Case report - Cardiac general
Internal mammary revascularization in patients with variant angina and normal coronary arteries
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Abstract
Patients with variant angina refractory to medical therapy pose a difficult management problem. In patients with discrete obstructive lesions, coronary revascularization may be helpful. However, it has been widely accepted that coronary revascularization is contraindicated in patients with isolated coronary spasm without evidence of obstructive disease. Here we describe the two patients with life-threatening, medically intractable Prinzmetal’s angina and angiographically normal coronary arteries, both of whom underwent coronary-artery-bypass surgery with the internal-mammary-artery (IMA) graft. These operations resulted in rapid, complete remission of coronary spastic attacks in both patients. Postoperative angiography reveals how the IMA graft works during spastic attacks.

Keywords: Internal-mammary-artery; Variant angina; Coronary-artery-bypass surgery

1. Introduction
Variant angina is caused by coronary artery spasm, and the clinical manifestations vary from chest discomfort to potentially life-threatening, ventricular arrhythmia and myocardial infarction, as well as sudden cardiac death. With a calcium-channel blocker and nitrate, the majority of patients have a favorable long-term prognosis and are associated with an event-free clinical course [1]. A few patients, however, sustain life-threatening attacks even with maximally tolerated doses of medication. Although coronary artery spasm usually develops at the site of an angiographically detectable obstruction, it may also occur in arteries with no detectable obstructive disease at angiography. In the patients with discrete, proximal fixed obstructive lesions, coronary angioplasty, or occasionally coronary-artery-bypass surgery (CABG), may be helpful [2]. However, it is generally accepted that isolated coronary artery spasm without evidence of obstructive disease is an absolute contraindication to coronary revascularization. Here we will describe two Japanese patients with life-threatening, medically intractable Prinzmetal’s angina and angiographically normal coronary arteries who underwent CABG with a successful therapeutic result.

2. Case reports
Patient 1, a 58-year-old woman had a six-month history of recurrent chest pain. Coronary angiography revealed normal coronary arteries with no evidence of atherosclerotic change (Fig. 1A and B). Variant angina was diagnosed by an ergonovine provocation test. Methylergometrine solution was injected into the left main coronary artery and, then, the right coronary artery through the catheter. Ergonovine provoked severe focal spasm of the right main coronary artery (Fig. 1C) accompanied by ST-segment elevation and complete A-V block. Medical treatment with maximally tolerated doses of a calcium-channel blocker and nitrate (6 mg/kg of diltiazem, 0.3 mg/kg of amlopidine, 0.8 mg/kg of nifedipine, and 1.25 mg/kg of nitrate) was prescribed. However, she sustained severe chest pain associated with bradycardia and hypotension. These attacks occurred every morning within 1 week prior to surgery. Therefore, we decided to perform CABG as a last hope.

Patient 2, a 69-year-old woman presented with one-year history of recurrent chest pain. Coronary angiography revealed normal coronary arteries. Ergonovine provoked severe focal spasm of the right main coronary artery accompanied by ST-segment elevation. Furthermore, we injected methylergometrine solution into the right internal-mammary-artery (IMA) directly, and methylergometrine did not induce the constriction of this artery. In spite of medical treatment with maximally tolerated doses of a calcium-channel blocker and nitrate (6 mg/kg of diltiazem, 0.3 mg/kg of amlopidine, 0.8 mg/kg of nifedipine, and 1.25 mg/kg of nitrate), she sustained severe angina. During hospitalization, she had an attack of ventricular fibrillation requiring cardioversion. This attack made us decide in performing CABG.
artery disease, was associated with high morbidity, mortality.

3. Discussion

Previous studies demonstrated that CABG in patients who had coronary spastic angina, without the fixed coronary artery disease, was associated with high morbidity, mortality, and recurrence of angina [3]. Possible explanations for the poor surgical results may include intraoperative coronary spasm, diffuse spasm involving the graft anastomosis site, and use of the saphenous vein grafts. In 1981, Sussman and colleagues reported CABG in two patients who had focal coronary spasm with fixed obstructions of less than 20% with favorable results [4]. Their revascularization methods were that a saphenous vein bypass graft was placed distal to the area of focal spasm and the native coronary artery was ligated proximally.

In our surgical revascularization methods, (1) the in-situ IMA was used, (2) the IMA graft was placed on the coronary artery distal to the spastic area, (3) we did not ligate the native coronary artery, and (4) we used cardiopulmonary bypass. First, for use of the in-situ IMA, Hanet and colleagues demonstrated that ergonovine did not change the caliber of IMA bypass graft significantly, whereas that of saphenous vein graft was reduced [6,7]. In addition, the IMA graft is thought to be capable of adapting its blood flow supply to meet the demands of the myocardium. Therefore, we postulated that the IMA would be a more suitable graft for patients with variant angina, as compared with saphenous vein. Second, focal rather than diffuse spasm with maintenance of distal flow may be a prerequisite for the success of surgical revascularization. Therefore, our two patients were carefully studied to document any spasm in the coronary arteries, and the IMA graft was placed on the coronary artery distal to the focal spastic area induced by the ergonovine provocation test. Third, spontaneous remission of variant angina is frequent [5]. Therefore, we hesitated to ligate the native artery in our patients. Finally, we were afraid that coronary spasm during

After the patients gave written informed consent, the two patients underwent CABG. Our surgical revascularization methods were: (1) the pedicled, in-situ right IMA was used as a graft, (2) the IMA graft was placed on the right coronary artery distal to the focal spastic area induced by the ergonovine provocation test, (3) we left the right coronary artery as it was, and (4) surgery was performed using cardiopulmonary bypass.

Immediately after the surgery, the two patients attained symptom-free completely, and needed no medication for variant angina. One month later, after the CABG surgery, both patients underwent an angiography. Two catheters were placed in each patient: one in the right coronary artery and the other in the right IMA so that we could inject contrast simultaneously. Before the ergonovine provocation test, a contrast injection in the right coronary arteries revealed normal antegrade blood flow, followed by a small filling defect at the anastomosis site between the IMA graft and native coronary artery (Fig. 2A). Next, we injected methylergometrine solution and contrast into the right coronary artery, and the IMA graft. Contrast injection in the native coronary artery demonstrated severe spasm of the proximal coronary artery with no filling of the distal portion of the coronary artery (Fig. 2B). In comparison, contrast injection in the IMA graft revealed that the distal coronary artery was filled through the IMA graft (Fig. 2C). The ergonovine provocation test induced neither chest pain nor ECG change in the two patients. Patient 1 remains symptom-free after more than 5 years, and Patient 2 remains symptom-free after more than 3 years.

3. Discussion

Previous studies demonstrated that CABG in patients who had coronary spastic angina, without the fixed coronary artery disease, was associated with high morbidity, mortal-
the anastomosis procedure would be devastating. Therefore, we performed the surgery with the use of cardiopulmonary bypass.

Post-operative angiography clearly demonstrated during the ergonovine provocation test, that the IMA graft supplied blood flow in the distal coronary artery. We believe that this blood supply could prevent angina, ventricular arrhythmia, and myocardial ischemia during a spastic attack. We are concerned about the long-term patency of the IMA grafts because competitive blood flow between the IMA graft and native coronary artery would reduce the patency of the IMA graft. However, our surgical method is indicated for the patients with medically intractable, life-threatening variant angina as a last hope.

References