

Unexpected Twists: A 61-Year-Old Male with Repeated HeartMate II Complications and Subsequent Replacement with HeartMate III

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ABSTRACT: An outflow graft twist of a left ventricular assist device (LVAD) remains a challenging clinical diagnosis and may even be misdiagnosed for other outflow obstructions. We present a case of a patient with two LVAD exchanges due to suspected outflow graft twisting in both clinical scenarios. As new LVADs continue to be designed and upgraded, clinicians must have a high index of suspicion for this rare complication.

INTRODUCTION

Left ventricular assist devices (LVADs), such as the HeartMate II (HM2) and HeartMate III (HM3), are used in many patients with end-stage heart failure as a bridge to transplant or destination therapy. At one point, the HM2 was implanted in more patients than any other durable LVAD.¹ With the increasing use of LVAD therapies overall and improved functioning of such devices, the rate of complications regarding the device pump and components is expected to increase.² The HM3 LVAD is already known to have a rare complication involving an outflow graft assembly that may cause it to twist. However, this complication has not been reported in the HM2. We present a case of outflow tract twisting on an initial HM2 implant and suspicion for twisting with a repeat implant.

CASE PRESENTATION

A 58-year-old Caucasian male presented with complaints of gradual decline in exercise and asymptomatic low-flow alarms while lying supine at night. He had undergone HM2 implantation at an outside institution in 2014 (destination therapy due to active smoking) and had a history of extensive coronary artery disease, ischemic cardiomyopathy, and chronic kidney disease. At baseline, HM2 speed was 9,000 rpm with 5.2 L/min of flow, pulsatility index (PI) of 7.6, and normal power values. Low-flow alarms were associated with power spikes up to 11 watts and PI events with occasional speed drops > 200 rpm.

There were no changes in weight. The patient was not on diuretics and was advised to increase fluid intake. Despite conservative measures, the low-flow alarms persisted. He was seen in the outpatient clinic, where he was noted to be

hypertensive with no evidence of orthostatic hypotension. Important physical exam findings included no signs of fluid overload. The HM2 hum was audible. Lab work included a therapeutic international normalized ratio (INR) of 2.3 and stable lactate dehydrogenase (LDH) level of 250 U/L on the day of admission and in the months preceding the outpatient visit.

Interrogation of the HM2 revealed very frequent low-flow alarms with occasional speed drops and power spikes. A computed tomography (CT) scan revealed a complete “twist” of his outflow graft causing LVAD obstruction (Figure 1, top panel). Despite giving up his smoking habits, the patient had already chosen not to pursue transplant candidacy for personal reasons and thus opted for device exchange. His diagnosis of outflow graft twisting was confirmed in the operating room, and the patient underwent a successful LVAD exchange (Figure 1, bottom panel).

Three years after his HM2 exchange, the patient came for an urgent clinic visit complaining of low-flow alarms over the past 4 days, increased shortness of breath, dyspnea on exertion, lower extremity swelling, and chest pressure. Lab work at this visit included an INR of 2.4 and LDH of 285 U/L. An echocardiography ramp study was positive for lack of LV unloading, opening of aortic valve at every beat, and no change in interventricular septum position despite a speed increase from 9,000 to 10,800 rpm. Given normal LDH and therapeutic INR levels, the study was concerning for another outflow graft obstruction.

Subsequent CT chest scans with 3-dimensional analysis showed significant proximal obstruction of the outflow tract concerning for repeat twisting, with a minimum diameter of less than 1 mm (Figure 2). It was recommended to proceed with either orthotopic heart transplantation (OHT) or LVAD

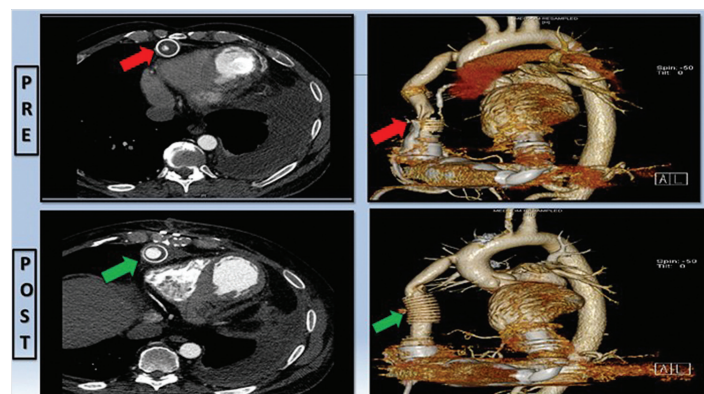


Figure 1.

Top row: Preprocedural computed tomography imaging showing a complete “twist” of the outflow graft causing left ventricular assist device obstruction. Bottom row: Postprocedural imaging shows device exchange without twisting.

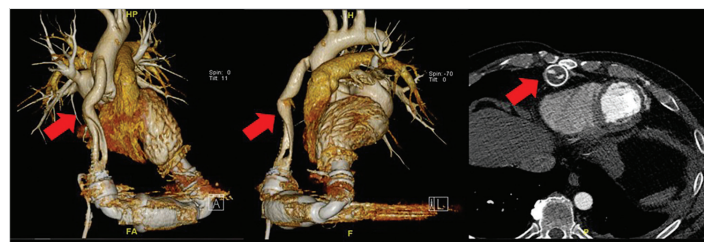


Figure 2.

Chest computed tomography showing proximal obstruction of the outflow tract.

exchange. After discussion with the transplant team, the patient opted for another exchange for several personal reasons. HM2 to HM3 LVAD exchange via redosternotomy and left subcostal approach was performed. There was intraoperative external compression of the graft from old, dark, thrombotic, gelatinous material within the bend relief with no twisting evident (Figure 3). Additionally, extensive adhesions were noted that did not allow for in-situ repair of the graft. The patient had a stable postprocedural course and a postoperative complication for sternal wound debridement. He was discharged 2 weeks after HM3 implant.

DISCUSSION

The HM2 was not immune to complications overall. One study in 2017 suggested that over 60% of device malfunction was attributed to components outside the pump itself, such as the battery, controller, and peripheral cables, with the majority of issues coming from the controller.² However, no data suggest the incidence of outflow tract twisting. Although cases

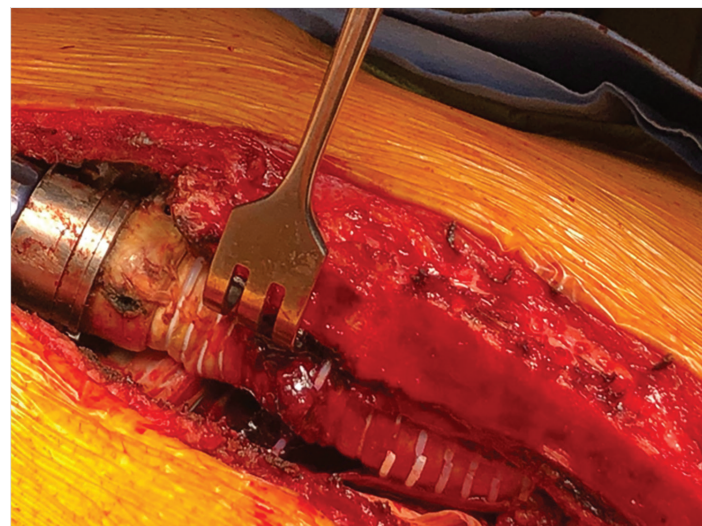


Figure 3.

Intraoperative photo of external compression of the graft from old, dark, thrombotic gelatinous material within the bend relief without evidence of graft twist.

have been reported of outflow obstruction due to thrombus formation³ or twisting of the percutaneous lead or driveline,⁴ the actual twisting of the outflow tract in the HM2 is still considered to be a rare occurrence.

Assessment of such obstructions is similar to the approach of other HM2 complications. Initial evaluation should include review of the patient’s symptoms and HM2 indicators of power spikes and low-flow alarms as well as obtaining lab values of INR and LDH.³ Imaging is also valuable and should start with echocardiography with LVAD ramp studies since this is an optimal way to assess device dysfunction.¹ CT imaging is preferred because it allows for visualization of bend relief, outflow and inflow cannula positioning, and outflow disruption to its connection with the ascending aorta.¹ In addition, the formation of gelatinous protein matrix between the outflow graft and the bend relief may contribute to twisting or external compression.⁴

Different techniques for surgical management based on differences in expertise have been reported. In our case, the first exchange involved a left subcostal approach with the outflow graft of the prior LVAD (with the twist) replaced with the new outflow graft. In the second exchange, there was a full redo sternotomy, LVAD exchange, and complete outflow graft exchange as well. An alternative option is an OHT instead of LVAD exchange. Although we acknowledge that the HM2 pump is now only rarely used and may soon become only historically relevant, we do not believe this diminishes the importance of the message.

CONCLUSION

This case demonstrates that an outflow graft cannula twist is not unique to the HM3 and may be seen with other LVADs, such as the HM2. Furthermore, imaging of an outflow graft twist may look similar to an external graft compression. As new pumps will continue to be designed, all with the potential of outflow graft twist or external thrombus causing an outflow obstruction, clinicians must have a high index of suspicion for these rare complications for all LVADs.

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Conflict of Interest Disclosure:

Dr. Hall is an advisor for Abbott, Medtronic, Abiomed, Evaheart, and CareDx and serves on the Speaker's Bureau for CareDx.

Keywords:

outflow graft rotation, left ventricular assist devices

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