

Surgical High-Risk Coronary Revascularization Supported by Use of Percutaneous Transseptal Ventricular Assistance (PTVA®)

Based on a case report by Paul R. Vogt¹, MD, FETCS, Martin Heidt¹, MD, Erwin P. Bauer², MD, FETCS

¹Department of Cardiovascular Surgery, University Hospital, Giessen, Germany

²Kerckhoff-Clinic Foundation, Bad Nauheim, Germany

Supported by the European Center for Cardiovascular Research (ECCR)

Abstract

This report describes the elective, perioperative use of the TandemHeart percutaneous ventricular assist system in a 65 year old female patient undergoing conventional coronary artery bypass grafting, presenting with grade IV angina and grade IV dyspnoe, low output syndrome evidenced by a cardiac index of 1.2 L/min/m², a left ventricular ejection fraction between 10% to 15%, and grade I aortic valve regurgitation. The patient was successfully stabilized by the TandemHeart prior to and after the high risk CABG procedure.

Introduction

The prophylactic use of the intra aortic balloon pump (IABP) has been recommended, e.g. for surgical revascularization in high-risk patients, and is said to decrease the perioperative mortality in this particular subset of patients¹. However, the IABP has its limitations and is contraindicated in patients with aortic valve regurgitation. The prophylactic use of a percutaneous left ventricular assist device, such as the TandemHeart™ pVAD, may support patients with decompensated heart failure and severely depressed cardiac function who could potentially benefit from cardiac surgery.

Case Report

A 65-year old female patient with long-standing insulin-dependent diabetes mellitus was referred to our institution with grade IV angina and dyspnoe. Despite maximal medical therapy the patient was bedridden. Cardiac catheterization revealed severe triple-vessel disease and a left ventricular ejection fraction (LVEF) between 10% and 15% (Figure 1. and 2). Right ventricular function was normal. Scintigraphy suggested viable myocardium infero-posteriorly, however, a dobutamin stress-echocardiography was inconclusive, even at high doses of dobutamin. Preoperative hemodynamic measurements were as follows: cardiac index (CI) 1.2 L/min/m²; left ventricular end diastolic pressure (LVEDP) 26 mmHg; central venous pressure (CVP) 6mmHg; mean arterial pressure (MAP) 70 mmHg.

The patient was rejected for surgery at three different centers before she was transferred to our institution for surgery using prophylactic insertion of the intra aortic balloon pump. However, the presence of very severe LV dysfunction and moderate aortic regurgitation (grade I to II) indicated that an IABP might not provide enough support. The

decision was then made to place the TandemHeart ventricular assist device.



(Figure 1.) End-Diastolic Volume in a 65 year old female patient with severely depressed left ventricular function

The patient was prepared on the cardiac catheterization table and heparin was administered. After a transseptal puncture, a 21 French cannula was inserted percutaneously into the right common femoral vein, advanced towards the right atrium, and placed into the left atrium. Correct positioning

was assessed by conventional radiography. Thereafter, the right common femoral artery was punctured and a 17 French arterial cannula was advanced until its tip was located at the aortic bifurcation. The patient was transferred back to the cardiac surgical intensive care unit and connected to the TandemHeart pVAD Controller.



(Figure 2.) End-Systolic Volume

Echocardiography confirmed complete unloading of the left ventricle, achieved by draining blood from the left atrium. A stable flow of 3 L/min was easily achieved, resulting in a low-normal CI of 2.8 L/min/m² with a normal mixed-oxygen venous saturation monitored by continuous cardiac output measurement.

Coronary artery bypass grafting was performed after 22 hours of support. The left internal mammary artery was used to bypass the left anterior descending coronary artery. The circumflex and right coronary artery both received saphenous vein grafts.

Surgery was performed using standard cardiopulmonary bypass techniques and moderate hypothermia of 32°C. All anastomosis were performed on the beating heart to avoid aortic cross-clamping. During the surgical procedure the patient was supported by a heart-lung-machine while the TandemHeart was stopped and clamped off. Weaning from cardiopulmonary bypass was uneventful with the TandemHeart delivering a steady flow of 3.5 L/min achieving a stable CI of 2.8 L/min/m² postoperatively. Catecholamines were not used pre- or postoperatively.

Transfer to the cardiac surgical ICU was uneventful. The patient was weaned from mechanical ventilation and extubated the first postoperative day demonstrating normal re-

covery from surgery. Full TandemHeart support was continued for 24 hours. The patient demonstrated hemodynamic stability and could therefore be gradually weaned from the device over the course of the next 12 hours. Prior to removal of the TandemHeart, transthoracic echocardiography revealed a left ventricular ejection of 25% and minimal residual pericardial fluid. The TandemHeart was removed surgically using local anesthesia performing direct reconstruction of the common femoral artery and vein. After removal, hemodynamic parameters were as follows: CI 2.8 L/min/m², PCWP 14 mmHg, MAP 70 mmHg, and, CVP 3 mmHg.

Both the transseptal and the arterial cannula were examined macroscopically. The cannulae appeared normal and no thrombi could be found on the surface or intraluminally.

The patient was discharged from the intensive care unit after 5 days. At hospital discharge, the patient was free from angina and dyspnoea was estimated at grade II. Six months later, the patient had near-normal life quality being in New York Heart Association Class I. Transthoracic echocardiography revealed a left ventricular ejection fraction of 35%.

Discussion

The number of high-risk patients needing cardiac surgery is rising. Patients are older and have multiple co-morbid diseases, as well as advanced cardiac pathology. These patients do not well with medical therapy, but can be difficult to care for before and after surgery. Nonetheless, the natural history of heart failure can be dramatically improved if surgery is possible and successful. Our patient who was bedridden and required constant care prior to surgery may serve as a good example of this point.

The prophylactic use of IABP therapy has been reported to substantially decrease the 30-day mortality rate and costs in patients undergoing conventional high-risk coronary surgery. In our patient however, the use of IABP was not possible due to aortic valve regurgitation and severe LV failure. The patient was previously rejected for surgery due to her advanced deterioration, which certainly put her at the most critical end of the risk scale for coronary bypass surgery.

The TandemHeart was inserted percutaneously to unload the left ventricle preoperatively. It is possible to do this with sedation in a non-intubated patient, however, anticipating subsequent surgery, our patient asked for intubation and mechanical ventilation prior to insertion of the device.

This device was introduced into our clinical program without any major problems. Insertion of the transseptal and femoral arterial cannulae was not difficult and operation of the pump was straight forward. Percutaneous removal of the device is easily accomplished and well documented. Nevertheless, open surgical removal with local anesthesia, as performed in our patient, may help to mobilize the patient immediately following device explant.

The clinical indications for the TandemHeart are still evolving. In this case, it allowed us to salvage a patient with decompensated heart failure. In addition, the device could support patients with post-pump cardiac failure until recovery or required placement of a long-term LVAD.

Conclusion

In conclusion, the TandemHeart is a short-term left ventricular assist device, which can be implanted percutaneously. In our patient, it proved to be reliable and easy to handle. It successfully stabilized the patient prior and after the high risk procedure. This new device may be helpful in managing very high risk patients with preoperative heart failure, and also for post cardiectomy shock.

Acknowledgement

We wish to acknowledge Professor Vogt and his team for their assistance in developing this case report and for their contribution to the body of knowledge in cardiac surgery.

References

- 1 Christenson JT, Simonet F, Schmuziger M. Economic impact of preoperative intraaortic balloon pump therapy in high-risk coronary patients. *Ann Thorac Surg.* 2000;70:510-5