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STRUCTURAL HEART DISEASE

CASE REPORT: CLINICAL CASE

Transcatheter Edge-to-Edge Repair for Acute Papillary Muscle Rupture After Transvenous Lead Extraction in a d-TGA

Paméla Bélanger, MD, Louis Phillippe David, MD, Patrick Garceau, MD, Denis Bouchard, MD, Anita W. Asgar, MD, MSc

ABSTRACT

We present a case of a patient known for dextrotransposition of the great arteries corrected with a Mustard procedure, in whom severe mitral valve regurgitation secondary to transvenous lead extraction was successfully repaired with transcatheter edge-to-edge repair using the TriClip device (Abbott Vascular). (J Am Coll Cardiol Case Rep 2024;29:102213)

HISTORY OF PRESENTATION

A 33-year-old woman, known for a history of dextrotransposition of the great arteries dextrotransposition of the great arteries surgically corrected with a Mustard procedure at a young age, was admitted electively for transcatheter lead extraction (1 atrial lead and 2 subpulmonary left ventricular leads) and implantation of a new transvenous pacemaker system in the context of pacemaker lead dysfunction. A transthoracic echocardiogram before the procedure showed mild systemic right ventricular enlargement and dysfunction with mild tricuspid regurgitation. The subpulmonary left ventricular ejection fraction was preserved with no other significant valve disease. The extraction of the atrial lead and first ventricular lead were performed using laser extraction and mechanical rotational traction without complication; however, after laser, manual traction, and extraction of the second ventricular lead, severe mitral regurgitation was noted with an anterior leaflet flail. The patient remained otherwise hemodynamically stable. An AAI pacemaker was put in place at the end of the procedure and an additional stent was implanted in the superior systemic venous baffle, inside a previously stenosed SSVB stent.

LEARNING OBJECTIVES

- To recognize the occurrence of severe valve regurgitation associated with transvenous lead extraction in a patient with complex congenital anatomy.
- To discuss the use of transcatheter edge to edge repair using the TriClip system for a patient with congenital heart disease, complex cardiac anatomy, and complicated post-transvenous lead extraction.
- To review the importance of understanding the anatomy for device selection and steering maneuvers and the need for good quality imaging when performing these procedures and the use of nonstandard views in patients with complex congenital anatomy with previous surgical repair.

From the Montreal Heart Institute, Montreal, Canada.
The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the Author Center.

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PAST MEDICAL HISTORY

The patient was diagnosed with dextrotransposition of the great arteries at birth, treated initially with a Rashkind atrial septostomy, and then repaired at the age of 1 year with a ventricular septal defect closure and a Mustard procedure. The Mustard procedure is an atrial switch operation that uses a prosthetic baffle to direct deoxygenated blood from systemic venous return to the subpulmonary left ventricle and oxygenated blood from the pulmonary veins to the systemic right ventricle (Figure 1). Postoperatively, she developed complete atrioventricular block requiring the implantation of an epicardial pacemaker, that was later changed for a transvenous DDD pacemaker. The pacemaker lead trajectory is via the superior systemic venous baffle and mitral valve into the subpulmonary left ventricle. In 2012, an additional ventricular pacing lead was implanted, without extraction of the previous lead. She underwent additional procedures including balloon dilation and stenting of the superior and inferior systemic venous baffles owing to baffle stenosis, transcatheter baffle leak closure and atrial flutter ablation in the setting of a previous transient ischemic attack in 2011.

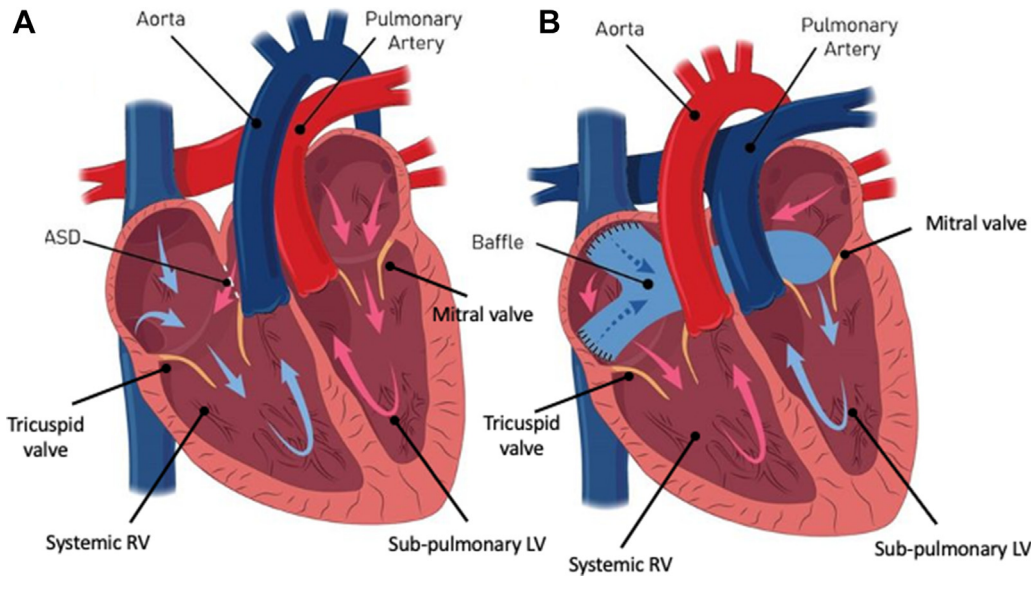
DIFFERENTIAL DIAGNOSIS

In the context of a mitral valve leaflet flail occurring immediately after extraction of a ventricular lead in congenitally corrected transposition of the great arteries, the differential diagnosis is a traumatic injury to the leaflets or to the subvalvular mitral apparatus, including the chordae tendineae or the papillary muscles.

INVESTIGATIONS

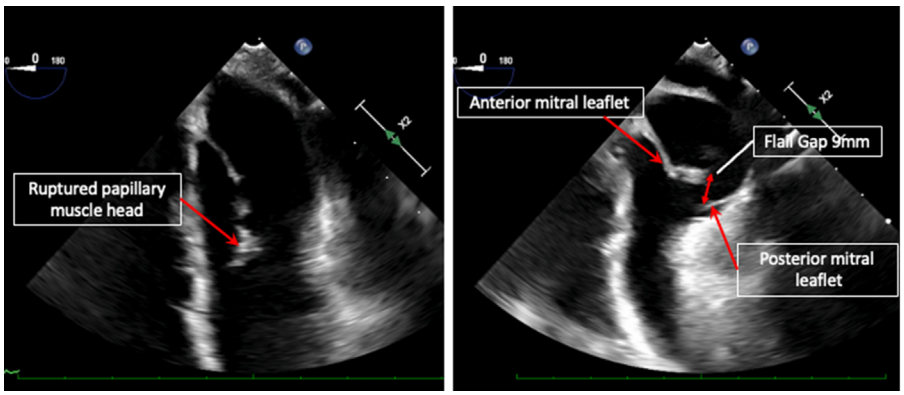
A postextraction transesophageal echocardiogram showed a subpulmonary left ventricle with normal systolic function, but severe mitral valve regurgitation with an eccentric jet originating between A1 and A2, with a mean gradient of 8 mm Hg. A mobile element was seen at the extremity of the anterior leaflet, suspicious for a papillary muscle rupture. The flail gap measured 9 mm. The rest of the examination was similar to previous echocardiographic imaging results before the procedure.

FIGURE 1 Drawing of d-TGA and Anatomy Post-Mustard Repair



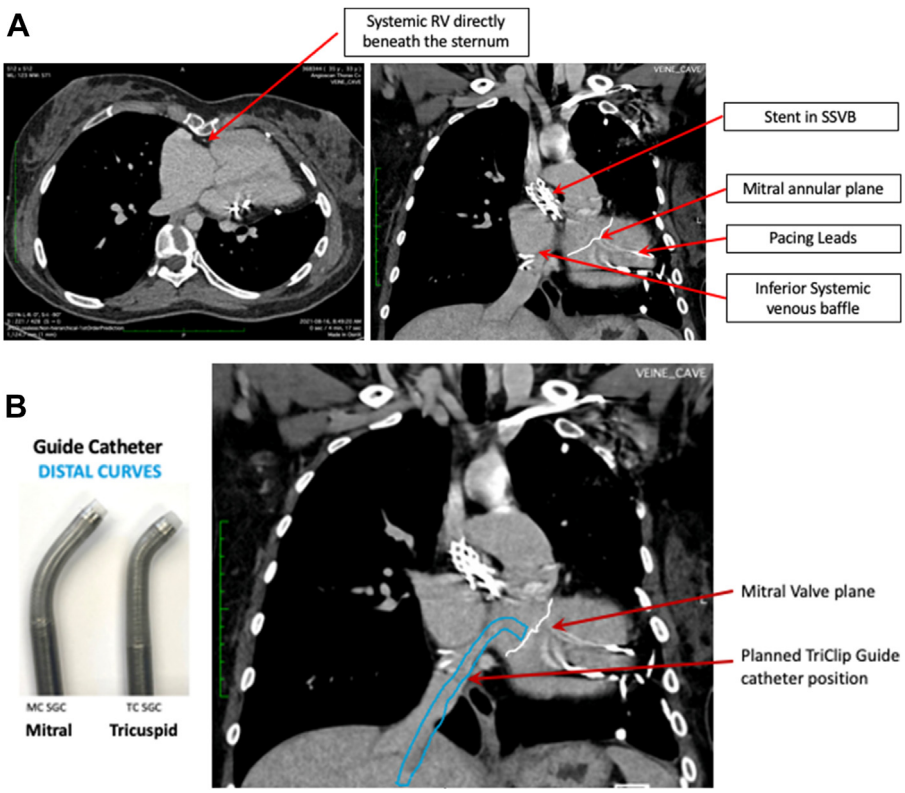
(A) Depiction of d-TGA with a systemic right ventricle with the tricuspid valve, that is connected to the aorta. The blue arrows demonstrate the flow of deoxygenated blood from the systemic venous return to the aorta resulting in cyanosis after birth. The subpulmonary left ventricle (LV) with the mitral valve is connected to the pulmonary artery, such that oxygenated blood (red arrows) returning via the pulmonary veins is recirculated to the lungs. (B) After surgical repair with the Mustard procedure, a prosthetic baffle is attached to the vena cava and systemic venous return is directed via the baffle to the mitral valve of the subpulmonary left ventricle, which is connected to the pulmonary artery. Flow from the pulmonary veins flows behind the baffle to the tricuspid valve and systemic right ventricle. The correct flow of deoxygenated and oxygenated blood has been restored as shown by the arrows. ASD = atrial septal defect; d-TGA = dextrotransposition of the great arteries; RV = right ventricle.

FIGURE 2 **Still Echo Images**



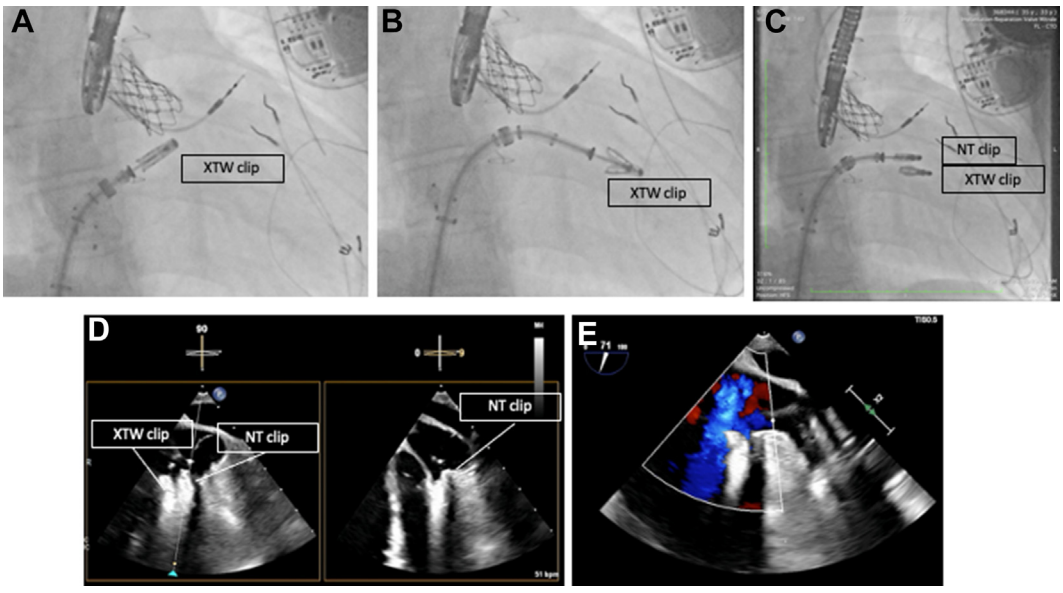
Still echo images of anterior mitral leaflet flail after lead extraction illustrating the ruptured papillary muscle, flail fap, and restricted posterior leaflet.

FIGURE 3 **CT Images**



(A) Axial and coronal computed tomography (CT) imaging of patient with identification of baffles and stents and mitral annular plane. In the axial image the systemic RV is visualized directly behind the sternum with a mild pectus deformity. In the coronal image, a stent can be visualized in the superior systemic venous baffle and pacing leads are seen in the subpulmonary LV. The mitral annular plane has been drawn in to illustrate the position on the CT scan. (B) Images of MitraClip and TriClip guide catheter with planned trajectory on CT scan imaging. Abbreviations as in Figure 1.

FIGURE 4 TriClip Procedure



(A) Triclip wide clip (XTW) device maneuvered in the systemic venous baffle. (B) Lealfet grasping with the XTW. (C) Two clips in position, XTW at A2P2 and NT at the lateral segment of A2P2. (D) Echo imaging showing 2 clips in place. (E) Trace residual mitral regurgitation.

MANAGEMENT

Owing to the young age of the patient and her previous cardiac surgery history, a heart team discussion was performed with the congenital surgeon, treating cardiologist and structural interventional team. Contrast-enhanced computed tomography (CT) imaging revealed an anterior systemic right ventricle directly underneath the sternum, raising concerns for reoperation. In addition, the systemic right ventricle had evidence of moderate dysfunction with a tricuspid annular plane systolic excursion of 9 mm. The heart team decision was, therefore, to attempt transcatheter edge-to-edge repair given the high risk of a repeat surgical intervention.

PROCEDURAL STRATEGY

Given the complex congenital anatomy and numerous previous interventions, procedural planning was performed using the CT scan to select the appropriate system for transcatheter edge-to-edge repair. The small baffle anatomy, paucity of maneuvering space in the baffle, and lack of need for a transseptal suggested that the TriClip system may be better suited for the task given the shorter guide tip and ability to steer the system away from the septum (Figures 2 and 3). The CT scan was also used to plan the device trajectory to the mitral valve. The post-transcatheter lead extraction transesophageal echocardiogram demonstrated the lack of standard views for a mitral transcatheter edge-to-edge repair procedure with the absence of a true bicommissural or left ventricular outflow tract view; therefore, a nonstandard single long axis view was the only available intent to clip imaging view with the assistance of multiplanar imaging. Given the large anterior flail segment a longer arm, a wide clip was chosen for the first clip, with the plan to add a second clip as required.

The procedure (see Figure 4) was performed under general anesthesia with transesophageal echocardiography guidance using a TriClip system. Access was obtained through the right common femoral vein with venous pre-closure using the Perclose ProGlide system (Abbott Vascular). After progressive skin dilation, the TriClip delivery sheath was advanced into the systemic venous baffle. The wide clip TriClip was introduced, and steering was performed using fluoroscopic and echocardiographic guidance. Despite the atypical angulation, maneuvering was not restricted, and the tip of the clip was successfully positioned over the anterior mitral leaflet flail segment (A2).

After confirming appropriate orientation and position of the clip, it was advanced into the left ventricle. The use of several independent grasping attempts was required to achieve an adequate grasp of A2 and P2 leaflets given the restricted posterior leaflet and anterior flail. After confirmation of a significant decrease in mitral regurgitation, the clip was deployed. A residual jet was noted on the lateral segment of A2; therefore, a second clip, NT was positioned laterally to the first. The final result was excellent, with a substantial reduction of mitral regurgitation, from severe to trace and mean gradient of 3 mm Hg. The patient was discharged 2 days later without additional complications.

DISCUSSION

Transvenous lead extraction has been associated with new or increased tricuspid regurgitation in ≤11.5% of patients.[1] Risk factors for new-onset tricuspid valve regurgitation include longer lead implant duration, extraction of pacemaker rather than defibrillator leads. The development of new tricuspid regurgitation is associated with anatomic injury to the tricuspid valve, and longer postextraction hospital stays. We present the first reported case of new onset mitral regurgitation owing to papillary muscle rupture and flail of the anterior mitral leaflet in a patient with congenitally corrected transposition of the great arteries after lead extraction successfully treated with the TriClip device. This case demonstrates that, in patients with congenital heart disease, transcatheter edge-to-edge repair may be a good alternative to a surgical approach in high-risk surgical patients.[2] The challenge in this population, however, is the complex congenital anatomy and previous interventions; therefore, the use of all imaging modalities is essential for procedural planning and execution. In this case, CT imaging was used to select the appropriate system for edge-to-edge repair and 3-dimensional multiplanar imaging was used to identify the best 2-dimensional imaging nonstandard view. We previously described the use of the MitraClip system (Abbott Vascular) to address tricuspid regurgitation in a patient with congenitally corrected transposition of the great arteries,[3] illustrating that transcatheter techniques may have a place in this challenging population.

FOLLOW-UP

Echocardiographic follow-up performed 2 weeks after hospital discharge demonstrated 2 clips in good position, with a stable trace mitral regurgitation and mean gradient of 3 mm Hg. The patient was seen at the 12-month follow-up, she remained asymptomatic (NYHA functional class I/IV). The AAI pacemaker was functioning normally, with no sign of atrioventricular block. Transthoracic echocardiogram showed stable trace mitral regurgitation and mean gradient of 3 mm Hg, with normal function of the subpulmonary left ventricle.

CONCLUSIONS

Severe mitral regurgitation in dTGA patients with a Mustard procedure can successfully be repaired using a TriClip system.

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Dr Asgar is a consultant for Abbott Structural. All other authors have reported that they have no relationships relevant to the contents of this paper to disclose.

ADDRESS FOR CORRESPONDENCE: Dr Anita W. Asgar, Montreal Heart Institute, 5000 rue Belanger, Montreal H1T 1C8, Canada. E-mail: anita.asgar@umontreal.ca.

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KEY WORDS congenital, TriClip, valve replacement