Late Suture Failure in the Pathogenesis of Anastomotic False Aneurysms

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THE pathogenesis of noninfected false aneurysms is controversial. Possible causes for this complication are anastomotic tension, which may occur when grafts are brought across joints, disruption of an intact suture line from a weak arterial wall, lack of supporting structures about the anastomosis, duration of vascular reconstructive operations and vibratory fatigue with end-to-side anastomoses.[2-8] Several authors report that suture breakage, specifically arterial silk sutures, is important in the formation of false aneurysms; however, they also state that bringing grafts across joint creases, such as aorto-to-common-femoral anastomoses, should be avoided since most false aneurysms seem to occur in the femoral region.[4, 6, 7]

Because there had been a significant incidence of false aneurysms during an era when silk sutures were used, and this abruptly stopped with the use of braided Dacron suture, we were prompted to evaluate false aneurysms that were treated, to determine what predisposing factors might be identified.

Clinical Material

The records of all patients admitted to the San Francisco Veterans Administration Hospital with the diagnoses of false aneurysms were reviewed. The data evaluated included the type of operation, the type of graft material, patency of the graft at reoperation, the suture material used for the anastomoses, time of onset of the false aneurysm from the date of initial operation, location of the false aneurysm, findings at operation, and the results of cultures taken at the time of repair. Only records of patients who had sterile cultures at the time of repair were included in this study. To compare our experience with results of others in bringing grafts across the inguinal ligament, we reviewed our bypass grafts to the femoral artery performed between September 1960 and September 1968. These patients were evaluated for the presence or absence of false aneurysms in the groin.

Results

Seventeen patients with 25 false aneurysms are the basis of this report. Ages ranged from 51 to 79 with a median of 67. The time interval between the original operation and the discovery of a false aneurysm ranged from 1 to 8 years with a median time of 5 years. Seven patients had multiple false aneurysms. Six had two false aneurysms each and one had three false aneurysms. The remaining ten patients had single false aneurysms. Two patients with a combined total of three false aneurysms had recurrences after inadequate primary repair. These were successfully repaired at reoperation. The false aneurysms were located in the aorta and iliac, common femoral, superficial femoral and carotid arteries. Twenty false aneurysms were associated with knitted Dacron grafts, two with woven

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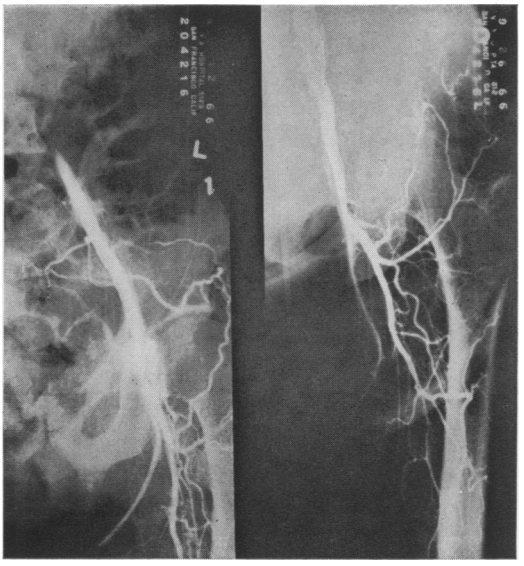

FIG. 1. (Left) Arteriogram demonstrates a false aneurysm at the anastomosis of a Dacron graft to the left common femoral artery. (Right) Radiographic appearance following false aneurysm excision.

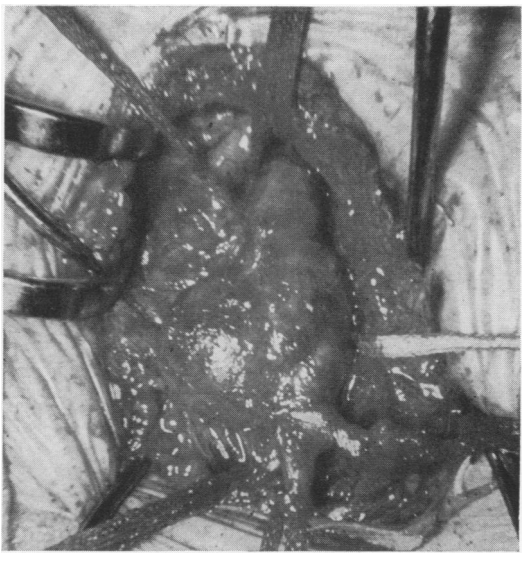

FIG. 2. Findings at operation. Note the false aneurysm presenting from the medial aspect of the graft—common femoral anastomosis. There is nothing remaining of the previously used arterial silk suture.

Teflon grafts, one with thromboendarterectomy, one with a Dacron patch, and one with a vein patch. Five false aneurysms occurred with end-to-end anastomoses, two with arterial patches, one with a thromboendarterectomy, and 17 with end-to-side anastomoses. Of grafts across joints 15 false aneurysms occurred with anastomoses subjected to the stress of joint motion and ten occurred in the absence of joint motion. Primary operations included aorto-femoral bypass—seven; abdominal aortic aneurysm resection—four; aorto-ilio-femoral thromboendarterectomy—one; femoral-femoral cross leg bypass grafts—one; femoral patch angioplasty—one; axillary-femoral bypass—two, and carotid thromboendarterectomy with patch angioplasty—one. Primary anastomoses were performed with silk sutures in all 25 false aneurysms; in most silk sutures were 3-0 and 4-0, but four false aneurysms occurred following anastomosis with 5-0 silk.

The two factors that have the highest correlative association with false aneurysms are silk sutures and femoral end-to-side anastomoses. To further evaluate the risk of false aneurysm following femoral end-to-side anastomoses, we reviewed 135 grafts anastomosed across the inguinal ligament, end-to-side with the common femoral artery but using Dacron rather than silk sutures. In this series, followed from 1 to 9 years, no false aneurysmal degeneration occurred.

Of 17 patients with false aneurysms, 15 underwent operations for 21 false aneurysms. In one the false aneurysm was discovered at autopsy. One patient's condition was too poor to permit operation. Operative or autopsy findings in 16 patients with 23 false aneurysms were either fractured or completely absent (presumably absorbed) sutures. The grafts or patches were invariably separated from the host artery in varying degrees with false aneurysms emerging and bridging the gap between the grafts and host arteries (Figs. 1, 2).

Case Report

A 74-year-old man was admitted to a hospital for emergency resection of a rupturing abdominal

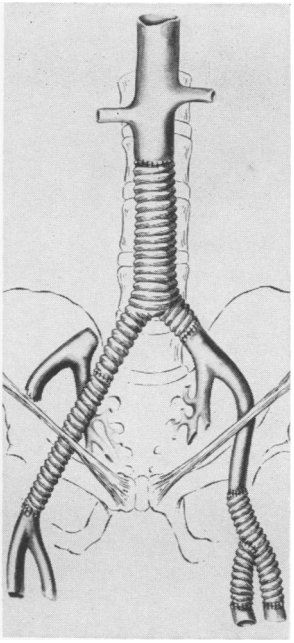

FIG. 3. Illustration depicts the final reconstruction after excision of aortic and bilateral femoral aneurysms in 1961.

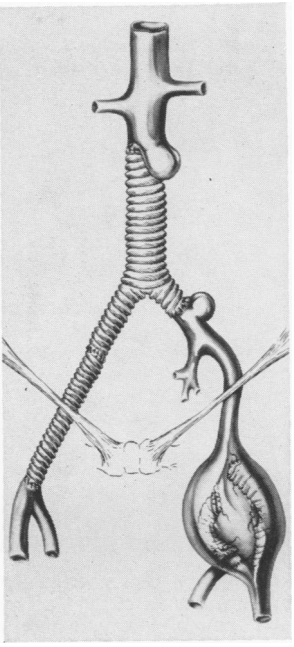

FIG. 4. Appearance of reconstruction 5 years after original operation. False aneurysms are present at the aortic anastomosis as well as the left iliac and common femoral anastomoses, all previously performed with arterial silk suture. Note that the right iliac and common femoral anastomoses performed with braided Dacron suture are still intact.

aortic aneurysm. Reconstruction consisted of a 22 mm. knitted Dacron bifurcation replacement graft with a proximal anastomosis to the infrarenal aorta and distal anastomoses to the common iliac arteries. The proximal anastomosis was performed with a running 3-0 arterial silk suture and the iliac anastomoses were performed with 4-0 silk suture. This patient was first seen at San Francisco Veterans Administration Hospital in January 1961 for treatment of bilateral femoral aneurysms. On January 20 the right femoral aneurysm which extended above the inguinal ligament was excised. An extension tube was anastomosed to the right limb of the previously placed bifurcation graft and brought distally to the profunda femoris artery. The proximal graft to graft anastomosis was performed with 4-0 merseline and the distal graft to profunda femoris artery anastomosis was performed in an end-to-end fashion, using 4-0 merseline. In March 1961 the left femoral aneurysm was excised. The aneurysm involved both superficial and profunda femoris arteries and a bifurcation replacement graft was fashioned with one limb to the superficial femoral artery and one limb to the profunda femoris artery. The graft material was 10 mm. woven Teflon. In the proximal anastomosis to the external iliac artery continuous sutures of 4-0 arterial silk were used. In the graft-to-graft anastomosis 4-0 arterial silk and in both distal anastomoses to the superficial femoral and profunda femoris arteries 4-0 silk sutures were used. All anastomoses were end-to-end (Fig. 3). The patient was discharged and was well until September 1966, when he was readmitted with a left femoral false aneurysm. In November 1966 at operation through a combined left femoral and lower abdominal incision the arterial silk suture of the femoral replacement graft was found completely dissolved at each anastomosis. This included the external iliac, the graft-to-graft anastomosis and both grafts to superficial femoral and profunda femoris anastomoses. This entire graft was incorporated into a giant false aneurysm in the groin.

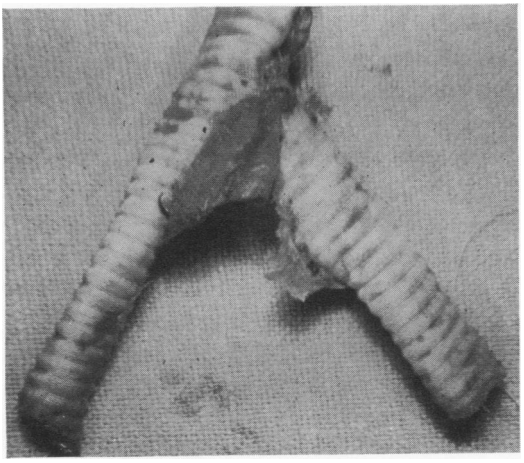

FIG. 5. Graft removed from the left femoral anastomoses. Note the absence of the previously placed arterial silk suture.

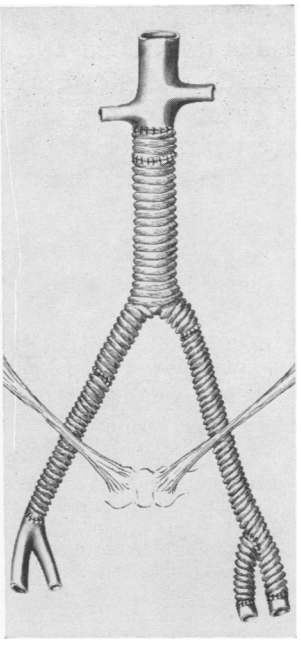

FIG. 6. Illustration showing the vascular reconstruction following removal of the false aneurysms.

During exploration of the lower abdomen a false aneurysm involving the left common iliac anastomosis and a lemon-sized false aneurysm of the abdominal aortic anastomosis were found (Figs. 4, 5). The left iliac and left femoral false aneurysms were excised and a new graft was fastened to the previous left limb of the bifurcation graft and brought directly to the groin and anastomosed to the superficial femoral artery. A side arm was brought off that graft and anastomosed to the profunda femoris artery. Because of the extent of this procedure, excision of the aortic false aneurysm was delayed for a second operation. In February 1967 the aortic false aneurysm was resected with a sleeve replacement graft of knitted Dacron. The proximal and distal sutures were 3-0 merseline (Fig. 6). The patient has done well and in August 1968 had no evidence of recurrence.

Comment. This patient was operated upon during a transition in the use of vascular suture material and provides a controlled study of arterial silk suture compared to Dacron. He also had grafts across joint spaces and intra-abdominal grafts; end-to-end and end-to-side anastomoses. Knitted Dacron material was used as well as woven Teflon material. False aneurysms developed at aortic, left common iliac, and left femoral suture lines. Aortic and iliac false aneurysms involved end-to-end anastomoses within the abdomen not subjected to the stress of joint motion. The abdominal grafts were knitted Dacron, but the femoral graft was woven Teflon. The only common factor with the false aneurysms was arterial silk sutures for each anastomosis which subsequently degenerated to false aneurysms. As compared to results on the opposite side, there was a graft across the inguinal ligament; however, all anastomoses on the right side were performed with permanent Dacron sutures and have not undergone aneurysmal degeneration.

Discussion

False aneurysms following vascular reconstruction are rare but distressing. To understand this complication further, authors have attempted to correlate factors that might be implicated. In this report the association between false aneurysms and the type of graft material, location of the graft or arterial reconstruction, type of anastomosis, and duration of the anastomosis prior to formation of a false aneurysm have been inconstantly correlated with false aneurysmal degeneration. The most striking feature is the finding in every case of suture fragmentation or dissolution accompanying the false aneurysm. In all false aneurysms the initial anastomosis was performed with arterial silk. That silk suture is not permanent, was pointed out by Cutler and Dunphy who demonstrated that silk fibers fragment and are removed by mononuclear phagocytes.[1]

Apparently the ultimate strength of a prosthetic vascular anastomosis is dependent upon the suture material. Experiments currently in progress in our laboratory support this thesis. We believe that prosthetic vascular anastomoses should be performed with braided synthetic sutures, since this material appears to have permanent lasting qualities.

While most authors implicate silk sutures as a factor in false aneurysm formation, attention is also focused on anastomoses across a joint crease. Joint motion appears to add additional stress to the anastomoses; however, in our opinion the primary factor is fragmentation of suture material, rather than stress of joint motion. In our experience with aorto-femoral bypass using Dacron sutures false aneurysms occur in the absence of infection.

False aneurysm is usually diagnosed easily when the aneurysms can be palpated; however within the abdomen, such as at aortic or iliac anastomoses, diagnosis is by aortography or operation. Previous vascular reconstructive procedures in which anastomoses were performed with silk should be considered as possible sites for false aneurysmal degeneration.

Summary

Records of 25 noninfected false aneurysms in 17 patients were studied and factors potentially responsible for this complication were analyzed. The only consistent findings were the use of arterial silk suture at the time of the original operation and the finding of suture disruption or dissolution at reoperation. It is suggested that the ultimate strength of a prosthetic vascular anastomosis is dependent upon the suture material and, therefore, a braided synthetic suture is recommended.

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