Long-term total cardiac support in a Fontan-type circulation with HeartMate II left ventricular assist device

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Received 28 October 2015; received in revised form 19 December 2015; accepted 11 January 2016

Abstract

Interest in utilizing long-term mechanical circulatory support for Fontan-type circulation has been high. Unfortunately, so far such attempts have not been successful. Herein, we are presenting the first case of an individual with biventricular heart failure and Fontan-type circulation on long-term mechanical circulatory support with a continuous-flow left ventricular assist device.

Keywords: Fontan-type circulation • Biventricular failure • Left ventricular assist device
was explanted through a thoracic incision, without reopening the sternum, 33 days from her original surgery. The patient has not required any further surgical interventions.

Subsequent echocardiograms demonstrated Fontan-type circulation with minimal right ventricular contractility, severe tricuspid regurgitation and continuously open tricuspid, mitral and pulmonary valves, with respiratory augmentation of flow across the pulmonic valve. Seven years later, despite her functionally inert right ventricle (tricuspid annular plane systolic excursion 0.4 cm), the patient lives quite comfortably with mild heart failure symptoms (NYHA II). She is maintained on oral diuretics and sildenafil and is listed as UNOS status 7 for heart transplant. Her most recent echocardiogram images are shown (Figs 1 and 2).

With a non-functional right ventricle, the patient’s right heart serves as an inert conduit, whereas her low pulmonary vascular resistance is allowing successful univentricular support. Though not technically a true Fontan circulation, the patient demonstrates a functionally Fontan physiology. As such, it could be argued that the patient would be better served as a true Fontan as over time her right ventricle has continued to dilate and may ultimately impact left ventricular filling.

Interest in the potential usefulness of LVAD in this scenario has been high; however, reportedly, these attempts had been unsuccessful and invariably led to the death of the patient [2]. Literature search shows only one case of short-term total cardiac support with LVAD for 45 days as a bridge to heart transplant. [3] To the best of our knowledge, this is the only known case of an individual with biventricular heart failure with Fontan-type circulation who is alive on long-term mechanical circulatory support with an LVAD.

The strategy of sternal closure with the possibility of remote decannulation of RVAD was critical in ultimately transitioning to the

Figure 1: (A) Tricuspid valve non-coaptation, width of systolic tricuspid regurgitation equalling full width of tricuspid annulus (arrows). (B) M-mode shows tricuspid valve non-coaptation with systolic tricuspid regurgitation (single arrow: diastolic RV filling; double arrows: systolic tricuspid regurgitation).

Figure 2: (A) Pulse Doppler shows antegrade systolic (double arrows) and diastolic (single arrow) flow through the pulmonary valve. (B) M-mode shows no inspiratory collapse of inferior vena cava with sniff.
LVAD alone. In Glenn and Fontan patients, extensive documentation supports the negative effects of positive pressure ventilation and the positive effects of negative pressure ventilation on pulmonary blood flow and cardiac output [4, 5]. The early sternal closure and the ability to extubate the patient after pulmonary optimization allowed ascertaining the pulmonary blood flow and LVAD flow in a negative pressure state. The ability to forego reoperative sternotomy to remove the RVAD avoids the return to prolonged positive pressure ventilation with its deleterious effects on pulmonary blood flow and LVAD flow which is more critical in this Fontan-type physiology.

Conflict of interest: H.T. Massey is a consultant and proctor for Thoratec Corporation.

REFERENCES