Case Report

Multivisceral Fibromuscular Dysplasia: An Unusual Case of Renal and Superior Mesenteric Involvement

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Fibromuscular dysplasia (FMD), a disease process which leads to arterial stenosis and aneurysm formation, has been reported to occur in almost every arterial bed in the body. However, multivisceral FMD is rare, and we report a 43-year-old woman with hypertension who had incidental finding of FMD of both renal arteries and the superior mesenteric artery (SMA). The left renal aneurysms and right renal stenosis were successfully treated by aneurysm resection and aortorenal bypass and percutaneous transluminal angioplasty, respectively. The asymptomatic FMD of the SMA was treated conservatively. The indications for intervention in patients with asymptomatic FMD have not been clarified till date, and we therefore advise a close surveillance program.

Key words: fibromuscular dysplasia, aneurysm, superior mesenteric artery

INTRODUCTION

Fibromuscular dysplasia (FMD) is a nonatherosclerotic and noninflammatory vascular disease that causes arterial stenosis and aneurysms.¹⁾ FMD mostly occurs in the renal artery, followed by the carotid vessels in frequency. FMD involving multiple visceral arteries is rare; however, in a review of 1,100 cases, 2% cases showed significant changes in the mesenteric and celiac arteries.²⁾ The most common clinical manifestation of FMD is hypertension secondary to renal artery stenosis. Renal artery aneurysms have been frequently reported to be associated with FMD.³⁻⁵⁾ In this report, we present a rare case of multivisceral FMD involving the superior mesenteric artery (SMA) and the right renal artery with stenosis, and the left renal artery with aneurysm formation.

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CASE REPORT

Routine physical examination of a 43-year-old woman revealed severe hypertension. Ultrasound examination of the abdomen revealed left renal masses suggestive of vascular deformity. She was referred to our hospital for further evaluation.

On admission, her blood pressure level was 190/110 mmHg and antihypertensive therapy was commenced. She had no history of crampy abdominal pain, stroke, or transient ischemic attack (TIA). The blood pressure in both her arms was equal, and her ankle-brachial pressure index was normal. Duplex ultrasonography of the internal carotid arteries and magnetic resonance angiography of the brain showed no stenotic or irregular lesions. ^{99m}Tc-labeled diethylenetriaminepentaacetic acid (DTPA) renogram revealed decreased uptake of the radioactive agent by both kidneys, the glomerular filtration rate (GFR) was estimated to be 32.7 ml/min on the right and 26.9 ml/min on the left. The chest radiograph, electrocardiogram, the levels of serum creatinine (0.8 mg/dL) and hemoglobin (12.4 g/dL), and the results of urinalysis were normal. The serum level of plasma renin activity (PRA) was 3.9 ng/ml/h (normal range, 0.3-2.9).

Multidetector row computed tomography (MDCT)

Fig. 1 Multidetector row computed tomography. Volume-rendering image showing 3 saccular aneurysms in the left renal artery. (A) Two aneurysms are connected with narrow segment (arrow). (B) The third one is presented at the bifurcation of the main renal artery.

revealed 3 saccular aneurysms in the left renal artery. Two aneurysms, measuring 2.2×1.6 and 2.3×1.8 cm, respectively, were connected, protruded cranially, and were 2 cm distal to the origin of the left renal artery (**Fig. 1A**). The third aneurysm measured 1.1×0.9 cm and was located at the bifurcation of the main renal artery (**Fig. 1B**). We performed abdominal aortograph and selective visceral arteriography. The left renal artery was severely tortuous and showed severe fibrodysplastic stenosis and saccular aneurysms with a narrow neck (**Fig. 2A**). The patient had 2 right renal arteries: one on the upper renal pole, which appeared irregular in arterial wall without stenosis (**Fig. 2B**), and one on the lower renal pole, which had multiple stenotic irregularities and a “string-of-beads” appearance, which was consistent with FMD (**Fig. 2C**). Selective renal venous sampling revealed that PRA in the right and left renal vein were 4.5 and 7.7 ng/ml/h, respectively. Selective arteriography of the SMA showed findings similar to those observed in the renal artery—severe stenosis with post-stenotic dilatation at proximal part, immediately after the origin of the artery (**Fig. 2D**).

Open surgery was performed to resect the renal artery aneurysms. An upper midline incision was taken and the abdominal aorta was dissected between the renal arteries and the inferior mesenteric artery. After the origin and aneurysms of the left renal artery were adequately exposed, we ligated the left renal artery at the origin and resected all renal aneurysms. Aortorenal reconstruction was performed by implanting a saphenous vein graft. The patient maintained adequate urine output throughout the operation. Histopathological examination of the resected

aneurysm showed intimal fibroplasia and medial hyperplasia and attenuation—findings consistent with FMD (**Fig. 3A**).

The patient's postoperative course was unremarkable with no evidence of renal dysfunction. Follow-up CT revealed good patency of the aortorenal bypass graft (**Fig. 3B**); however, mild hypertension was present even under antihypertensive treatment. Therefore, we performed percutaneous transluminal angioplasty (PTA) for right inferior renal FMD (**Fig. 3C**). A follow-up renogram showed an improved uptake of the radioactive agent by both the kidneys, and the patient's blood pressure returned to normal levels, thereby eliminating the need for antihypertensive medication.

DISCUSSION

FMD is a nonatherosclerotic and noninflammatory vascular disease that results in arterial narrowing and aneurysms of small- and medium-sized vessels.¹⁾ FMD has been reported to occur in almost every arterial bed in the body, and it most commonly involves the renal and carotid arteries; however, FMD is less commonly observed in the coronary, iliac, and abdominal visceral arteries. In a comprehensive literature review, Mettinger analyzed the reports of 1,197 patients with FMD. Renal arteries were involved in 58% of cases, internal carotid and vertebral arteries in 32%, and mesenteric and celiac arteries only in 2% cases.²⁾ Although Luscher et al. have reported a 26% incidence of multivessel involvement⁶⁾, multivisceral artery aneurysms due to FMD have been rarely reported. FMD can have

Fig. 2 Selective visceral angiography. (A) Multiple saccular aneurysms are observed in the left renal artery with severe fibrodysplastic stenosis (arrowhead). (B) The right upper renal artery shows an irregular arterial wall. (C) The “string-of-beads” appearance, typical of fibromuscular dysplasia (FMD), is shown in the right lower renal artery. (D) Severe stenosis with poststenotic dilatation is detected at proximal part of the superior mesenteric artery.

Fig. 3 Pathological examination and postoperative image. (A) Intimal fibroplasia, loss of internal elastic lamina, and massive destruction of the media are observed in the aneurysm wall (Elastica van Gieson stain, original magnification $\times 40$). (B) Postoperative computed tomography. Volume-rendering image showing good patency of aortorenal bypass graft. (C) Digital subtraction arteriogram of the right renal artery following percutaneous transluminal angioplasty (PTA). Although “beading” is still seen, no pressure gradient remains.

various pathological sequelae. In almost all cases, FMD is asymptomatic, but the dysplasia may lead to various complications, such as hypertension, renal dysfunction, TIA, or stroke, depending upon the vascular domain affected and the severity of stenosis.

Aneurysm formation is a well-known complication of FMD. FMD was the most prominent cause of aneurysm in 34–54% of the patients who underwent reconstruction for renal artery aneurysm (RAA).^{4, 7, 8)} FMD causes arterial stenosis due to hyperplasia of the media or intima, and the underlying arterial matrix disruption that exists in these dysplastic arteries may lead to aneurysm formation. A majority of true RAAs are asymptomatic and are discovered during detailed investigation for hypertension. Because the natural history of RAA has not been entirely clarified, the surgical indications for RAA remain controversial. Surgery is considered to be indicated for symptomatic or enlarging aneurysms; aneurysms larger than 1.5–2 cm, aneurysms complicated by renovascular hypertension, renal embolization and infarction; and aneurysms in pregnant women or women with childbearing potential.^{4, 7, 8)}

Over the past 30 years, the strategy for surgical treatment of renal artery lesions (aneurysm and/or stenosis) has changed significantly. Nephrectomy, frequent in the past, is now rarely performed. Endovascular intervention for renal artery lesions has recently been described as an alternative to open surgical repair. Three general approaches, namely PTA for stenosis,⁹⁾ transcatheter embolization,⁵⁾ and endovascular stentgrafting³⁾ for aneurysm have been reported. However, the indication and the success rate of endovascular treatment are highly dependent on the morphology of the renal artery lesion. Endovascular intervention for patients with poor anatomical morphology (kinking, tortuosity, and stenosis of the main renal artery or branch vessel renal artery disease) has been developing. Since only few reports have addressed the indication for intervention in such cases, the criteria for patient selection are not uniform.

In our case, the left renal artery aneurysms clearly required open surgical repair. RAA reconstruction has been reported to show excellent results in terms of maintenance of renal function and decreased mortality rate. The patency rates were reported to vary from 75% to 97% and the mortality rate was extremely low.^{4, 7, 8)} After the left renal artery aneurysm repair, although follow-up CT revealed good patency of the aortorenal bypass graft, the patient required medication for the treatment of hypertension because of the persistence of right renal FMD. At

many institutions, including our own, PTA for the main renal artery stenosis due to FMD is the first line of therapy. Initial success has been reported for 79–100% cases at most centers,⁹⁾ particularly for medial fibroplasia. In this case, PTA was suitable for right main renal stenosis due to FMD.

The diagnosis of FMD is most often made by the characteristic angiographic appearance. The characteristic “string-of-beads” finding (**Fig. 2C**) is found in the majority of patients with FMD. In case with focal and tubular FMD stenoses, differential diagnoses are atherosclerotic or inflammatory artery disease, and vascular Ehlers-Danlos syndrome. Most patients with FMD are young and present few or no risk factors for atherosclerosis and no aortic plaques. FMD differ from inflammatory disease like Takayasu arteritis by the absence of inflammation or aortic stenosis. Ehlers-Danlos syndrome is a rare inherited disorder of the connective tissue that is characterized by hyperextensible skin and hypermobile joints. Histopathological findings of the arterial tissue are diagnostic; however the tissue specimens are rarely obtained. Therefore, digital subtraction angiography remains the most accurate technique to diagnose FMD and evaluate its location, extent, and complications. However, because of the invasiveness of this technique, other noninvasive imaging modalities such as ultrasonography, CT, and magnetic resonance imaging are employed for diagnosis.⁹⁾ Although detailed examination of the renal arteries by using Doppler ultrasonography is possible in some patients, it is a technically demanding procedure and has several limitations such as non-usability in obese patients, poor compliance for respiratory renal movement, and failure to visualize the entire artery or to define accessory arteries. Several reports have indicated the utility of MDCT for the noninvasive assessment of vascular pathologies.¹⁰⁾ Although much less frequently observed than in the renal, carotid, and vertebral arteries, FMD may occur asymptotically in almost all arteries of the body. Therefore, all visible visceral vessels should be evaluated to exclude additional involvement. Because the fast data acquisition of MDCT enables acquisition of volumetric data of the abdominopelvic area during a single breath-hold, this imaging modality can help visualize lesions of all visceral arteries, including the renal artery. Furthermore, volume-rendering CT is an excellent technique for immersive visualization that can be used for evaluating the three-dimensional volume and for displaying vascular pathology as well.¹⁰⁾ This can be an advantage in determining the choice of interventional therapy, such as PTA,

coil embolization, stentgrafting, or surgery.

In the visceral arteries, FMD may develop in the celiac, superior mesenteric, inferior mesenteric, hepatic, and splenic arteries. FMD involving the mesenteric arteries may present as intestinal angina, nausea, vomiting, anorexia, weight loss, and abdominal pain. However, in the chronic phase, these clinical presentations occur when at least 2 of the major mesenteric arteries are involved and are stenosed. Our patient was totally asymptomatic. Endovascular stentgrafting for SMA aneurysm has been reported. Although their results have been successful so far, its long-term results have yet to be determined. The interventional indication for SMA stenosis or small aneurysm without any clinical presentations has not been clarified; therefore, we decided that our patient was not an ideal candidate for intervention at that time.

In summary, FMD is a rare condition primarily affecting the renal arteries and secondarily the carotid arteries. Common clinical manifestations of FMD are resistant hypertension and TIA or stroke; the clinical manifestations depend on the arterial beds involved, although in almost all cases, FMD is asymptomatic. FMD predisposes the patients to aneurysm formation. Furthermore, in around 5–10% of cases, extrarenal and extracarotid involvement is an incidental finding in the majority of cases. Detection of extrarenal and extracarotid FMD is important because limited information is available about the natural history of the asymptomatic disease. An appropriate procedure should be used to treat symptomatic disease and aneurysmal disease. Asymptomatic disease may not require urgent treatment, but a close follow-up should be recommended.

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