Graft-to-Vein Fistulas Associated with Polytetrafluoroethylene Dialysis Grafts: Diagnosis and Clinical Significance

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PURPOSE: To describe the diagnosis and morphology of abnormal fistulas between dialysis grafts and adjacent native veins in five patients and to discuss their clinical significance.

PATIENTS AND METHODS: Five patients with PTFE loop-type forearm dialysis grafts were found to have graft-to-vein fistulas in the presence of venous outflow stenosis or occlusion. Three patients underwent surgical revision and two patients underwent percutaneous angioplasty of the venous obstruction. Only one patient required ligation of the abnormal graft-to-vein fistula. The clinical history, dialysis records, surgical reports, and subsequent radiographs of the fistula were reviewed to determine the clinical significance of these fistulas.

RESULTS: Two patients presented with partial graft thrombosis; the proximal portion of the graft remained patent due to persistent flow through the fistulous communication to an adjacent native vein. Two other patients had a graft-to-vein fistula arising from a pseudoaneurysm, which itself was originating from the graft. After either surgical or percutaneous treatment of the venous obstruction, all five grafts remained functional during the follow-up period.

CONCLUSION: These iatrogenic, small-caliber fistulas are not uncommon but only manifest during periods of elevated graft pressure. Once the graft pressure is normalized, these fistulas have minimal hemodynamic effect and need not be specifically treated.
errant communications between PTFE grafts and adjacent native veins.

PATIENTS AND METHODS

From June 1, 1993, to May 30, 1994, 127 patients were referred to our department for diagnostic imaging of a fistula. Five patients, all with loop-type PTFE grafts in the forearm, were found to have fistulous communications between their grafts and an adjacent native vein. The patients ranged in age from 38 to 72 years; three were women and two were men.

Indications for diagnostic imaging in this group of patients included elevated recirculation values (patients 1 and 3), increased venous pressures during dialysis (patient 3), dilated superficial veins of the forearm (patient 5), and physical examinations suggestive of graft thrombosis (patients 2, 4, and 5).

Diagnostic imaging of the fistula was performed via a 19-gauge butterfly needle in the arterial limb of the PTFE loop graft. Digital subtraction angiograms of the graft and upper extremity venous outflow tract were obtained in multiple projections after 5–10-mL injections of Conray 43 (Mallinckrodt Chemical, St. Louis, Mo). These examinations included visualization of the venous outflow to the superior vena cava and visualization of the arterial anastomosis using a suprasystolic blood pressure cuff (10).

Follow-up of these five patients included review of the patient’s hospital and dialysis records. Subsequent diagnostic imaging of the fistula was performed in only one patient (patient 3), and these images were also reviewed. The follow-up period ranged from 2 to 15 months (mean, 7.4 months).

RESULTS

Patient 1 had a PTFE graft that was 2 years old when routine recirculation values showed elevated recirculation values. A 19-gauge needle was inserted into the arterial limb of the PTFE graft, and digital subtraction angiograms were obtained. The examination showed a graft-to-vein fistula and a venous outflow stenosis.

Figure 1. Patient 1. (a) Drawing of the PTFE forearm loop graft. The fistula (arrow) originates from a pseudoaneurysm, which arises from the arterial limb of the graft. Note the venous outflow stenosis (arrowhead). (b) Diagnostic image of the fistula shows the graft-to-vein fistula and the venous anastomotic stenosis.

Figure 2. Patient 2. (a) Drawing of the fistula. The graft-to-vein fistula (small arrow) originates from a pseudoaneurysm (large arrowhead), which arises from the arterial limb of the graft. There is a stenosis (small arrowhead) at the venous anastomosis and an adjacent pseudoaneurysm (large arrow) in the native venous outflow. (b) Diagnostic image of the fistula obtained after successful pulse-spray thrombolysis. The fistula (arrowhead) originates from a pseudoaneurysm (small arrow). There is a stenosis (large arrow) at the venous anastomosis.
calculation values became elevated (>15%). The images of the fistula revealed a pseudoaneurysm arising from the proximal arterial limb of the graft and a fistulous communication between this pseudoaneurysm and an adjacent native vein (Fig 1). A high-grade stenosis was also identified at the venous anastomosis and was successfully treated with angioplasty. The pseudoaneurysm and fistula were not treated.

Patient 2 presented with a 1-year-old PTFE graft that had recently thrombosed and was referred for thrombolysis. Her graft was successfully lysed with 500,000 U of urokinase (Abbott Laboratories, North Chicago, Ill) administered using the crossed-catheter, pulse spray technique (11). After thrombolysis, diagnostic imaging of the fistula revealed a pseudoaneurysm arising from the venous limb of the graft and a fistula between the pseudoaneurysm and an adjacent native vein (Fig 2). A high-grade stenosis was also identified at the venous anastomosis and was successfully treated with angioplasty. The pseudoaneurysm and fistula were not treated.

Patient 3 had a graft that was only 5 weeks old when moderate swelling in the antecubital fossa was noted on physical examination. He also had elevated venous pressures during dialysis and an elevated re-circulation value (31%). Imaging studies demonstrated an occlusion of the primary native venous outflow just distal to the venous anastomosis (Fig 3). Small collateral veins arising from the venous anastomotic region provided graft outflow. In addition, there was a fistula between the distal venous limb of the PTFE graft and an adjacent native vein. The patient underwent surgical revision of the venous anastomosis, but the graft-to-vein fistula was not ligated.

Patient 4 had a 3-year-old graft that on physical examination was found to have pulsations in the proximal arterial limb but none detected in the remainder of the PTFE loop. The subsequent fistula image revealed an abnormal communication between the arterial limb of the graft and a superficial forearm vein (Fig 4). The graft, distal to this fistula, was thrombosed. The patient underwent a surgical thrombectomy at which time a venous anastomotic stenosis was identified, and the anastomosis was revised with a patch angioplasty. The graft-to-vein fistula was not treated.

Patient 5 had a PTFE graft that had been in place for 4 months when several superficial forearm veins became progressively dilated. Physical examination of the graft identified a palpable thrill in the arterial limb, but no pulsations were present in the venous limb. On the fistula im-
age, there was an abnormal communication arising from the arterial limb connecting to an adjacent native vein (Fig 5). Distal to this fistula the graft was thrombosed. This patient also underwent a surgical thrombectomy and patch angioplasty of the venous anastomosis. The graft-to-vein fistula was ligated at that time.

A single fistulous communication between a loop-type forearm PTFE graft and an adjacent native vein was identified in each of these five patients. The graft age at the time of diagnosis of the abnormal fistula ranged from 5 weeks to 3 years old. In addition, every patient had a venous anastomotic stenosis or venous outflow occlusion. Two patients had graft-to-vein fistulas originating from a pseudoaneurysm, which itself was arising from either the arterial limb (patient 1) or venous limb (patient 2) of the PTFE graft. Two patients underwent percutaneous balloon angioplasty of a venous anastomotic stenosis and three patients underwent surgical revision of the venous anastomosis. Only one patient (patient 5) had the graft-to-vein fistula ligated or otherwise occluded.

All five patients had fully functioning dialysis grafts during the follow-up period. No problems were subsequently identified by using routine surveillance techniques. Only one patient (patient 3) underwent follow-up diagnostic imaging of the fistula. Although patent, the flow through the fistula subjectively appeared slower.

**DISCUSSION**

The most likely cause of a graft-to-vein fistula is the simultaneous puncture through the wall of a PTFE graft and a nearby native vein by the dialysis cannula. In the absence of a distal outflow stenosis or occlusion it is unlikely that such a small-diameter fistula creates any significant hemodynamic effects within the graft. As was seen in this small series of patients, these abnormal fistulous communications manifest in the presence of increased graft pressure, an expected finding with venous outflow obstruction or occlusion (12). Despite its presence, the small caliber of this type of fistula, created by a 15-gauge cannula, is not likely to reduce the flow to the more distal loop thereby predisposing the graft to thrombosis. Although three patients had graft thrombosis at presentation, all three had an underlying venous outflow stenosis identified following removal of the thrombus. We speculate that the venous stenosis was the most significant factor predisposing the graft to thrombosis and that the shunting of blood through such a small-caliber graft-to-vein fistula produces minimal hemodynamic effects. If the fistula diameter were to increase, such as might occur after long-standing elevated graft pressures, the shunting of blood may be large enough to significantly alter flow in the distal graft.

Another potential problem may arise when a graft-to-vein fistula originates from the proximal arterial limb. If the dialysis cannula tip is distal to a larger caliber fistula, the flow to the cannula tip may be reduced and thereby decrease dialysis efficiency. In the two patients with thrombosed grafts (patient 4 and 5), the iatrogenic fistula provided the only graft outflow channel, thereby maintaining patency of the loop proximal to the origin of the fistula.

Only one of the five patients underwent ligation of the graft-to-vein fistula. The persistence of the iatrogenic fistula following correction of the venous outflow obstruc-
Figure 5. Patient 5. (a) Drawing of the PTFE loop graft. The graft-to-vein fistula (small arrow) arises from the arterial limb. The venous limb of the graft (large arrow) is thrombosed. (b) The diagnostic image demonstrates the thrombosed graft (large arrow) distal to the graft-to-vein fistula (small arrow).

Comparison in the other four patients did not lead to any clinically apparent sequelae. Although the follow-up period in this series was short, a mean of 7.4 months, no further problems occurred in any of the five grafts.

We conclude that this type of small-caliber fistula between prosthetic dialysis grafts and adjacent forearm veins may manifest concurrently with venous outflow obstruction or occlusion. The presence of the abnormal fistula is indicative of a significant elevated graft pressure. Following relief of outflow obstruction, these fistulas have minimal hemodynamic effect and need not be specifically treated.

References