Direct transaortic transcatheter valve-in-valve implantation into a mechanical aortic valve prosthesis during left ventricular assist device implantation: description of a surgical technique

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Abstract

The presence of a mechanical aortic valve prosthesis is considered a relative contraindication for left ventricular assist device implantation (LVAD) due to the occurrence of thromboembolic events. Five patients were operated on for LVAD implantation with status post mechanical aortic valve implantation (n = 3 with status post Bentall procedure). After removal of the leaflets, a transcatheter balloon-expandable valve was placed within the mechanical ring in all patients. Three patients were discharged from hospital with a maximum follow-up of 3.3 years. Transaortic transcatheter valve implantation into a mechanical aortic valve during LVAD implantation is a feasible option. It reduces operative times and might also prevent thromboembolic events.

Keywords: Transcatheter Aortic Valve Replacement • Valve-in-Valve concept • Mechanical Aortic Valve • Left Ventricular Assist Device

INTRODUCTION

Rarely patients selected for left ventricular assist device (LVAD) implantation have had prior mechanical aortic valve implantation. The thrombogenicity of the valve itself but also the changed haemodynamics over the valve might represent a source of thromboembolic complications or valve dysfunction [1]. An extensive redo procedure is a possible strategy but is associated with prolonged cardioplegic arrest during surgery and decreased perioperative and long-term survival [2]. To circumvent these complications, different techniques for the closure of the left ventricular outflow tract have been attempted [3]. We herein describe a technique of direct transcatheter aortic valve implantation into a mechanical aortic valve during LVAD implantation.

METHODS

Five patients were operated on for long-term mechanical circulatory support due to end-stage heart failure at our institution. All patients have had at least 1 previous cardiac operation with mechanical aortic valve implantation (3 Bentall procedures). For patient characteristic, see Table 1. Concomitant direct transcatheter aortic valve-in-valve replacement was conducted in all patients. A preoperative computed tomography was carried out in all patients to obtain information about the anatomical relationships of the aortic root and, if the valve diameter was not known, to determine the true inner diameter for determining the size of the transcatheter valve prosthesis.

Patient characteristics and follow-up data were retrospectively analysed. The study was approved by the ethics committee of the medical faculty of the University of Leipzig (No. 047-17-19092017). Written informed consent was provided by all patients who were in an adequate conscious state preoperatively.

SURGICAL TECHNIQUE

In 4 patients, an intrapericardial fully magnetically levitated LVAD (HeartMate 3, St. Jude Medical, USA), and in 1 patient, an intrapericardial centrifugal-flow LVAD (HeartWare, Medtronic, Inc, Minneapolis, MN) was implanted. After successful placement of the LVAD, aortic cross clamping and cardiac arrest or ventricular fibrillation were introduced. In 1 patient, the aortic valve procedure was undertaken in ventricular fibrillation due to competent bypass grafts. After aortotomy, an extracted gauze-pad was placed into the left ventricular outflow tract through the leaflets of the mechanical aortic valve prosthesis to prevent the embolization of fragments. The leaflets of the mechanical prosthesis were broken out and the gauze-pad carefully removed (see Video 1). Three stay sutures were placed at the covered stent frame of the mechanical prosthesis for additional fixation of the TAVR, which was placed under angiographic guidance in the first case (see Video 1). Sizing of the transcatheter aortic valve replacement (TAVR) prosthesis was undertaken according to the given inner diameter as provided by the manufacturer or as seen on...
the preoperative computed tomography (CT) scan, when the valve size was unknown. All valve prostheses were oversized by at least 2 mm. In all cases, a transapical delivery system was used in which the valve prosthesis was crimped as for the transaortic approach.

In all patients a 23-mm Edwards Sapien 3 prosthesis (Edwards SAPIEN 3, Irvine, CA, USA) was chosen for intervention. In 1 patient, the SAPIEN prosthesis could not properly be placed. Due to the valve prosthesis being too deeply seated, it was decided to exchange for a 21-mm rapid-deployment aortic valve prosthesis (Edwards INTUITY, Irvine, CA, USA) as a (financial) bail out. Therefore, stay sutures were placed around the valve ring of the mechanical prosthesis and the INTUITY was placed.

In the last step, the LVAD-outflow graft was anastomosed to the ascending aorta. The mean aortic cross-clamp time was 36.8 ± 8.3 min. In 2 patients, right heart failure occurred after weaning form CPB. In these 2 patients, a CentriMag right heart assist device (Abbott Park, IL, USA) was placed for temporary circulatory support. In both patients, the CentriMag was removed after 22 and 46 days, respectively.

POSTOPERATIVE COURSE AND SURVIVAL

One patient died after 22 days due to refractory right heart failure with consecutive multi-organ failure. This patient was already in a critical clinical condition preoperatively with incipient secondary organ dysfunction. Another patient died 47 days after surgery due to septic shock during the index hospitalization. All patients were set on warfarin as soon as clinically justifiable. The median survival days for hospital survivors (n = 3) were 1011 days. In the 3 survivors, no relevant aortic regurgitation and regular opening was registered during the regular echocardiographic controls. All patients were in a good clinical condition.

DISCUSSION

To the best of our knowledge, this is the first report on the implantation of transcatheter aortic valves as a valve-in-valve procedure in a mechanical valve. This rare indication has been implemented in patients who were intended for LVAD implantation, in whom a mechanical aortic valve prosthesis had already been implanted. The advantages of the procedure are a significant reduction in the ischaemia time and the avoidance of an extensive re-do after aortic root replacement. The results of our study also show that right heart failure can still occur in these patients and has a significant impact on survival. For hospital survivors, however, the valve-in-valve procedure seems to result in an acceptable solution.

REVIEWER INFORMATION

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