Case report - Assisted circulation

ECMO support for the treatment of cardiogenic shock due to left ventricular free wall rupture

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1. Introduction

Perioperative management of left ventricular free wall rupture (LVFWR) is not clearly standardized and surgical repair is the only therapeutic option. When cardiogenic shock (CS) occurs in emergency department (ED), the option to stabilize the patient with percutaneous ECMO should be taken into consideration.

2. Case description

A 51-years-old man with a history of coronary artery disease and a previous myocardial infarction (MI) was admitted to ED in collapse. The 12-leads ECG showed an inferior ST sopraelevation. Because of a strong suspicion of acute MI, a trans-oesophageal echocardiogram (TEE) was done. It showed pericardial effusion around the heart and consequently the LVFWR was diagnosed. Emergent pericardiocentesis and extracorporeal membrane oxygenation (ECMO) support. We report a case of cardiac rupture with tamponade and cardiogenic shock in which cardiopulmonary support with portable ECMO was used to rescue the patient before the operation.

Summary

Left ventricular free wall rupture (LVFWR) is still an uncommon catastrophic complication after acute myocardial infarction (MI), and it is one of the most frequent causes of sudden cardiac death. Immediate surgical repair is the treatment of choice. When LVFWR presents acutely with tamponade and cardiogenic shock in emergency department, salvage with a good outcome is still possible by timely pericardiocentesis and extracorporeal membrane oxygenation (ECMO) support. We report a case of cardiac rupture with tamponade and cardiogenic shock in which cardiopulmonary support with portable ECMO was used to rescue the patient before the operation.

Keywords: Left ventricular wall rupture; Myocardial infarction; Extracorporeal membrane oxygenation; Cardiogenic shock
strips plus resorcin-formolo glue (Gluetiss, Berlin Heart, Berlin, Germany). Then, LAD artery was grafted with left internal thoracic artery, and RCA and obtuse marginal were grafted with two single vein grafts.

CPB was weaned off and the ECMO flow was resumed. An IABP was inserted through the left femoral artery to keep a low afterload after ECMO was removed and therefore reducing greatly the risk of re-rupture.

The ECMO flow was adjusted to achieve mixed venous oxygen saturation (SvO₂) of 70%. Oxygen flow (FiO₂) ranged between 40 and 60 ml to maintain a postoxygenator partial oxygen pressure of approximately 300 mmHg. Carbon dioxide was kept between 35 and 45 mmHg.

Intravenous heparin was administered continuously and varied according to ACT with a target of 160–180 s. The hematocrit was maintained between 30 and 35%. Red packet cells and fresh frozen plasma were transfused as required.

Exploration for bleeding was necessary in the first operative day.

Sedation by infusion of midazolam and fentanyl was obtained. During ECMO, ventilation set at 10 breaths per minute, tidal volume of 7 ml/kg, positive end expiratory pressure of 5 cm H₂O. Inotropic support with dobutamine was maintained throughout the ECMO and after.

The criteria for ECMO weaning included SvO₂ ≥ 70%, stable haemodynamic and inotropic support, echocardiographic absence of tamponade and of left heart distension, and a left ventricle EF ≥ 0.35. These criteria are also used in all prior ECMO cases treated. The ECMO flow was reduced gradually and at the same time, the cardiac function was continuously monitored with TEE.

Then the flow was maintained at 0.5 l/min/m² for 2 h, and the patients were decannulated at the bedside once the heart did not show any impaired function.

The ECMO duration after surgery was 36 hs. The patient had a good recovery in ICU. He was extubated on the fifth postoperative day, and discharged on 20th operative day. The pre-dimission TEE showed a mild reduction of EF (0.45) without mitral regurgitation.

At 5 months follow-up, the patient was in NYHA I-II, the EF was 0.45 and the left ventricle had normal dimension.

3. Discussion

Cardiac rupture during acute MI is one of the most frequent causes of sudden cardiac death. LVFRW occurred with an incidence between 0.96 and 3.5% [1,2] and 30-day mortality rate between 17.6 and 83.3% [1–3]. The suggested risk factors of LVFRW are advanced age (> 65 years), female gender, lower body mass index (< 1.66), first MI, re-infarction, anterior MI, hypertension, increased sympathetic tone [1,4]. Use of IABP is described as support, [1,5,6] nevertheless, it is not always useful to avoid further complications in critical patients and when death of patient is imminent. In this latter case, the role of portable ECMO, implanted in ED, could be useful to stabilize the haemodynamic status, improving the postoperative course and reducing the mortality rate.

Use of ECMO for emergency resuscitation is not recent. In 1937, John Gibbon proposed this concept to treat severe pulmonary tromboembolism. Nowadays, portable CPB systems allow to act rapidly, and to stabilize the patient’s condition in such circumstances in which an operation cannot be performed in a very short period.

Indications for going on ECMO are now clarified as follows: cardiac arrest, failure to wean off CPB, acute deterioration, CS with anatomically problems, bridge to transplantation [7].

Most frequently described complications are bleeding, sepsis, ARDS, renal failure, ischemia of lower limbs, stroke, and oxygenator failure [7,8]. The main causes of in-hospital death are myocardial failure, multiorgan failure, cerebral infarction or bleeding, sepsis, disseminated intravascular coagulation, and leg ischemia [8,9].

Since 1999 in our Department, we are regularly using the Jostra Rota Flow (RF-32) as pump head and the Quadrox D as oxygenator. Some advantages about RF-32 have been described: no traumatism, compact prime volume (32 ml), high biocompatibility and no thrombus formation [9].

The high preoperative mortality of cardiac rupture [10], and the short interval time from onset of acute MI and cardiac rupture (below 72 h in most of cases), are the limiting factors to establish a timely surgical strategy. Often, the LVFRW occurs out of the hospital or in the clinical department where obtaining a diagnosis of cardiac rupture in time is sometimes difficult. Moreover, apart from ED or intensive care unit, ECMO preparation is difficult, or even impossible, in other hospital areas.

In conclusion, to go on ECMO in ED to treat cardiogenic shock due to LVFRW is a valid rescue mean when death is imminent. The current portable ECMO systems allow a relatively rapid haemodynamic stabilization of the patient, so that any other diagnostic procedure could be arranged before operation.

Acknowledgments

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References

Morgagni reported 11 cases of myocardial rupture at autopsy and he himself died of myocardial rupture. Although commonly used in aortic operation, gelatin resorcin for-}

gelatin resorcin component when in contact with formaldehyde or glutaral-}

greater bonding strength than fibrin glues owing to polymerization of the}

lack of toxicity and complete biocompatibility such that healing is not}

after the degradation of exogenous fibrinogen. The main advantage is their}

reproducing the normal clotting cascade and result in a stable fibrin matrix}

types and include: the biologic glues (fibrin based or gelatin hydrogels) as}

infarcted myocardium, thereby avoiding issues related to myocardial friabil-

from angina and our policy is to bypass major vessels with significant}

rate. Proper revascularization has a positive impact on survival and freedom}

to get out of the operating room at more risk for late complications than patients who did not need the glue}

coagulopathy and local tissue compromise are now surviving. They may be}

analogous to duct taping an area that should have been bolted together).}

I. Local cell death from toxic products in the glue that lead to tissue}

breakdown over time.

II. The aortic glue may have stopped bleeding in an area that would have}

been better served over the long term with a suture than by glue closure}

(although to duct taping an area that should have been bolted together).

III. Patients who would not have survived surgery due to bleeding from}

coaagulopathy and local tissue compromise are now surviving. They may be}

at more risk for late complications than patients who did not need the glue}

to get out of the operating room [5].

References


[2] Coma Caneilla J, Lopez Sendon J, Gonzalez A. Hemodynamic effect of Dobutamine, Dextran and pericardiocentesis in cardiac tamponade fol-


