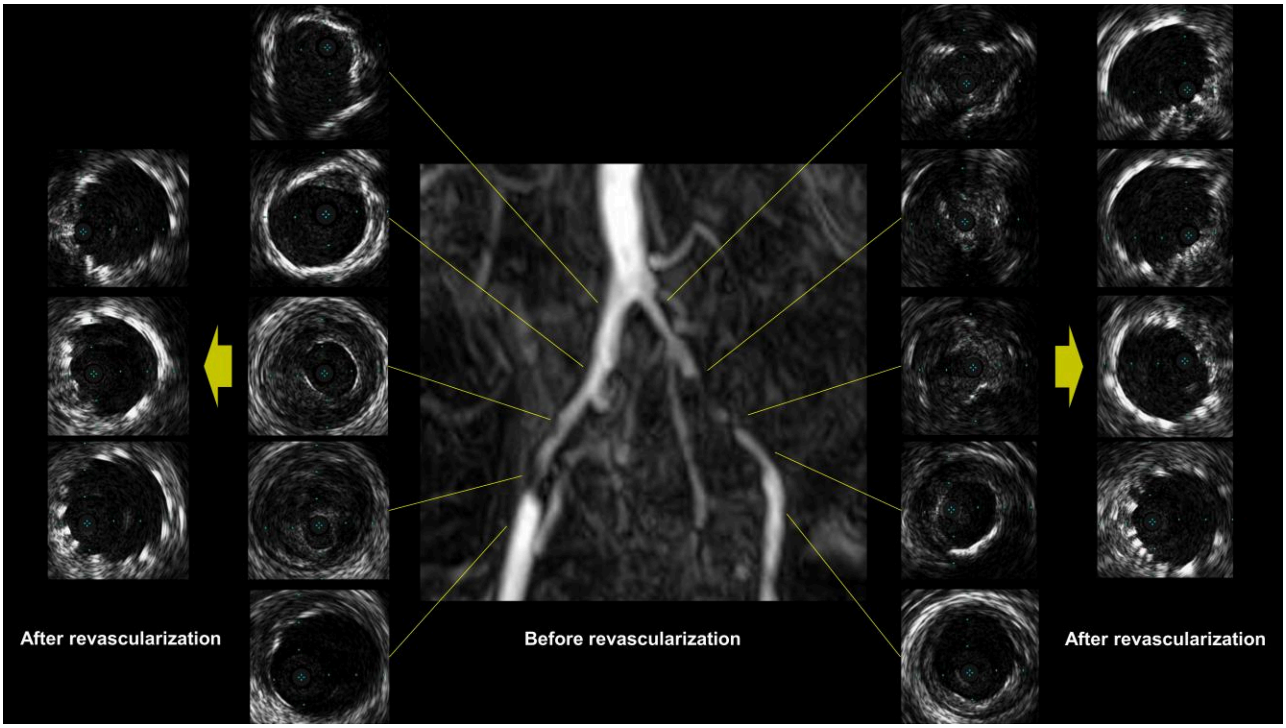


Figure 3 Intra-vascular ultrasound was performed before pre-dilatation and after post-dilatation for stent. Severe narrowing lesions of both iliac arteries were observed before revascularization. The stent dilatation was excellent, with optimal apposition and no complications.

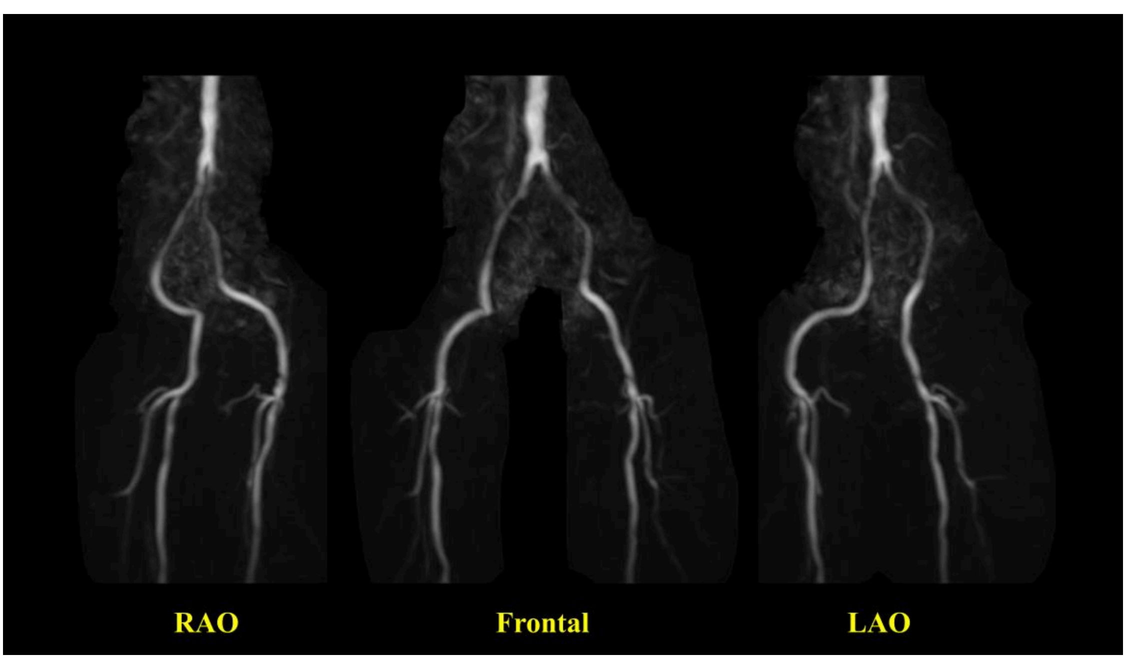


Figure 4 Eight months after the procedure, the patient received non-contrast magnetic resonance angiography with the same protocol. Despite a significant artefact due to stent implantation, the patency was still confirmed. Non-contrast magnetic resonance angiography seemed to be useful to assess the vessels even after stent implantation. RAO, right anterior oblique; LAO, left anterior oblique.

Zero-contrast endovascular therapy

The targets of EVT were severe stenotic lesions on the bilateral CIA to EIA. The procedure was performed with local anaesthesia. The approach was through bilateral common femoral arteries with a 6Fr guiding sheath. The findings of MRA were used as a reference. All procedures were performed under IVUS (Visions PV®, Philips, Amsterdam, the Netherland) and fluoroscopy guidance without contrast. The guidewire crossed the lesion of the right iliac artery and IVUS was performed (*Figure 3*; Supplementary material online, *Video S1*). The lesion was dilated with a φ7.0-mm semi-compliance balloon, 10 atm. A self-expanding stent (Absolute Pro®, 8 × 80 mm, Abbott, Illinois, USA) was deployed, and post-dilatation was performed using a φ8.0-mm non-compliance balloon, 10 atm. The lesion of the left iliac artery was dilated with a φ7.0-mm semi-compliance balloon, 6 atm. A self-expanding stent (Absolute Pro®, 8 × 100 mm) was deployed, and post-dilatation was performed using a φ8.0-mm non-compliance balloon, 10 atm. Stent dilatation was excellent, with optimal apposition and no complication on IVUS (*Figure 2*). The total procedure time was 47 min, and the fluoroscopy time was 21 min. The radiation exposure dose was 28.8 mGy, and the total contrast volume was 0.

Post-procedural course

The patient was discharged the day after the procedure without claudication (ABI: 1.14/1.10) and worsening renal function (serum creatinine, 1.93 mg/dL; eGFR: 27 mL/min/1.73 m^2). At review 8 months later, the patient remained free from claudication (ABI: 1.11/1.05). The renal function was unchanged (serum creatinine level, 2.04 mg/dL; eGFR, 25.5 mL/min/1.73 m^2). The patency of the iliac arteries was confirmed on 8-month follow-up non-contrast MRA (*Figure 4*).

Discussion

This case offers an example of diagnosis and complete revascularization without contrast in an individual with bilateral stenotic iliac disease and advanced CKD. This suggests that the combination of non-contrast MRA and IVUS can be used for contrast-free diagnosis and revascularization in some high-risk patients.

Fresh blood imaging is a new technique and its spatial resolution of images for PAD is comparable with that of contrast-enhanced MRA.[10–12] Further development in this technology will facilitate a more accurate assessment of PAD in the future. Little information is available regarding zero-contrast intervention for PAD. In this case, a three-dimensional image of non-contrast MRA gives sufficient information on vessel anatomy and the distribution of atherosclerotic lesion. Intra-vascular ultrasound guidance, in addition to the reference of MRA images, enabled EVT without contrast using the same technique as zero-contrast PCI. The procedure was simple and had a short procedure and fluoroscopy time. As a limitation, zero-contrast EVT requires operator experience and expertise with intra-vascular imaging. A systematic study for safety and feasibility of this zero-contrast strategy for diagnosis and revascularization of PAD is yet to be established.

In conclusion, the case illustrates that a zero-contrast strategy with a combination of MRA and IVUS enables an entirely contrast-free diagnosis and revascularization for PAD. This strategy contributes to avoiding worsening renal function and the requirement for renal replacement therapy and gives better outcomes in some patients who have a contraindication to contrast medium.

Lead author biography

Dr Kohei Wakabayashi completed a training of general cardiology and interventional cardiology at Showa University Fujigaoka Hospital. He is currently a chief of interventional cardiology at Showa University Koto-Toyosu Hospital. He is an expert and skilful operator of zero-contrast PCI.

Supplementary material

Supplementary material is available at *European Heart Journal – Case Reports*.

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Consent: The authors confirm that written consent for submission and publication of this case report, including images and associated text, was obtained from the patient in line with COPE guidance.

Patient perspective: He thanked so much for release from severe claudication, decision of zero-contrast strategy, and clinical course without worsening renal function.

Conflict of interest: None declared.

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Data availability

The data underlying this article are available in the article and in its online supplementary material.

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