

A tale of three pumps and a mechanical heart

Tarek Omran¹, Cornelia S Carr¹, Lateef Wani¹,
Imad Mahmoud², Rula Taha³, Bassam Shoman³,
Amr Salah Omar³  and Abdulaziz M Alkhulaifi¹

SAGE Open Medical Case Reports
Volume 8: 1–3
© The Author(s) 2020
Article reuse guidelines:
sagepub.com/journals-permissions
DOI: 10.1177/2050313X20940543
journals.sagepub.com/home/sco



Abstract

Temporary mechanical circulatory support device (tMCS) failure could qualify patients with advanced heart failure to receive a long-term solution. We report on a patient who presented with cardiorespiratory arrest that required a tMCS and developed acute type A aortic dissection. Data Sources: our case adds further evidence regarding the support of a patient with a second (or more) incidence of tMCS. This patient subsequently underwent left ventricular assist device insertion and type A aortic dissection repair, as a combined procedure, with a satisfactory outcome.

Keywords

Mechanical circulatory support, LVAD, aortic dissection, resuscitation

Date received: 10 February 2020; accepted: 15 June 2020

Introduction

Left ventricular assist device (LVAD) implantation is an established treatment for end-stage heart failure as a destination therapy or bridge to transplantation. The underlying diagnosis is dilated cardiomyopathy in the majority of patients, but ischemic cardiomyopathy represents about 30% of the total. Temporary mechanical circulatory support (tMCS) devices could bridge patients to more definitive therapeutic modalities, and so on. a venoarterial extracorporeal membrane oxygenation (VA-ECMO). However, some patients may experience deterioration in cardiovascular functions that requires re-cannulation after weaning from VA-ECMO.¹

The result of performing concomitant cardiac procedures with LVAD implantation remains undefined due to the small number of reported cases.² We report here on a patient who presented with cardiorespiratory arrest that required tMCS, developed acute type A aortic dissection while on tMCS, and subsequently underwent type A aortic dissection repair and LVAD insertion, as a combined procedure, with a satisfactory outcome.

Case report

A 43-year-old man (smoker) presented with chest pain, electrocardiogram (ECG) changes suggesting postero-lateral myocardial infarction, and high serum troponin levels. He then suffered a cardiac arrest (ventricular fibrillation). When he failed to have a return of spontaneous circulation, as per

our hospital protocol, he was evaluated and accepted for resuscitation with tMCS. A CentriMag™ Circulatory Support System (Abbott Laboratories, USA) was introduced through the left femoral artery and the right femoral vein. Cardiorespiratory collapse was reversed, by tMCS via the CentriMag™, within a short time (12 min) with a 3.5 L/min blood flow. A coronary angiogram showed severe 3-vessel coronary artery disease, and stents were placed in two obtuse marginal arteries. The rest of his coronary circulation was unsuitable for either further percutaneous coronary or surgical intervention. An intra-aortic balloon pump was inserted per our tMCS protocol. The left ventricular ejection fraction was 19% by biplane disk summation technique. Our tMCS weaning protocol suggested satisfactory recovery after 5 days (hemodynamic, echocardiographic, and biochemical parameters) and it was clear that he was neurologically intact; therefore, the tMCS device was explanted. Eight

¹Departments of Cardiothoracic Surgery, Heart Hospital, Hamad medical corporation, Doha, Qatar

²Department of Radiology, Heart Hospital, Hamad medical corporation, Doha, Qatar

³Anesthesia and Intensive care, Cardiothoracic surgery department, Heart Hospital, Doha, Qatar

Corresponding Author:

Amr Salah Omar, Department of Cardiothoracic Surgery/Cardiac, Anaesthesia & ICU Section, Heart Hospital, Hamad Medical Corporation, Doha, (PO: 3050), Qatar.

Email: a_s_omar@yahoo.com



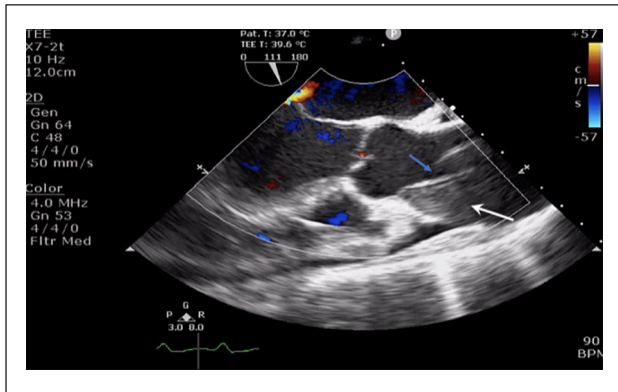


Figure 1. Transesophageal echocardiogram showing the presence of a longitudinal flap (blue arrow) extending from the sino-tubular junction to the distal ascending aorta.

hours after removal of the tMCS device, the patient suddenly deteriorated and tMCS had to be re-established; we again used the femoral approach. After a further 8 days, the patient was deemed weanable and the tMCS device was explanted; however, 3 days later, his hemodynamic status deteriorated and the tMCS CentriMag™ was instituted once again. Due to left groin sepsis, the arterial cannula was re-sited in the left subclavian artery via a tube graft. The venous drainage remained the same, that is, via the right femoral vein.

Once the sepsis was cleared, it was decided to perform an LVAD implantation (bridge to transplantation) using a continuous flow pump. By offering this patient LVAD treatment, we were able to refer him to another country where transplantation can be performed at a later stage.

Twelve days into the third period of tMCS, an echocardiogram detected the presence of an ascending aortic intimal flap (Figure 1); type A aortic dissection was confirmed by an ECG-gated computerized tomographic (CT) aortogram (Figure 2). On CT, an intimal flap extended from the ascending aorta (sino-tubular junction) around the arch, descending aorta, abdominal aorta, and both iliac arteries with no evidence of a communication between the true and false lumens (Figure 2).

Prior to surgery, a strategy was agreed upon: the dissection repair would be limited to the ascending aorta (tube graft) and followed by implantation of the LVAD system. At operation, the ascending aorta was found to be dilated with a large hematoma and free pericardial blood. Cardiopulmonary bypass was established using the left subclavian cannula (inserted through an 8mm vascular graft “Vascutek” anastomosed to the subclavian) for the arterial return and a two-stage right atrial cannula for venous drainage. The ascending aorta was clamped just proximal to the innominate artery and was incised to reveal a significant split that extended from the sino-tubular junction and beyond the distal ascending aorta. There was no communication between the true and false lumen at the level of the ascending aorta. The ascending aorta was



Figure 2. CT image showing flap from the sino-tubular junction and extending through the arch to descending aorta and beyond, with no demonstrable communication between the two lumens.

replaced with a tube graft (28 mm, Haemashield, Maguet, Getinge Group, Germany) anastomosed at the sino-tubular junction and the distal ascending aorta was supported with Teflon strips. Myocardial protection was achieved with intermittent antegrade cold blood cardioplegia and topical slush. This was followed by implantation of a HeartMate 3 (Abbott Laboratories, USA) using the left ventricular apex for inflow. The HeartMate outflow graft was anastomosed to the aortic interposition graft. The patient was weaned off cardiopulmonary bypass relatively smoothly after deairing of the heart and the pump. The patient stayed in the intensive care unit for 2 weeks, then on the ward for 4 weeks, and was then discharged home. Four months post-LVAD, his functional status is excellent and he is totally independent.

Discussion

This case demonstrates that the concomitant repair of an iatrogenic acute type A aortic dissection and LVAD implantation in an INTERMACS profile I patient can be performed with a satisfactory outcome. The rapid deployment of tMCS for the treatment of cardiorespiratory arrest and/or severe cardiogenic shock is gaining greater acceptance.^{3,4} Successful usage of repeated MCS has also been demonstrated previously,^{3,4} but may be associated with serious vascular complications.³ Since our patient was young, with no major comorbidities, and suffered a witnessed cardiac arrest, we were convinced that he would benefit from tMCS when conventional resuscitation failed. The weaning process from tMCS was protracted with multiple cannulations of his left femoral artery and later the subclavian artery,

which we feel that the later led to the iatrogenic retrograde aortic dissection. Notably, this complication has scarcely been reported following the use of tMCS in cardiorespiratory resuscitation.^{4,5}

Acute type A aortic dissection carries a high mortality rate if left untreated, and even in the setting of early intervention, the post-operative mortality remains high.⁶ The concomitant performance of LVAD and repair of acute type A aortic dissection has been reported only once previously,⁷ with an additional case of chronic type A dissection reported.⁸ Orthotopic cardiac transplantation is unavailable in our country, so we decided to implant an LVAD as a bridge to transplantation (to be performed elsewhere), which is an acceptable clinical application of LVAD.⁹

Conclusion

We have shown that tMCS could have more than one reason for failure and could be complicated with aortic dissection. Implantation of long-term MCS and repair of the dissection could provide the desired outcome.

Acknowledgments

To all members of the cardiothoracic surgery department, Heart Hospital and medical research center, Hamad medical corporation, Doha, Qatar

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

Ethical approval

Ethical approval to report this case was obtained from *NAME OF ETHICS COMMITTEE OR INSTITUTIONAL REVIEW BOARD (APPROVAL NUMBER/ID)*. Hamad medical corporation, medical research center **MRC-04-20-262**

Informed consent

Written informed consent was obtained electronically from the patient(s) for their anonymized information to be published in this article.

ORCID iD

Amr Salah Omar  <https://orcid.org/0000-0001-8560-2745>

References

1. Fisher JC, Stolar CJ and Cowles RA. Extracorporeal membrane oxygenation for cardiopulmonary failure in pediatric patients: is a second course justified? *J Surg Res* 2008; 148(1): 100–108.
2. Morgan JA, Tsiouris A, Nemeh HW, et al. Impact of concomitant cardiac procedures performed during implantation of long-term left ventricular assist devices. *J Heart Lung Transplant* 2013; 32(12): 1255–1261.
3. Xie A, Phan K, Tsai Y-C, et al. Venoarterial extracorporeal membrane oxygenation for cardiogenic shock and cardiac arrest: a meta-analysis. *J Cardiothorac Vasc Anesth* 2015; 29(3): 637–645.
4. Cheng R, Hachamovitch R and Kittleson M. Complications of extracorporeal membrane oxygenation for treatment of cardiogenic shock and cardiac arrest: a meta-analysis of 1,866 adult patients. *Ann Thorac Surg* 2014; 97(2): 610–616.
5. Joffe J, Preda G, Arrivé L, et al. Fatal aortic dissection during extracorporeal membrane oxygenation axillary cannulation confirmed by postmortem computed tomography angiography. *Am J Respir Crit Care Med* 2017; 195(7): 953–954.
6. Leontyev S, Borger MA, Legare J, et al. Iatrogenic type A aortic dissection during cardiac procedures: early and late outcome in 48 patients. *Eur J Cardiothorac Surg* 2012; 41(3): 641–646.
7. Gregoric ID, Palanichamy N, La Francesca S, et al. Simultaneous insertion of a left ventricular assist system and repair of an ascending aortic dissection. *Tex Heart Inst J* 2007; 34(4): 463–465.
8. Netuka I, Maly J, Szarszoi O, et al. Single-stage extensive chronic type A dissecting aortic aneurysm repair and continuous-flow ventricular assist device implantation. *J Heart Lung Transplant* 2009; 28(5): 523–526.
9. Stevenson LW, Pagani FD, Young JB, et al. INTERMACS profiles of advanced heart failure: the current picture. *J Heart Lung Transplant* 2009; 28(6): 535–541.