Fibromuscular Dysplasia accompanied by Giant Intracranial Fusiform Aneurysm

—Report of Two Cases—

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Abstract

Although the association between fibromuscular dysplasia (FMD) and intracranial aneurysms is well known, giant aneurysms are rarely encountered in this context. The authors treated two patients with FMD accompanied by giant intracranial aneurysms, one in the left cavernous sinus and the other at the left vertebral artery. Neither patient underwent surgery; with conservative treatment both patients' neurological symptoms abated. The characteristic features of FMD are outlined and various aspects of the association between FMD and intracranial aneurysms are discussed, with particular emphasis on the possible etiology and the treatment of giant aneurysms accompanying FMD.

Key words: fibromuscular dysplasia, intracranial giant aneurysm, angiography

Introduction

There are over 300 reports of cervicocephalic fibromuscular dysplasia (FMD) from Western countries,¹⁷⁾ but only about 20 from Japan.^{4,5,7,12,14,16,20,26,31,34)} This epidemiological disparity of FMD, as well as its predominance among middle-aged women,^{3,11,21,25,27,29,30)} are well known. Since FMD is accompanied by an intracranial aneurysm in 21–51.4% of cases,^{6,17,18,27,29)} many feel that there is an etiological relationship between the two conditions, *i.e.*, that FMD may entail a predisposition to the formation of intracranial aneurysms. There are, however, only two reported cases of FMD accompanied by a giant aneurysm.^{8,24)} In 1983 and 1984, we encountered two patients with FMD complicated by giant intracranial aneurysms. We describe these cases, review the relevant literature, and discuss the difficulty of treating such patients.

Case Reports

Case 1: A 35-year-old female complained of visual disturbance in January of 1983. Her blood pressure was 180/120 mmHg, and she was diagnosed as having hypertensive retinopathy due to renal failure. Two months later, she presented at a local hospital with double vision on the left lateral gaze. A neurological examination revealed diminished visual acuity on the left side, left abducens palsy, and anisocoria (left > right). A precontrast computed tomographic (CT) scan showed a mass of slightly high-density in the left cavernous sinus; the mass was markedly enhanced after administration of contrast medium (Fig. 1). Angiography by Seldinger's method demonstrated the so-called "string of beads" changes in the bilateral external carotid arteries and the left vertebral artery, as well as a giant fusiform aneurysm in the left cavernous sinus (Fig. 2). Since the anterior communicating artery, as a part of the circle of Willis, was hypoplastic, a sufficient amount

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Fig. 1 Postcontrast CT scan of Case 1 showing a high-density mass in the left cavernous sinus.

Fig. 2 *left:* Left carotid angiogram demonstrating FMD of the external carotid artery and a giant aneurysm at the portion of the cavernous sinus. *right:* Left vertebral angiogram showing a fusiform aneurysm-like dilatation of the left vertebral artery.

of collateral circulation could not be expected, if the giant aneurysm should be treated by ligation of the internal carotid artery in the neck. Examination of blood serum disclosed significant elevations of plasma renin activity (20 ng/ml/hr), angiotensin I (16,425 pg/ml), and angiotensin II (2,171 pg/ml), but digital subtraction angiography indicated no abnormality of the renal arteries. HE staining of a biopsy sample from the superficial temporal artery (STA) revealed the fibrous hyperplasia of the intima and partial muscular hyperplasia that are character-

istic of FMD²⁰⁾ (Fig. 3). Elastic and van Gieson staining was not performed, so that the condition of the internal elastic lamina was not ascertained. She was treated with an angiotensin I converting enzyme blocker, and as of the 3-year follow-up examination, her blood pressure was within the normal range and her abducens palsy had slightly improved.

Case 2: A 42-year-old male had a sudden attack of severe lower abdominal pain in April of 1984. In October of the same year he underwent surgery, and the diagnosis was dissecting aneurysms of both external iliac arteries. In May, 1985, he had a sudden, brief episode of right motor weakness, which resolved spontaneously, and on May 17 he was examined at our hospital. His father and sister had had strokes in their fifth and fourth decades, respectively. On admission, neither neurological abnormalities nor hypertension were found, but postcontrast CT revealed a high-density mass in the center of the posterior fossa (Fig. 4). Carotid angiography disclosed the "string of beads" configuration in the right cervical internal carotid artery and a saccular aneurysm on the left cervical internal carotid artery. In addition, a giant fusiform aneurysm of the left vertebral artery was discovered (Fig. 5). The right vertebral artery was hypoplastic and flowed into the basilar artery at the distal portion of the giant aneurysm. The bilateral posterior communicating arteries were also hypoplastic. The renal arteries were not examined. A biopsy of the STA revealed severe fibrous hyperplasia of the intima (Fig. 6), which indicated FMD.²⁰⁾ Elastic and van Gieson staining showed no changes in the internal elastic lamina. He was treated with antiplatelet agents, and during the subsequent 2 years was free of transient ischemic attacks and bleeding.

Fig. 3 Photomicrograph of the STA in Case 1 revealing intimal fibrous hyperplasia and partial muscular hyperplasia of the media. HE stain, $\times 30$.

Fig. 4 Postcontrast CT scan of Case 2 showing a high-density mass in the center of the posterior fossa.

Fig. 5 *left*: Right carotid angiogram showing the "string of beads" pattern of the cervical internal carotid artery. *right*: Left vertebral angiogram demonstrating a giant fusiform aneurysm of the left vertebral artery.

Discussion

In 1938 Leadbetter and Burkland¹⁵⁾ published the first report on FMD of the renal artery. Since then FMD has been a known cause of renal hypertension. In 1964 FMD of the extrarenal (celiac) artery was reported by Palubinskas and Ripley.²²⁾ In 1965 Connert and Lansche²⁾ reported the first case of FMD of the cervical internal carotid artery, which led to the recognition of FMD as a systemic arterial disease involving not only the renal arteries but also the extrarenal arteries. To date, more than 300 case reports of cervicocephalic FMD have been published,¹⁷⁾ and

Fig. 6 Photomicrograph of the STA in Case 2 showing marked intimal fibrous hyperplasia. HE stain, $\times 30$.

FMD is relatively well known in Western countries. On the other hand, FMD seldom occurs in black populations,^{1,17)} and only about 20 cases have been reported in Japan.^{4,5,7,12,14,16,20,26,31,34)} Thus, there are racial differences in the incidence of FMD,^{1,17)} in addition to its prevalence in middle-aged women, who constitute approximately 80% of the reported cases.^{3,11,21,25,27,29,30)}

FMD is detected in 0.25–0.9% of cerebral angiograms.^{6,10,11,18,19,27,29)} Mettinger and Ericson¹⁸⁾ stated that seven of 37 cases of cervicocephalic FMD initially manifested as focal ischemia, whereas 21 patients developed cerebral hemorrhage. So *et al.*²⁷⁾ noted that focal ischemic disorder was the initial symptom in 18 of 32 cases (56%). On the other hand, Sandok *et al.*²⁵⁾ claimed that FMD seldom produces neurological deficits and is likely to be found incidentally on angiographic screening for other disorders.

FMD is often accompanied by an intracranial aneurysm. In 1966 Wylie *et al.*³³⁾ reported that five of six patients with FMD of the cervical internal carotid artery (among 70 patients with renal arterial FMD) had intracranial aneurysms. They also postulated that intracranial aneurysms histologically resemble renal arterial FMD. With a reported incidence of 21–51.4%,^{6,17,18,27,29)} the association between FMD and intracranial aneurysms has attracted interest. Mettinger¹⁷⁾ proposed that more detailed angiography would result in a higher observed incidence of this association. Furthermore, he emphasized that its incidence is significantly higher than that of intracranial aneurysms found in large autopsy series.

Mettinger and Ericson¹⁸⁾ suspected an etiological relationship between FMD and intracranial aneurysm because hypertension was present in only nine of 19 patients, most of whom had intracranial aneu-

rysms in the same arterial system as FMD. Nevertheless, because there is a higher than average risk of hypertension with renal FMD, the likelihood of aneurysmal rupture is greatly increased. Wylie *et al.*³³⁾ histologically demonstrated medial hyperplasia in the arterial wall near the ruptured aneurysm, which suggests an important association between FMD and aneurysm formation.

The association of FMD with an intracranial giant aneurysm has been reported only twice. In 1975 Hirsch and Roessmann⁸⁾ described an 11-year-old girl who died of sudden subarachnoid hemorrhage; the autopsy revealed a giant fusiform aneurysm of the basilar artery and systemic FMD. In 1983 Rebollo *et al.*²⁴⁾ reported a 56-year-old female whose angiograms showed FMD of both internal cervical carotid arteries and a giant aneurysm in the left cavernous sinus.

The reason for the development of giant aneurysms is uncertain, but it might be related to the natural history of FMD of intracranial arteries. Abdul-Rahman *et al.*¹⁾ reported a case in which follow-up angiography after 8 years disclosed FMD and an aneurysm, and Yamamoto *et al.*³⁴⁾ discussed a case in which the "string of beads" evolved into tubular stenosis within 2 months. The natural course of FMD may lead to arterial tubular stenosis and even to complete occlusion; or it may lead to dilatation of the artery and, sometimes, formation of a giant aneurysm. Three of the four giant aneurysms reported, including our two cases, were fusiform aneurysms, and therefore dilatation of the artery affected by FMD was suspected as the cause. We conclude that our two patients were probably in the end stage of a process of dilatation of the arteries affected by FMD.

In the diagnosis of FMD, the angiographic appearance, particularly the "string of beads" finding, is most important.^{10,20)} Histologically, marked intimal fibrous hyperplasia, seen in both of our cases, and partial muscular hyperplasia of the media, observed in Case 1, are pathognomic for FMD.²⁰⁾ To our regret, we did not perform elastic staining in Case 1 and therefore do not know if the internal elastic lamina had undergone pathological change.

In most cases, direct surgery for giant intracranial aneurysms is very difficult. Also, relative to that of typical aneurysms, the incidence of rupture of giant aneurysms is fairly low — according to Whittle *et al.*,³²⁾ 36%. This group also reported that intracavernous giant aneurysms seldom rupture, and that three patients subjected to carotid ligation showed no neurological improvement. The patient reported by Rebollo *et al.*²⁴⁾ showed some neurological improve-

ment after carotid ligation. The usual treatment for intracavernous giant aneurysm is ligation of the carotid artery with or without external carotid to internal carotid (EC-IC) artery bypass,²⁸⁾ but this procedure often leads to complications.¹³⁾ In our Case 1, the collateral circulation to the left cerebral hemisphere appeared poor on angiography, and the STA was not considered competent as a donor artery because of its fibromuscular degeneration. In the ligation of the proximal basilar artery or vertebral arteries for an unclippable giant basilar artery aneurysm, a sufficient blood supply from the internal carotid system *via* at least one posterior communicating artery is necessary.²³⁾ Hopkins *et al.*⁹⁾ reported two cases of giant basilar tip aneurysm treated with proximal basilar artery ligation plus EC-IC artery bypass. However, one of their patients was comatose for 1 month postoperatively. In our Case 2, angiography showed the bilateral posterior communicating arteries to be hypoplastic, as was the right vertebral artery. Therefore, we felt that ligation of the proximal portion of the artery feeding the giant aneurysm would be exceedingly dangerous.

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