Abdominal aortic ectasia resulting from peripheral traumatic arteriovenous fistulization

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A 61-year-old World War II fighter pilot sustained a gunshot injury to the right fibula and an arteriovenous fistula subsequently developed. Angiographic examination 44 years later for evaluation of an abdominal aortic aneurysm showed an unusually shaped aneurysm and the right arteriovenous fistula with antegrade dilatation of the ipsilateral arterial system in continuity with the aneurysm. We hypothesize that this arteriovenous fistula, which involved the peroneal and anterior tibial arteries of the right leg of 44 years' duration, was responsible for the development of this man's abdominal aortic aneurysm. (J Vasc Surg 1987;5:882-6.)

Abdominal aortic aneurysms are the most common of the forms of symptomatic aneurysms. Factors contributing to aneurysm formation are either mural or mechanical—mural factors relate to intrinsic strength and structural integrity of the arterial wall and mechanical factors relate to mechanical stresses imposed on that wall. Causes of wall weakness include atherosclerosis (in most cases), congenital syndromes, trauma, and infection. Abnormal mechanical stress in relation to aneurysm formation is less often implicated, except perhaps in poststenotic aneurysms. This article reports the case of a unique patient with an abdominal aortic aneurysm that we believe developed in response to the chronic mechanical stress of proximal arterial dilation caused by a longstanding traumatic arteriovenous fistula of the right lower leg.

CASE REPORT

A 61-year-old man, a former World War II fighter pilot, had sustained a bullet injury to the right lower leg in 1941. The injury occurred with the patient lying on his abdomen. A bullet, intended for his head, passed over his head, entered the upper medial aspect of his right calf, exited out the lower lateral right calf, and lodged in his boot. During the ensuing years the patient noticed that he had a constant ticking and buzzing sensation in his right calf, and increased warmth and size of the right leg compared with the left. As this condition gave him no discomfort, he did not seek medical advice. Thirty-nine years after the injury, a small abdominal aortic aneurysm was incidentally found. This aneurysm was initially evaluated until its growth necessitated operative decision, 44 years after the leg injury. The only other relevant history was 2 years of treated hypertension. Physical examination showed a pulsatile abdominal mass, 8 cm in diameter, and a prominent right popliteal pulse (aneurysmal). The right calf was slightly enlarged compared with the left, with a palpable...
Fig. 2. Aortogram shows (A) aneurysmal dilatation of right external iliac, common femoral, and superficial femoral arteries, compared with normal left side and (B) aneurysmal dilatation of right popliteal artery and normal left side.

thrill over it (most prominent posteriorly in the proximal one third), increased warmth, and a loud bruit on auscultation.

An abdominal ultrasound scan showed a distal abdominal aortic aneurysm measuring 7 x 8 cm in maximum diameter extending to the level of the bifurcation of the iliac vessels. There was moderate dilatation of the popliteal artery and evidence of an arteriovenous fistula on ultrasound. Translumbar aortography (to examine the relationship of the aneurysm to the renal arteries) showed the aortic aneurysm measuring approximately 8 cm at its widest intraluminal diameter, originating below two patent renal arteries (Fig. 1). The aneurysm involved the origin of the right common iliac artery and there was aneurysmal dilatation of the right iliac, femoral, and popliteal artery system (Fig. 2, A and B). Continuing distally a huge arteriovenous complex was seen; all the runoff vessels were dilated down to the ankle. The patient was admitted for abdominal aortic aneurysm repair. The aneurysm measured at least 10 cm in greatest diameter. The aneurysm was unusual in that the proximal and distal ends of the aneurysm (neck and iliac vessels) were quite thin and felt like normal artery wall. Also unusual was that, when the aneurysm was opened, all the lumbar arteries bled vigorously. A bifurcation graft measuring 18 x 9 mm of knitted Dacron (Microvel) was sewn end to end to the abdominal aorta proximally; the right limb was anastomosed end to end, to the right external iliac artery and the left limb to the left common iliac artery. Biopsy specimens of the right iliac artery, the neck of the aneurysm, and the aortic aneurysm were taken. The patient did well and was discharged 10 days later. Approximately 3 months later, the patient was readmitted for excision of the arteriovenous fistula. A right femoral arteriogram showed the fistula between the peroneal artery and peroneal vein at the site of the old gunshot wound, involving the midshaft of the fibula. Selective angiography of the lower leg (Fig. 3, A and B) showed a large venous structure arising in the area of the bone defect with direct communication with the peroneal and anterior tibial arteries. The patient underwent partial fibulectomy and closure of the arteriovenous fistula, with clamping and ligating of feeding arteries and draining veins under tourniquet control. The patient was discharged home 2 weeks later with a warm and well-perfused right lower leg.

The aortic and arterial tissues were routinely processed and stained for light microscopy. The biopsy specimens of iliac artery showed degenerative changes of media and only mild atherosclerosis. The sections of aorta had adventitial fibrosis, medial thinning with replacement fibrosis, and loss of elastic tissue. There were proliferative intimal changes and complicated atherosclerosis (which did not appear to differ significantly from usual aortic aneurysms). The excised piece of fibula, 10.5 cm in length, was decalcified, serially sectioned, and stained for light microscopy. The fibula was grossly normal at the resection lines but had fusiform expansion of its midportion, up to 4 x 3 cm in greatest diameters. The cross sections of it had an expanded marrow space with thinned cortical bone overlying it. The marrow space was replaced by layered old and recent thrombus. The convoluted cavity seen centrally in the fibula
Fig. 3. Selective femoral artery angiogram shows (A) early arterial phase with feeding vessel to arteriovenous fistula and (B) fistula in lateral view (subtraction film).

at this point (Fig. 4) had a lining consistent with thinned and attenuated, greatly expanded, vessel wall. In several sections a large vessel of indeterminant type could be seen entering the cavity.

DISCUSSION

An arteriovenous fistula is a “short circuit” between the high pressure arterial and the low pressure venous systems. Pathophysiologic changes associated with arteriovenous fistulas may occur peripherally, centrally, and locally. Peripherally, ischemia may develop in portions of the limb distal to the fistula. Ischemia and the associated accumulation of metabolites stimulate proximal vasodilation. This may in turn cause problems of cardiac failure because of markedly increased flow. Finally, local effects of degeneration of the blood vessels leading to and draining the fistula may occur. Blood flow in the proximal artery is always increased and may be excessive if the fistula is very large.

This increased arterial and venous flow causes morphologic changes in the contributing vessels of chronic fistulas. These changes include progressive elongation and distention of the proximal artery to the point of becoming tortuous and aneurysmal. Hunter was the first to report this in 1764. Since then there have been few reports of patients with long-term peripheral arteriovenous fistulas developing proximal aneurysmal disease. Sako and Varco reported their 20-year experience with 57 patients who had congenital and acquired arteriovenous fistulas of the extremities, abdomen, and chest wall. Four of these patients had acquired arteriovenous fistula of the distal extremity as a result of bullet wounds. They required operation on the dilated arterial segments proximal to their arteriovenous fistulas, although their fistulas had been corrected years before. Because of this, these authors cautioned that, in all such patients with longstanding arteriovenous fistulas, long-term observation is required. Similarly, five other reports describe chronic arteriovenous fistulas. These series describe a total of 11 patients with duration of fistula communication ranging from 7 to 34 years. In some cases, irreversible arterial wall
Fig. 4. Cross section of midportion of fibula shows replacement of marrow space by expanded vascular structure with mural thrombus (T); dystrophic calcification (star) is associated with the entry point of a large vessel on the medial aspect of the fibula (arrow) (ruler is 1 cm).

degeneration with smooth muscle atrophy and acceleration of atherosclerosis have been observed in arteriovenous fistulas allowed to persist for more than one or two years.⁶ Similarly, changes of dilatation and tortuosity have been observed in the proximal veins of such fistulas.¹¹,¹³

The cause of changes in the proximal artery is not precisely defined, but hemodynamic factors such as increased velocity of blood are probably responsible.¹⁴,¹⁵ Sako and Varco⁶ experimentally demonstrated degeneration of the artery proximal to the fistula in an iliac arteriovenous fistula of 8 years' duration in a dog. Two other canine experimental arteriovenous fistulas of shorter duration (5 and 14 months) had marked proximal arterial dilatation and atherosclerosis when cholesterol levels were maintained at 880 mg/dl.

The patient reported herein was relatively asymptomatic (no heart failure) after traumatic arteriovenous fistula of the right lower leg 44 years previously. The fistula was only discovered incidentally during investigation for aortic aneurysm repair. Review of the patient's angiography shows unilateral arterial dilatation beginning at the level of the arteriovenous fistula and continuing retrogradely to the level of the abdominal aorta. We speculate that the increased arterial flow over 44 years, on the side of the fistula, produced this unilateral arterial dilatation. This dilatation continued into the abdominal aorta and caused a most unusually shaped abdominal aorta with a peculiarly shaped aneurysm involving mainly the right side.

In this patient examination of the small biopsy specimens of the aneurysm failed to reveal any features distinguishing this from the more usual atherosclerotic aortic aneurysm. However, in this case, the atherosclerosis seen in the aortic tissues probably occurred as a secondary change. Both the unusual gross and radiographic appearances of this man's aortic aneurysm and right leg arteries support the hypothesis that the abdominal aortic aneurysm resulted from the phenomenon of increased flow over many years. Because of the paucity of such cases described in the literature, this case is presented as one of the rarest and most unusual causes of abdominal aortic aneurysm.

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REFERENCES


