



CASE REPORT

Encasement of the left anterior descending coronary artery: association with Takotsubo syndrome, and diagnostic and therapeutic options

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Abstract

Myocardial bridging is a rare event, which leads to chest pain, arrhythmias and discussable Takotsubo syndrome (cardiomyopathy).

We enrolled 41 patients (33 females, mean age 68.4 years), the majority of whom had Takotsubo cardiomyopathy in any form, and 6 had echocardiographic mid-ventricular hypokinesia along with chest pain. Thirty patients had apical ballooning, 3 had mid-ventricular ballooning, and 1 had basal ballooning, according to left ventricular angiography.

Intravascular ultrasonography and fractional flow reserve with either an adenosine or dobutamine injection are the best methods for accurately diagnosing myocardial bridging.

Beyond atherosclerosis, myocardial bridging is a prominent cause of chest pain, although ischemia is difficult to verify.

Key words myocardial bridging, Takotsubo cardiomyopathy, intravascular ultrasound, fractional flow reserve, apical ballooning.

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Introduction

Atherosclerotic lesions, but also myocardial bridging or vasospasms, can cause chest pain, myocardial infarction and sudden cardiac death.¹

Myocardial bridging generally presents with systolic impairment when the main vessel proceeds into the myocardium. A special form of myocardial bridging is complete or partial encasement of the vessel characterized by a rigid straightening without systolic lumen reduction described by Migliore *et al.*² In these cases, myocardial bridging is best defined by computed tomography (CT). By CT encasement can be diagnosed in 76% of cases, by coronary angiography only in 40%.

In the meanwhile, there remains debate over whether encasement of the left anterior descending coronary artery with chest discomfort and aborted abrupt cardiac death from recurrent ventricular fibrillation can induce Takotsubo syndrome.^{3,4}

Definitely, chest pain can be caused of encasement mainly of the left anterior descending coronary artery, but also of other vessels.⁵

Materials and Methods

The group of 41 patients (mean age 68.4 years; 33 females) includes 30 cases of apical ballooning, 3 cases of mid-ventricular ballooning (plus additional basal ballooning and recurrent ventricular fibrillation in one case), 1 case of isolated basal ballooning, and 6 cases of chest pain with echocardiographic mid-ventricular hypokinesia but no changes to the electrocardiogram. Coronary angiography was performed in each case. In neither case was CT performed.

Results

In all cases coronary angiography ruled out any atherosclerotic lesions of the coronary vessels. Again, in all but one cases a rigid straightening of the mid-portion of the left anterior descending coronary artery suggesting complete or full encasement was evident. Systolic lumen reduction of the main vessel could be ruled out in all but one case, but systolic compression

of septal (and in two cases diagonal branches) could be presented in all but one cases. In a single case systolic lumen reduction was evident in the mid-portion of the circumflex artery suggesting incomplete or partial encasement.

Patients with apical ballooning had a wrap-around phenomenon of the left anterior descending artery (LAD), in cases of atypical mid-ventricular or basal ballooning wrap-around phenomenon of the LAD could be excluded.

A typical example of rigid straightening of the mid-portion of the left anterior descending coronary artery (complete encasement) can be seen in Figure 1.

Discussion

Myocardial bridging is a diagnostic dilemma. It is a supposed cause of chest pain, although the evidence of ischemia is hard to demonstrate. Compared to coronary angiography, both intravascular ultrasound and CT-angiography provide morphological aspects of myocardial bridging (complete or partial encasement). However, these modalities are limited in defining the hemodynamic and clinical significance of myocardial bridging. Fractional flow reserve (FFR) after adenosine infusion has been used to assess the hemodynamic significance of myocardial bridging, but FFR after adenosine induced hyperemia underestimates the significance of myocardial bridging. On the other hand, high dose dobutamine by increasing the contractility of the bridging segment unmasks ischemia.⁶ FFR under high dose dobutamine can be divided into two aspects: mean FFR and diastolic FFR. Only then ischemia prolongs in diastole, the clinical significance of myocardial bridging is confirmed. In these terms, diastolic FFR is more important than mean FFR.⁷

Takotsubo syndrome can result from myocardial bridging in either a stressful or happy environment (or reversible car-

diomyopathy). In all but one cases included in this study group, a rigid straightening of the mid-portion of the left anterior descending coronary artery could be revealed as a hint for encasement of the LAD. In many cases myocardial edema in Takotsubo syndrome produces reversible myocardial bridging.⁸

Only in a few cases, encasement of the LAD results in systolic lumen reduction.⁹ The definition of myocardial bridging by rigid straightening of the mid-portion of the LAD without systolic lumen reduction in coronary angiography is a relevant finding and could be described elsewhere.²

This study group includes a mixture of Takotsubo cardiomyopathy and chest pain, although the performance of the left ventricle revealed segmental impairment in all but one cases. Concealed mid-ventricular ballooning with either inferomedial or anteromedial hypokinesia by angiography or echocardiography was addressed in literature.¹⁰

One case with recurrent ventricular fibrillation was due to reversible basal and mid-ventricular ballooning after gall bladder removal under complex psychotic medication.

Beyond atherosclerosis, myocardial bridging is a prominent cause of chest pain, although ischemia is difficult to verify.

Limitations

In this study only 41 patients were reported. Myocardial bridging is a rare event, causing chest pain, ventricular arrhythmias and Takotsubo cardiomyopathy with either apical ballooning, or midventricular, or basal ballooning.

Conclusions

In many cases, Takotsubo cardiomyopathy with transient dysfunction of the left ventricle is caused by myocardial bridging, primarily of the left anterior descending coronary artery.

Conflict of interest

The author declares no potential conflict of interest.

References

1. Peters S. Typical and atypical takotsubo cardiomyopathy – simply stress – induced or dependent of the left anterior descending coronary artery? *Int J Cardiol* 2016;223:475-6.
2. Migliore F, Maffei E, Perazzolo Marra M, Bilato C, Napodano M, Corbetti F, et al. LAD coronary artery myocardial bridging and apical ballooning syndrome. *JACC Cardiovasc Imaging* 2013; 6:32-41.
3. Peters S. Identification of mid-ventricular ballooning takotsubo cardiomyopathy by pure coronary angiography. *Int J Cardiol* 2016;221:697.
4. Peters S. Takotsubo cardiomyopathy and structural abnormalities

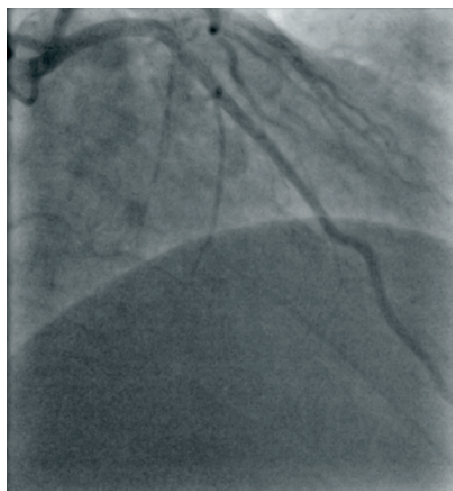


Figure 1. Typical rigid straightening of the mid-portion of the left anterior descending coronary artery.

- of the left anterior descending coronary artery. *Int J Cardiol* 2016;223:510-1.
5. Peters S. Unusual case of myocardial bridging of the circumflex artery and initially intractable chest pain. *Int J Cardiol* 2015;179:25-6.
 6. Hakeem A, Cilingiroglu M, Leesar MA. Hemodynamic and inter-vascular ultrasound assessment of myocardial bridging: fractional flow reserve paradox with dobutamine versus adenosine. *Catheter Cardiovasc Interv* 2010;75:229-36.
 7. Escaned J, Cortes J, Flores A, Goicolea J, Alfonso F, Hernandez R, et al. Importance of diastolic fractional flow reserve and dobutamine challenge in physiologic assessment of myocardial bridging. *J Am Coll Cardiol* 2003;42:226-33.
 8. Madias JE. Is the coronary artery myocardial bridging and left anterior descending straightening mediated by the myocardial wall motion abnormalities and edema in takotsubo syndrome. *Int J Cardiol* 2016;225:18-9.
 9. Ussitalo V, Saraste A, Knuuti J. Multimodality imaging in the assessment of the physiological significance of myocardial bridging. *Curr Cardiol Rep* 2016;18:2.
 10. Peters S. Mid-ventricular ballooning in takotsubo cardiomyopathy: from a concealed to a manifest form. *Int J Cardiol* 2016; 223:195-8.