Conservative Approach to HeartMate II Thrombosis

Thrombotic events in HeartMate II left ventricular assist devices (LVAD) are uncommon but extremely serious, often requiring device replacement; however, there are reports about their conservative treatment. We present a case of fibrinolytic therapy as an option to device replacement.

CASE REPORT

We describe the case of a 56-year-old male patient with idiopathic dilated cardiomyopathy, who after several admissions due to decompensation under optimal treatment, outpatient inotropic therapy, and cardioverter-defibrillator implantation received a HeartMate II LVAD as bridge-to-transplantation.

As part of the routine management, after drainage removal, the patient was started on warfarin [with the therapeutic goal of an international normalized ratio (INR) ranging between 2.5 and 3.5] and aspirin 81 mg. After 5 days in ICU, the patient required prolonged use of inotropes due to right ventricular dysfunction, and was then transferred to the general ward. On postoperative day 7, the patient had upper gastrointestinal bleeding with melena (INR 3.7), so anticoagulants and aspirin were discontinued.

The following day, control LVAD parameters were altered, evidencing increased pump power value of 12, and rapid reduction of pulsatility index (Figures 1 A & Figure 2). Laboratory tests showed free hemoglobin and haptoglobin, and high LDH. In view of suspected thrombotic event, an echocardiography was performed, which showed a slightly increased LV diameter but no thrombotic obstruction in the inflow/outflow cannulae. Chest CT scan was negative for thrombus in the cannulae or device (Figure 1 B and C).

Given the evident failure of the LVAD and the presence of hemolysis, thrombosis of the device was diagnosed, requiring its replacement. Administration of low dose thrombolytic agents was considered as an option, considering the risk of hemorrhage in a patient with recent gastrointestinal bleeding.

The patient was transferred to the catheterization laboratory, where a catheter was carefully advanced into the outflow cannula and 1 mg of tissue plasminogen activator (tPA) was infused.

Parameters were immediately normalized, with work reduction and increased pulsatility index (Figure 1 D). Echocardiography performed 48 hours later showed reduction of LV size.

HeartMate II is the most widely used LVAD, with more than 10,000 implantations. Compared to earlier devices, HeartMate II is thrombus-resistant due to several unique features of its textured inner surface. (1)

Thrombotic event occurrence is low, with a rate of 0.01% to 6% and its diagnosis is a highly complex challenge. (2)

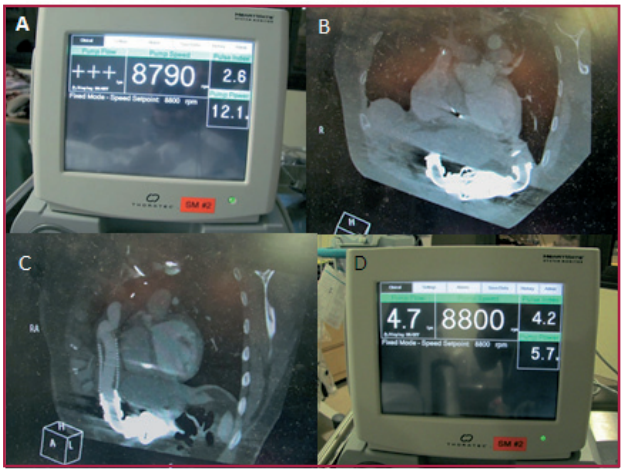

Fig. 1. A Abnormal increase in pump power and reduction of pulsatility index. **B** & **C.** CT scan of HeartMate II cannulas and device. **D.** Normalization of parameters following thrombolytic therapy.

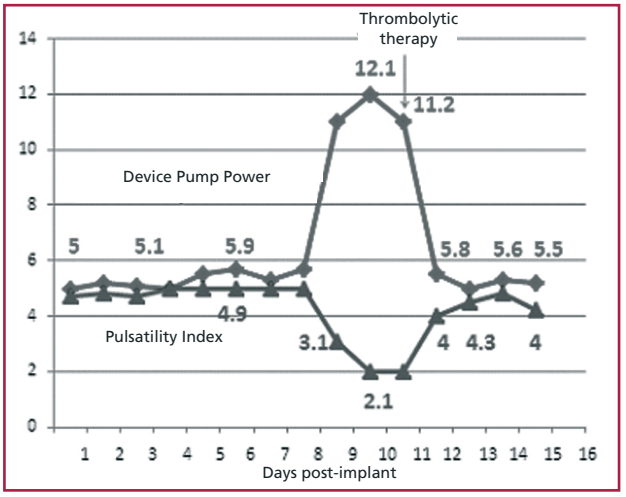

Fig. 2. Sequence of pulsatility index and pump power values.

CT scan is often unable to detect thrombosis, while echocardiography can assess thrombotic occlusion of the inflow cannula, presence of LV thrombus, absence of normal size variation response to LVAD speed changes (ramp test), or increased size of the left ventricular chamber as indirect expression of some type of LVAD occlusion, the last two observed in our patient.

Diagnosis is often presumptive and is based on lab tests and abnormal system parameter changes. Lab tests include suggestive hemolysis data such as increased LDH, free hemoglobin in plasma or haptoglobin. Among abnormal system parameter changes, increased LVAD work, showing some kind of obstruction, drop in the pulsatility index, evidencing reduced flow through the system and lack of response to speed

changes suggest thrombosis. (3)

Once the patient was diagnosed, the next problem was treatment definition. The prospect of a second major surgery to replace the LVAD in a relatively unstable patient with gastrointestinal bleeding was difficult and risky, while the use of systemic fibrinolytics was impracticable in the context of a recent gastrointestinal bleeding.

In a multidisciplinary meeting, it was agreed to use a "local" treatment in the inner part of the device, using low doses of thrombolytic agents, accepting both the risks of bleeding and of possible complications related to advancing a catheter into the LVAD. It was also agreed to prepare the patient for a possible emergency device replacement.

After the administration of local tPA (1 mg), device hemodynamic parameters were normalized, with resolution of echocardiography and laboratory abnormalities.

The references published about the "local" use of thrombolytic therapy in patients with LVAD are limited. Delgado et al. report the infusion of tPA at a rate of 1 mg/min through a catheter advanced into the left ventricle in Jarvik 2000 bearers, while Tshirkov et al. describe the use of tPA inside the inflow cannula of a Berlin Heart device; both procedures successful and with no bleeding complications. (4, 5)

Furthermore, Kieman et al. report a thrombus inside a HeartWare LVAD successfully managed with intraventricular tPA, also with no further complications. (6)

Our presentation is in line with those previously reported, and poses the administration of local low dose fibrinolytic therapy as a viable alternative to complex device replacement in selected patients.

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Tibial Angioplasty with 2D Perfusion Imaging

Endovascular treatment for occlusive disease of the lower limbs has gained popularity in the treatment of patients with critical ischemia and lesions at the level of the tibial territory. (1, 2) New advances in technology, specific work material, more experience and new techniques, have turned tibial balloon angioplasty into a successful procedure in a selected group of patients. But the advent of this technique has entailed the need for angiosome-guided revascularization.

Angiosome is not a physiological but an anatomical concept, defined as the blood supply from a main, secondary or distributing artery to a specific tissue area. (3, 4)

Each angiosome includes skin, muscle, tendon, nerve and/or bone. Angiosome junction occurs in the deep muscles, providing anastomotic channels if the main artery and/or vein is blocked. (4)

The angiosome model for lower limb revascularization was incorporated since the first publication of Alexandrescu in 2008. (3, 5) This model accounts for blood supply to the skin and adjacent structures, allowing mapping of the three-dimensional vascular territories to plan incisions and flaps, and providing the basis for the interpretation of several physiological and pathological processes including delayed healing or flap necrosis. (4) It is used in various medical fields, including myocardial revascularization, selective visceral embolization, and flap, incision or amputation planning. Over the past decade, a small number of studies have analyzed the viability of angiosome-oriented revascularization strategy in critically ischemic legs with tissue lesions, showing higher benefits in treating wounds and in recovering ischemic limbs. (3, 6-8)

A second point is the possibility of verifying reperfusion of an ischemic territory/ulcer using 2D perfusion angiographic imaging. Specialized software is used not only to show but also to measure the contrast agent flowing in arteries or tissues. This technique shows the arrival rate or wash-out using a color scale. In this case, the perfusion image verified adequate angiographic and hemodynamic results, providing a direct source of perfusion to the lesion. The image is strictly correlated to the corresponding angiosome. The system consists of a Flat Panel Detector 20 (Philips Medical Systems, Netherlands) single-plane angiography in combination with a 3DRA workstation (Prototype, Philips Netherlands), responsible for per-