Thoracoabdominal Aneurysm after Resection and Dacron Graft Replacement of the Descending Thoracic Aorta

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TREATMENT of thoracoabdominal aortic aneurysms by excision and graft replacement has been accepted and the technics for its application are now well established.[7,10] As in the management of aneurysms located elsewhere, the principles of surgical therapy include eradication of the aneurysm and maintenance or restoration of circulation through the region of disease and into the peripheral beds of the major visceral branches arising from the involved aortic segment.

The surgical risk and incidence of postoperative neurological dysfunction increases as longer segments of the thoracic and abdominal aorta are removed and replaced with prosthetic material. During the last 6 years one of us (E.S.C.) has operated upon three patients with large thoracoabdominal aortic aneurysms, all of whom had undergone previous Dacron graft replacement of the proximal descending thoracic aorta for treatment of aneurysmal disease. The purpose of this presentation is to discuss the technics and results of operation concerned with this experience with particular emphasis on the prevention of spinal cord ischemia during the resection and graft replacement of large portions of the thoracic and abdominal aorta.

Case Reports

Case 1. C. W., a 42-year-old man, underwent excision of an aneurysm of the descending thoracic aorta and replacement with a Dacron graft in 1962 (Fig. 1). He returned to The Methodist Hospital in Houston, Texas 3 years later with epigastric discomfort at which time a large dissecting abdominal and lower thoracic aortic aneurysm was demonstrated. The aneurysm originated at the level of the previous anastomosis between the Dacron graft and the thoracic aorta and it extended to involve the entire abdominal aorta, its visceral branches, and the iliac arteries. On April 8, 1965, the thoracoabdominal aneurysm was resected and replaced with a composite Dacron prosthesis (Fig. 2). The new graft consisted of joined bifurcation and tube segments. to which were sutured 8 mm. Dacron limbs for anastomoses to the celiac axis, superior mesenteric, and renal arteries. The distal right portion of the bifurcation graft was sutured to the common femoral artery, while on the left side, an end-to-side anastomosis to the external iliac artery was performed. Postoperatively, lower extremity weakness and loss of pain sensation were noted. There were no signs of gastrointestinal, hepatic, or renal dysfunction. Nine years after removal of the thoracic aortic aneurysm and 6 years following resection and graft replacement of the thoracoabdominal aneurysm the patient has remained well except for moderate residual paraparesis.

Case 2. On December 15, 1958, V. B., a 48-year-old man underwent excision and Dacron graft substitution of a fusiform aneurysm of the descending thoracic aorta (Fig. 3). Six years later the patient first began to notice a sensation of abdominal fullness and epigastric discomfort. Thoracic and abdominal aortography at that time revealed a huge thoracoabdominal aortic aneurysm which involved all the abdominal visceral branches and extended to the iliac arteries. An operation was performed on May 3, 1965, utilizing a thoracoabdominal incision. Exposure was enhanced by dividing the left colonic lateral peritoneal attachments and then reflecting the splenic flexure and stomach to the right. An 18 mm. woven bifurcated Dacron prosthesis was selected and the distal anastomoses to the left external iliac and right common femoral arteries were made in an end-to-end fashion. The proximal anastomosis between the graft and the distal thoracic aorta was performed after which four 8 mm. Dacron side-arms were sutured from the aortic prosthesis to the visceral branches. The thoracoabdominal aneurysm was then incised and a pair of large lumbar arteries were identified and removed with a button of surrounding aortic tissue. A small circular segment of Dacron graft was excised and the portion of aorta with the preserved lumbar arteries was sutured in its place (Fig. 4). Postoperatively there was no clinical or laboratory evidence of gastrointestinal, renal, hepatic, or spinal

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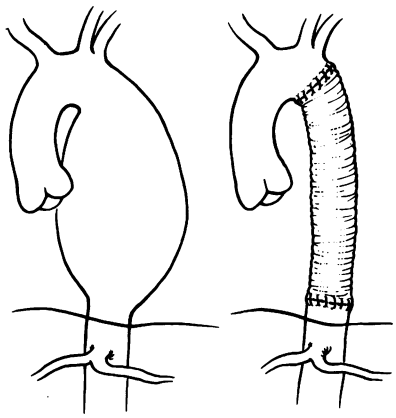

FIG. 1. An aneurysm of the descending thoracic aorta was resected and substituted with a Dacron vascular prosthesis.

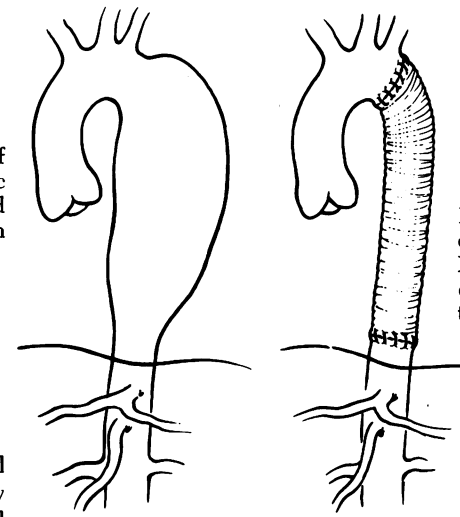

FIG. 3. Patient V. B. underwent resection and Dacron graft replacement of a large descending thoracic aortic aneurysm.

cord malfunction. The patient was discharged from the hospital on May 22, 1965, and he returned to full activity. It is now 13 years since the thoracic aortic aneurysm was resected and 6 years after excision and graft replacement of the large thoracoabdominal aneurysm. He has remained completely asymptomatic since 1965.

Case 3. M. C., a 38-year-old hypertensive woman underwent resection and graft replacement of an aneurysm of the descending thoracic aorta on March 11, 1960 (Fig. 5). Nine and one-half years later she was admitted again to The Methodist Hospital in Houston, Texas with a 3-month history of left upper quadrant abdominal pain. Trans-brachial aortography illustrated a large thoracoabdominal aneurysm which extended to the level of the renal arteries. An operation was performed on December 7, 1970, once again using a thoracoabdominal incision to properly expose and control the large thin-walled arterial lesion. The distal margin of the aneurysm reached the mid-portion of the abdominal aorta and produced almost complete occlusion of the aortic orifice of the left renal artery. The aneurysm was excised and replaced with a woven Dacron tube graft. The distal end of the graft was cut at a 45 degree angle and then sutured to the preserved and tailored anterior wall of the abdominal aorta, eliminating the need for separate anastomoses to the celiac axis and superior mesenteric artery (Fig. 6). An 8 mm. side-arm from the aortic prosthesis to the left renal artery, restored normal circulation to the left kidney. The postoperative course was unremarkable. The patient currently is asymptomatic 13 months after excision and graft replacement of the thoracoabdominal aneurysm and 11 years following removal of the aneurysm of the descending thoracic aorta.

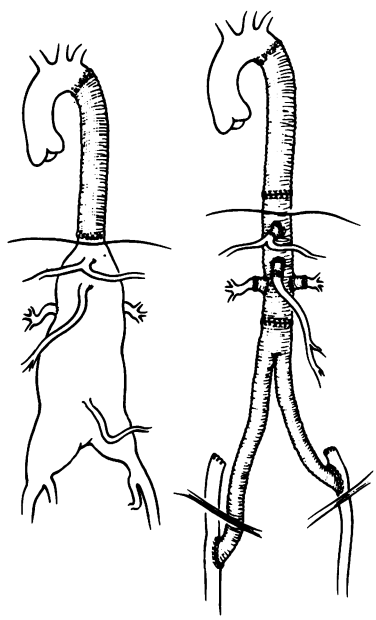

FIG. 2. Resection of the thoracoabdominal aneurysm in patient C. W. resulted in Dacron prosthetic replacement of the entire aorta and its visceral branches distal to the left subclavian artery.

Discussion

The first successful operations for thoracoabdominal aneurysms in 1955 and 1956 incited interest in the development of technics to progressively decrease the high mortality and morbidity accompanying surgical treatment of these large aortic lesions.[3,6,8,9] Complications associated with the excision and graft replacement of this type of aneurysm were a function of compounding two basic problems: 1) maintenance or restoration of celiac, superior mesenteric, and renal artery blood flow after removal of the supra-renal abdominal aorta, and 2) prevention of ischemic necrosis of the spinal cord when a large segment of the thoracic and abdominal aorta was excised. The first of these two difficulties was overcome by refinements of the technics to manage mesenteric and renal arterial occlusive disease utilizing Dacron or autogenous vein bypass grafts from the abdominal aorta to the obstructed artery.[7,13,14] The visceral ischemic time during removal of a thoracoabdominal aneurysm has been further reduced by the use of a thoracic-to-abdominal aorta Dacron internal shunt, which after performance of the celiac axis, superior mesenteric, and renal artery anastomoses, becomes the permanent thoracoabdominal aortic substitute, thus allowing safer aneurysmectomy.[5,10]

Defunctionalization of intercostal and lumbar arteries during aortic surgery has led to the possibility of critically reducing anterior spinal artery blood flow with subsequent damage to the ventral portion of the spinal cord. The clinical result is a reproducible syndrome characterized by paraplegia or paraparesis, loss of rectal and

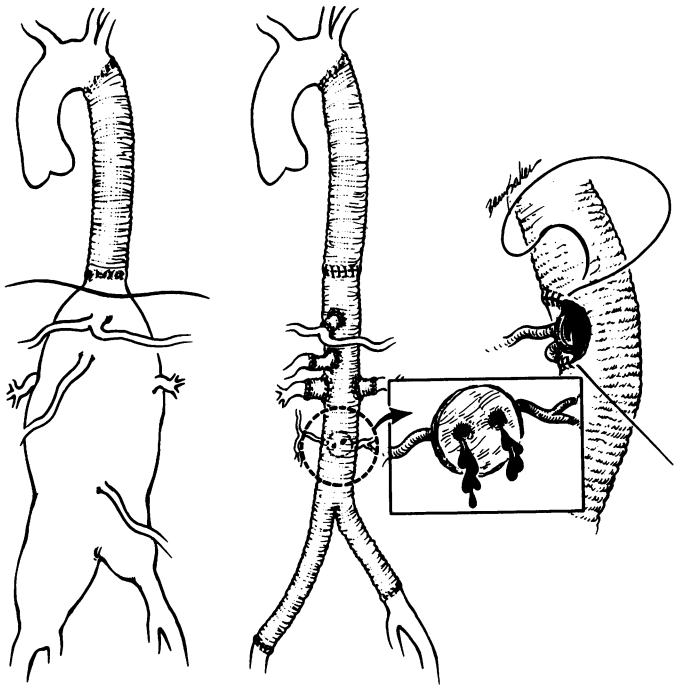

FIG. 4. A cuff of aorta with two large lumbar arteries was preserved during resection of the thoracoabdominal aneurysm. This patch of tissue was then sutured to the new abdominal Dacron graft in an effort to avoid ischemia in the distribution of the anterior spinal artery.

urinary sphincter tone, and diminished pain sensation with retention of tactile, proprioceptive and vibratory sensibility.[4,11,17] Spencer has experimentally shown uniform severe neurologic damage produced by acute ligation of intercostal arteries in dogs.[15] When longer aortic segments were removed the chance of interrupting a critical number of lumbar and intercostal arteries supplying important spinal branches increased. Thoracoabdominal aneurysms presented an added risk in that it is between the eighth thoracic and fourth lumbar spinal segments that the major anterior radicular artery originates. This vessel is the primary source of anterior spinal artery blood flow for the inferior half of the body.[1,2,12,16]

Many patients have tolerated removal of a large thoracoabdominal aneurysm without demonstrating any postoperative neurologic deficit. It has been impossible to determine in these cases whether the lack of spinal cord damage was due to the prior development of adequate collateral circulation or instead was the function of the fortuitous location of important radicular arteries in relation to the excised aortic segment. There also has been no manner to accurately predict which patients are more likely to suffer neurologic damage after surgical removal of an aortic aneurysm.

All three patients described in this report had large aneurysms of the thoracoabdominal aorta, and each had undergone previous excision and Dacron graft

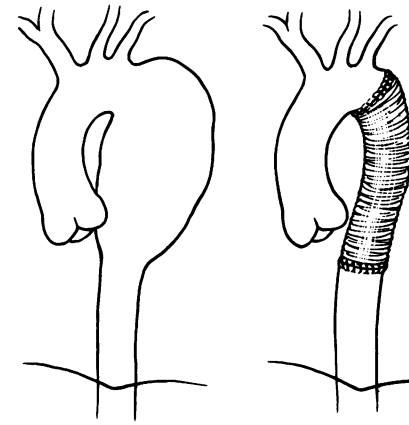

FIG. 5. Excision and Dacron graft replacement of a large saccular aneurysm of the descending thoracic aorta in patient M. C.

replacement of the proximal portion of the descending thoracic aorta. Completion of the second operative procedure in two patients resulted in Dacron graft substitution of the entire thoracic and abdominal aorta distal to the left subclavian artery. The third patient's aortic prosthesis ended at the renal artery level, leaving only a short segment of infra-renal abdominal aorta not replaced by the Dacron graft. The three patients survived the operations and it is now 9, 13, and 11 years following excision of the descending thoracic aortic aneurysms and 6, 6, and 1.2 years after removal and Dacron graft replacement of the aneurysms of the thoracoabdominal aorta. Only the first patient demonstrated a postoperative neurologic deficit and it was typical of that induced by anterior spinal artery ischemia. Spencer has shown that by leaving only two pairs of intercostal arteries unharmed during ligation of all other spinal branches, neurologic damage could always be prevented in the experimental laboratory.[15] A technic of sparing large lumbar arteries by suturing

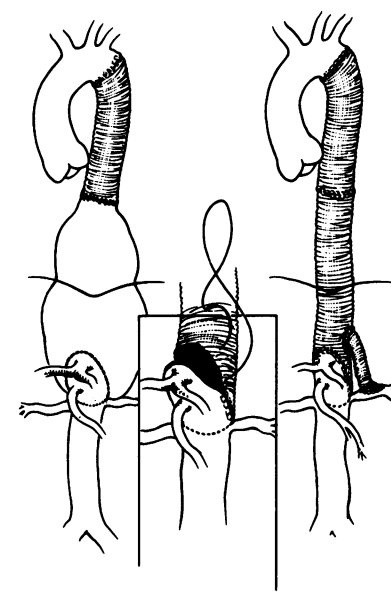

FIG. 6. The thoracoabdominal aneurysm is resected and replaced with a Dacron graft. A technic of aneurysmorrhaphy is utilized to preserve the celiac axis and superior mesenteric artery.

an aortic segment to the Dacron graft was therefore devised and used successfully in our second patient. No neurologic deficit occurred in the last patient in whom it was possible to leave intact the abdominal aorta and its lumbar branches below the renal artery level.

The experience gained in these three patients in whom long portions of the thoracic and abdominal aorta were excised and replaced with a Dacron graft suggest that whenever possible intercostal and lumbar arteries should be preserved during extensive aortic surgery. This may be done either by suturing a section of aorta to the graft or by tailoring the aneurysm in such a manner that a small portion of posterior aortic wall remains intact. At all times emphasis should be placed on carefully delineating the termination of the diseased segment of aorta so that as much aorta as possible may be left to maintain normal anterior spinal artery circulation and thus prevent spinal cord ischemia.

Summary

Three patients who underwent excision of thoracoabdominal aneurysms following prosthetic graft replacement of the proximal descending thoracic aorta were presented. Each has survived for long periods following the operations. The first patient in whom the entire thoracic and abdominal aorta distal to the left subclavian artery was replaced by a Dacron graft, incurred ventral spinal cord damage with resultant paraparesis, while the other two patients experienced no significant difficulties whatsoever.

The uncommon problem of neurologic deficit following aortic surgery was discussed and emphasis was placed on the unpredictability of this complication. The technics of lumbar artery preservation and aneurysmorrhaphy were suggested as helpful measures to prevent spinal cord and visceral organ damage during resection of large thoracoabdominal aortic segments.

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