Wall Reinforcement with Highly Porous Dacron® Mesh in Aortic Surgery

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Wall reinforcement with highly porous synthetic Dacron® mesh was devised and evaluated in various aortic operations. Excellent attachment of the mesh to the aortic wall, good preservation of pliability of the aorta, and efficient pressure resistance with minimal scar tissue formation were the usual findings. This type of wall reinforcement was employed in 60 patients for the following indications: 1) prevention of suture line complications; 2) wall reinforcement of aortic aneurysm without resection; 3) reinforcement of adventitia or autogenous vein following thromboendarterectomy. It is concluded that reinforcement with highly porous synthetic Dacron mesh should be superior to reinforcement with conventional prosthetic Dacron graft.

THE RECENT DEVELOPMENT of various prosthetic grafts has contributed greatly to the field of arterial reconstructive surgery. Nevertheless, there are several limitations of currently employed prosthetic grafts after implantation. These include early thrombosis, hemorrhage, graft constriction, late occlusion, and anastomotic aneurysms.[2–4,15] Although infrequent, suture line complications occur particularly in aortic lesions related to severe degeneration, cystic medial necrosis, or chronic inflammation of the aorta. When these suture line complications occur, the resultant consequences make reparative procedures formidable. Several approaches have been made to overcome the suture line complications including application of special suture techniques, different suture materials, peritonealization of the graft, and wrapping of the suture line with a prosthetic graft.

The present study was designed to evaluate the effects of reinforcement using a highly porous synthetic mesh in order to prevent these suture line complications more effectively.[18–20]

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Clinical Experience

Reinforcement procedures with highly porous synthetic Dacron® mesh have been performed in 60 aortic operations during the past eight years. Forty patients had the reinforcement procedure at the anastomotic sites of the aorta (six in the thoracic aorta, one in the thoracoabdominal aorta, and 33 in the abdominal aorta). Nine patients had reinforcement of the aortic aneurysm without resection, six had reinforcement of the adventitia following thromboendarterectomy, and five had reinforcement of an autogenous vein patch graft (Table 1).

The conventional Dacron prosthetic graft was trimmed to the necessary length to fit to a lesion of the aorta. A segment of highly porous Dacron mesh 2–3 cm in length with a slightly wider circumference was used (Fig. 1). The mesh was first sutured around the upper end of Dacron graft using approximately eight interrupted stay sutures (Fig. 2). When it became necessary, the distal end of the Dacron graft was also sutured with the mesh in the similar manner. The cuffed mesh was then reflected to the side of the Dacron graft, downward at the proximal end, and upward at the distal end. After resection of the aortic lesion, the Dacron graft was anastomosed to the stumped end of the aorta using a continuous over and over suture technique in either end-to-end or end-to-side manner. Following the completion of the anastomosis, the cuffed mesh was reflected to the aorta and covered loosely with several interrupted stay sutures (Fig. 3). Both ends of the mesh were closed with a continuous suture technique. Wrapping of the graft with residual aneurysmal wall or peritonealization was also performed in all patients.

The lesions encountered in the patients included arteriosclerotic aneurysms (33), dissecting aneurysms (5), and atypical coarctation and aortitis syndrome (2).

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TABLE 1. *Reinforcement Procedures*

Applications	Cases
Prevention of suture line complication	40
thoracic aortic aneurysm	3
abdominal aortic aneurysm	30
dissecting aneurysm	5
atypical coarctation	2
Wall reinforcement of aortic aneurysm	9
thoracic aortic aneurysm	5
abdominal aortic aneurysm	3
carotid aneurysm	1
Reinforcement of adventitia of vein patch	11
thromboendarterectomy	6
vein patch graft	5

The proposed procedures were found to be effective, and no instance of suture line insufficiency developed. One patient died following severe hemorrhage due to a rupture of an aneurysm of the thoracic aorta during surgery. The other 39 patients were followed postoperatively with a mean follow-up period of 4.2 years. It was found that five patients died from other unrelated medical causes; carcinoma of the stomach, myocardial infarction, and ileus. However, in these five patients autopsy revealed excellent attachment of the mesh to the aortic wall, and minimal structural changes in the wrapped aortic wall. A minute hyaline degeneration in the outer layer of the aorta was the single change and no other changes such as the destruction of elastic fibers were observed. The remainder of the patients are well and free of symptoms.

For wall reinforcement of an aortic aneurysm without resection, the aorta was exposed in the usual manner. The involved segment was mobilized for its entire length. The highly porous synthetic Dacron mesh was placed around the aneurysm, and mesh was tailored and sewn to the aortic wall using an interrupted suturing method. The mesh was then wrapped around the aneurysm, and snugly fitted to it (Fig. 4). This mesh reinforcement procedure was used in 9 patients. Five patients had a fusiform thoracic aneurysm and each patient was aged and debilitated and the method was used as a palliative measure. There were three aged patients with a small sized abdominal fusiform aneurysm and poor distal circulation. One patient had a carotid aneurysm. There were no technical difficulties and no complications attributable to the procedure. One patient died from severe hemorrhage during operation, but the other eight were followed postoperatively with a mean follow-up period of 4.0 years without apparent enlargements or ruptured aneurysms. One patient died from carcinoma of the stomach four years postoperatively, and autopsy revealed

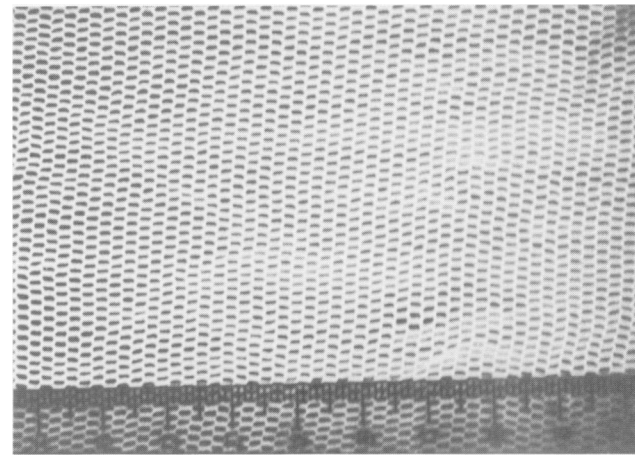

FIG. 1. A highly porous synthetic Dacron mesh.

excellent attachment of the mesh to the aortic aneurysm and no apparent dilatation of its size.

Several anastomotic aneurysms were seen in patients with thromboendarterectomy and autogenous vein patch grafting in the iliac artery. The proposed mesh reinforcement procedure was performed on 11 patients with arteriosclerosis obliterans; six with thromboendarterectomy, and five with patch vein grafting. Two of these 11 patients developed gradual stenosis one year postoperatively. Reoperations were performed in these two patients. It was found that the causes of stenosis were related to progression of the disease,

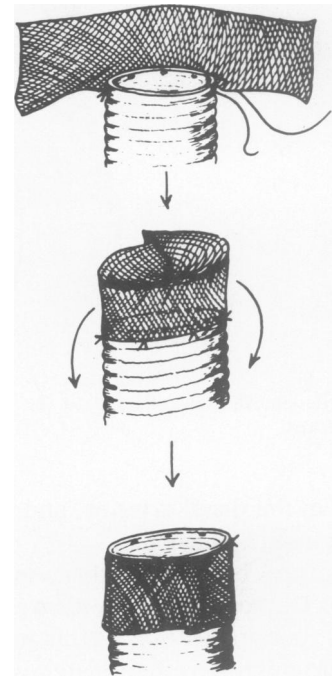

FIG. 2. The mesh was sutured around the end of Dacron graft.

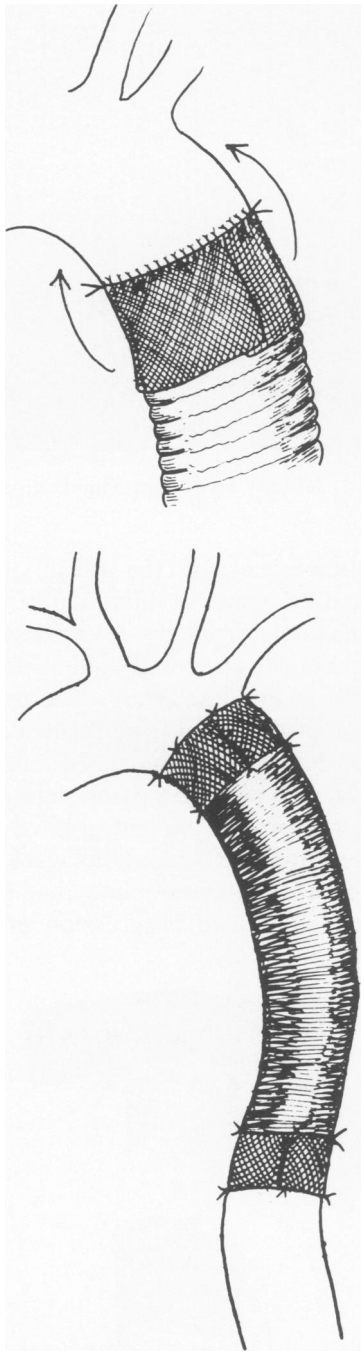

FIG. 3. The cuffed mesh was reflected to the aorta and covered with several sutures.

poor run-off in the distal arteries, and proliferation of scar tissue around the mesh.

The authors now believe that this reinforcement with highly porous Dacron mesh should be applied to aortic anastomoses, but application of this procedure to the thromboendarterectomized or patch-grafted iliac artery, should be restricted to the lesion with a severely damaged arterial wall and with systemic hypertension.

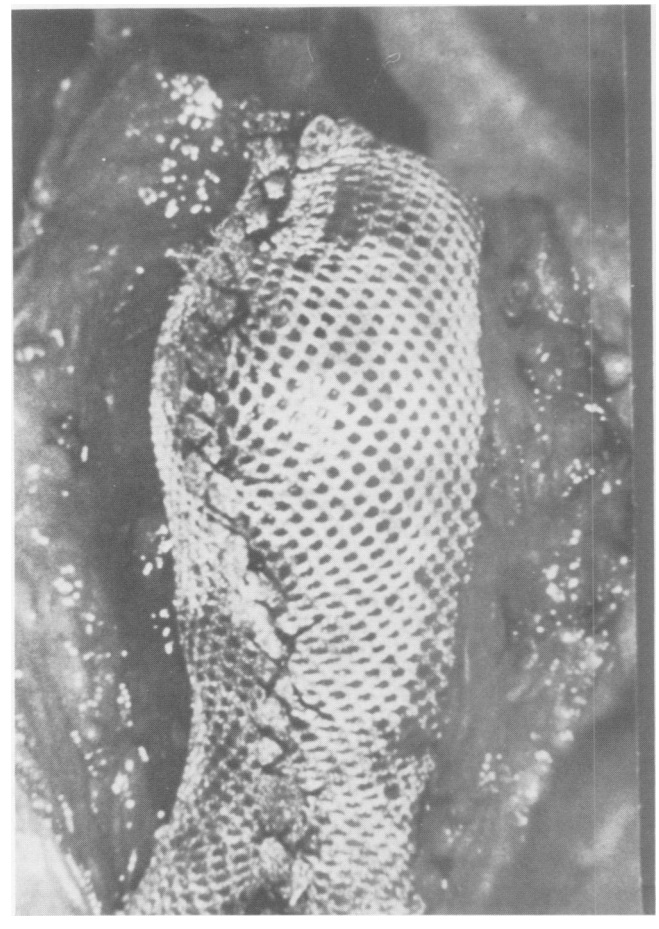

FIG. 4. Wall reinforcement of aortic aneurysm without resection.

Discussion

Aortic wrapping with various kinds of materials, such as cellophane film, diethyl phosphate liquid and sponge, fascia lata, and Dacron or Teflon® graft, have each been reported.[1,4,6,7,16] None of these materials have been completely successful for reinforcement of a diseased arterial wall. While wrapping has had a limited acceptance, it has never had a wide popularity.

Robicsek and associates have made extensive evaluations on wall reinforcement with use of conventional prosthetic graft.[8–14] Applying the principle of external grafting in 142 instances for prevention of rupture of an aneurysm, they reported satisfactory early and late results. The concept of our reinforcement procedure with high porous Dacron mesh is similar to the procedure reported by Robicsek, but the effects on the aortic wall are quite different. A more porous material permits good attachment of the surrounding tissue to the aorta through the wide interstices of the fabric. Experimental evaluation in the canine thoracic aorta has demonstrated excellent attachment of the mesh to the aorta as well as good preservation of pliability in the aorta

and efficient pressure resistance with minimal scar tissue formation. This mesh had good resistance to aortic pressure and showed firm attachment to the aortic wall. The structure of the wrapped aortic wall was well preserved and its pliability was retained well. Reinforcement with highly porous mesh should by no means be mistaken for what has been reported as wrapping of aneurysms with certain other material, such as cellophane film, sponge, fascia lata, prosthetic grafts, and felt. The latter wrapping procedures do not reinforce the aortic wall properly and usually produce unattached scar tissue and moderate structural changes of the aorta. Differences in the aortic changes and attachment to the aortic wall are produced by the construction of the fabric. Loose reinforcement of a more porous material prevents destructive changes of the aortic wall and provide firm attachment of the surrounding tissues. Good attachment of the mesh to the aortic wall provides reliable support, prevention of expansion and suture line complications.[18–20]

Reinforcement with highly porous synthetic Dacron mesh should be superior to reinforcement with a conventional prosthetic Dacron graft. This procedure can be safely applied for prevention of rupture of the aneurysm and for prevention of suture line complications.

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