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Recurrent HeartMate 3 Right Ventricular Assist Device Stoppages in a Biventricular Assist Device Carrier

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ABSTRACT

A 44-year-old female patient with chemotherapy-induced cardiomyopathy presented with acute cardiogenic shock requiring ECMO support. Multiple failed weaning trials from temporary mechanical circulatory assistance prompted a transition to staged durable biventricular support. Her course was complicated with recurrent RVAD stoppages. The initial event was treated with pump exchange, while for the subsequent RVAD standstill, we employed a device wash-out and reimplantation strategy. A brief period of circulatory arrest was employed to explore the right-sided cardiac chambers using a single-use bronchoscope.

INTRODUCTION

Right ventricular (RV) failure after left ventricular assist device (LVAD) implantation carries a significant mortality burden. Attempts to synthesize invasive hemodynamic, echocardiographic, and biochemical markers into a unified algorithm to predict post-LVAD RV failure have thus far fallen short [Bellavia 2017]. In patients who transitioned from veno-arterial extracorporeal membrane oxygenation (ECMO) to a durable LVAD, preoperative assessment of RV function is particularly challenging. HeartMate 3 (HM3) has become the primary choice for LV support [Mehra 2019]. Albeit rare, pump thrombosis remains a problem. Its etiology is multifactorial [Massicotte 2017]. Making the distinction between de-novo pump thrombosis and thrombus ingestion is difficult [Iyengar 2019]. While HM3 has been recognized as the standard for LV support, much less data is available on HM3 for durable RV support. Even more so, data on implantable right ventricular assist device (RVAD) thrombosis is decidedly insufficient to elucidate its true incidence and management strategies.

CASE REPORT

We present a case with biventricular HM3 support and recurrent RVAD stoppages due to thrombus ingestion. The etiology of biventricular heart failure was breast cancer chemotherapy. She presented with hemodynamic instability, and was unresponsive to medical therapy, requiring ECMO. She was transitioned from ECMO to a durable LVAD. A temporary RVAD support was placed during the same procedure due to unmasked RV dysfunction. The temporary RVAD was exchanged 14 days after the index operation for a durable RVAD, since multiple RVAD weaning trials had failed. She was not a cardiac transplant candidate since her acute heart failure occurred in proximity to her malignancy. Two days after an uneventful HM3 RVAD implant, the device acutely stopped. (Figure 1) The patient was not

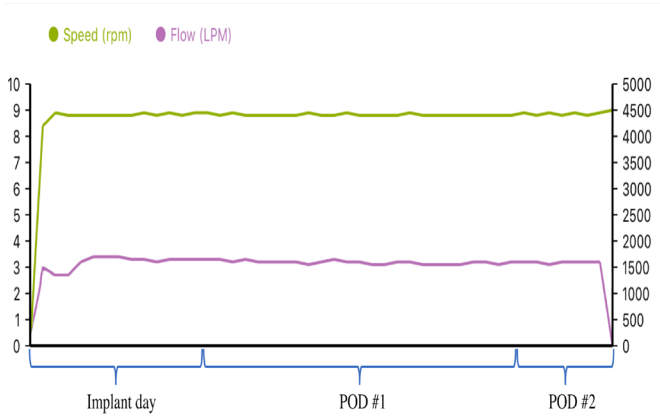

Figure 1. HeartMate 3 RVAD log file from implantation to the event resulting in no forward flow from the pump.

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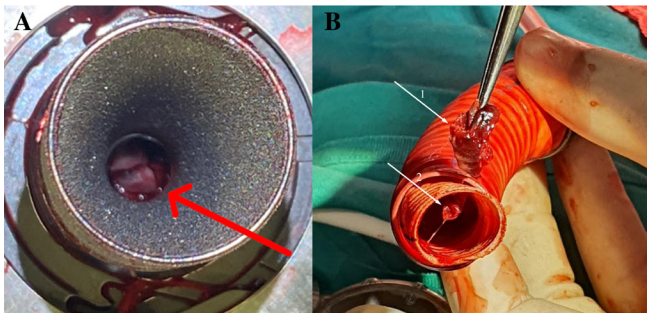

Figure 2. A) Thrombus within the HM3 assist device (arrow) B) HM3 RVAD outflow graft thrombus (arrows).

anticoagulated during the first 24 postoperative hours, after which time unfractionated heparin was initiated. An emergent sternotomy excluded reversible causes, such as obstruction, outflow graft angulation/kinking, or tamponade. The patient's LVAD flows were below 1.4 L/min. The RVAD was explanted under CPB support. Upon device removal, inspection revealed an ingested thrombus within the pump and RVAD outflow graft (Figures 2A and 2B). (Figure 2) A new HM3 RVAD was implanted via the same inflow sewing ring (ISR). After initially stable RVAD flows, the pump stopped again after <5 minutes of operation. We felt that exploring the right-sided heart chambers was paramount, as echocardiography could not exclude intracavitary pathology due to canula-induced image artifacts. Since the ISR occupied most of the free right atrial (RA) free wall, conventional exploration of the RA was deemed impossible without removing the entire ISR from a prohibitively fragile RA. The decision was made to explore the right-sided chambers under brief hypothermic circulatory arrest (HCA) with a single-use bronchoscope inserted through the ISR. The RVAD outflow graft was opened during cooling, and some thrombus was removed. (Figure 3) The outflow graft was trimmed, leaving only a 5-mm cuff that later was used as a site for a new outflow graft anastomosis. This method proved efficient in removing material from the RA (Figure 1D). The implantable RVAD was flushed and left to operate in saline for 10 minutes. It was then reinserted into its position. Upon completion of the surgical procedure, the patient was transferred directly to the interventional radiology suite, where an inferior vena cava (IVC) filter was placed. Both LVAD and RVAD flows remained stable thereafter. The patient was discharged home after 6 weeks of RVAD. The IVC filter was removed prior to discharge.

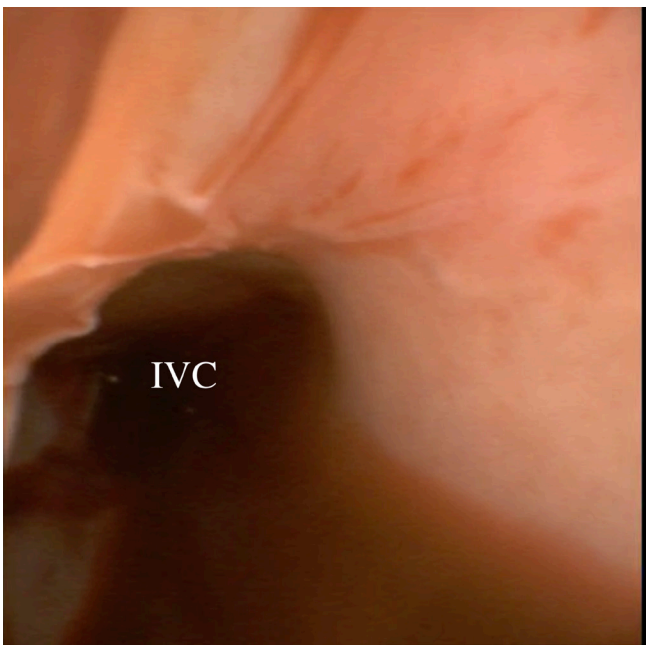

Figure 3. Right atrial view obtained from the single-use bronchoscope. POD, postoperative day; RVAD, right ventricular assist device; IVC, inferior vena cava.

COMMENT

Biventricular HM3 support infrequently is utilized, as RV support is not the pump's primary target. We describe a rare clinical scenario in which a durable RVAD ingested thrombus and stopped in a BiVAD carrier. This event recurred in the new RVAD pump. The initial event was successfully managed with a pump exchange. The subsequent event was treated with pump removal, followed by an ex-vivo washout. The ingested material likely originated from the IVC or its tributaries.

Exploration of the right-sided cavities under HCA with the use of a single-use bronchoscope proved to be a useful adjunct to the re-replacement of the RVAD. Additionally, the placement of an IVC filter may have prevented new events, allowing time for the patient's intrinsic fibrinolytic pathways to remove the remaining thrombus. We feel that prompt surgical revision of the BiVAD configuration, incorporating adjunctive RA exploration and IVC filter placement, allowed for a favorable clinical outcome.

REFERENCES

Bellavia D, Iacovoni A, Scardulla C, et al. 2017. Prediction of right ventricular failure after ventricular assist device implant: systematic review and meta-analysis of observational studies. Eur J Heart Fail. 19:926-946.

Iyengar A, Atluri P. 2019. Commentary: You are what you eat-Pump thrombosis and device exchange of a HeartMate 3. J Thorac Cardiovasc Surg. 158:e41-e42.

Massicotte P, Snyder T, Stulak J, et al. 2017. Ventricular assist device thrombosis: Mind your P's &Q's-Pumps, patients, and pills. J Thorac Cardiovasc Surg. 153:1503-1506.

Mehra MR, Uriel N, Naka Y, et al. MOMENTUM 3 Investigators. 2019. A Fully Magnetically Levitated Left Ventricular Assist Device - Final Report. N Engl J Med. 380:1618-1627.