Use of Mechanical Circulatory Support in Cases of End-Stage Acute Heart Failure

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Introdução

The incidence of cardiogenic shock following acute myocardial infarction (AMI) is 7.5%, with a lethality of 60% to 80%[1]. Mortality among these patients remains high even when revascularization of the responsible artery is performed immediately[1,2]. Within this context, the use of mechanical ventricular support seems to improve the surgical results and long-term survival[2,3].

The aim of this study is to report the initial experiences with the left ventricular assist device (VAD) EXCOR® (Berlin Heart).

Methods

Case reports of the first two patients who had EXCOR® VAD devices implanted in Brazil, in 2006.

Patient 1 - A male patient, 44 years of age, 80 kg, 1.79 cm, hypertensive, smoker, with a family history of coronary artery disease, suffered an anterior-wall AMI after intense recreational physical activity. Fifteen hours after the pain had begun, the patient was taken to the hemodynamics laboratory for coronary angiography which showed proximal occlusion of the anterior descending artery (LAD). Coronary angioplasty was performed and a conventional stent was implanted in the proximal LAD, but there was distal embolization with final TIMI-II flow. The patient progressed with worsening of his hemodynamic status, orotracheal intubation, intra-aortic balloon (IAB) implantation, metabolic acidosis, and rhabdomyolysis. Due to unavailability of the EXCOR® VAD device at that moment, and also due to the worsening of both pulmonary and liver function, the treatment of choice was cardiopulmonary support using a centrifugal pump and extracorporeal membrane oxygenation (ECMO) through cannulation of femoral vessels. The patient developed nosocomial pneumonia and renal failure, and required hemodialysis. On the eighth day of short-term ECMO support, the patient was taken to the operating room to have an EXCOR® device implanted.

Patient 2 - A male patient, 53 years of age, obese, hypertensive, with type II diabetes, smoker and with a family history of coronary artery disease, was transferred one week after an untreated AMI presenting with cardiogenic shock and pulmonary edema, and received an IAB. The patient progressed to worsening of renal function, hepatic dysfunction, and a coagulation disorder. Coronary angiography showed occlusion of the ostium of the circumflex artery (Cx), occlusion in the distal third of the LAD, a 60% lesion in the middle third of the right coronary artery, and a 90% lesion in the ostium of the posterior ventricular artery. Angioplasty was performed with stent implantation in the LAD and Cx arteries. Multiple electrical cardioversions were required due to ventricular tachycardia and fibrillation. A femoral-femoral ECMO bypass was installed restoring the patient's hemodynamic status. The patient progressed to oliguric acute renal failure requiring hemodialysis. After clinical stabilization, the EXCOR® VAD device was implanted.

Implantation of the EXCOR® VAD device

Both patients underwent median sternotomy with cannulation of the right atrium and the ascending aorta artery to establish conventional extracorporeal circulation (ECC). In the first case, the VAD device was implanted with the heart beating (without aortic clamping), whereas in the second patient, implantation was performed under cardioplegic arrest.

Apical cannula - A small ventriculotomy was performed to allow left ventricular apex cannulation with an individual apical cannula. The cannula was attached to the ventricular wall using interrupted U-shaped Prolene 3-0 sutures with Teflon pledgets (fig. 1). After fixation, a bovine pericardial flap was fixed to the epicardium around the cannulation area (continuous Prolene 4-0 suture) to prevent bleeding.

Aortic cannula - The same principle was applied for aortic cannulation. The cannula was attached to the aortotomy using interrupted U-shaped Prolene 4-0 sutures with Teflon pledgets (fig. 2).

After passing through the aponeurosis, both cannulas exited the body through the upper abdominal wall. Following maneuvers to withdraw air from the system, the cannulas were connected to the 80 ml paracorporeal Berlin Heart EXCOR® assist device (figs. 3 and 4).

Results

After implantation of mechanical circulatory support, the hemodynamic parameters improved and the need for vasopressor drugs was reduced.

Key words

Thoracic surgery; shock, cardiogenic; assisted circulation; heart transplantation.

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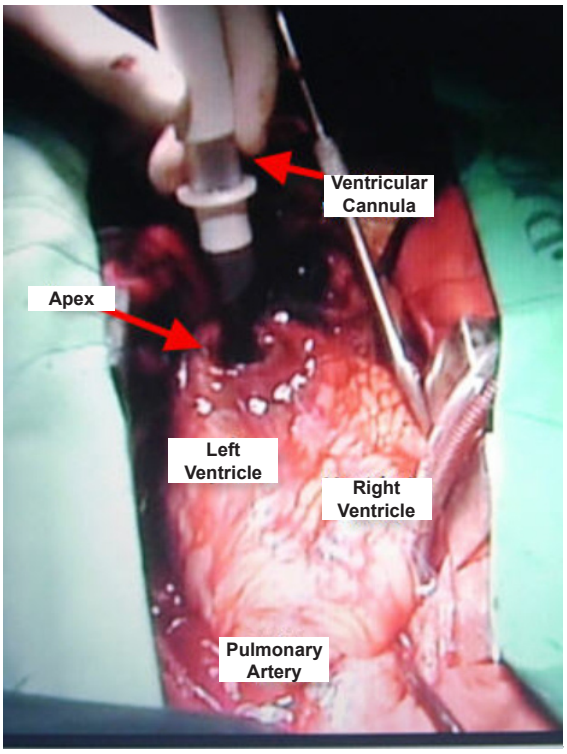

Fig. 1 - *Left ventricular apex cannulation.*

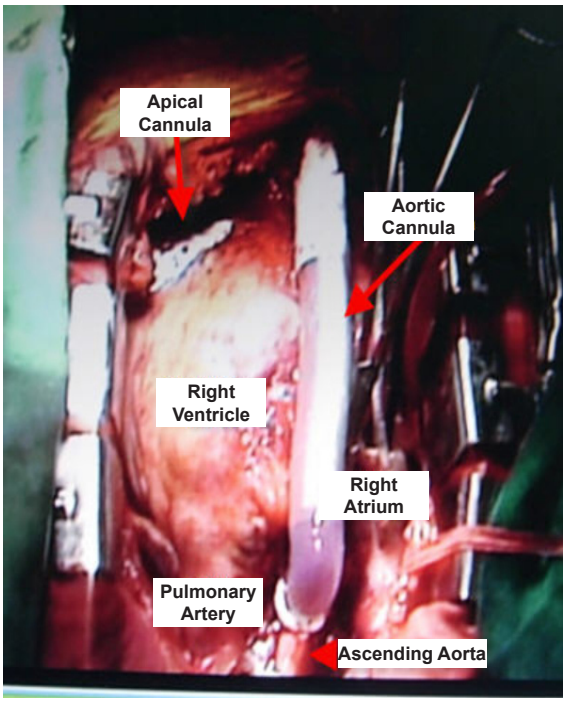

Fig. 2 - *Ascending artery cannulation.*

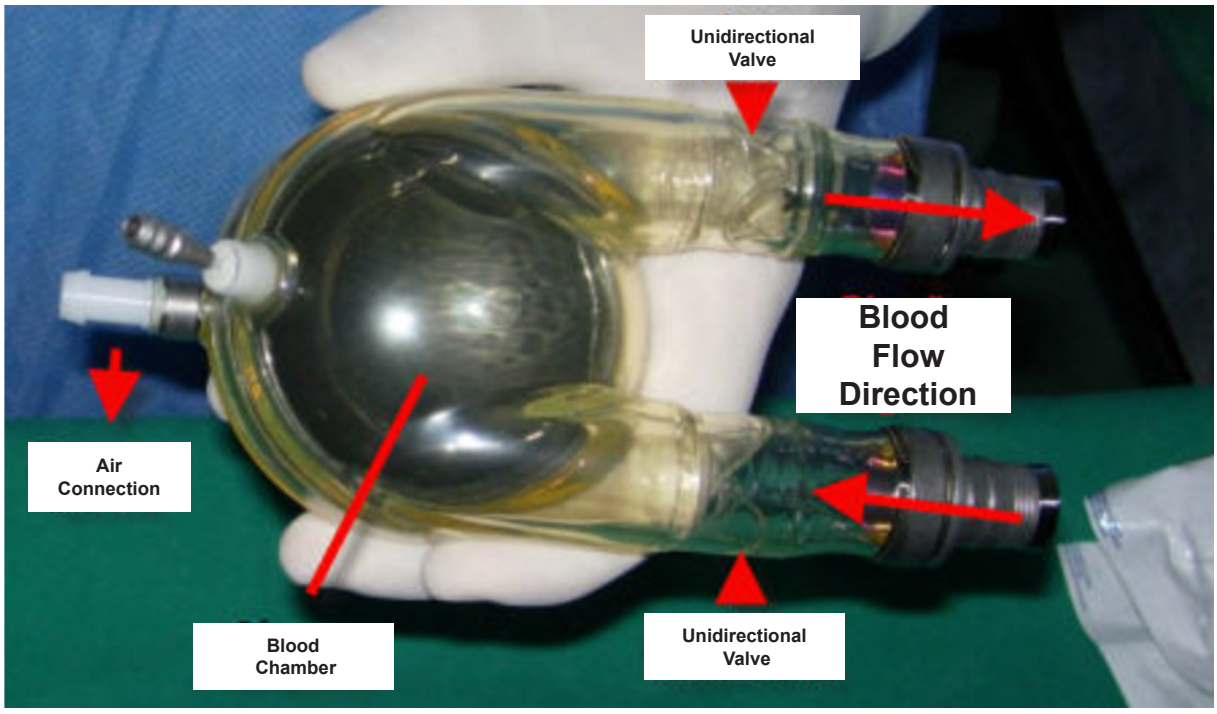

Fig. 3 - *EXCOR® assist device with 80 ml chamber.*

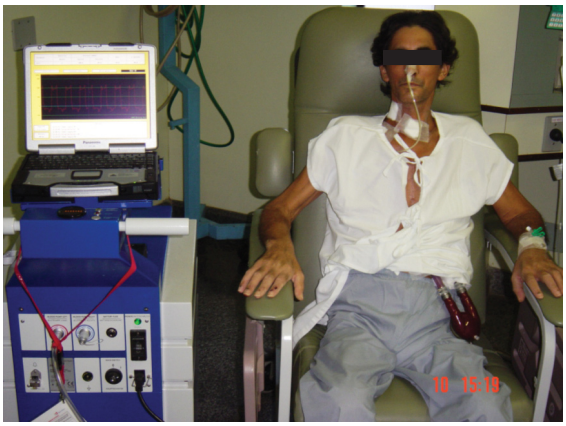

Fig. 4 - Patient with an implanted EXCOR® VAD device.

Perfusion times with ECMO were 176 hours and 89 hours, respectively, for patients 1 and 2.

The ECC times for EXCOR® device implantation were 90 minutes and 150 minutes, and the clamping time in the second case was 65 minutes.

The first patient partially recovered his renal function and remained under conservative treatment while awaiting cardiac transplantation which was performed almost five months after ventricular support had been instituted. The second patient remained under ventricular support for 32 days and died of mesenteric infarction following severe digestive hemorrhage and tissue hypoperfusion.

Discussion

The superiority of VADs over cardiogenic shock treatment with venous drugs has been confirmed by many authors[4-6]. The use of these devices, combined with myocardial revascularization therapy (surgical or percutaneous) in patients experiencing cardiogenic shock following AMI, not only diminishes hospital mortality, but also improves five-year survival in this group of patients[2].

In Brazil, where mechanical ventricular support therapy has not yet been widely adopted and patients are maintained on clinical treatment, the mortality rate in the subgroup of patients on the waiting list for cardiac transplantation is more than 50% in a period of slightly more than 2 months[7].

Both patients presented late in the progression of the AMI, and revascularization of the responsible artery was also performed late. These factors point to the remote chance of myocardial recovery, and consequently, VAD was used as a bridge to cardiac transplantation. Early indication for the use of mechanical assist devices capable of generating a high blood flow and ventricular decompression is directly related to the favorable survival results obtained with this procedure[8].

Hospital mortality rates among patients who received ventricular support are still greater than 35%, depending on the etiology of the myocardial aggression, how soon the procedure is indicated, and the patients selected, in addition to the level of experience of the institution where the implant is performed[3,9]. The main factors that lead to the death of these patients are irreversible multiorgan dysfunction, sepsis, cerebrovascular accidents, bleeding, and malfunction of the device[3,10].

Conclusion

Long-term left ventricular support can revert multiorgan dysfunction secondary to cardiogenic shock following AIM in selected patients, allowing their survival after cardiac transplantation. However, early intervention, selection of patients, and level of training of the multiprofessional team are vital for achieving better results and minimizing costs.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

Sources of Funding

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Study Association

This study is not associated with any graduation program.

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