Clinical Research in Cardiology (2019) 108:574–576
https://doi.org/10.1007/s00392-018-1395-z

LETTER TO THE EDITORS

Secondary rise in blood pressure and leg swelling after central arteriovenous anastomosis

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Received: 2 October 2018 / Accepted: 16 November 2018 / Published online: 23 November 2018

Sirs:

Arterial hypertension is the most important isolated risk factor for cardiovascular morbidity and death [1]. Especially in patients with isolated systolic hypertension (ISH), blood pressure (BP) control remains unsatisfactorily low despite the availability of safe and effective antihypertensive drugs. The major pathophysiological contributor to ISH is large artery stiffening attributable to fatigue of elastin [2]. As stiff arteries are incapable of dilatating and thereby reducing vascular resistance, patients with ISH are more likely to experience an attenuated response to therapies targeting neurohumoral mechanisms when compared with combined systolic–diastolic hypertension [3]. Unlike device-based therapies targeting neurohumoral mechanisms such as renal denervation and carotid body modulation, the creation of a central iliac arteriovenous (AV) anastomosis between the external iliac artery and vein has shown to cause a similar BP reduction in patients with combined and ISH by connecting the systemic arterial circulation to a low-resistance, high-compliance venous compartment [2, 4]. However, up to one-third of the patients with AV anastomosis develops venous iliac stenosis proximal to the AV anastomosis requiring treatment [5]. Similar to patients with hemodialysis vascular access dysfunction, hemodynamic alterations may induce neointimal hyperplasia and thus cause venous stenosis [6]. We report a case illustrating the clinical signs and a treatment option for venous iliac stenosis following AV coupler implantation.

A 59-year-old Afro-American with resistant hypertension presented with severe unilateral lower extremity edema after the creation of a central AV anastomosis 9 months ago. The patient was initially referred to our outpatient hypertension unit due to long-standing severe resistant hypertension with insufficient BP control. Catheter-based renal denervation was performed in February 2011 and resulted in modest BP lowering. Despite intake of five antihypertensive drugs, 24-h ambulatory BP monitoring documented severe uncontrolled hypertension (179/100 mmHg). After excluding secondary causes of hypertension including renal artery stenosis post-renal denervation and confirming adherence to the prescribed antihypertensive medication using toxicological analysis, an AV coupler (ROX Medical, San Clemente, CA, USA) was implanted percutaneously to create a fixed 4-mm-diameter fistula between the right external iliac vein and artery. Right heart catheterization was performed prior to AV coupler implantation which documented normal pulmonary pressures. After placement of the AV coupler, systolic and diastolic BP immediately dropped by 41/23 mmHg and thereupon continued to decrease until 6-month follow-up (24-h ambulatory BP 121/70 mmHg). At 9 months, the patient suffered from severe progressive edema of the right lower limb (8-cm difference in thigh circumference) despite intensive diuretic therapy and the use of compression stockings. Furthermore, BP increased to baseline values. Venous thrombosis was excluded by duplex sonography. Computed tomographic angiography was subsequently performed which confirmed the diagnosis of severe venous stenosis of 3 cm length 1.5 cm proximal to the AV fistula (Fig. 1). Following percutaneous transluminal venoplasty with percutaneous transluminal angioplasty (Admiral Xtreme, Medtronic, CA, USA) and cutting balloon (AngioSculpt, Boston Scientific, MA, USA), a venous stent (Venovo Venous Stent 16/80 mm, Bard, AZ, USA) was implanted. After stent implantation and post-dilatation (ATLAS GOLD PTA dilatation

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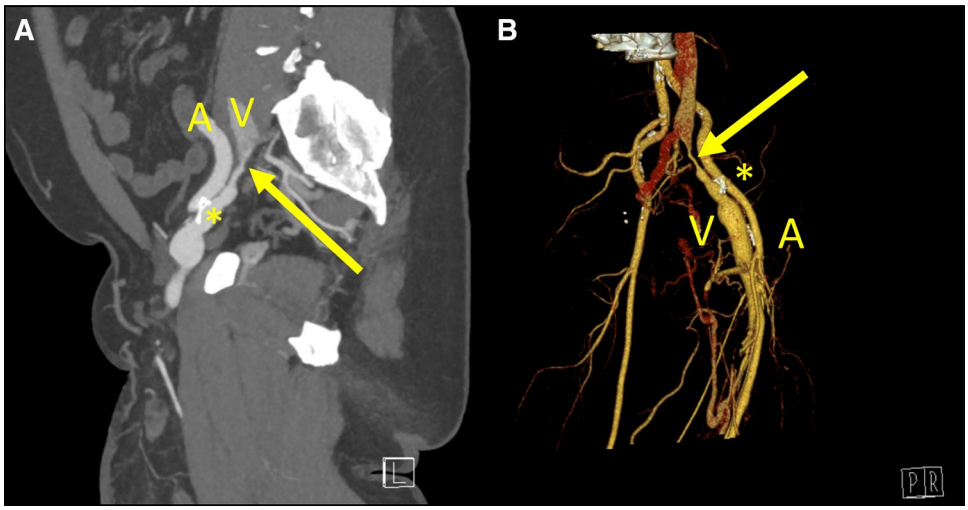

Fig. 1 **a** The sagittal plane and **b** the three-dimensional reconstruction (posterolateral view) of the computed tomographic angiography of the femoral and iliac vessels. The arteriovenous anastomosis (*) was created between the right external vein (V) and artery (A). The arrow marks the high-grade stenosis of the right external iliac vein 1.5 cm proximal to the arteriovenous anastomosis

catheter, Bard, AZ, USA), mean venous pressure distal to the lesion immediately dropped from 63 to 20 mmHg and the leg swelling gradually alleviated during the next few days (Fig. 2). As the venous intervention did not require arterial access, no invasive arterial blood pressure measurements or pressure–volume loops have been assessed. While an increase in end-diastolic as well as end-systolic pressures and, ultimately, cardiac output is conceivable, the restoration of AV shunt flow may balance these effects. However, basic hemodynamic monitoring including non-invasive upper arm blood pressure measurements did not reveal an immediate blood pressure response.

Although iliac venous stenosis is fortunately treatable, the long-term effects on cardiac hemodynamics remain subject of further research. As with any interventional approach, safety is an essential matter of concern, and thus strategies to prevent venous stenosis and improve patient selection have to become available before central AV anastomosis could be recommended for broader application.

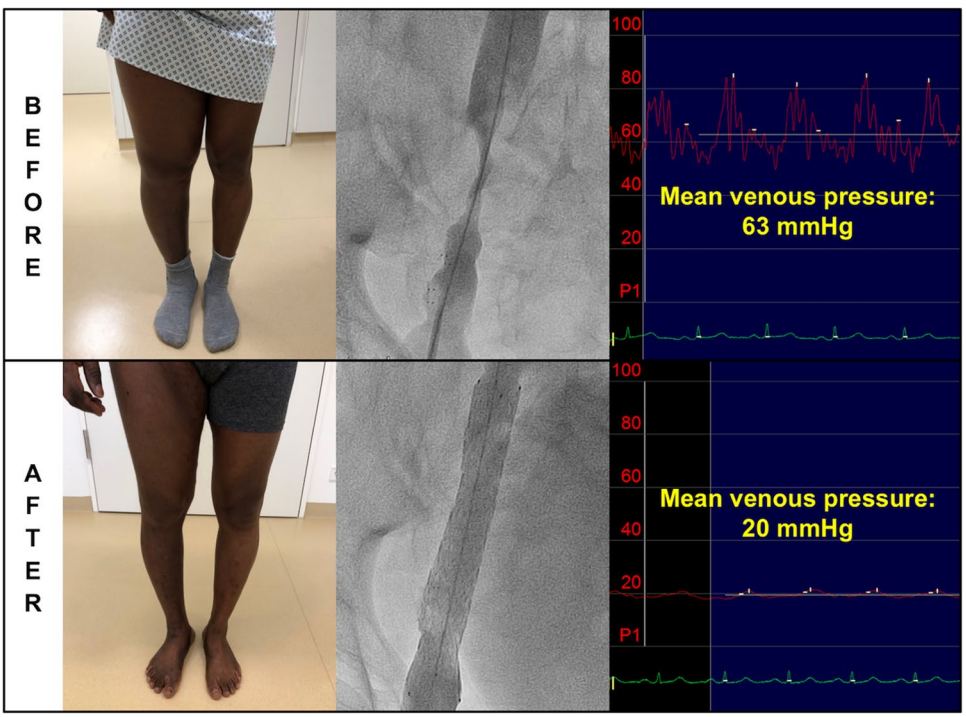

Fig. 2 The patient's lower limbs, the fluoroscopic angiography of the right external iliac vein and mean venous pressures distal to the lesion before and after percutaneous transluminal angioplasty and stenting

Acknowledgements We would like to thank Peter Balmforth (Rox Medical, Inc.) and Dr. Gerard O'Sullivan (Galway, Ireland) for their support and considerable expertise.

Compliance with ethical standards

Conflict of interest MB receives honoraria for lectures and scientific advice from Abbott, Astra-Zeneca, BMS, Boehringer-Ingelheim, and Servier. FM is supported by Deutsche Hochdruckliga, Deutsche Gesellschaft für Kardiologie, and Deutsche Forschungsgemeinschaft (SFB TRR219). FM and SE have received scientific support and speaker honoraria from Medtronic and ReCor.

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