A Case of Acute Myocardial Infarction

Intracoronary Thrombus Formation at a Previously Provoked Vasospasm Site

Yasuyo TANIGUCHI, MD, Motoyuki NAKAMURA, MD, Tomomi SUZUKI, MD, Tomoyuki SUZUKI, MD, Hidehiko AOKI, MD, Ken-ichi FUKAMI, MD

SUMMARY
A 58-year-old Japanese man with variant angina developed acute myocardial infarction (AMI). Emergency coronary angiography demonstrated thrombotic occlusion in the proximal site of the left anterior descending artery. The occluded region appeared to be coincident with the area in which severe vasospasm had been provoked by intracoronary administration of acetylcholine 1.5 years before the onset of AMI. This case may give us a unique opportunity to consider the role of vasospasm in the etiology of AMI. (Jpn Heart J 2000; 41: 761-766)

Key words: Variant angina, Thrombotic occlusion, Coronary vasospasm, Acute myocardial infarction

It has been suggested that coronary artery spasm plays an important role in the pathophysiology of some cases of acute myocardial infarction (AMI). Several studies have demonstrated that patients with vasospastic angina have suffered from AMI during a long-term follow-up period. However, it has not yet been determined whether a close relationship exists between coronary artery spasm and the occurrence of AMI. To the best of our knowledge, no reports have documented the progression of a site of coronary vasospasm to coronary thrombus formation and consequent AMI. In the case reported here, an intracoronary thrombus formed in a region of the left anterior descending (LAD) artery coincident with that in which vasospasm had been provoked previously.

CASE REPORT
A 58-year-old Japanese man with severe precordial chest pain was

From the Second Department of Internal Medicine, Iwate Medical University, Morioka, Iwate, Japan.
Address for correspondence: Yasuyo Taniguchi, MD, Second Department of Internal Medicine, Iwate Medical University, Uchimaru 19-1, Morioka, Iwate 020-8505, Japan.
Received for publication July 17, 2000.
transferred to our hospital on an emergency basis on September 28, 1996. About 1.5 years before this admission (March 1995), he had been admitted to our hospital complaining of chest pain. This was diagnosed as vasospastic angina because a coronary angiographic study showed an absence of significant coronary artery stenosis and revealed coronary artery spasm provoked by acetylcholine (ACh) in the LAD artery (Figure 1A, B). At that time, ECG showed maximum 0.3 mV ST segment elevation with hyper-acute T waves in the V1 through V4 leads with negative U waves (Figure 2A, B). The patient was treated with a calcium channel blocker, nicorandil and aspirin. Although his chest pain had been occurring every 2 or 3 months, a nitroglycerin (NTG) inhaler relieved his symptoms promptly. These medications were continued during the follow-up period.

On the day of the present admission (September 28, 1996) at 7 AM, he felt chest pain which radiated to his left shoulder. This was eased by a NTG inhaler. At 8 AM, while walking he experienced severe chest pain for which the NTG inhaler was not effective. He consulted a cardiologist and was immediately transferred to our hospital for suspected AMI. He had no personal history of hypertension, hyperlipidemia, diabetes mellitus, smoking or uratemia, nor any family history of obvious heart disease or sudden death. On this admission, he was fully conscious and complained of continuous precordial chest pain. His blood pressure was 113 / 52 mmHg and his heart rate was 58 beats / min. A fourth heart sound was heard at the apex, but a heart murmur and pulmonary rales were not

Figure 1. Coronary angiograms showing coronary spasm before (control) (A) and during (B) the acetylcholine (ACh) provocation test one year before the onset of acute myocardial infarction (AMI). The left anterior descending artery had < 50% organic stenosis and distal area occlusion after intracoronary administration of ACh. Coronary angiograms at the time of admission (17 hrs after the onset of myocardial infarction). TIMI grade I flow was observed after intracoronary infusion of nitroglycerin (C). AMI with thrombus formation occurred in the same site where the spasm was provoked previously.
present. An ECG showed a normal sinus rhythm, normal axis, maximum 0.3 mV ST segment elevation with hyper-acute T waves in the V₁ through V₄ leads and small q waves in the I, aVL, and V₃ through V₆ leads (Figure 2C). The pattern of ECG change was comparable to that recorded during

Figure 2. Twelve-lead electrocardiographs before (control) (A) and during (B) the acetylcholine provocation test and immediately after the onset of acute myocardial infarction (C).

Figure 3. Left ventriculogram at the time of admission (17 hrs after the onset of myocardial infarction). Right anterior oblique (RAO) view and left anterior oblique (LAO) view of diastole and systole.
the previous ACh provocation test (March, 1995). Chest X-rays showed no pulmonary congestion and the cardiothoracic ratio was 50%. His white blood cell count was 15,980 / mc\(^l\) and serum creatine kinase (CK) was 460 IU / l. Emergency coronary angiography (CAG) showed a complete coronary obstruction at segment 7 with massive thrombus. This region appeared to coincide with the site of spasm observed in the previous ACh provocation test. Thrombolysis in Myocardial Infarction (TIMI) grade I flow was observed after infusing NTG into the coronary artery (Figure 1C). Direct percutaneous transluminal coronary angioplasty was performed and the residual stenosis decreased to 32% of the reference diameter at 5 hours after the onset of AMI. His left ventriculogram showed akinesis in segments 2, 3 and 6 (Figure 3). Maximum levels of CK and CK-MB were 2,049 and 184 IU / l, respectively, at 16 hours after the onset of AMI. The patient remained free of complications. On the twenty-first day after the onset of AMI, elective CAG was performed and showed no significant coronary stenosis in the affected region. Spasm was again provoked in the LAD artery after administration of ACh into the left coronary artery. During this provocation test, plasma levels of fibrinopeptide A and plasminogen activator inhibitor I activity rose from 2.3 and 34 ng / ml before provocation to 4.2 and 54 ng/ml, respectively, after provocation.

**DISCUSSION**

Cardiac death or AMI occurs in some patients with variant angina pectoris. However, the exact pathophysiological relationship between coronary spasm and AMI remains unclear. Maseri, et al. and Conti have suggested that in AMI without significant coronary artery stenosis, the most likely cause of ST segment elevation is spasm. In the present case, intracoronary thrombus formation in the LAD artery was found at the distal site of a previously provoked spasm. In addition, the pattern of ECG changes in the early phase of AMI was similar to that observed in the previous ACh provocation test, and emergency CAG showed comparable coronary obstruction. It has also been suggested that coronary atheromatous plaque rupture with subsequent thrombus formation is a common cause of acute coronary syndrome. In view of these observations, we hypothesize that vasospasm may have contributed to the onset of coronary thrombosis and AMI in this case.

It has been reported that patients with AMI manifest a “jump up phenomenon” on coronary angiogram, in which a minimal coronary artery stenosis progresses to total obstruction due to thrombus formation.
ever, the mechanism that generates this phenomenon remains unknown. In this regard, several reports have shown that coronary spasm plays an important role in the triggering of AMI in up to 20% of cases.\(^2,3\) In a Japanese multicenter trial, 349 patients with vasospastic angina were followed for a period of 3.4 ± 0.1 years and AMI occurred in 5%.\(^8\) This suggests that coronary artery spasm plays some part in the pathophysiology underlying the development of AMI. Although the exact role played by vasospasm in the onset of AMI could not be defined in the present case, we speculate that prolonged coronary vasospasm with endothelial damage and/or vascular smooth muscle changes may induce intramural plaque rupture and hemorrhage, resulting in acute thrombus formation and the development of a persistent total coronary occlusion. In addition, coronary vasospasm increases thrombogenicity and decreases fibrinolysis,\(^9-11\) further increasing the likelihood of intracoronary thrombus formation. Indeed, in the case discussed here, plasma levels of fibrinopeptide A and plasminogen activator inhibitor I activity were increased 2 fold and 1.5 fold, respectively, following an ACh provocation test, although we were not able to measure circulating levels of these substances immediately prior to the onset of AMI. To support our hypothesis, it may be necessary to carry out further studies employing intravascular ultrasound to demonstrate the presence of unstable plaques at the site of coronary vasospasm.

In the patient discussed here, infarction-related complete thrombotic occlusion of the LAD artery was shown to have occurred in a coronary region which appeared to coincide with the site of vasospasm documented 1.5 years before the onset of AMI. Although we were unable to define the role played by vasospasm in the onset of AMI, this patient may give us a unique opportunity to consider the role of vasospasm in the etiology of AMI.

**REFERENCES**

ACUTE MYOCARDIAL INFARCTION AT THE VASOSPASM SITE