HeartMate II thrombosis treated without explantation in the waiting period for heart transplantation: a case report

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Background

The HeartMate II (HMII) is a high speed, axial flow, rotary blood pump that restores systemic flow by draining blood from the left ventricular (LV) apex and ejecting into the aortic root. This LV assist device was previously used in patients with medically refractory advanced-stage heart failure, for both destination therapy and bridge to transplantation until the introduction of HeartMate III.

Case summary

We report herein a case of a 25-year-old patient with Interagency Registry for Mechanical Assisted circulatory Support profile implanted with HMII device for an end-stage dilated cardiomyopathy, who experienced a pump thrombosis despite a well-conducted anticoagulant protocol. A thrombophilia with heterozygous mutation of factor II and V was diagnosed at that time. We chose to stop the device without explantation until heart transplantation.

Discussion

Pump thrombosis with HMII is associated with a prohibitive risk of morbidity and mortality. Pump thrombosis is suspected when haemolysis or congestive heart failure occurs, also in cases of overconsumption of pump power (>10 W). Pump thrombosis treatment is challenging in the case of clotting factors mutation. Pump exchange could be ineffective, exposing the patient to the recurrence of thrombo-embolic events. Intravenous thrombolysis may be used for patients not candidates for redo procedures but could be unsuccessful and expose patients to high bleeding risk. Heart transplantation remains a reliable option. In our case, pump explantation was considered too hazardous by the heart team due to a prohibitive risk of redo surgery. Then, we decided to turn off the HMII pump after the introduction of continuous intravenous dobutamine support. The haemodynamic stability allowed us to wait for heart transplantation in favourable conditions.

Keywords

LVAD thrombosis • Heart transplantation • Case report
Introduction

The HeartMate II (HMII) is a left ventricular (LV) assist device, which significantly improves long term survival when compared to optimal medical management. Several adverse events can occur with HMII, including bleeding, infection, thrombo-embolic events, and pump thrombosis. We report herein a case of a 25-year-old patient who experienced an HMII pump thrombosis despite a well-conducted anticoagulant protocol and an aggressive implementation of antiplatelet therapy.

Timeline

Case presentation

A 25-year-old male, with no past medical history, was admitted to the Department of Cardiology with cardiogenic shock (CHF) revealing a dilated cardiomyopathy with healthy coronary arteries and left ventricular ejection fraction (LVEF) of 20% (Supplementary material online, Videos S1 and S2). The cardiovascular risk factors were grade 2 obesity (185 cm, 120 kg, Body Mass Index (BMI) = 35 kg/m²), and a 15-pack year history of smoking. On admission, the patient showed moderate renal (creatinine level = 123 μmol/L) and hepatic failure (serum glutamic-oxaloacetic transaminase (SGOT) = 439 UI/L, serum glutamic-pyruvic transaminase (SGPT) = 817 UI/L, factor V = 0.59). Lactate level was 2.86 mmol/L (normal value = 1.5–2 mmol/L) (Supplementary material online, Appendix S1).

A treatment with dobutamine 15 μg/kg/min and intravenous diuretics (250 mg/50 mL, 2 ml/h) was initiated. The patient was placed on the waiting list for an emergency heart transplant. However, no heart graft was found owing to recipient obesity and the rarity of the recipient blood type B. Our heart team endorsed the decision of HMII implantation as a bridge-to-transplantation. The Interagency Registry for Mechanical Assisted circulatory (INTERMACS) classification provides prognostic information for patients with end-stage heart failure needing mechanical support. INTERMACS level was considered INTERMACS 3 since the hemodynamic stability was reached with a mild dose of inotropes but demonstrating a failure to wean from them because of hypotension and worsening symptoms. At the end of the HMII implantation by conventional sternotomy, the right ventricular failure required temporary mechanical support with the centrifugal pump, which was maintained for 3 days. The clinical evolution was thereafter uneventful, and the patient could be extubated and weaned from dobutamine. An effective anticoagulant treatment with Unfractionated Heparin (UFH) [target therapeutic range of activated partial thromboplastin time (aPTT) 60 s] and aspirin 75 mg was conducted.

On the 6th post-operative day, the patient showed fever and hyperleukocytosis. An infectious aetiology was sought and transoesophageal echography (TOE) and computed tomography (CT) scan were performed. Both exams revealed a 21.6 mm × 16.8 mm thrombus in the right atrium without pulmonary embolism, while anticoagulation was reached at therapeutic range (Supplementary material online, Video S3 and Figure 1).

A second antiplatelet therapy by clopidogrel was added to the antithrombotic treatment and transition to Vitamin K antagonist

Learning points

- Intra-pump thrombosis is a severe complication of left ventricular assist device.
- Pump thrombosis treatment is challenging in case of clotting factors mutation.
- Pump thrombosis is suspected when haemolysis or Congestive Heart Failure (CHF) occurs, also in case of overconsumption of pump power (>10 W).
- Thrombolysis could be unsuccessful and is associated with high risk of bleeding.
- Pump exchange could be ineffective, exposing patient to recurrence of thrombo-embolic events.
- Heart transplantation remains a reliable option.
(VKA) was made for an International Normalized Ratio (INR) 2.5–3.5. Blood tests revealed an unknown heterozygous mutation of factor II and V.

On 24th postoperative day, the patient was discharged to the cardiac surgery ward. INR was 2.7 with no resistance to dual antiplatelet therapy. Eleven days later, a major haemolysis was observed (red blood cells = 2.8 T/L, haemoglobin = 7.2 g/dL, Lactic Acid dehydrogenase (LDH) = 1476 UI/L, total bilirubin = 24.8 μmol/L, haptoglobin < 0.08 g/L) while no pump alarm had occurred (Supplementary material online, Appendix S1).

Haemolysis decreased spontaneously after an increase in INR target to 3.5. Ten days later, while any adverse events had occurred until then, we were alerted in the early morning by sudden overconsumption of HMII power with peak ranging from 16 W to 20 W. Concomitant sudden decrease of pump speed from 9800 to 8000 rpm and decrease in pulsatility index were suggestive of Left Ventricular Assist Device (LVAD) thrombosis. LVAD parameters continued to worsen progressively during the morning: pump flow was 0, pump speed was 1160 rpm, pump power was 30 W, pulse index was 11.2, alarms sounded and indicated, 'pump off' (Figure 2). This condition was well tolerated with stable haemodynamic parameters. The patient described dyspnoea and digestive pain but remained conscious. He was readmitted to Intensive Care Unit (ICU) for monitoring. A TOE and a CT scan ruled out any LV or inflow/outflow cannula thrombus (Figures 3 and 4).

Aortic valve opening occurred at each systole. Secondary mitral regurgitation was considered as mild. LV remains pulsatile with an LVEF of 30–35% (Supplementary material online, Videos S4 and S5).

In light of the echo findings, we decided to turn off the HMII pump after the introduction of continuous intravenous dobutamine support (10 μg/kg/min). Pump explantation was discussed with the heart team. However, the prohibitive risk of redo surgery, as well as the good patient haemodynamic tolerance, led to the decision not to replace the device and to undergo urgent heart transplantation. The
HMII was left shut off and maintained in the patient with anticoagulation and dual antiplatelet therapy. There was no more discomfort, haemolysis, or low perfusion signs thereafter. INTERMACS level was INTERMACS 3 since haemodynamic stability was reached with moderate doses of inotropes (‘dependent stability’).

Five weeks later, the patient underwent heart transplantation with an uneventful course until hospitalization discharge. The explanted pump analysis showed an intrarotator thrombosis.

**Discussion**

Treatment of end-stage congestive heart failure with an LVAD is well established. The first generation of LVADs was pulsatile devices, providing adequate support for the LV ventricle but hampered by size and limited durability. In 2008, continuous axial flow Heartmate 2 pump received Food and Drug Administration (FDA) approval for clinical use as a bridge to transplantation therapy in the USA. Since 2017, centrifugal fully magnetically levitated continuous-flow HeartMate3 pump has raised as a novel pulsatile-flow LVAD without mechanical bearings which limits the risk of haemocompatibility-related complications, including pump thrombosis, stroke, and gastrointestinal bleeding.3

LVAD thrombosis is a severe but uncommon complication of Heartmate II which is defined as ‘an event in which the pump or its conduits contain a thrombus that results in or could potentially induce circulatory failure’.6,7 Pump thrombosis is suspected in case of clinical sign of haemolysis, a sudden increase in LDH, worsening heart failure, negative ramp test without LV unloading, or abnormal pump parameters suggestive of elevated pump power.7

In 2014, the unexpected increase in pump thrombosis raised suspicion of lack of device haemocompatibility. However, the increased use of inadequate anticoagulation protocol was unveiled after several surveys in expert centres, highlighting the need for standardized anticoagulant management.3 In 2017, the authors of the PREVENT study achieved to limit the risk of heartmate 2 thrombosis by following strict protocol related to surgical implantation techniques, anticoagulation and antiplatelet therapy, and management of pump speed and blood pressure.7

Our anticoagulant protocols are in line with these recommendations. After heartmate II implantation, intravenous UFH is started a few hours after implantation to a target therapeutic range aPTT 60 s if there is no bleeding by chest tubes. VKA is introduced on the third postoperative day with a target range of 2.0 to 3.0 and aspirin is introduced at ICU discharge.

Despite well-conducted anticoagulant protocol and aggressive implementation in antiplatelet therapy when right atrium thrombus has occurred, we have been unable to prevent pump thrombosis that was retrospectively due to blood clotting disorders. Unfortunately, the diagnosis of Factor V Leiden and prothrombin mutations was performed post-operatively since coagulation tests were not done in routine in the absence of thrombo-embolic event in the patient’s medical history. In a similar situation, we would aim to do a baseline coagulation profile prior to initiation of anticoagulation in patients, as this would be routine now in most centres.

Intra-pump thrombosis treatment is challenging in the case of clotting factors mutation. Pump exchange could be ineffective, exposing the patient to the recurrence of thrombo-embolic events. Intravenous thrombolysis may be used for patients not candidates for redo procedures but could be unsuccessful and exposed patient to high bleeding risk. Heart transplantation remains a reliable option.8 The good haemodynamic tolerance allowed us to stop the LVAD with a lot of caution. Then, the patient was maintained in ICU with inotropic support to wait for heart transplantation without LVAD explantation.

The patient is still alive. He is now 32 years old and has returned to work. He has not presented with any thrombo-embolic events on anticoagulants. He experienced no heart transplant rejection and is now living a normal life.

**Supplementary material**

**Supplementary material** is available at European Heart Journal - Case Reports online.

**Slide sets:** A fully edited slide set detailing this case and suitable for local presentation is available online as Supplementary data.

**Consent:** The author/s confirm that written consent for submission and publication of this case report including image(s) and associated text has been obtained from the patient in line with COPE guidelines.

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