Use of HeartMate 3 Ventricular Assist Device in Second Redo Sternotomy for Congenitally Corrected Transposition of the Great Arteries with Dextrocardia and Situs Solitus

Gustavo L. Knop, MD¹, Alejandra Castro-Varela, MD¹, William R. Miranda, MD², Philip J. Spencer, MD¹, Mauricio A. Villavicencio, MD¹

ORCID ID numbers:
Gustavo L. Knop, MD¹, 0000-0001-5547-3524
Alejandra Castro-Varela, MD¹, 0000-0003-0733-0910
William R. Miranda, MD², 0000-0001-8864-8474
Philip J. Spencer, MD¹, not available
Mauricio A. Villavicencio, MD¹, not available

Author Affiliations:
¹ Department of Cardiovascular Surgery, Mayo Clinic, Rochester, Minnesota
² Department of Cardiovascular Medicine, Mayo Clinic, Rochester, Minnesota

Corresponding Author:
Gustavo L. Knop, MD
Department of Cardiovascular Surgery, Mayo Clinic, Rochester, Minnesota
1216 2nd St SW, Rochester, MN 55902
Knop.Gustavo@mayo.edu

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List of Abbreviations

ccTGA: congenitally corrected transposition of the great arteries
HF: heart failure
HM3: HeartMate 3
LV: left ventricle
PH: pulmonary hypertension
PVR: pulmonary vascular resistance
sRV: systemic right ventricle
VAD: ventricular assist device

Keywords
congenitally corrected transposition of the great arteries; second redo sternotomy; HeartMate 3 ventricular assist device; dextrocardia; situs solitus

Central Picture Legend
Pre and postoperative X-rays of HeartMate 3 VAD implantation in ccTGA and redo sternotomy.
Central Message:

We present the use of HeartMate 3 ventricular assist device in a patient with two previous sternotomies and ccTGA with dextrocardia and situs solitus as a bridge to transplant or destination therapy.
Abstract

Background: The coexistence of dextrocardia and congenitally corrected transposition of the great arteries (ccTGA) involves a very small proportion of congenital heart disease cases. Few publications have described the use of ventricular assist devices (VAD) in systemic right ventricles. We report the implantation of a HeartMate 3 (HM3) VAD in a patient with a second redo sternotomy with ccTGA and dextrocardia with situs solitus.

Case presentation: We describe a 62-year-old patient with end-stage heart failure (HF), ccTGA and dextrocardia with situs solitus. He had previously undergone pulmonary valvotomy followed by surgical replacement of the pulmonary and systemic tricuspid valve. The patient was deemed not a suitable transplant candidate due to moderate to severe pulmonary hypertension (64/37, mean 46 mmHg) and high pulmonary vascular resistance (3.7 Wood units). A HM3 VAD was implanted in the systemic right ventricle in the setting of cardiogenic shock and multiorgan failure. Complete recovery was achieved.

Conclusions: HM3 VAD implantation used as a bridge to transplant or destination therapy in elderly patients with acute decompensated HF due to congenital heart disease of this combined etiology has recently proven feasible. This strategy offers an opportunity to avoid inevitable fatal outcome.
Congenitally corrected transposition of the great arteries (ccTGA) is a rare congenital cardiac defect featuring both atrioventricular and ventriculoarterial discordance: the right atrium is connected to the subpulmonary left ventricle (LV) and the left atrium to the systemic right ventricle (sRV). The aorta is located anterior and left-sided while the pulmonary artery is posterior and right-sided. Dextrocardia occurs in approximately 20% of patients with ccTGA. In current practice, a growing number of patients with ccTGA survive into adulthood and subsequently develop end-stage heart failure during their fourth or fifth decade of life. The unique anatomic abnormalities, such as sRV prominent trabeculation, present distinct challenges with respect to cannula insertion of a ventricular assist device (VAD). We report a case of HeartMate 3 (HM3) VAD implantation in a patient with a second redo sternotomy with ccTGA and dextrocardia with situs solitus. There are several published reports describing VAD use in ccTGA patients. In regards to the specific use of HM3, there has been two reports in patients with ccTGA without dextrocardia and one case with dextrocardia, but none with redo sternotomy.

A 62-year-old male with ccTGA and dextrocardia with situs solitus was admitted with decompensated chronic heart failure, cardiogenic shock (INTERMACS 2), and renal failure. Two years prior, he had undergone tricuspid and pulmonary valve replacement for severe incompetence of both valves, associated with resection of subpulmonary stenosis and closure of the left atrial appendage; and as a child, he had a pulmonary valvotomy. The patient had been previously evaluated for heart transplantation but was declined due to the presence of moderate to severe pulmonary hypertension (PH) (64/37, mean 46 mmHg) and high pulmonary vascular resistance (PVR) (3.7 Wood units). The VAD was implanted with both heart transplant and destination therapy as possible outcomes.
Due to progressive multiorgan failure he was taken to the operating room for urgent VAD implantation (Figure 1). There was severe biventricular dilatation and the HM3 inflow cannula was inserted through the apex of the hypertrophic and dilated sRV. Extensive RV trabeculae and fibrous muscle bundles resection inside the ventricle was performed to avoid inflow cannula obstruction. Severe bleeding was encountered while suturing the HM3 ring due to the thin nature of the ventricular wall and additional reinforcement sutures were needed. There was concern for suction events due to the thin and flaccid nature of the sRV, so the HM3 was secured with heavy non-absorbable pericostal sutures to the chest wall to prevent this. Of note, the outflow graft was placed intrapericardially to the left side of the heart (in a mirror direction of the usual technique) and anastomosed to the left-side aorta. The speed of the VAD was adjusted accordingly to avoid shift of the interventricular septum from the midline and cause opposite ventricular failure, and to allow the sRV to eject through the native valve and to avoid leaflet fusion and valvular regurgitation. At the first chest closure attempt the HM3 flow and the cardiac output dropped precipitously prompting chest opening. The HM3 was suspended to the chest wall further to the left (Figure 2). This allowed the HM3 to seat in the left chest.

The intra-operative course was complicated with severe vasoplegia, coagulopathy, bleeding requiring massive blood transfusion, and pulmonary ventricle failure. The chest was left open because of ongoing coagulopathy. Peripheral veno-arterial extracorporeal membrane oxygenation was temporarily required but successfully weaned off three days after, followed by chest closure. GoreTex patch was not applied with closure due to infection risk after having left the chest open for three days in an uncertain transplant candidate. His postoperative course was complicated by dialysis-requiring acute on chronic renal failure. He was discharged 45 days after surgery. His kidney function normalized with significant improvement in functional capacity
(class II). After discharge, the patient received long-term antibiotic treatment and surgical
debridement for a driveline infection that has recently improved. He may be reconsidered for
transplantation if the PH and PVR have decreased to normal range as expected.

The use of HM3 VAD in a patient with second redo sternotomy for ccTGA and
dextrocardia with situs solitus proved feasible and can serve as a bridge to heart transplant or
destination therapy. The role of durable ventricular assist devices in patients with failing sRV
(particularly in those with ccTGA) warrants further investigation.

Review by institutional review board is not required. Informed consent has been
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References


Figure Legends

Figure 1. Pre- and post-operative X-rays of HeartMate 3 VAD implantation. A and B) Chest x-ray two months prior to VAD implantation. C and D) Chest x-ray three months post VAD implantation. Inflow cannula is inserted through the apex of the hypertrophic and dilated systemic right ventricle. The outflow graft was placed intrapericardially to the left side of the heart (in a mirror direction of the usual technique) and anastomosed to the left-side aorta.

Figure 2. A) Arrow illustrates the initial orientation of the inflow cannula, which was directed inferiorly in close contact with the right ventricular (RV) wall. B) After repositioning, the cannula lied horizontally towards the ventricular septum/left ventricle (LV).