

Transcatheter edge-to-edge tricuspid repair for recurrence of valvular regurgitation after left ventricular assist device and tricuspid ring implantation

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Abstract

Tricuspid regurgitation in patients with left ventricular assist device (LVAD) has a significant impact on prognosis and quality of life, and its effects on liver and renal function could negatively impact planned heart transplantation. The aim of the present case is to report the feasibility and the clinical impact of tricuspid transcatheter edge-to-edge repair in LVAD patients as adjunctive bridge to transplantation strategy. A 59-year-old female patient previously treated with LVAD implantation (HeartMate III) and tricuspid valve repair with 32 mm rigid ring (Medtronic Contour 3D) as bridge to transplantation developed recurrence of significant tricuspid regurgitation with right ventricular decompensation needing inotropic support. Preoperative echo showed torrential tricuspid valve regurgitation Effective regurgitant orifice area (EROA 1.4 cm²) with suspicious of partial detachment of the prosthetic ring. The patient was successfully treated with transcatheter edge-to-edge repair with the MitraClip XTR device. Tricuspid regurgitation was reduced by 50% (postoperative EROA 0.7 cm²). She remained stable under continuous inotropic support with no other episodes of right ventricular decompensation and was successfully transplanted 30 days after the clipping procedure. Transcatheter treatment of tricuspid regurgitation in a patient with LVAD was an effective strategy to gain time and bridge the patient to heart transplantation.

Keywords Transcatheter tricuspid repair; Left ventricle assist device; Tricuspid regurgitation; Right ventricle failure

Received: 25 June 2019; Revised: 6 October 2019; Accepted: 11 November 2019

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Introduction

The favourable effects on survival of left ventricular assist devices (LVADs) as bridge to transplantation or destination therapy for patients with end-stage heart failure are well established and largely reported.^{1,2} However, this patient population represents a very fragile subgroup, and the medical history is often characterized by the occurrence of several adverse events and need for readmissions due to infections, bleedings, stroke, and right ventricle failure associated to tricuspid valve regurgitation (TR).^{3,4} In approximately half of the patients undergoing LVAD

implantation, a moderate or severe TR is already detected on echocardiography before device implantation, and usually, it is secondary to changes in the right ventricular (RV) dimensions in response to a higher afterload due to left-sided heart disease. Although a spontaneous reduction of TR after LVAD implantation alone was also reported, the recurrence of the pathology and its dynamic changes represents still a challenge in the management of these patients.⁵

The transcatheter approach to functional tricuspid regurgitation has been recently reported with promising results but not applied in this challenging patient population.⁶

Case report

Herein, we report the case of a 59-year-old female patient with chemotherapy (breast cancer, 7 years before) induced chronic heart failure, arterial hypertension, history of smoking, and diabetes mellitus.

In March 2019, the patient presented with therapy refractory cardiac decompensation (INTERMACS Class III). Therefore, the patient underwent LVAD implantation (HeartMate III) and tricuspid valve repair with 32 mm rigid ring (Medtronic Contour 3D) as bridge to transplantation. In addition, a temporary right ventricular assist device was implanted due to borderline RV function which could be weaned on postoperative day (POD) 11. The patient was discharged for rehabilitation on POD 43 in good clinical condition with no signs of right heart failure. On POD 53, she was readmitted for LVAD low flow. Subsequently, a retrosternal haematoma compressing the right ventricle and highly reduced RV function with severe tricuspid regurgitation were diagnosed. The patient therefore underwent surgical revision (POD 64) to remove the retrosternal haematoma which did not improve RV function, and inotropic therapy had to be instituted. A thorough trans esophageal echocardiography (TEE) workup revealed torrential TR (EROA 1.4 cm^2 , gap width 4 mm) (Figures 1A and 1B) with a very poor RV function (tricuspid

annular plane systolic excursion 5 mm; central venous pressure 18 mmHg; RVOT-VTI 4.4 cm and calculated RV cardiac output 1.9 l/min, RV fractional area change 18.6%) and an echo-based sPAP of 38 mmHg. The main jet location was central and postero-septal. In the 3D assessment, the prosthetic ring appeared partially detached from the annulus with no para-annular regurgitation (Figure 1C).

In an attempt to improve RV geometry and optimize RV preload a transthoracic echocardiography (TTE) guided change of LVAD speed was performed prior to clip implantation; however, it did not reduce TR or improve RV function.

Therefore, given the poor clinical condition and the high operative risk (EuroSCORE II 25%), a transcatheter treatment of the recurrent TR was approved by the local heart team. The potential ring detachment contraindicated a potential valve-in-ring solution.

The TriClip procedure was performed under general anaesthesia and with inotropic support (dobutamine 3 mcg/kg/min) and was guided by TEE and fluoroscopy. A semimanual CT segmentation of the right atrium, caval veins, and the previously implanted ring was performed and used for fusion imaging (Figure 2A). The right femoral vein was used as site for the introduction of the 24 F Mitraclip XTR steerable guide. The insertion of the clip delivery system was performed 90° counter-clockwise from its usual locking position, as recently

Figure 1 Transoesophageal echocardiography findings. (A) Preoperative tricuspid valve regurgitation in four-chambers view; (B) preoperative trans-gastric short axis view; (C) 3D assessment (green arrow shows suspected ring detachment area); (D) postoperative residual tricuspid valve regurgitation.

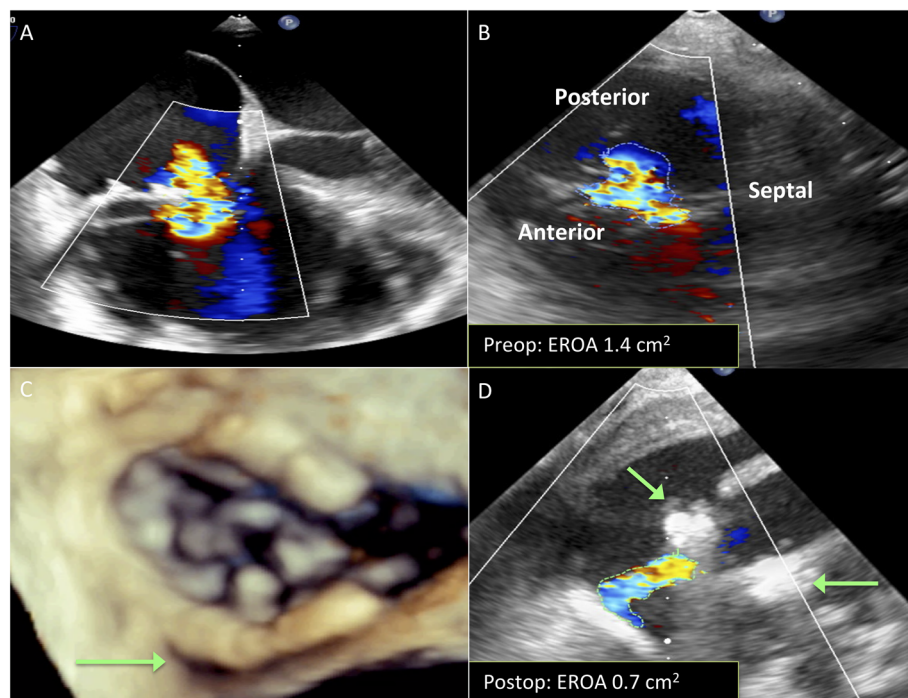
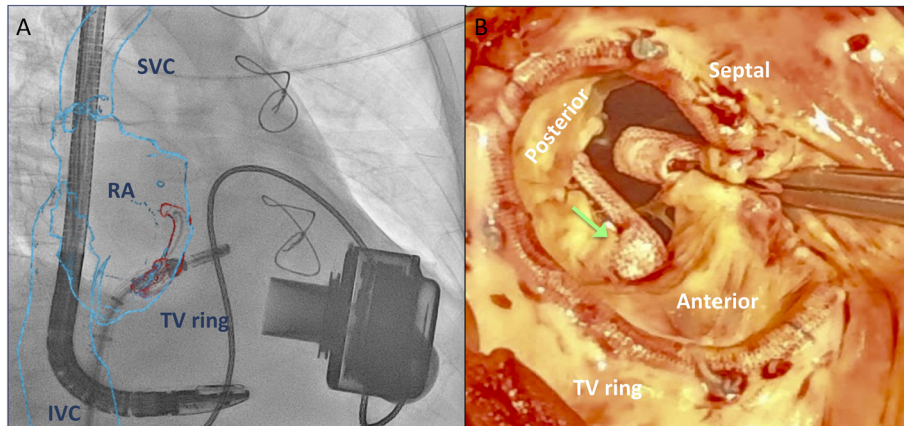


Figure 2 (A) Fluoroscopy with fusion imaging features. IVC, inferior vena cava; SVC, superior vena cava; RA, right atrium; TV, tricuspid valve. (B) Post-explant view. The green arrow shows the clip place in the postero-septal commissure with single leaflet attachment to the posterior leaflet.



proposed.⁷ We decided to use the Mitraclip XTR device to facilitate leaflet grasping. Our standard technique is to clip the antero-septal commissure to close the middle of the valve and to apply radial tension on the tricuspid annulus.⁸ In this case, a ‘triple orifice technique’ with an adjunctive Mitraclip XTR placed between the septal and the posterior leaflet, according to the residual regurgitant jet location detected after the implantation of the first clip, was performed.

Postoperative echo showed a 50% reduction in the EROA (0.7 cm^2) (Figure 1D) with a postoperative gradient through the tricuspid valve of 3 mmHg. An improvement of right ventricular output (RVOT-VTI 7.2 cm; calculated RV cardiac output 3.4 L/min) was recorded (Figure 3). LVAD flow remained stable during the procedure (pre 3.5 L/min vs. post 3.3 L/min).

Recovery after the intervention was uncomplicated, and TR grade remained stable during the postoperative course. Despite stabilization of the patient, RV function did not recover, and the patient was kept on the waiting list for heart transplantation. She underwent heart transplantation on

POD 31 after the clipping procedure and was discharged home completely asymptomatic 40 days after. Intraoperative inspection of the tricuspid valve on the explanted heart showed a single leaflet attachment (SLA) of the clip device positioned at the postero-septal commissure (Figure 2B, green arrow).

Discussion

The role of transcatheter valve therapies in patients with heart failure represents the continuous evolution of cardiovascular therapies in which medical, surgical, and percutaneous therapies cooperate to achieve a complex balance between cardiac function and freedom from symptoms.^{9,10}

The present case represents a successful example of an integrative approach in the treatment of patients with chronic heart failure, and several considerations could be raised.

Figure 3 Pre (A) and post-clipping (B) calculation of right ventricle cardiac output



Tricuspid regurgitation in LVAD patients may have a significant impact on prognosis and quality of life. Its effects on liver and renal function could negatively impact planned heart transplantation or the outcome of destination therapy. Therefore, the guidelines of the International Society for Heart and Lung transplantation recommend prompt consideration of surgical repair at the time of implant (Class IIa, level of evidence C). However, this approach is still controversial and largely debated.¹¹

In the setting of chronic heart failure, a partial reduction of the tricuspid regurgitation could be of great importance to increase RVOT and reducing symptoms without excessive overload of the right ventricle.¹² In this scenario, the transcatheter edge-to-edge repair with the Mitraclip XTR device offers big advantages: the amount of regurgitant volume is evaluated during the procedure step by step and after each clip deployment before releasing. Therefore, it can be modulated by the operator, changing grasping zone or deciding to interrupt the procedure according to the haemodynamic response of the patient and the evaluation of right cardiac output. According to our experience, we believe that a reduction of 50% of the effective regurgitant orifice area represented an acceptable result. Moreover, the novel XTR could have the adjunctive effect on early annular reshaping when considering patient with no previous ring in place.¹³ An SLA was noticed during the heart transplantation (HTX): retrospective evaluation of fluoroscopic images showed that the second clip had a different spatial orientation when compared with the previous implanted one but still effective in reducing TR. Therefore, we suppose that the SLA was occurred during the postoperative course or was associated with HTX manipulation.

Despite these promising perspectives, imaging guidance remains the most important limiting factor,¹⁴ especially in the presence of previously implanted assist devices or a prosthetic ring that may create shadowing or artefacts. Echo guidance was feasible in the presented case and offered a good window for deep trans-gastric view. A backup with intracardiac echocardiography as previously described should be taken into consideration during the pre-procedural planning.

Specific technical considerations were considered for this case. Indeed, several other potential options were a valve-in-ring procedure, an annuloplasty device or caval valve implantation. The first solution was contraindicated in the present case of a potential ring dehiscence. Annular plication with the Cardioband System¹⁵ (Edwards Lifescience, Irvine, USA) or the Trialign (Mitralign, Tewksbury, Massachusetts)⁸ may represent an interesting technique but was not applicable in the present case while other annular solutions as the TriCinch system (4Tech Cardio, Galway, Ireland) would not represent an optimal solution in the case of bridge to transplantation for the possible technical issues during the heart transplantation related to the stent released in the inferior vena cava. The same problem should be considered when planning a caval valve implantation with or without custom-made prostheses.

In conclusion, patients with a previously implanted LVAD represent a high-risk patient population with a high morbidity and mortality rate associated with residual or recurrent TR in which transcatheter repair with the edge-to-edge technique represents a promising tool as bridge strategy. We demonstrated that this therapeutic strategy was feasible, hemodynamically tolerated and resulted in reduction of TR also in the presence of a previously implanted tricuspid ring. Follow-up data and impact on prognosis will be a matter of further analysis.

Conflict of interest

M. Andreas has a research grant and is proctor (Edwards, Abbott) and member of an advisory board (Medtronic). A. Kocher is consultant for Edwards Lifesciences and receives speaker fees from Medtronic, Boston Scientific and Abbott. D. Wiedemann is consultant for Abbott. D. Zimpfer receives research grants from Abbott and Medtronic, is advisory board member for Abbott, Medtronic and Berlin Heart, and proctor for Abbott and Medtronic. The other authors have no conflict of interest to declare.

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