

Novel adjunctive use of venoarterial extracorporeal membrane oxygenation in atrioventricular groove disruption following mitral valve surgery



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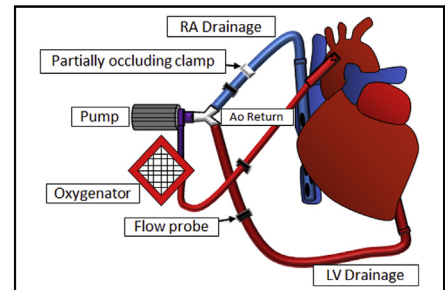
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Atrioventricular groove disruption (AVGD) is a rare but potentially catastrophic complication after mitral valve surgery. Despite the availability of different repair techniques, mortality rates can exceed 75%.¹ Herein, we present 2 patients undergoing mitral valve surgery who developed AVGD where central venoarterial extracorporeal membrane oxygenation (VA-ECMO) incorporating a left ventricular (LV) vent was successfully used as an adjunctive therapy to promote hemostasis and myocardial recovery. Institutional review board approval and informed consent was obtained for this research.

CLINICAL SUMMARY

Case 1

An 85-year-old woman with severe mitral regurgitation, mild annular calcification, and reduced ejection fraction (35%) presented with acute decompensated heart failure and was taken for urgent mitral valve surgery. After she underwent an unremarkable mitral valve annuloplasty (#30 Rigid Saddle Ring; St Jude Medical, Inc, St Paul, Minn), bleeding was noted from behind the LV once the crossclamp was removed. As the bleeding did not improve with epicardial hemostatic agents, the aorta was re-crossclamped, the ring explanted, and a bovine pericardial patch was sewn across the posterior atrioventricular groove and anchored to the LV wall and the left atrium with 4-0 PROLENE sutures (Ethicon, Somerville, NJ). A 25-mm supra-annular bioprosthetic valve was then sewn in with pledgeted sutures and the crossclamp removed. Total bypass and crossclamp times were 5 hours, 16 minutes and 3 hours, 7 minutes, respectively.



Central VA-ECMO schematic with an LV vent.

CENTRAL MESSAGE

Central VA-ECMO with an LV vent can promote hemostasis, myocardial recovery, and may prevent prosthetic valve thrombosis after atrioventricular groove disruption during mitral valve surgery.

See Commentaries on pages 216 and 218.

Case 2

A 64-year-old man underwent an elective mitral valve repair (posterior quadrangular resection and #32 Cosgrove Ring; Edwards Lifesciences, Irvine, Calif) but developed refractory posterior AVGD. Intraoperatively, it was noted that his tissues were exceptionally thin and fragile. The crossclamp was reapplied, an intracardiac patch placed, and a 27-mm supra-annular bioprosthetic valve was sewn in place. Total bypass and crossclamp times were 3 hours, 18 minutes and 2 hours, 48 minutes, respectively.

Despite these efforts, bleeding continued in both cases, and transesophageal echocardiography demonstrated depressed cardiac function. The decision was made to convert cardiopulmonary bypass to central VA-ECMO with an LV vent (Figure 1). The 7.0-mm aortic cannula was left in place and the bicaval cannulae were replaced with a 34-Fr right atrial drainage cannula. To depressurize the LV, a Medtronic 22-Fr malleable venous cannula (Medtronic, Minneapolis, Minn) was inserted into LV apex, secured with 3 horizontal pledgeted sutures and tourniquets, and brought out through the left anterior chest to prevent kinking.

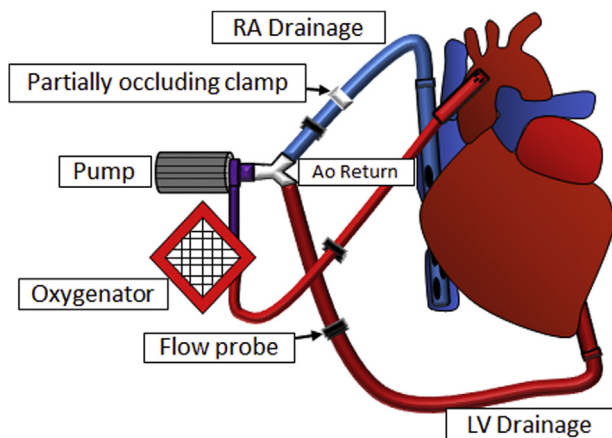


FIGURE 1. Central venoarterial extracorporeal membrane oxygenation schematic with an LV vent for atrioventricular groove disruption after mitral valve surgery. RA, Right atrium; Ao, aortic; LV, left ventricle.

This was then connected to the right atrial drainage cannula using a Y-connector. Heparin was fully reversed with protamine and, in both cases, bleeding significantly improved. Both chests were left open and no anticoagulation was initiated. ECMO flows were 4.0 and 4.7 L/min, respectively, and pulmonary artery (PA) catheters were kept in for monitoring. The relative amounts of drainage from the right atrial and LV vent cannulas were adjusted with a partially occluding clamp (Figure 2). We targeted 1.5 to 2 L/min of apical venting flow to reduce the risk of cannula thrombosis and ensured adequate volume to prevent air entrainment through LV “suck-down.” By adjusting volume and right atrial drainage flow, we achieved a minimum PA pulsatility of 5 to 10 mm Hg. Adequate LV decompression was assessed by minimal arterial pulsatility and a low wedge pressure. Once the bleeding had completely subsided, central ECMO was

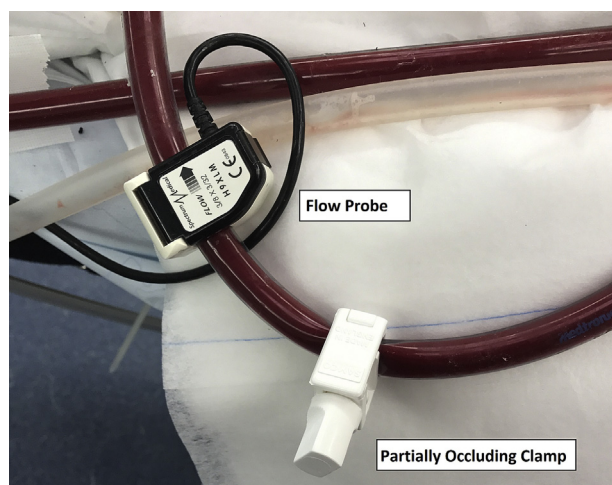


FIGURE 2. Photograph demonstrating partial occluding clamp on the left ventricular drainage cannula with a flow probe to control and monitor differential flows.

converted to femoral VA-ECMO, the LV vent removed, and the pledgeted sutures tied down to close the LV apex (case 1: postoperative day [POD] 2, case 2: POD 3). Heparin was initiated on day 4 and 3, respectively at 300U/h and up-titrated to a partial thromboplastin time goal of 45 to 60 seconds. Femoral ECMO was decannulated on POD5 and 9, respectively. Both patients were eventually discharged to rehab; patient 1 was alive at 1 year and patient 2 died of pneumonia 8 months postdischarge.

DISCUSSION

Posterior AVGD is an oftentimes fatal complication after mitral valve surgery. Although the best repair strategy has yet to be defined, an internal patch repair is the most commonly recommended approach, requiring removal of the prosthesis, additional crossclamping, and prosthesis re-implantation—significantly prolonging operative time.²⁻⁴

One of the biggest obstacles to repairing AVGD is significant bleeding from the relatively inaccessible posterior of the heart. Intracardiac repair permits reconstruction under direct vision but, once the atriotomy is closed, manipulation of the heart for additional external hemostasis maneuvers may exacerbate bleeding and further disruption given the presence of the mitral prosthesis.

Our unique strategy of using VA-ECMO with an LV vent can aid in this refractory bleeding, as it permits ventricular decompression while simultaneously providing hemodynamic support for a struggling myocardium after a prolonged crossclamp time. Persistent bleeding dramatically improved in both cases by decompressing LV and ECMO facilitated myocardial recovery. This salvage should only be reserved for patients who are refractory to conventional AVGD repair.

Drainage flow was adjusted to maintain PA pulsatility while maximizing LV unloading. Full drainage from the right atrial cannula can limit PA pulsatility, reducing antegrade flow through prosthetic mitral valve to the point where stagnant flow may facilitate prosthetic valve thrombosis.⁵ While bioprosthetic valves may be at lower risk of thrombosis than mechanical valve, we believe the incidence of bioprosthetic valve thrombosis is both under-recognized and under-reported. The key advantage of our strategy is the maintenance of some blood flow through the prosthetic valve to prevent thrombosis while unloading using the LV vent to completely unload the LV. Indeed, neither of these patients had any evidence of valve thrombosis on follow-up echocardiograms.

In summary, central VA-ECMO with the addition of an LV vent appears to be an effective adjunctive strategy in promoting hemostasis without prosthetic valve thrombosis in patients who develop AVGD after mitral surgery.

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