cal symptoms of heart failure; therefore, we decided to apply permanent BVP to the patient. A permanent pacemaker (KDR701, Medtronic) was implanted in the left subcostal space, and the three leads were connected to the pacemaker with a Y-adapter (5866-38M, Medtronic). We set the pacemaker to dual chamber pacing, dual chamber sensing, dual mode of response (DDD) pacing with an AV delay of 120 milliseconds. The threshold of the LV ventricular lead was 1.5 V at a pulse width of 0.4 milliseconds. Fifteen months after surgery, the patient is doing well, without special limitations on his daily life.

## Comment

Most surgical treatments for severe congestive heart failure remain challenging. Endoventricular circular patch plasty with CABG ameliorates clinical symptoms and aids long-term survival in patients with ischemic cardiomyopathy [1]. Biventricular pacing has also been shown to improve cardiac contractility and clinical symptoms in patients with severe chronic heart failure and interventricular conduction delay, especially CLBBB [2, 3]. Cardiac inefficiency occurring in CLBBB is due to dyssynchronous LV contraction. Biventricular pacing restores systolic contractile synchrony (resynchronization), which also results in efficient LV contraction and reduces mitral regurgitation [2]. The AV interval is shortened to optimize ventricular filling, thus also decreasing presystolic mitral regurgitation [3].

Preoperative evaluation of our patient showed good indication for BVP (CLBBB on electrocardiography and severe LV dysfunction on ultrasonic echocardiography). Because intravenous coronary sinus lead implantation for BVP has not been approved in Japan, we decided to implant an epicardial LV lead that would be available for temporary or permanent use for BVP. Just after surgery, BVP increased blood pressure and LV stroke work index, and reduced mitral regurgitation and pulmonary arterial wedge pressure. Because of the significant improvement obtained by BVP, the pacing was continued with a temporary pacemaker, and a permanent generator was implanted 1 month after the initial operation. Recently, intravenous lead implantation for BVP has become common, but the success rate of coronary sinus lead implantation is reported to be low (53.3% to 83%) [4, 5]. Surgical implantation of epicardial LV leads during primary surgery is more reliable than intravenous implantation, and may be an optional strategy for cardiac surgery patients with severe LV dysfunction and CLBBB.

It is extremely important to minimize ischemic injury of viable myocardium in surgery for patients with severely impaired LV function. In recent years, off-pump CABG has been reported to induce less myocardial injury than conventional CABG using cardioplegic solution [6]. To protect the viable myocardium during surgery, we performed all procedures on the beating heart with the assistance of cardiopulmonary bypass, and immediately perfused the grafted area after each distal anastomosis through a coronary perfusion cannula connected to the cardiopulmonary bypass circuit. This method allows continuous coronary perfusion to be maintained except for the short-term regional cardiac ischemia that occurs during creation of distal anastomoses.

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CASE REPORTS

# Severe Hemoptysis 6 Years After Coronary Artery Bypass Grafting

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**A patient with a history of coronary artery bypass grafting was admitted with severe hemoptysis. Bronchoscopy showed recent bleeding with clot formation in the lingular bronchus, but no tumor was visualized. Several biopsies of the underlying mucosa were negative. Coronary angiography showed patent venous and arterial bypass grafts. Selective angiography of the left internal mammary artery revealed one large and two smaller aberrant bronchial side branches, which probably caused the lingular hemorrhage. We performed embolization of the largest aberrant branch. After a follow-up of 3 months, hemoptysis had not recurred.**

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When a patient is admitted with coughing of blood, differential diagnosis must be made with hemoptysis, hematemesis, and bleeding in the upper airways such as epistaxis. When hemoptysis is obvious, several causes must be excluded, bronchogenic carcinoma being most common. Other causes (eg, tuberculosis, bronchiectasis, chronic pulmonary embolism, aspergilloma, benign pulmonary neoplasia, thoracic trauma, bronchitis, left ventricular failure, mitral insufficiency, clotting abnormalities, amyloidosis, bilateral congenital pulmonary artery stenosis, and pulmonary venous obstruction) are to be considered. If a patient has a history of coronary artery bypass surgery (CABG), the cause of hemoptysis may be related to the grafts used in the surgical procedure.

A 68-year-old man presented with severe hemoptysis of about 1.5 L. History revealed CABG 6 years before, which was indicated for three-vessel coronary artery disease. The left internal mammary artery was grafted to the mid portion of the left anterior descending artery, and saphenous vein grafts were used to bypass the circumflex and right coronary artery. An interposition graft for an abdominal aortic aneurysm had been inserted 1 year before.

Physical examination showed tachycardia (120 beats/min) and arterial hypertension (193/122 mm Hg). Besides a slightly decreased kidney function (urea 64 mg/dL, creatinine 1.62 mg/dL, normal plasma osmolarity) and an elevated fibrinogen (580 mg/dL), blood tests were normal. Hemoglobin concentration was 15.5 g/dL, indicating that hemodilution had not yet occurred. Clotting tests were normal. Electrocardiography did not show any abnormality. Chest radiography demonstrated intense bronchovascular markings. Computed tomography of the chest identified a dense infiltrate in the lingula that was compatible with recent hemorrhage.

Bronchoscopy showed clot formation in the lingular bronchus without any evidence of a bronchogenic carcinoma. Several biopsy specimens of the underlying lingular mucosa were taken to exclude malignancy; results were negative in all cases. Gastroduodenoscopy did not reveal any abnormalities. The bleeding spontaneously ceased.

One week later, the patient had a second episode of hemoptysis of about 25 mL. Coronary angiography demonstrated patent arterial and venous bypass grafts. An initial attempt to catheterize the left internal mammary artery from a femoral approach was unsuccessful. Therefore, the artery was catheterized from a left brachial approach, with a 4F Cobra catheter (Terumo, Haasrode, Belgium), and showed the existence of one large and two smaller aberrant bronchial arterial branches coursing to the lingular segment (Fig 1). Most likely, these vessels gave rise to the episodes of lingular hemorrhage. The major aberrant side branch of the internal mammary artery was superselectively catheterized using a 2.7F Leggiero catheter (Terumo), and embolization was performed using polyvinyl alcohol particles (Contour, 250 to 355 $\mu$, Target, Boston Scientific Corporation, Natick, MA)

*Fig 1. Aberrant left bronchial arterial branches originating from the left internal mammary artery.*

and platinum flower microcoils (2 mm/2 cm and 3 mm/3 cm, Target, Boston Scientific Corporation) (Fig 2).

After a follow-up of 3 months, the patient was in good general condition, and hemoptysis had not recurred.

## Comment

This case report describes a patient with episodes of severe hemoptysis 6 years after CABG, a widely used procedure in the treatment of significant coronary artery disease. Extensive hemoptysis post-CABG is a very rare complication. One publication reports a case of hemoptysis caused by an aneurysm of the saphenous vein bypass graft after mediastinal infection [1].

Left bronchial arterial branches that usually originate directly from the aorta have been reported to arise from the internal mammary artery [2]. Several reports indicate the importance of the internal mammary artery, its side branches, and collateral vessels in patients with recurrent hemoptysis. However, none of these patients had a history of CABG [3].

Unusual complications after CABG include an arteriovenous fistula of the left internal mammary artery and vein, and a fistula between the internal mammary artery

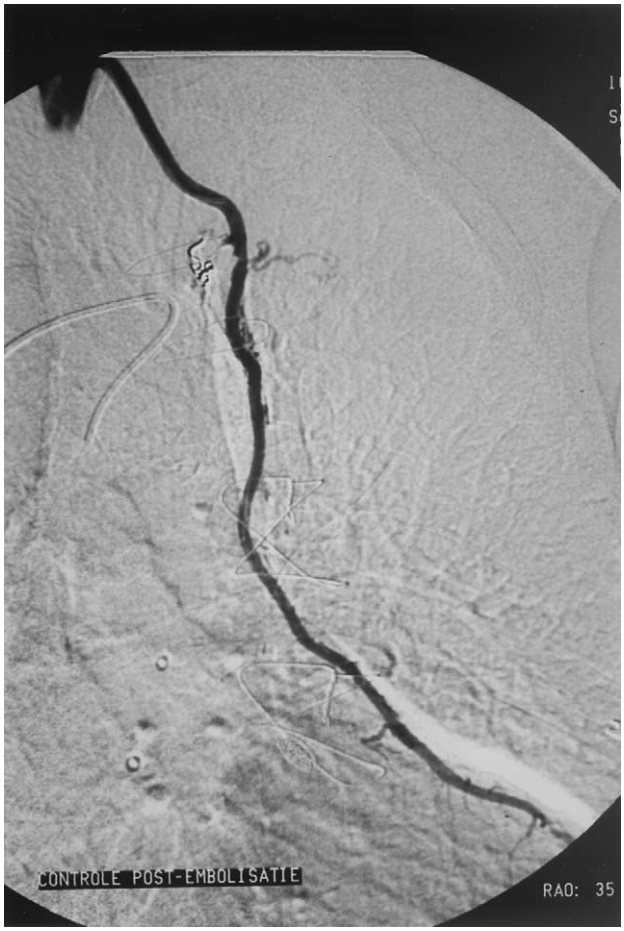


*Fig 2. Embolization of the largest aberrant bronchial artery using polyvinyl alcohol particles and platinum flower microcoils.*

and the pulmonary vasculature. In these cases, however, hemoptysis was not reported. Mostly, these patients experience recurrent angina as a result of a steal phenomenon by side branches of the internal mammary artery bypass graft [4–6].

With our patient, the large amount of blood did suspect an extensive bleeding in the lung after hematemesis was ruled out. Most likely, the aberrant bronchial side branches of the left internal mammary artery caused the lingular bleeding. The fact that the bleeding arose several years after the surgical procedure is quite remarkable. We suggest that a chronic elevated blood flow and intravascular pressure in a functional internal mammary artery bypass graft caused an erosion of the aberrant side branches into the lingular segment. Such progressively degenerative changes in these branches, which were not ligated during the initial CABG, could explain the interval between operation and event of hemoptysis.

Several studies demonstrate the value of embolization of the internal mammary artery side branches in case of recurrent hemoptysis, although no patients with post-CABG hemoptysis are reported in these publications [3]. With our patient, embolization of the major aberrant side branch was perfomed using polyvinyl alcohol particles and platinum flower microcoils. This was done carefully to avoid reflux of particles into the coronary artery or coil misplacement in the internal mammary artery. In this case, embolization was an acceptable alternative for reoperation and effective control of hemoptysis was obtained.

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CASE REPORTS

# A Successfully Treated Case of Blunt Traumatic Right Coronary Ostium Rupture

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**Cardiac tamponade due to coronary artery rupture, as a consequence of blunt trauma, is a rare but usually fatal condition. We successfully obtained primary hemostasis with emergency room thoracotomy, followed by delayed definitive treatment of the ruptured right coronary artery ostium in a motor vehicle accident victim with multifocal hemorrhagic lesions. Survival of patients with the described serious trauma has not been reported, and we discuss herein our treatment strategy.**

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