

Our patient had a delayed presentation with sudden cardiac arrest, possibly caused by arrhythmia secondary to physical activity. He received appropriate resuscitation and was not left with any residual complications. It was necessary, therefore, to offer him a simple, safe, and quick procedure with minimal potential complications; these benefits are offered by OPCAB. He remained symptom free, with no limitations on his physical activity, 6 months after the operation. Although grafts are avoided in young patients, total arterial grafting with bilateral mammary arteries has been associated with the best long-term outcome because of the inherent capacity of these grafts to grow and autoregulate flow in the face of variations in vascular resistance and flow dynamics [8].

Associated mitral regurgitation is usually functional secondary to chronic ischemia, affecting the left ventricular geometry and function. It is recommended not to address this at the initial operation because most patients with patent two-coronary repair will recover to have normal mitral valve function [1, 2].

Total arterial revascularization with OPCAB and ligation of the origin of the LMS in adults with ALCAPA or Bland-White-Garland syndrome is a safe and reasonable alternative procedure associated with low morbidity and mortality, and it should be considered for similar cases to avoid potential challenges and complications.

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## Left Atrium Ball Thrombus in a Patient With Hemorrhagic Cerebral Infarction

Shota Yasuda, MD, Shigehiko Tokunaga, MD, Yusuke Matsuki, MD, Hironao Okamoto, MD, Daisuke Machida, MD, and Munetaka Masuda, MD

Department of Cardiovascular Surgery, Kanagawa Cardiovascular and Respiratory Center, and Department of Surgery, Yokohama City University Hospital, Yokohama, Japan

The patient was a 72-year-old man with left hemiparesis. Multiple hemorrhagic cerebral infarctions were recognized on a computed tomographic (CT) scan. A transesophageal echocardiogram showed a huge left atrial mass, which was floating and nearly obstructed the mitral orifice in the diastolic phase. Emergency left atrial mass removal was performed. To reduce the risk of critical brain hemorrhage, the dose of heparin was reduced (100 U/kg) and 1 mg/kg/h of nafamostat mesilate was administered into the venous circuit during extracorporeal circulation. A postoperative brain CT scan showed no evidence of deterioration of cerebral hemorrhage. Pathologic examination showed a ball thrombus.

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In open heart surgical procedures for the patient with hemorrhagic cerebral infarction, exacerbation of intracranial bleeding is a critical concern. We present an anticoagulation protocol devised for cardiopulmonary bypass using nafamostat mesilate with reduced heparin for a patient with significant hemorrhagic cerebral infarction caused by a left atrial ball thrombus.

A 72-year-old man with a history of hypertension lost consciousness because of left hemiparesis and was admitted to a local hospital. A plain CT scan revealed multiple hemorrhagic cerebral infarcts. A transthoracic echocardiogram showed a large mass in the left atrium (LA), and cardiogenic cerebral infarction was diagnosed. He was transferred to our hospital 5 days after the cerebral infarction.

A neurologic examination showed left hemiparesis, dysarthria, left facial nerve palsy, right conjugate deviation, and right blepharoptosis. An electrocardiogram showed atrial fibrillation. Transesophageal echocardiography revealed a huge mass (4.8 × 2.8 cm) floating in the LA, nearly obstructing the mitral orifice in the diastolic phase (Fig 1). Mild mitral regurgitation was noted, but there was no evidence of mitral stenosis. A CT scan of the

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Address correspondence to Dr Tokunaga, Department of Cardiovascular Surgery, Kanagawa Cardiovascular and Respiratory Center, 6-16-1 Tomioka-Higashi, Kanazawa-ku, Yokohama, 236-0051, Japan; e-mail: tokunaga@kanagawa-junko.jp.



Fig 1. Preoperative transesophageal echocardiogram. Huge mass in left atrium nearly obstructed mitral inlet in diastole phase.

head showed hemorrhagic cerebral infarction in the territory of the right middle cerebral artery (Fig 2). Despite the extreme risk of exacerbating the cerebral hemorrhage, we decided to perform an emergency operation for LA mass removal because seating of the mass in the mitral orifice would be fatal.

A heparin-coated bypass circuit (Capiiox Custom Pack FX, Terumo Cardiovascular Systems, Tokyo, Japan) was used with a membrane oxygenator (Capiiox FX, Terumo, Cardiovascular Systems, Tokyo, Japan). To reduce the risk of critical brain hemorrhage, the dose of heparin was reduced (100 U/kg; our normal dose is 300 U/kg) and 1 mg/kg/h of nafamostat mesilate was administered into the venous circuit during extracorporeal circulation to prevent clot formation. After systemic heparinization, an 8-mm aortic cannula (Sarns, Terumo Cardiovascular Systems, Tokyo, Japan) and bicaval venous cannulas (Flexmate, Toyobo Co Ltd, Osaka, Japan) were placed. Blood samples were taken from the arterial circuit line in the pump, and the target activated clotting time was kept at longer than 400 seconds. The pump flow was set at 2.5 L/min/kg, and mild hypothermia was induced.

A superior transseptal approach was used, and a mass measuring 5.0 × 3.5 × 2.5 cm was extracted. The mass had some cracks and was divided into 2 parts (Fig 3). The mass was no longer attached to the left atrial wall; its likely original attachment point was near the superior right and left pulmonary veins. The base of the mass and the surrounding thickened intima were carefully shaved. The appendage, with no thrombus, was closed with a 4-0 Prolene (Ethicon, Somerville, NJ) running suture from inside the LA. The patient was easily weaned from extracorporeal circulation. Protamine (1 mg/kg) was given to reverse the effects of heparin. The activated clotting time was controlled at 366 to 601 seconds during bypass, and the dose of nafamostat mesilate was regulated at 0 to 1 mg/kg/h (Fig 4). The lowest rectal temperature recorded was 34.6°C.

A postoperative CT scan showed no increase of the cerebral hemorrhage. The pathologic diagnosis of the extracted specimen was a ball thrombus (Fig 3).

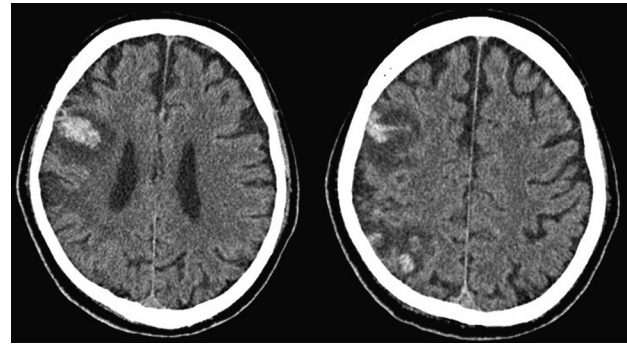


Fig 2. Preoperative computed tomographic scan of head. Hemorrhagic cerebral infarction in territory of right middle cerebral artery was revealed.

Although the patient did not recover left limb function, he was able to ingest light meals and was transferred to a rehabilitation hospital on postoperative day 53.

## Comment

Left atrial ball thrombi are rare but can be fatal because of the high risk of mitral orifice obstruction or major distal embolization. Our patient had atrial fibrillation as a concurrent condition, but neither mitral stenosis nor left atrial dilatation was present. It is rare for a ball thrombus to form in a patient without mitral disease [1]. We had initially thought the mass was a cardiac tumor such as myxoma, but the final pathologic diagnosis was a ball thrombus consisting mainly of fibrin. The reason for thrombus formation is unclear, but the presence of degeneration and stiffness of the intima of the LA suggested that thrombus formation was triggered by intimal injury. Although the patient had atrial fibrillation with thrombus, we decided not to perform a Maze procedure to limit the aortic cross-clamp time, because the patient had had long-standing atrial fibrillation: this was a good trade-off.

An open heart surgical procedure during the acute phase of hemorrhagic cerebral infarction can lead to worsening of cerebral complications [2]. Eishi and colleagues [3] asserted that cardiac operations can be done safely 4 weeks after cerebral infarction. Some patients, however, require emergency operations. Some recent reports have shown that patients with infective endocarditis and cardiogenic shock can safely undergo cardiac operations and cardiopulmonary bypass with the use of low-dose heparin and nafamostat mesilate [4, 5]. Nafamostat mesilate, (6-amino-2-naphthyl-p-guanidinobenzoate dimethanesulfonate) is a serine protease inhibitor that has anticoagulant and antifibrinolytic activities and a very short half-life of 8 minutes [6, 7]. It is commonly used as an anticoagulant for hemodialysis and extracorporeal membrane oxygenation; however, it is currently available only in Japan and Korea. Different doses of heparin and nafamostat mesilate have been used clinically, and we followed the dosage proposed by Ota and colleagues [4]. Although an anticoagulant, nafamostat

Fig 3. Extracted specimen. (Left) Mass had several cracks and was divided into 2 parts. (Right) Pathologic findings: Mass consisted of fibrin, and ball thrombus was finally diagnosed.

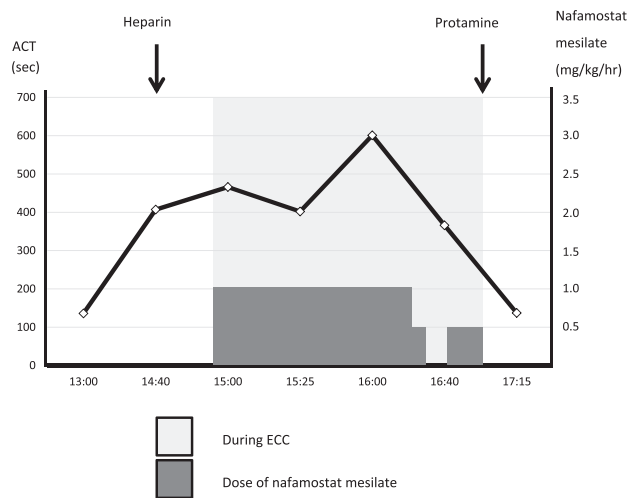
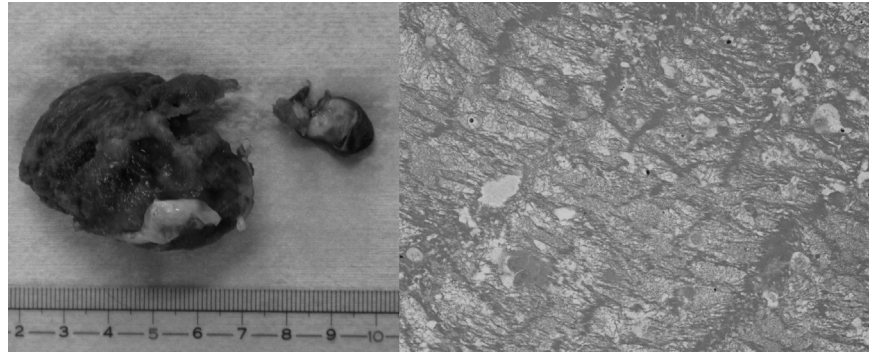


Fig 4. Changes in coagulation variables during surgical procedure. (ACT = activated clotting time; ECC = extracorporeal circulation.)

mesilate also reduces blood loss during cardiac operations [8], and it inhibits activation of fibrinolysis. Because fibrinolysis can increase the risk of bleeding, suppression of fibrinolysis by nafamostat mesilate most likely contributed to the prevention of further cerebral hemorrhage.

It might have been possible to remove the mass using inflow occlusion and avoid heparin or cardiopulmonary bypass altogether, but we were concerned that although we might have been able to remove a right atrial mass in an off-pump procedure, we would not have been able to remove all the left atrial mass and remove air in a short time with the off-pump technique. Therefore, we chose on-pump LA mass removal with nafamostat mesilate and reduced systemic heparinization.

In conclusion, we successfully performed surgical removal of a left atrial ball thrombus without further injury to the brain in a patient with hemorrhagic cerebral infarction using nafamostat mesilate and a reduced dose of heparin.

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## Successful Repair of a Mitral Valve Aneurysm With Cleft of Anterior Mitral Leaflet in an Adult

Suguru Ohira, MD, Kiyoshi Doi, MD, PhD,  
Tetsuhiro Yamano, MD, PhD, and  
Hitoshi Yaku, MD, PhD

Departments of Cardiovascular Surgery and Cardiology, Kyoto Prefectural University of Medicine, Kyoto, Japan

A 40-year-old woman was admitted with severe mitral regurgitation (MR) and atrial fibrillation. Preoperative

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Address correspondence to Dr Ohira, Department of Cardiovascular Surgery, Kyoto Prefectural University of Medicine 465 Kajji-cho, Kawaramachi-Hirokoji, Kamigyo-ku, Kyoto 602-8566, Japan; e-mail: suguru19820411@gmail.com.