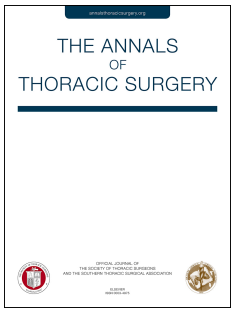

A step-by-step problem-solving strategy in a patient with heart failure and cerebral aneurysm

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A step-by-step problem-solving strategy in a patient with heart failure and cerebral aneurysm

Running title: Cerebral Aneurysm and Heart Failure

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Abstract

Left ventricular assist devices (LVAD) implantation is an established treatment for patients with end-stage heart failure. HeartMate 3 (HM3) is a continuous□flow centrifugal pump, recently introduced in the clinic, which has shown greater hemocompatibility compared to similar devices of previous generations. Nevertheless, anticoagulation is still required after HM3 implant to avoid pump dysfunction. Hereafter, we describe the case of a patient candidate to LVAD implantation for end-stage heart failure presenting a concomitant cerebrovascular lesion, accidentally found during pre-operative assessment, which would have contraindicated the procedure (for the prohibitive risk of cerebral hemorrhage), unless a step by step problem-solving approach was adopted.

The growing burden of end-stage heart failure (HF) and the limited availability of donor organs, coupled with the constant improvement in performance and reliability of LVADs, have progressively increased their use worldwide (1). Compared to other similar devices, Heartmate 3, a new generation of fully-magnetically levitated pumps, has demonstrated improved hemocompatibility and low rate of adverse events (2), but it still requires anticoagulation to avoid pump thrombosis and dysfunction. The presence of a cerebrovascular lesion (which in the general population, has a prevalence of 3.7% and 6.0% in retrospective and prospective angiographic studies, respectively) (3) significantly increases the procedural risk and its postoperative course; therefore, it may represent a contraindication. We describe our step by step approach to solve this clinical challenge.

A 59-year old man with ischemic dilated cardiomyopathy (ICM) was admitted at our department with congestive HF. At first, he was treated with high doses of inotropes and diuretics, with a transient clinical improvement. Nevertheless, weaning from inotropes was not achievable and patient's candidacy to heart transplant was promptly considered. As for our institutional protocols, a thoracoabdominal computed tomography (CT) angiography was performed to define the anatomy of the thoracic structures and to exclude the presence of significant aortic calcifications and/or neoplastic lesions. Additionally, a transthoracic echocardiogram (TTE) and a right heart catheterization were performed to assess right ventricular function and pulmonary vascular resistance. During the following days, the patient's clinical and hemodynamic conditions rapidly worsened. Patient candidacy to transplant was still uncertain by that time, due to psychological issues, as the patient had previously shown hostile behavior and low level of compliance to the medical treatment. Therefore, an LVAD was judged as the most suitable therapeutic option. Cerebral angiography and angio-CT were performed. The study revealed the presence of a fusiform aneurysm of the left anterior cerebral artery at the origin of the A2 segment (Figure 1 A, B, C). Neurosurgical clipping was contraindicated in such a critical scenario and the LVAD implantation

(entailing the need of postoperative anticoagulation) was also judged at increased risk for cerebral hemorrhage. Therefore, we decided to adopt a step by step problem-solving strategy to face this clinical challenge. At first, as previously described by our group (4, 5), a para-corporeal LVAD was implanted using a less invasive approach. The inflow cannula was inserted into the left ventricular apex through a mini-left thoracotomy and the outflow cannula into the right femoral artery, surgically isolated. No intraoperative complications occurred, and the patient was transferred to our intensive care unit. He was extubated on the first postoperative day (POD). During the first postoperative week, an anticoagulant regimen was guaranteed with a continuous intravenous heparin administration (to reach aPTT value of 45 sec); afterward, as a pre-medication, aspirin and clopidogrel were administered as anti-platelet agents. Therefore, on the 8th POD, the patient underwent a transcatheter cerebral aneurysm exclusion with Flow-Diverter stent implantation, through the left femoral artery. An immediate postoperative cerebral angiography and a later angio-CT performed after 7 days, confirmed the good result of the procedure and no complications. (Figure 1D). Finally, at 16th POD, a bridge-to-bridge strategy was completed by switching the para-corporeal circulatory support to a long-term, totally implantable, HM3. The procedure was performed through a full-sternotomy, after establishing CPB, the apical cannula of the para-corporeal LVAD was removed and the HM3 inflow cannula was inserted, followed by the anastomosis of the outflow graft to the ascending aorta (CPB time was 80 minutes). The following hospitalization was uneventful, and the patient was discharged to a rehabilitation center 20 days after the HM3 implantation. At most recent follow-up (after 3 months), the patient is doing well under double antiplatelets and oral anticoagulation therapy.

Comment

Left ventricular assist device devices' related complications, such as bleeding, particularly cerebral hemorrhage, continue to limit patients' survival and may lead to unfavorable outcomes, challenging the wider acceptance of mechanical circulatory support strategy to manage HF (6). Although

necessary, the need for anticoagulant and/or antiplatelet therapies expose these patients to an increased risk of bleeding events (1,2). The INTERMACS registry reported a 10,57% stroke incidence, with a rate of 0,123 stroke pt/year. Additionally, 48.62% of strokes were hemorrhagic, with a significantly worse prognosis than the ischemic ones (6-months survival was 34,8%) (1). Therefore, if not adequately approached, the preoperative evidence of a predisposing cerebrovascular lesion may contraindicate the cardiac procedure. Although not specifically recommended by currently available guidelines (7) at our center, in candidates for LVAD we routinely explore by imaging (angio-CT) the intracerebral vasculature to exclude the presence of predisposing lesions, which can potentially increase the risk of intracranial hemorrhages, such as aneurysms or vascular malformations. In the present case, heart transplantation was not indicated due to psychological reasons (8), but the hemodynamic instability made our patient not eligible for the endovascular closure of the aneurysm. Therefore, we decided to face the clinical problem adopting a less-invasive and more efficient strategy by first (4-5), stabilizing the patient with a para-corporeal LVAD (through a minimally invasive surgical approach) and second, allowing the endovascular exclusion of a cerebral aneurysm, that would have otherwise contraindicated the implant of a long-term device. Additionally, the para-corporeal LVAD was preferred to other solutions, (e.g. Extra-Corporeal Membrane Oxygenation, ECMO) as it provides more physiological circulatory support and for a longer period of time. In conclusion our step by step approach allowed to obtain stable hemodynamic conditions, to treat the cerebrovascular lesion and to proceed with the implant of a durable LVAD in a patient with refractory HF for which a heart transplant was not indicated.

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Figure Legend

Figure 1. Composite figure showing the aneurysm of the left A1-A2 junction (arrows). In A and B, preoperative angiogram (anteroposterior view) and 3D reconstruction. In C, pre-operative CT angiography showing the fusiform no-necked aneurysm. In D, CT angiography that shows implanted FD Stent - Silk Vista Baby (arrowhead) and complete exclusion of the sac.

Abbreviations

CPB	Cardiopulmonary Bypass
CT	Computed Tomography
HM3	Heartmate 3
HF	Heart Failure
ICM	Ischemic Cardio-Myopathy
LVAD	Left Ventricular Assist Device
POD	Post-Operative Day
TTE	TransThoracic Echocardiogram