

Never Give Up: Deep Hypothermic Circulatory Arrest for Transcatheter Mitral Edge-To-Edge Repair Failure in Porcelain Aorta – A Case Report

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This study was carried out at the Poliambulanza Foundation Hospital Institute, Brescia, Lombardia, Italy.

ABSTRACT

We report the case of a surgical treatment after transcatheter edge-to-edge mitral valve repair failure in a 79-year-old patient who had undergone cardiac surgery 30 years earlier. The transcatheter procedure of mitral valve got complicated by single leaflet device attachment leading to recurrent severe regurgitation. Despite the extremely high surgical risk and a porcelain aorta, we deemed the patient operable thanks to his performant physical and

cognitive status. He underwent mitral valve replacement with a bioprosthesis in deep hypothermic circulatory arrest and retrograde cerebral perfusion. The postoperative course was regular, and he is in good functional class at one-year follow-up.

Keywords: Mitral Valve. Thoracic Surgery. Circulatory Arrest, Deep Hypothermia Induced. Bioprosthesis. Aorta.

Abbreviations, Acronyms & Symbols	
AML	= Anterior mitral leaflet
CPB	= Cardiopulmonary bypass
DHCA	= Deep hypothermic circulatory arrest
MC	= MitraClip™
MR	= Mitral regurgitation
PA	= Porcelain aorta
PML	= Posterior mitral leaflet
SLDA	= Single leaflet device attachment
TEER	= Transcatheter edge-to-edge mitral valve repair

coronary artery and valvular heart disease. As far as these solutions were not widespread, surgeons tried to overcome these major contraindications to surgery developing new surgical strategies which still include: deep hypothermic circulatory arrest (DHCA), calcified ascending aorta replacement, balloon occlusion, endarterectomy, apico-aortic valved conduit, or a combination of them^[1]. Actually, in selected patients, these options have been proven to be safely performed, as reported by Urbansky et al.^[2]. Widely diffused transcatheter treatments for valve disease are not free from complications either. Among those following transcatheter edge-to-edge mitral valve repair (TEER), leaflet injury has an incidence of 0-2%^[3]. Mechanisms of injury can be either leaflet perforation or tear by the end of clip arm or entrapment of the clip in leaflets and subvalvular structures^[4]. Bailout maneuvers can be attempted through the transcatheter approach itself, but risks of ineffectiveness or further lesions are high. Surgery might be the last option in patients despite prohibitive perioperative risk.

INTRODUCTION


Severe and diffuse calcification of the thoracic aorta, also known as “porcelain aorta” (PA), represents an absolute contraindication to aortic cannulation and cross-clamping in patients needing cardiac surgery. The improvements in both off-pump and transcatheter techniques have partially solved this issue in

CASE PRESENTATION

We report the case of a 79-year-old man who had undergone, 30 years before, single coronary artery bypass grafting and aortic

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Article received on April 2nd, 2024.
Article accepted on October 17th, 2024.

valve replacement with a mechanical prosthesis. One month before current hospitalization, due to worsening dyspnea, he had undergone TEER for severe mitral regurgitation (MR) by MitraClip™ (MC) system (Abbott, Abbott Park, Illinois, United States of America) in a different hospital. Patient charts reported the application of two clips grasping A2 and P2 scallops, but significant MR was still evident. PA was deemed an absolute contraindication to rescue surgery and, accordingly, he was discharged on medical therapy. A few weeks later, an episode of acute heart failure despite optimal medical therapy led the patient to our emergency room. Our echocardiogram confirmed severe MR caused by posterior leaflet tear with the lateral clip grasping only the anterior leaflet (single leaflet device attachment [SLDA]) (Figure 1). A computed tomography scan confirmed the presence of PA (Video 1) and diffused calcific arteriopathy that forced us to exclude the options of an endoclamp and of circulatory arrest with antegrade cerebral perfusion through right subclavian artery cannulation. However, spots free from calcifications along the femoral arteries were judged eligible for peripheral cannulation. Despite the high surgical risk (European System for Cardiac Operative Risk Evaluation II 21.86% and Society of Thoracic Surgeons risk of morbidity or mortality 26.3%), we decided to perform a surgical correction of the TEER failure, since no effective transcatheter options were available and the patient was in good physical and cognitive status.

Surgical Technique

Cardiopulmonary bypass (CPB) was instituted through left common femoral artery and bicaval cannulation after re-sternotomy. Deep hypothermic status was the target (17.2°C nasopharyngeal temperature). CPB was interrupted and retrograde cerebral perfusion performed through the right internal jugular vein. Cold blood cardioplegia was delivered in a retrograde fashion. Mitral valve exposure through left atriotomy was partially restricted by the mechanical aortic prosthesis and the incompressible PA, thus limiting the view of the anterior annulus. Our echocardiographic suspicions were confirmed, with one clip efficiently grasping A2-P2 scallops, a SLDA (A2 lateral portion), and a torn posterior leaflet (P2 lateral portion) (Figure 1). The valve was not amenable to repair, so it was excised, and a bovine pericardial bioprosthesis was implanted. After a 40-minute DHCA, CPB was re-started. De-airing was obtained by CO₂ flooding and ascending aorta venting through a needle placed in a confined area without calcifications. The postoperative period was free of major complications. Progressive improvements in both hemodynamics and physical performance were observed in the following days. Pre-discharge transthoracic echocardiography showed both aortic and mitral prostheses properly working and no paravalvular leakage, confirmed at echocardiography four months later. On the 11th postoperative day, he moved to the rehabilitation department.

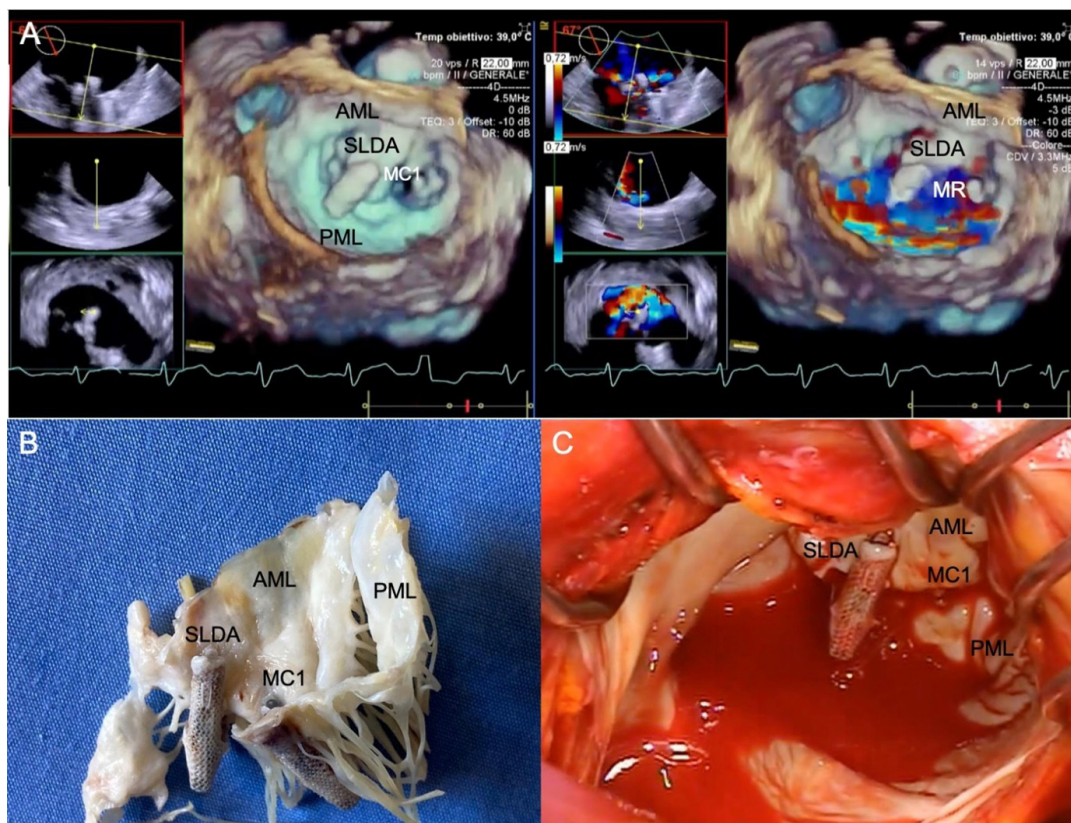
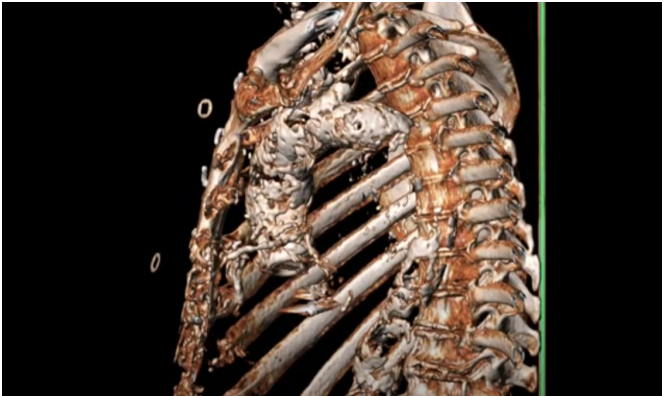


Fig. 1 - Transesophageal echocardiography (A), excised mitral valve (B), and intraoperative photograph (C) showing both anterior and posterior mitral leaflet (AML and PML, retrospectively). Single leaflet device attachment (SLDA) can be seen on the lateral portion of the AML, next to the clip (MC1), efficiently grasping A2-P2 scallops, thus determining severe mitral regurgitation (MR).



Video 1 - Overview of aortic calcifications at computed tomography scan.

Link: <https://youtu.be/IUIVRQSQ4t4>

DISCUSSION

Among the aforementioned options for surgery in PA, DHCA seems to be the only adoptable in isolated mitral valve surgery, where aorta is not intended to be opened. This strategy is not free from complications though, with the neurological ones being the most fearsome, although most interventions requiring DHCA seem to be safely performed when DHCA lasts < 50 minutes^[5]. According to current guidelines of severe MR^[6], TEER may be considered in symptomatic patients who are judged inoperable or at high surgical risk by the Heart Team and fulfill the echocardiographic criteria of eligibility. Mechanisms of recurrent MR after MC have been extensively investigated, and in primary MR worsening mitral leaflet prolapse seems to be the main risk factor^[7], especially a flail leaflet with gap length ≥ 11 mm^[8]. For this reason, a careful multidisciplinary approach should not be confined to the preoperative evaluation of the patient, as guidelines recommend^[9], but should involve the procedures themselves and the postprocedural phase of interventions to monitor the results and possibly solve the complications. In fact, albeit in the era of transcatheter intervention and according to the positive experiences of different centers^[1,2,9], we think that traditional surgery should still be considered a valid bailout option in complicated aortic or mitral transcatheter procedures, balancing a high risk of mortality or major perioperative complications with life expectancy. That's why, in our case, after reconsidering the clinical condition and life expectancy of the patient, the hypothermic circulatory arrest was judged feasible. This new evaluation did not contradict the previous Heart Team opinion, but it was updated according to the new clinical context.

CONCLUSION

In the era of a multidisciplinary approach to the patient and his disease, the continuous exchange of views between professionals requires a special effort from everyone but it aims at achieving the most tailored and safe treatment for the patient

Ethical Approval

The research was conducted with informed and appropriate consent from the patient involved. Written consent has been obtained from the patient for the publication of any details or photographs that may identify an individual.

**No financial support.
No conflict of interest.**

Authors' Roles & Responsibilities

ADC	Substantial contributions to the conception of the work; and the acquisition of data for the work; drafting the work; final approval of the version to be published
GT	Substantial contributions to the conception of the work; and the acquisition of data for the work; revising the work; final approval of the version to be published
PF	Substantial contributions to the conception of the work; revising the work; final approval of the version to be published
EC	Substantial contributions to the conception of the work; and the acquisition of data for the work; final approval of the version to be published
AM	Substantial contributions to the conception of the work; and the acquisition of data for the work; final approval of the version to be published
EV	Substantial contributions to the conception of the work; and the acquisition of data for the work; revising the work; final approval of the version to be published

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Brazilian Journal of Cardiovascular Surgery
vol. 40, no. 6, e20240129, 2025

Sociedade Brasileira de Cirurgia Cardiovascular,

ISSN: 0102-7638

ISSN-E: 1678-9741

DOI: <https://doi.org/10.21470/1678-9741-2024-0129>