LEFT VENTRICULAR RECOVERY IN AN HVAD PATIENT: **THE ROLE OF LOGFILES**

Case Study:
University of California
San Francisco

Medtronic
Further, Together

CASE STUDY:
UNIVERSITY OF CALIFORNIA, SAN FRANCISCO

CASE AT-A-GLANCE

Gender: Female
Age: 60 years old
History: CAD (status post (s/p) stent left 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 cardiomyiopathy, 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 logfile 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.

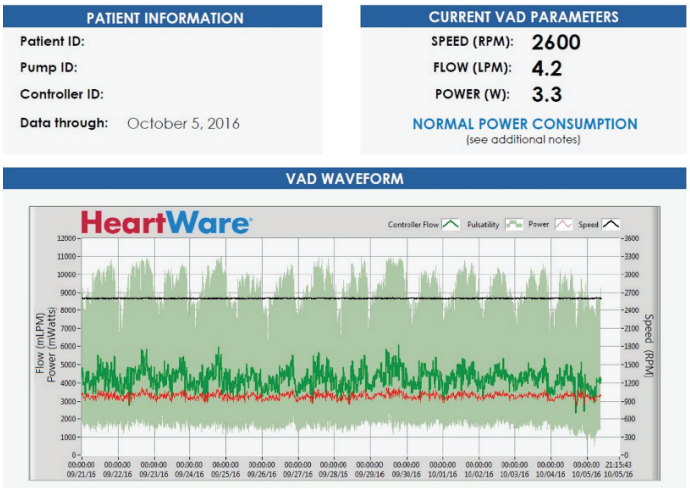

Figure 1: Normal Power and Flow for 2600 RPM

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.

Figure 2: Results of the coronary angiography

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.

Figure 3: Summary of staged PCI procedures

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 abnormalties, RV function Normal

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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.

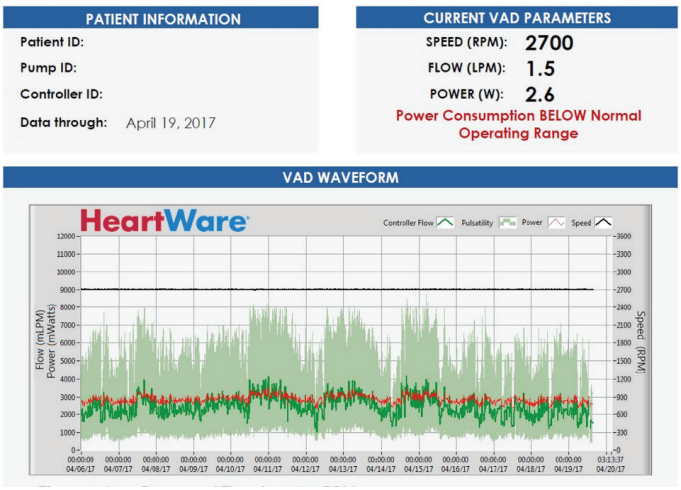

Figure 4: Low Power and Flow for 2700 RPM

Given the complete revascularization of her known 3 vessel CAD and improrovement 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.

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

*thermodilution

Figure 5: Hemodynamic changes going from full HVAD support to minimum HVAD support

Given the improvement of ejection fraction, complete revascularlization of her CAD, stablility of hemodynamics with minimal HVAD support, and recent cancer precluding her for heart/kidney transplant, the decision was made to go forward with HVAD decommissioning.

The patient was taken to the operating room on April 28th, 2017 and the HVAD Pump was accessed through a left subcostal incision, the outflow graft was ligated, and the pump and driveline were removed. Following the explant the intraop transesophageal echo showed LV volume to be moderately increased and LV function to be mild-moderately decreased with an approximate EF of 40% but this was unchanged from pre-op TEE. It should be noted that the patient was started on dobutamine in the OR prior to HVAD decommissioning. Following the explant the patient was extubated in the OR and transferred to the ICU in stable condition. To this day, the patient continues to do well. She remains off iHD with an elevated, but stable, creatinine level and has had no recurrent heart failure symptoms.

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

[1]Rich JD, Burkhoff D. HVAD flow waveform morphologies: theoretical foundation and implications for clinical practice. ASAIO J. 2017 Sep;63(5):526-535.

Brief Statement: HeartWare™ HVAD™ System

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

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