

Bridging Collateral from an Internal Mammary Arterial Graft to a Coronary Artery

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Summary. We report a rare case with bridging collateral communication from an occluded internal mammary arterial graft to the native left anterior descending coronary artery. Although the mechanism underlying the development of this unique collateral vessel is unknown, the phenomenon may imply a future possibility of effective angiogenesis from extra-cardiac systemic arteries to the coronary arteries in humans.

Key words— angiography, angiogenesis, collateral blood flow, CABG arterial grafts.

INTRODUCTION

Implementing angiogenesis is a future therapeutic strategy for ischemic heart diseases. Nevertheless recent basic and clinical efforts, we have not succeeded in inducing angiographically visible angiogenesis. Inter-coronary collateral vessels are angiographically visible and seem to be outgrowths of pre-existing immature vascular connections; namely arteriogenesis. Bridging collateral vessels may also represent angiogenesis, but they are much rarer than inter-coronary collaterals. The factors leading to the formation of bridging collaterals are unknown. We report here a case with bridging collateral communications from an occluded internal mammary arterial graft to the native left anterior descending coronary artery. Although the mechanism underlying the development of this unique collateral

vessel is unknown, the phenomenon may imply a future possibility of effective angiogenesis from extra-cardiac systemic arteries to the coronary arteries in humans.

CASE REPORT

A 63-year-old Japanese man was admitted to Niigata University Hospital in March 2003 for follow-up coronary angiography. He had complained of chest oppression on exertion 22 years before. Some three years later (on May 24, 1984), he underwent his first coronary artery bypass grafting (CABG) operation using aorto-coronary saphenous vein bypasses to the left anterior descending (LAD), left circumflex (LCX), and right coronary arteries (RCA). The vein graft connected to the LCX was occluded immediately after the operation. Eleven years after the first operation, a graft from ascending aorta to RCA was also occluded.

In October 2001, the patient felt chest oppression while walking and was admitted to our hospital. His electrocardiogram showed negative (inverted) T-waves in leads V2-V4. Coronary angiography revealed a totally occluded saphenous vein bypass connecting the ascending aorta and the LAD. Therefore, he underwent a second CABG operation on December 4, 2001 connecting the left internal mammary artery to the LAD, with another bypass from the ascending aorta to the RCA using the free left radial artery. Soon after the second CABG, coronary angiography revealed that both bypass grafts were patent with 50% stenosis at the left internal

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Abbreviations – CABG, coronary artery bypass grafting; LAD, left anterior descending artery; LCX, left circumflex artery; RCA, right coronary artery.

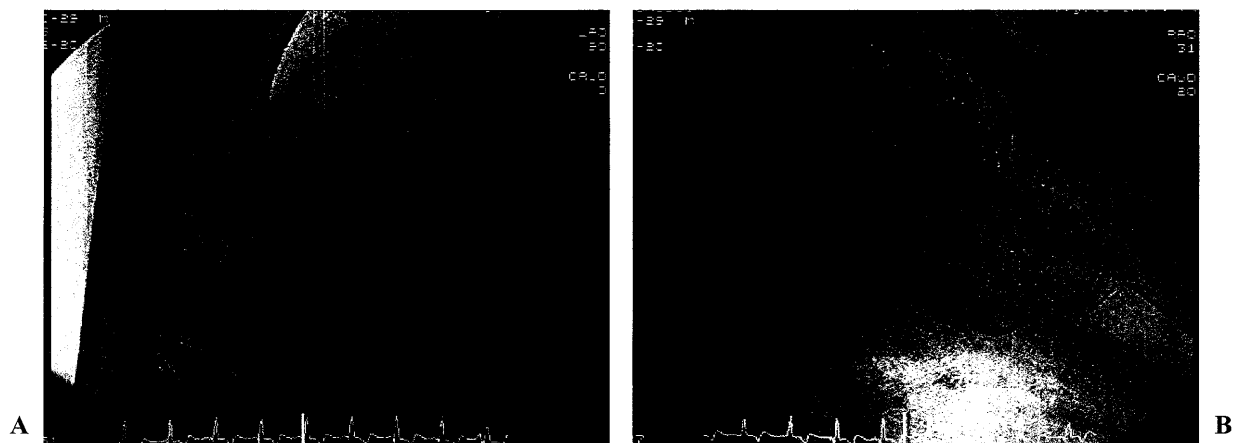


Fig. 1. Coronary angiography performed soon after the second coronary artery bypass grafting (CABG) revealed a patent internal mammary arterial graft with 50% stenosis at the anastomosis site. **A** is right anterior oblique and caudal view. **B** is a left lateral view.

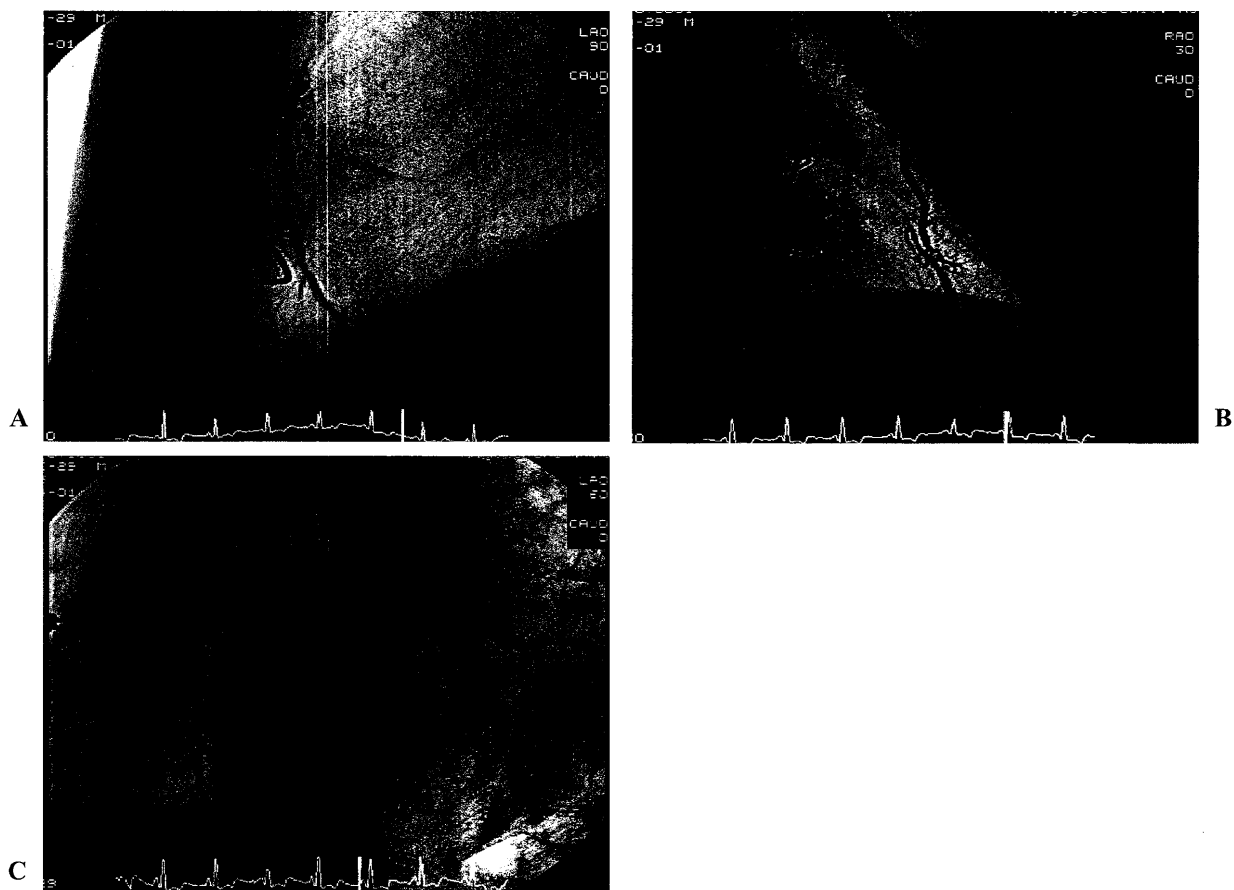


Fig. 2. Follow-up coronary angiography showed total occlusion of the left internal mammary artery at its anastomosis site, with the appearance of bridging collateral vessels from the left internal mammary artery to the left anterior descending artery (LAD). **A** is a right anterior oblique view. **B** is a left lateral view, and **C** is a left anterior oblique view.

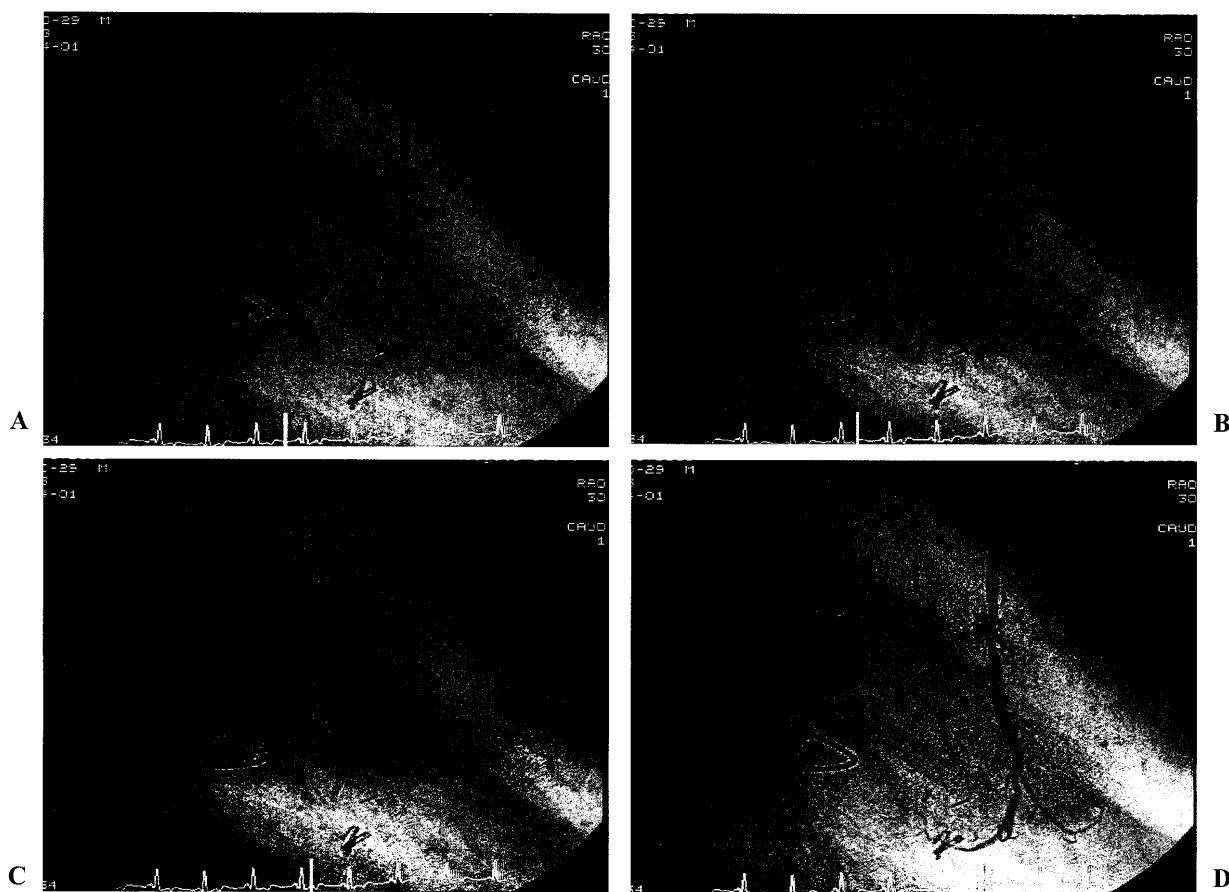


Fig. 3. Sequential views of coronary angiography via the left internal mammary artery graft. **A** shows bridging collateral vessels at the anastomosis site. The left anterior descending artery has been slightly filled by contrast through the bridging collateral at **B**. **C** and **D** are subsequent views.

mammary anastomosis site (Fig.1). Following this, the patient reported symptomatic relief and was discharged and followed up in the out-patient clinic.

Fifteen months later after the second CABG, the patient was re-admitted to our hospital for a follow-up examination on March 28, 2003. Coronary angiography showed a total occlusion of the left internal mammary artery at the site of anastomosis, with the appearance of bridging collateral vessels from the left internal mammary artery to the LAD (Fig.2 and 3). Notably, the LAD was promptly filled through these bridging collateral vessels. Left ventriculography showed apical asynergy, which had been reported in the prior examination. On exercise testing, the patient did not complain of angina or other chest symptoms. Thus, these unique bridging collateral vessels seemed effective in preserving his functional class.

DISCUSSION

The formation of new collateral vessels from extra-cardiac systemic arteries to the coronary artery is an extremely rare event. Usually, the pericardium and pericardial space constitute natural barriers that prevent the development of collateral vessels from the extra-cardiac arteries. Only a few reports have described such communication between an intact left internal mammary artery and coronary artery via pericardial twigs.^{1,2)} Those kinds of collaterals might represent an arteriogenesis phenomenon. The unique event in this case was the development of bridging collateral vessels from an occluded left internal mammary arterial graft to the LAD, which — to our knowledge — has not been reported to date. The bridging collateral vessels in this case represent an exclusive phenomenon of newly-developed angiogenesis, but not arteriogenesis. In fact, it

is impossible for us to clarify the mechanisms underlying the development of bridging collaterals in this case. The operative procedure-related inflammation may play a crucial role in the development of this phenomenon.

When internal mammary arteries are implanted into the myocardium by the Vineberg procedure, effective collaterals occasionally develop.^{3,4)} However, the Vineberg procedure has a low potential to induce the formation of collateral communications along with its high post-operative mortality during the periods needed to fully develop these presumed collaterals.⁵⁾ Though direct bypass grafting to the coronary arteries is a quite effective procedure, graft insufficiency may appear in a long-term follow up. The conjunctive therapy of direct bypass grafting with the other procedures promoting the formation of collateral vessels between grafted arteries and the coronaries may become a promising therapeutic option in the future.

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