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Perioperative ST-segment Elevation Myocardial Infarction during Mitral Valve Annuloplasty: Role of Early Angiography

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Abstract

latrogenic myocardial infarction is a rare complication of valve surgery, most commonly mitral valve replacement. Few cases have been described related to mitral annuloplasty and none have been reported when using minimally invasive valve repair. We present two cases of iatrogenic acute ST-segment elevation myocardial infraction after surgical repair of the mitral valve and prosthetic annuloplasty, one of them after minimal invasive surgery. Emergent cardiac catheterization was performed suggesting different underlying mechanisms. We discuss possible mechanisms, prevention and management of this rare but important complication, highlighting the role of early angiography to elucidate the cause and guide the strategy.

Introduction

Surgical mitral valve (MV) repair for posterior leaflet prolapse is associated with low operative risk and excellent long-term survival [1]. Operative techniques continue to evolve and newer less invasive approaches are been used with increasing frequency in experienced centers [2].

Iatrogenic acute myocardial infarction (AMI) after mitral valve surgery is unusual and the various potential mechanisms may be incompletely understood [3-5]. We describe two cases of peri-operative AMI after MV repair and annuloplasty, reporting for the first time AMI as a complication of a minimal invasive approach. In both cases emergent cardiac catheterization was crucial to elucidate the possible mechanism and guide the best management strategy.

Case 1

In December 2010, a 75 year old lady with symptomatic, chronic severe mitral regurgitation (MR) was referred for elective MV repair. Pre-operative echocardiography confirmed severe MR due to posterior





leaflet (PMVL) prolapse and no wall abnormalities were noted. Coronary angiography showed a left-dominant system with no apparent atherosclerotic disease. At hemisternotomy, surgical examination did not confirm PMLV prolapse; instead peri-operative TEE suggested mitral regurgitation was due to annular dilatation. Annuloplasty was undertaken with implantation of a 28mm Carpentier-Edwards Physio II ring (Edwards Lifesciences LLC; Irvine, Calif). On cessation of bypass, transesophageal echocardiography (TEE) showed a good result for the valvular repair, but inferior and lateral wall hypokinesia with a paced rhythm on the electrocardiogram (ECG). In the cardiovascular intensive care unit, the pacemaker was stopped to reveal ECG evidence of acute inferolateral myocardial infarction (AV block, ST elevation in leads II, III, aVF, I, aVL, V5, and V6). Unfortunately, re-activation of the pacemaker induced ventricular fibrillation, as first pacemaker stimuli fell in the vulnerable period (Figure 1). This resolved with of DC cardioversion (3 x 200 joules). The patient developed hypotension (blood pressure 85/40 mmHg) that was responsive to medication (dobutamine). Emergency coronary angiography was undertaken, revealing sub-total occlusion of the proximal left circumflex artery (Cx) before the origin of the obtuse marginal branch and a total occlusion after it, near the ring delineating the mitral annulus (Figure 2 and Figure 4). Percutaneous revascularisation was performed dilating with progressively larger diameter balloons (1.5 x 20mm and 3 x 15mm) (Figure 3). Complete expansion was achieved but because of the elastic recoil of the dilated segment, 2 overlapping bare metal stents (3 x 15 and 3.5 x 18 mm) were implanted and post-dilated a high pressure, covering the entire injured segment. The global ischemia time was 2 hours and 20 minutes with CPK pick of 3650 UI/L and ultrasensitive troponine more than 10.000ng/dl. During the subsequent 48 hours hemodynamic stabilization was achieved and inotropic support was gradually weaned.

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Figure 2: Postoperative coronary angiogram shows subocclusion of the proximal tract of the coronary circumflex artery before the emergence of the obtuse marginal branch and a total occlusion after it. Few mm from the circle that indicates the mitral annulus.



Figure 3: Percutaneous coronary intervention of dominant left circumflex artery. b and d) Balloon dilatation $(1.5 \times 20 \text{mm and } 3 \times 15 \text{mm})$. e) 2 overlapped bare metal stents (3 x 15 and 3.5 x 18 mm) were implanted successfully.



Figure 4: Right anterior oblique caudal projection after angioplasty and stenting of the mid and proximal circumflex artery.



Figure 5: a) Post-operative electrocardiogram, showed a ST segment elevation on leads II, III, aVF, with a specular reflexion on leads V1, V2 and aVL, suggestive of acute inferoposterior myocardial infraction. b) Post-angiograpgy **b)** and first 24 hours **c)** EKG gradually normalized.



Figure 6: Post-operative angiography control did not show significant coronary stenosis with TIMI flow III.

Serial echocardiography showed gradual but incomplete recovery of global LV systolic function (LVEF 45%) with no mitral incompetence. The patient was discharged from hospital on the 14th postoperative day, the ECG showing preserved rS waves in lead III and a small q wave in aVF. After surgery the patient was fully anti-coagulated for 3 months. With the bare metal stent, dual antiplatelet therapy was also recommended with clopidogrel, 75 mg daily, for at least 1 month, and aspirin 75 mg lifelong.

Case 2

One week after first case, a 41 year-old woman was admitted for elective MV repair for severe symptomatic MR secondary to PMVL prolapse. In this case the patient underwent minimally invasive right thoracotomy. Cardiopulmonary bypass was begun through right femoral access. The left atrium was opened through an incision parallel to the interatrial groove. PMVL (P1 and P2) prolapse secondary to P2 chordal rupture was confirmed with co-existing mitral annular dilatation. Posterior leaflet prolapse was treated without resection Citation: Vaquerizo B, Serra A, García-Picart J (2011) Perioperative ST-segment Elevation Myocardial Infarction during Mitral Valve Annuloplasty: Role of Early Angiography. J Clinic Experiment Cardiol 2:136. doi:10.4172/2155-9880.1000136

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(3 neochordae) and annular application was performed. A 30 mm Carpentier-Edwards Phisio II annuloplasty ring (Edwards Lifesciences LLC; Irvine, Calif) was implanted. A saline test confirmed adequate coaptation but TEE showed posterior akinesia and inferior hipokinesia associated with ECG changes of acute inferoposterior myocardial infarction (Figure 5a). In the postoperative period the patient was hemodynamically unstable with blood pressure 90/60mmHg under vasoactive drugs (norepinephrine and dopamine) and taken for emergency coronary angiography 1 hour 45 minutes after EKG changes were detected. The angiogram demonstrated a right dominant system with no angiographically apparent lesion (Figure 6). The subsequent postoperative course was good with normalization of the ECG during the first 24 hours (Figure 5b and Figure 5c), but significantly elevated cardiac enzymes (CPK pick 3534 UI/L and ultrasensitive troponine 4593 ng/dl). The patient was discharged from hospital day 8th, at which time transthoracic echocardiography showed severe inferior and discrete lateral hypokinesis. Left ventricular ejection fraction was of 41% with mild to moderate MR. In case 2, according to standard protocol after mitral valve repair and prosthetic annulopasty the patient was anti-coagulated for the first 3 months after surgery and prescribed aspirin lifelong.

Discussion

Degenerative mitral valve disease is the most common indication for surgical mitral valve intervention, affecting around 2% of the population⁶. The most common cause of degenerative MR is leaflet prolapse with leaflet malcoaption.

Mitral valve repair is superior to valve replacement both in terms of peri-operative morbidity and mortality and long-term survival [7]. Minimally invasive approaches, including right sided minithoracotomies, have been developed in the last decade in many expert centers [8].

Peri-operative MI is a potential complication of any cardiac surgery and the etiology may be uncertain. The precise incidence in patients undergoing mitral valve repair is not well reported and the phenomena is less well documented when minimally invasive approaches are used [7,9].

In the two cases of peri-operative STEMI described, early cardiac catheterization was crucial to find the underlying mechanism and to guide treatment. In Case 1 iatrogenic occlusion of the dominant Cx artery was repaired with angioplasty and stent implantation. There are relatively few references to this complication in the literature [3-

5] most of which have occurred during mitral valve replacement and been attributed to the inadvertent suture of dominant or co-dominant circumflex [10]. Because of the proximity of the Cx to the annulus and anterolateral commisure, the Cx is prone to injury during MV replacement or surgical annuloplasty (Figure 7). Anatomic studies have documented that in patients with a left dominant coronary system, the Cx courses much closer to the posterior mitral annulus [10]. The typical distance of 8.4mm in patients with right coronary dominance is reduced to around 4 mm, in patients with a left dominant system. Sutures securing the annular ring are more likely to distort or frankly injure the left Cx artery in these patients. There are various other possible mechanisms of injury [5] and in this case the probable cause was severe distortion of the dominant Cx by the annular sutures. This hypothesis is supported by the fact that complete expansion of the injured segment was achieved through balloon angioplasty whilst the occluded vessel did not respond to vasodilators and no thrombus was observed. Fixed mechanical-suture of the vessel, coronary artery spasm or thrombotic occlusions are therefore all less likely. Preservation of the mitral repair and early revascularization was accomplished successfully by PCI in this case. It is important to note that if the underlying mechanism had been inadvertent suture of the vessel, the likelihood of wiring the occluded vessel and opening it by PCI is improbable and the results are unpredictable.

Case 2 was unusual in that inferior STEMI occurred in a patient with right dominant system and this is the first description using a minimally approach. An emergent coronary angiography showed no significant coronary lesion and the patient's ST-segment elevation rapidly normalized (Figure 6). Other causes of AMI after surgical procedures involving the mitral valve to be considered here are coronary embolism and coronary spasm.

Coronary artery air embolism during open heart surgery can produce the same clinical scenario (ie, ECG changes, hemodynamic instability and regional wall motion abnormalities) as a direct mechanical circumflex injury. Obarski et al. [7] hypothesized that air embolism into right coronary artery (RCA) can occur when the surgeon manually tries to test the competence of the repaired MV (filling the left ventricle with fluid under pressure). With the patient supine the ostium of the RCA is anterior to the aortic root and left ventricle. During insuflation, air introduced into the left ventricle or aortic root is forced under pressure up into the RCA. In addition inadequate left ventricle venting during closure of the left atrium can lead to air trapping in the ventricle [7].

Another possible explanation could be excessive traction on the RCA during retraction of the left atrium causing transient spasm. The main method of differentiating air embolism or spasm from fixed iatrogenic coronary injury is, as in our case, emergency coronary angiography to rule out significant fixed mechanical obstruction. The only other differentiating factor is that for air embolism and spasm the observed ECG changes are usually reversible with time. In this case differentiating between resolved air emboli or spasm is nearly impossible.

It is notable that even without a fixed mechanical coronary injury or obstruction in case 2 perioperative STEMI was confirmed in both cases with consequent reduction in previously normal LV systolic function. Finally there is no information about what kind of medical treatment including antiplatelet therapy would need at follow-up, these patients who have suffered a perioperative MI. We think that, as we do not have studies about that, it could be individualized depending on the underlying mechanism and its acute treatment. Citation: Vaquerizo B, Serra A, García-Picart J (2011) Perioperative ST-segment Elevation Myocardial Infarction during Mitral Valve Annuloplasty: Role of Early Angiography. J Clinic Experiment Cardiol 2:136. doi:10.4172/2155-9880.1000136

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Conclusions

In conclusion, mitral valve surgery even with a minimally invasive approach carries a risk of iatrogenic myocardial infarction. In order to reduce its frequency, the course of the Cx should be verified at angiography and considered in every patient thereby potentially avoiding maneuvers that increase the risk damage to this vessel. Our cases also illustrate a role for early coronary angiography inpatients with ECG changes, new wall-motion abnormalities on TEE, hemodynamic instability or ventricular irritability, all of which may be related to coronary injury after annulopasty. In these cases angiography could be crucial to suggest mechanisms that may be resolved rapidly by PCI.

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