

Subcutaneous Arterial Bypass Grafts in the Management of Fistulae between the Bowel and Plastic Arterial Prostheses

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FISTULAE between the aorta and the intestinal tract result from an occasional complication of aortic reconstructive surgery. Primary aorto-enteric fistulae are rare.¹³ The first recognized postsurgical aorto-enteric fistula was reported by Brock in 1953 in a patient in whom an aortic homograft was used to replace the infrarenal abdominal aorta.³ Subsequent reports of fistulae occurring in aortic homografts attributed these complications to degeneration that occurs in the wall of the homograft.^{6, 15, 22} Although the introduction of synthetic aortic grafts overcame the problem of homograft degeneration, other properties of synthetic grafts contributed to the continuing appearance of postoperative aorto-enteric fistulae.

Fistulae appearing after grafting with synthetic arterial prostheses usually occur at one of the arterial anastomotic lines. The frequent contiguity of the proximal aortic suture line and the overlying duodenum has made the duodenum the most common intestinal site of fistulous erosion. Fistulae into any segment of the small or large intestine may result from breakdown of the distal anastomosis.⁸

The relationship between extraluminal sepsis and arterial and intestinal erosion is uncertain. Even when overt local sepsis is absent, however, operative repair of the fistula is uniformly accompanied by variable degrees of bacterial contamination from intestinal contents. The capacity of a synthetic graft to become a nidus of continuing infection is well recognized.^{12, 21} Control of infected synthetic grafts requires the removal of all related prosthetic material. Restoration of arterial continuity can be accomplished in these circumstances either by local autogenous tissue replacement or by uncontaminated grafts which widely circumvent the area of infection.^{2, 10, 27}

In the following three cases of arterio-enteric fistulae, successful results followed closure of the fistulae, removal of the intra-abdominal synthetic graft, and restoration of blood flow to the lower extremities by means of circumventing subcutaneous grafts.

Case Reports

Case 1. Late postendarterectomy occlusion of the right common iliac artery in a 51-year-old man was treated by a Dacron bypass graft from the aorta to the right external iliac artery. Nine months later the patient was readmitted to the hospital after three days of melena without other gastrointestinal complaints. Abdominal examination dis-

Submitted for publication January 10, 1968.

This study was supported in part by Grants from the Wellcome Trust and the National Heart Institute U.S.P.H.S. Grant HE-04850.

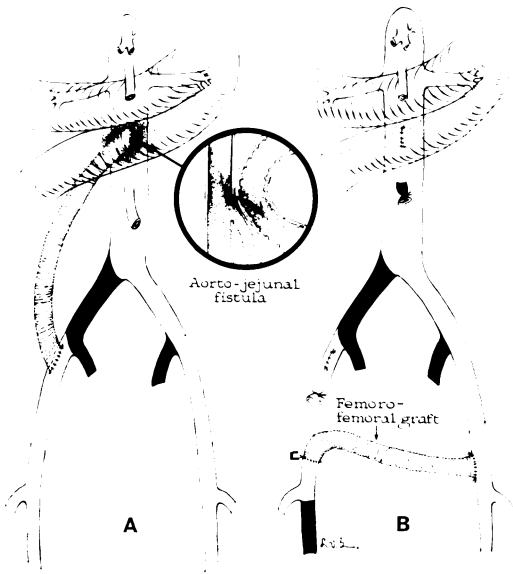


FIG. 1. (Case 1) A. Aorto-jejunal fistula at the site of the proximal graft anastomosis. B. Postoperative reconstruction showing removal of intra-abdominal prosthetic graft and subcutaneous femoro-femoral graft.

closed no abnormalities. The lower limb pulses were normal. The hematocrit was 31%. One thousand ml. of whole blood were given on the day of admission. There was no further bleeding until a massive hematemesis on the subsequent morning induced profound hypovolemic shock. Surgical exploration of the abdomen showed a fistula between the aorta at the level of the proximal anastomosis and the upper jejunum (Fig. 1A). After the aorta was clamped and the jejunum freed, a 2 cm. opening in the jejunum was closed. The entire graft was removed and the openings in the aorta and external iliac artery were closed. Blood flow to the right leg was restored by a subcutaneous 10 mm. Dacron graft from the left to the right common femoral artery (Fig. 1B, C).

During the operation ischemic changes in the left colon developed from ligation of the inferior mesenteric artery. The descending colon was resected and a colostomy established. Subsequently the colostomy was closed and bowel continuity restored by a transverse colon-rectal anastomosis. The graft has remained patent and adequate circulation has been maintained in both legs for the 15 months since operation.

Comment: Although overt sepsis was not apparent in the region of the aorto-jejunal fistula, the unavoidable contamination of

the retroperitoneum made it necessary to remove the intra-abdominal arterial prosthesis. Revascularization by cross-leg grafting in an uncontaminated area preserved lower limb viability and function.

Case 2. The infrarenal aorta and common iliac arteries were replaced with a Dacron bifurcation graft in a 53-year-old man for the treatment of aortic common-iliac and bilateral superficial femoral occlusive disease. Three years later progressive occlusion of the external iliac arteries developed. A Dacron tubular extension graft was interposed between the limbs of the bifurcation graft and the distal ends of the external iliac arteries. Silk sutures were used in all of the vascular anastomoses.

Three years later asymptomatic false aneurysms developed at the site of each of the Dacron to Dacron anastomoses. The patient was scheduled for elective resection of the aneurysms. While awaiting admission, however, he was brought to the hospital after having suddenly passed approximately one pint of bright red blood per rectum. Within two hours of admission he passed several

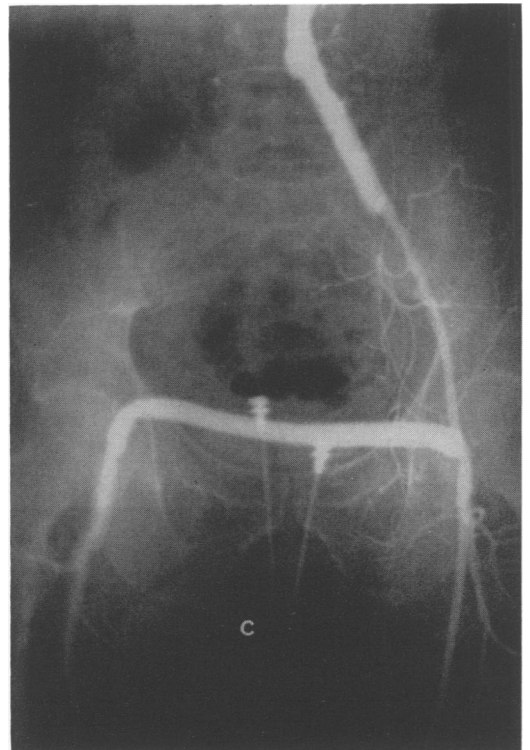


FIG. 1C. Postoperative arteriogram showing the femoro-femoral graft.

TABLE 1. Results of Operations for Fistulae Between Synthetic Arterial Grafts and the Intestinal Tract*

Source	Result of Operation	Source	Result of Operation
Local Repair—87% Mortality		Regraft—64% Mortality (<i>Continued</i>)	
Sharf ²⁰	1959 Died of hemorrhage during operation	Javid ¹⁷	1962 Died of recurrence of fistula (date not given)
MGH Case 4528 ²⁴	1959 Died of uremia on 9th post-operative day (culture showed infected graft)	Garrett ¹³	1963 Survived, well 4 years later
MGH Case 45522 ⁵	1959 Survived	Garrett ¹³	1963 Died during operation
Cordell ⁶	1960 Died 2nd day of hypotension and massive intravascular thrombosis	Garrett ¹³	1963 Alive and well 6 months later
DeWeese ⁸	1962 Died 2nd day of cardiac arrest	Levy ¹⁸	1965 Died of cardiac arrest during operation
Szilagy ²⁵	1962 Died of hemorrhage same day	Levy ¹⁸	1965 Survived
Javid ¹⁷	1962 Died of hemorrhage 1 week after operation	Ferris ¹¹	1965 Survived**
Humphries ¹⁵	1963 Died of hemorrhage (length of survival not stated)	Excision and Ligation—50% Mortality	
Humphries ¹⁵	1963 Died 3 weeks postoperation, cause unknown	Crawford ⁷	1962 Survived
Humphries ¹⁵	1963 Died of hemorrhage on day of operation	Crawford ⁷	1962 Survived, later amputation
Humphries ¹⁵	1963 Died on day of operation, graft infected	Beach ¹	1965 Died 4 days postoperatively of ascending gangrene
Humphries ¹⁵	1963 Died of hemorrhage 2 days postoperation	Donovan ⁹	1967 Died 3 days postoperatively, bilateral lower limb ischemia
Jamieson ¹⁶	1963 Died of hemorrhage 2nd day	Excision Plus Alternate Conduit—13% Mortality	
Ferris ¹¹	1965 Survived, fistula recurred 3 months later**	Garrett ¹³	1963 Died of infection 4 months after excision and aortorrhaphy
Wierman ²⁸	1966 Died 3 months postoperatively, persistent graft infection and recurrent fistula	Garrett ¹³	1963 Well 4 years after excision and aortorrhaphy
Regraft—64% Mortality		Donovan ⁹	1967 Well 5 years after removal of graft and thoracic aorta-iliac bypass
Thistlethwaite ²⁶	1960 Died 12 hours after operation of irreversible shock	Donovan ⁹	1967 Well 14 months after removal of graft and thoracic aorta-iliac bypass
Sproul ²⁴	1962 Alive and well 18 months after operation	Robicsek ¹⁹	1967 Well 6 months after thoracic aorta-femoral graft
Hershey ¹⁴	1962 Died of infection 8 weeks later	Present Series	
Humphries ¹⁵	1963 Died of cardiac arrest 3 days postoperatively	Case 1	1968 Well 15 months after graft excision and femoro-femoral bypass
Humphries ¹⁵	1963 Died of infection same day	Present Series	
Humphries ¹⁵	1963 Died of cardiac arrest 8 days postoperatively	Case 2	1968 Well 18 months after graft excision and axillo-femoral bypass
Humphries ¹⁵	1963 Died of uremia same day	Present Series	
		Case 3	1968 Alive 14 months after graft excision and axillo-femoral bypass, bilateral above-knee amputation

* Cases in which a definitive arterial procedure was not carried out are excluded.

** Recurrent fistula treated by regraft.

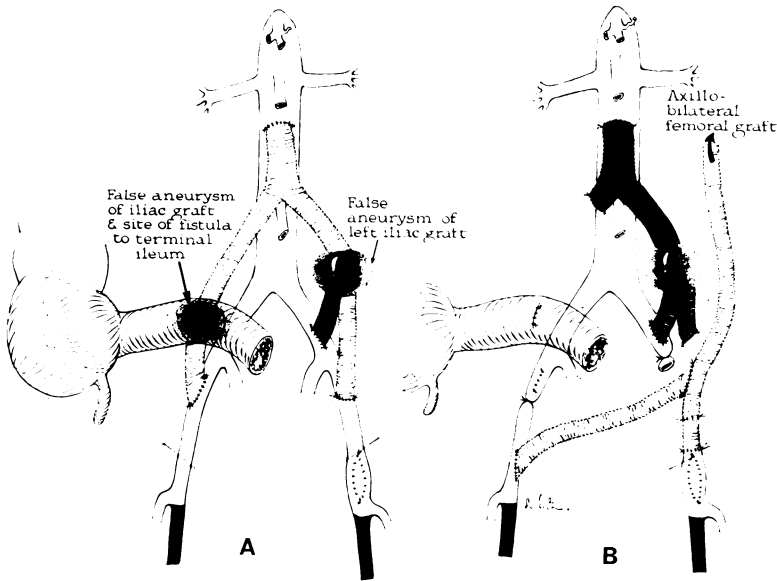


FIG. 2. (Case 2) A. Bilateral iliac graft false aneurysms with a fistula to the terminal ileum. B. Postoperative reconstruction with a subcutaneous axillo-bilateral femoral graft after excision of the involved prosthesis.

more bloody stools and became profoundly hypotensive. After rapid blood and fluid replacement, laparotomy was performed.

At operation, a fistula was identified between the right iliac false aneurysm and the terminal ileum (Fig. 2A). During closure of the opening into the ileum a small quantity of ileal contents was spilled into the wound. The right iliac arm of the graft was transected and closed at its origin without contamination. The distal iliac arm of the graft was removed. Circulation to the right leg was restored by a supra-pubic subcutaneous graft from the left to the right common femoral arteries.

After three months of adequate distal circulation acute ischemia of both lower legs appeared. An aortogram showed that the original prosthesis and the femoro-femoral graft were occluded. A subcutaneous 10 mm. Dacron graft was brought from the left axillary artery to the left profunda femoris artery and connected by a side-arm graft to the right profunda femoris artery (Fig. 2B, C). Two months later intermittent abdominal pain caused by episodes of large bowel ischemia necessitated a left hemicolectomy and a transverse colostomy. When examined 8 months later the patient was well and the axillo-bilateral femoral graft was patent (Fig. 2D).

Comment: Contamination of the wound by intestinal contents made the retention of a plastic arterial prosthesis hazardous. A circumventing subcutaneous graft enabled the involved prosthesis to be re-

moved. Although cross-leg grafting with synthetic material was ultimately successful in both Cases 1 and 2, thrombosis of the first graft, as in Case 2, is a recognized hazard of synthetic materials for small artery replacement. It is probable that saphenous vein grafts would have been preferable.¹⁰

Case 3. A 50-year-old woman had several unsuccessful grafting operations for an aorto-iliac occlusion at another hospital. A Dacron bifurcation graft was then successfully interposed between the infrarenal aorta and the distal common femoral arteries. One year later the patient was admitted to this hospital with a history of recent episodes of melena and intermittent fever (39° C.). The hemoglobin was 6.9 Gm. and the white cell count 13,700. During the next month numerous examinations were performed to identify the source of bleeding. Repeated radiographic studies of the gastrointestinal tract were normal. Finally an abdominal exploration was carried out with a presumptive diagnosis of an arterio-enteric fistula.

A fistula between the duodenum and the proximal aortic suture line was found (Fig. 3A). Purulent fluid which later grew out *E. coli* in cultures was present around the graft. Bleeding from the arterial suture line was controlled by clamping the suprarenal aorta and the renal arteries. The aortic anastomosis was dismantled and the aorta ligated. The opening in the duodenum was closed. All prosthetic graft material was removed from the

abdomen and both groins. Flow to both common femoral arteries was restored with a subcutaneous side-arm Dacron bifurcation graft connected proximally to the right axillary artery (Fig. 3B). This graft functioned well for one month but was removed because of persistent infection in both groins. Flow to the right leg was restored by continuing an axillary-superficial femoral graft along a separate uninfected route to the mid superficial-femoral artery. It was not feasible to route a graft through uninfected tissue to the left leg. A left above-knee amputation was performed one week later. The right axillary-superficial femoral graft remained patent for 7 months after which it occluded, presumably because of the known advanced outflow disease. A right above-knee amputation was performed.

Comment: Although the circumventing subcutaneous grafts occluded within seven months of insertion their initial patency prevented immediate postoperative ascending gangrene of the lower limbs. This complication is usually fatal.^{1, 9}

Discussion

Arterio-enteric fistulae are now usually associated with prosthetic grafts, since primary fistulae are rare,¹³ and endarterectomy has been implicated on only two occasions.^{6, 23} Many of the previous recommendations about the management of aorto-enteric fistulae were based on conclusions derived from studies which included primary fistulae and others secondary to homografts. Since the management of both the latter fistulae does not involve the problem of potentially infected plastic prostheses acting as foreign bodies, these conclusions are not entirely applicable at the present time.

To obtain more pertinent information the results of operation in all the reported cases of prosthetic graft to bowel fistulae were analyzed. Cases in which the arterial end of the fistula was not treated by definitive arterial surgery were excluded. The technic of bowel closure was not a critical issue and was not specifically studied. A total of 41 fistulae were suitable for analysis. The

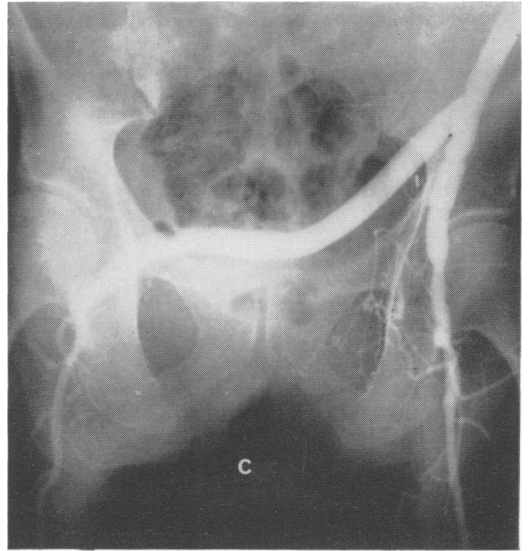


FIG. 2C. Postoperative arteriogram, showing the axillo-bilateral femoral graft anastomosed to the profunda femoris arteries.

reported method of managing the arterial prostheses could be placed in one of four categories (Table 1).

In the largest group of fistulae in Table 1, the arterial opening was repaired locally. Methods of repair included simple suture

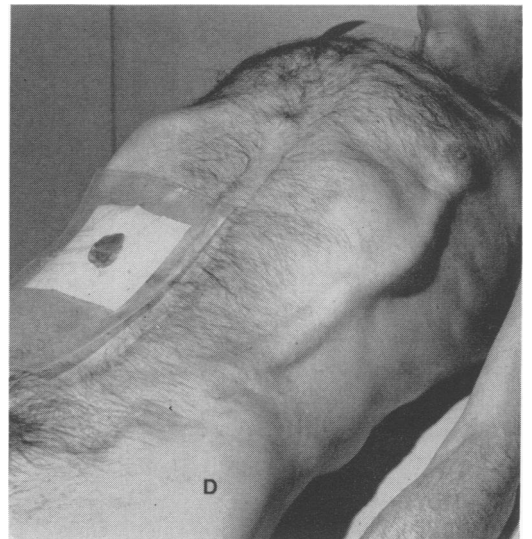


FIG. 2D. Subcutaneous course of the axillo-bilateral femoral graft.

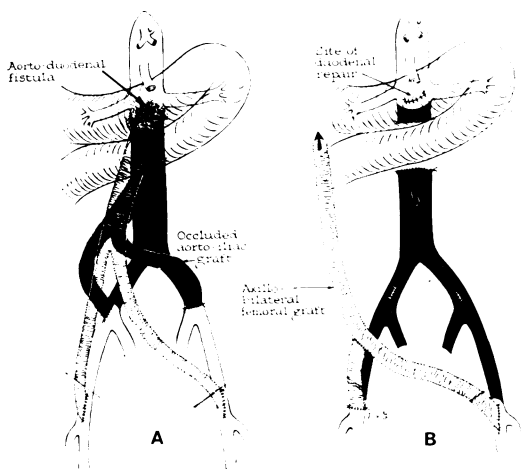


FIG. 3. (Case 3) A. Aorto-duodenal fistula at the site of the proximal graft anastomosis. B. Conversion to subcutaneous axillo-bilateral femoral graft. All infected graft material has been removed.

closure, a limited resection and reanastomosis, an onlay patch graft, or a revision of an anastomotic suture line. Thirteen of 15 patients managed in this way died. Death usually resulted from uncontrollable bleeding during the operation or in the immediate postoperative period. In one of the survivors, the fistula recurred 3 months after repair and required reoperation.

The results of excision and replacement of all or part of the involved graft were slightly better. Five patients of 14 treated in this way were still alive during the short followup period described by the authors. At least two of the nine patients who died had persistent graft infection.^{14, 15}

Removal of the graft and ligation of the aorta without restoration of peripheral flow was performed on four occasions with two fatalities. One of the deaths was attributed to ascending gangrene demarcating at the buttock level.¹ In the other patient, death was ascribed to heart failure although there was also irreversible ischemia in both legs.⁹ One of the two survivors also had lower limb ischemia severe enough to require amputation.⁷ Removal of the graft and ligation of the aorta satisfies the mandates of managing potentially infected grafts since

graft infection cannot be controlled while the foreign prosthesis remains *in situ*.²¹ However, the over-all results of ligation of the aorta clearly define the need to provide an alternative conduit to the lower limbs.

A combined procedure in which the involved graft was removed and blood re-routed to the lower limbs was performed in eight patients, with seven survivors. In two of these it was possible to re-establish distal circulation through the normal anatomical route since a patent aorta had been bypassed at the initial operation.¹³ On three occasions the thoracic aorta was connected by a long prosthetic graft to either the iliac⁹ or femoral¹³ arteries. We have followed the same principles in managing our three patients although we prefer subcutaneous grafts to thoracic aorto-iliac or femoral bypass.

In each of our patients the synthetic prosthesis was removed from the area of the fistula. Subcutaneous arterial grafts were then inserted outside the area of actual or potential contamination. Although one of our patients (Case 3) required later amputation after thrombosis of her axillo-femoral Dacron graft we believe that during the critical initial period of its patency the functioning graft contributed to her survival. The combination of removal of the involved prosthesis and the use of subcutaneous prostheses as alternative arterial conduits has certain logical advantages over previous methods of management. This combination facilitates the control of infection while maintaining a distal circulation. The new graft is inserted in a non-contaminated field. It is also accessible to clinical examination so that graft occlusion is readily detectable.

Summary

The management of fistulae between the intestinal tract and a plastic arterial prosthesis in three cases is reported. The combination of subcutaneous arterial grafts and

removal of the involved prosthesis gave results that appear to be superior to those obtained by other methods reported in the literature. The technic enables intra-abdominal sepsis to be controlled or forestalled while the blood supply to the lower half of the body is preserved.

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