We report 2 cases in which patients were misdiagnosed as having fibromuscular dysplasia (FMD) due to the finding of standing arterial waves on lower extremity angiography.

**Patient 1**
A 40-year-old woman with a 3-year history of chronic fatigue, as well as bilateral exertional upper and lower extremity pain, was referred to our center for suspected FMD due to the finding of diffuse beading noted in multiple arterial segments on lower extremity angiography performed at another institution (Figure 1). Her vascular examination was unremarkable except for nonpalpable pulses at the anterior tibial and dorsalis pedis arterial bilaterally, which likely represented an anatomic variant. Ankle-brachial indices were normal at rest and after treadmill exercise was terminated due to bilateral leg pain. Plethysmographic tracings of the toes were dampened and toe-brachial indices were mildly reduced, findings that were attributed to mild vasospasm. Magnetic resonance imaging performed at the outside facility showed normal renal arteries. Repeat arteriography demonstrated no significant stenoses or beading pattern in the abdominal aorta, bilateral renal, mesenteric, or lower extremities arteries, though there was somewhat slow filling of the infrapopliteal arteries bilaterally, particularly in the anterior tibial arteries. The patient was ultimately found to have a mitochondrial disorder that was felt to account for her limb symptoms.

**Patient 2**
A 55-year-old woman with a 15-year history of constant bilateral leg pain was referred for suspected FMD based on the finding of beading of bilateral superficial femoral, per-
oneal, and tibial arteries on a lower extremity angiogram performed at an outside institution (Figure 2). Her history and physical examination were not consistent with any clinically evident vascular disease. Ankle brachial indices were normal at rest, and an arterial duplex ultrasound examination of the renal, mesenteric, abdominal aorta, and lower extremity arteries was normal, with no beaded appearance or velocity shifts consistent with FMD or arterial stenosis. Carotid arterial duplex study demonstrated no evidence of FMD and normal peak systolic velocities, but demonstrated very mild nonobstructive atherosclerotic plaque in the internal carotid arteries bilaterally.

In both of the above cases, on review of the outside angiogram examinations, it was clear that operators had misinterpreted the finding of standing arterial waves as lower extremity FMD.

Fibromuscular dysplasia is an uncommon nonatherosclerotic arterial disorder that may present with a “string of beads” appearance on angiography in its most common form (medial fibroplasia). The renal and extracranial carotid and vertebral arteries are the most commonly involved vessels, and patients may present with multi-vessel involvement. Fibromuscular dysplasia is less commonly diagnosed in the lower extremities, and in such cases typically presents as beading in the external iliac arteries (Figure 3) rather than the superficial femoral arteries, as was seen in our 2 patients with standing waves. In contrast to FMD, standing arterial waves is most commonly seen in the superficial femoral arteries.

Figure 2. Patient 2: Digital subtraction arteriography in a 55-year-old woman. There is regular beading of the right (Panel A) and left (panel B) superficial femoral arteries. Panel C demonstrates beading in (1) the left tibioperoneal trunk, (2) anterior tibialis artery, (3) posterior tibialis artery, and (4) peroneal artery.
Both of our patients misdiagnosed as having lower extremity FMD had standing arterial waves. Standing waves are a benign phenomenon of uncertain etiology. The proposed mechanisms for this phenomenon are usually based on vasospasm, particularly given case reports of resolution of standing waves after administration of vasodilators.\textsuperscript{2,3} However, there also have been reports of resolution of standing waves seen on immediate repeat angiography without administration of vasodilators. Other mechanisms for standing waves have been proposed, including a physiological response of the vasculature to rapid injection of contrast or artifact from flow-related disruption of contrast medium layering in vessels.\textsuperscript{2–4} Although standing waves have been reported predominantly during conventional arteriography, they also have been reported in magnetic resonance angiography.\textsuperscript{5} There is 1 report of misinterpretation of standing waves, as FMD is previously described in the French medical literature.\textsuperscript{4} In contrast to FMD, a fixed irregular filling defect, standing waves are regular and transient, and thereby may not be reproduced on repeat contrast injections.

Standing waves are a benign phenomenon that can be misinterpreted as FMD. It is important that the interventional community recognizes this potential mimic to avoid the inaccurate diagnosis of fibromuscular dysplasia.

**Disclosures**

Dr Heather Gornik is a volunteer member of the medical advisory board of Fibromuscular Dysplasia Society of America.

Dr Aditya M. Sharma has no disclosures or conflicts of interest.

**References**


**Keywords:** peripheral vascular disease, fibromuscular dysplasia, angiography

---

**Figure 3.** Computed tomographic angiography of external iliac artery fibromuscular dysplasia (FMD). The classic beading (white arrows) of medial type FMD is seen in the external iliac arteries bilaterally in this patient with confirmed FMD.
Standing Arterial Waves Is NOT Fibromuscular Dysplasia
Aditya M. Sharma and Heather L. Gornik

Circ Cardiovasc Interv. 2012;5:e9-e11
doi: 10.1161/CIRCINTERVENTIONS.111.967828
Circulation: Cardiovascular Interventions is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 2012 American Heart Association, Inc. All rights reserved.
Print ISSN: 1941-7640. Online ISSN: 1941-7632

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://circinterventions.ahajournals.org/content/5/1/e9

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in Circulation: Cardiovascular Interventions can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to Circulation: Cardiovascular Interventions is online at:
http://circinterventions.ahajournals.org/subscriptions/