Delayed-Onset Systolic Anterior Motion of the Mitral Valve After Aortic Valve Replacement for Severe Aortic Stenosis

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SUMMARY

Systolic anterior motion (SAM) of the mitral valve after aortic valve replacement (AVR) for severe aortic stenosis (AS) is one of the causes of perioperative left ventricular outflow tract (LVOT) obstruction in older patients. A 90-year-old woman underwent AVR with a 19-mm bioprosthesis for symptomatic aortic valve stenosis. Preoperative transthoracic echocardiography (TTE) showed left ventricular hypertrophy, with LVOT obstruction and mild mitral regurgitation (MR). Intraoperative transesophageal echocardiography and postoperative TTE showed that the degree of MR was unchanged after surgery. The patient’s postoperative course was uneventful. However, she developed shortness of breath 6 months after discharge. A subsequent TTE showed significant LVOT obstruction and SAM, which resulted in moderate to severe MR. Because of the patient’s advanced age, cibenzoline was administered to decrease the left ventricular pressure gradient (LVPG) and improve the left ventricular diastolic function. Two months after administration of cibenzoline, a TTE showed decreased LVPG, trivial MR, and the absence of SAM. This case clearly demonstrated that cibenzoline improved the SAM of the mitral valve that arose after AVR for AS in a remote postoperative period. (Int Heart J 2013; 54: 292-296)

Key words: Left ventricular outflow tract obstruction, Aortic valve stenosis, Cibenzoline

Case Report

A 90-year-old woman (weight, 41.8 kg; height, 144 cm), who had complained of shortness of breath and palpitations due to severe AS, was referred to our hospital for AVR. Transthoracic echocardiography (TTE) showed a calcified, immobile aortic valve with peak and mean pressure gradients of 129 and 82 mmHg, respectively. The left ventricular (LV) end-diastolic and systolic diameters were 37 and 20 mm, respectively, with an ejection fraction (EF) of 78%. During diastole, the thickness of the interventricular septum was 16 mm and that of the posterior wall was 14 mm. The left ventricle showed secondary hypertrophy with a significant LVOT pressure gradient of 20 mmHg. Mitral regurgitation (MR) was mild, and no significant SAM was observed. Angiography showed normal coronary arteries.

During AVR, her heavily calcified leaflet was removed and replaced with a 19-mm Carpentier-Edwards Perimount Magna aortic bioprosthesis (Edwards LifeSciences, Irvine, CA, USA), with supra-annular placement in the aortic position. Intraoperative transesophageal echocardiography, performed before weaning from cardiopulmonary bypass (CPB), showed mild MR and the absence of significant obstruction of the LVOT (Figure 1). Thus, weaning from CPB was uneventful. Surgery was completed without any complications. The patient was extubated 3 hours after the surgery.

TTE was performed on the 11th postoperative day, and demonstrated concentric hypertrophy, normal LV function (EF, 74%), and no significant deterioration of MR grade. Although the cardiologist noted slight worsening of the mitral valve SAM and LVOT obstruction (the LVOT pressure gradient was 47 mmHg) (Figure 2A–B), there was no evidence of hemodynamically significant SAM, MR, or LVOT obstruction during the postoperative period. The patient demonstrated steady recovery and was discharged on the 20th postoperative day.

Although the postoperative course went well, the patient again developed shortness of breath 6 months after discharge. A physical examination revealed that her blood pressure was...
133/83 mmHg, and her heart rate was 97 bpm and regular. She was categorized under functional class III heart failure, according to the New York Heart Association (NYHA). Her TTE showed moderate to severe MR, moderate tricuspid regurgitation, pulmonary hypertension, and high intraventricular flow velocities due to significant SAM of the mitral valve. Simultaneous measurements of the left ventricular and aortic valve pressures showed a LVOT peak pressure gradient of 188 mmHg (Figure 3). The LV end-diastolic and systolic diameters were 36 and 21 mm, respectively, with an EF of 74%.

Had she not been an elderly patient, a surgical intervention, like mitral valve replacement or septal myectomy, would have been considered. However, medical therapy with cibenzoline was chosen because of her advanced age. To reduce the LVOT obstruction, 150 mg/day of cibenzoline—a class IA antiarrhythmic agent—was administered in addition to 5 mg/day of carvedilol, which was prescribed at discharge. One month after the addition of cibenzoline, the LVOT peak pressure gradient had gradually decreased to 79 mmHg. She was asymptomatic and free of any complications. An additional month later, the SAM had disappeared and TTE showed trivial MR, and no significant LVOT pressure gradient and a 30 mmHg peak aortic valve pressure gradient (Figure 4 and Table). The patient was still doing well 1 year after her surgery.

**Ethical considerations**: All procedures were followed in accordance with the guidelines of the institutional ethics review board of Kyoto Prefectural University of Medicine. The patient provided informed consent.

**Discussion**

Doppler ultrasonography-detected LV intracavity gradients are relatively common in patients undergoing AVR for severe AS.\(^1\)\(^-\)\(^3\) Although SAM with an associated LVOT gradient sometimes occurs after AVR for AS, it is rarely related to clinical symptoms. Several reports have demonstrated that LVOT obstruction, with MR resulting from SAM after AVR, leads to hemodynamic collapse. Routledge, et al\(^7\) reported a case of mitral valve replacement for MR resulting from this phenomenon. A death because of LVOT obstruction after AVR for AS has also been reported.\(^9\)

The mechanism of this phenomenon is believed to involve the reduction of LV systolic and diastolic internal dimensions and the enhancement of LV contractility during the postoperative period after AVR. This may occur because of afterload reduction caused by the relief of the AS and because of drug therapy. Intravascular volume depletion may also contribute to the smaller ventricular volumes. These factors result in narrowing of the LVOT and increased LVOT blood flow velocity. The venturi effect created by such high velocity flows may give rise to SAM of the mitral valve and LVOT obstruction, leading to severe MR.\(^5\) The most common cause is an afterload reduction caused by the relief of the AS. Hence, the published cases indicate that this phenomenon occurs before weaning the patient from the CPB and in the early postoperative period, before discharge.\(^4\)\(^-\)\(^8\) Patients who develop SAM after AVR are recommended to be managed with intravenous volume loading, reduction or discontinuation of inotropic drugs, and with increased afterload.

The risk factors for post-AVR SAM with dynamic LVOT obstruction include hypovolemia,\(^4\)\(^-\)\(^5\) inotropes, a narrow left-
ventricular cavity, perioperative use of an intra-aortic balloon pump, and a structurally abnormal mitral apparatus. The structural abnormalities may include a mitral apparatus with elongated chordae, a redundant mitral apparatus, a calcified mitral annulus, or left ventricular septal hypertrophy (sigmoid septum).

The present case had many risk factors for the development of post-AVR SAM. Therefore, the patient was carefully weaned from the CPB with aggressive volume loading to open the LVOT. Beta-blocker infusion was initiated and the catecholamine dosage was decreased, to reduce contractility, in order to prevent LVOT obstruction. Fortunately, a deterioration of SAM, LVOT obstruction, and MR were avoided, along with the hemodynamic instability that typically occurs during the postsurgical hospitalization period. However, this patient developed symptomatic congestive heart failure due to SAM deterioration, LVOT obstruction, and MR 6 months after discharge. Her TTE revealed moderate to severe MR, as mentioned earlier. The observed LVOT obstruction and accompanying left ventricular pressure gradient was clearly related to this patient’s clinical symptoms as well as to those of patients with hypertrophic obstructive cardiomyopathy. Because of the patient’s age, it was expected that dehydration could have deteriorated her symptoms and echocardiographic findings. However, the 4-mg torasemide dose that had been prescribed as a diuretic for postoperative pleural effusion was withdrawn 2 weeks after discharge because her chest X-ray revealed that pleural effusion had resolved. Thereafter, she only consumed 5 mg/day of carvedilol and did not take any drugs that may have caused LVOT obstruction. Furthermore, her physical examination, blood test, and echocardiogram findings did not indicate dehydration as a cause. Rather, LV end-diastolic diameters were smaller when SAM disappeared 8 months after discharge than at the onset of SAM (Table).

If the patient had been younger, a surgical intervention, such as a mitral valve replacement, could have been considered. For this elderly patient, medical therapy with cibenzoline—a drug widely used in hypertrophic obstructive cardiomyopathy (HOCM) patients to decrease the left ventricular pressure gradient and improve the left ventricular diastolic function—was chosen. After the initiation of this therapy, the patient gradually recovered and her symptoms were relieved, including the SAM, which disappeared after 2 months of cibenzoline treatment.

Cibenzoline, a class IA antiarrhythmic agent, has been reported to have beneficial effects on the left ventricular pressure gradient and diastolic function in patients with HOCM. Cibenzoline is a strong Na’ channel-blocking agent.
agent, which promotes a decrease in the intracellular Ca\textsuperscript{2+} concentration of cardiac myocytes\textsuperscript{15} and has a Ca\textsuperscript{2+} channel blocking action. Konishi, et al\textsuperscript{16} described a similar effect of cibenzoline injection on the left ventricular pressure gradient in a patient with a sigmoid septum.

In general, the significant reduction in left ventricular wall thickness and mass starts early and is sustained in patients undergoing AVR for AS. LV mass index (LVMI) also gradually decreases in these patients over time.\textsuperscript{17} However, we observed only limited reduction beyond the normal LVMI range in our patient until 6 months after discharge (Table). Further, this index significantly decreased after the initiation of cibenzoline treatment.

Table. Changes in Echocardiographic Findings and Parameters

<table>
<thead>
<tr>
<th>NYHA</th>
<th>Pre Operative</th>
<th>Post Operative</th>
<th>6 months (Before cibenzoline)</th>
<th>7 months (After cibenzoline)</th>
<th>8 months (After cibenzoline)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MR</td>
<td>II</td>
<td>I</td>
<td>III</td>
<td>II</td>
<td>I</td>
</tr>
<tr>
<td>Mild</td>
<td>Mild</td>
<td>Moderate to severe</td>
<td>Moderate</td>
<td>Trivial</td>
<td></td>
</tr>
<tr>
<td>AV peak PG (mmHg)</td>
<td>100</td>
<td>47</td>
<td>188*</td>
<td>79*</td>
<td></td>
</tr>
<tr>
<td>LV peak PG (mmHg)</td>
<td>20</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>LVDD/LVDs (mm)</td>
<td>37/20</td>
<td>38/24</td>
<td>36/21</td>
<td>35/21</td>
<td></td>
</tr>
<tr>
<td>EF (%)</td>
<td>78</td>
<td>67</td>
<td>74</td>
<td>72</td>
<td></td>
</tr>
<tr>
<td>IVSTd/IVTs (mm)</td>
<td>16/14</td>
<td>13/13</td>
<td>14/14</td>
<td>14/13</td>
<td></td>
</tr>
<tr>
<td>LVMI (g/m\textsuperscript{2})</td>
<td>162</td>
<td>134</td>
<td>139</td>
<td>126</td>
<td></td>
</tr>
</tbody>
</table>

NYHA indicates, New York Heart Association functional class; MR, mitral regurgitation; AV, aortic valve; LV, left ventricular; PG, pressure gradient; LVDs, left ventricular dimension at systole; EF, ejection fraction ratio (%); LVDD, left ventricular dimension at diastole; IVSTd, interventricular septal thickness at end-diastole; PWTd, posterior wall thickness at end diastole; and LVMI, left ventricular mass index. * left ventricular and aortic valve pressures were measured simultaneously because of the difficulty in separating the 2 structures.
zoline treatment. The changes in interventricular septal thickness at end-diastole and posterior wall thickness at end-diastole were also similar to those in LVMI (Table). Although the occurrence of post-AVR SAM was unexpected, the timing of improvement in the above findings and the patient’s symptoms coincided with that of the initiation of cibenzoline treatment. Moreover, no change in the patient’s prescription—except for cibenzoline since 2 weeks after discharge—was recommended; this suggests that cibenzoline was effective in improving the heart condition and played a role in improving the echocardiographic findings, especially LVOT obstruction, like in HOCM patients.

Thus, we believed that cibenzoline would also have beneficial effects in post AVR SAM cases.

The present case demonstrates 2 singular features. First, even asymptomatic SAM at discharge, after AVR, can cause functional abnormalities of the heart and clinically significant symptoms in a remote postoperative period. This phenomenon probably occurs more frequently than is reported. Furthermore, this phenomenon may occur in not only the intraoperative and early postoperative periods, as reported in previous cases, but also in the long-term postoperative period. Second, this case suggests that cibenzoline may be useful for the treatment of LVOT obstruction caused by SAM after AVR and for HOCM. Therefore, we think that cibenzoline administration before further surgical manipulation is an effective therapy for patients who develop SAM after AVR. To our knowledge, this is the first report of delayed-onset SAM, after AVR-induced LVOT obstruction that was managed by cibenzoline.

**Conclusion:** This case report describes an elderly patient who underwent aortic valve replacement and developed significant LVOT obstruction and SAM, which resulted in moderate to severe MR. Because of the patient’s advanced age, she was treated with cibenzoline, a drug more commonly used to treat HOCM. The successful resolution of her symptoms suggests that cibenzoline should be considered prior to surgical interventions in similar cases. Further, cardiothoracic surgeons and cardiologists should remember that even asymptomatic SAM at discharge, after AVR, can cause functional abnormalities of the heart and clinically significant symptoms in a remote postoperative period.

**REFERENCES**