Giant pseudoaneurysm on left ventricular posterolateral wall with an orifice between papillary muscles

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Abstract

A left ventricular pseudoaneurysm develops when myocardial rupture is contained by the pericardium. Although left ventricular pseudoaneurysm has been a topic of discussion since the pioneering days of open heart surgery, it still remains a technical challenge in reconstructive cardiac surgery. Reoperation following pseudoaneurysm repair is also frequent. We report surgical treatment in two patients with a pseudoaneurysm on the left ventricular posterolateral wall. The pseudoaneurysm and left ventricular cavity communicated at a point just between the anterolateral and posteromedial papillary muscle attachments. Such a manifestation is highly infrequent but potentially lethal. During aneurysmectomy, special attention was paid to avoid the development of mitral regurgitation because the papillary muscle geometry changes after removal of the pseudoaneurysm. In both cases, surgical decision-making was facilitated by preoperative assessment using electrocardiographic-gated multislice computed tomography.

Keywords: Left ventricular aneurysm • Mitral regurgitation • Mitral valve repair • Imaging modality

INTRODUCTION

The mortality rate of patients with a left ventricular (LV) pseudoaneurysm is 23% in those treated surgically and 48% in those treated medically [1]. In a series from the Cleveland Clinic, four of 24 patients underwent reoperation after pseudoaneurysm repair, two for a recurrent pseudoaneurysm, one for a residual ventricular septal defect and one for progression of coronary artery disease [2]. Owing to its variety of aetiology and clinical presentation, pseudoaneurysm cannot always be repaired by aneurysmectomy alone, but requires an integrated strategy to deal with concomitant disease.

Case 1

A 67-year old man with a history of coronary artery disease experienced exertional angina and was referred to our institution. Echocardiography showed an LV ejection fraction (LVEF) of 35% and end-diastolic diameter (LVEDD) of 58 mm, whereas mitral regurgitation (MR) was Grade I. An electrocardiographic-gated multislice computed tomography (MSCT) revealed a pseudoaneurysm measuring 65 × 48 × 108 mm originating from the LV posterolateral wall. The neck was located between the two papillary muscle attachments on the LV wall (Fig. 1A and B). LV end-diastolic volume index (LVEDVI) and end-systolic volume index (LVESVI) were 236.2 and 212.8 ml/m², respectively. As a result of significant volume shift into the aneurysm, there was a paradoxical increase in the aneurysmal volume from 120.9 ml/m² in end-diastole (AnEDVI) to 133.3 ml/m² in end-systole (AnESVI). Mitral valve morphology was assessed on MSCT and the coaptation distance was 9.4 mm (Supplementary Fig. S1). The mitral valve was considered to be tethered because of the volume shift into the pseudoaneurysm in systole. Angiography showed double-vessel coronary artery disease affecting the left anterior descending artery and the right coronary artery. EuroSCORE II was 1.78%. Thus, the patient was electively scheduled for aneurysmectomy and coronary artery bypass grafting (CABG). Through a median sternotomy, because the heart was strongly adherent to the pericardium, the aneurysmal sac was opened after cardiac arrest. Inside the sac, a neck of size 6 × 3.5 cm was identified between the two papillary muscles without organic change. We performed aneurysmectomy, patch closure of the neck using a Dacron patch equivalent in size to the defect and CABG. The patient was discharged home on post-operative day 10 and was still alive without a sign of pseudoaneurysm recurrence or development of MR more than 2 years after the operation.

Case 2

A 35-year old man with no prior medical history presented with progressive orthopnoea over the previous 5 days. On admission, New York Heart Association functional class was IV and echocardiography revealed an LV aneurysm, which resulted in a moderate degree of MR with an LVEF of 30%. A CT scan showed a 73 × 74 × 60 mm posterolateral LV aneurysm. An emergency catheter study showed total occlusion of the left circumflex artery and the right
coronary artery. On repeat MSCT after transfer to our institution, the pseudoaneurysm was seen to originate between the two papillary muscle attachments, and the thinned posteromedial papillary muscle showed scar-like changes (Fig. 2). LVEDVI/LVESVI was considerably increased (304.5 and 256.5 ml/m², respectively). AnEDVI and AnESVI were 124.1 and 137.2 ml/m², respectively. Mitral valve inter-commissural diameter of 55 mm and interpapillary distance of 55 mm were highly increased. Mitral valve coaptation depth was 16 mm. EuroSCORE II was 13.10%. Owing to the clinical symptoms and severe coronary stenosis, the operation was urgently performed. Cardiopulmonary bypass was established with bicaval cannulation and the pseudoaneurysm was opened. Through the neck, the posterior papillary muscle and the connecting chordae showed elongation. The size of the LV defect was approximately 8 × 8 cm and we applied a 6 × 4 cm knitted Dacron patch to approximate the interpapillary muscle distance. The mitral valve with annular dilatation was exposed through a right-sided left atriotomy. We performed an undersized posterior annuloplasty and CABG. The patient was transferred to the postoperative care unit with an intra-aortic balloon pump, which was removed on the fourth postoperative day. Postoperative MSCT showed a mitral valve coaptation distance of 13 mm. The inter-commissural diameter and the interpapillary distance were reduced to 35 and 43 mm, respectively. Three months after discharge, the LVEDD and the LVEF were still 73 mm and 30%, respectively, on echocardiography with no residual MR, but the patient’s physical condition was good, with tolerance for Nordic walking.

**DISCUSSION**

A pseudoaneurysm arising between two papillary muscles has rarely been described and the morbidity of such a location was otherwise unknown. MRI has been considered a gold standard approach for assessing the LV pseudoaneurysm, but recently MSCT has been widely employed. Electrocardiographic-gated MSCT allows unrestricted reconstruction of primary three-dimensionally acquired data sets. High spatial resolution of up to 0.6 mm and time resolution of up to 75 ms permits a detailed analysis of cardiac anatomy, including valve anatomy and function. Although echocardiography is the most common tool for evaluating MR, the submitral apparatus is hardly visualized. In the present cases, MSCT led to a better understanding of the characteristics of the pseudoaneurysm involving the papillary muscles as a basal component of the aneurysm.

Preoperative mitral valve coaptation depth of 11 mm or greater was reportedly associated with a higher recurrence rate of functional MR [3]. As MSCT showed, loss of contractility of the papillary muscle and coaptation depth of 16 mm in Patient 2 were the key findings for performing concomitant mitral surgery. We used an undersized

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**Figure 1:** Multislice computed tomography (MSCT) scan imaging and intraoperative picture of Patient 1. (A) 3D MSCT reconstruction showing posterolateral left ventricular pseudoaneurysm. (B) Short-axis view demonstrating that the pseudoaneurysm communicated into the left ventricular cavity between two papillary muscle attachments to the left ventricular wall. (C and D) Intraoperative pictures demonstrating the view after (C) opening of the pseudoaneurysmal sac and (D) closure of a left ventricular defect using a Dacron patch. The aneurysmal sac is composed of pericardium. The right side of the pictures is the cranial direction. RV: right ventricle; LV: left ventricle.
patch for LV defect closure intended to approximate the interpapillary distance, whereas a patch of corresponding size was applied in Patient 1 to preserve the papillary muscle geometry. Given that the significantly increased interpapillary distance of 55 mm and the elevated LVEDVI in Patient 2 suggested less chance for reverse remodelling after surgery, we applied a patch of 6 × 4 cm concomitant with the undersized mitral annuloplasty because too small a patch might cause further dislocation of the papillary muscles.

In conclusion, such cases are extremely rare, but preoperative considerations that include MSCT could help in defining the surgical approach. Although the level of evidence is not sufficient on the basis of only two cases, we believe that this experience adds to current knowledge.

**SUPPLEMENTARY MATERIAL**

Supplementary material is available at ICVTS online.

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**REFERENCES**


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**Figure 2:** Pre- and postoperative imaging of Patient 2. (A) Preoperative multislice computed tomography (MSCT) scan and (B) postoperative MSCT imaging demonstrating reduction of the interpapillary muscle distance after surgery. (C) Intraoperative transoesophageal echocardiogram before aneurysmectomy showing dilatation of the mitral annulus resulting in a moderate degree of mitral regurgitation. (D) Transthoracic echocardiogram taken 9 days after operation showing no mitral regurgitation. RV: right ventricle; LV: left ventricle; LA: left atrium.