Acute Mitral Valve Regurgitation due to Complete Rupture of Anterior Papillary Muscle Mimicking Mitral Valve Vegetation

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We report the successful treatment of a 77-year-old man after a difficult diagnosis of mitral valve regurgitation resulting from complete rupture of the anterior papillary muscle. The patient with cardiogenic shock was an emergency admission. An electrocardiogram showed acute lateral wall myocardial infarction. He had complications of leukocytosis and a high-grade fever. Transesophageal echocardiography seemed to show the appearance of a large area of vegetation attached to the anterior mitral valve leaflet and aortic non-coronary cusp, resulting in severe mitral regurgitation. We performed coronary angiography, which showed complete obstruction of the circumflex coronary artery. We determined that the condition was caused by infective endocarditis. Emergency surgery showed the complete rupture of the anterior papillary muscle, but there was no vegetation. The mitral valve was replaced with a bioprosthetic valve and the circumflex coronary artery was bypassed with a saphenous vein graft. Pathological examination revealed mitral valve to be non-mycotic, and the postoperative course was uneventful.

Key words: papillary muscle rupture, anterior papillary muscle, acute myocardial infarction, mitral valve vegetation

Introduction

Papillary muscle rupture (PMR) has been reported to occur in about 1–5% of cases of acute myocardial infarction (AMI).1) However, a complete rupture of the anterior papillary muscle, in particular, is very rare. This condition may result in acute mitral regurgitation, acute pulmonary edema, and/or cardiogenic shock.2) Sometimes it is difficult to diagnose PMR, particularly anterior PMR, using only transthoracic or transesophageal echocardiography.3) If PMR is not treated surgically, the prognosis is poor, with an approximately 80% mortality rate in the first 24 hours; nevertheless, even with surgery, the mortality rate of patients afterwards has been reported to be very high.4) Hence, we report successful surgical treatment of mitral valve regurgitation due to complete anterior PMR mimicking the echocardiographic appearance of mitral valve vegetation.

Case Report

A 77-year-old man presented to the emergency care unit with a 2-day history of chest pain and fever. At the initial clinical examination, the patient was hypoxic requiring mechanical ventilation, hypotensive with a blood pressure of 50/30 mmHg, and a pulse rate of 140 beats per minute. The chest roentgenogram showed a
normal heart size but with severe pulmonary vascular congestion. Transthoracic echocardiography showed severe mitral regurgitation (MR), resulting from mitral valve prolapse, with normal left ventricular regional and systolic function. Hematologic evaluation revealed a hemoglobin value of 19.9 g/dL and a white blood cell count of 28400/mm$^3$. Biochemical values included an elevated creatine kinase level of 1133 U/L, a CK-MB level of 136 U/L, an aspartate aminotransferase level of 129 U/L, and a lactate dehydrogenase level of 547 U/L. Despite high-dose administration of catecholamine, intra-aortic balloon pumping (IABP) and percutaneous cardiopulmonary support (PCPS) were necessary to stabilize the hemodynamic state. Emergency coronary angiography demonstrated 100% obstruction of the left circumflex artery without stenosis of the left anterior descending artery or the right coronary artery (Fig. 1). Transesophageal echocardiography (TEE) indicated 2 large and mobile masses attached to the anterior mitral leaflet and aortic non-coronary cusp (Fig. 2). Together with the presence of fever, leukocytosis, and echocardiographic findings, the patient was suspected to have acute MR caused by infective endocarditis, and embolization of the left circumflex artery by vegetation. Since most acute cases of MR causing an unstable hemodynamic state require emergency surgery, we decided on immediate mitral valve replacement (MVR) surgery with coronary artery bypass grafting (CABG). We preformed a median sternotomy and cardiopulmonary bypass by arterial cannulation of the aorta and venous cannulation of both the superior and inferior vena cava. Since we suspected infective endocarditis in the aortic and mitral valves, the aorta was opened and examined first; the aortic valve showed no evidence of vegetation first; the aortic valve showed no evidence of vegetation. After a trans-septal approach, we examined the ruptured head of the anterior papillary muscle; it also showed no vegetation (Fig. 3). The prolapsed anterior leaflet was excised completely, but the posterior leaflet was preserved. After MVR with a Carpentier-Edwards 27M prosthetic valve, aortic declamping was performed to shorten the cardiac arrest.

Fig. 1 Coronary angiography demonstrates 100% obstruction of the left circumflex artery without stenosis of the left anterior descending artery.

Fig. 2 Transesophageal echocardiography indicates 2 large and mobile masses moving freely in the left ventricle during diastole and a mobile mass prolapsing into the left atrium during systole. Arrow indicates mobile masses. LA; left atrium, LV; left ventricle.
time. Then, we performed on-pump beating bypass to the posterior lateral branch with a saphenous vein graft. Histopathologic examination demonstrated no mycosis but showed acute coagulation necrosis of the anterior papillary muscle. Postoperatively, the patient was weaned from PCPS after 1 day and IABP after 3 days. The postoperative course was uneventful, and the patient was discharged on the 60th day after surgery.

Comment

The first clinically diagnosed case of PMR was reported in 1948, and Austen et al. first reported successful MVR for anterior PMR in 1965. It has been reported that the short term mortality rate of patients was 19–27% after surgery. In the era before surgical treatment, approximately 80% of patients with PMR died within the first 24 hours, and 6% survived for 2 or more months.

The arterial supply to the papillary muscles consists of small coronary vessels derived from the large epicardial arteries. Because the posteromedial muscle has a single blood supply from the posterior descending artery, it is involved in ruptures 6–12-times more frequently than the anterolateral muscle, which has a dual blood supply from the left anterior descending and left circumflex coronary arteries.

To date, there are about 20 reported cases of successful operations for anterior PMR, published in English or Japanese and searchable in Medline (Table 1). Most cases were complete PMR, with an almost equal morbidity rate between male and female patients. The most frequent AMI sites were the left circumflex artery followed by the diagonal branch or the left anterior descending artery. In one case of PMR caused by a single lesion of the right coronary artery, we assumed that the anterior papillary muscle was perfused by a single right coronary artery. IABP was necessary for almost all cases requiring emergency surgery within a few days. Most patients underwent MVR with a prosthetic valve and half had concomitant CABG at the AMI site. Patients with partial PMR underwent mitral valve plasty. Until now, there have been few successful cases of cardiogenic shock needing PCPS in complete PMR patients.

Moustapha et al. reported a case of an AMI, solely as a complete rupture of the anterolateral papillary muscle of the mitral valve, having the echocardiographic appearance of mitral valve vegetation. For this case, we could not correctly diagnose PMR until we opened the heart because we were too dependent on the echocardiographic appearance. TEE showed 2 large and mobile masses moving freely in the same phase as a result of tachycardia; 1 mobile mass was attached to the anterior mitral valve and the other, underneath the non-coronary cusp. However, these mobile masses were a sole PMR attached to the anterior mitral valve moving freely during systole and diastole. TEE was very helpful, but there was still a misdiagnosis until open surgery. We consider that the sudden onset of cardiogenic shock 2 days after AMI was a crucial element in the present case. Even if, clinical findings and the echocardiographic appearance of vegetation were suspiciously similar to infective endocarditis, we should have, as a priority, taken account of the clinical history and suspected PMR.

Surgical treatment is necessary for this unstable condition. Even in cases of unstable hemodynamic condition requiring PCPS, it is recommended to perform coronary angiography to confirm the presence of coronary artery disease. Mitral valve repair or mitral valve surgery should be selected based on the shape of the ruptured papillary muscle. Yamanishi et al. reported that valve repair is judged to be appropriate in the case of partial PMR with a small infarction. For a complete PMR, MVR is generally preferred in view of the durability of valve tissue, because the papillary muscle itself is edematous and fragile. Considering the postoperative management and long-term risk of mortality, we thought that it would be desirable for patients to undergo concomitant CABG. When necessary, on-pump beating-heart CABG is an effective approach for managing short-duration cardiac
Table 1  Reported surgical cases of ruptured anterior papillary muscle.

<table>
<thead>
<tr>
<th>Author</th>
<th>Age (y)</th>
<th>Sex</th>
<th>Type</th>
<th>AMI site</th>
<th>IABP</th>
<th>PCPS</th>
<th>Interval Rupture to operation</th>
<th>Surgery</th>
<th>Additional CABG</th>
<th>Surgical outcome</th>
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<tbody>
<tr>
<td>Austen,4)</td>
<td>1965</td>
<td>M</td>
<td>C</td>
<td>Lateral site</td>
<td>-</td>
<td>-</td>
<td>6 days</td>
<td>MVR</td>
<td>-</td>
<td>S</td>
</tr>
<tr>
<td>Gula,12)</td>
<td>1981</td>
<td>M</td>
<td>C</td>
<td>D2 100%</td>
<td>-</td>
<td>-</td>
<td>2 months</td>
<td>MVP</td>
<td>-</td>
<td>S</td>
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<tr>
<td>Nishimura,13)</td>
<td>1983</td>
<td>F</td>
<td>P</td>
<td>RCA</td>
<td>-</td>
<td>-</td>
<td>Unknown</td>
<td>MVR</td>
<td>Unknown</td>
<td>S</td>
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<tr>
<td>Clements,10)</td>
<td>1985</td>
<td>M</td>
<td>Unknown</td>
<td>LAD, RCA</td>
<td>-</td>
<td>-</td>
<td>26 days</td>
<td>MVR</td>
<td>Unknown</td>
<td>S</td>
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<tr>
<td>Hoshino,14)</td>
<td>1993</td>
<td>F</td>
<td>C</td>
<td>LCX (#13)</td>
<td>YES</td>
<td>-</td>
<td>Immediate operation</td>
<td>MVR</td>
<td>(SJM27)</td>
<td>SVG-14PL</td>
</tr>
<tr>
<td>Kranidis,15)</td>
<td>1993</td>
<td>M</td>
<td>C</td>
<td>LCX 100%</td>
<td>-</td>
<td>-</td>
<td>unknown</td>
<td>MVR</td>
<td>(SJM29)</td>
<td>S</td>
</tr>
<tr>
<td>Moriyama,16)</td>
<td>1995</td>
<td>M</td>
<td>C</td>
<td>LCX (#12) 100%</td>
<td>YES</td>
<td>-</td>
<td>3 hours</td>
<td>MVR</td>
<td>(SJM29)</td>
<td>S</td>
</tr>
<tr>
<td>Akasaka,17)</td>
<td>1996</td>
<td>M</td>
<td>C</td>
<td>LCX (#12) 99%</td>
<td>YES</td>
<td>-</td>
<td>Several hours</td>
<td>MVR</td>
<td>SVG-LAD</td>
<td>S</td>
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<tr>
<td>Masuda,18)</td>
<td>1997</td>
<td>M</td>
<td>C</td>
<td>LCX 100%</td>
<td>YES</td>
<td>-</td>
<td>1 hours</td>
<td>MVR</td>
<td>(SJM29)</td>
<td>S</td>
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<tr>
<td>Hoshino,19)</td>
<td>1993</td>
<td>F</td>
<td>C</td>
<td>LCX (#13)</td>
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<td>-</td>
<td>1 day</td>
<td>MVR</td>
<td>(ATS27)</td>
<td>S</td>
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<tr>
<td>Yamanishi,9)</td>
<td>1998</td>
<td>M</td>
<td>P</td>
<td>D1 100%</td>
<td>YES</td>
<td>-</td>
<td>Unknown</td>
<td>MVR</td>
<td>-</td>
<td>S</td>
</tr>
<tr>
<td>Moustapha,20)</td>
<td>2001</td>
<td>M</td>
<td>C</td>
<td>LCX 100%</td>
<td>YES</td>
<td>-</td>
<td>Several hours</td>
<td>MVR</td>
<td>(SJM)</td>
<td>S</td>
</tr>
<tr>
<td>Takahashi,21)</td>
<td>2002</td>
<td>F</td>
<td>C</td>
<td>D1 100%</td>
<td>YES</td>
<td>-</td>
<td>1 day</td>
<td>MVR</td>
<td>(CEP25)</td>
<td>S</td>
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<tr>
<td>Yoshida,22)</td>
<td>2003</td>
<td>F</td>
<td>C</td>
<td>D1</td>
<td>YES</td>
<td>-</td>
<td>2.5 days</td>
<td>MVR</td>
<td>(CEP25)</td>
<td>S</td>
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<tr>
<td>Inoue,23)</td>
<td>2003</td>
<td>F</td>
<td>C</td>
<td>LCX (#12) 99%</td>
<td>YES</td>
<td>-</td>
<td>Several hours</td>
<td>MVR</td>
<td>(SJM29)</td>
<td>SVG-LAD, SVG-#12</td>
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<tr>
<td>Minami,24)</td>
<td>2004</td>
<td>M</td>
<td>P</td>
<td>LAD</td>
<td>YES</td>
<td>YES</td>
<td>Several hours</td>
<td>MVR</td>
<td>LAD</td>
<td>D</td>
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<tr>
<td>Ishii,25)</td>
<td>2005</td>
<td>M</td>
<td>C</td>
<td>LCX</td>
<td>YES</td>
<td>-</td>
<td>Several hours</td>
<td>MVR</td>
<td>LCX</td>
<td>S</td>
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<tr>
<td>Hutyra,26)</td>
<td>2006</td>
<td>F</td>
<td>C</td>
<td>LCX (#11) 100%</td>
<td>YES</td>
<td>-</td>
<td>2 day</td>
<td>MVR</td>
<td>(SJM27)</td>
<td>LITA-LAD, RA-14PL</td>
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<tr>
<td>Ushiyama,27)</td>
<td>2007</td>
<td>M</td>
<td>P</td>
<td>LAD (#6) 100%</td>
<td>YES</td>
<td>-</td>
<td>33 days</td>
<td>MVP</td>
<td>(cosgrove 26)</td>
<td>SVD-LAD, SVG-#12</td>
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<tr>
<td>Takahashi,28)</td>
<td>2007</td>
<td>M</td>
<td>C</td>
<td>LCX (#11) 100%</td>
<td>YES</td>
<td>YES</td>
<td>7 hours</td>
<td>MVR</td>
<td>(CEP)</td>
<td>SVG-LCX</td>
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</table>

C, complete; P, partial; M, male; F, female; AMI, acute myocardial infarction; IABP, intra-aortic balloon pumping; PCPS, percutaneous cardiopulmonary support; CABG, coronary artery bypass grafting; D1, first diagonal branch; D2, second diagonal branch; LAD, left anterior descending artery; LCX, left circumflex artery; RCA, right coronary artery; PL, posterolateral branch; PD, posterior descending artery; LITA, left internal thoracic artery; RA, radial artery; SVG, saphenous vein graft; MVR, mitral valve replacement; MVP, mitral valve plasty; SJM, St. Jude Medical mechanical valve; CEP, Carpentier-Edwards pericardial valve; PCI, percutaneous coronary intervention; S, survival; D, dead

arrest time in patients with preoperative hemodynamic shock. Kishon et al. reported that concomitant CABG contributed to lower mortality in short- and long-term postoperative periods. Russo et al. reported that operative mortality decreased from 67% before 1990 without CABG, to 8.7% after 1990 with CABG.7 We produced a better result in the present case, despite cardiogenic shock requiring PCPS, since we performed MVR with concomitant CABG.

We have reported a rare case of acute mitral regurgitation caused by complete anterior PMR as a complication of AMI, treated by successful emergency replacement of the mitral valve with concomitant CABG. We recommend that preoperative diagnosis of PMR should be made cautiously, especially in anterior PMR, because of the possible appearance of mitral valve vegetation in the echocardiograph in some cases, as in the case reported here.
References


