LEFT VENTRICULAR RECOVERY IN AN HVAD PATIENT:
THE ROLE OF LOGFILES
CASE AT-A-GLANCE
Gender: Female
Age: 60 years old
History: CAD (status post (s/p) stent circumflex (LCx) 2001, percutaneous coronary intervention (PCI) x3 to left anterior descending (LAD), PCI x2 to LCx 2/2017), malignant melanoma, middle cerebral artery (MCA) stroke, LVAD implantation as BTT (5/28/2016), end-stage renal disease (ESRD) on hemodialysis (HD), hypertension (HTN), diabetes mellitus (DM), pulmonary hypertension (PH)
Treatment Approach: Wean LVAD s/p LV recovery
Treatment Facility: University of California, San Francisco

CASE HISTORY
A 60 year old female with a history of diabetes mellitus, hypertension, 3 vessel CAD with no revascularization options, and ischemic cardiomyopathy, ACC/AHA Stage D, NYHA Class IV had an HVAD implant as a bridge to transplant (BTT) on 5/18/2016. Following the HVAD implant, her kidney function continued to worsen and she was started on hemodialysis (HD) with a tunneled line placed 9/2/2016. She was admitted from an outside hospital on 10/5/2016 secondary to a right middle cerebral artery (R MCA) stroke complicated by a small subarachnoid hemorrhage (SAH) likely precipitated by hypertension and/or a thromboembolic event from the HVAD related to holding warfarin in preparation for a right heart catheterization (RHC). During this admission, a log file request was put into Heartware and the results showed normal operation of the HVAD pump with a high degree of pulsatility (light green area in Figure 1). The results of that are shown in Figure 1. Also, at the time of this admission, a transthoracic echocardiogram (TTE) showed LV size and function to be grossly normal.

On January 24, 2017, she was readmitted with hypotension, somnolence, and anemia in the setting of UTI (recurrent Klebsiella). During her admission, she continued to have symptomatic low flow alarms on her HVAD. Given her improvement of LV function on ECHO, newly diagnosed melanoma, and recent stroke on HVAD, discussion with interventional cardiology was began with a plan for revascularization with possible HVAD explant. A coronary angiography was performed and the results are shown in Figure 2.

2/3/17: Coronary Angiography report
Left Main: Mildly diseased
LAD: The mid-to-distal LAD is diffusely and severely diseased
Circumflex: The entire LCx system is diffusely diseased with a stent in the proximal circumflex with mild-to moderate in-stent stenosis. There is 60% stenosis of the mid-LCx, 50% stenosis of the ostial OM4, followed by serial 50% lesions of the mid- to distal OM4.
RCA: The RCA is diffusely diseased and heavily calcified with tandem 40-70% lesions throughout the proximal and mid RCA and serial 80% stenosis in the distal RCA involving the bifurcation of the PDA and PL arteries.
Conclusion: Severe multi-vessel coronary disease most prominently in the proximal LAD and distal RCA with a stent present in the proximal circumflex with mild-to-moderate ISR.

Based on these findings, she underwent complex, staged percutaneous intervention (PCI) as outlined in Figure 3.

2/10/2017: PCI
Successful PCI of the left main into LAD using three overlapping drug eluting stents.
Successful PCI of the LCx using two overlapping drug eluting stents.

2/21/2017: PCI#2
Successful PCI of the RCA into PDA using three drug eluting stents.
Successful PCI of the mid LAD using one drug eluting stent.

Following this procedure, the patient was discharged home with the plan to return for right heart catheterization with an LVAD turn down study to assess her hemodynamics and LV function on minimal support from her HVAD.

3/9/2017: ECHO post PCI interventions (TTE)
Limited study to assess systolic function: LV volume normal, EF 50-55%, no wall motion abnormalities, RV function Normal
On April 19, 2017, the patient was seen in clinic and it was noted that flow on her HVAD was significantly lower than previously, around 1.5 LPM at 2700 RPM (recall the flow had been 4.2 at 2600 RPM 6 months prior). Another logfile was downloaded from the hospital monitor and sent into Medtronic for analysis. The report is shown in Figure 4.

Given the complete revascularization of her known 3 vessel CAD and improvement of ejection fraction, we went ahead with the plan for assessing recovery under right heart catheterization with HVAD turndown.

The patient was taken to the catheterization lab and hemodynamics were collected at baseline speed of 2700 and then the speed was reduced to 1800 RPM and, after 30 min, hemodynamics were again recorded. The results are shown in Figure 5.

<table>
<thead>
<tr>
<th>Baseline HVAD 2700</th>
<th>Low Speed HVAD 1800</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ao: 107/49/68</td>
<td>Ao: 129/46/72</td>
</tr>
<tr>
<td>HR: 83</td>
<td>HR: 78</td>
</tr>
<tr>
<td>RA: 3</td>
<td>RA: 3</td>
</tr>
<tr>
<td>PA: 13/3/(6)</td>
<td>PA: 22/7/(13)</td>
</tr>
<tr>
<td>PCWP: 3</td>
<td>PCWP: 7</td>
</tr>
<tr>
<td>PA Sat: 62.2%</td>
<td>PA Sat: 58.7%</td>
</tr>
<tr>
<td>Ao Sat 97%</td>
<td>Ao Sat 98%</td>
</tr>
<tr>
<td>CO: 4.7 L/min*</td>
<td>CO: 4.3 L/min*</td>
</tr>
<tr>
<td>CI: 2.56</td>
<td>CI: 2.34</td>
</tr>
</tbody>
</table>

*thermodilution

DISCUSSION

In the setting of reverse remodeling and myocardial recovery, an increase in LV contractility increases LV systolic pressure generation, resulting in more consistent aortic valve opening, and tends to decrease end-diastolic pressure.1 In this case, the logfile shows increased pulsatility but lower flow as more blood flows natively through the aortic valve.

In this instance, the patient’s logfiles were one of the tools that gave us insight into why she was dizzy during her rehab from stroke. Given her multiple episodes of low flow, increased flow pulsatility, and improvement in EF, we determined that it was due to competitive flow between the pump and native LV function.

As part of our workflow in clinic, we send logfiles on all patients coming for clinical follow-up. We have the MCS coordinator send it off before the MD see’s the patient so he/she can review it when seeing the patient. This case demonstrates the utility of integrating this practice into common practice when assessing a patient supported by the HeartWare HVAD System.

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References

Brief Statement: HeartWare™ HVAD™ System

Indications for Use
The HeartWare™ HVAD™ System is indicated for hemodynamic support in patients with advanced, refractory left ventricular heart failure; either as a Bridge to Cardiac Transplantation (BTT), myocardial recovery, or as Destination Therapy (DT) in patients for whom subsequent transplantation is not planned.

Contraindications
The HeartWare System is contraindicated in patients who cannot tolerate anticoagulation therapy.

Warnings/Precautions
Proper usage and maintenance of the HVAD™ System is critical for the functioning of the device. Serious and life threatening adverse events, including stroke, have been associated with use of this device. Blood pressure management may reduce the risk of stroke. Never disconnect from two power sources at the same time (batteries or power adapters) since this will stop the pump, which could lead to serious injury or death. At least one power source must be connected at all times. Always keep a spare controller and fully charged spare batteries available at all times in case of an emergency. Do not disconnect the driveline from the controller or the pump will stop.

Avoid devices and conditions that may induce strong static discharges as this may cause the VAD to perform improperly or stop. Magnetic resonance imaging (MRI) could cause harm to the patient or could cause the pump to stop. The HVAD™ Pump may cause interference with automatic implantable cardioverter-defibrillators (AICDs), which may lead to inappropriate shocks, arrhythmia and death. Chest compressions may pose a risk due to pump location and position of the outflow graft on the aorta - use clinical judgment. If chest compressions have been administered, confirm function and positioning of HVAD Pump post CPR.

Potential Complications
Implantation of a VAD is an invasive procedure requiring general anesthesia and entry into the thoracic cavity. There are numerous known risks associated with this surgical procedure and the therapy including, but not limited to, death, stroke, neurological dysfunction, device malfunction, peripheral and device-related thromboembolic events, bleeding, right ventricular failure, infection, hemolysis and sepsis.

Refer to the “Instructions for Use” for detailed information regarding the implant procedure, indications, contraindications, warnings, precautions and potential adverse events prior to using this device. The IFU can be found at www.heartware.com/clinicians/instructions-use.

Caution: Federal law (USA) restricts these devices to sale by or on the order of a physician.