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CASE REPORT

Systolic Anterior Motion: An Illustrative Case and Discussion of Management Strategy

Amit Bardia, Balachundhar Subramaniam

ABSTRACT

Systolic anterior motion (SAM) of the mitral leaflets can lead to hemodynamic instability following mitral valve repair. Perioperative echocardiography plays a crucial role in the management of SAM. Perioperative echocardiography helps to (a) identify patients at high risk for SAM before repair, (b) assess SAM and diagnose severity and (c) follow-up management efficacy. An illustrative case is shown in this report to take the reader through the current management strategy of SAM following mitral valve repair.

Keywords: SAM, Mitral repair, Myxomatous.

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INTRODUCTION

Systolic anterior motion (SAM) of the mitral leaflet can occur after mitral repair or aortic valve replacement. It can also be a reason for hemodynamic instability in critically ill patients. Echocardiography is a readily available tool to detect and change management strategy during hemodynamic instability. Here, we present different case scenarios and discuss the management pathway in a cardiac surgery setting.

CASE REPORT

A 52-year-old male (70 inches tall, weighing 86 kg and body mass index of 27) with a known history of mitral regurgitation was being followed by his cardiologist with serial transthoracic echocardiography (TTE). He was preoperatively on pravastatin alone. He had no other systemic illness and had good exercise tolerance. During follow-up, he was noted to have a sudden change in exercise tolerance. His exam included a repeat TTE that showed severe mitral regurgitation (Fig. 1) with normal systolic function by echocardiography. His cardiac catheterization revealed clean coronaries. Subsequently, mitral valve surgery was planned.

His intraoperative transesophageal echo examination revealed normal biventricular systolic function. His mitral valve exam showed a flail P2 segment with an anteriorly directed eccentric jet consistent with severe mitral regurgitation. Anterior mitral leaflet was 3.4 cm, posterior mitral leaflet was 1.5 cm and coaptation point-septum (C-sept) distance was 2.4 cm (Fig. 2).

He underwent a resection of P2 segment followed up approximation of the resected edges. A 30 mm Physio II annuloplasty ring was placed. The anterior leaflet was large, floppy and showed Barlow's disease characteristics. The anterior leaflet was not addressed during this repair.

His postoperative exam revealed SAM, mostly chordal with a resting peak gradient of 15 mm Hg across the left ventricular outflow tract (LVOT) (Fig. 3). This was

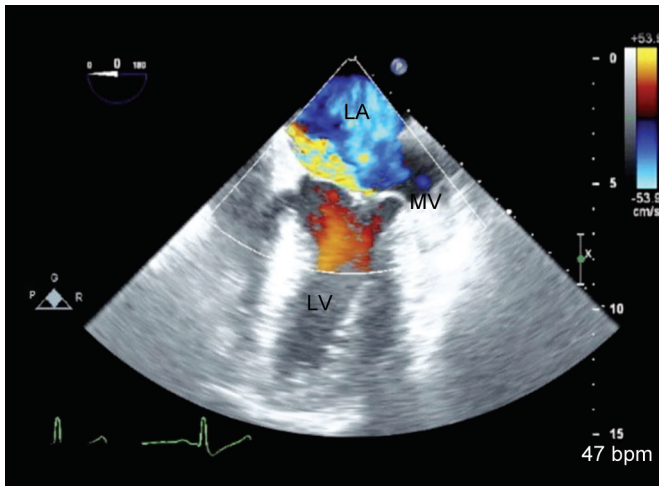

Fig. 1: TEE four-chamber view showing severe, eccentric mitral regurgitation prior to repair (MV: Mitral valve; LA: Left atrium; LV: Left ventricle)

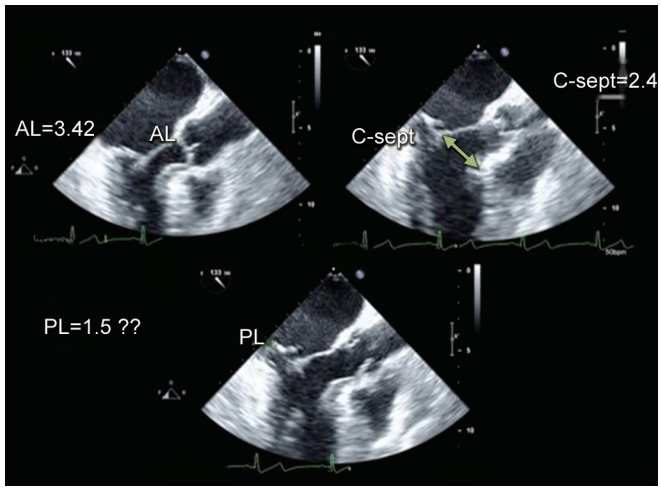

Fig. 2: TEE showing the mitral valve and the LVOT. The ruptured chord made it difficult to correctly assess the length of posterior leaflet (AL: Anterior leaflet of the mitral valve; PL: Posterior leaflet of the mitral valve)

associated with a severe mitral regurgitation. He had a good cardiac output 2 l/min/m^2 and a heart rate of 85/min. He was taken to the ICU and was extubated in 3 hours. First postoperative day showed a clinically normal patient with sternotomy wound, heart rate of 82 beats per minute, blood pressure range of 100/50 to 125/66 mm Hg, oxygen saturation of 99% with oxygen by nasal prongs 2 l/min, CVP of 8 mm Hg, pulmonary artery pressures 40/20 mm Hg and a cardiac index of 3 l/min/m^2.

He had episodes of desaturation, hypotension, and increased systolic murmur on postoperative day 2. He was managed with intravenous fluids, vasopressors. Inotropes and diuretics were strictly avoided. His vitals on postoperative day 2 were heart rate of 72/min, blood pressure range of 130/70 to 146/80 mm Hg, CVP 3, CI 3 l/min/m^2 and oxygen saturation of 93% with a facemask (oxygen flows up to 10 l/min). His repeat TTE showed a resting LVOT peak gradient of 55 mm Hg and a hyperdynamic LV with ejection fraction of 75% (Figs 4 and 5). He had a weight gain of 9 kg. He was scheduled for repeat mitral surgery the next day.

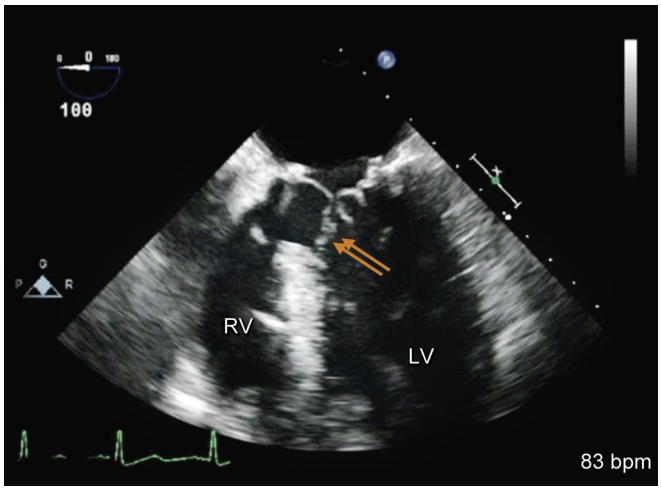

Fig. 3: TEE four-chamber view showing chordal SAM (arrows) (RV: Right ventricle; LV: Left ventricle)

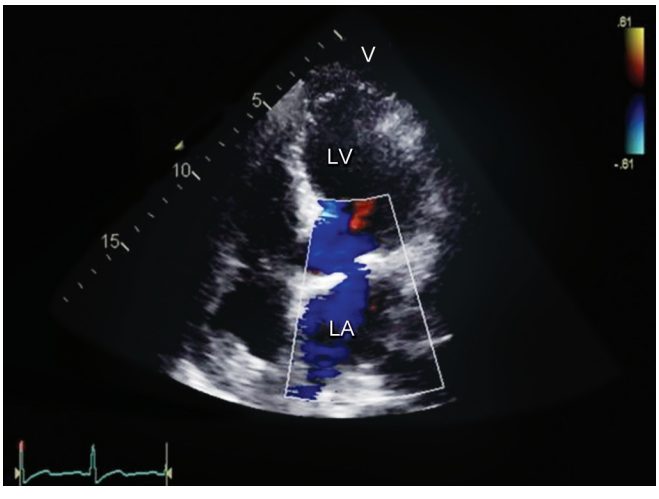

Fig. 4: TTE showing mitral regurgitation, a component of SAM (LA: Left atrium; LV: Left ventricle)

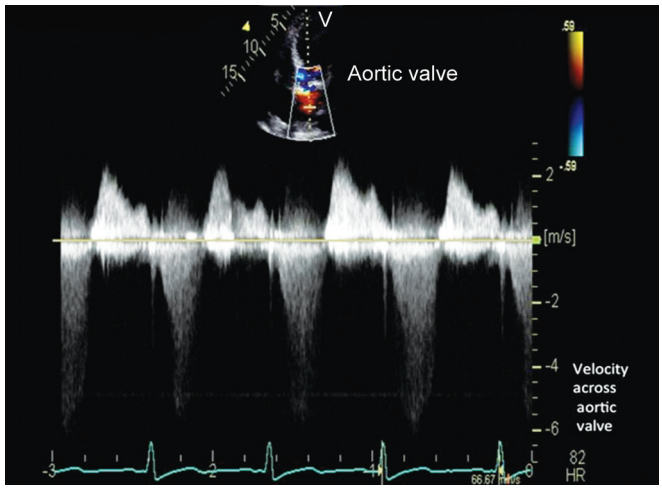

Fig. 5: TTE elevated velocities and thereby elevated resting peak gradient across the LVOT

In the operating room, an attempt was made to avoid mechanical valve (given his age and subsequent anticoagulation as he was a firefighter. There was further resection of the P2 segment and a sliding plasty to P1 was performed to reduce the height of posterior leaflet to no more than 3 mm. A 32 mm Physio II ring was placed this time to accommodate the larger floppy diseased anterior leaflet. The repair was retested and found to be intact with no regurgitation upon filling of the left ventricle with saline. An attempt was made to come off bypass with this repair. He again showed dynamic LVOT gradients despite slowing down the heart rate and filling up the heart nicely. This was a significant SAM and a decision was made to replace with valve. A 27 mm mechanical mitral valve was placed (Fig. 6). He was separated successfully from cardiopulmonary bypass and discharged home on 5th postoperative day.

DISCUSSION

SAM is defined as displacement of distal portion of the anterior leaflet of the mitral valve toward LVOT during

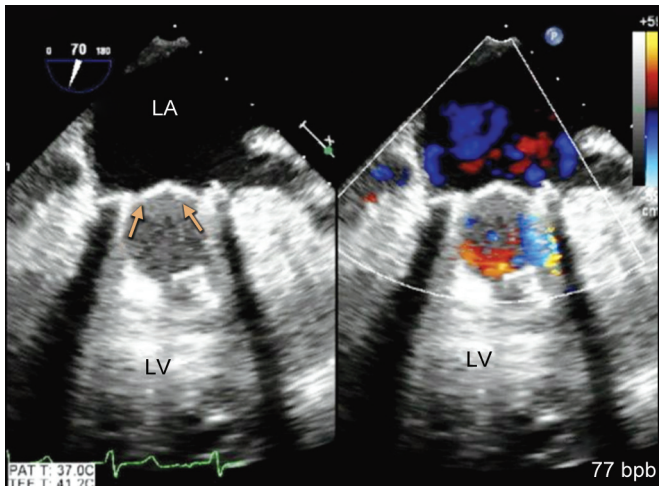

Fig. 6: TEE showing new mechanical mitral valve (arrows) with no regurgitation (LA: Left atrium; LV: Left ventricle)

systole. The incidence is described to be about 6 to 11%. SAM is common especially after mitral valve prolapse repairs. The mechanism is said to be due to both push (drag the leaflet into the LVOT) and pull (venturi effect) phenomenon.[1] SAM is said to be severe if the LVOT gradient is more than 50 mm Hg and/or mild MR or greater. Otherwise, it is described as mild SAM (LVOT gradient less than 50 mm Hg and/or trivial MR).

Predictors of SAM

Risk factors can be patient or surgical technique factors. A narrow aortomitral angle, bulging left ventricular septum and a hyperdynamic left ventricle can potentially lead to SAM.[2] Excessive posterior leaflet tissue after surgery and an undersized annuloplasty ring relative to anterior leaflet size could also potentially lead to SAM after surgery.[3] Maslow et al in their work tried to use echocardiography to predict patient dependent factors. The ratio of anterior leaflet (AL) and posterior leaflet (PL) defined as AL/PL < 1.0 and a C-sept (cooptation point to the most prominent part of the septum) < 2.5 were very good predictors of SAM following mitral valve surge.

Management of SAM

Different groups have proposed their experiences in the management of SAM that occurs following surgery. The most important question is when to intervene with another repair or replacement of the mitral valve. The Mount Sinai group had followed up a large number of patients with mitral valve surgery.[4]

Operating Room Management

From their series,[4] if the posterior leaflet height was <15 mm and if the mitral ring was sized appropriately, inotropes should be weaned in patients with SAM following mitral surgery. Preload should be increased, tachycardia should be avoided and MAP should be kept around 80 to 90 mm Hg with vasopressor support. If the SAM persists, the degree of SAM should be assessed. If it was mild, chest should be closed and patient should be observed in the intensive care unit (ICU). A repeat echocardiogram should be done on day 2/3. Beta-blockade should be commenced as soon as possible. Severe SAM should be addressed surgically before leaving the operating room. They strongly advocate keeping the coaptation depth of the mitral valve less than 10 mm with ink test[4] during cardiopulmonary bypass (CPB).

Intensive Care Unit Management

Repeat echocardiogram in the ICU if shows mild SAM, beta-blocker therapy with a follow-up echocardiogram in 6 weeks is recommended. If there is severe SAM in the ICU, they advocate beta blockade, allowing hypertension, avoiding diuretics, administering fluids for the next 48 hours and observe. If there is persistent severe SAM, returning to operating rooms to re-repair the mitral valve or replacement is recommended.

Other Management Strategies

Another group has described their observation in 608 patients undergoing mitral repair [5] out of which 60 patients had SAM. Out of these, 40 patients had easy to revert SAM. If the SAM reverted to mild or normal with intravascular volume expansion and/or stopping the inotropic drugs, it was described as easy to revert SAM. In those 20 patients who had persistent SAM with the above strategy, increasing afterload with manual compression of ascending aorta was performed by the surgeon in the operating room. Beta blockade (esmolol 1 mg/kg) was administered simultaneously. If the severity decreased (was seen in 15 patients), they were classified as difficult to revert SAM. They were observed in the ICU and managed with beta blockade, intravenous fluids and no inotropy in the ICU. TEE was done before extubation in these patients. In the remaining five patients, immediate surgical management was performed. They advocate their approach as a clinical management strategy for patients with SAM following mitral repair.

CONCLUSION

Systolic anterior motion (SAM) is a frequent complication arising after mitral valve repair or aortic valve replacement. Arising from a mismatch between the size of the mitral valve leaflet and the valve ring apparatus, SAM can clinically cause significant hemodynamic compromise postoperatively. Various echocardiographic parameters, such as AL/P and C-sept, have been used to predict SAM. Initial medical management includes increasing preload and maintaining adequate afterload with avoidance of tachycardia, inotropes and diuretics. However, reoperations involving re-repair or valve replacement may often be required in cases of severe SAM. Many studies have proposed protocols to address management of SAM but a standard consensus is still lacking.

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ABOUT THE AUTHORS

Amit Bardia (Corresponding Author)

Clinical Fellow, Department of Anesthesiology, Harvard Medical School, Boston, MA, USA, e-mail: abardia1@bidmc.harvard.edu

Balachundhar Subramaniam

Associate Professor, Department of Anesthesiology, Harvard Medical School; Director of Cardiac Anesthesia Research, Beth Israel Deaconess Medical Center, Boston, MA, USA