

Clinical, imaging and surgical variability of postoperative pseudoaneurysm of the ascending aorta: Report of three cases

Oswaldo Valdés-Dupeyrón^a✉, MD, MSc; Manuel Nafeh-AbizReck^a, MD; Alejandro Villar-Inclán^a, MD; Raiza Hernandez-Núñez^a, MD; Rolando N. Carballo-Hidalgo^a, MD; Katina Rodríguez-Rey^a, BS; and Jean L. Chao García^b, MD, MSc

^a Department of Cardiovascular Surgery. Hermanos Ameijeiras Hospital. Havana, Cuba.

^b Department of Cardiovascular Surgery. Center for Medical and Surgical Research. Havana, Cuba.

Este artículo también está disponible en español

ARTICLE INFORMATION

Received: January 24, 2014
Accepted: February 18, 2014

Competing interests

The authors declare no competing interests

Acronyms

PSA: pseudoaneurysms
TEE: transesophageal echocardiography
TTE: transthoracic echocardiography
CT: computed tomography
CPB: cardiopulmonary bypass
ICU: intensive care unit

On-Line Versions:
Spanish - English

✉ O Valdés Dupeyrón
Edif. 331, Apto. 22
Rpto. Camilo Cienfuegos
Habana del Este CP 11700
La Habana, Cuba.
E-mail address:
osvaldovaldes@infomed.sld.cu

ABSTRACT

The postoperative pseudoaneurysms of the ascending aorta present varied clinical symptoms, and range from asymptomatic forms to severe toxic infectious cases or a rupture. They also show diversity with regard to location, time of occurrence after the first surgery and surgical findings. Three cases of patients who underwent surgery at the Department of Cardiovascular Surgery of the Hermanos Ameijeiras Hospital over a four-year period are reported. The first case is that of a patient who underwent atrial septal defect surgery and days after the surgical closure presented with a fever. The second case was a patient who was diagnosed with pseudoaneurysm three months after an aortic valve replacement surgery, with the only antecedent of repeated febrile episodes; and the third is a patient who had undergone aortic coarctation surgery and the following year underwent aortic valve replacement, then, 17 years later, presented with chest pain, fatigue and loss of consciousness. The postoperative aortic pseudoaneurysms are a challenge for all cardiology and cardiovascular surgery departments as they show a great variety in their forms of clinical-surgical presentation.

Key words: Pseudoaneurysm, Ascending aorta, Clinical variability, Surgical treatment

Variabilidad clínica, imagenológica y quirúrgica del pseudoaneurisma posquirúrgico de la aorta ascendente. Informe de tres casos

RESUMEN

Los pseudoaneurismas posquirúrgicos de la aorta ascendente presentan un cuadro clínico muy variado, y se manifiestan desde una forma asintomática hasta un cuadro tóxico infeccioso grave o la rotura. También expresan diversidad en cuanto a localización, tiempo de aparición posterior a la primera cirugía y hallazgos quirúrgicos. Se presentan tres casos operados en el Servicio de Cirugía Cardiovascular del Hospital "Hermanos Ameijeiras", en un período de cuatro años. El primero es un paciente operado de comunicación interauricular que días después de su cierre quirúrgico comenzó con un cuadro febril. El segundo caso es una paciente que tres meses posteriores a

una cirugía de sustitución valvular aórtica se diagnostica el pseudoaneurisma, donde se recoge, como único antecedente, cuadros febriles a repeticiones; y el tercero, es un enfermo que había sido intervenido de coartación aórtica y al año siguiente, de reemplazo de la válvula aórtica; 17 años más tarde comenzó con dolor precordial, astenia y pérdida de conciencia. Los pseudoaneurismas posquirúrgicos aórticos constituyen un desafío para todos los servicios de cardiología y cirugía cardiovascular, pues muestran gran variedad en sus formas de presentación clínico-quirúrgicas.

Palabras clave: Pseudoaneurisma, Aorta ascendente, Variabilidad clínica, Tratamiento quirúrgico

INTRODUCTION

Postoperative pseudoaneurysms (PSA) of the ascending aorta are a serious complication of cardiovascular surgery. Despite its low incidence, diagnosis must be accurate because they have a high mortality rate.

The aorta, in spite of the thinness of its wall, can resist a pressure of thousands of millimeters of mercury without tearing. However, when its integrity is damaged in cardiac surgery, diagnostic and therapeutic endovascular procedures¹, as well as in open and closed chest trauma, direct or indirect lesions may occur in one of the layers of the aorta, which leads to the formation of aneurysms, dissection or rupture²⁻⁴. The main mechanism in the genesis of the false aneurysm is the disruption of some of the layers of the artery, which is contained by the remaining layers and adjacent structures, with or without the development of the neointima. The most common locations are: the line of the aortotomy scar; the site of aortic cannulation, cardioplegy, clamping; the anastomosis of vein grafts and vascular prostheses; and, less frequently, in the aortic sutures after cardiac transplant and infective endocarditis of valve prosthesis⁵⁻⁸.

A primary infectious origin in the aorta is very rare, although cases of vascular involvement by contiguity or hematogenous spread have been described, especially in a previously diseased aorta, causing a small transmural perforation, with hematoma formation that forms the wall of the pseudoaneurysm^{8,9}. Usually, this infection is due to septic processes in pre-existing aneurysms, dissemination of an aortic valvular bacterial endocarditis or prosthetic materials that have been infected. These so-called mycotic aneurysms may be caused by countless pathogens, not only fungi, and are typically fast-forming and fast-growing due to the weakness aortic wall⁹.

The cases of three patients who underwent surgery with a diagnosis of pseudoaneurysm of the ascending

aorta over a four-year period (June 2004 to June 2008), at the Cardiovascular Surgery Department of the Hermanos Ameijeiras Hospital, are reported.

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

The information was collected through a review of medical records, operative reports and the anesthesia and perfusion sheets of the patients.

CASES REPORT

Case 1

Male patient, 37 years old, who underwent surgery in 2004 due to ostium secundum atrial septal defect, which required an autologous pericardial patch. In the immediate postoperative, the patient presented with a fever, therefore, additional testing were performed. The white blood cell count showed a predominance of polymorphonuclears. The transthoracic echocardiography (TTE) and transesophageal echocardiography (TEE) suggested the possibility of patch dehiscence due to endocarditis. The fever disappeared and the patient was discharged.

A week later the patient returned with constant cough, marked fatigue and leg edema. A chest radiography (**Figure 1**) showed a widened mediastinum, something that was not present in previous studies. An emergency TEE was also performed; it showed an aneurysm of the right atrium due to the dehiscence of the pericardial patch implanted in the atrial septal defect. With this result, it was decided to perform a contrasted computed tomography (CT) scan (**Figure 2**) that showed the existence of a mediastinal mass in front of the heart, which originated in the ascending

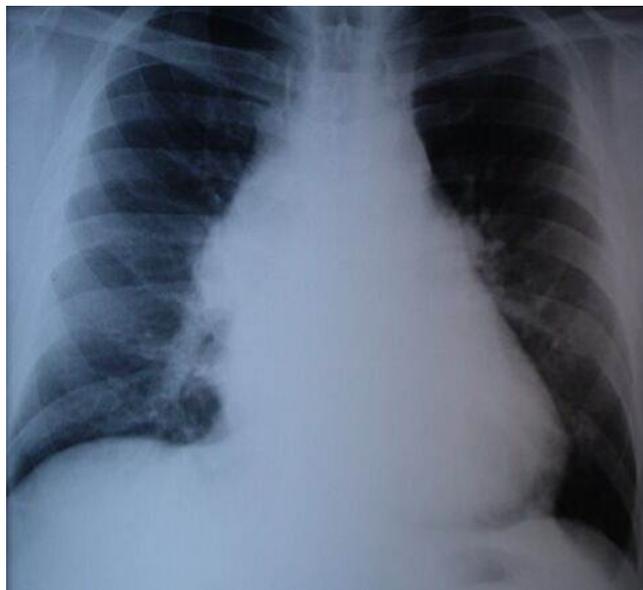


Figure 1. Postero-anterior chest radiography showing mediastinal widening.

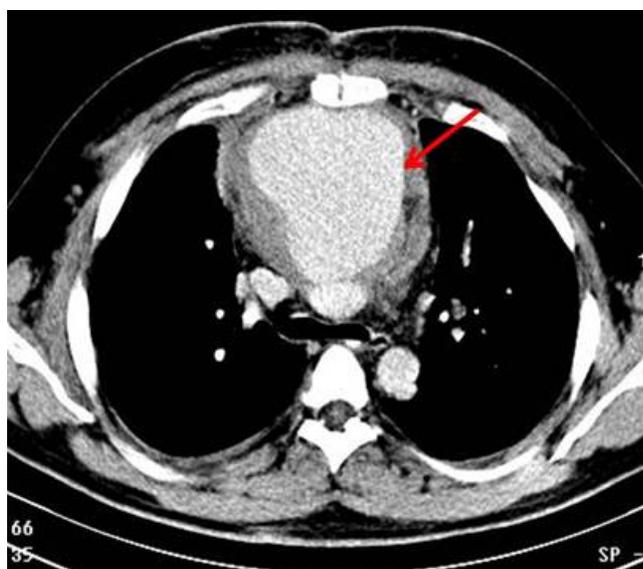


Figure 2. Contrasted helical CT scan showing an aneurysmal area at the level of the ascending aorta (arrow).

aorta, with contrast passing from the lumen to the mass. The possible diagnosis of postoperative pseudoaneurysm was discussed by the medical team and an emergency surgery was decided.

In the operating room, the femoral vessels were dissected and cannulated, cardiopulmonary bypass

(CPB) was started and temperature was decreased until causing ventricular fibrillation. A median sternotomy was performed and a septic aneurysm of the thoracic aorta was found, starting from the area of the aortic cannulation during the first operation.

After ruling out the possibility of a right atrium aneurysm and patch dehiscence, the elements of the false aneurysm were resected and the aorta was repaired with a Dacron patch. The aortic clamp was removed and the heart started beating spontaneously. The patient was removed from CPB, with 165 minutes of aortic clamping time and 220 minutes of CPB time. The patient was extubated early and had a stay of 48 hours in the intensive care unit (ICU), with a favorable outcome.

Case 2

Female patient, 40 years of age, who underwent aortic valve replacement surgery in May 2007 and was reoperated for severe pericardial effusion. Two months later she presented with a fever that did not recede with antibiotic treatment. For this reason it was decided to admit her to hospital in order to conduct further studies. A TTE and a CT scan of the mediastinum were performed, which led to a diagnosis of aneurysm of the ascending aorta. The following day, a contrasted CT scan was performed (**Figure 3**), which showed a pseudoaneurysmatic dilatation of the ascending aorta at the supra-avalvular level, including the ostium of the left coronary artery and occupying the anterior and left lateral plane; furthermore, a smaller mass was observed in the posterior plane. For all the above, an emergency surgery was decided.

In the operating room, the femoral vein and artery were cannulated. Temperature was lowered to induce ventricular fibrillation and a sternotomy was performed. The false aneurysm was dissected and aortic clamping was performed in the ascending aorta, distal to the aneurysm and close to the supra-aortic trunks. The PSA was punctured and a cardioplegic solution was administered. Then, the aneurysmal sac was opened and a dehiscence of the anterior aortic suture was found.

The prosthetic valve and coronary ostia were explored, which were not included in the false aneurysm. It was decided to rebuild the previous suture, which was reinforced with elements of the aneurysmal sac. The clamp was removed and a spontaneous heartbeat

occurred. However, after 10 minutes the patient developed ventricular fibrillation, which was successfully treated with internal defibrillation. On the first attempt to leave of the CPB, there was a decreased in blood pressure, therefore a support bypass was performed for 25 minutes. It was possible to suspend the CPB, although the patient required support with dobutamine and epinephrine. The time of aortic clamping and CPB were 106 and 210 minutes, respectively. The patient was later moved to the ICU, where she was extubated at 14 hours and had a positive outcome. The patient was discharged at day 30, after completing the recommended antibiotic treatment.



Figure 3. Contrast CT scan with two aneurysmal sacs.

Case 3

Male patient, 53 years of age, with a history of having undergone surgery for coarctation and aortic valve replacement in 1990 and 1991, respectively. He came to our hospital 17 years later due to oppressive chest pain and loss of consciousness in three occasions. He was admitted to hospital, and imaging studies were conducted. The TEE showed an aneurysmal dilatation of the ascending aorta, beginning at the aortic root immediately at the level of the sinuses of Valsalva

(aortic root 87 mm). The mechanical prosthetic aortic valve was functioning normally, without periprosthetic leak. The chest CT scan showed a PSA of the ascending aorta, which involved the sinuses of Valsalva. The left anterior descending artery showed calcification on its route, but no significant lesions. The aneurysm measured 10 x 10 cm in its greatest diameter. Also, the contrasted CT scan showed an aneurysm of the ascending aorta that arose above the aortic valve prosthesis and involved the coronary sinus, without defining the ostium of the coronary arteries.

The aneurysm, measuring 95 x 96 x 103 mm, produced a marked compression of the left atrium (**Figure 4A**) and showed calcified atheromatous plaques on the right side wall. No signs of dissection or associated thrombosis were evident. In addition, a coarctation of the aorta was visualized (**Figure 4B**), approximately 15 mm from the emergence of the left subclavian artery, with a lumen of 14 mm. With these results, an emergency surgery was decided

In the operating room, a femoro-femoral cannulation was performed, and CPB was started. The temperature was lowered to cause ventricular fibrillation and a median sternotomy was performed. A giant PSA was found immediate to the valve plane, displacing the right ventricle. It was decided to remove the prosthesis, root and part of the ascending aorta. A valved tube, number 23, was implanted, with reimplantation of the left coronary ostium; in addition, the right coronary artery was revascularized with a saphenous vein graft. Then, the aortic clamp was removed and ventricular fibrillation occurred. An internal defibrillation was performed and an idioventricular rhythm appeared, so a pacemaker was placed. It was possible to separate the patient from CPB with dobutamine support, 7 mcg/kg/minute. CPB time and aortic clamping time were 350 and 184 minutes, respectively.

The patient was moved to the ICU where he remained for 48 hours and had a favorable surgical outcome.

COMMENT

The variability of the PSA begins with its etiopathogenesis, although aortic valve replacement remains the main cause. Mohammadi *et al*¹¹ and Atik *et al*¹² suggest that PSA formation after aortic surgery, in the presence of dissection, is probably because of the fragility of the tissues.

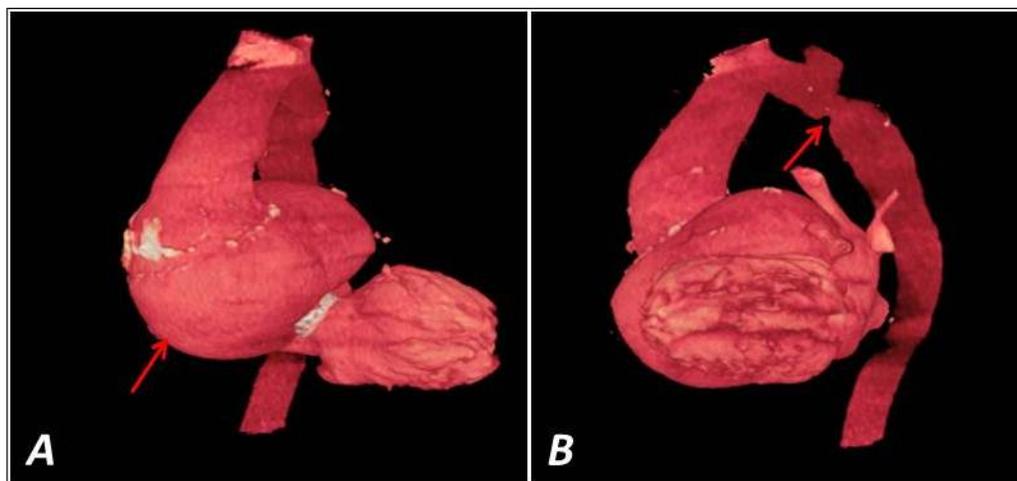


Figure 4. Contrast-enhanced CT scan. **A.** Giant PSA (arrow) occupying the sinuses of Valsalva and the aortic root. **B.** Besides PSA, residual coarctation of the aorta (arrow) is observed.

Regarding the clinical symptoms, there is a great diversity in their presentation. Many diagnoses are made with routine tests in asymptomatic patients. In a multicenter study in three European countries¹³, including 43 cases that underwent surgery for aortic PSA, 23 of them had no symptoms when they were diagnosed by CT scan. Other series showed a higher number of symptomatic cases with a predominance of chest pain and signs of heart failure^{12,14}.

In these three cases, the three patients had symptoms suggestive of the disease, with prevalence of fever in two of them. Moreover, these conditions may cause respiratory symptoms due to compression and bronchial or tracheal obstruction, and, less frequently, an aorto-bronchial fistula may occur, with massive hemorrhage. PSA may also be accompanied by dysphagia, due to esophageal compression, or hematemesis due to an aorto-esophageal fistula⁵⁻⁸. Similarly, when its growth is significant, it usually compresses other structures such as the superior vena cava and the pulmonary artery, including the chest wall, making it difficult a posterior surgical approach¹⁵.

With regard to the time between primary surgery and the diagnosis of the disease, postoperative PSA may appear days, months and even years after surgery. Malvindi *et al*¹³ had a mean of 98 months, ranging between 2 and 452 months. In other series^{11,12,14}, this period ranged from about 2 to 6 years, approximately.

In the current paper, the three patients showed a clinical diversity, as one of them presented with PSA days after surgery, another one three months after

surgery and the last one had the disease diagnosed 17 years after surgery.

Concerning the place of formation of the PSA, which was discussed in the introduction, there is dissimilarity. Imaging studies are the cornerstone to corroborate clinical thinking in these situations. The TEE, CT scan and magnetic resonance imaging are the most widely used diagnos-

tic techniques. In our hospital, the CT scan is the imaging pattern in all surgical diseases of the aorta, regardless of the diagnosis with another complementary technique¹⁶.

The treatment of PSA is exclusively surgical, and almost always is of extreme emergency. One of the principles that the surgical team should take into account, prior to surgery, is to have an understanding of the anatomical conditions of the PSA through imaging studies. Subsequently, the anesthesiologist, the perfusionist and the surgeon plan the strategy, in order to minimize the possibility of accidents during surgery. With regard to sternotomy, several studies raise a number of variants^{5,11,14,16-20}, all of them in cardiopulmonary bypass, with a lesser or greater degree of hypothermia, with or without ventricular fibrillation, but always with the purpose of making the opening of the chest under the most optimal conditions.

Moreover, the use of circulatory arrest with a supra-aortic vessel cannulation for antegrade cerebral protection is a safe alternative in the treatment of complex aortic PSA. In our hospital, all the above described variants are performed. In the last ten years, axillary and carotid arteries cannulation was introduced as a method of antegrade cerebral protection with excellent results.

The surgical techniques used are also diverse and depend mainly on the general condition of the patient and the morphological characteristics of the PSA. When tissues are very friable or damaged, a radical

replacement technique should be performed, such as the use of vascular prostheses (valved or non-valved prostheses), provided that the patient's condition allows it. Conversely, if the false aneurysm is small, localized, away from the valve plane, with normal-appearing surrounding tissue, then a repair technique should be performed, with or without prosthetic material. In addition, our hospital is working on incorporating endovascular procedures, which have been used in the PSA of the ascending aorta for the last few years²⁰⁻²².

CONCLUSIONS

The clinical, imaging and surgical variability of post-operative PSA of the ascending aorta entails that the clinical-surgical treatment be entrusted to the most experienced medical staff in these conditions. The diagnosis and treatment of PSA include a set of consistent and safe decisions, which, if not made correctly, would lead to the occurrence of complications or death.

REFERENCES

1. Van der Wal H, Van Geel PP, De Boer RA. Mycotic aneurysm of the aorta as an unusual complication of coronary angiography. *Eur J Vasc Endovasc Surg.* 2008;36(2):178-81.
2. Schmoker JD, Miller DC. A simple trick for repairing coronary pseudoaneurysm complicating a Bentall operation. *Ann Thorac Surg.* 2002;74(1):268-70.
3. Pomes H, Trainini JC, Volman S, Mauro V, Sampó E, Hershson A, *et al.* Consenso de patología de la aorta. *Rev Argent Cardiol.* 2004;72(5):387-401.
4. Vaccarino GN, Piccinini FF, Nacinovich F, Delli Carpini L, Dorsa A, Navia DO. Seudoaneurisma de la aorta ascendente luego de reemplazo valvular aórtico: una emergencia quirúrgica. *Rev Argent Cardiol.* 2005;73(4):308-10.
5. Valdés O, Céspedes G, Mederos B, Pupo P. Pseudoaneurisma de la aorta ascendente después de sustitución valvular aórtica. *Medisur [Internet].* 2010 [citado 2011 Ene 12];8(3):[aprox. 3p.]. Disponible en: http://scielo.sld.cu/scielo.php?pid=S1727-897X2010000300013&script=sci_arttext
6. Gabbieri D, Dohmen PM, Linneweber J, Lembcke A, von Heymann C, Konertz WF. Mycotic pseudoaneurysm of the ascending aorta at site of aortic cannulation. *Asian Cardiovasc Thorac Ann.* 2008;16(2):e15-7.
7. Konia M, Uppington J, Moore P, Liu H. Ascending aortic pseudoaneurysm: a late complication of coronary artery bypass. *Anesth Analg.* 2008;106(3):767-8.
8. Escribano P, López F, Delgado JF, Sotelo T, Aguado JM, Rodríguez E. Aneurisma micótico en la línea de sutura aórtica tras el trasplante cardíaco. *Rev Esp Cardiol.* 2000;53(10):1403-5.
9. Martínez-Vázquez C, Nodar A, Crespo M, Seijas M, Cid D, López A, *et al.* Pseudoaneurisma micótico por *Mycobacterium tuberculosis*. *An Med Interna.* 2001;18(11):594-6.
10. del Cueto H. Aneurisma disecante de aorta ascendente. *MEDISAN [Internet].* 1998 [citado 2011 Ene 12];2(Esp.):30-72. Disponible en: http://bvs.sld.cu/revistas/san/vol2_s_98/esp03198.pdf
11. Mohammadi S, Bonnet N, Leprince P, Kolsi M, Rama A, Pavie A, *et al.* Reoperation for false aneurysm of the ascending aorta after its prosthetic replacement: surgical strategy. *Ann Thorac Surg.* 2005;79(1):147-52.
12. Atik FA, Navia JL, Svensson L, Vega PR, Feng J, Brizio ME, *et al.* Surgical treatment of pseudoaneurysm of the thoracic aorta. *J Thorac Cardiovasc Surg.* 2006;132(2):379-85.
13. Malvindi PG, van Putte BP, Heijmen RH, Schepens MA, Morshuis WJ. Reoperations for aortic false aneurysms after cardiac surgery. *Ann Thorac Surg.* 2010;90(5):1437-43.
14. Settepani F, Muretti M, Barbone A, Citterio E, Eusebio A, Ornaghi D, *et al.* Reoperation for aortic false aneurysm: our experience and strategy for safe re-sternotomy. *J Card Surg.* 2008;23(3):216-20.
15. Bachet J, Pirotte M, Laborde F, Guilmet D. Reoperation for giant false aneurysm of the thoracic aorta: how to reenter the chest? *Ann Thorac Surg.* 2007;83(5):1610-4.
16. Valdés Dupeyrón O, Villar Inclán A, Nafeh Abiz-Reck M, Pedroso J, Guevara González L, Chao González N, *et al.* Tratamiento quirúrgico de las enfermedades de la aorta ascendente. Estudio de tres años. *RACCV.* 2011;IX (1):47-59.
17. Kirsch EW, Radu NC, Mekontso A, Hillion ML, Loisanse D. Aortic root replacement after previous surgical intervention on the aortic valve, aortic root, or ascending aorta. *J Thorac Cardiovasc Surg.* 2006;131(3):601-8.
18. Malvindi PG, van Putte BP, Heijmen RH, Schepens

- MA, Morshuis WJ. Reoperations on the aortic root: experience in 46 patients. *Ann Thorac Surg.* 2010; 89(1):81-6.
19. Emamina A, Amirghofran AA, Shafa M, Moaref A, Javan R. Ascending aortic pseudoaneurysm after aortic valve replacement: watch the tip of the cardioplegia cannula! *J Thorac Cardiovasc Surg.* 2009;137(5):1285-6.
20. Dumont E, Carrier M, Cartier R, Pellerin M, Poirier N, Bouchard D, *et al.* Repair of aortic false aneurysm using deep hypothermia and circulatory arrest. *Ann Thorac Surg.* 2004;78(1):117-20.
21. Kannan BR, Jain AK, Qureshi SA, Rothman MT, Rosenthal E, Mathur A. Successful exclusion of large post-surgical pseudoaneurysm of the ascending aorta by a percutaneous approach. *Ann Thorac Surg.* 2009;87(4):1281-4.
22. Kpodonu J, Wheatley GH, Ramaiah VG, Rodriguez JA, Strumpf RK, Diethrich EB. Endovascular repair of an ascending aortic pseudoaneurysm with a septal occluder device: mid-term follow-up. *Ann Thorac Surg.* 2008;85(1):349-51.