

## Post-Coronary Artery Bypass Grafting Myocardial Ischemia Caused by an Overgrown Left Internal Thoracic Artery Side Branch

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We present a patient who developed recurrent angina after coronary artery bypass grafting (CABG). Myocardial single-photon emission computed tomography (SPECT) demonstrated deterioration in the myocardial perfusion, and coronary angiography revealed an overgrown side branch of the grafted left internal thoracic artery (ITA); otherwise, there were no significant changes compared with previous imaging studies obtained after the CABG. After percutaneous embolization of the grafted left ITA side branch, the angina was resolved and myocardial SPECT showed improved perfusion.

Key words: 1. Angina  
2. Coronary artery bypass surgery  
3. Mammary arteries  
4. Therapeutic embolization

### CASE REPORT

A 73-year-old man with a history of hypertension and hyperlipidemia presented with dyspnea during exercise and recurrent angina. The patient had undergone off-pump coronary artery bypass grafting (OPCAB) 5 years prior due to unstable angina with 3-vessel disease. The left internal thoracic artery (ITA) was skeletonized as proximally as possible, and all the visible branches were clipped and divided. Then, the right gastroepiploic artery (RGEA) graft was anastomosed to the side of the left ITA in order to construct a Y-composite graft. Thereafter, the left ITA was grafted to the second diagonal (D2) artery and the left anterior descending coronary artery (LAD), and the RGEA was grafted to the first diagonal artery (D1) and the obtuse marginal coronary artery in a sequential

manner. On postoperative day 1, a coronary angiography was performed to confirm all patent grafts and good blood flow to the coronary arteries. Outside of that, a side branch of the grafted left ITA, which we were unable to remove because of its proximal branching position, was noticed. At the 1-year postoperative follow-up, an angiography revealed an occluded left ITA-to-LAD anastomosis. Although the patient did not exhibit symptoms of angina, percutaneous coronary stenting of the native LAD was performed to improve the coronary perfusion of the LAD region. Although the patient had been free of angina since the OPCAB, dyspnea on exertion and occasional chest discomfort developed several months before the 5-year follow-up. Myocardial single-photon emission computed tomography (SPECT) showed aggravated resting perfusion of the lateral cardiac wall compared with the 1-year

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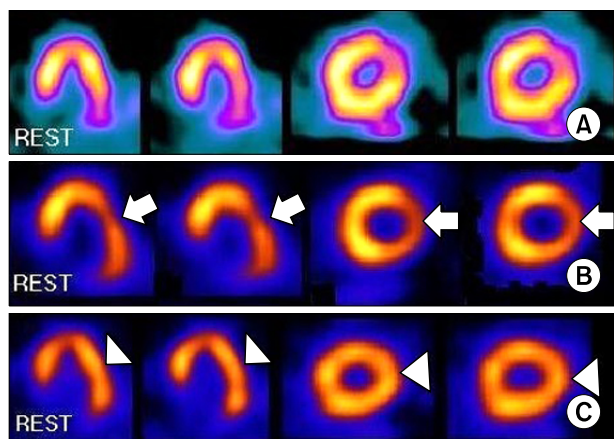
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postoperative myocardial SPECT (Fig. 1). Coronary angiography demonstrated the patency of the LAD stent and the other grafts (except for the LAD graft) and the absence of



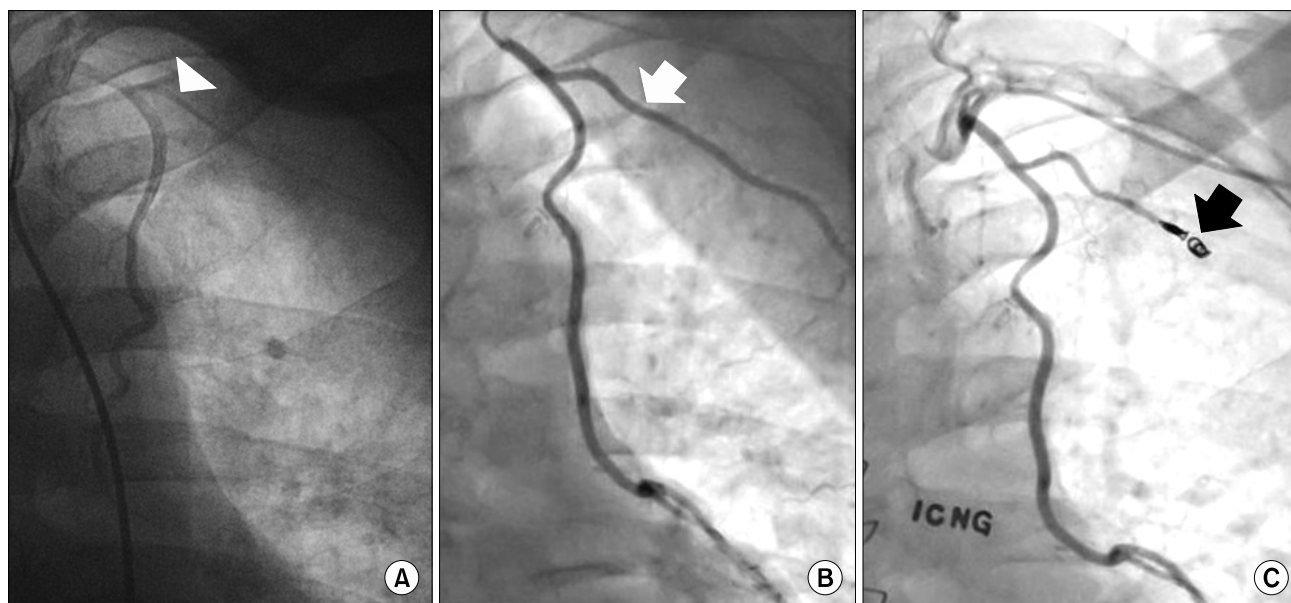
**Fig. 1.** Changes in myocardial SPECT. (A) Follow-up myocardial SPECT obtained 1 year after coronary artery bypass grafting. (B) Myocardial SPECT obtained after the reappearance of angina symptoms shows aggravated resting perfusion of the lateral wall as compared to the previous one (white arrow). (C) Myocardial SPECT obtained 4 months after the left internal thoracic artery side branch embolization demonstrates improved lateral wall perfusion (white arrow head). SPECT, single-photon emission computed tomography.

significant progression of the native coronary artery disease. A comparison with the preoperative angiogram revealed that the side branch of the grafted left ITA had overgrown to a size similar to that of the left ITA (Fig. 2).

We decided to occlude the vessel through a percutaneous approach because there were no possible causes of angina or dyspnea other than the overgrown side branch of the grafted left ITA. After approaching the left ITA through the left radial artery by using a 7-Fr internal mammary-guiding catheter (Launcher; Medtronic, Minneapolis, MN, USA), 4/2 and 5/2 microcoils (Tornado embolization microcoil; Cook, Bloomington, IN, USA) were deployed at the proximal end of the side branch of the grafted left ITA. The vessel was successfully occluded with no complications, and no residual flow was observed (Fig. 2). After the procedure, the patient's angina symptoms disappeared. A follow-up myocardial SPECT performed 4 months after the vessel occlusion procedure demonstrated improved perfusion of the lateral cardiac wall (Fig. 1).

## DISCUSSION

The ITA has become the primary conduit to revascularize



**Fig. 2.** Percutaneous embolization of the overgrown side branch of the left ITA. (A) Preoperative angiogram shows a relative small side branch as compared to the left ITA (white arrowhead). (B) Postoperative angiogram demonstrating the overgrown side branch of the left ITA (white arrow). (C) The overgrown side branch of the left ITA was successfully occluded (black arrow). ITA, internal thoracic artery.

the LAD because of its excellent long-term patency and increased long-term survival rate compared with saphenous vein grafts [1,2]. The incidence of the large side branch of the in situ left ITA is reported to occur in approximately 10% of patients who have undergone coronary artery bypass grafting [3]. Some studies have demonstrated the existence of coronary steal due to a large left ITA (LITA) side branch in patients with recurrent angina [4,5]. It is hypothesized that a large ITA side branch has preferential flow and draws blood away from the myocardium through patent side branches, causing angina recurrence or graft failure. However, the association between the large left ITA side branch and recurrent angina remains controversial. Other studies have evaluated the potential effects of the enlarged ITA side branch and have demonstrated that there is no significant diversion of the flow from the coronary circulation [6,7].

Therefore, coronary steal by the overgrown ITA side branch should be considered the cause of recurrent angina only after the exclusion of other possibilities. Major causes of recurrent angina include incomplete revascularization, progression of native coronary disease, and graft occlusion. In addition, the overgrown side branches of the ITA may be considered the cause of recurrent angina if other causes have been excluded. In the present case, angiography showed a patent LAD stent, patent grafts to other coronary territories, and the absence of native coronary disease progression. The myocardial SPECT showed deterioration in the resting perfusion of the lateral cardiac wall relative to 1 year postoperatively. Furthermore, after the occlusion of the overgrown side branch of the grafted left ITA, the patient's angina symptoms disappeared, and the myocardial SPECT demonstrated improved perfusion of the lateral myocardial wall.

The occlusion of the ITA side branch can be performed using either open or video-assisted thoracoscopic surgery [8]. However, recent studies have concluded that less invasive methods, such as percutaneous transcatheter embolization, are preferable [5]. To occlude the ITA side branch safely and effectively, some principles are recommended. First, the possibility of damaging the ITA should be minimized by using a small-diameter delivery system with a smooth distal section. Second, the occlusion must be solid and permanent. Although we deployed two coils, additional coils may be used if the

ITA side branch is large. Third, the transradial approach has some advantages over the transfemoral approach, including reduced local complications, greater patient comfort, and ease of access to the LITA.

In conclusion, although coronary steal by the ITA side branch is uncommon, it should be considered a cause of recurrent angina after other causes are excluded. Furthermore, percutaneous transcatheter embolization can be a safe option for occluding an ITA side branch.

## CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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