CASE REPORTS

Coronary Spasm and Thrombosis Associated with Myocardial Infarction in a Patient with Nearly Normal Coronary Arteries

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SUMMARY A 37-year-old man presented with an evolving inferior myocardial infarction. Coronary angiography performed within 3 hours after the onset of the pain showed spasm of the right coronary artery and the presence of intracoronary thrombi. After resolution of spasm and the disappearance of thrombi, angiography revealed nearly normal coronary arteries. An ergonovine test was positive when the patient was not taking medication and became negative when he was taking diltiazem. The course was uncomplicated, and after 9 months the patient is free of angina.

WHAT CAUSES myocardial infarction (MI) in patients with angiographically normal or nearly normal coronary arteries remains unclear. Some studies have suggested a role for coronary artery spasm, but the importance of thrombosis has been better documented, since coronary angiography is performed within the first hours of acute MI. We recently studied a patient with an acute MI associated with probable coronary artery spasm, coronary thrombosis and only slight irregularities of the coronary arterial tree.

Case Report
A 37-year-old white man was admitted to the coronary care unit (CCU) for prolonged anginal chest pain. He had no history of hypertension, diabetes mellitus or lipid abnormalities, but had smoked 30 cigarettes daily for 20 years. He had a 1-year history of infrequent spontaneous and exertional substernal pain. At 11:30 a.m. on December 23, 1981, he experienced a severe typical anginal pain and was admitted to the CCU at 12:45 p.m. Physical examination was normal. The chest x-ray revealed a heart of normal size. Serum creatine kinase was 23 U (normal range 0–140 U/ml). Hemoglobin was 13.2 g. An ECG showed normal sinus rhythm and 0.2 mV of ST-segment elevation in leads III and V; (fig. 1). An inferior myocardial infarction was suspected and the patient was considered for percutaneous transluminal coronary recanalization. The procedure was started at 2:00 p.m. Cardiac catheterization was performed using a percutaneous femoral approach. Left ventriculography was obtained in the 30° right anterior oblique projection at 50 frames/sec using a #8F pigtail catheter and selective coronary angiography in multiple views using a #8F Judkins catheters. Left ventricular systolic pressure was 15 mm Hg. Left ventriculography revealed diaphragmatic and posterobasal akinesia and a global ejection fraction of 54%. The left coronary angiogram was normal. The right coronary angiogram (fig. 2) showed complete obstruction of the proximal right coronary artery (RCA). Heart rate (HR) was 90 beats/min and blood pressure (BP) 95/60 mm Hg. Intracoronary nitroglycerin (1.5 mg) was injected.

The patient experienced severe bradycardia (38 beats/min) followed by a drop in BP to 50/25 mm Hg and a 3-second pause. Half a milligram of i.v. atropine was injected and cardiac massage was performed. After 30 seconds, his HR was 50 beats/min and BP 70/40 mm Hg; HR and BP returned to previous values within 2 minutes. Another right coronary angiogram showed only a discrete stenosis at the site of the previous obstruction and the presence of intracoronary filling defects consistent with thrombi (fig. 3). A second left ventriculogram showed local contraction improvement, moderate diaphragmatic and posterobasal hypokinesia and a global ejection fraction of 61%. Because of the cardiac massage, intracoronary injection of streptokinase was cancelled. The patient received i.v. heparin, 360 mg, and i.v. nitroglycerin, 25 mg daily. His clinical course was uncomplicated (no pain, arrhythmia or heart failure). The maximum CK value of 1000 U/ml was reached on December 24. The ECG (fig. 4) showed a definite inferior MI. Another catheterization was performed on January 5, 1982, using the same technique. The left ventriculography once again revealed moderate diaphragmatic and posterobasal hypokinesia and a global ejection fraction of 61%. Coronary angiography showed a normal left coronary artery, only slight irregularities of the proximal RCA and the disappearance of intracoronary filling defects (fig. 5). An ergonovine test was performed in the CCU, off medication, using a progressive protocol as previously described. Ten minutes after the 0.2-mg injection of ergonovine maleate, the patient experienced typical anginal pain and the ECG (fig. 4) showed 0.2 mV of ST-segment elevation in the inferior leads, which was reversed with 0.3 mg of i.v. nitroglycerin. Nifedipine was prescribed and could not be increased because of severe nausea; an ergonovine test

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was performed at the highest well-tolerated dose (40 mg/day). The test remained positive in the same leads for the same dose of ergometrine. Nifedipine was then replaced by diltiazem, 360 mg/day, and the ergonovine test became negative. The patient was discharged on January 16, 1982. After a 9-month follow-up, he is free of angina and diltiazem is well tolerated.

Discussion
This case illustrates the occurrence of both coronary spasm and thrombosis within 3 hours of the onset of pain in an evolving MI in a young cigarette smoker. Historical, electrocardiographic, enzymatic and ventriculographic evidence of MI was associated with nearly normal coronary arteries. The second coronary angiogram performed after intracoronary injection of nitroglycerin showed patency at the site of previous obstruction. The presence of two intracoronary filling defects and their disappearance on the subsequent angiogram are consistent with the diagnosis of intracoronary thrombi. After intracoronary nitroglycerin, bradycardia and a drop in BP required i.v. atropine and cardiac massage. Because 1.5 mg of nitroglycerin were injected into the RCA, it might be suggested that this dosage induced the fall in BP; however, it seems more likely that this hypotension without transient tachycardia and preceded by bradycardia was vagally mediated, as suggested by the response to atropine. Such an effect seems to be unrelated to the dosage. It could be argued that cardiac massage might have fragmented the clot sufficiently for patency of the vessel to be reestablished; but in this case the coronary angiogram would probably have shown intracoronary thrombi more distally in the vessel and the cardiac massage was brief. Thus, it seems more likely that the mechanism of the reappearance of a forward flow in the RCA was coronary spasm relieved by intracoronary nitroglycerin. In addition, 2 weeks later the ergonovine test was positive in the inferior leads and it can be assumed that this resulted from right coronary spasm.

For decades, coronary thrombi were believed to be the sole precipitating factor of MI because they were found at necropsy in patients with fatal MI. In a recent necropsy study, thrombi were found in major coronary arteries already narrowed by atherosclerotic
plaques. De Wood et al.,4 in an angiographic study of patients in the early stage of MI, demonstrated a complete absence of blood flow in 87.3% of patients studied within 4 hours and in 85.3% between 4 and 6 hours. Of these 322 patients, 69.8% had definite angiographic features of thrombus. The first data of intracoronary thrombolytic therapy, which restored angiographic patency in as many as 80% of patients,5,10 suggest that intracoronary thrombi were present at this stage of acute MI. Because of the delay between the onset of MI and the coronary angiography, these findings do not establish the responsibility of thrombosis as the initial event in acute MI.

Coronary spasm has been shown to be a major factor in patients with variant angina,11 but its exact relevance in MI remains controversial.12 Several reports indirectly suggest an important role for coronary spasm in acute MI: MIs during coronary angiography in patients with normal coronary arteries were probably caused by arterial spasm,2,13 similar to MIs induced by long-term nitroglycerin exposure and subsequent withdrawal.1 Coronary spasm superimposed on an atherosclerotic obstruction has been strongly suggested by the study by Oliva and Breckinridge,14 who showed the reappearance of a forward flow after intracoronary nitroglycerin in six of 15 patients within 10 hours after an acute MI. Maseri et al.15 demonstrated the occurrence of MI due to the occlusion of an artery at the site of a previous vasospasm. Ergonovine-induced coronary spasm has been shown in 20% of 116 patients within 6 weeks of an acute MI.16

Some investigators pointed out the usual ineffectiveness of intracoronary nitroglycerin injected before streptokinase to restore a forward flow in acute MI.17 In most studies, intracoronary thrombi often appeared to be superimposed on a severe atherosclerotic coronary stenosis.5,18 Conversely, the patient we studied is another case of MI in a young male smoker with nearly normal coronary arteries. The presence of coronary spasm at the site of coronary occlusion was suggested because of complete reopening of the coronary lumen after intracoronary nitroglycerin. The presence of both vasospasm and thrombosis do not establish which was the primary event. The positivity of a subsequent ergonovine test in the same artery in our patient suggests the existence of "vasospastic disease." Although evidence for direct cause and effect is still lacking, we
hypothesize that in some cases, as in our patient, coronary spasm may have initiated the process that resulted in thrombotic occlusion of the coronary artery.

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References
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