Surgical Treatment of Blow-out Type Left Ventricular Free Wall Rupture after Full Sternotomy

Mizuki Sumi¹,2, Koji Hashizume¹ and Kiyoyuki Eishi²

We report on the successful surgical treatment of a blow-out type left ventricular free wall rupture (LVFWR), which had been diagnosed as an oozing type LVFWR. After full sternotomy, cardiac rupture suddenly occurred, and the pericardial cavity filled with blood in a few seconds. Because we could not secure a field of vision, it was difficult to apply a cardio-pulmonary bypass (CPB) by direct cannulation via the ascending aorta. Based on this experience, we recommend that given a diagnosis of oozing type LVFWR: access to the femoral artery and vein are prepared before full sternotomy in case a CPB becomes necessary for maintaining hemodynamics.

KEY WORDS: left ventricular free wall rupture, myocardial infarction

I. Introduction

Left ventricular free wall rupture (LVFWR) is a rare but unpredictable complication of acute myocardial infarction (AMI). Shortly after a LVFWR, the majority of patients die of cardiac tamponade and hemodynamic collapse. We conducted surgical patch repair using a cardio-pulmonary bypass (CPB) for repairing one patient’s blow-out type LVFWR, which occurred after full sternotomy. Our report of this case includes a key intra-operative cautionary point.

II. Case report

A 65-year-old woman was transferred to our hospital 24 hours after the onset of exertional dyspnea symptoms. On arrival, her heart rate was 86 beats per minute, and she had a blood pressure of 116/71 mmHg, and a respiratory rate of 18 breaths per minute (O₂ saturation =96%). Electrocardiography showed ST elevation in leads I, aVL, and V1–5, ST depression in leads II, III, and aVF, and QS pattern in leads I, aVL, and V1–5. She had no history of angina pectoris or myocardial infarction. Levels of creatine kinase (3,243 U/l), high-sensitivity troponin T (5,580 ng/ml) and N-terminal pro-brain natriuretic peptide (2,168 pg/ml) were elevated. Transthoracic echocardiograms (TTE) showed severe hypokinesis of anteroseptal and lateral movements, a left ventricular ejection fraction (LVEF) of 30%, and pericardial effusion. Free-wall rupture of the left ventricle (LV) was suspected. Coronary angiography (CAG) showed single vessel disease, with total occlusion of the left anterior descending artery (LAD). An intra-aortic balloon pump (IABP) was inserted for hemodynamic support. On computed tomography (CT), the CT dose index showed a 15-mm bloody pericardial effusion (Fig. 1). The patient was diagnosed with anterior AMI, oozing type free wall rupture, and cardiac tamponade. Additionally, she complained of persistent chest pain. She was consequently transported to the operating room.

1. Operative procedure

Given the diagnosis of oozing type free wall rupture, we had planned on hematoma removal and repair with a sutureless technique without CPB. After pericardiotomy, a small quantity of bloody pericardial effusion was drained. The epicardium was adhered to the pericardium such that the LAD and LV area could not be identified. While we were carefully exfoliating the LV side of the adhesion, massive bleeding suddenly occurred. The bleeding was so massive that the pericardial cavity was filled within blood in a few seconds (Fig. 2, Movie 1*). We tried to control the bleeding by applying pressure using a finger. However, even when inserting a finger into the ruptured portion of the LV, blood continued to overflow from the ruptured point. We tried to establish CPB by direct cannulation via the ascending aorta but we were unable to do so because we could not secure a field of vision in the pericardial cavity. The epicardium was adhered to the pericardium such that the LAD and LV area could not be identified. While we were carefully exfoliating the LV side of the adhesion, massive bleeding suddenly occurred. The bleeding was so massive that the pericardial cavity was filled within blood in a few seconds (Fig. 2, Movie 1*). We tried to control the bleeding by applying pressure using a finger. However, even when inserting a finger into the ruptured portion of the LV, blood continued to overflow from the ruptured point. We tried to establish CPB by direct cannulation via the ascending aorta but we were unable to do so because we could not secure a field of vision in the pericardial cavity. Systemic blood pressure dropped from 90 mmHg to 30 mmHg. The patient’s pupils dilated from 2 mm to 5 mm. We started to apply cardiopulmonary resuscitation (CPR) compressions directly. The femoral artery was pulseless because of hypotension; therefore, we experienced some difficulty in exposing the femoral artery. We inserted the femoral arterial cannula and started CPB perfusion with suction.
in the pericardial cavity (blood perfusion was achieved by CPB 11 minutes after cardiac rupture, during which time the low blood pressure was sustained for 5 minutes). We then established CPB with cannulation into the right atrium (16 minutes after cardiac rupture). The patient’s pupils gradually contracted. A ventricular longitudinal tear was identified; tear size was 40 mm × 30 mm, and the tear’s nearer edge was located 10 mm from the LAD (Fig. 3a). The fragile necrotic margin was debrided. The tear was first closed with a bovine pericardial patch (Edwards Lifesciences model 4,700) and 4-0 polypropylene mattress sutures (4-0 prolene SH needle). The 4-0 prolene was sewn with a margin of 1.5 cm from the edges of the rupture (Fig. 3b). The bovine patch was intentionally oversized in order to reduce the stress on the sutured tissues. Seven pairs of mattress sutures (those in line with the LAD) were stitched trans-septally, to the right side of the LAD. The mattress sutures were secured with two Teflon felt strips. Suture pairs were then tied together (Fig. 3c). Next, another bovine patch was placed in order to fully close the orifice of the tear, and to reduce the tension on the inside of the cardiac muscle. The two felt strips and outside bovine patch were sewn together with over-and-over sutures (Fig. 3d). Bio-glue surgical adhesion (Cryolife International Inc. Kennesaw, Georgia, USA) was injected into the space between the two patches and coated over the outside patch (Fig. 4). Fortunately, we succeeded in weaning the patient off CPB through use of an IABP and a moderate dose of inotropes. CPB time was 158 minutes, and operation time was 292 minutes.

2. Postoperative course

We managed to support the patient with IABP and long-term sedation, to reduce the LV work load. She was extubated on post-operative day 11. IABP was discontinued on post-operative day 13. Postoperative TTE showed asynergy movements and a thin LV anterior wall with an LVEF of 44%. The patient was transferred by foot to a rehabilitation facility without complications in preparation for her return home.

III. Discussion

In the Global Registry of Acute Coronary Events (GRACE), a large registry of acute coronary syndrome, it was found that the incidence of LVFWR was 0.2% and that the mortality was 80%, which was higher than that of ventricular septum perforation (41%)\(^3\). The definitive treatment for cardiac rupture is emergency surgical repair\(^4\). While several surgical repair procedures have been proposed, recent reports have been trending towards the sutureless technique without CPB. It has been reported that for an oozing type rupture, the techniques of sutureless repair

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with adhesive coating, or of sutures with patches around the rupture are effective. If the rupture is small, it is possible to treat it with the sutureless method without CPB, even in the blowout type\(^3\)\(^,\)\(^5\). In our present case, the rupture area was very large; therefore, we selected surgical treatment with double patch repair using an infarction exclusion technique\(^6\). As a surgery method, we placed felt bands on both sides of the rupture in order to reduce the pressure on the suture lines. We performed suturing with constant care to avoid overtightening. Combined with our subsequent coating method with bio-glue, we managed to stop the bleeding. A key problem of this case was the patient’s pre-operative diagnosis of oozing type LVFWR, when in fact the LVFWR was of the blow-out type, with hemostasis conserved only by adhesions. It is usually thought that it is easy to cannu-

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**Fig. 3** Operative findings.
a: LVFWR after AMI.
b: Repair of LVFWR with bovine pericardial patch.
c: Mattress sutures were secured with Teflon felt strips. Sutures were tied.
d: Two felt strips and an outside bovine patch were sewn together with over-and-over sutures.

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**Fig. 4** Schema of LVFWR repair using double bovine pericardial patch. RV: right ventricle; LV: left ventricle.
late from the ascending aorta after a median full sternotomy. However, in the case of a defect tear as large as our patient's, it is very difficult to control bleeding. The cardiac sac fills with blood, and visibility deteriorates quickly, even when using cell saver. It becomes difficult to establish CPB from ascending aorta cannulation as under normal conditions. In the present case, it also took time to expose the pulseless femoral artery because of hypotension. Therefore, when planning surgical repair of an oozing type LVFWR with a sutureless technique without CPB, access to the femoral artery and vein should be prepared before median full sternotomy in consideration of such a worst-case scenario. Additionally, it is important for CPB to be accessible on standby.

IV. Conclusion

We managed to provide lifesaving surgical care in a case of blow-out type LVFWR, which occurred after full sternotomy. Given a patient diagnosis of oozing type LVFWR, we recommend preparing access to the femoral artery and vein before full sternotomy so as to maintain hemodynamics using CPB in consideration of the worst-case scenario.

Disclosure Statement

None of the authors have any conflicts of interest to declare.

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