Myocardial bridge, surgery or stenting?

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1. Introduction

Myocardial bridge (MB) has generally been viewed as a congenital anomaly of the coronary arteries and has been characterized by systolic compression of part of an epicardial vessel by a segment of overlying myocardium [1]. The reported prevalence of MB at autopsy varies from 5.4% to 85.7% and 0.5% to 16% on angiography [2]. MB is usually a benign condition with an excellent long-term survival but has been implicated in causing myocardial ischemia [3], myocardial infarction [4], exercise-induced tachycardia [5], paroxysmal AV blockade [6], and sudden cardiac death [7].

Negative inotropic and/or negative chronotropic agent [8, 9], coronary artery bypass grafting [10], excision of the overlying muscle band [11], and stenting [12] have been used to treat patients with myocardial ischemia attributed to a muscle bridge. Most reports about MB are based on scattered cases. This report reviews our clinical experience with stenting and surgical treatment on MB at Fu Wai Hospital over the past 7 years.

2. Patients and methods

There were 109 patients who were diagnosed with MB by coronary angiography in Fu Wai Hospital from 1997 to November 2004. Nine of them were asymptomatic and no treatments were performed. Eighty-one patients were responsible for medication. The remaining 19 patients were refractory to medication. Fifteen patients underwent operation and 4 patients accepted stent implantation. All patients signed an informed consent for having these procedures and was approved by the Ethics Committee of Fu Wai hospital. Data were obtained from medical records. All these patients were symptomatic and had a reversible perfusion detected in LAD territory in a Tc-99 m sestamibi SPECT test performed before coronary angiography to confirm ischemia. In addition, 11 patients had a positive exercise ECG test with ≥1 mm horizontal or downsloping ST segment depression in at least two contiguous leads. Thirteen patients accepted ergonovine provoking during angiography and no spasm was induced. Survivors were contacted by letter and telephone. Follow-up of all patients ranged from 6 months to 75 months (mean follow-up, 23.5 months) and the follow-up angiography was also documented.

3. Results

3.1. Surgical treatment group

There were 10 male patients and 5 female patients with a mean age of 49.2 years ranging from 35 to 67 years. Six patients were MB only; 2 patients were MB with hypertro-
### Table 1

<table>
<thead>
<tr>
<th>Patients</th>
<th>Diagnosis</th>
<th>Preoperative angiography</th>
<th>Post-angiography</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MB only</td>
<td>95% systolic compression at the midportion of the LAD (Fig. 1A, B)</td>
<td>Complete relief of systolic compression (Fig. 1C)</td>
<td>Myotomy (off-pump)</td>
</tr>
<tr>
<td>2</td>
<td>MB only</td>
<td>95% systolic compression of LAD and 70% systolic compression at the distal of the OM1</td>
<td>The grafts are patent</td>
<td>CABG with IMA to LAD and SV to OM1 (off-pump)</td>
</tr>
<tr>
<td>3</td>
<td>MB only</td>
<td>80% systolic compression of LAD</td>
<td>Complete relief</td>
<td>Myotomy</td>
</tr>
<tr>
<td>4</td>
<td>MB only</td>
<td>95% systolic compression of LAD</td>
<td>Complete relief</td>
<td>Myotomy (off-pump)</td>
</tr>
<tr>
<td>5</td>
<td>MB only</td>
<td>85% systolic compression of LAD</td>
<td>The graft is patent</td>
<td>CABG with IMA to LAD</td>
</tr>
<tr>
<td>6</td>
<td>MB only</td>
<td>85% systolic compression of LAD</td>
<td>Complete relief</td>
<td>Myotomy</td>
</tr>
<tr>
<td>7</td>
<td>MB with HOCM</td>
<td>85% systolic compression of LAD and 90% systolic compression of PDA</td>
<td>The grafts are patent</td>
<td>CABG with IMA to LAD and SV to PDA</td>
</tr>
<tr>
<td>8</td>
<td>MB with HOCM</td>
<td>85% systolic compression of LAD</td>
<td>Unperformed</td>
<td>Myotomy and myomectomy</td>
</tr>
<tr>
<td>9</td>
<td>MB with CHD</td>
<td>75% systolic compression of LAD, diffuse stenosis and dilation co-exist in RCA</td>
<td>The grafts are patent</td>
<td>CABG with IMA to LAD and SV to RCA (off-pump)</td>
</tr>
<tr>
<td>10</td>
<td>MB with CHD</td>
<td>75% systolic compression of LAD, segmental and eccentric stenosis in RCA with more than 60% diameter loss</td>
<td>The grafts are patent</td>
<td>CABG with IMA to LAD and SV to RCA</td>
</tr>
<tr>
<td>11</td>
<td>MB with mitral valve stenosis</td>
<td>70% systolic compression of LAD, segmental eccentric stenosis proximal to the midportion of the RCA (50% diameter loss)</td>
<td>The grafts are patent</td>
<td>CABG with IMA to LAD and 5V to RCA and MVR</td>
</tr>
<tr>
<td>12</td>
<td>MB with mitral valve prolapse</td>
<td>70% systolic compression of LAD</td>
<td>Complete relief</td>
<td>Myotomy and MVP (double orifice technique)</td>
</tr>
<tr>
<td>13</td>
<td>MB with mitral valve stenosis</td>
<td>85% systolic compression of LAD</td>
<td>Complete relief</td>
<td>CABG with IMA to LAD and bivalve replacement</td>
</tr>
<tr>
<td>14</td>
<td>MB with bivalve disease</td>
<td>55% systolic compression of LAD</td>
<td>Unperformed</td>
<td>CABG with LMA to LAD and bivalve replacement</td>
</tr>
<tr>
<td>15</td>
<td>MB with bivalve disease</td>
<td>70% systolic compression of LAD</td>
<td>Unperformed</td>
<td>CABG with LMA to LAD and bivalve replacement</td>
</tr>
</tbody>
</table>

CABG: coronary artery bypass grafting; LAD: left anterior descending artery; IMA: internal mammary artery; RCA: right coronary artery; PDA: posterior descending branch; OM: obtuse marginal; SV: saphenous vein; MVR: mitral valve replacement; MVP: mitral valve repair.

3.2. Stenting group

There were 3 male patients and 1 female patient with a mean age of 57.6 years ranging from 46 to 66 years. All of them were MB only. They all had a history of stable angina and more frequent paroxysm several months later and refractory to medication. All of their coronary angiograms revealed an MB in the middle of LAD and also systolic compression ≥75% (ranging from 75% to 90%). Coronary interventions were performed using an NIR stent with excellent angiographic results. They all remained pain-free in the hospital. Follow-up ranged from 26 to 46 months and showed that only two patients were markedly improved with only occasional pain and no readmission. The other two patients had typical angina within 3 months and 7 months, respectively, after stenting and had to be readmitted. The postangiography showed that moderate intimal proliferation and systolic compression still existed in these two patients. One underwent CABG at a local hospital 14 months after stenting and had no complaint of angina. The other one was treated with medication.

4. Discussion

The first mention of an intramyocardial course of a segment of an epicardial coronary artery was made by Reyman in 1737 [13], although the first angiographic description was not reported until 1960 [14]. Myocardial bridge is a distinctive anatomical entity whose pathophys-
Fig. 1. Angiography is shown and a photograph of a myotomy MB: a long narrowing (arrow) present at the LAD in systolic phase (A); recovered in diastolic phase (B); post-angiography showing complete relief of LAD (C); Photographs of operation showing thorough excision of overlying band of LAD (D).

Fig. 2. Post-angiography of a stenting MB showing moderate intimal proliferation and systolic compression still existed (arrow): systolic phase (A); diastolic phase (B).

Photographs of operation showing thorough excision of overlying band of LAD with the typical ‘milking effect’ and a ‘step down standard for diagnosing MB now is coronary angiography. The physiological role has brought about much controversy. The standard for diagnosing MB now is coronary angiography with the typical ‘milking effect’ and a ‘step down–step up’ phenomenon induced by systolic compression of the tunneled vessel. The new imaging techniques, such as intravascular ultrasound (IVUS) and intracoronary Doppler ultrasound (ICD), have provided better identification and functional quantitation to establish a link between systolic compression and the clinical presentation.

The LAD is the most clinically important vessel that is affected by MB. Anatomical studies run between the proximal third and middle third of the LAD. Someone reported that MB appeared in multiple sites such as PDA and RCA [15]. In our review, two patients were found with MB at multiple sites including PDA and OM1. Seventeen patients had a single MB at the midportion of the LAD.

In symptomatic patients, three treatment strategies have been explored: (1) medical treatment includes optimal doses of negative inotropic and/or negative chronotropic agents with the objective of relieving symptoms and/or protecting against the risk of future coronary events [8,9]; (2) coronary stenting in MB [12]; and (3) surgical myotomy and/or CABG [10,11]. Medical treatment is the first choice. Most of the 109 patients with MB can be alleviated by medication. However, long-term follow-up is needed to validate these results. To the patients who were refractory to the medication, at first both of stenting and surgery were recommended in our hospital. Now, according to the follow-up results, we prefer to adopt surgical treatment because stent placement has been complicated by intimal proliferation. Thrombus formation, and restenosis, and stent compression are also matters for concern. Also, we are short of randomized data to demonstrate the efficacy of stenting in the tunneled vessel in the long run.

We consider that the patients who are refractory to medication should undergo the surgical treatment when the compression of LAD is \( \geq 75\% \). Obvious myocardial ischemia or myocardial infarction are also a surgical indication. Surgical myotomy was an earlier technique that applied to MB. Although there were some risky reports, including mural aneurysm and scar formation with subsequent recurring vessel compression [11], we consider myotomy is suitable for all MB patients (Figs. 3 and 4). Careful separation and thorough excision of the overlying muscle band are the keys for operation. In our review, one patient suffered a right ventricular perforation that was successfully repaired while we attempted to perform myotomy. CABG was also applied to MB. The LIMA may be the best choice for grafting. We prefer to adopt myotomy because CABG has its shortcomings including restenosis and hemorrhage. When surgery is chosen, the procedure of ‘on or off’ pump should be determined by the surgical expertise of the institution and individual surgeon.

Here we report 9 patients of MB with different types of heart diseases. Because the symptom of ischemia may be covered preoperatively, and it may be aggravated postoperatively, it should be more active to treat with MB when it is associated with another cardiac disease such as CHD heart valve disease. Four of the patients underwent surgical treatment when the compression reached 50%. All patients completely recovered and the postoperative courses were uneventful.

5. Conclusion

Surgical treatment may be a better choice for patients who are refractory to medication. Myotomy should be advocated because of its good results. Finally, we should be more positive in applying an operation to patients with MB who are associated with other heart diseases.

References


