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CASE REPORT

Massive pulmonary embolism after off-pump coronary artery bypass surgery

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Abstract An 88-year-old woman developed an acute massive pulmonary embolism after off-pump coronary artery bypass surgery. She experienced dyspnea while walking on the sixth day after operation. Her chest radiograph showed pleural effusion. Initially, she was treated for heart failure due to bypass graft occlusion. A repeat echocardiogram revealed enlargement of the right ventricle. Multislice computed tomography showed a massive embolus in the pulmonary artery. Surgical embolectomy was performed, and her postoperative course was easy. Recently, the incidence of pulmonary embolism in Japanese people has been rising. In addition, widespread implementation of off-pump coronary artery bypass compromises the protective effect against pulmonary embolus after cardiac surgery. Although the incidence of pulmonary embolism after coronary artery bypass surgery is still low in Japan in comparison to that in Western countries, prophylaxis against pulmonary embolism after off-pump coronary artery surgery is becoming more important.

Key words Pulmonary embolism · Off-pump CABG · Prophylaxis

Introduction

Although pulmonary embolism after coronary artery bypass surgery is not uncommon in the West, it is still uncommon in Japan. This article describes a case of massive pulmonary embolism after off-pump coronary artery bypass surgery.

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Case

An 88-year-old woman was referred to our hospital because of exacerbation of effort angina. She had been medicated with an antihypertensive drug, aspirin, nitrate, and a hypolipidemic agent by her family doctor for the past 10 years. She had no history of thrombosis. Her angina had gotten worse over the last 2 weeks. Her blood pressure was 188/98 mmHg, and her heart rate was 72/min with regular rhythm. Auscultation revealed no abnormality in the heart or lungs. Her electrocardiogram revealed ST depression in leads I, aV_L, V_5, and V_6.

Coronary angiography revealed severe three-vessel coronary artery disease with complete occlusion of the left anterior descending artery and the circumflex artery. An intraaortic balloon pump (IABP) was inserted for the angina. On the day after admission, off-pump coronary artery bypass grafting (CABG) was performed with both an internal mammary artery and a left great saphenous vein graft. After administration of 12000 units of heparin sodium intravenously, the activated clotting time (ACT) was >407 s. The right internal mammary artery was anastomosed to the left anterior descending artery, which was deeply buried underneath myocardium and fat. The left internal mammary artery and the saphenous vein graft were anastomosed to the left posterior branch and the right posterior branch, respectively. The heparin was neutralized with 120 mg protamine sulfate, and the ACT was 133 s after administration. She was withdrawn from the IABP right after the operation. She was easily

weaned from mechanical ventilation (total intubation time was 11 h after operation). Her blood gas analysis was good, with oxygen supplementation 5 l/min through a face mask. Aspirin was started on the third postoperative day.

Six days after the operation she experienced dyspnea while walking. Her chest radiograph showed pleural effusion. She was treated with diuretics for congestive heart failure. Because of tachypnea and dyspnea, she could not withdraw from oxygen supplementation. Her pulse oximetry was 95%–98% with oxygen supplementation (5 l/min) through a mask without a reservoir.

She complained of dyspnea and anxiety on day 12 after the operation. Her chest radiograph showed no change except pleural effusion. The electrocardiogram revealed ST depression in leads V_4 to V_6. Her pulse oximetry showed 93%–94% with the same oxygen supplementation. An emergency coronary angiogram revealed total occlusion of the right internal mammary artery to the anterior descending artery and stenosis of the vein graft to the right posterior descending artery, which supplied collateral flow to the left anterior descending artery. It was difficult to insert a pulmonary artery catheter into the pulmonary artery and we could not wedge it. The systolic pulmonary artery pressure, diastolic pressure, and mean pressure were markedly high: 60, 27, and 34 mmHg, respectively. At this time she was diagnosed with heart failure due to graft occlusion. A stent was implanted into the distal anastomotic region of the saphenous vein graft.

Her condition did not change, however, and the dyspnea was getting worse. Her blood gas analysis was Pao_2 75.9 mmHg and $Paco_2$ 37.0 mmHg with oxygen supplementation (5 l/min) through a mask without a reservoir. Her blood pressure was 92/63 mmHg. Repeat echocardiography revealed right ventricular enlargement. Contrast multislice computed tomography (CT) revealed a massive embolus in the pulmonary artery on both sides (Fig. 1). Her lower legs bilaterally showed no symptoms of deep vein thrombosis. V/Q scanning was not performed.

Surgical embolectomy was selected instead of thrombolytic treatment or other catheter intervention as the definite onset time was unknown. Surgical embolectomy was performed urgently. Under intermittent deep hypothermic circulatory arrest (DHCA), the right pulmonary artery was opened longitudinally behind the ascending aorta. Endoscopy revealed a massive pulmonary embolus. (Fig. 2) The embolus was totally removed under video assistance. Following that, the left pulmonary artery was opened, and an incision was made from the main pulmonary trunk to the left pulmonary artery. The embolus here was removed in the same fashion.

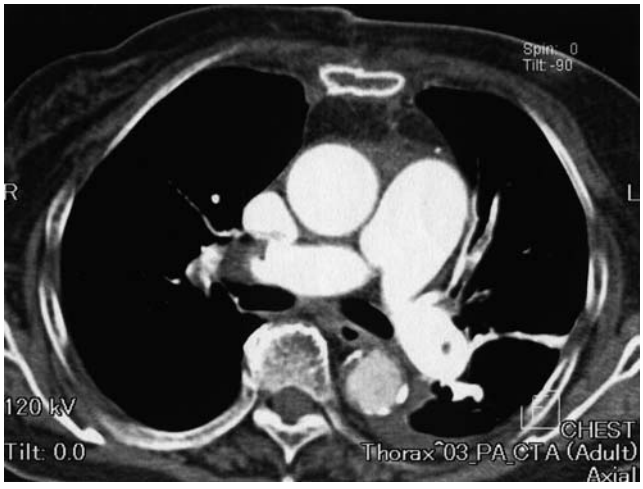

Fig. 1 Contrast multislice computed tomography revealed a massive embolus in the pulmonary artery

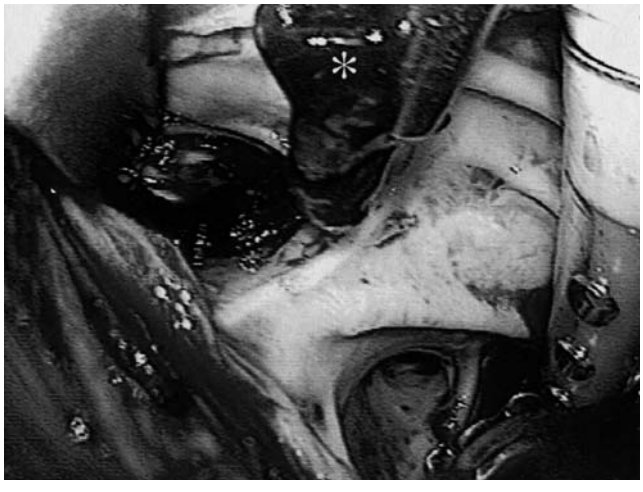

Fig. 2 Endoscopy during operation revealed a pulmonary embolus (*)

The total DHCA time was 24 min. After that, to confirm that there was no residual embolus in the right atrium, right atriotomy was performed. After operation, her blood gases improved to Pao_2 401.8 mmHg and $Paco_2$ 32.7 mmHg with 100% O_2 supplementation from a tracheal tube. Moreover, her systolic pulmonary artery pressure, diastolic pressure, and mean pressure underwent marked decreases to 27, 14, and 21 mmHg, respectively. The inferior vena cava filter was inserted on the right after the second operation.

Anticoagulation with Coumadin was started on the third postoperative day. Because her postoperative course was quite good, she was withdrawn from oxygen supplementation.

Discussion

Pulmonary embolism (PE) after coronary artery surgery, associated with high morbidity and mortality, is not uncommon in the West.[1] PE occurs in approximately 0.3%–0.7% after coronary artery surgery, and deep vein thrombosis (DVT) occurs in almost 20% as seen by ultrasonographie screening. In contrast, quite a few cases have been reported in Japan,[2,3] although a prospective large cohort study for estimating the incidence of PE and DVT after cardiac surgery is lacking. This is the first case of PE after both coronary and other cardiac surgeries in our institution. We have undertaken 1712 cardiac surgeries in 7 years: 787 cases of coronary artery surgery and 925 of other cardiac surgeries. The incidence of PE among the coronary artery surgeries is estimated at 0.0013% and the incidence for the cardiac surgeries at 0.0006% in our institution. These incidences are much lower than those reported in Western countries.

The incidence of PE after coronary artery bypass surgery is lower than that after other general surgeries. Generally, patients with cardiovascular surgery receive a large amount of heparin intraoperatively—in the range of 40 000 to 50 000 units—to keep the activated clotting time >400 s with the hope of preventing clots from forming during surgery. Moreover, hemodilution during cardiopulmonary bypass compromises clotting and aggregation. In addition, routine antiplatelet therapy with aspirin or another agent is administered after bypass surgery. Probably the large amounts of heparin administered, hemodilution after cardiopulmonary bypass, and antiplatelet therapy after surgery offer some protection against DVT and PE.

Coronary artery surgery without cardiopulmonary bypass (OP-CABG) has become widespread in recent days. Hemodilution after OP-CABG is less than that after coronary artery bypass with cardiopulmonary bypass (CABG). Moreover, the heparin dose is reduced during OP-CABG. These measures can compromise the protective effect against PE and DVT. Our case was after OP-CABG, whereas we did not have a PE case after CABG. Cartier and Robitaille reported three cases of PE and two cases of DVT among 500 OP-CABG patients.[4] They found that the incidence of DVT and PE after OP-CABG is double that after CABG (1.0% and 0.5%, respectively). Although, these incidences did not reach statistical significance in their cohort, the findings raise an alarm about the importance of DVT and PE prophylaxis after OP-CABG. In our experience, the incidence of PE after CABG is 0%, whereas that of after OP-CABG is 0.002%.

DVTs and PEs are also increased in Japan because of the development of diagnostic methods and recent life style changes. The death toll due to PE increased 2.8-fold during the past decade in Japan.[5] The incidence of fatal PE is 28 per 1 million in Japan in compared to 500/100 000 in the United States. This extremely low incidence in Japan may be influenced the incidence after coronary artery surgery. In future, the incidence of DVT and PE may increase among those undergoing cardiac surgery. Accordingly, PE prophylaxis after cardiac surgery increases in importance.

We prescribed early ambulation and routine aspirin use after coronary artery surgery. In contrast, we did not use PE prophylaxis, such as graded compression stocking (GCS), sequential compression devices (SCDs), or other pharmacologic agents, such as Coumadin, low-molecular-weight heparin (LMWH), or unfractionated heparin (UFH). In the case described, delayed ambulation and IABP insertion may have contributed to the PE formation. Some guidelines recommend PE and DVT prophylaxis after several general surgeries, including general, orthopedic, gynecologic-obstetric, urologyic, and trauma surgery, as well as neurosurgery. There is no recommendation for cardiovascular surgery. Some PE and DVT prophylactic measures after coronary artery surgery have been reported. In those reports, prophylaxis using a combination of early ambulation, GCS, SCD, aspirin, dipyridamole, and subcutaneous heparin (both LMWH and UFH) are considered effective.[1,6] SCD is difficult to use in normal, early ambulating patients. Dipyridamole has the side effect of tachycardia and increases oxygen consumption by the heart, making it difficult to administer in this setting. Subcutaneous heparin administration right after surgery intensifies the risk of bleeding.

The combination of GCS, routine use of aspirin, and early ambulation may be useful for preventing DVT and PE after coronary artery surgery. In a nonambulating, high-risk patient with slow recovery, however, a more aggressive prophylaxis regimen may be necessary for its prevention. Further investigations are needed to obtain the accurate incidences of PE and DVT after coronary artery surgery and to prove the effectiveness of prophylaxis and these measures in Japanese populations.

Conclusion

We report a rare case of PE after OP-CABG. The diagnosis of PE is still challenging, and it is difficult to reach an early diagnosis. Because of widespread implementation of OP-CABG and the increasing number of PEs in Japanese people, PE prophylaxis after OP-CABG is now strongly recommended. The combination of routine use of GCS, early ambulation, and oral aspirin may be useful.

References

1. Shammas NW. Pulmonary embolus after coronary artery bypass surgery: a review of the literature. Clin Cardiol 2000;23: 637–44.
2. Nawa Y, Masuda Y, Imaizumi H, Yoshida H, Kihara C, Okada Y, et al. A case of pulmonary thromboembolism after cardiac surgery Masui 2004;53:547–50.
3. Saito T, Terada Y, Fukuda S, Sakao Y, Takayama T, Suma H, et al. Acute pulmonary thromboembolism after coronary artery bypass grafting. Kyobu Geka 1991;44:1003–5.
4. Cartier R, Robitaille D. Thrombotic complications in beating heart operations. J Thorac Cardiovasc Surg 2001;121:920–2.
5. Japanese Circulation Society. Guidelines for the diagnosis, treatment and prevention of pulmonary thromboembolism and deep vein thrombosis (JCS 2004) J Cardiol 2005;45:349–366.
6. Ramos R, Salem BI, De Pawlikowski MP, Coordes C, Eisenberg S, Leidenfrost R. The efficacy of pneumatic compression stockings in the prevention of pulmonary embolism after cardiac surgery. Chest 1996;109:82–5.