

In situ reconstruction of septic aortic pseudoaneurysm due to *Salmonella* or *Streptococcus* microbial aortitis: Long-term follow-up

Chwan-Yau Luo, MD,^a Wen-Chien Ko, MD,^b Chung-Dann Kan, MD,^{a,c} Pao-Yen Lin, MD,^{a,c} and Yu-Jen Yang, MD, PhD,^a *Tainan, Taiwan*

Objective: This study was undertaken to illustrate the safety of in situ reconstruction of septic aortic pseudoaneurysm (SAP) secondary to microbial aortitis, with or without long-term antibiotic treatment.

Methods: Data for patients with SAP (11 abdominal, 4 thoracic) operated on between 1993 and 1999 were reviewed. Computed tomography and aortography showed septic pseudoaneurysm in all patients before surgery. After diagnosis of SAP, all patients underwent aneurysm resection and extensive debridement, with in situ prosthetic grafting or patch repair angioplasty. The graft in 10 of the 11 patients with abdominal SAP was also wrapped with an omental pedicle. In vitro active parenteral antibiotic therapy was prescribed for all patients for at least 2 to 8 weeks after surgery.

Results: All 15 patients had positive preoperative blood cultures or intraoperative tissue cultures for *Salmonella* spp (n = 12), viridans *Streptococcus* (n = 1), group G *Streptococcus* (n = 1), or *Streptococcus pneumoniae* (n = 1). There were two perioperative deaths (13.3%), one 6 days after surgery and the other 19 days after surgery, and two late deaths, at 8 and 10 months after surgery, neither of which was related to aortic repair. One patient was unavailable for follow-up. The other 10 patients have been regularly followed up with abdominal ultrasound or computed tomography (mean, 84 months; range, 47-118 months). To date, there has been no graft infection, thrombosis, false aneurysm, or subsequent aortic surgery in these 10 patients.

Conclusion: SAP due to *Salmonella* and streptococcal microbial aortitis can be successfully treated with resection of the aneurysm and extensive debridement, followed by in situ prosthetic graft interposition or patch repair aortoplasty. This is a safe and effective treatment that may result in complete remission of SAP. Postoperative parenteral antibiotic therapy should be continued for 2 to 8 weeks. Although usually recommended, lifelong suppressive antibiotic therapy appears to be nonessential with this approach. (J Vasc Surg 2003;38:975-82.)

The term “mycotic aneurysm” was first used in 1885 by Sir William Osler¹ because of the beaded and multilobulated appearance of the aneurysm formation occurring in “malignant endocarditis.” Most authors use it in a broader sense to describe any kind of infected aneurysm, regardless of its pathogenesis. In this report, however, septic aortic pseudoaneurysm (SAP) is used to describe aortic pseudoaneurysm caused by bacterial invasion of the vessel wall, with or without bacteremia.² There are three criteria for inclusion: positive signs of infection; a documented pseudoaneurysm; and either a positive blood culture or positive tissue culture, or both.

Aortic infection is still highly lethal, and surgical treatment of SAP remains challenging.³ A literature review⁴⁻¹² of surgical treatment of SAP can be confusing. Whether a patient should undergo extra-anatomic bypass grafting or in situ reconstruction with prosthetic graft or allograft is not well established and remains controversial, as does the required duration of postoperative antibiotic therapy. The purposes of this study were to review the clinical course in 15 patients who underwent surgical treatment of SAP secondary to microbial aortitis during 1993 to 1999, and to examine the safety of in situ reconstruction with or without long-term antibiotic therapy.

PATIENTS AND METHODS

Between 1993 and 1999, 113 patients underwent surgery in our hospital to treat aortic aneurysm disease. We excluded two patients with fusiform aneurysm, not pseudoaneurysm; one patient with pseudoaneurysm without positive signs of infection; and one patient with pseudoaneurysm without a positive blood or tissue culture. SAP was diagnosed in 15 patients (13.3%; 10 men, 5 women; age range, 53-77 years). Eleven patients had abdominal SAP (group 1, patients 1-11), and four patients had thoracic SAP (group 2, patients 12-15) (Table I). All had a medicinally documented febrile illness. Eleven patients (73.3%)

From the Division of Cardiovascular Surgery, Department of Surgery,^a Division of Infectious Disease, Department of Internal Medicine,^b and Institute of Clinical Medicine,^c National Cheng Kung University Hospital and College of Medicine.

Competition of interest: none.

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Reprint requests: Yu-Jen Yang, MD, PhD, Department of Surgery, National Cheng Kung University Hospital and College of Medicine, 138 Sheng-Li Road, Tainan 704, Taiwan (e-mail: luochwya@mail.ncku.edu.tw).

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Table I. Preoperative clinical and bacteriologic data

Patient no.	Sex	Age (y)	Signs and symptoms	Associated disease	Bacterial species isolated	Source of culture
Group 1						
1	F	64	Fever, abdominal pain, pulsatile mass	DM, H/T	<i>Salmonella choleraesuis</i>	Blood, aneurysm wall
2	F	71	Fever, abdominal pain, septic shock	DM	<i>Salmonella enteritidis</i> , group B	Aneurysm wall, purulent pus
3	M	69	Fever, abdominal pain, septic shock	CAD	<i>Salmonella enteritidis</i> , group B	Blood, aneurysm wall, periaortic pus
4	F	75	Fever, abdominal pain, pulsatile mass	DM, H/T	<i>Salmonella enteritidis</i> , group B	Blood
5	M	72	Fever, consciousness disturbance	H/T, Parkinsonism	<i>Streptococcus pneumoniae</i>	Blood
6	M	71	Fever, abdominal pain	H/T	viridans <i>Streptococcus</i>	Aneurysm wall
7	M	65	Fever, abdominal pain	H/T	<i>S choleraesuis</i>	Blood, aneurysm wall, periaortic pus
8	M	53	Fever		<i>Salmonella enteritidis</i> , group C	Blood, aneurysm wall
9	M	70	Fever, abdominal pain	CAD, DM	<i>Salmonella enteritidis</i> , group B	Aneurysm wall, purulent pus
10	M	60	Fever, shock (ruptured aneurysm)	DM	<i>Salmonella enteritidis</i> , group B	Blood, aneurysm wall, purulent pus
11	M	77	Fever, septic shock	H/T	<i>Salmonella enteritidis</i> , group B	Blood
Group 2						
12	M	67	Fever, hemoptysis, hoarseness		<i>Salmonella choleraesuis</i>	aneurysm wall
13	F	59	Fever, chest pain, hoarseness	DM, H/T	group G <i>Streptococcus</i>	Blood, urine, aneurysm wall, periaortic pus
14	F	71	Fever, hemothorax, shock (ruptured aneurysm)	DM	<i>Salmonella enteritidis</i> , group B	Blood, aneurysm wall, purulent pus
15	M	75	Fever, hemoptysis	DM, CAD	<i>Salmonella choleraesuis</i>	Aneurysm wall

CAD, Coronary artery disease; DM, diabetes mellitus; H/T, hypertension.

had preoperative abdominal, lower back, or chest pain. Ten patients (66.7%) had positive preoperative blood cultures, including *Salmonella* bacteremia in eight patients and *Streptococcus* bacteremia in two patients. Bacterial cultures of the specimens obtained during surgery, however, yielded *Salmonella* spp in 10 patients and *Streptococcus* in 2 patients. Surgical specimens from three of these patients exhibited bacterial colonies. More than half of the patients (56%, 8 of 15) had diabetes mellitus-associated disease. All patients underwent emergency aortic computed tomography (CT) and aortography before surgery. After the diagnosis and appropriate antibiotic therapy, these patients were scheduled for surgery as soon as possible for early control of infection and reduction of risk for aneurysm rupture.

Resection of SAP, with aggressive and extensive debridement, was performed in each patient. Aortic continuity was reconstructed with an in situ graft or patch repair angioplasty (until and including 1996, Hemashield; Meadox Medicals, Oakland, NJ; 1996 and after, Hemashield Gold; Boston Scientific Medi-Tech, Wayne, NJ). In 10 of 11 patients in group 1, the in situ prosthetic graft was also protected with a great omentum pedicle. There are at least two techniques for using the omentum pedicle for graft protection: covering the graft with the pedicle^{11,13,14} and completely wrapping the graft in the pedicle.¹⁵ We wrapped the prosthesis completely with the omentum pedi-

cle through the antecolic or retrocolic route, then stapled it to the surface of the periaortic tissue. The choice of route is at the discretion of the surgeon. From our experience, if the prosthesis or the proximal anastomosis is located in a higher position, such as the suprarenal abdominal aorta, the retrocolic route seems reasonable; on the contrary, the antecolic route is suitable with a prosthesis in a lower position. The pseudoaneurysm in patient 5 was located close to the diaphragm, too high for the somewhat atrophic and short omentum to reach the graft; therefore in this patient the graft was not wrapped in an omentum pedicle. In another patient there was also patch necrosis of the fourth portion of the duodenum where it attached to the SAP, which necessitated wedge resection with primary repair. For the omentum wrapping procedure we used a retrocolic approach in three patients and an antecolic route in the rest of the patients in group 1 (Table II). Two patients each with an aneurysm located on the distal arch underwent cardiopulmonary bypass surgery with deep hypothermia and circulatory arrest to excise the SAP and repair the defect with patch aortoplasty. The left subclavian artery in one of these patients was also sutured without blood flow restoration. Two patients were supported with a femorofemoral bypass to excise the SAP and reconstruct the artery with an in situ graft or patch angioplasty (Table II). Each of these patients underwent simultaneous left upper lobectomy, because the left upper lobes had been invaded by the aneurysm. Cul-

Table II. Summary of surgical findings and procedures

<i>Patient no.</i>	<i>Aneurysm location</i>	<i>Surgical findings</i>	<i>Surgical procedure</i>	<i>Omentum wrapping/route</i>
Group 1				
1	Infrarenal AA	Aortic pseudoaneurysm	In situ graft	Yes/retrocolic
2	Infrarenal AA	Ruptured aortic pseudoaneurysm, retroperitoneal hematoma, duodenal perforation, purulent pus	In situ graft	Yes/antecolic
3	Infrarenal AA	Aortic pseudoaneurysm, periaortic pus	In situ graft with inferior mesenteric artery implantation	Yes/antecolic
4	Infrarenal AA Left iliac artery	Aortic pseudoaneurysm, left iliac pseudoaneurysm	In situ graft (aortobiiliac bypass)	Yes/antecolic
5	Suprarenal AA	Aortic pseudoaneurysm	In situ graft	No/NA
6	Infrarenal AA	Aortic pseudoaneurysm	In situ graft (aortobiiliac bypass)	Yes/antecolic
7	Infrarenal AA	Aortic pseudoaneurysm, periaortic pus	In situ graft	Yes/antecolic
8	Infrarenal AA	Aortic pseudoaneurysm	In situ graft (aortobiiliac bypass)	Yes/antecolic
9	Aortoiliac (left)	Aortic pseudoaneurysm, purulent pus, lumbar spine invasion	In situ graft (aortobiiliac bypass)	Yes/antecolic
10	Infrarenal AA	Ruptured aortic pseudoaneurysm, purulent pus, retroperitoneal hematoma	In situ graft (aortobifemoral bypass)	Yes/retrocolic
11	Suprarenal AA	Aortic pseudoaneurysm	In situ graft with celiac trunk implantation	Yes/retrocolic
Group 2				
12	Distal aortic arch	Distal aortic pseudoaneurysm	Patch repair aortoplasty	NA
13	Distal aortic arch	Distal aortic pseudoaneurysm, periaortic pus	Patch repair aortoplasty with left subclavian artery sutured ligation	NA
14	Descending TA	Ruptured aortic pseudoaneurysm purulent pus	In situ graft with left upper lobectomy	NA
15	Descending TA	Aortic pseudoaneurysm	Patch repair aortoplasty with left upper lobectomy	NA

AA, Abdominal aorta; TA, thoracic aorta; NA, not applicable.

tures from the aneurysm wall and periaortic infected tissues or purulent materials were obtained from all patients during surgery.

Regular follow-up was carried out in eight patients over the long term (>1 year). During the first year these patients were seen monthly for the first 3 months and at 3-month intervals for the next 9 months. Subsequently they were followed up once a year for 6 years. Imaging studies were obtained once or twice, at 6 months or 12 months. One patient was lost to follow-up immediately after surgery. Another two patients lived far from our hospital and therefore sometimes visited other hospitals. All patients were urged to return to our clinic if they were febrile and had abdominal or chest pain.

RESULTS

Overview. SAP was located at the distal aortic arch in 2 patients, descending thoracic aorta in 2 patients, suprarenal abdominal aorta in 2 patients, infrarenal abdominal aorta in 7 patients, and terminal aorta in 2 patients (Fig 1, online only). One patient had two aneurysms, one at the

terminal aorta and the other one at the left common iliac artery. A preoperative contrast medium-enhanced aortic CT scan showed an irregular aortic lumen and characteristic hypodense periaortic masses, with ring enhancement beyond the intimal calcification. The patients who underwent preoperative aortography demonstrated typical saccular or lobular eccentric aneurysms. All patients underwent surgery 0 to 21 days after diagnosis. Two patients were reluctant to have surgery, and their operations were considerably delayed. During surgery most SAP were found to arise from the anterior or lateral aspect of the aorta. Induration, thickening, and inflammation of the wall of the pseudoaneurysm were noted. In most patients, microscopic examination of the resected specimens revealed fibrosis and atheromatous plaque composed of foamy, multinucleated giant cells and cholesterol crystals, with acute and chronic inflammatory cell infiltration, and sometimes a bacterial colony in the aortic wall.

Early results. Two patients died after surgery. In one of these patients, duodenal leakage developed the day after surgery, and the patient died 19 days later of uncontrolled

sepsis and severe gastroduodenal bleeding. Wide and segmental resection of the fourth portion of the duodenum should have been performed in this patient. The second patient, with a preoperative ruptured aneurysm and hemorrhagic shock, had graft anastomosis leakage the day after surgery and was returned to the operating room for another graft replacement because of inadequate debridement of infected aortic tissue. Paraplegia and acute renal failure developed after the secondary intervention, and the patient died 6 days later of multiple organ failure. Seven (53.8%) of 13 surviving patients had one or more non-prosthesis-related complications (Table I). A duodenal obstruction due to an adhesion band crossing over the portion just below the duodenojejunal junction complicated recovery in one patient and required enterolysis. In one patient with septic aortoiliac pseudoaneurysm (Fig 2, A, online only) that had invaded the lumbar vertebrae body (Fig 2, B, online only), a *Salmonella*-associated epidural abscess at L3/5 (Fig 2, C, online only) developed 1 month after the initial operation, and wide debridement and drainage were required. This patient was given long-term oral antibiotic therapy for 4 months. Because an active infected field with fulminate pus was found during surgery in patient 10, aggressive and wide debridement was performed. Bilateral lower leg edema and groin lymph leakage occurred after the operation, but subsided progressively after conservative treatment. One patient sustained upper gastroduodenal bleeding, pneumonia, and bacteremia (oxacillin-resistant *Staphylococcus aureus*) via the central venous pressure catheter 1 week after excision of a suprarenal SAP. An additional 2-month regimen of parenteral antibiotic therapy was administered for persistent bacteremia, and the patient was discharged after 4 months of hospitalization. One patient with a septic aortic arch pseudoaneurysm, who underwent deep hypothermia and circulatory arrest during aneurysm excision and patch aortoplasty, had an early postoperative seizure and consciousness disturbance complications, but recovered without neurologic sequelae. A patient with *Streptococcus* bacteremia via a urinary tract infection also had intermittent chest pain and hoarseness before admission. An enhanced chest CT scan demonstrated a distal arch pseudoaneurysm encircled by a periaortic soft tissue mass (Fig 3, A). Aortography also proved a distal aortic arch aneurysm (Fig 3, B). After extensive aneurysmectomy and patch aortoplasty, the patient was discharged on completion of a full 4-week course of parenteral antibiotic therapy.

Late results. No recurrent graft infection developed in any surviving patients during mean follow-up of 84 months (Tables II and III). Eight patients received 2-week to 9-month oral antibiotic regimens (Table III), but most chose to terminate the medication early. Four patients were not given any oral antibiotic therapy. One patient was unavailable for follow-up 1 month after surgery. There were two late deaths: one at 10 months, due to brain stem hemorrhage, and one at 8 months, due to intractable heart failure. Neither patient had demonstrated signs of graft infection.

DISCUSSION

SAP is a potentially life-threatening aortic lesion. It is uncommon, but not rare, and an increasing incidence has been reported in recent years.^{5,7,9,16} Compared with the 0.85% incidence (1 of 117 patients) reported by Chan et al,⁹ our 13.3% incidence seems higher than series reported in the West. Moreover, we have the highest incidence of *Salmonella* aortitis (80%, 12 of 15 patients) in patients with SAP published in the English literature.^{5,7-9,11,12,17-19} There are two important reasons for this. First, people in the rural agricultural regions of southern Taiwan generally do not go to supermarkets, which hygienically process, package, and sell raw meat and fish. Rather, a great many people in southern Taiwan go to traditional markets, where all kinds of raw meat or fish are mixed and sold under hygienically questionable conditions. *Salmonella* infection develops easily in these consumers. Second, despite the 1984 revelation by Brown et al³ that the bacteriology of infected aneurysms had changed pattern, *Salmonella* organisms were found in only 10% after 1965. In recent reports^{5,7,8,11,19-22} of infected aortitis, however, the incidence of *Salmonella* infection varies from 18% to 74%. In our subtropical area, salmonellosis is still common, with sporadic outbreaks. A similarly large group of patients with *Salmonella* aortitis in this area was reported in 1996,¹³ but the incidence of SAP was not documented.

Because the signs and symptoms of SAP are often elusive and nonspecific, a high index of suspicion is required to establish the diagnosis. Any patient with prolonged fever of unknown origin, with or without recurrent bacteremia, accompanied by abdominal, back, or chest pain, should be evaluated for a possible arterial infection source. Ten of our 15 patients (67%) had prolonged fever of unknown origin with bacteremia during the first few days of admission and diagnostic examination. The diagnosis of SAP was made after CT and aortography. CT is the most sensitive and useful tool for early detection of the signs of aortic infection^{5,23} and should be the first imaging study done. Although rare—and seen in only one patient in our series—air in the aortic wall appears to be pathognomonic of an infected aorta. If the aortic pseudoaneurysm is well demonstrated on a CT scan, aortography should be performed to confirm the diagnosis and assist in planning the proper surgical procedure. Aortography often reveals a characteristic saccular or lobulated eccentric aneurysm.

A combination of aneurysm resection and administration of in vitro active preoperative and postoperative antibiotic therapy is mandatory for effective treatment of SAP. Successful surgical management of bacterially infected aortic aneurysms consists of wide and extensive debridement of infected tissue and restoration of distal perfusion. However, some insist that extra-anatomic vascular bypass grafting is optimal,^{4,5} whereas others believe an in situ prosthetic graft or allograft is preferable.^{9-11,13,24} Conventionally, the extra-anatomic route is recommended to avert placing a prosthetic graft in a contaminated region, because of the great risk for graft infection.

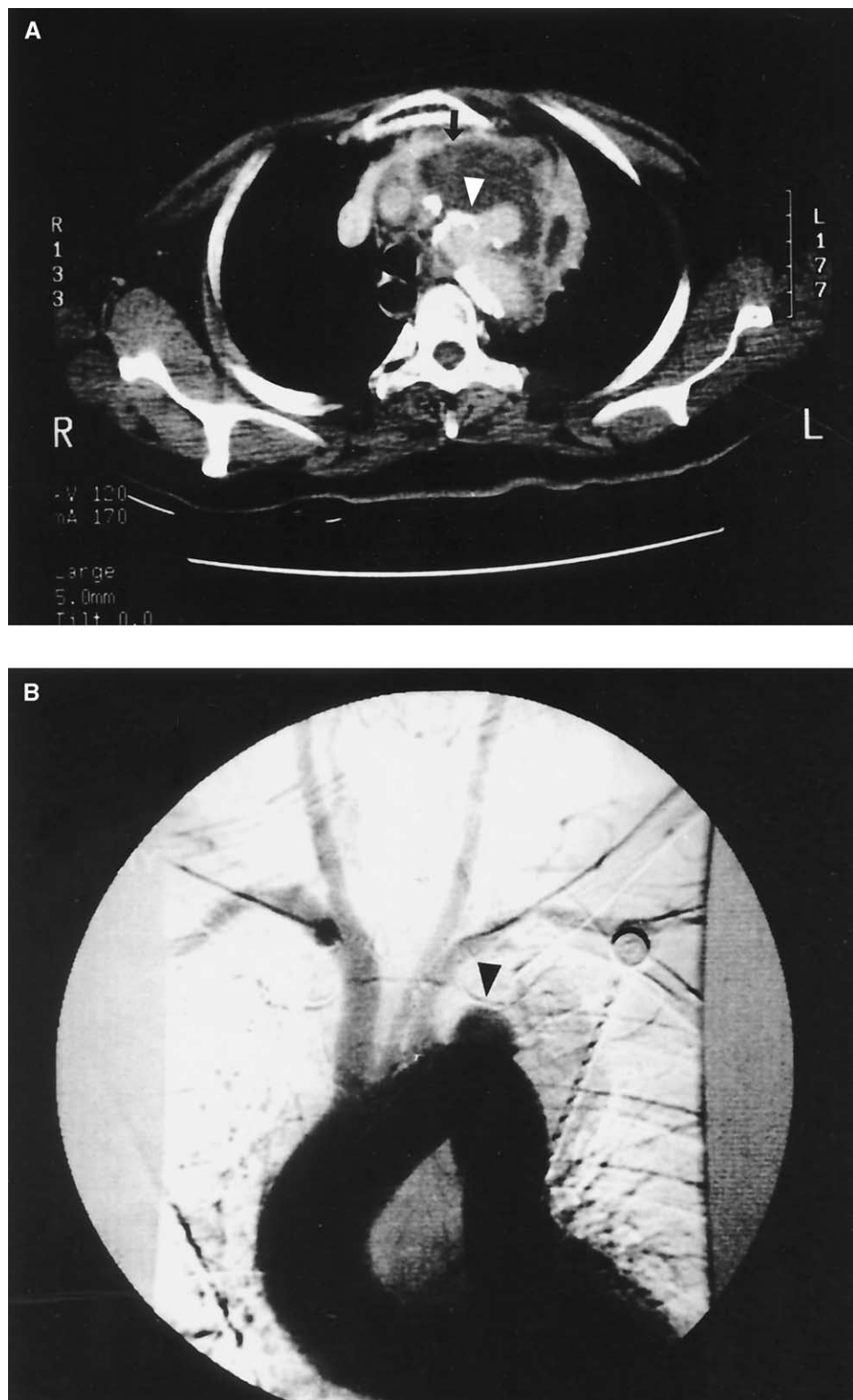


Fig 3. A, Preoperative chest CT scan reveals aortic arch pseudoaneurysm beyond the intimal calcification (*arrowhead*) within a large periaortic mass with ring enhancement (*arrow*). The tissue culture disclosed *Streptococcus* group G organisms. B, Preoperative angiogram of patient with *Streptococcus* bacteremia shows distal aortic arch pseudoaneurysm (*arrowhead*).

Table III. Postoperative clinical features and outcomes

Patient no.	Complication	Outcome	Parenteral antibiotic therapy		Oral antibiotic therapy		Duration of follow-up (mo)
			Regimen and duration	Total duration (wk)	Regimen and duration (mo)	Total duration (mo)	
Group 1							
1	Adhesion ileus	Alive	Ampicillin-sulbactam 750 mg q6h	4.0	—	—	107.0
2	Duodenal leakage	Died at 19 d postsurgery	Ampicillin-sulbactam 1.5 g q6h	2.5	—	—	—
3	None	Alive	Cefmetazole 1.0 g q6h	4.0	Ciprofloxacin 250 mg bid	4.0	101.0
4	None	Alive	Ampicillin-sulbactam 750 mg q6h	4.0	—	—	107.0
5	None	Alive	Cefotaxime 2.0 g q6h, 2.0 wk Vancomycin 500 mg q6h, 2.0 more wk	4.0	—	—	Lost to follow-up
6	None	Alive	Penicillin G 300 million units q6h	4.0	—	—	85.0
7	None	Alive	Ampicillin 2.0 g q6h	2.0	Ciprofloxacin 250 mg bid	0.5	84.0
8	None	Alive	Cefotaxime 2.0 g q6h	4.0	Ciprofloxacin 500 mg bid	1.0	64.0
9	L3-5 osteomyelitis, epidural abscess	Alive	Ciprofloxacin 400 mg q12h; 4.0 wk for infected aneurysm, 4.0 more wk for epidural abscess	8.0	Ciprofloxacin 500 mg bid	4.0	60.0
10	Lower leg edema, groin lymph leakage	Alive	Cefotaxime 1.0 g q6h	4.0	—	—	47.0
11	Pneumonia, bacteremia (<i>Staphylococcus aureus</i>)	Late death (10 mo) Brain stem hemorrhage	Ciprofloxacin 300 mg q12h; 4.0 wk for salmonellosis Teicoplanin 400 mg qd; 8.0 more wk for pneumonia	4.0	Ciprofloxacin 500 mg bid	3.0	10.0
Group 2							
12	Seizure	Alive	Ampicillin 1.0 g q6h; 2.0 wk; Ceftriaxone 2.0 g qd; 4.0 more wk	6.0	Ofloxacin 200 mg bid	9.0	118.0
13	Hoarseness	Alive	Penicillin G 300 million units q6h	4.0	Cefadroxil 500 mg bid	8.0	80.0
14	Bleeding, paraplegia	Died at 6 d postsurgery	Cefotaxime 2.0 g q6h	1.0	—	—	—
15	Low cardiac output	Late death (8 mo) from heart failure	Cefotaxime 2.0 g q6h	4.0	Ciprofloxacin 500 mg bid	2.0	8.0

This approach has the disadvantage of a reduced graft patency rate and acute rupture of the aortic stump. It is also technically difficult when the SAP is located close to the heart or to the origins of the great visceral vessels. A 1989 review by Oz et al⁵ of 24 patients treated with extra-anatomic bypass grafting shows that 11 patients (46%) died of disease-related complications. This unacceptably high mortality is attributable to the surgical method selected. Instead of the multiple operations required for extra-anatomic reconstruction to restore natural blood flow, in situ grafting offers a definitive solution in a single operation. The question of whether it is safe to perform such a procedure in an infected field may arise. Excellent long-term results after prosthetic

graft or allograft replacement for management of infections have been reported.^{9,24-27} Chan et al⁹ reported that only 1 of 19 patients had recurrent infection after follow-up of 3 months to 8 years combined with life-long suppressive antibiotic therapy. In our series, long-term suppressive antibiotic therapy was not necessary, because of our surgical approach.

In one report¹⁶ of in situ allograft replacement for infrarenal infected aortic aneurysm in 43 patients, 5 patients (12%) died after surgery, and the rate of recurrent infection was 2.3% with mean follow-up of 13.8 months. Other preliminary results are also encouraging,^{24,27-29} especially those that claim no need for long-term or lifelong oral antibiotic therapy after 4 to 6 weeks of parenteral

antibiotic therapy.²⁷ Although an allograft may offer greater resistance to infection and allow another in situ treatment option for infected aortic aneurysm,^{16,24,27-29} the choice of method for preserving the allograft and preventing secondary and late deterioration of arterial allografts remains a major concern. It will require longer follow-up and make close surveillance of these allografts an obvious necessity. Moreover, organ donation has been a social issue in Taiwan, and donor sources will be another concern for in situ allograft reconstruction here.

Oz et al⁵ reported that diffuse sepsis, large retroperitoneal hematoma, or large atherosclerotic aneurysm with superinfection dictates extra-anatomic bypass grafting after debridement. Other reports^{10,11,30} agree when extremely diffuse sepsis with a collection of pus is seen on CT scans or when osteomyelitis is involved. We, however, think that none of these conditions necessarily contraindicate in situ grafting. Adequate and extensive debridement is crucial in treating SAP. In our series, during surgery frank pus was seen in seven patients, all of whom had positive cultures for *Salmonella* spp or *Streptococcus*, and four patients even had extensive purulent pus formations in the periaortic tissue or advanced infection in the vertebral body. Of the latter four patients, two survived without late graft infection after the infected aortic wall and periaortic tissue were extensively excised. However, the other two patients died in the early postoperative period as a result of inadequate debridement, one of duodenal leakage on the second day after surgery and the other of anastomosis leakage when sutures were placed in the infected aorta. Although this kind of extensive debridement may cause some unavoidable complications, they seem minor in comparison with the high mortality when surgery is inadequate.

Our initial plan was to give parenteral antibiotics for 4 weeks, followed by oral antibiotic therapy for the rest of the patient's life, as suggested by some authors. However, only eight of our surviving patients received an additional 2 weeks to 9 months of oral antibiotic therapy, and the rest received only 4 weeks of parenteral antibiotic therapy (Table III). All surviving patients seemed to do well, with no recurrence of graft or other infection after mean follow-up of 84 months. We believe that debridement of infected tissue was crucial during surgery to resect infected abdominal SAP; however, omentum pedicle wrapping of the graft probably also had an important role in the prevention of abdominal graft infection. One patient had postoperative lumbar osteomyelitis. Despite this, there was no graft infection because, we suspect, the omentum wrapping provided protection against it. Although an adhesion ileus developed in one patient in whom the retrocolic route was used, it is difficult to definitely attribute this complication to choice of route.

In group 2, lesions confined to the thoracic aorta in three patients were reconstructed with simple patch repair angioplasty after adequate debridement. There was no recurrent sepsis despite no lifelong maintenance antibiotic therapy. Patch angioplasty for aortic continuity is a simple procedure and requires less bypass time.

In conclusion, septic abdominal or thoracic aortic pseudoaneurysm should be suspected in patients with prolonged fever of unknown origin, with or without bacteremia and abdominal pain; with fever of unknown origin with or without a pulsatile abdominal mass; or with fever and chest pain plus hemoptysis or hoarseness. CT is a rapid diagnostic tool, and aortography is helpful in surgical planning. In our series, in situ graft or patch repair angioplasty after extensive debridement seemed to be safe and effective when *Salmonella* or *Streptococcus* was cultured, even without long-term antibiotic therapy. Ten of 14 patients (71%), or 10 of 15 patients (68%) if we include the patient lost to follow-up, remained well and without graft infection at a mean of 84 months after surgery. Although we might speculate that in situ reconstruction is worthwhile for other infections, our data support recommending its use only in cases in which *Salmonella* and *Streptococcus* are cultured. Also, despite our small population size, the low early mortality rate of 13.3% compares favorably with the best results of recent series in which in situ reconstruction was used,^{9,10,12,16,17} and the high long-term survival rate without maintenance oral antibiotic therapy is quite encouraging. Regular follow-up is mandatory, because sepsis recurrence is still a potential problem.

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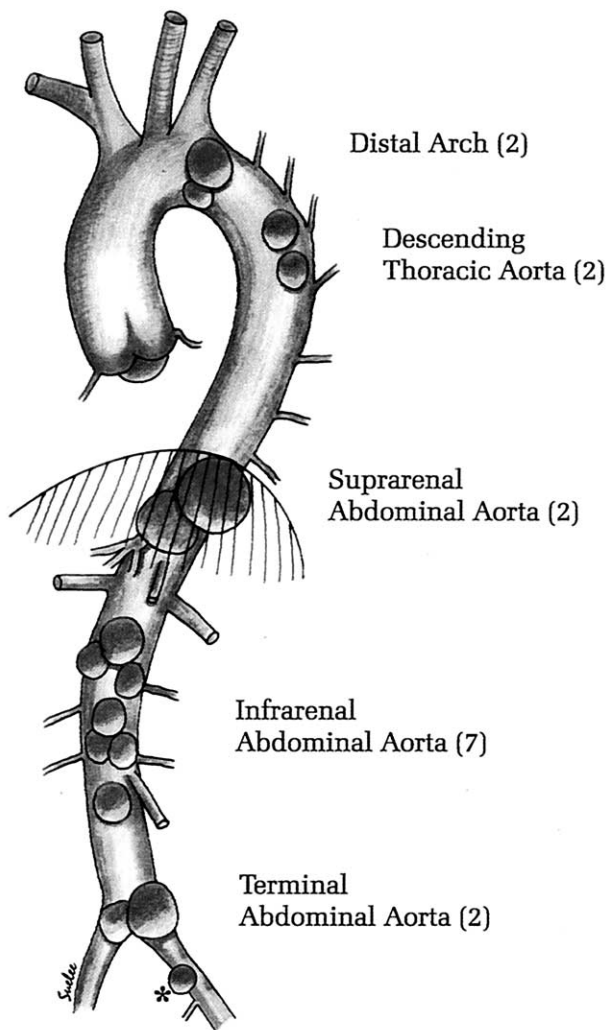


Fig 1, online only. The demographic distribution of septic aortic pseudoaneurysms. *Left common iliac infected aneurysms coincidentally existed with one septic terminal abdominal aortic pseudoaneurysm in patient 4.

Fig 2, online only. A, Preoperative CT aortography of patient 9 reveals an aortoiliac typical saccular eccentric pseudoaneurysm (arrowhead). B, Post-contrast MRI in patient 9 after *Salmonella* septic aortic pseudoaneurysm excised one month postoperatively demonstrates lumbar 3-5 osteomyelitis (arrowhead), and epidural abscess (arrow).