Successful explantation of a left ventricular assist device following acute fulminant myocarditis

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A left ventricular (LV) assist device was implanted in a 53-year-old woman in cardiogenic shock secondary to fulminant myocarditis. LV function recovered to normal after one week of support from an LV assist device. The device was explanted and the patient is showing a good outcome with a normalized LV function.

Key Words: Myocarditis; Shock; Ventricular assist device

CASE PRESENTATION

A 53-year-old, 50 kg woman with no prior medical history was transferred from a community hospital in cardiogenic shock. The patient was sedated but responsive to stimulation, and she was mechanically ventilated. Hemodynamic support at the time of transfer consisted of a perfusion of noradrenaline (0.2 µg/kg/min) and dopamine (10 µg/kg/min), and an intra-aortic balloon pump. Her central venous pressure was lower than 16 mmHg, urine output was maintained, lactate levels were in the upper normal range and hepatic function tests were normal.

Two weeks before admission, the patient presented with a mild respiratory infection, which resolved spontaneously after a few days. No antibiotics were administered. One day before admission to the referring hospital, the patient was still working but complained of nonspecific gastrointestinal symptoms, and she was febrile. On the day of admission, she complained of retrosternal pain, which led her to consult a physician. A cardiac workup showed positive cardiac enzymes and no specific electrocardiographic changes. An initial echocardiogram showed diffuse hypokinesia and a left ventricular (LV) ejection fraction estimated at 30%. A coronary angiogram, performed to rule out coronary artery disease, was normal. Within a few hours, the patient's hemodynamic status severely deteriorated and required insertion of an intra-aortic balloon pump and transfer to the Montreal Heart Institute (MHI) (Montreal, Quebec).

The patient's status on arrival was as described above. Following an initial period of medical management and observation, during which time the patient's status seemed to stabilize, the decision was made to insert an LV assist device (LVAD) as a bridge to transplantation; this decision was made due to

L'explantation réussie d'un dispositif d'assistance ventriculaire gauche après une myocardite fulminante aiguë

Un dispositif d'assistance ventriculaire gauche (VG) a été implanté à une femme de 53 ans en choc cardiogène secondaire à une myocardite fulminante. La fonction VG est redevenue normale après un soutien d'une semaine à l'aide du dispositif d'assistance VG. Le dispositif a été explanté et l'évolution de la patiente est positive, avec une fonction VG normalisée.

clinical deterioration manifesting through low cardiac output (less than 2.0 L/min/m²), despite increasing doses of inotropes and vasopressors, and transthoracic echocardiography showing a residual LV ejection fraction of 10%. A Thoratec device (Thoratec Corporation, USA) was inserted with an inflow cannula in the LV apex and an outflow cannula in the ascending aorta. The procedure was uneventful and the device output matched the patient's requirements (approximately 5 L/min/m²). On postoperative day 2, the patient was extubated. She was neurologically intact, except for a brief period of postoperative delirium. All hemodynamic parameters were satisfactory (device output, urine output, lactate levels and venous oxygen saturation). No bleeding or thromboembolic complications were encountered. Pathological examination confirmed the diagnosis of acute myocarditis with the presence of myolysis and a moderate infiltration of lymphocytes and macrophages within the myocardium (Figure 1). On postoperative day 4, a control echocardiogram, performed under full assistance, showed good left and right ventricular contractility. On postoperative day 5, weaning from LVAD was performed under echocardiographic monitoring, and the patient showed complete recuperation of cardiac function and contractility. Therefore, the decision was taken to explant the device on postoperative day 7. No specific or progressive weaning protocols were used to wean the patient from the LVAD; she was simply brought to the operating room and the device was turned off. After 5 min of hemodynamic stability, it was removed. Because the inflow cannula was recently inserted and the surrounding tissues were of good quality, it was fully explanted under cardiopulmonary bypass. A circular Fontan stitch was performed to close the gap left by the cannula followed by two large Teflon felts to 'sandwich' the ventriculotomy

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Figure 1) Pathological examination of the myocardium shows the presence of myolysis and inflammatory infiltrates in the myocardium

(Figure 2). Explantation was well tolerated. The patient left the hospital two weeks following explantation in excellent condition. She was put on small dose beta-blockers and angiotensin-converting enzyme inhibitors. A predischarge echocardiogram showed normal biventricular function.

DISCUSSION

LVADs have been available in Canada since 1986 (1). The two accepted indications for its use are as a bridge to transplantation and as a bridge to recovery. This is the first case of successful weaning and explantation of a mechanical assist device at the MHI (the first mechanical support system was implanted in 1987, and 35 were implanted before this patient). Looking back at the LVAD database at the MHI, some patients with acute myocarditis were transplanted within a few days from the time of implantation, leaving little time for recuperation of cardiac function. Although this is but a single case, it leads one to re-evaluate the timing of listing these patients for transplantation, considering that they are usually listed as status 4 unless complications or end-organ damage occurs, which often leads to swift transplantations in an era of donor shortages. Therefore, in patients with fulminant myocarditis that show good clinical and hemodynamic parameters under LVAD support, serial echocardiograms should be performed to evaluate the potential for recovery (2).

A quicker and much less expensive alternative to LVAD support is venoarterial extracorporeal membrane oxygenation (ECMO) support. ECMO allows initiating hemodynamic and oxygenation support through peripheral access, which permits the evaluation of a patient's neurological status and recuperation potential. However, ECMO does not provide cardiac outputs of the magnitude of those provided by central LVAD support, and it often fails (oxygenator failure) before the patient has time to recuperate. Therefore, in the present case, because the patient's neurological status was normal preoperatively, a decision to bridge to transplantation was made and ECMO support was not undertaken. It has also been suggested that cannulating the left atrium will avoid the ventriculotomy associated with the apical 'punch', which creates a 2 cm to 3 cm diameter hole in the LV apex. However, device outputs are limited by the size of the inflow cannula, which is relatively smaller. In addition, by increasing the vacuum on the Thoratec

Figure 2) Left ventricular apical view following explantation of the Thoratec device (Thoratec Corporation, USA)

device, the atrium often occludes the inflow cannula, thereby dropping the output suddenly and causing potential management problems. Two management options are available at the time of explantation for the apical inflow cannula. It can be removed, as in the present case, followed by a modified Dor procedure, or it can be left in place and covered by a pericardial patch. The latter option dictates lifelong anticoagulation to avoid thromboembolic complications related to the presence of the cannula remaining in the left ventricle. The quality of the surrounding LV muscle and the time from implantation are two major factors to be considered when deciding upon either strategy.

Pharmacological management of patients on LVAD support as a bridge to recovery is an area of great potential. Some groups recommend administering clenbuterol, a beta-2-adrenergic receptor agonist, to promote reverse remodelling in a decompressed heart under total circulatory support (3). No such therapy was provided in the present case, but one can speculate that the introduction of such therapeutic strategies may lead to increased numbers of explantations. Following explantation, the patient was put on small dose beta-blockers and angiotensin-converting enzyme inhibitors; this was done empirically, despite normal biventricular function. The patient continues to be followed closely and remains in excellent condition three months after explantation.

CONCLUSIONS

Full recovery of ventricular function in patients with fulminant myocarditis is possible once the left ventricle is unloaded and the patient is put on full circulatory support for several days. Early LVAD implantation, along with close surveillance of ventricular function, is essential to maximize the number of candidates for weaning from LVAD support in this clinical setting.

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