CASE REPORT

Systemic Ventricular Assistance using a HeartMate 2 Device as Bridge to Transplant in Corrected Transposition of the Great Arteries

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ABSTRACT

Due to continuous advances in medical and surgical treatment, the number of adult patients with congenital heart disease is increasing. With the passage of time, these patients develop several complications, including advanced heart failure, which may require therapeutic approaches such as heart transplant and, in certain cases, the implantation of a circulatory assist device, both as a bridge to transplant or as final treatment.
This report describes a case that shows the problem of the adult population with congenital heart disease. It is the case a 41 year-old male with corrected transposition of the great arteries who developed advanced heart failure of the morphological right ventricle supporting the systemic circulation. Due to several decompensations under medical treatment, including the home use of inotropes, a circulatory assist device was implanted as an early bridge to transplant. After several postoperative complications, the patient was transferred to a rehabilitation center to await transplantation.

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Key words > Congenital heart disease - Transposition of the great arteries – Artificial heart - Heart transplant

Abbreviations >

VAD	Ventricular assist device	**CTGA**	Corrected transposition of the great arteries

BACKGROUND

Continuous advances in medical and surgical treatment have resulted in an increased number of adult patients with congenital heart disease. At present, it is estimated that there is a total of 850,000 patients in the United States, and about 20,000 new cases reaching adulthood every year. (1)

Corrected transposition of the great arteries (CTGA) is found in less than 0.5% of the patients with congenital heart disease. It represents an atrioventricular and ventriculoarterial discordance in which the morphological left ventricle supports the pulmonary circulation; the pulmonary veins return to the left atrium, and from there blood passes through the atrioventricular valve –anatomically, the triscupid valve– toward the morphological right ventricle which pumps blood to the systemic circulation. Associated anomalies are often present in these patients, including ventricular septal defect, right ventricular outflow tract obstruction, and congenital conduction disorders. The risk of complications is higher with increasing age, heart failure being one of them, particularly since the fourth decade of life. (2, 3)

The present report describes the case of a patient with CTGA (Figures 1 and 2 A-C), who developed advanced heart failure and required the implantation of a ventricular assist device (VAD) as a bridge to transplantation.

CLINICAL REPORT

This is the case of a 41-year-old male presenting CTGA, with a history of complete atrioventricular block with permanent pacemaker implantation and severe systemic atrioventricular (tricuspid) valve insufficiency. The patient underwent valve replacement with a mechanical prosthesis in 1990, and developed progressive systemic heart failure (of the morphologic right ventricle), and complex ventricular arrhythmia, which required an implantable cardiac defibrillator. As a result of progressive pump failure and after several hospitalizations due to decompensation, intravenous milrinone therapy was started in December 2010. Subsequently, he was discharged, assessed, and included in the list for heart transplant. A severe decompensation required his admission to the intensive care unit in August

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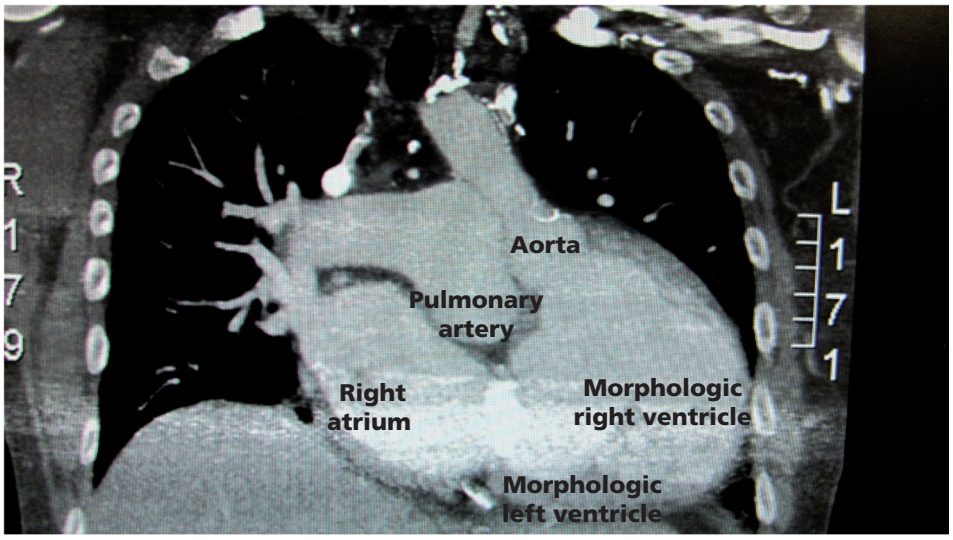

Fig. 1. Preimplantation Chest CT angiography.

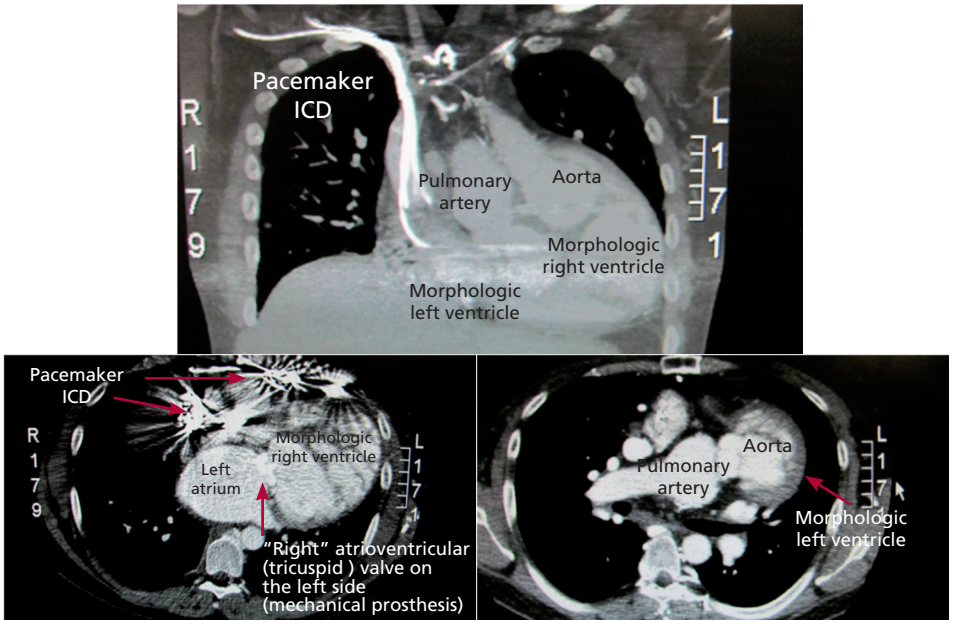

Fig. 2. A-C. Preimplantation Chest CT angiography. ICD: Implantable cardioverter-defibrillator.

2011. He was partially compensated and a VAD implantation as a bridge to transplant was evaluated. A HeartMate II continuous-flow left ventricular assist device (Figure 3) was implanted (Thoratec Corporation; Pleasanton, Calif.) by placing the inflow cannula into the morphologic right ventricle, and the outflow cannula into the ascending aorta, associated with closure of an interventricular communication, and appropriate function of the previously implanted tricuspid mechanical prosthetic valve. After a long recovery period –which included tracheostomy due to respiratory failure, renal replacement therapy with continuous arteriovenous filtration for 25 days due to renal failure, and use of vasopressor and inotropic drugs for 3 weeks–, the patient was finally discharged and transferred to a rehabilitation center to complete his recovery and await transplantation.

DISCUSSION

The restricted number of donors and the continuous increase in the number of patients who develop advanced forms of heart failure in need of heart transplant pose serious challenges both for patients and attending physicians. In such circumstances, the implantation of a VAD, if available, is a valid alternative that allows the patient's compensation and/or offers further time to reach transplantation (bridge to transplant), or the possibility of implantation as final therapy or bridge to destiny. Over the years, an increasing number of congenital heart diseases in adults correspond to the etiology leading to heart transplantation. (4, 5)

There are only a few reports in the literature regarding the use of VAD in patients with CTGA, a procedure that consists in assisting the morphologic

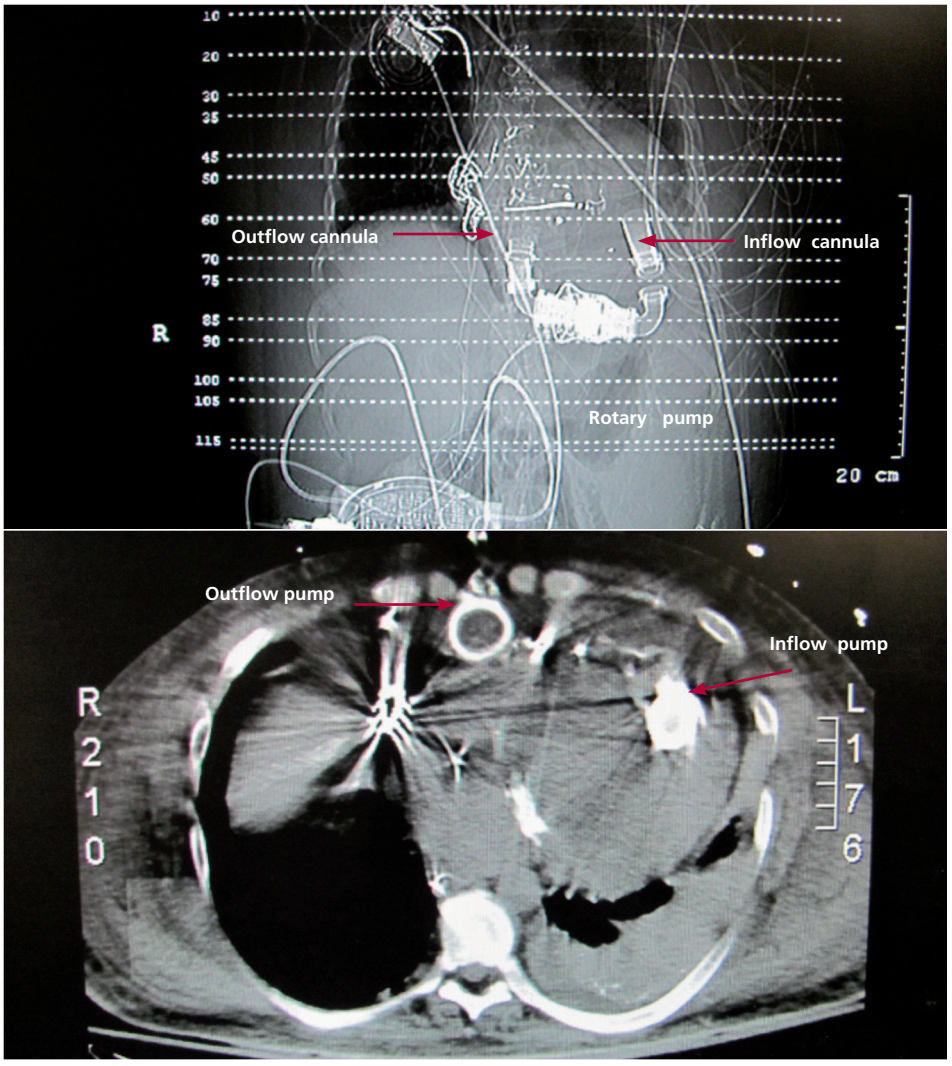

Fig. 3. A and **B.** Chest and abdomen CT angiography after HeartMate 2 implantation.

right ventricle which supports the systemic circulation. The first case corresponds to Stewart et al, who, in 2002, detailed the implantation of a TCI Heartmate pulsatile-flow VAD as bridge to transplant in a 30-year-old patient with CTGA who –as in the case of our patient– had a previous systemic atrioventricular valve replacement. The patient was treated for eight months until transplantation, with subsequent positive outcome. (6)

In 2005, Gregoric et al reported the case of a 53-year-old patient with CTGA and severe systemic ventricular dysfunction, who received a pulstatile-flow VAD, and after 8 months of assistance underwent cardiac transplantation. (7)

Joyce et al reported another three patients with CTGA, one of them with corrected transposition and the other two with transposition and dextrocardia. A continuous-flow device was implanted in all three patients. One of them underwent a successful transplant, and the other two patients are waiting for a donor. (8)

Our patient –included in our restarted circulatory assistance program– received a continuous-flow VAD. At present, the development of new technologies and the miniaturization of continuous-flow rotary pumps with limited pulsatile volume are under clinical evaluation. This type of VAD, in addition to being smaller, silent, and durable compared to pulsatile devices, has improved hemodynamic support, functional status and quality of life in patients awaiting transplantation. (9, 10)

In a recent comparison of ineligible patients for transplantation –134 patients with continuous-flow VAD against 66 patients with pulsatile VAD–, increased survival free of stroke and primary device failure was detected in the first group of patients, though both groups improved their quality of life and functional class. (11)

In the forthcoming years, late development of systemic ventricular failure would be expected to increase due to the growing number of patients with Senning or Mustard procedures or with CTGA reaching adulthood. The absence of real, definite surgical options, in addition to the referred shortage

of donors might pose the alternative use –due to its availability– of a VAD as a bridge to transplant or as "final" treatment for these patients.

RESUMEN

Asistencia ventricular sistémica con dispositivo HeartMate 2 como puente al trasplante en la transposición corregida de los grandes vasos

Introducción

Merced a los continuos progresos en el tratamiento médico y quirúrgico, el número de pacientes adultos portadores de cardiopatías congénitas se encuentra en incremento, quienes con el paso del tiempo desarrollan diversas complicaciones, entre ellas insuficiencia cardíaca avanzada, la cual puede requerir terapéuticas como el trasplante cardíaco y en ocasiones plantea la necesidad del implante de un dispositivo de asistencia circulatoria, ya sea como puente al trasplante o como tratamiento definitivo.

En esta presentación se describe un caso que ilustra la problemática de la población portadora de cardiopatías congénitas en el adulto. Se trata de un paciente de sexo masculino, de 41 años, portador de transposición corregida de los grandes vasos que desarrolló insuficiencia cardíaca avanzada del ventrículo morfológicamente derecho, el cual sostiene la circulación sistémica. Ante reiteradas descompensaciones bajo tratamiento médico, incluido el uso domiciliario de inotrópicos, se procedió al implante de un dispositivo de asistencia circulatoria inicialmente planteado como puente al trasplante. Tras diversas complicaciones posoperatorias, el paciente fue derivado a una institución de rehabilitación a la espera del trasplante.

Palabras clave > Cardiopatías congénitas - Transposición de los grandes vasos - Corazón artificial - Trasplante de corazón

Conflict of interest

None declared

REFERENCES

1. Marelli AJ, Therrien J, Mackie AS, Ionescu-Ittu R, Pilote L. Planning the specialized care of adult congenital heart disease patients: from numbers to guidelines; an epidemiologic approach. Am Heart J 2009;157:1-8. http://doi.org/fcsx2t

2. Graham TP Jr, Bernard YD, Mellen BG, Celermajer D, Baumgartner H, Cetta F, et al. Long-term outcome in congenitally corrected transposition of the great arteries: a multi-institutional study. J Am Coll Cardiol 2000;36:255-61. http://doi.org/bmb23z

3. Dyer K, Graham TP. Congenitally corrected transposition of the great arteries: current treatment options. Curr Treat Options Cardiovasc Med 2003;5:399-407. http://doi.org/cffzjr

4. Stehlik J, Edwards LB, Kucheryavaya AY, Aurora P, Christie JD, Kirk R, et al. The Registry of the International Society for Heart and Lung Transplantation: twenty-seventh official adult heart transplant report 2010. J Heart Lung Transplant 2010;29:1089-103. http://doi.org/fkrv4x

5. Johnson MR, Meyer KH, Haft J, Kinder D, Webber SA, Dyke DB. Heart transplantation in the United States, 1999-2008. Am J Transplant 2010;10:1035-46. http://doi.org/df7tgs

6. Stewart AS, Gorman RC, Pocchetino A, Rosengard BR, Acker MA. Left ventricular assist device for right side assistance in patients with transposition. Ann Thorac Surg 2002;74:912-4. http://doi.org/cdxp4g

7. Gregoric ID, Kosir R, Smart FW, Messner GN, Patel VS, La Francesca S, et al. Left ventricular assist device implantation in a patient with congenitally corrected transposition of the great arteries. Tex Heart Inst J 2005;32:567-9.

8. Joyce DL, Crow SS, John R, St Louis JD, Braunlin EA, Pyles LA, et al. Mechanical circulatory support in patients with heart failure secondary to transposition of the great arteries. J Heart Lung Transplant 2010;29:1302-5. http://doi.org/db7r42

9. Miller LW, Pagani FD, Russell SD, John R, Boyle AJ, Aaronson KD, et al; HeartMate II Clinical Investigators. Use of a continuous-flow device in patients awaiting heart transplantation. N Engl J Med 2007;357:885-96. http://doi.org/cxkq2g

10. Pagani FD, Miller LW, Russell SD, Aaronson KD, John R, Boyle AJ; HeartMate II Investigators. Extended mechanical circulatory support with a continuous-flow rotary left ventricular assist device. J Am Coll Cardiol 2009;54:312-21. http://doi.org/fb2cb8

11. Slaughter MS, Rogers JG, Milano CA, Russell SD, Conte JV, Feldman D; HeartMate II Investigators. Advanced heart failure treated with continuous-flow left ventricular assist device. N Engl J Med 2009;361:2241-51. http://doi.org/fsdvpp