Left Ventricular Assist Device Implantation combined with direct transaortic transcatheter valve-in-annular stent implantation after rescue mechanical Bentall procedure, A case report.

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Case Report

Keywords: left ventricular assist device (LVAD), mechanical aortic valve prosthesis, mechanical circulatory support, Myval, Valve-in-ring

Posted Date: September 1st, 2022

DOI: https://doi.org/10.21203/rs.3.rs-2003586/v1

Abstract

Background

Ventricular assist devices are an important technological development for patients with decompensated end-stage heart failure as bridging therapy for patients awaiting heart transplantation or as destination therapy. This report illustrates a case of a direct transaortic transcatheter valve-in-valve implantation into a mechanical aortic valve prosthesis during LVAD implantation. The advantage of our procedure in this case report is a significant reduction of ischemia time and the avoidance of such an extensive reoperation period as an aortic root replacement.

Case presentation:

A 34-year-old male suffering from Marfan's syndrome underwent an emergency aortic root replacement with a 27/30 mm St. Jude Medical Masters conducted by the Bentall-De Bono technique combined implantation veno-arterial extracorporeal membrane oxygenation (ECMO): subclavian artery – femoral vein. The patient had been on temporary extracorporeal support for 17 days. There was a progression of renal, respiratory, and heart failure in the postoperative period and echocardiography revealed a left ventricular ejection fraction of about 11%, severe mitral and tricuspid valve regurgitation. Taking into account these indicators LVAD implantation was recommended by the council of doctors. The patient resided in the ICU department for 27 days and was discharged at 45 days after LVAD implantation.

Conclusions

Currently, an increasing number of patients with previously implanted mechanical prostheses are in need of mechanical circulatory support. At the same time, taking into consideration the high risk of thrombosis, a mechanical prosthesis should be replaced with a biological one. Complete replacement of the aortic root takes a long time, especially under conditions of reoperation period, which can significantly aggravate right ventricular failure and increase hospital mortality in such category of patients.

Background

Ventricular assist devices are an important technological development for patients with decompensated end-stage heart failure as bridging therapy for patients awaiting heart transplantation or as destination therapy. Recently, more patients, with previously having mechanical mitral or aortic valve implantation, have selected left ventricular assist device (LVAD) implantation [2, 3]. A preexisting mechanical aortic valve is thought to be a thrombogenic risk factor after LVAD implantation. Usually mechanical aortic valves encountered during LVAD implantation are managed by replacement with a tissue valve or closure of the valve together with a patch [1, 4, 5]. This report illustrates a case of a direct transaortic

transcatheter valve-in-valve implantation into a mechanical aortic valve prosthesis during LVAD implantation.

Case Presentation

A 34-year-old male suffering from Marfan's syndrome, had a cardiac surgery before, which was a repair mitral valve on October 17th 2013. On February 7th, 2022 the patient underwent an emergency aortic root replacement with a 27/30 mm St. Jude Medical Masters conducted by the Bentall-De Bono technique combined implantation veno-arterial extracorporeal membrane oxygenation (ECMO): subclavian artery – femoral vein. Preoperative echo showed the following data: aortic diameter 65 mm, left ventricular end-diastolic volume (EDV LV) 221 ml, left ventricular end-systolic volume (ESV LV) 127 ml, left ventricular end-systolic diameter (ESD LV) 5.3 cm, left ventricular end-diastolic diameter (EDD LV) 6.4 cm, ejection fraction (EF) 42%.

On February 14, 2022, ECMO was switched to veno-venous (femoral-external jugular). Totally, he had been on temporary extracorporeal support for 17 days. There was a progression of renal, respiratory, and heart failure in the postoperative period.

Echocardiography revealed a left ventricular ejection fraction of about 11%, severe mitral and tricuspid valve regurgitation (Table 1).

Table 1
Time line

Echo Date	**10/20/2013**	**02/07/2022**	**04/04/2022**
Ascending aortic, mm	40	65	30
EDV LV, ml	252	221	321
ESV LV, ml	150	127	287
EDD LV, cm	8	6.4	7.5
ESD LV, cm	5.4	5.3	6.9
EF LV, %	40	42	11
EDD RV, cm	2.5	2.3	3.6
TAPSE	2	1.8	0.85
MR	-	-	+++
TR	-	+/++	+++

Table note: EDV- end diastolic volume, LV- left ventricle, ESV- end sistolic volume, EDD- end diastolic diameter, ESD- end sistolic diameter, EF- ejection fraction, EDD RV- right ventricular end diastolic diameter, TAPSE- tricuspid annular plane systolic excursion, MR- mitral regurgitation, TR- tricuspid regurgitation.

In the interdisciplinary case after discussion, we noticed the indication for implantation of LVAD. Preoperative characteristics of the patient are shown in the Table 2.

Table 2
Patient's demographics preoperative baseline characteristics and laboratory parameters.

Demographic data	Value
Age, years	34
Body mass index, kg/m2	23
Body surface area, m2	2.1
Cardiorespiratory conditions preoperatively	
INTERMACS class	II
Intensive Care Unit Length of stay, days	58
Duration of mechanical ventilation, days	58
Hemodialysis prior to surgery, days	21
CVP, mmHg	16
Laboratory parameters	
White blood cell count, 109/l	13
Creatinine, mg/dl	2.1
Blood urea nitrogen, mg/dl	42
C-reactive protein, mg/dl	10
AST, U/l	16
ALT, U/l	11
Serum bilirubin, mg/dl	1.2
ProBNP	35000
INR	1.8
MELD score	27
Table note: INTERMACS- interagency registry for mechanically assisted circulatory support, AST-Aspartate transaminase, ALT-Alanine aminotransferase, ProBNP - Brain natriuretic peptide test, INR - nternational normalized ratio, MELD score - model for end-stage liver disease.	

Surgical procedure.

Femoral arterial and femoral venous cannulations had been performed before the chest opening. The heart and the ascending aortic graft were mobilized to allow a distal ascending aortic clamp. Antegrade

blood cardioplegia was administered. The ascending aortic graft was opened longitudinally. The leaflets of the prosthesis were broken and removed. The crimped ballon expandable transcatheter aortic valve MyVal 27.5 (Meril Life Sciences Pvt. Ltd) was inserted through the ascending aorta, positioned into the mechanical valve (proportion 70/30) and implanted (Fig. 1, 2).

The outflow graft of the device (Heart Mate 3 TM Abbott Laboratories, USA) was anastomosed to the ascending aortic graft in an end-to-side type (Fig. 3).

Then the cross-clamp was removed. The implantation site of the inflow cannula was chosen anterior to the apex of the left ventricle and 2 cm lateral to the anterior interventricular branch. The orifice of the left ventricle was made with a special apical knife. Then inflow cannula was placed and made tunneling of the driveline. De-airing was done before and after creating the anastomosis between proximal and distal parts of outflow graft. The procedure of implantation driveline is typical for such kind of operation. The LVAD pump was launched, and the cardiopulmonary bypass (CPB) was removed from the patient. After extended bleeding control, the chest was covered. The skin-to-skin time was 380 min. with an acceptable CPB time of 194 min. The aortic cross-clamp time was 43 min. Under low catecholamine as well as inotropic support and nitrogen monoxide (NO), ventilation was provided. The mean arterial pressure, Central venous pressure (CVP), cardiac rhythm and pulmonary capillary wedge pressure were 71mmHg, 9 mmHg, 110 beats\minute, and 12 mmHg, respectively. The pump speed, pump flow and pulse index were 4400 rpm, 3.2 l\min and 4.8 respectively. The patient was transferred to our intensive care unit (ICU). Postoperative echocardiography: AR(0), mean gradient-6mmHg, peak gradient-12mmHg.

The patient came to consciousness 2 hours later after surgery and his neurological status was found entirely normal. He was extubated on 21st day. The hemodiafiltration was held during 13 days after surgery. The patient resided in the ICU department for 27 days and was discharged 45 days after LVAD implantation.

Discussion

With increasing clinical experience in the surgical treatment of heart failure, particularly mechanical circulatory support indications for implantation has been expanded. Currently, an increasing number of patients with previously implanted a mechanical prostheses are in need of mechanical circulatory support. At the same time, taking into consideration the high risk of thrombosis, mechanical prosthesis should be replaced with a biological prosthesis [6, 9]. Complete replacement of the aortic root takes a long time, especially under conditions of reoperation period, which can significantly aggravate right ventricular failure and increase hospital mortality in such category of patients [1, 7, 8]. The advantage of our procedure in this case report is a significant reduction of ischemia time and the avoidance of such an extensive reoperation period as an aortic root replacement.

Conclusions

There is lack of information about this surgical procedure in the literature. The valve-in-valve implantation is reasonable way intending reduction of the cardioplegic arrest time and the avoidance of an aggressive aortic root replacement. In order to get reliable and long-term results, a larger and longer follow-up of a larger number of cases should be carried out.

List Of Abbreviations

extracorporeal membrane oxygenation (ECMO)

left ventricular assist device (LVAD)

Intensive care unit (ICU)

left ventricular end-diastolic volume (EDV LV)

left ventricular end-systolic volume (ESV LV)

left ventricular end-systolic diameter (ESD LV)

left ventricular end-diastolic diameter (EDD LV)

ejection fraction (EF)

cardiopulmonary bypass (CPB)

nitrogen monoxide (NO)

Central venous pressure (CVP)

Declarations

Ethics approval and consent to participate.

The case report was approved by the Institutional Review Ethics Committee of the National Re-search Cardiac Surgery Center (#01-97/2022 from 22/04/22), the name of the chairperson of the ethics committee – Alibek Kossumov and has been conducted in accordance with the principles in the Helsinki Declaration.

Patient consent.

Patient has given his informed consent for participation in the case study and for the publication of photographs.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests

Funding

The authors report no involvement in the research by the sponsor that could have influenced the outcome of this work.

Authors' contributions

All authors contributed equally to the manuscript and read and approved the final version of the manuscript.

Acknowledgements

Authors' information (optional)

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Figures

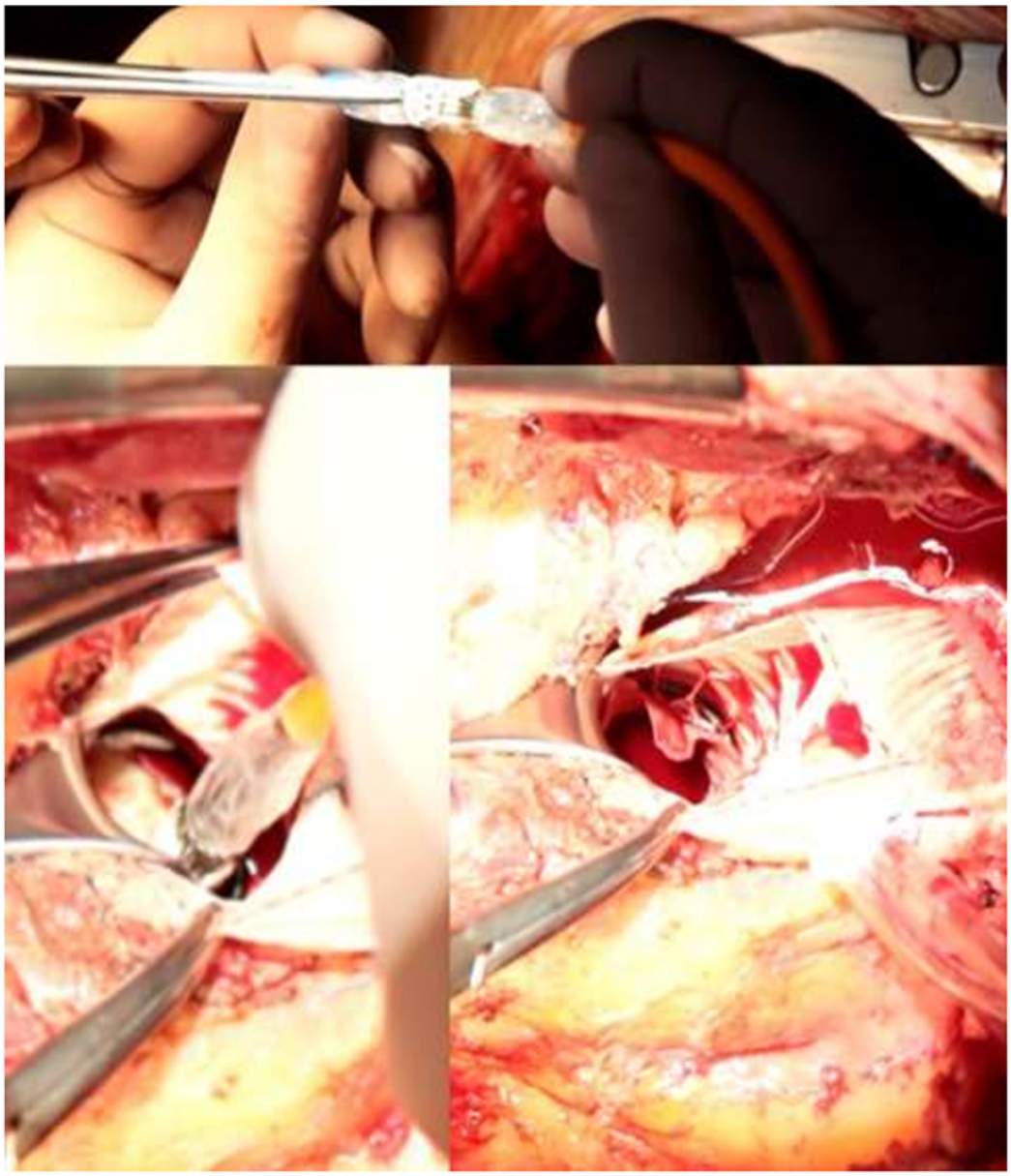


Figure 1

The moment of implanting through the ascending aorta crimped ballon expandable transcatheter aortic valve MyVal 27.5 (Meril Life Sciences Pvt. Ltd).

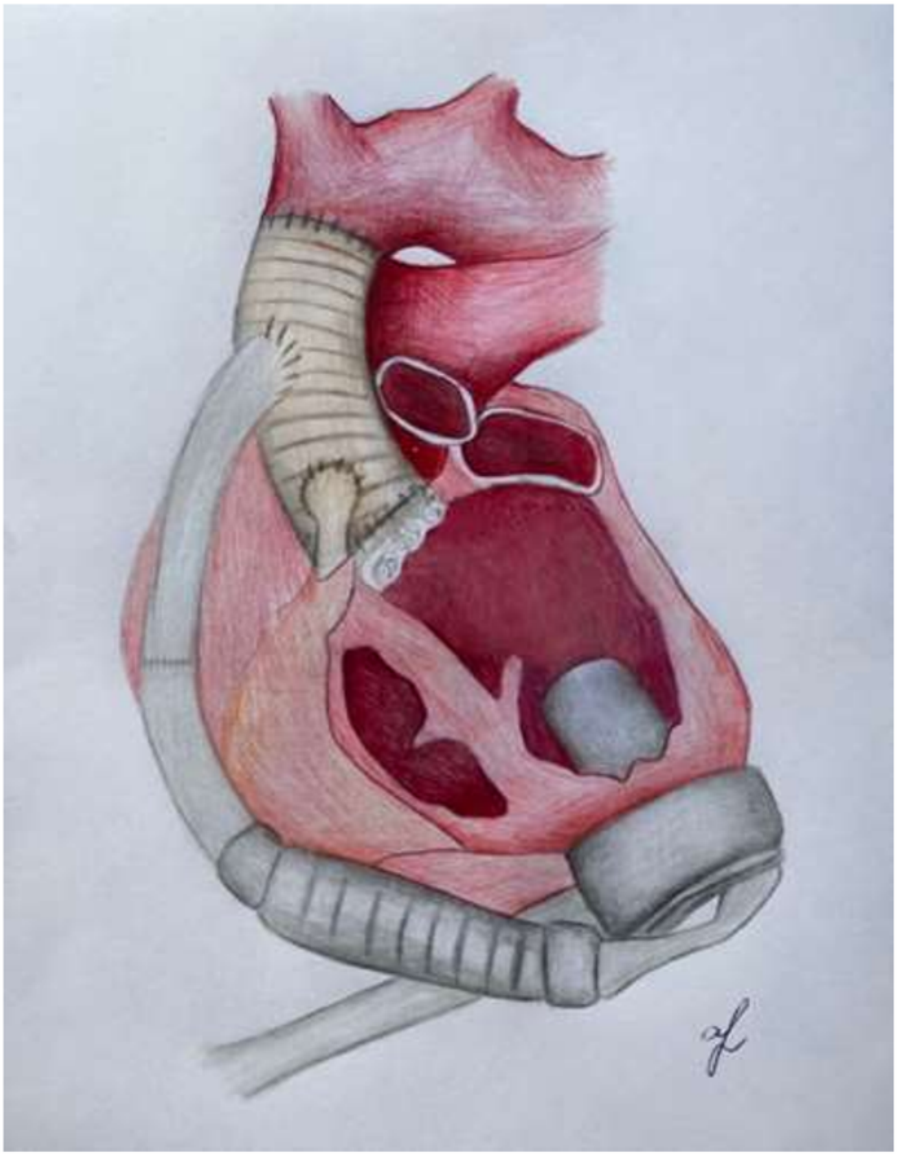
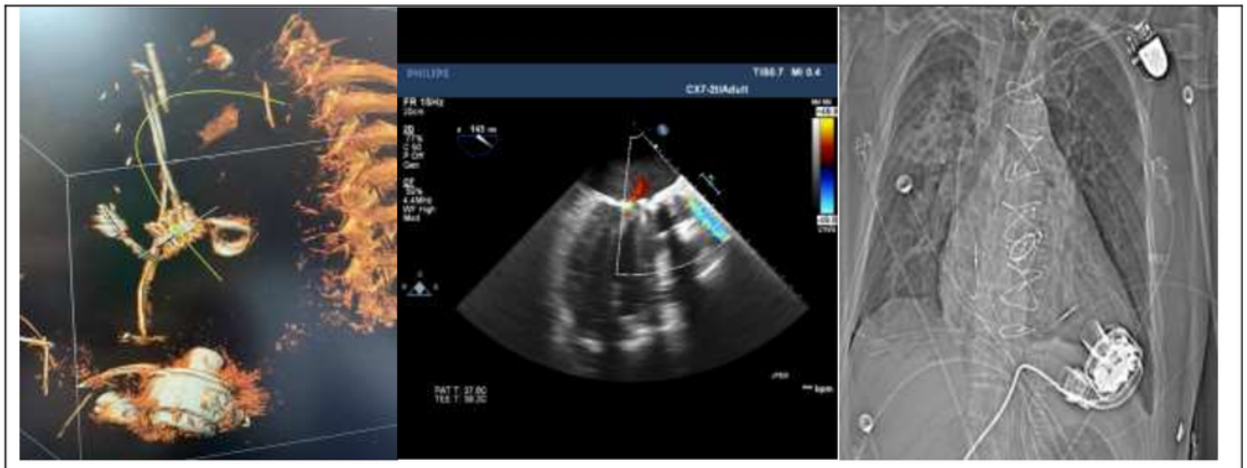


Figure 2

Schematic diagram of an operating procedure.



A- CT scan with contrast, arrangement of transcather aortic valve, left ventricle assist device and annuloplasty ring	B- Intraoperative TEE(transesophageal echocardiogram)	C- Postoperative Chest X-Ray

Figure 3

Visualization of LVAD and prosthesis positioning