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Acute aortic dissection during vertical displacement of the heart in off-pump coronary artery bypass grafting (OPCAB)

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Introduction

Off-pump coronary artery bypass grafting (OPCAB) has become an accepted technique for myocardial revascularization. OPCAB provides advantages in some patients with poor ventricular function or risk factors for cardiopulmonary bypass (CPB). However, a number of problems have been recognized—including low cardiac output state and severe hypotension—during displacement of the heart to access the circumflex branches and the right coronary artery [1]. The problems have been partly solved by the clinical application of a suction-based mechanical coronary stabilizing system, such as the Octopus (Medtronic, Minneapolis, MN, USA) system [2]. This technique has developed rapidly over the past decade, which implies that there may be complications that have yet to be widely recognized. We report a patient in whom an acute aortic dissection occurred at the time of vertical displacement of the heart during an OPCAB.

Case report

An 81-year-old man with coronary artery disease, who had undergone percutaneous transluminal coronary angioplasty (PTCA) twice, was presented for OPCAB. He was able to lead his daily life without help, and no significant complication was detected, except for mild diabetes mellitus. An echocardiogram revealed that the end-diastolic diameter and ejection fraction of the left ventricle (LVEDD and LVEF) were 43 mm and 0.70, respectively, by which we judged that the patient would tolerate the operation. A coronary angiogram revealed stenoses in segments 1, 2, 5, and 13. An OPCAB was planned to include grafting the left internal thoracic artery (LITA) to segment 8, the right internal thoracic artery (RITA) to segment 2, and the radial artery (RA) to segment 14.

After induction of general anesthesia with tracheal intubation, we established vital monitoring, including direct arterial pressure (with a catheter placed in the right RA), pulmonary arterial pressure, central venous pressure, and continuous cardiac output (with a pulmonary artery catheter through the right internal jugular vein). After median sternotomy, designated grafts were obtained from the LITA, the RITA, and the left RA. Because significant decreases in cardiac output and blood pressure were expected during the procedure, due to the age of the patient, we employed percutaneous/partial cardiopulmonary support (PCPS). The PCPS was operated with cannulations into the right femoral artery and the right atrium. During grafting of the RA graft to segment 14, when the heart was vertically displaced with a Star-fish stabilizer (Medtronic, Minneapolis, MN, USA) (Fig. 1), the monitored pressure waveform from the right RA abruptly disappeared. Simultaneously, an operator noticed a change in the color of the surface of the ascending aorta. The operator examined the aorta by direct ultrasonography, which revealed acute dissection of the ascending aorta. The surgeons decided to perform a graft replacement of the ascending aorta, and started to establish CPB with an arterial cannula placed into the right femoral artery, as well as venous cannulae placed into the superior and inferior cavenous veins through the right atrium. During the preparation for CPB, we intravenously administered thiamylal ($5\,mg \cdot kg^{-1}$), a continuous infusion of which was started simultaneously at a rate of $4\,mg \cdot kg^{-1} \cdot h^{-1}$, and we began to chill the patient's head with ice bags so as to protect his brain from hypoxic

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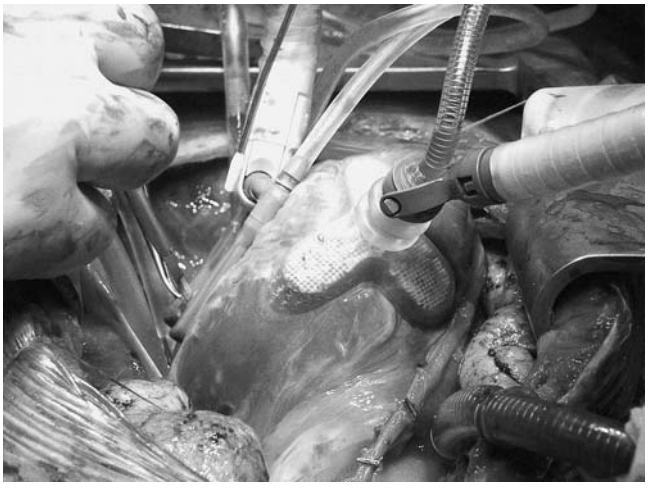

Fig. 1. Vertical displacement of the heart during grafting of the radial artery (RA) graft to segment 14, using tissue stabilizers—the Octopus (Medtronic) and Star-fish (Medtronic) systems. The acute aortic dissection occurred during positioning of the heart

damage. However, his pupils progressively dilated before the completion of the CPB preparation, with which condition advancing brain damage was suspected. The CPB was established 55 min after the diagnosis of aortic dissection was obtained, and refrigeration had lowered the patient's rectal temperature to under 20°C, to allow circulatory arrest. The graft replacement to the ascending aorta was performed under the condition of circulatory arrest with retrograde cerebral perfusion. After the procedure was completed and rectal temperature was returned to the normal level by rewarming, we attempted weaning from the CPB, which had operated for 330 min by that time. However, the patient had incurred a severe low cardiac output state, which was not alleviated by large doses of catecholamines, including dopamine ($10\,\mu g \cdot kg^{-1} \cdot min^{-1}$), norepinephrine ($0.05\,\mu g \cdot kg^{-1} \cdot min^{-1}$), and epinephrine ($0.05\,\mu g \cdot kg^{-1} \cdot min^{-1}$), causing difficulty in weaning from the CPB. To treat this condition we applied PCPS to the patient once again and transferred him to the intensive care unit; however, he expired on the day after the surgery.

Discussion

This report demonstrates that, compared with a conventional coronary artery bypass graft (CABG), OPCAB has an increased risk of certain types of complication, such as acute aortic dissection. This patient's acute aortic dissection probably resulted from unexpected stress during the procedure, at the circumflex branch, caused by vertical displacement of the heart. The heart was displaced with recently developed tissue stabilizers (the Octopus system [Medtronic] and the Star-fish system [Medtronic]), which can stabilize the heart while allowing access to the coronary arteries [2,3]. These devices enable the heart to be displaced to a position in which coronary artery grafting is simplified. However, when the heart is displaced from its natural position using these stabilizers, the aorta can be expected to receive a significant and extraordinary stress. Thus, it is possible that these devices could have adverse effects in susceptible patients.

In fact, some researchers have reported that the perioperative incidence of acute aortic dissection in OPCAB exceeds that in on-pump CABG [4]. They consider that OPCAB may increase the risk of aortic injury because of the pulsatile pattern of the arterial pressure. In contrast, during conventional CABG, nonpulsatile CPB allows a temporary decrease in arterial pressure, reducing the risk of aortic injury. It is suggested that a combination of the pulsatile arterial pressure and the displacement of the heart during OPCAB can produce critical stresses in the ascending aorta.

When acute aortic dissection occurs, immediate establishment of diagnosis is essential to allow prompt surgical repair. To establish the diagnosis of intraoperative aortic dissection, some researchers have reported the usefulness of transesophageal echocardiography (TEE) [5,6]; they reported that TEE enabled the detection of even the entry lesion on the inner aortic wall when color-flow mapping was combined with the method, and they found that TEE was beneficial for the planning of surgical repair as well. We managed the anesthesia for the present patient without TEE and employed, as an alternative, direct ultrasonography to detect the aortic dissection. TEE may have revealed the lesion more immediately in this patient. However, when aortic dissection occurs during OPCAB, protection of the brain may be difficult because it is impossible to provide the rapid refrigeration that is available with CPB. In this patient, before the establishment of CPB, we topically chilled his head and administered thiamylal so as to minimize the insult. These methods were regarded as useful options for brain protection prior to refrigeration by CPB; unfortunately, the brain damage was so serious that recovery was impossible.

We conclude that OPCAB may have a larger risk of intraoperative acute aortic dissection compared with conventional CABG, and that newly developed stabilizers may be responsible for the injury.

References

1. Grudenman PF, Borst C, van Herwaarden JA, Mansvelt Beck HG, Jansen EWL (1997) Hemodynamic changes during displacement

of the beating heart by Utrecht Octopus method. Ann Thorac Surg 63:S88–S92
2. Hart JC, Spooner TH, Pym J, Flavin TF, Edgerton JR, Mack MJ, Jansen EW (2000) A review of 1582 consecutive Octopus off-pump coronary bypass patients. Ann Thorac Surg 70:1017–1020
3. Tokunaga S, Prejean CA Jr, Kay GL (2000) Early experience of off-pump coronary artery bypass using Octopus Tissue Stabilizer. Jpn J Thorac Cardiovasc Surg 48:489–493
4. Chavanon O, Carrier M, Cartier R, Hebert Y, Pellerin M, Page P, Perraut LP (2001) Increased incidence of acute ascending aortic dissection with off-pump aortocoronary surgery? Ann Thorac Surg 71:117–121
5. Katz ES, Tunick PA, Colvin SB, Culliford AT, Koronzon I (1993) Aortic dissection complicating cardiac surgery: diagnosis by intraoperative biplane transesophageal echocardiography. J Am Soc Echocardiagr 6:217–222
6. Troianos CA, Savino JS, Weiss RL (1991) Transesophageal echocardiographic diagnosis of aortic dissection during cardiac surgery. Anesthesiology 75:149–153