

Surgical Treatment of Postoperative Ascending Aortic Pseudoaneurysm. Short- and Mid-Term Follow-Up

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ABSTRACT

Postoperative pseudoaneurysms of the ascending aorta constitute a severe complication of cardiovascular surgery, developing in most cases after aortic valve replacement or myocardial revascularization surgery, and after other procedures involving aortic manipulation, trauma and infections. Six consecutive patients with pseudoaneurysm of the ascending aorta were studied and operated on at the Department of Cardiovascular Surgery of the Hospital Hermanos Ameijeiras over a 7-year period. The variables mainly related with the diagnosis and surgical procedures, as well as the outcome and subsequent follow-up, were analyzed. A history of aortic valve replacement was present in 83.4% of the patients; fever was the most prevalent symptom and pseudoaneurysms were most commonly located at the previous aortotomy site. Synthetic patch graft aortoplasty was the most frequently used procedure. In-hospital mortality was 16.66% with a one-year survival of 66.66%.

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Key words >

Aorta - Pseudoaneurysm, - Surgery - Follow-up Studies

BACKGROUND

Pseudoaneurysm results from disruption of a vessel wall, with the leak contained by the other layers and surrounding adjacent structures, with or without neointimal development. Most aortic pseudoaneurysms are asymptomatic and are found during physical examination or are discovered incidentally on radiological imaging studies performed for other purposes. (1) Previous aortic valve replacement is the most common cause of pseudoaneurysm, with an incidence of 0.6%. Pseudoaneurysms have also been described at the suture line years after previous aortoplasty with or without Dacron stiff patch. (2) As opposed to true aneurysms, which develop at the aortic wall opposite the patch, pseudoaneurysms are a consequence of early failure in primary repair, (3) and should undergo urgent surgery due to their complexity. (2-4)

METHODS

From June 2004 to June 2011, six consecutive patients with pseudoaneurysm of the ascending aorta underwent surgery at the Department of Cardiovascular Surgery, Hospital Hermanos Ameijeiras. Despite the small sample size, the variables mainly related with the diagnosis and surgical procedures, outcome and subsequent follow-up, were analyzed.

Continuous variables were expressed as mean \pm standard deviation and range, and categorical variables as percentages.

The surgical approach included resection of the pseudoaneurysm and aortoplasty with or without synthetic material and aortic valve and aortic root replacement using a valved conduit, with reimplantation of the coronary arteries.

The information was obtained from the clinical histories, surgical reports, and anesthesia and perfusion records.

After discharge, patients were followed-up in the out-patient clinic once a month during the first trimester and then every three months up to one year post surgery.

RESULTS

Five of the six consecutive patients undergoing surgery for pseudoaneurysm of the ascending aorta diagnosed after cardiovascular surgery had had previous aortic valve replacement (Table 1); one of them had also undergone mitral valve replacement, another one had been previously operated on due to coarctation of the aorta, and an aortic root replacement with a valved conduit had been performed to another patient. Patient number six had a history of closure of an ostium secundum atrial septal defect using a pericardial patch.

Mean age was of 45.5 ± 9.33 years (range: 27-64) (see Table 1). Four patients were men. Fever occurred in all the case at some point of the postoperative period; asthenia was present in four cases and only one patient presented chest pain.

Fifty percent of the patients were in New York

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Heart Association (NYHA) functional class (FC) III, and the other 50% were in FCI-II (see Table 1). Left ventricular ejection fraction was normal ($\geq 50\%$) in five cases and one patient presented moderate dysfunction ($\geq 30\%$ and $< 50\%$).

In all the patients, the diagnosis was confirmed by computed tomography scan (Figure 1) and transesophageal echocardiography, although a simple chest x-ray was suggestive of pseudoaneurysm in half of the cases. The diagnosis of pseudoaneurysm was performed in four patients within the first 12 months after the initial intervention, in one of them during admission (see Table 1). In the remaining two patients, the diagnosis was made after 15 and 17 months, respectively, of the last cardiovascular surgery.

In the six cases, surgery was performed within the first 72 hours after the diagnosis of aortic pseudoaneurysm was confirmed. All the patients were admitted to the intensive care unit before being transferred to the operating room. Two patients required rapid stabilization of their hemodynamic condition to provide the best possible preoperative status prior to emergency surgery (see Table 1)

Three patients had blood cultures positive for *Staphylococcus aureus* and *Klebsiella pneumoniae* was isolated in one patient. The remaining blood cultures were not conclusive.

Table 1. Clinical characteristics

Variables	
Age, years	45.5 \pm 9.33(27-64)
Gender, n (%)	
Male	4(66.6%)
Female	2(33.3%)
Marfan syndrome, n (%)	1(16.6%)
LVEF, n (%)	
$\geq 50\%$	5(83.3%)
$\geq 30\%$ and $< 50\%$	1(16.6%)
Functional class (NYHA), n (%)	
I-II	3(50%)
III-IV	3(50%)
Previous cardiovascular surgery, n (%)	
1 intervention	5(83.3%)
2 or more interventions	1(16.6%)
Time interval between the last surgery and the diagnosis, n (%)	
≤ 1 year	4(66.6%)
> 1 year and ≤ 5 years	1(16.6%)
> 5 years	1(16.6%)
Emergency surgery, n (%)	
Yes	2(33.3%)
No	4(66.6%)

LVEF: Left ventricular ejection fraction. NYHA: New York Heart Association.

The following procedure was performed in five cases: after the femoral vessels were dissected and cannulated, the patient was placed on cardiopulmonary bypass, and body temperature was lowered until ventricular fibrillation was induced. Sternotomy was performed and the distal aorta was clamped; the false aneurysm was incised and antegrade cardioplegia was established. In one patient, in whom reoperation was due to pseudoaneurysm formation at the distal suture line of the conduit, cardiopulmonary bypass was established from the right atrium to the axillary artery.

Custodiol was used as cardioplegic solution in all the cases. Total circulatory arrest was necessary in one patient.

The pseudoaneurysm was located in the aortic suture line in five cases (Table 2); one of them was the patient in whom a valved conduit had been implanted in the proximal suture line, adjacent to the roof of the left atrium. In the sixth patient, who had been operated on of an atrial septal defect, the false aneurysm developed at the site of aortic cannulation (Figure 2).

The pseudoaneurysm was incised in the six patients and was resected in five of them. The aorta was repaired with a Dacron patch in four patients. In the remaining patient, the aorta was stitched again and covered with the components of the false aneurysm. In the sixth patient, the aortic prosthesis and the ascending aorta were replaced by a valved conduit, with reimplantation of the left coronary artery ostium and right coronary artery revascularization with a saphenous vein graft.

Cardiopulmonary bypass time was of 210.00 \pm 121.82 min (range: 118-380) and cardiac arrest time was of 134.66 \pm 72.27 min (range: 70-240); A total circulatory arrest of 34 minutes was necessary in only one patient (see Table 2). The longest times corresponded to a patient who had undergone mitral valve and aortic valve replacement three months before and was transferred to our institution with severe

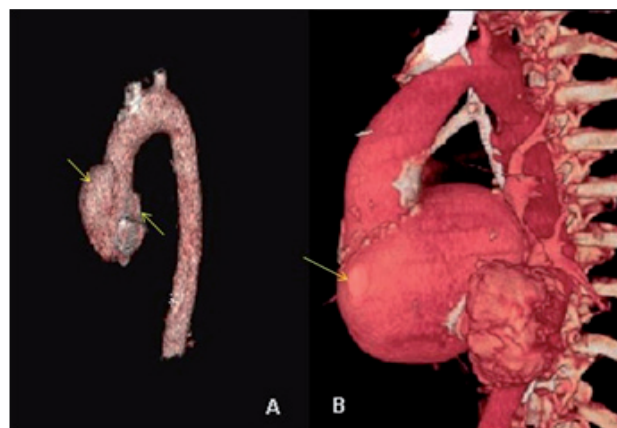


Fig. 1. Contrast-enhanced computed tomography. **A.** Two aneurysmal sacs, one related to the anterior aortic suture line, and another smaller and posterior. **B.** Giant pseudoaneurysm discovered 17 years after aortic valve replacement.

hemodynamic instability. When the heart was exposed, a pseudoaneurysm was found with signs of active infection and highly friable tissues. Resection of the aortic root and of the aortic prosthesis with insertion of a valved conduit was not possible due to the patient's critical condition. Cardiopulmonary bypass support was necessary in several occasions before weaning from the heart-lung machine.

Five patients were extubated within the first 12 hours following surgery (see Table 2) and were transferred to a general ward within 48 hours. The sixth patient could not be weaned from mechanical ventilation and died at the intensive care unit 72 hours after surgery. All the patients completed four weeks of intravenous antibiotic therapy during hospitalization.

Postoperative complications occurred mainly in the patient who could not be extubated; the other patients evolved with practically no complications. One patient

presented atrial fibrillation with rapid ventricular response that was successfully treated with intravenous amiodarone and another had fever that lasted four-days and recovered without additional therapy.

Only one patient died (see Table 2), representing an in-hospital mortality of 16.66%. This is the patient previously mentioned, who was admitted with a critical condition, presented a very complex anatomy, required intraoperative and postoperative inotropic support and died three days after surgery due to multiple organ failure. The other patients had a favorable outcome after surgery and were discharged.

During follow-up in the out-patient clinic (see Table 2), a female patient was readmitted due to fever and peripheral infarctions. Prosthetic aortic valve endocarditis was diagnosed. The patient underwent emergency surgery and died one day after. The survival rate of our patients undergoing surgery for pseudoaneurysm of the ascending aorta was of 66.6% at one year.

The remaining patients are currently without physical disability (New York Heart Association FC I-II); three of them are active workers and one female patient is retired but does not present functional limitations. One of these patients underwent computed tomography scan after 6 months, which did not show recurrence of the aortic pseudoaneurysm (Figure 3). The patient is still being followed-up after 6 years of surgery and annual transthoracic echocardiographies do not show abnormalities.

DISCUSSION

Pseudoaneurysm of the ascending aorta is an infrequent complication following cardiovascular surgery, interventional procedures or trauma. The most common sites of pseudoaneurysms are aortotomy lines, (4) aortic cannulation sites (5) proximal anastomoses of saphenous vein grafts conduits, (6) and, less frequently, aortic suture lines after heart transplantation (7) and prosthetic valves with infective endocarditis. They are considered potentially lethal due to the risk of sudden rupture, thrombosis or fistulization to adjacent structures. Pseudoaneurysms may produce respiratory symptoms due to bronchial or tracheal compression and obstruction, with brassy cough, wheezes and pneumonitis secondary to obstruction. Rarely, a lethal aortobronchial fistula may develop with the risk of massive bleeding. (8) Dysphagia may occur due to esophageal compression, although this complication is more common in aneurysms of the descending aorta. Massive hematemesis has also been described due to aorto-esophageal fistula. (9) Compression of vascular structures as the superior vena cava and pulmonary artery, or even of the chest wall, may also occur. (10) Therefore, aortic pseudoaneurysm should be suspected in any patient with a history of cardiovascular surgery presenting a pulsatile chest wall mass of recent onset or superior vena cava syndrome. Fistulizations to cardiac chambers as the right atrium (11) and the right ventricle have also been reported.

Table 2. Intraoperative and postoperative variables

Variables	
Bypass time, mean \pm SD	210.00 \pm 121.82 (118-380)
Anoxic cardiac arrest time, mean \pm SD	134.66 \pm 72.27 (70-240)
Circulatory arrest time	1 case (34 min)
Site of Pseudoaneurysm, n (%)	
Anterior aortic suture line	5(83%)
Cannulation site	1(16.6%)
Intubation time n (%)	
\leq 12 hours	5(83%)
$>$ 12 hours	1(16.6%)
ICU stay, n (%)	
\leq 48 hours	5(83%)
$>$ 48 hours	1(16.6%)
Mortality, n (%)	1(16.6%)
1-year survival, n (%)	4(66.6%)

SD: Standard deviation. ICU: Intensive Care Unit.

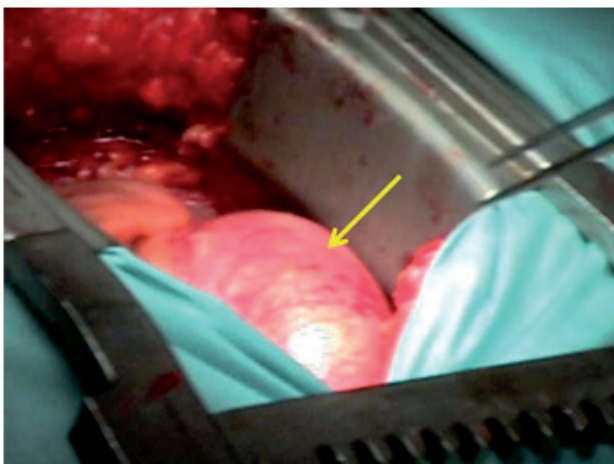


Fig. 2. Pseudoaneurysm developed at the site of aortic cannulation. Picture taken during surgery.

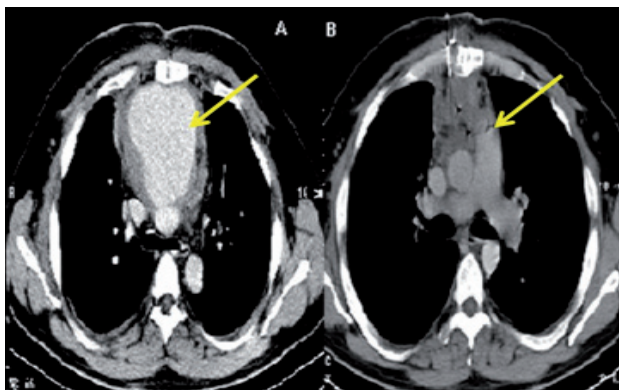


Fig. 3. Computed tomography scan of a pseudoaneurysm of the ascending aorta. **A.** Before surgery where the pseudoaneurysm is shown. **B.** After surgery, where the image shown in A is no longer seen.

(12)

Aortic pseudoaneurysms are a challenge for cardiovascular surgeons, starting from cannulation and continuing with chest opening, the choice of cardiopulmonary bypass method, the decision of employing circulatory arrest and if this procedure is adopted, whether brain protection is to be used. In addition, the surgical technique is another challenge, depending on the patient's hemodynamic status and anatomy, and on the operator's behavior. (13) Lethal intraoperative bleeding has been reported due to aneurysm rupture during median sternotomy. Thus, femoro-femoral cardiopulmonary bypass with hypothermic circulatory arrest has been suggested to protect the brain and systemic perfusion before opening the chest. (14-19) There were no complications related with resternotomy in our study, as imaging studies provided previous information of the pseudoaneurysm morphological characteristics. Similarly, cardiopulmonary bypass was started and temperature was cooled down before sternotomy in case of risk of vascular injury. Oscillating saw was used for chest reopening to prevent fatal bleeding.

In the current study, the incidence of fever was greater than that reported by other publications, as the prestigious study published in 2010 including 43 cases during a 15-year follow-up period, (20) which reported that most patients were asymptomatic ($n = 23$). However, history of previous aortic valve replacement in 93% of the patients, prevalence of male gender, computed tomography scan as diagnostic method, ejection fraction and the femoral approach for cardiopulmonary bypass were similar to our results. The location of pseudoaneurysms in the proximal and distal suture lines of the ascending aorta and the aortic arch in patients with previous vascular grafts was also similar to our findings. On the contrary, operative times and mortality differed from our findings, though it must be borne in mind that the afore mentioned study included a highly experienced center in which thoracic aorta surgery has become a routine practice. However,

our results are consistent with those of other known series, as the one published in 2004 by Dumont et al., from the Department of Surgery, Research Center of the Montreal Heart Institute and the University of Montreal, (21), which reported a mortality rate of 18% in 11 patients with pseudoaneurysm of the aorta using circulatory arrest and deep hypothermia.

The results of the present study are acceptable in terms of operative mortality and one-year survival, considering the severity of these entities, and the anatomical conditions of these patients, with one or more previous cardiac surgeries with manipulation of the aorta, and usually distorted and friable tissues. We also consider that these patients should be intervened by highly experienced staff, as surgery of pseudoaneurysm of the aorta includes a series of constant and safe decisions that should be always taken into account to prevent the development of postoperative complications or death.

RESUMEN

Tratamiento quirúrgico de los pseudoaneurismas posquirúrgicos de la aorta ascendente. Seguimiento a corto y a mediano plazos

Introducción

Los pseudoaneurismas posquirúrgicos de la aorta ascendente constituyen una complicación grave de la cirugía cardiovascular, que en la mayoría de los casos se presenta luego de procedimientos de recambio valvular aórtico y de revascularización miocárdica, aunque suelen aparecer en pacientes que han sido sometidos a otras intervenciones quirúrgicas con manipulación de la aorta, traumas e infecciones. En un período de 7 años, en el Servicio de Cirugía Cardiovascular del Hospital Hermanos Ameijeiras estudiaron y se operaron seis casos consecutivos de pseudoaneurisma posquirúrgico de la aorta ascendente. Se analizaron variables relacionadas fundamentalmente con el diagnóstico y con los procedimientos quirúrgicos, así como su evolución y seguimiento ulterior. El 83,4% de los pacientes tenían el antecedente de sustitución valvular aórtica; la fiebre fue el síntoma de mayor incidencia y la localización más frecuente fue el sitio de la aortotomía de la cirugía anterior. El procedimiento quirúrgico de mayor empleo fue la aortoplastia con parche sintético. La mortalidad hospitalaria fue del 16,66% y la supervivencia al año, del 66,66%.

Palabras clave > Aorta - Aneurisma, falso - Cirugía - Estudios de seguimiento

Conflicts of interest

None declared.

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