CJC Open 3 (2021) 1313–1315

Case Report

Aortic Root Thrombus Directly After Left Ventricular Assist Device Implantation

Constantin Mork, MD,[a] Otmar Pfister, MD,[b] Luca Koechlin, MD,[a] Simon Scheifele,[a] Anne Morgen,[a] Lukas Altwegg, MD,[c] David Heppel, MD,[d] Denis Berdajs, MD,[a] Ayham Darwisch, MD,[a] Michael Kuehne, MD,[b] Oliver Reuthebuch, MD,[a] Ulrich Schurr, MD,[a] Martin Siegemund, MD,[e,f] Friedrich Eckstein, MD,[a] David Santer, MD, PhD,[a] and Qian Zhou, MD[b]

[a] *Department of Cardiac Surgery, University Hospital Basel, Basel, Switzerland*
[b] *Department of Cardiology, University Hospital Basel, Basel, Switzerland*
[c] *Department of Cardiology, St Claraspital, Basel, Switzerland*
[d] *Department of Anesthesiology, Operative Intensive Care, Preclinical Emergency Medicine and Pain Management, University Hospital Basel, Basel, Switzerland*
[e] *Intensive Care Unit, University Hospital Basel, Basel, Switzerland*
[f] *Department of Clinical Research, University Hospital Basel, Basel, Switzerland*

ABSTRACT

A 70-year-old female heart failure patient could not be weaned from temporary left ventricular mechanical support with Impella CP (Abiomed Inc, Danvers, MA) after myocardial infarction; therefore, she underwent left ventricular assist device implantation (HeartMate 3; Abbott, Chicago, IL). After uneventful surgery, the patient had an early postoperative thrombus in the aortic root, and surgical thrombectomy on extracorporeal circulation was performed on the seventh postoperative day. The patient recovered well and presented in good condition with no neurologic symptoms at the 6-month follow-up visit. Surgical excision of aortic root thrombus is a feasible option even for frail patients with a left ventricular assist device.

RÉSUMÉ

Après un infarctus du myocarde, une patiente de 70 ans présentant une insuffisance cardiaque n'a pas pu être sevrée d'une assistance mécanique temporaire pour le ventricule gauche par dispositif Impella CP (Abiomed Inc, Danvers, MA); elle a donc subi l'implantation d'un dispositif d'assistance ventriculaire gauche (HeartMate 3; Abbott, Chicago, IL). Après une intervention sans incident, la patiente a présenté un thrombus postopératoire précoce dans l'anneau aortique, et une thrombectomie chirurgicale sous circulation extracorporelle a été réalisée le septième jour suivant l'intervention. La patiente s'est bien rétablie et semblait en bonne santé, sans symptômes neurologiques, au moment de la visite de suivi six mois plus tard. L'excision chirurgicale du thrombus de l'anneau aortique est une option réaliste même chez les patients fragiles ayant un dispositif d'assistance ventriculaire gauche.

Patients with acute and chronic heart failure benefit from device innovations for permanent and temporary mechanical circulatory support. Although technological advancements continuously improved outcome with left ventricular assist devices (LVAD),[1] modern temporary mechanical left ventricular support with Impella (Abiomed Inc, Danvers, MA) might increase the number of potential candidates for LVAD but also challenge heart teams with new complications[2] as described in this case report.

Case

A 70-year-old female patient presented to an outside hospital with pain in the upper abdomen, both shoulders, and the left arm as well as clamminess. The electrocardiogram (ECG) showed a myocardial infarction of the posterior wall with ST-deviations in V2-V4. (Supplemental Fig. S1). Emergent cardiac catheterization found an ejection fraction of 15% and 3-vessel disease, and drug-eluting stents were placed into the left circumflex and marginal arteries (Supplemental Fig. S2). The patient had cardiogenic shock, and an intra-aortic balloon

Received for publication April 16, 2021. Accepted May 28, 2021.

Ethics Statement: The reported research adhered to the Declaration of Helsinki.

Corresponding author: Dr David Santer, Department of Cardiac Surgery, University Hospital Basel, Spitalstrasse 21, 4031 Basel, Switzerland. Tel.: +41 (0) 61 265 25 25 (CH).
E-mail: david.santer@usb.ch

See page 1315 for disclosure information.

https://doi.org/10.1016/j.cjco.2021.05.016

Novel Teaching Points

- Aortic root thrombus is a potential complication after treatment with a left ventricular Impella device.
- Early postoperative echocardiography after LVAD implantation should evaluate for aortic root thrombus.
- Surgical excision of aortic root thrombus is a feasible option even in frail LVAD patients.
- LVAD patients are challenging and demand close monitoring, especially in the early and postoperative phase by specialized multidisciplinary heart teams.

pump (IABP) (Cardiosave IABP Hybrid; MAQUET, Wayne, NJ, USA) was implanted via femoral artery access. The patient was transferred to another outside hospital at her own request. Full revascularization was obtained by stenting the right and left anterior descending coronary arteries. During this interventional procedure, the patient experienced hemodynamic instability caused by tachycardic atrial fibrillation (160 bpm); therefore, the IAPB was replaced by an Impella CP (Abiomed Inc) via femoral access on day 2. After 2 days, additional stents were placed into the right and left coronary arteries. Transthoracic echocardiography found left ventricular hypertrophy with severely impaired left ventricular ejection fraction of 15% and moderate mitral valve regurgitation. New-onset atrial fibrillation with rapid ventricular response was treated with amiodarone intravenously (1 g/d). Because of massive bleeding from the arterial femoral puncture site, the patient went into haemorrhagic shock and was transferred to a tertiary care centre. Immediate computed tomography found a retroperitoneal haematoma without active bleeding, and the patient was weaned successfully from Impella support on the sixth day.

On the tenth day, the patient suffered from electrical storm with scar-related monomorphic premature ventricular contractions, repetitively inducing ventricular tachycardia requiring 25 electrical cardioversions and in-hospital resuscitation. During the electrophysiologic study, isolated potentials and fractioned signals in the area of the infero-lateral and antero-latero-basal scars were mapped (CARTO3; Biosense Webster, Inc, Irvine, CA), and radiofrequency catheter ablation was performed. At the end of the procedure, a reimplantation of an Impella CP was performed owing to left ventricular end-diastolic pressure of 42 mm Hg. Two days later, the patient showed a single episode of ventricular fibrillation under Impella support. After chest compressions for 5 minutes and 1 defibrillation with 200 joules, the patient had a normocardic sinus rhythm. Because weaning from the Impella device was unsuccessful due to development of pulmonary edema under flow reduction (Supplemental Fig. S3), the heart team opted for an early implant of an LVAD (bridge-to-destination) in combination with a mitral valve repair. Uneventful explantation of the Impella CP with simultaneous implantation of a Heart Mate 3 device (HeartMate 3; Abbott, Chicago, IL), and concomitant mitral valve ring annuloplasty (Medtronic Simulus Semi-Rigid Annuloplasty ring, 30 mm; Münchenbuchsee, Switzerland) were performed on day 21. Cardiopulmonary bypass (CPB) time was 131 minutes, aortic cross clamp time was 30 minutes. Anticoagulation therapy (heparin 32.500 IU/d) was started 24 hours postoperatively, and inotropic medication was stopped 36 hours after surgery. Under hemodynamic stability (pump speed, 5200 RPM; flow, 4.4 L/min; power, 3.5 watt), the patient was extubated on day 24. The postoperative transoesophageal echocardiography found a previously undetected patent foramen ovale and a new thrombus in the left coronary cusp of the aortic valve (Fig. 1). Although the dose of intravenous heparin was increased, the thrombus size could not be reduced during the following days.

On day 29, surgical thrombectomy was performed via resternotomy (CPB time, 49 minutes; aortic cross clamp time, 19 minutes). Closure of the patent foramen ovale was performed, and the thrombus in the left coronary cusp of the aortic valve (Fig. 2) was excised in total. No obvious pathologic condition of the native aortic valve was observed during the operation. Two days after thrombectomy, the patient presented with temporary neurologic symptoms of the right side (hanging right corner of the mouth, weakness of the right arm), which correlated with 2 left cerebellar infarctions in computed tomography. Four weeks later, neurologic dysfunctions could no longer be reproduced.

Permanent oral anticoagulation therapy with phenprocoumon (target international normalized ratio, 2-3) was initiated

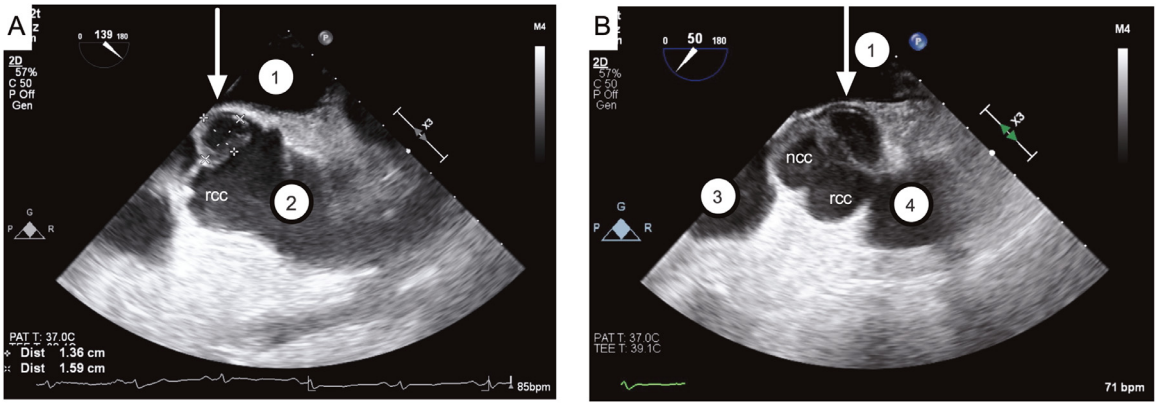

Figure 1. On the third day postimplant of the left ventricular assist device, a thrombus (**white arrows**) in the left coronary cusp of the aortic valve was observed on transesophageal echocardiography in the mid-esophageal aortic valve (**A**) long-axis and (**B**) short-axis views. Also highlighted are the left atrium (**1**), ascending aorta (**2**), right atrium (**3**), right ventricular outflow tract (**4**), right coronary cusp (rcc) and noncoronary cusp (ncc).

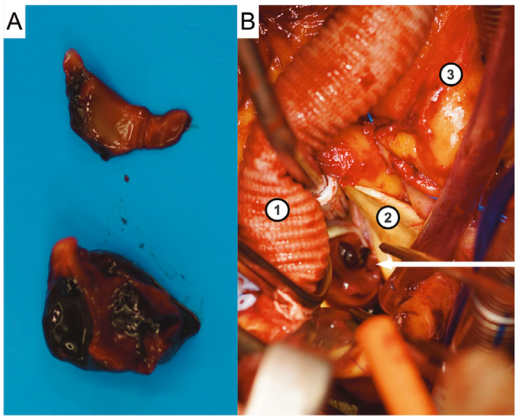

Figure 2. The thrombus formation is visible in the aortic sinus. The thrombus with an approximate diameter of 1 cm (**A, white arrow**) is visible within the aortic root sinus. The outflow graft (**1**), aortic wall (**2**), and right ventricle (**3**) are also shown.

in combination with 100 mg of acetylsalicylic acid (100 mg/d). One and 2 weeks after surgical thrombectomy, echocardiography-guided ramp tests were performed to optimize LVAD speed to improve left ventricular unloading while still enabling sporadic opening of the aortic valve to minimize rethrombosis. During cardiac rehabilitation, the patient's 6-minute walking distance improved from 120 m to 300 m, and the MacNew Heart Disease quality of life score[3] improved from 5.9 to 6.6 points. A timeline of the case is shown in Supplemental Figure S4.

Discussion

Substantial efforts have been made to improve the outcomes of patients with LVAD; nevertheless, our case highlights the need for sustained peri- and postoperative alertness, even after uneventful implantation. A potential explanation for thrombus formation in the aortic root might be the prolonged support with Impella CP, which induces low flow between the blood inlet and outlet area and potentially prevents cusp movement. Data on the development of aortic root thrombus after Impella support and LVAD implantation are still scarce.[4,5] Due to the lack of recommendations regarding the management of aortic root thrombus, different therapeutic approaches were discussed: (1) conservative management, (2) catheter-based local thrombolysis, and (3) reoperation with removal of thrombus. The rationale for reoperation in our case was the anticipated lower bleeding risk compared with lysis. Whether this approach is also associated with a decreased stroke risk is currently unknown. We admit that the opinions within the heart team were diverse, and the decision to perform redo surgery demanded multiple discussions preoperatively as well as postoperatively.

Our case highlights that peri- and postinterventional echocardiography should include a focus on the aortic root because bridging with an Impella device preceding the LVAD implantation might potentially predispose patients to aortic root thrombus formation caused by Impella-related injury to the aortic valve and aortic root stasis.

Heart teams need to be aware of early postoperative thrombus formation that might potentially be formed in the aortic root after LVAD implantation, especially when patients have undergone previous Impella support. In our case, redo surgery via aortotomy on CPB was successful even in a frail bridge-to-destination patient, but whether this approach is superior to conservative treatment is unknown. Postoperative echocardiography should be performed during the early postimplantation period to evaluate the aortic root. In addition, further studies are needed to evaluate the risk for aortic root thrombosis under mechanical left ventricular support with Impella devices.

Further studies are needed to evaluate the risk for aortic root thrombosis under mechanical left ventricular support with Impella devices.

Funding Sources

This research received no external funding.

Disclosures

David Santer received speaker honoraria and educational grants from Abbott and speaker honoraria from Nycomed GmbH. Michael Kühne reports personal fees from Bayer, Boehringer Ingelheim, Pfizer BMS, Daiichi Sankyo, Medtronic, Biotronik, Boston Scientific, and Johnson & Johnson and grants from Bayer, Pfizer, Boston Scientific, BMS, and Biotronik. The other authors report no financial support and no other potential conflict of interest relevant to this article.

References

1. Mehra MR, Uriel N, Naka Y, et al. A fully magnetically levitated left ventricular assist device - final report. N Engl J Med 2019;380:1618–27.
2. Philipson DJ, Cohen DJ, Fonarow GC, Ziaeian B. Analysis of adverse events related to impella usage (from the Manufacturer and User Facility Device Experience and National Inpatient Sample Databases). Am J Cardiol 2021;140:91–4.
3. Lim LL, Valenti LA, Knapp JC, et al. A self-administered quality-of-life questionnaire after acute myocardial infarction. J Clin Epidemiol 1993;46:1249–56.
4. Jahanyar J, Liao JM, DeValeria P, et al. Early postoperative aortic root thrombus after heartmate 3. Heart Surg Forum 2019;22:E372–4.
5. Demirozu ZT, Frazier OH. Aortic valve noncoronary cusp thrombosis after implantation of a nonpulsatile, continuous-flow pump. Tex Heart Inst J 2012;39:618–20.

Supplementary Material

To access the supplementary material accompanying this article, visit *CJC Open* at https://www.cjcopen.ca/ and at doi:10.1016/j.cjco.2021.05.016.