Repair of left atrioventricular disruption after mitral valve replacement using extracorporeal life support system for effective ventricular unloading

Ralf Sodian*, Daniel Schmauss, Christian Hagl and Gerd Juchem

* Corresponding author. Department of Cardiac Surgery, Ludwig-Maximilians-Universität, Marchioninistr. 15, 81377 Munich, Germany. Tel: +49-89-70971844; fax: +49-89-70971848; e-mail: ralf.sodian@med.uni-muenchen.de (R. Sodian).

Keywords: Bleeding • Circulatory support devices • Mitral valve replacement • Myocardial injury

INTRODUCTION

Atrioventricular (AV) disruption is a technically challenging complication after prosthetic mitral valve replacement (MVR) [1, 2]. In the early days of MVR surgery AV disruption was more common but is a rare complication today (0.5–2% of MVR). It is classified as Type I to Type III depending on the anatomical site of ventricular rupture. The intraoperative mortality is reported to be up to 75% [2, 3]. Risk factors for AV disruption are the aggressive debridement of the posterior annulus and the subvalvular apparatus or the oversizing of the prosthesis [3]. Surgical management of this severe complication is not standardized and is found mostly in case reports.

We describe the successful management of an AV disruption Type I using an extracorporeal life support (ECLS) system for ventricular unloading and afterload reduction, followed by a surgical patch repair. To our knowledge, this is the first report of repairing AV disruption using this technique.

CASE REPORT

A 76-year old woman was admitted to our institution with severe mitral valve regurgitation. Cardiac catheterization revealed an occluded right coronary artery collateralized from the ramus circumflexus (RCX). Transoesophageal echocardiography showed normal left ventricular (LV) ejection fraction (60%), a dilated left atrium and significant mitral valve regurgitation combined with severely calcified leaflets, chordal tissue and papillary muscles.

In the operating room, we performed a standard sternotomy and cardiopulmonary bypass (CPB). We opened the left atrium via the interatrial groove and analysed the mitral valve as described by Carpentier [4]. The anterior leaflet was severely calcified, the posterior leaflet small, restricted and calcified. The anatomy presented itself unsuitable for primary valve repair and we decided to perform a straightforward MVR using a biological valve (25 mm, Perimount Magna-Mitral-Ease, Edwards Lifesciences). All but 5 mm of the anterior leaflet was removed leaving a subaortic curtain. Effort was made to preserve the posterior leaflet and its chordae tendineae in order to keep good annular tissue. From the ventricular side, we placed 2-0 pledged Ethibond sutures circumferentially through the posterior leaflet, positioned the valve and tied the sutures.

During the weaning process from CPB, we noticed severe bleeding around the posterior AV groove under the left atrial appendage and discovered a 2-cm AV disruption, determined as Type I. We decided to complete the weaning process from CPB and fully antagonize the heparin.

We carefully placed several layers of TachoComb (Nycomed) and applied manual pressure for 60 min. Unfortunately, this was not successful and excessive bleeding continued. Owing to high LV pressure and fragile myocardial tissue, we decided to unload...
the heart and minimize myocardial tension using an ECLS system, thus facilitating surgical repair.

A multistage venous cannula was inserted via the right femoral vein. The arterial cannula was inserted into the distal ascending aorta due to a severely atherosclerotic left femoral artery. The whole procedure was performed without any additional heparinization in order to avoid anticoagulation in this severe bleeding situation.

The ECLS pump rate was adjusted to 4.5 l/min, resulting in effective ventricular unloading. This enabled us to localize the area of AV disruption and to place a 4 × 1 cm teflon-pledget suture. Additionally, TachoComb and fibrin glue were applied to the area of disruption. The bleeding completely stopped and the patient went to the intensive care unit with continued ECLS ventricular unloading.

We decided to unload the left ventricle for additional 48 hours before weaning the patient from the ECLS system. After 2 days of continuous ventricular unloading and only minor bleeding (350 ml), we explanted the ECLS system and closed the chest. We did not administer any anticoagulatory agents while the patient was on ECLS. The patient recovered and was discharged from the hospital after three more weeks. At the time of discharge, echocardiography showed normal LV function and appropriate valve function without regurgitation, paravalvular leakage or pseudoaneurysm.

**COMMENT**

AV disruption is a fatal complication after MVR. Reviewing the literature, we found that this complication was more frequent in the early days of mitral valve surgery and has been rarely reported in recent years [1–5]. However, the optimal surgical management of AV disruptions is not clear and several techniques, ranging from sealing with surgical glue to cardiac autotransplantation, were described over the last decades [5]. One option reported is to go back on-pump with cardioplegic arrest, remove the prosthesis and close the tear with buttress or patch sutures, followed by re-MVR [3]. This invasive technique is associated with prolonged CPB and aortic cross-clamp time, excessive blood loss and high mortality.

Schuetz et al. described epicardial tissue sealing with a biodegradable collagen system and a fibrinogen-based coating (TachoComp) [3]. Several layers were placed over the bleeding site and manual pressure applied for 30–60 min.

In our report, we describe a new approach to manage a severe AV disruption Type I most likely caused by excessive debridement in a 76-year old patient. In this situation, re-MVR with intraventricular patch reconstruction was not appropriate due to the patient’s age and severe comorbidities. As a last resort, we decided to unload the heart, and the left ventricle in particular, using an ECLS system. This allowed us to safely place a Teflon patch to close the disruption. Furthermore, heparinization was not necessary and we were able to administer additional haemostatic agents under controlled conditions.

From our point of view, avoiding re-heparinization and establishing an effective haemostasis is the major advantage of our approach. We strongly believe that the combination of an effective haemostasis combined with ventricular decompression using an ECLS system were the key factors for the successful management of our patient. Moreover, this technique allowed slowly weaning the patient from the ECLS and better control of ventricular loading and compression. In our opinion, the volume of bleeding and the function of the ventricles during the first days of ECLS are essential criteria for weaning the patient from the support system. However, this is the first time we used ECLS for this indication.

In summary, employing ECLS is suitable not only for patients in cardiogenic shock, but also for patients who need effective ventricular unloading and decompression. This technique may not be the optimal solution for all AV disruptions and is limited to centres that have expertise with ECLS systems. Nevertheless, the use of ECLS is a highly effective approach for certain ventricular injuries that can be best controlled through ventricular decompression.

**Conflict of interest:** none declared.

**REFERENCES**


