

Surgical Treatment of Acute Ascending Aortic Dissection

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Since adopting a policy of immediate operation on patients with acute dissection of the ascending aorta, 42 men and 6 women (ages 18–67 years) have been managed surgically. Thirty-two patients had graft replacement of the ascending aorta and resuspension of the incompetent aortic valve. One of these had a coronary graft. There were five deaths in this group. Eight patients required aortic valve replacement because of a diseased aortic valve as well as grafting of the ascending aorta, with one death. Three patients had resuspension of the aortic valve and primary repair of their dissection without mortality. Two patients were managed successfully with an intraluminal prosthesis and resuspension of the aortic valve. Another patient had successful repair with a valved conduit and reimplantation of the coronaries. Two patients dissected 4 and 6 years after aortic valve replacement and neither survived operative repair.

Of the surviving patients, one required dialysis, one a femoral-femoral bypass graft, and one an axillo-femoral bypass graft. One patient required a pacemaker for heart block, and two underwent successful repair of suture line aneurysms, both occurring three years after operation.

On the basis of this experience, prompt surgical intervention for acute ascending aortic dissection is the treatment of choice. A variety of techniques are available to repair the dissected aorta. Long-term results for resuspension of the aortic valve in acute ascending aortic dissection have been excellent and emphasize that valve replacement should be reserved for those patients found at operation to have a primary abnormality of the aortic valve.

ASCENDING AORTIC DISSECTIONS include both DeBakey types I and II dissections. Type III dissections begin distal to the left subclavian.⁶ Dissecting aneurysms may be related to hypertension, cystic medial necrosis, pure Marfan's syndrome, or aortic valve disease. In our series of patients, 50% had hypertension and one patient had classic Marfan's syndrome. Several patients had characteristics that were suspicious for Marfan's syndrome, but did not meet the classic criteria. Ten of our patients had dissections related to a diseased aortic valve.

The philosophy that acute aortic dissection involving the ascending aorta requires surgical therapy relates to

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an understanding of the pathophysiology of this lesion. In acute dissection involving the ascending aorta, the non-coronary cusp becomes incompetent as the dissection proceeds toward the aortic annulus; this cusp prolapses into the ventricle, producing significant aortic insufficiency. The other cusps are usually spared as the coronary ostia anchor the intima to the media and adventitia. The course of those patients who have significant aortic insufficiency is usually that of pulmonary edema, low cardiac output, and renal failure. Sudden death from myocardial infarction or arrhythmias is likely if dissection involves the coronaries. Bleeding into the pericardium commonly occurs and may cause death due to tamponade. Less frequently, the ascending aorta may rupture into the mediastinum. Rupture into either the pericardium or the mediastinum is frequently immediately fatal.^{8,12} Consequently, our approach has been to proceed with immediate surgery once the diagnosis has been made. Diagnosis was established in all of our patients with an aortogram.

Presentation

Chest pain was the most frequent presenting symptom in our series, being present in all patients. Patients with chest pain should have a chest x-ray as well as a concurrent workup for possible myocardial infarction. The history, physical examination, and presence of an abnormal mediastinum on chest x-ray led to consideration of aortic dissection. The patients who were hypertensive on presentation were treated with Nitroprusside, while their evaluation proceeded. The aortogram localized the origin of the dissection in all cases. Following aortography, the patients were prepared immediately for operative intervention.

Surgical Procedure

After median sternotomy, standard cardiopulmonary bypass was instituted, using a femoral artery cannula and a single venous cannula in the right atrium. The left ventricle was vented through the right superior pul-

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monary vein. The goal of operative repair was to correct the aortic insufficiency and repair the dissection of the ascending aorta, directing the blood back into the true lumen. This was accomplished using several techniques, the most common being grafting of the ascending aorta and resuspension of the aortic valve. With the aorta clamped proximal to the innominate artery, the aorta was opened and cardioplegic solution was perfused directly into the coronaries. The adventitia of the aorta initially is carefully protected and the aortic incision carefully planned, because secure hemostasis depends upon closure of the adventitia over the graft at completion of the operation. In the aortic dissections without antecedent valve disease, the prolapsing portion of the aortic valve (usually the non-coronary cusp) was resuspended with pledgeted sutures in order to restore competency of the valve. If the aortic valve was diseased, it was replaced with an artificial valve.

In 40 patients, a woven Dacron® graft was then sutured in place in the ascending aorta in the supra-coronary position. The graft size was selected to match the distal aorta, and then the graft was beveled to fit the supra-coronary aorta. One patient had an aortic valve, containing conduit, placed with reimplantation of the coronaries. Three patients had primary repair of the aorta and two had intraluminal prostheses. Two other patients, who dissected years following a previous aortic valve replacement, underwent replacement of the original valve prosthesis and grafting of the ascending aorta. The patients were then rewarmed and the adventitia were closed over the graft. The patients were separated from cardiopulmonary bypass and protamine was administered to reverse heparin. Nitroprusside was used to control the pressure. Once hemostasis was complete, the wound was closed in standard fashion.^{2,13}

Results

Grafting and Resuspension of the Aortic Valve (Table 1)

Thirty-two patients underwent grafting of the ascending aorta with a woven Dacron graft and resuspension of the aortic valve. Five deaths occurred in this group. One patient early in the series died from bleeding from the suture lines. The second had bleeding which was controlled, but developed mediastinitis and finally suc-

TABLE 1. *Acute Ascending Dissection*

Grafting of ascending aorta and resuspension of aortic valve	32	
Bleeding		(1)*
Bleeding/mediastinal infection		(1)
Intestinal infarction		(2)
Cardiac failure		(1)

* () = Number of deaths.

TABLE 2. *Acute Ascending Dissections*

Grafting of ascending aorta with aortic valve replacement	8	(1)*
Aortic valve conduit and reimplantation of coronaries	1	(0)
Dissection after aortic valve replacement	2	(2)

* () = Number of deaths.

cumbed from that infection. Two patients died from intestinal infarction in the initial postoperative period. One patient died of myocardial failure following repair of dissection and could not be separated from cardiopulmonary bypass.

Acute Ascending Dissection with Valve Replacement (Table 2)

Eight patients underwent grafting of the ascending aorta with aortic valve replacement. Each of the patients in this group had a clear history of antecedent valve disease, and it was obvious at operation that they had primary valve dysfunction prior to the dissection. Most of these patients had aortic stenosis of varying degrees. All underwent replacement of the aortic valve and supra-coronary placement of a graft in the ascending aorta. One hospital death occurred in this group, secondary to problems with bleeding and low cardiac output.

One patient had clear involvement of one coronary artery on angiography and underwent placement of an aortic valve containing conduit and reimplantation of the coronaries into the graft; this patient has done well.

Two patients were seen 4 and 6 years following aortic valve replacement with acute dissections of the ascending aorta. Both were DeBakey type I. Both underwent reoperation with replacement of the valve and supra-coronary grafting of the ascending aorta. Both died from intestinal infarction.

Dissection with Primary Repair of the Aorta (Table 3)

Three patients have undergone primary repair of the aorta. All of these patients had a DeBakey type II dissection. All had repair of the intimal defect with the use of Teflon® strips, running and interrupted sutures to reconstruct the aorta and redirect the blood into the true lumen. There were no hospital deaths in this group of patients. Two patients had placement of an intraluminal prosthesis with resuspension of the aortic valve. Both of these patients survived.

TABLE 3. *Acute Ascending Dissections*

Primary repair of aorta and resuspension of aortic valve	3	(0)*
Intraluminal prosthesis	2	(0)

* () = Number of deaths.

TABLE 4. *Acute Ascending Dissection—Early Problems*

Delirium tremens	1
Dialysis	1
Heart block	1
Ischemic limb	1
Tracheotomy	1
Fixed neurologic deficit	2

Early Postoperative Period

The postoperative course in most of the patients was benign. Most patients underwent extubation within 24 hours and were maintained on propranolol, methyl-dopa, or hydralazine hydrochloride to control hypertension. Almost all of the patients were discharged on propranolol (Table 4). As indicated, only one patient required peritoneal dialysis in the immediate postoperative period. This was a hypertensive patient with impaired renal function prior to his dissection. His renal function has returned to its preoperative level and he no longer requires dialysis. One patient required a permanent pacemaker. The two patients, with fixed neurologic deficits as a complication of their initial dissection, were discharged from the hospital, but one subsequently died because of this complication. The other continues to make steady improvement. One patient, not included in the table, had a TIA in the postoperative period that resolved spontaneously. He currently is on no medication and is without any neurologic sequelae. One patient had an axillo-femoral graft because of poor perfusion in the distal extremities following initial operation. During the postoperative period, femoral pulses returned and the axillo-femoral graft underwent spontaneous thrombosis.

Late Problems

Four patients have had surgical intervention in the postoperative period (Table 5). Two patients required reoperation, 3 years following their initial operation, because of false aneurysms at their distal suture lines.⁹ In one case, the suture line into the true lumen was intact completely, but the dissection had broken back and produced a false channel into the wrap around the graft that had been placed at the initial operation. In the other, there was a suture line dehiscence, with a false aneurysm encompassing the graft. In both of these patients, reoperation consisting of redoing the distal anastomosis between the graft and the aorta was successful

TABLE 5. *Acute Ascending Dissection—Late Problems*

Reoperation for suture-line aneurysm	2	(0)*
Femoral-femoral	2	(0)

* () = Number of deaths.

TABLE 6. *Acute Ascending Dissection—Late Deaths*

Rupture of thoracic aorta	(3)*
Myocardial infarction	(1)
Arrhythmias	(1)
Renal failure	(1)
Complications following fixed neurologic deficits	(1)

* () = Number of deaths.

and both are alive and well without evidence of problems today. Both of these patients had antecedent aortic valve disease and both had aortic valve replacement with their initial operation.

Two patients have undergone femoral artery reconstruction and femoral bypass because after operation, they had absent pulses and claudication in their lower extremities. Both patients have done well following their reconstruction.

Late Deaths

Long-term follow-up has been gratifying, with the initial patient operated on in 1974 still alive today. However, there have been three late deaths (Table 6) that have been related to enlargement and rupture of the descending thoracic aorta. All of these occurred in the fifth and sixth postoperative years. One patient had a fatal myocardial infarction approximately 18 months following his operation. He was found at autopsy to have left main coronary artery disease. One patient died following a morning walk and, at autopsy, death was thought to be related to arrhythmia. One patient died in the fifth postoperative year, having begun hemodialysis in his third postoperative year because of renal insufficiency. His death was thought to be related to electrolyte imbalance following dialysis. One patient had a persistent neurologic deficit and died approximately 18 months following surgical repair.

Discussion

Presently, we feel that acute dissecting aneurysms involving the ascending aorta (DeBakey types I and II) should be treated with immediate surgery.^{1,11,13} Clearly, there is a role for aggressive antihypertensive treatment in the immediate preoperative and postoperative periods; however, the basic therapeutic approach for ascending dissections is surgical. The goals of the operation are correction of aortic insufficiency and graft replacement of the ascending aorta, which will prevent progression and involvement of the coronary arteries and rupture into the mediastinum or pericardium.

Resuspension of the aortic valve is the procedure of

choice. None of our patients has had to have aortic valve replacement as a second operation following re-suspension.⁵ The procedure shortens operating time and provides an excellent hemodynamic result without adding the additional risks that accompany a prosthetic valve in the postoperative period. It is clear that patients with antecedent valve disease or clear aortic valve involvement, usually aortic stenosis, should undergo aortic valve replacement. There is no question that aortic valve replacement is necessary in patients with chronic dissection and aortic insufficiency.

Occasionally, primary repair of the aorta can be done and, at times, the use of composite aortic valve grafts have a role in the management of ascending dissections.³ Also, the intraluminal prosthesis has been used successfully by us as well as by others,¹⁰ but we feel that in most instances, the suture line next to the coronaries should be hand sewn, while the prosthesis distally can be secured in the usual manner with a tape. There is no question that if the aorta in the area of the coronaries is normal, suturing the graft in the supra-coronary position to normal tissue in this area appears at this time to be secure without significant complications.^{7,13}

In our patients needing reoperation, the problem occurred at the distal suture line; it is recommended that this suture line be banded very carefully with Teflon strips because here the tissues are friable. The sutures may cut through and the false lumen may re-enter, if this suture line is not carefully banded with Teflon strips. long-term follow-up is clearly important, and it is recommended by Crawford⁴ that operative replacement of the descending aorta in patients with documented enlargement is indicated. Certainly, in view of the fact that three of our patients have died in the late postoperative period from complications involving the descending thoracic aorta, more aggressive management in the late postoperative period of an enlarging descending thoracic aorta is indicated.

DISCUSSION

DR. PETER HAIRSTON (Charleston, South Carolina): I would like to offer a small experience of my own which demonstrates the applicability of the described techniques in dealing with this problem in the community hospital setting.

In the 18 months between March 1981 and September 1982, we encountered five such patients at the Roper Hospital in Charleston. All of the patients were men, in the age group between 34 and 68 years, presenting with symptoms of chest pain and, in three patients, neurologic deficits and syncope; examination revealed aortic murmurs, carotid bruits, and upper extremity pressure disparity.

The admitting chest films usually demonstrated the mediastinal widening. Aortography in most cases demonstrated the classic Type 2 dissection, which in two of our patients extended into the innominate.

Those patients with hypertension must have their blood pressure controlled very carefully. Long-term problems, associated with acute dissection, are evident in this series. Of the 48 patients operated on, 30 patients are alive at this time. One patient is surviving at 7 years, with three late deaths occurring in the fifth and sixth years following operation. Careful follow-up is essential, and consideration must be given to subsequent operations, either on the descending aorta or other areas of the vascular system in this group of patients, since they very often develop secondary major vascular problems.

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In one of our patients, the dissection began in the supra-avalvular aorta and extended up to and including the innominate artery; the repair was one of multilayered grafting.

In Type 1 dissection—incidentally, we have had only one patient of this type—we utilized sutureless intraluminal prosthesis. It should not be called "sutureless," since it requires multiple fixation sutures. I certainly agree with Dr. Wolfe that this leaves something to be desired; however, it proved quite successful in managing this patient.

In our experience with five patients, four of whom underwent surgery, all of the surgical patients are living and well, one now 18 months following the surgical procedure. One patient refused surgery, and died 11 hours after admission.

From this experience and from the experience reported by Dr. Wolfe, we conclude that in acute ascending aortic dissection, with immediate intervention—both diagnostic and therapeutic, the application of appropriate techniques for cerebral and myocardial preser-