Surgery of Descending Aorta*

A Method of Autotransfusion and Intercostal Artery Preservation

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Paraplegia is a tragic complication of surgery of the descending aorta. It is unpredictable and occurs with a similar incidence with or without distal circulatory support. Hypotension, prolonged aortic cross clamp time, and ligation of intercostal arteries have been considered causative factors. Recent experience with ten consecutive patients undergoing descending aortic surgery without shunts employed a method of autotransfusion and intercostal preservation. There were no deaths, renal failure, or paraplegia. The perioperative blood requirement per patient was 2.4 units of blood.

The challenge of surgery of the descending aorta is in avoiding the complications of temporary interruption of the distal blood flow. Various bypass or shunting procedures have been described, and more recently, simple aortic cross clamping has been proposed. The occurrence of paraplegia has been unpredictable and similar whether or not shunts to avoid ischemia have been utilized. Because of variability of blood supply to the spinal cord, preservation of intercostal arteries may be of greater significance than generally appreciated. Recent experience with ten consecutive patients implemented a method of autotransfusion and intercostal artery preservation.

MATERIALS AND METHODS

From April 1980, through March 1981, ten patients underwent descending aortic surgery at Jackson Memorial Hospital. There were six men and four women ranging in age from 29 to 79 years with a median of 50 years. Six patients had arteriosclerotic disease (four saccular and two fusiform), and four patients sustained vehicular deceleration injury with traumatic disruption and contained pseudoaneurysm. All patients with arteriosclerotic disease were hypertensive.

A double lumen endotracheal tube (Carlen) was uniformly used. Patients were placed in the right lateral decubitus position with the left hip extended. A standard left posterolateral thoracotomy with resection of the fifth rib was performed. The left saphenous vein was exposed at the groin area. Prior to aortic cross clamping, all patients received furosemide, mannitol, and 0.5 mg/kg heparin. A large bore arterial cannula, usually 16 French (USCI), connected through a microvee filter (Pall) to a autotransfuser reservoir (Bentley Laboratories) primed with one unit of whole blood and an additional 0.5 mg/kg heparin was inserted into the saphenous vein at its junction with the common femoral vein (Fig 1).

During aortic cross clamping, no shunts or bypass devices were utilized. Proximal hypertension was controlled with intravenous sodium administration of nitroprusside or trimethaphan. After aortotomy, a suction apparatus connected to the autotransfuser maintained a dry field without necessity to clamp or to ligate the exposed intercostal arteries. A woven Teflon graft (Edwards-USCI) was used without preclotting. A single layer of anastomoses was constructed with continuous 000 Prolene (Ethicon Inc) sutures. In five patients with arteriosclerotic aneurysms, the anterior three fourths of the diseased aortic wall was excised (Fig 2). The remaining posterior aortic wall where the intercostal arteries originated was used to reconstruct a long aortoplasty. In the other five patients (four with traumatic disruption and one with a chronic aneurysm), total circumferential graft replacement was necessary. In two of these patients, all the intercostal arteries were preserved. To accomplish this, the distal end of the graft was cut at a level to a varying distance to accommodate inclusion of as many intercostal arteries as possible. In the remaining (three) patients, only the upper intercostal arteries were not preserved.

During aortic declamping, hypotension was prevented with prior volume replacement and gradual release of the aortic clamp. Systolic arterial pressure was maintained above 100 mm Hg in all patients. Declamping time varied between three and ten minutes. Cross clamp time ranged from 28 to 69 minutes with a median of 43 minutes. Inotropic support with dopamine was required for a brief period in one patient. Blood requirement was 2.4 units per patient. In nine patients, the heparin effect was neutralized with protamine. There were no deaths, paraplegia, or renal failure. One patient with multiple trauma and bilateral lung contusions had respiratory failure. One other patient sustained vocal cord paralysis. Reoperation was necessary for postoperative bleeding in one patient. In this patient, heparinization was not counteracted with protamine initially, but was carried out during re-exploration.

DISCUSSION

Paraplegia is an infrequent tragic complication (1.3 percent) of descending aortic surgery. Hypo-
tension, prolonged aortic cross clamp time, and ligation of major intercostal arteries have been cited as risk factors. In animal experiments, the systemic arterial pressure was the most important factor controlling blood flow to the spinal cord, and in humans, paraplegia has followed episodes of hypotension. Coordination between the surgeon and anesthesiologist is required to maintain adequate volume expansion and possibly inotropic support while the aortic cross clamp is removed gradually.

Experimentally, the risk of paraplegia is greater with increasing cross clamp time (greater than 30 minutes). Recently, multivariate analyses of a group of 35 patients with descending aortic traumatic aneurysms indicated that spinal cord ischemia was more likely to occur with long aortic cross clamp times when no shunt was used to perfuse the distal aorta. However, in all reported series with and without distal perfusion, there has been no statistical difference in the incidence of paraplegia.

The blood supply of the thoracic spinal cord varies considerably. In some patients, the radicularis magna artery (originating at the level of T-8-T-10) is the entire source, whereas in others, intercostal arterial collateral vessels are major contributors. Unfortunately, the surgeon has no method of predicting the precise spinal cord anatomy in his patient. For this reason, preservation of intercostal arteries is an important aspect of this operation. Excessive dissection is required for individual intercostal artery control with microvascular clamps. The autotransfuser enables more expedient control as it maintains a relatively dry field when the intercostal arteries are permitted to freely back-bleed.

Intraoperative autotransfusion has been used successfully in abdominal aortic resection and in cardiac surgery. To the best of our knowledge, this is the first report of its use in descending aortic surgery. The autotransfuser reservoir (Bentley) unit employs a roller pump to aspirate blood into a reservoir. Although roller pump trauma to platelets has been reported, no major bleeding diathesis...
was encountered, and no patient developed thrombocytopenia postoperatively. Although this study lacks a control group, it points to the fact that the method is satisfactory with no major drawbacks. The blood requirement of 2.4 units per patient is similar to that reported by other techniques.

In summary, recent experience incorporated autotransfusion and simple aortic cross clamping in ten patients undergoing descending aortic aneurysmectomy. This method is practical and simple and facilitates intercostal artery preservation.

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