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Surgical Outcome and Clinical Follow-up in Patients with Symptomatic Myocardial Bridging

ABSTRACT

From 1997 to 2006, 37 463 patients received selective coronary angiography in the Fuwai Cardiovascular Hospital, Beijing, China. Of these, 484 patients had angiographic diagnosis of myocardial bridging. Of the 484 patients, 35 underwent surgery for treatment of myocardial bridging with significant systolic arterial compression. Among the surgical treatment patients, 24 presented with other cardiac disorders, and the remaining 11 symptomatic patients with isolated myocardial bridging were included in the follow-up study.

Keywords: *myocardial bridging, myocardial ischaemia, myotomy, coronary artery bypass grafting, coronary angiography*

1. Introduction

Muscle overlying the intramyocardial segment of an epicardial coronary artery is termed a myocardial bridging, and it is generally confined to the middle segment of the left anterior descending artery (LAD)[1]. Traditionally, myocardial bridging is considered a benign condition[2,3], but it may be associated with myocardial ischaemia[4], acute coronary syndromes and sudden death[5]. Surgery has been attempted in selected patients[6,7]. However, there is little information about the prognosis of patients with this anomaly, especially the outcome of surgical treatment for myocardial bridging. Therefore, we analyzed the clinical, angiographic and functional followup after surgical treatment in patients with isolated symptomatic myocardial bridging.

2. Methods

2.1. Patient Selection

From 1997 to 2006, 37 463 patients received selective coronary angiography in the Fuwai Cardiovascular Hospital, Beijing, China. Cardiac catheterization was performed with the use of a standard Judkins technique and images were obtained in multiple views, in which systolic compression of the anterior descending coronary artery could be observed clearly in every patient. Of these, 484 patients had angiographic diagnosis of myocardial bridging. Out of the 484 patients, 35 underwent surgical treatment of myocardial bridging with significant systolic arterial compression. The patients who had a diagnosis of moderate or severe aortic stenosis, moderate or severe left ventricular hypertrophy of any origin or hypertrophic cardiomyopathy were excluded. Patients with coronary artery disease, understood as fixed stenosis of more than 50% at some point of the coronary network, were also excluded. From these 35 patients, 8 men and 3 women with myocardial bridging but without other cardiac diseases were included in the followup study. The coronary angiographies and medical histories of these 11 patients were reviewed.

2.2. Follow-up

Follow-up was carried out by telephone and completed with a review of the medical histories of the patients who had new admissions and medical records at the hospital. Clinical evaluation was also accomplished by direct interview of the patients at clinic visits. Clinical symptoms, daily activities without chest pain or anginal symptoms, current medical treatment, and events experienced (myocardial infarction, need to repeat coronary angiography or revascularization) were analyzed throughout the follow-up period.

3. Results

The 37 463 patients with selective coronary angiographic analysis included 484 with myocardial bridging; a prevalence of 1.3%. Of these 484 patients, 35 received surgical treatment for myocardial bridging with systolic compression of the left anterior descending artery. Among the surgically treated patients, 24 presented with other cardiac disorders: hypertrophic cardiomyopathy in 3 cases, coronary heart disease in 3, and valve and other cardiac diseases in 18. We only studied the remaining 11 patients with isolated myocardial bridging. All of their coronary angiographies revealed myocardial bridging in the middle segment of LAD with systolic compression ≥75% (ranging from 75% to 90%).

The mean age of the male patients was 48.4 years (SD=8.9 years). Four patients had arterial hypertension and 6 were active smokers at the time that coronary angiography was performed. The clinical presentation was typical angina in 10 patients and atypical chest pain in 1. Two patients had previous anterior myocardial infarction. ECG stress testing showed significant ST segment depression or T wave inversion from the anterior leads during exercise in six of the 11 patients, while five had a positive Tc-99^{m} Sestamibi SPECT (single photon emission computed tomography) test with filling defects during stress, which were reversible at rest. Ventricular function was normal in all of these patients. Surgical myotomy was performed in 3 patients and CABG in 8. Eight patients were operated on with an off-pump approach and 3 patients with a cardiopulmonary bypass technique after medial sternotomy. Conversion to on pump CABG surgery was necessary in 1 patient because of perforation of the right ventricle. The left internal mammary artery (LIMA) was the graft used in all the patients with CABG. The acute clinical success rate was 100% with respect to the absence of myocardial infarction, death or other in-hospital complications. Complete recovery was achieved in the postoperative period in all patients.

All of the patients were followed up clinically. The median follow-up was 35.3 months (range: 6 to 120 months). Nine patients were free from symptoms and one of them continued taking beta-blockers. The remaining 2 patients with myotomy had symptoms of atypical chest pain. One of them received coronary angiography again and no stenosis was found at two years after operation; while exercise testing was performed in the other patient and revealed no evidence of myocardial ischaemia. Both of them were taking beta-blockers and symptoms were controlled. No myocardial infarction or other major adverse cardiac events were encountered in these patients during follow-up.

4. Discussion

Myocardial bridging was recognized at autopsy in 1737 and first described angiographically in 1960. The current best method for diagnosing myocardial bridging is selective coronary artery angiography and the typical angiographic finding is systolic narrowing of an epicardial artery. The incidence of myocardial bridging reported in angiographic studies ranged from 0.5% to 40%. The limited frequency of myocardial bridging observed angiographically is in contrast with that of autopsy studies, which have reported a frequencies of 5% to 86%[1]. In the present study of selective coronary angiography with more than 37 000 patients, the prevalence of myocardial bridging is 1.3%. Variation between autopsy and angiography may in part be attributable to small and thin bridges causing little compression. New imaging techniques like intravascular ultrasound, intracoronary Doppler ultrasound and electron beam tomography and multislice CT[8] as noninvasive imaging techniques can be used for diagnosis of functional and morphological status of bridging.

Though bridging is considered as a harmless anatomical vessel malformation in most cases, the intramural course of certain portions in the left anterior descending coronary artery may cause myocardial ischaemia and infarction[4]. The mechanism by which myocardial bridging causes myocardial ischaemia is not very clear but associated with decreased coronary flow reserve[9]. Indeed, intravascular ultrasonography and Doppler imaging have demonstrated that vessel compression during systole is followed by a delay in the increase in luminal diameter during diastole, thus affecting the predominant phase of coronary perfusion, especially during episodes of tarchycardia[10,11]. In the present follow-up study, at baseline before operation, all of the patients had angina and two had myocardial infarction of the anterior wall.

In symptomatic cases, there are several therapeutic options available. The medications of choice are beta-blockers[10,12], whose mechanism of action is through a negative inotropic and chronotropic effect. Sometimes medical treatment is insufficient and other interventions are required. The efficacy and long term outcome of stent implantation in symptomatic myocardial bridging is still controversial[13], though several studies have demonstrated that stenting can prevent external compression of bridged coronary artery segments, with increase in luminal diameter and improve symptoms. Haager et al[14] evaluated the results of coronary stenting in 11 patients with symptomatic myocardial bridging of the central portion of the LAD. Followup angiography at 7 weeks demonstrated mild to moderate or severe stent stenosis in 5 patients; revascularization was repeated in 4 patients. High restenosis[15,16] or major periprocedural complications[17], including perforation of the artery have been reported in other studies. Thus, the rate of restenosis of stent implantation in myocardial bridging has been too high to generally recommend this approach in symptomatic patients.

Surgical treatment with dissection of the overlying myocardium (myotomy)[6,7] or coronary artery bypass grafting[18] is limited to patients with symptoms that persist despite medical treatment. Surgical myotomy, first reported by Binet et al, abolishes clinical symptoms and is associated with reversal of local myocardial ischaemia and an increase in coronary flow[6]. However, this treatment strategy carries certain risk. The unpredictable intramural course of the coronary artery may require deep incision of the ventricular wall, potentially leading to subsequent perforation of the right ventricle[7,19]. There is little information about the prognosis of surgical treatment for symptomatic myocardial bridging.

In the present study, for all 11 patients, isolated myocardial bridging had caused more than 75% compression of the middle portion of the anterior descending coronary artery and was refractory to oral medication. Myotomy was performed in 3 patients and CABG in 8 patients. The LIMA was the graft used in all of the patients. One patient suffered a right ventricular perforation that was successfully repaired by change to on pump CABG. The others had no serious surgical complications and they were discharged from the hospital uneventfully. During the middle- and long-term follow-up of 3 years (range: 6 to 120 months), 2 had atypical chest pain and were controlled by medical treatment. The other 9 patients were symptom free without the need for further invasive diagnostic studies. No myocardial infarction or other major adverse cardiac events occurred during follow-up study. Therefore, surgery either by myotomy or CABG is relatively safe and is an option for the treatment of selected patients with symptomatic myocardial bridging. Additional studies are needed to investigate which patients should be selected for surgical therapy and to assess the long term prognosis of the surgical treatment.

There were several limitations in this study. Patients were included in the study based on a coronary angiography made before the study was designed, so there was no established protocol for the coronary angiography. Not every patient received intracoronary nitroglycerine at the time of angiography in our study, thus the prevalence could be underestimated. Additionally after operation during followup, only one of our patients underwent coronary angiography again.

In conclusion, myocardial bridging, a congenital vessel anomaly, is a relatively common angiographic finding[20]. Although usually a benign condition, myocardial bridging can occasionally generate clinically important complications. Medication is the initial therapy for symptomatic patients. Surgical myotomy or CABG should be limited to patients who are refractory to oral medication. Benefits with low operative risk and excellent middle- and long-term results can be achieved by surgical relief of myocardial ischaemia due to systolic compression of intramyocardial coronary arteries. When surgery is chosen, the decision to perform myotomy or CABG is made on a case by case basis. In arteries that take a very deep course through the septum, approaching the right ventricular subendocardium and surgical exposure of the intramuscular coronary artery may be difficult, CABG is preferred to myotomy and the LIMA is the best choice of graft.

5. Conclusions

Myocardial bridging is a relatively common angiographic finding. Surgical myotomy or CABG should be limited to patients who are refractory to oral medication. Surgical relief of myocardial ischaemia due to systolic compression of intramyocardial coronary arteries can be accomplished with low operative risk and excellent middle- and long-term results.

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