Left Main Coronary Spasm: an Extremely Rare Entity with Possible Life-Threatening Complications

A. Al Emam, MBBS¹ N. Sricharoen, MD¹

¹ Department of Cardiology, University of Nebraska Medical Center, Omaha, Nebraska

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Address for correspondence A. Al Emam, MBBS, Department of Cardiology, University of Nebraska Medical Center, 982265 Nebraska Medical Center, Omaha, NE 68198-2265 (e-mail: emammd@gmail.com).

Abstract

Keywords

- coronary intervention
- left main coronary artery spasm
- acute coronary syndrome
- ischemia
- cardiac catheterization
- intravascular ultrasound

Coronary artery spasm is a known cause of acute coronary syndrome. However, left main coronary spasm is an extremely rare entity and can present in different ways depending on the duration and severity of the spasm. We present a 44-year-old female patient who presented with transient ST elevation in the lead aVR and ST depression in the lateral and inferior leads. Coronary angiography showed mid left main and ostial right coronary artery spasm that significantly improved after intracoronary nitroglycerine administration. Intravascular ultrasound showed no significant left main coronary atherosclerosis. She was treated chronically with calcium channel blockers (CCB), nitrates, and arginine with significant improvement. In conclusion, left main coronary spasm is an extremely rare entity with wide spectrum of clinical manifestations. Definite etiology is still questionable, and special precaution is needed during coronary angiography in order not to be confused with significant fixed lesions. Intravascular ultrasound can be valuable in excluding underlying atherosclerosis. Medical management with nitrates acutely then CCB is the mainstay of chronic management with PCI preserved to refractory cases.

Coronary artery spasm (CAS) is a known cause of acute coronary syndrome (ACS). However, left main CAS is an extremely rare entity and can present in different ways depending on the duration and severity of the spasm. We present a patient with left main and right coronary spasm resolved with intracoronary nitroglycerine; the patient responded well to outpatient management with calcium channel blockers (CCB), nitrates, and arginine.

Case Presentation

A 44-year-old female patient with no significant cardiac history presented to the emergency department with typical chest pain. Her vital signs were stable. Initial electrocardiogram (ECG) was within normal limits but a repeat ECG after symptom recurrence showed ST elevation in aVR and ST

depression in leads I, II, aVL, and V₃–V₆ (➤**Fig. 1**). She was given aspirin and intravenous (IV) heparin and transferred to our facility for further care. At the time of arrival, her symptoms had resolved as well as her ECG changes. Her troponin I was borderline and CKMB (creatinine kinase-MB) remained within normal limits. Given her typical chest pain and ECG changes, she underwent coronary angiography that showed mid left main coronary spasm (➤**Fig. 2**) that improved after intracoronary nitroglycerine injection (➤**Fig. 3**). To confirm the absence of left main atherosclerosis, intravascular ultrasound (IVUS) of the left main artery was performed and showed minimal plaque burden (➤**Fig. 4**). There was also ostial right CAS that resolved after intracoronary nitroglycerine. The patient was started on oral nitrates but had symptom recurrence. Amlodipine and arginine were added. No further symptoms reported.

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Fig. 1 ST elevation in the lead aVR and ST depression in the lateral and inferior leads.

Discussion

Definition and Prevalence

CAS is defined as a sudden vasoconstriction of one or more epicardial coronary artery causing vessel occlusion or near occlusion. It is the usual cause of variant angina, although it is involved in other coronary syndromes.¹ The actual prevalence of this entity is unknown and the diagnosis is probably underestimated. Previous reports show that up to 28% of patients who present with ACS have no significant

lesions and ~50% of patients who underwent provocative testing had CAS.² Left main coronary spasm is an extremely rare entity with only a few cases reported in the literature.³

Clinical Risk Factors

Except for smoking, traditional coronary artery disease risk factors are not associated with CAS. Another acquired risk factor is heavy alcohol consumption as well as exposure to cocaine, marijuana, amphetamine, sumatriptan, and 5 fluorouracil.¹

Fig. 2 Mid left main coronary stenosis secondary to spasm (arrow).

Fig. 3 Spasm improving after intracoronary nitroglycerine administration.

Fig. 4 IVUS showing minimal plaque burden.

Etiology and Mechanism

It was suggested that endothelial dysfunction has a crucial role in CAS through causing vasoconstriction instead of vasodilatation with specific stimuli. However, recent literature indicated that although it may favor CAS induction at the susceptible coronary segment, it is unlikely to be responsible by itself for this phenomenon. There is increasing evidence that primary vascular smooth muscle hyperreactivity is the main abnormality causing CAS.¹ Magnesium deficiency can increase intracellular calcium flow in the vascular smooth muscle cells causing CAS. Genetic factors seem to have a role, suggested by the big difference in prevalence between the Japanese and western populations. However, well-designed prospective comparative studies are lacking. Other less understood potential substrates for CAS include passive mechanical collapse, coronary fibromuscular dysplasia, and adventitial abnormalities.^{1,4} The relationship between the autonomic nervous system and CAS is complex, as it can be induced by an increase in either sympathetic or parasympathetic tone.¹

Presentation

Depending on the affected coronary artery, number of coronaries affected, and severity and duration of the spasm, CAS has wide range of presentations from silent ischemia to unstable angina, myocardial infarction, ventricular arrhythmias, and sudden cardiac death. Typically, patients usually present with chest pain, which starts during rest, at night or early morning. The pain is unpredictable and is associated with transient ST segment elevation (or, rarely, ST depression) in different leads depending on the affected coronary artery. Resting echocardiogram usually shows no regional wall motion abnormalities and stress tests are negative for inducible ischemia.^{5,6} On the other hand, acute left main coronary obstruction usually causes severe hemodynamic instability resulting in a less favorable prognosis.⁶

Diagnosis

The diagnosis is mainly clinical, and provocative testing should be deferred for patients with unclear presentation. Typical symptoms, transient ECG changes, and negative stress testing are usually sufficient to make the diagnosis in the setting of normal wall motion on echocardiography.⁵ However, many patients will undergo coronary angiography with recurrent episodes.

Coronary Angiography

The spasm appears as a smooth tapering stenosis of the affected segment on coronary angiography with complete or near-complete resolution after intracoronary nitroglycerine injection. Although it was thought that the spasm commonly occurs in angiographically “normal” coronary segments, it appears that most patients had luminal irregularities and nonobstructive lesions rather than completely normal coronaries. In most cases, this can be confirmed by IVUS imaging.⁵ Provocative testing is an effective way of confirming the diagnosis of CAS,¹ although it is much frequently performed nowadays in the western countries for time and reimbursement issues⁵; testing needs experienced physicians and the patient should not have obstructive coronary artery disease. The diagnostic yield of both acetylcholine and ergonovine is similar. With ergonovine, intracoronary injection, rather than IV injection, is useful in identifying the culprit vasospastic vessel.⁷ A recent study showed that among patients with CAS, those with thyrotoxicosis were more likely to have multivessel or left main spasm compared with patients with no thyrotoxicosis but with similar clinical outcomes.⁸ Spontaneous versus catheter-induced CAS is sometimes difficult to differentiate. Reportedly, catheter-induced spasm usually appears within 1 mm from the catheter tip.⁹ Our patient had significant ST changes before catheterization and had mid rather than ostial left main spasm, both suggesting spontaneous spasm.

Prognosis

Underlying coronary atherosclerosis and severe multivessel spasm were associated with worse outcome.^{1,5} The long-term prognosis is directly related to the severity of any underlying atherosclerosis.⁵ Compared with patients with obstructive ACS, ACS patients without culprit lesion and proof of CAS have an excellent prognosis for survival and coronary events after 3 years. However, persistent angina represents a challenging problem in these patients.¹⁰

Medical Treatment

Avoiding drugs that are known to cause CAS and smoking cessation are important in preventing recurrence. Short-acting nitroglycerine is usually effective in aborting the attack. CCB are considered the first-line medications for chronic treatment of patients with documented CAS. They improve symptoms and prognosis.⁵ Sometimes a combination of dihydropyridines and nondihydropyridines is needed for symptom control. Short-term use of long-acting nitrates is also useful in addition to CCB but their chronic use has not shown to improve the prognosis. Low-dose aspirin is

reasonable and statins are associated with better outcomes. Beta blockers should be avoided unless there is significant coronary atherosclerosis where they can be used after the acute attack as long as the patient is on CCB. L-arginine may also help in patients with hypofunctioning endothelial nitric oxide synthase.⁵

Revascularization

In the rare, carefully selected patient, percutaneous coronary intervention (PCI) may represent an adjunct in the management of focal CAS, although currently medical therapy remains the standard initial approach. Limitations include both persistent spasm and spasm in a different artery, but recurrent spasm within the stent is unlikely.¹¹ However, in cases of left main spasm, coronary artery bypass grafting has poor outcome, likely secondary to competitive flow after spasm resolution and the resulting graft shutdown. It was reported that about one-third of the left internal mammary grafts were occluded for patient who probably had left main spasm before the surgery but had no obstructive lesions on repeat angiography.¹² Even in patients with patent grafts, spasm of another artery or segment will cause symptom recurrence.

Conclusion

Left main coronary spasm is an extremely rare entity with wide spectrum of clinical manifestations. Definite etiology is still questionable and special precaution is needed during coronary angiography in order not to be confused with significant fixed lesions. IVUS can be valuable in excluding underlying atherosclerosis. Medical management with nitrates acutely then CCB is the mainstay of chronic management with PCI preserved to refractory cases.

Note

The work was done at the University of Nebraska Medical Center, Omaha, NE.

Conflict of Interest

The authors report no financial relationships or conflicts of interest regarding the content herein.

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