Posted on Authorea 3 Jun 2022 | The copyright holder is the author/funder. All rights reserved. No reuse without permission. | https://doi.org/10.22541/au.165423908.84782398/v1 | This a preprint and has not been peer reviewed. Data may be preliminary.

Decommission of a Heartmate 3 LVAD in a patient with left ventricular recovery

S. Allan Schaffer[1] and Stephen Shannon[1]

[1]St Boniface General Hospital

June 3, 2022

Abstract

Background: Left ventricular assist devices have been a significant development in the treatment of patients with advanced heart failure supporting circulation as a bridge to transplant, recovery or long-term destination therapy. When ventricular recovery occurs, there are multiple described ways of proceeding. HM2 decommissions are well described with varying degrees of explant operations, less so in HM3 due to the novelty of the device. In certain situations, invasive surgery can carry high risk and so a minimally invasive decommission, leaving the LVAD essentially intact in situ can be considered. **Case report** In this report, we describe the case of a 35-year-old male diagnosed with an idiopathic dilated cardiomyopathy requiring an LVAD with subsequent identification of cardiac recovery with the asymptomatic thrombosis of the 2 nd HM3 device. Investigations demonstrated absent flow through the pump whilst the patient-reported NYHA I functional class symptoms. The Driveline was cut with the remaining internal pump components decommissioned and left in situ. At 1 year the patient continues to do well with continued features of cardiac recovery with an LVEF of over 40%. **Conclusion** LV recovery is well recognized with typical management being LVAD explant surgeries performed. Each case should be analyzed for risks and benefits to the patient and future research showed be directed towards levels of decommissioning surgery and management post-LVAD decommission patient care.

Decommission of a Heartmate 3 LVAD in a patient with left ventricular recovery

Stephen Shannon MB BCh BAO, Cardiac Sciences Program, St. Boniface Hospital, Winnipeg, Canada

S. Allan Schaffer MD FRCPC, Section of Cardiology, Assistant Professor of Medicine, Max Rady College of Medicine, University of Manitoba, Winnipeg, Canada

Abstract

Background:

Left ventricular assist devices have been a significant development in the treatment of patients with advanced heart failure supporting circulation as a bridge to transplant, recovery or long-term destination therapy. When ventricular recovery occurs, there are multiple described ways of proceeding. HM2 decommissions are well described with varying degrees of explant operations, less so in HM3 due to the novelty of the device. In certain situations, invasive surgery can carry high risk and so a minimally invasive decommission, leaving the LVAD essentially intact in situ can be considered.

Case report

In this report, we describe the case of a 35-year-old male diagnosed with an idiopathic dilated cardiomyopathy requiring an LVAD with subsequent identification of cardiac recovery with the asymptomatic thrombosis of the 2nd HM3 device. Investigations demonstrated absent flow through the pump whilst the patient-reported NYHA I functional class symptoms. The Driveline was cut with the remaining internal pump components

Posted on Authorea 3 Jun 2022 | The copyright holder is the author/funder. All rights reserved. No reuse without permission. | https://doi.org/10.22541/au.165423908.84782398/v1 | This a preprint and has not been peer reviewed. Data may be preliminary.

decommissioned and left in situ. At 1 year the patient continues to do well with continued features of cardiac recovery with an LVEF of over 40%.

Conclusion

LV recovery is well recognized with typical management being LVAD explant surgeries performed. Each case should be analyzed for risks and benefits to the patient and future research showed be directed towards levels of decommissioning surgery and management post-LVAD decommission patient care.

Keywords: Adult, Heart-Assist Devices, Cardiomyopathy-dilated, heart failure, thrombosis, patient reported outcome measures

Background

Thrombotic complications have been a major limitation with left ventricular assist devices since initial designs. With design modifications magnetically levitated rotor, wide flow gaps, and reduced heat generation, the updated Heartmate 3 Left ventricular assist device (Abbott) has been shown to have favourable outcomes(1). Despite these improvements pump thrombosis remains a devastating potential complication. With clot formation within the LVAD machinery, interference in pump function may occur, manifesting as hemolysis, systemic embolism, and obstruction in pump flow(2). Protocols at the time of implant as well as systemic anticoagulation with vitamin k antagonists and antiplatelet therapy reduce risk but events still occur(3). Confirmation of LVAD thrombosis can be a difficult diagnosis, requiring multimodality imaging including echocardiography assessing flow patterns and appropriate ventricular unloading to CT or conventional angiography evaluating for filling defects. Following diagnosis therapies may include intensification of anticoagulation, thrombolysis or device exchange(4). Infrequently, however, when an LVAD becomes non-functional clinicians may fortuitously discover that their patient is no longer dependent on mechanical support. Device deactivation is typically reserved for end-of-life care, typically in destination therapy patients or those who have suffered devastating complications(5).

Cardiac recovery in heart failure in the context of the presence of a left ventricular assist device (LVAD) is not an unknown occurrence(6), Younger age, female sex, and heart failure due to non-ischemic causes are known predicators of cardiac recovery(6). When recovery occurs, the LVAD can either be explanted in their entirety or simply decommissioned with varying methods.

Case Presentation

We present a case of a 35-year-old male with dilated cardiomyopathy and a background of cocaine and anabolic steroids use. A Transthoracic echo in 2018 demonstrated a severely dilated and hypokinetic left ventricle with an ejection fraction of $< 20\%$ and an LV end-diastolic dimension of 72mm. Following admission to the cardiac critical care unit, he underwent placement of a Heartmate 3 LVAD on February 14^{th}, 2018 with bridge transplant candidacy INTERMACS profile 3 (inotrope dependant). Subsequent recovery was uncomplicated and he was discharged with follow-up in the community. Nine months post initial implant, he presented with fatigue, dyspnea, and persistent low flow alarms. Subsequent workup demonstrated an outflow graft twist complicated by thrombosis. He underwent a redo sternotomy with pump exchange and bend relief repair. The operative procedure was complicated by extensive adhesions and excess intraoperative bleeding but again an uncomplicated postoperative course and was he discharged home, quickly returning to his usual activities reporting NYHA 1- 2 symptoms and after demonstrating abstinence from substance abuse was listed for cardiac transplant. Unfortunately, he developed a persistent Staphylococcus aureus driveline infection and was managed with chronic suppressive oral antimicrobials with the intermittent need for parenteral therapy during acute flares.

In January 2020, 23 months post initial implant, he was readmitted to the hospital again with persistent low flow alarms, this time entirely asymptomatic. Left ventricle end-diastolic diameter was 59mm on repeat echocardiography with an ejection fraction of 30-35%. Increases in pump speed did not result in any change in LV dimensions, consistent with LVAD obstruction. Six-minute walk demonstrated NYHA class 1 with a total distance of 413 m walked and a perceived exertion score of 2-3/ 10. Outflow graft thrombosis was

Posted on Authorea 3 Jun 2022 | The copyright holder is the author/funder. All rights reserved. No reuse without permission. | https://doi.org/10.22541/au.165423908.84782398/v1 | This a preprint and has not been peer reviewed. Data may be preliminary.

suspected on CT angiography and was subsequently confirmed on conventional angiogram which showed no flow through the outflow graft on both LV and aortic injections (FIGURE 1a and 1b). Following 2 days of absent flow through LVAD, the device was disconnected from the power supply without any subjective change reported by the patient. Three weeks following, to the reduce risk of progression of driveline infection, an incision was made in the left upper quadrant and the driveline was bisected and withdrawn from the exit site on the right with the remaining HM3 components, including pump and aortic graft left in situ. The patient was continued on his oral anticoagulation to reduce the risk of ventricular thrombus formation with a target INR of 2-3. After the time of this report, he is still thriving, NYHA functional class I with an LV ejection fraction of 40-50% by ECHO and 50% by radionuclide angiography.

Discussion

To our knowledge, this is one of the first examples of a case where a Heartmate3 device has been decommissioned and left complete in situ on the left side of the heart. Ina previous trials with Heartmate 2 (Abbott), patients were weaned off their devices and subsequently underwent explant procedures with the removal of the pre-peritoneal pump, often with abandoning but oversewing of inflow and/or outflow grafts(7).

Myocardial recovery following LVAD implantation is a known albeit infrequent occurrence(7). However, with increasing utilization of mechanical support devices, this will likely increase. In patients demonstrating cardiac recovery with functional LVAD, weaning protocols have been developed confirming suitability for liberation from a device with subsequent surgical explantation in appropriate cases(7).

Conclusions

This case is unique in that cardiac recovery was a serendipitous discovery following pump thrombosis. At the time of identification, the LVAD pump was entirely non-functional with inflow and outflows thrombosed. Surgical explant would be associated with significant risk (particularly bleeding given prior history) with uncertain benefit. The decision was made to leave LVAD in situ, decommissioning, with ongoing medical heart failure management. The short inflow cannula of the Heartmate 3 though measuring only 20mm protruding into the LV cavity at the apex, was felt to remain a thrombotic risk and systemic anticoagulation was continued. With time, endothelialisation will occur with lower risks of systemic embolization and the anticoagulation strategy will be revisited.

List of abbreviations:

HM2: Heartmate 2

HM3:Heartmate 3

LVAD: Left Ventricular assist device

NYHA: New York Heart Association

LV: Left ventricle

1. Hanke JS, Dogan G, Zoch A, Ricklefs M, Wert L, Feldmann C, et al. One-year outcomes with the HeartMate 3 left ventricular assist device. J Thorac Cardiovasc Surg. 2018;

2. Beyazpınar DS, Ersoy Ö, Gültekin B, Aliyev A, Avsever M, Akay HT, et al. Treatment of left ventricular assist device thrombosis: Single-center experience. Exp Clin Transplant. 2018;

3. Goldstein DJ, Naka Y, Horstmanshof D, Ravichandran AK, Schroder J, Ransom J, et al. Association of Clinical Outcomes with Left Ventricular Assist Device Use by Bridge to Transplant or Destination Therapy Intent: The Multicenter Study of MagLev Technology in Patients Undergoing Mechanical Circulatory Support Therapy with HeartMate 3 (MOMENTUM 3) Randomized Clinical Trial. JAMA Cardiol. 2020;

4. Hanke JS, Dogan G, Wert L, Ricklefs M, Heimeshoff J, Chatterjee A, et al. Left ventricular assist device exchange for the treatment of HeartMate II pump thrombosis. J Thorac Dis. 2018;

Posted on Authorea 3 Jun 2022 | The copyright holder is the author/funder. All rights reserved. No reuse without permission. | https://doi.org/10.22541/au.165423968.84782398/v1 | This a preprint and has not been peer reviewed. Data may be preliminary.

5. Verdoorn BP, Luckhardt AJ, Wordingham SE, Dunlay SM, Swetz KM. Palliative Medicine and Preparedness Planning for Patients Receiving Left Ventricular Assist Device as Destination Therapy—Challenges to Measuring Impact and Change in Institutional Culture. J Pain Symptom Manage. 2017;

6. Kitahara H, Ota T. Left ventricular assist device explant versus decommission for myocardial recovery. Journal of Thoracic and Cardiovascular Surgery. 2017.

7. Baldwin ACW, Sandoval E, Letsou G V., Mallidi HR, Cohn WE, Frazier OH. Surgical approach to continuous-flow left ventricular assist device explantation: A comparison of outcomes. J Thorac Cardiovasc Surg. 2016;

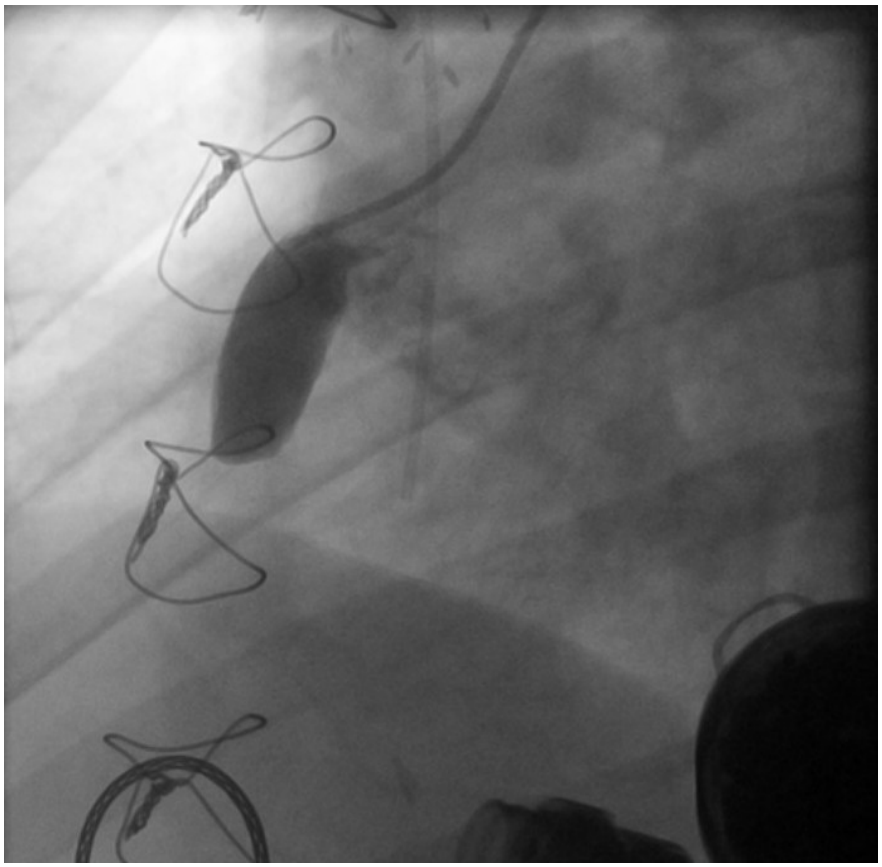

Figure 1a. Retrograde injection of outflow graft demonstrating occlusion in the distal segment

Posted on Authorea 3 Jun 2022 | The copyright holder is the author/funder. All rights reserved. No reuse without permission. | https://doi.org/10.22541/au.165423968.84782398/v1 | This a preprint and has not been peer reviewed. Data may be preliminary.

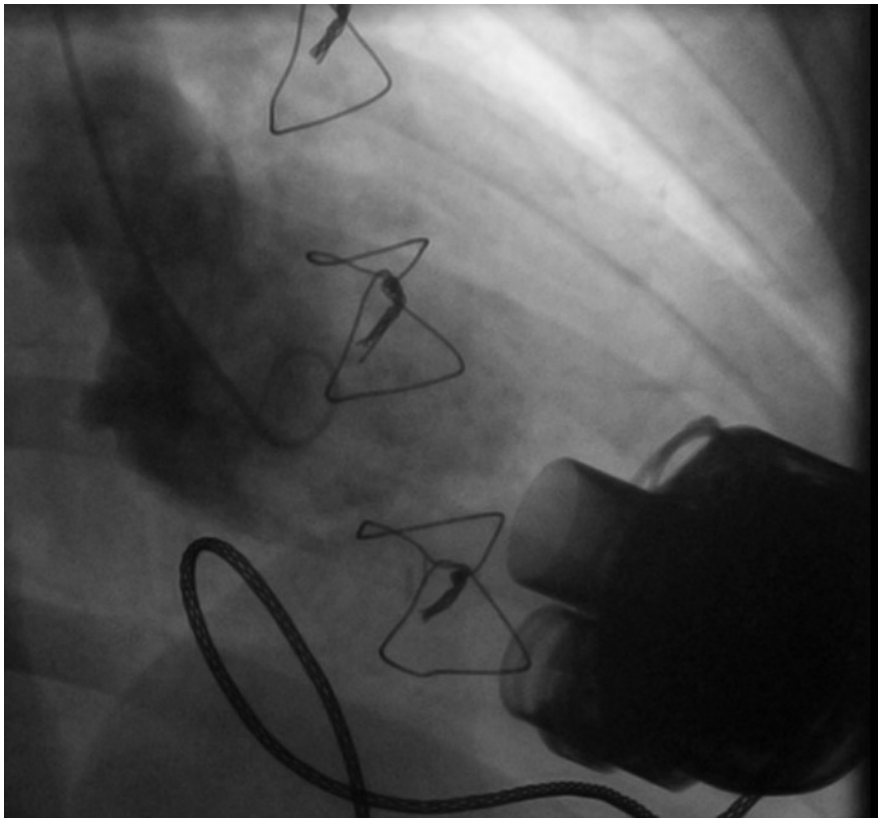

Figure 1b. Left ventriculography during systole demonstrates opacification of the left ventricle and ascending aorta without evidence of contrast in outflow graft.