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EMERGENCY THORACOABDOMINAL AORTIC ANEURYSM REPAIR: CLINICAL OUTCOME

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SURGERY FOR ACQUIRED CARDIOVASCULAR DISEASE

EMERGENCY THORACOABDOMINAL AORTIC ANEURYSM REPAIR: CLINICAL OUTCOME

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Objective: **Emergency repair of thoracoabdominal aortic aneurysm remains a formidable operation with high morbidity and mortality. Although advanced surgical and perioperative care techniques have reduced the risks in elective repair of these aneurysms, the mortality rate has remained high when emergency surgery is performed. We have evaluated the outcome of patients undergoing emergency repair of thoracoabdominal aortic aneurysm.** ***Methods:*** **Of 47 consecutive patients with thoracoabdominal aortic aneurysm observed from January 1993 to September 1998, 19 required an emergency operation. Twelve had a ruptured aneurysm and 7 an acute dissection. Twelve type I, 3 type II, 1 type III, and 3 type IV thoracoabdominal aortic aneurysms (Crawford's classification) were diagnosed. All patients were operated on via a thoracolaparotomy with partial femoral-femoral extracorporeal circulation. The cerebrospinal fluid pressure was monitored, and the aorta was replaced with a vascular graft. Patent intercostal arteries were reimplanted when feasible.** ***Results:*** **The early (30-day) mortality was 42.1%; there were 2 late deaths. Complications in the 11 surviving patients are summarized as follows: paraplegia/paraparesis, 3 cases; renal, 4 cases; pulmonary, 4 cases; cardiac, 1 case; cerebrovascular, 1 case; and reexploration for bleeding, 1 case. Hemodialysis and aortic dissection were predictive factors of hospital mortality.** ***Conclusions:*** **Our surgical experience in emergency repair of thoracoabdominal aortic aneurysm must be considered encouraging in terms of late outcome despite the in-hospital mortality of 42.1% and serious postoperative complications in the surviving patients. Moreover, our results show that acute aortic dissection and the need for hemodialysis are predictive factors for mortality. (J Thorac Cardiovasc Surg 1999;118:477-82)**

Emergency surgery for thoracoabdominal aortic aneurysm (TAAA) is a formidable challenge with a substantial morbidity and mortality.[1,2] An emergency situation is characterized by rupture or acute dissection of the aneurysm, and the postoperative results are dramatically influenced by cardiac, respiratory, and renal complications. Moreover, as in patients undergoing elective operations, the problem of how to prevent spinal cord ischemia with subsequent paraplegia/paraparesis is under continuous discussion.[3-5] From this angle, dissection has been considered an adjunctive risk factor.[6]

The purpose of this retrospective study is to evaluate the outcome of patients undergoing emergency repair of TAAA.

Patients and methods

In a consecutive series of 47 patients with TAAA observed from January 1993 to September 1998, 19 (40.4%) between the ages of 59 and 88 years (mean ± standard deviation, 67.1 ± 7.6 years; median, 66 years) required an emergency opera-

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tion (within 24 hours of diagnosis). Twelve (63.2) had suspected or true rupture of the aneurysm and 7 (36.8%) had acute dissections. The indications for immediate surgical treatment in the case of dissection were persistent pain, evidence of retrograde dissection with or without subtotal obstruction of the aortic true lumen, and organ (kidney, bowel) or limb ischemia. Ten of the 19 patients (52.6%) were very hypotensive (systolic blood pressure < 90 mm Hg) on admission to our institution, with 3 (15.8%) having had a cardiac arrest before the operation.

In all patients, contrast-enhanced computed tomography was performed, showing 12 (63.2%) type I, 3 (15.8%) type II, 1 (5.2%) type III, and 3 (15.8%) type IV TAAAs according to the Crawford classification system.[7]

Early mortality was defined as death within 30 days of the operation. Paraplegia or paraparesis was defined as a lower limb neuromuscular deficit that occurred in the hospital after full examination by a neurologist and a computed tomographic scan, if required. Renal failure was defined as the need for hemodialysis or creatinine serum levels greater than 2.5 mg/dL. Respiratory failure was defined as prolonged intubation (>48 hours) caused by adult respiratory distress syndrome or severe pulmonary infection or the need for a tracheostomy. Myocardial infarction, ventricular arrhythmias, and congestive heart failure were considered as cardiac complications.

Our surgical approach involved cerebrospinal fluid drainage, perfusion of the distal aorta, and reattachment of all patent intercostal arteries. A cerebrospinal fluid catheter was inserted before the operation at the level of L3 or L4, and a pressure of 10 mm Hg or below was maintained. This pressure was monitored for 48 hours after the operation in the absence of lower extremity deficits. The drainage catheter was reinserted if a neurologic deficit developed after this period.

After induction of anesthesia, a double-lumen endotracheal tube was inserted to permit collapse of the left lung. All patients were positioned on the operating table in the lateral position with the abdomen and the pelvis turned so that the groin was at a 45° angle to the table to allow cannulation of the femoral vessels for partial femoral-femoral extracorporeal circulation. An extended left posterolateral thoracotomy was performed with an upper entrance into the thorax through the fourth intercostal space and a lower entrance through the ninth intercostal space; the same skin incision was used for both. The fifth rib was completely resected. The aorta of the 3 patients with type IV TAAA was approached through the ninth intercostal space. The diaphragm was divided, the retroperitoneal structures exposed, and the peritoneal sac displaced to allow safe exposure of the aorta from the diaphragm to the bifurcation. The peritoneal sac was opened at the end of the operation to verify the integrity of all organs and the intestinal viability. In 3 patients (15.8%) a splenectomy was performed because of adhesions to the aneurysms or intraoperative lacerations.

The crossclamping technique was sequential when feasible, beginning below the left subclavian artery. After placement of the distal clamp and resection of the diseased aorta, the proximal anastomosis to a preclotted woven Dacron graft was performed with gelatin-resorcin-formaldehyde biologic glue to obliterate the false lumen in the 7 cases of dissection, external strips of Teflon felt were used to reinforce the wall in all cases, and a running 3-0 polypropylene monofilament suture was used in all.

Intercostal arteries considered obstructed at the origin by direct identification were not reimplanted. Patent arteries between T8 and L1 were reattached either individually to the graft or together with an aortic patch sutured to a side hole in the graft (6/19 patients, 31.6%). Dissection of the aorta, heavy atherosclerosis, or a remarkably fragile aortic wall were considered contraindications to intercostal artery reimplantation. After the distal anastomosis, the clamps were removed.

Complete follow-up was available in all patients by ambulatory examination and computed tomography.

All data are presented as mean ± standard deviation or as median and range. Perioperative risk factors were evaluated by univariate analysis with Fisher's exact test, and survival was determined according to Kaplan and Meier.[8] Relationships between independent variables were assessed by linear regression analysis.

Results

The overall in-hospital mortality was 42.1% (8/19 patients): One intraoperative death (5.3%) occurred in a patient who had a dramatic thoracic anterolateral rupture of a type II aneurysm (a dissection of the aortic wall was also found), and 1 perioperative death (5.3%) was related to an anteroseptal myocardial infarction in an 88-year–old man with a type I dissection. The other 6 hospital deaths (31.5%) occurred in 2 patients with dissected type I aneurysm and 1 patient with ruptured type IV aneurysm because of multiorgan failure, 1 patient with type IV dissected aneurysm and 1 patient with type III ruptured aneurysm complicated by renal failure and extensive bowel infarction, and 1 patient with dissected type I aneurysm who had a cerebrovascular accident.

The complications of the surviving patients with 9 ruptured and 2 dissected aneurysms are summarized in Table I.

Paraplegia developed in 2 patients with a dissected aneurysm, and paraparesis developed in 1 with a ruptured aneurysm. Together with 1 case each of paraplegia and paraparesis that occurred in 2 patients with a dissection and in-hospital deaths, the total percentage of complications due to spinal cord ischemia, excluding the patients who died intraoperatively or perioperatively, was 29.4%. The presence of aortic dissection was predictive of a neurologic injury ($P = .02$) and death ($P = .02$).

A total of 9 patients (50%), excluding the intraoper-

Table I. *Complications in 11 survived patients undergoing emergency TAAA repair*

	Patients	
Complication	*No.*	*Percent*
Paraplegia/paraparesis	3	27.3
Renal failure	4	36.4
Respiratory failure	4	36.4
Cardiac	1	9.1
Cerebrovascular accident	1	9.1
Reexploration for bleeding	1	9.1

Table II. *Mortality in 19 patients undergoing emergency repair of TAAA*

Type of aneurysm	*Early mortality (30-day)*	*Late mortality*	*Total*	
			No.	*Percent*
I	4	1	5	26.3
II	1	0	1	5.3
III	1	0	1	5.3
IV	2	1	3	15.8

ative death, had acute renal failure. Six patients needed hemodialysis and 3 had their renal function return to baseline level without hemodialysis. The extension of the aneurysm was not correlated to renal complication. The need for hemodialysis was considered a predictive factor for hospital mortality ($P = .04$). The mean crossclamp time was 63.58 ± 13.26 minutes (range, 45–95 minutes; median, 62 minutes). The effect of crossclamp time on renal function was evaluated, but an important correlation was not found ($P = .2$).

Postoperative respiratory complications were present in 7 patients (38.8%) excluding the intraoperative death and necessitated 3 tracheostomies. Three of these patients died, 1 with a tracheostomy that was not considered a risk factor predictive for death ($P = 1$).

There were 2 cardiac complications: 1 extensive myocardial infarction with consequent death and 1 complete atrioventricular block necessitating pacemaker implantation.

One patient had a cerebral ischemic neurologic accident resulting in death and 1 patient had a transient ischemic attack with subsequent return to normal function.

One patient was reoperated on because of perianastomotic bleeding and required additional external Teflon felt and a suture of 3-0 polypropylene.

The median hospital stay for all 19 patients was 12 days with a range of 1 to 92 days. The median length of stay for the 11 surviving patients was 18 days (range, 11-92 days).

All 11 patients discharged from the hospital were fully evaluated. The follow-up ranged from 3 to 68 months (median, 32 months). There were 2 late deaths (2/11, 18.2%), 1 due to septic shock occurring 1 year after the operation (aneurysm type IV) and 1 due to myocardial infarction at 18 months (aneurysm type I). The mortality related to the extent of the aneurysm is summarized in Table II. The median survival for all patients including those who died in the hospital was 6 months, whereas the median survival of the 11 surviving patients was 32 months with a 6-year actuarial survival of 48% (Fig 1).

Discussion

Our indications to perform emergency repair of TAAA are a suspected or true ruptured aneurysm or a dissected aneurysm causing partial or total obstruction of the aortic true lumen with consequent organ or limb ischemia. In our series of patients, acute aortic dissection is predictive of neurologic complications and death.

The review by Panneton and Hollier[9] shows aortic dissection as a variable associated with paraplegia and paraparesis. The same results have been reported by others.[1,7,10] On the other hand, there are reports that did not demonstrate the association between dissection and postoperative paraplegia/paraparesis.[11-13] The results of Coselli and coworkers[6] demonstrate no differences between patients with no dissection, acute dissection, or chronic dissection in terms of early mortality. With regard to the incidence of paraplegia/paraparesis, the same author concludes that only acute dissection increases the risk of this neurologic complication and suggests critical intercostal artery reattachment and atriodistal bypass as safe procedures with predictable results. In agreement with others,[1,2] we firmly believe that the presence of dissection or the need for emergency operation because of rupture of the aneurysm increases the risk for spinal cord injury.

Moreover, we believe that aortic crossclamp time does not influence significantly the risk of postoperative paraplegia/paraparesis if distal aortic perfusion is performed. The same conclusion was reported by Svensson and associates.[14]

Nevertheless, in their extensive review, Mauney and coworkers[15] conclude that spinal cord injury may be prevented by means of a combination of techniques.

The incidence of acute renal failure for TAAA repair varies between 4% and 29%.[16-19] In elective operations this incidence is correlated with age, male sex, preoperative renal occlusive disease and/or elevated serum

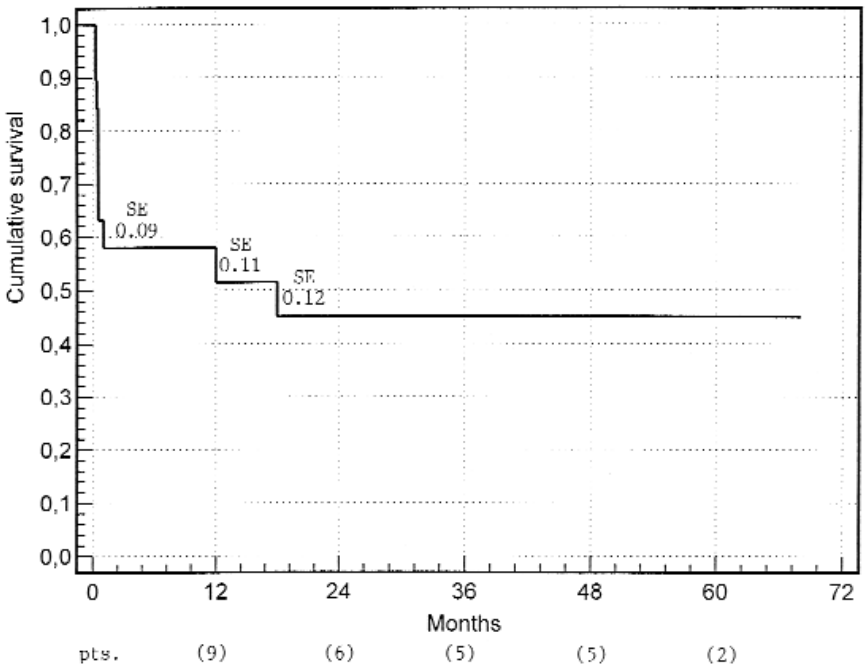

Fig 1. Cumulative survival of the 19 patients undergoing emergency repair of TAAA. *SE,* Standard error; *Pts,* number of patients still traced at 12, 24, 36, 48, and 60 months.

creatinine, visceral ischemia, use of a simple cross-clamp technique, and direct visceral perfusion.[17-19] Fifty percent of our patients had renal failure caused by poor preoperative hemodynamic conditions (52.6% had a systolic blood pressure < 90 mm Hg), probably causing visceral ischemia. The small number of patients together with the emergency nature of our surgical repair made the prediction of renal failure based only on preoperative renal occlusive disease and/or elevated serum creatinine impossible. Like Safi and associates,[19] we believe that distal aortic perfusion is protective against the development of acute renal failure, although our small numbers do not significantly support the use of femoral-femoral bypass alone.

This is confirmed by the statistical correlation between the need for hemodialysis and hospital mortality, so that distal aortic perfusion may play a role in protection of renal function and prevention of renal failure.

Postoperative respiratory complications were present in 38.8% of patients, with 3 deaths: 1 in a patient with multiple organ failure requiring a tracheostomy, 1 in a patient with stroke, and 1 in a patient who also had acute renal failure. Pulmonary complications are related to the preoperative status of the patients with a high correlation to age and to the presence of chronic obstructive pulmonary disease. Moreover, these complications prolong the hospital stay and increase the cost per patient. Nevertheless, we have not found any statistical correlation between the need for tracheostomy and postoperative mortality. On the basis of the high incidence of complications in our study, as well as those of others,[20] pulmonary complications must be considered a significant postoperative risk factor. We do not believe this is true of tracheostomy, as reported by Girardi and Coselli.[21]

The presence of postoperative cardiac complications in aortic surgery, principally due to coronary artery disease, has been widely recognized.[22,23] In our patients we had 1 early and 1 late death caused by myocardial infarction and 1 postoperative complete atrioventricular block. The small number of cases together with the impossibility for an accurate evaluation of the preoperative coronary conditions prevent us from drawing conclusions on this subject. Nevertheless, we can speculate that myocardial infarction must be strongly considered predictive of mortality, especially in elderly patients.[21]

In conclusion, we believe that emergency repair of TAAA can be performed with a satisfactory late outcome despite a high early mortality and major postoperative complications leading to death. The use of cerebrospinal fluid drainage, the reattachment of intercostal and lumbar arteries when feasible, and femoral-femoral bypass may be considered safe and effective

when used in combination, especially in the prevention of neurologic injury. However, further studies with a large number of patients are warranted to elucidate the exact correlation between single and multiple techniques of preserving organ function and improving the postoperative course so that reduction of mortality and morbidity may be realistically considered.

Addendum

From January to March 1999, another 2 patients with ruptured TAAA were admitted to our surgical unit. The first had a type IV aneurysm with a diameter of 9.5 cm (measured by computed tomography, which also revealed an anterolateral rupture); the patient died before the operation of hemorrhagic shock and consequently intractable cardiac arrest. The second patient had a type I aneurysm with a maximum diameter of 12 cm and with a large posterior aortic laceration (intraoperative view). This patient had 3 cardiac arrests before the operation and was operated on in a state of severe hypotension (systolic blood pressure of 50 mm Hg). The entire descending aorta was replaced. After 7 days the patient died of multiorgan failure.

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Commentary

In this series of 19 patients who underwent an emergency operation for thoracoabdominal aneurysm, 42.1% died, one third became paraplegic, and almost one half had acute renal failure. Clearly, surgery in this critically ill group of patients carries high risks. The role of various adjuncts to prevent these complications is difficult to evaluate in the experience reported because of the small numbers of patients, the heterogeneity of the extent of aneurysms, and the varying clinical presentations of the patients. As occurred in this experience, some patients, even with a true rupture that is contained, will be in hemodynamically stable condition for a while and can be treated with surgical adjuncts in a manner similar to patients having elective

operations. However, in the case of hypotension or free rupture, consideration should be given to performance of the simplest, most rapid operation possible. Rapid control of the proximal aorta followed by expeditious restoration of visceral and lower limb blood flow from a short clamp time should be the priority in these patients. "Nonsurgical" problems such as hypothermia, metabolic acidosis, and coagulopathy can easily assume overwhelming importance in these patients, despite the technical success of the operation. Referral of theses patients before rupture of these aneurysms requires ongoing education of the medical community as to the benefits and relative safety of elective operations compared with operations after rupture has occurred. The patient with a ruptured thoracoabdominal aneurysm represents an extreme surgical challenge, and the authors are to be commended for their efforts to improve the care of these critically ill patients.

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