JACC: CASE REPORTS VOL. 3, NO. 5, 2021

MINI-FOCUS ISSUE: INTERVENTIONAL CARDIOLOGY

INTERMEDIATE

CASE REPORT: CLINICAL CASE

Complete Atrioventricular Block

A Rare Complication of MitraClip Implantation

Ikenna Erinne, MD,[a] Arjun K. Theertham, MD,[a] Kataneh Maleki, MD,[b] Chunguang Chen, MD,[a] Mark Russo, MD,[a] Abdul Hakeem, MD[a]

ABSTRACT

MitraClip (Abbott Vascular, Inc., Santa Clara, California) has emerged as a viable alternative for treatment of symptomatic severe mitral regurgitation. Conduction abnormalities are not a known complication of this procedure. We report a case of complete heart block without a ventricular escape rhythm immediately following MitraClip placement near the medial leaflets (A3-P3) in a patient with underlying trifascicular block. (**Level of Difficulty: Intermediate.**) (J Am Coll Cardiol Case Rep 2021;3:772–7) © 2021 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

HISTORY OF PRESENTATION

An 87-year-old woman with severe mitral regurgitation (MR) and New York Heart Association functional class III to IV symptoms on maximally tolerated medical therapy was referred for elective implantation of a MitraClip device (MC, Abbott Vascular, Inc., Santa Clara, California). Her Society of Thoracic Surgeons risk score for surgical mitral valve (MV) repair was estimated at 10%. On admission, she was afebrile, with blood pressure of 160/70 mm Hg, heart rate 93 beats/min, and pulse oximetry of 96% on room air. Cardiovascular examination was notable for a 3/6 apical systolic murmur radiating to the axilla but with no signs of decompensated heart failure.

LEARNING OBJECTIVES

- In patients undergoing transcatheter MV repair, underlying conduction abnormalities can increase the risk of complete heart block and generate the need for a permanent pacemaker.
- The close proximity of the conduction system relative to the MV apparatus explains the risk of heart block from instrumentation of the MV apparatus.
- Pre-procedural and intraoperative electrocardiographic monitoring help identify patients at risk for this complication.

PAST MEDICAL HISTORY

Her past medical history also included coronary artery disease after percutaneous coronary intervention, atrial fibrillation, hypertension, and chronic kidney disease.

DIFFERENTIAL DIAGNOSIS

The differential diagnosis of the cause of the MR included severe prolapse or flail of a single MV leaflet or of multiple leaflets.

From the [a]Division of Cardiovascular Diseases and Cardiovascular Surgery, Rutgers Robert Wood Johnson Medical School, New Brunswick, New Jersey, USA; and the [b]Department of Cardiology, Robert Wood Johnson University Hospital, New Brunswick, New Jersey, USA.

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.

Manuscript received September 7, 2020; revised manuscript received February 2, 2021, accepted February 16, 2021.

ISSN 2666-0849 https://doi.org/10.1016/j.jaccas.2021.02.044

INVESTIGATIONS

A baseline transthoracic echocardiogram was notable for normal left ventricular (LV) ejection fraction (65% to 70%) and severe, posteriorly directed MR. The patient had been evaluated by the structural heart team a few months earlier and was deemed a high risk for open surgical repair given her advanced age, multiple comorbidities, and frailty. Before presentation, a screening transesophageal echocardiogram (TEE) was attempted with the patient under moderate sedation to evaluate the MV anatomy; however, the procedure was terminated prematurely because of the development of respiratory distress. The limited TEE that was completed revealed mild mitral annular calcification and moderate to severe MR with an eccentric regurgitant jet that was suggestive of primary, nonischemic MR (type II Carpentier class). A pre-procedural electrocardiogram showed normal sinus rhythm with first-degree atrioventricular (AV) block, right bundle branch block, and left anterior fascicular block (**Figure 1**). Routine laboratory tests and a coronavirus 2019 test were also performed.

MANAGEMENT

An intraoperative TEE confirmed a flail and prolapsing A2 segment adjacent to A3 with severe eccentric MR (**Figure 2,** Video 1), a normal LV ejection fraction, and small LV cavity size. The decision was made to proceed with transcatheter edge-to-edge mitral repair using an MC NTR clip delivery system (Abbott Vascular, Inc.). Complete AV block without ventricular escape developed immediately after an MC NTR clip was positioned in the LV cavity and was used to appose the A3-P3 segments (**Figure 3A**). She became hemodynamically unstable and required epinephrine and placement of a temporary pacemaker (**Figure 3B**). A single clip was placed across the A2-P2 segments adjacent to the A3-P3 segments, which significantly reduced the MR (Video 2). There was no sign of recovery of AV conduction intraoperatively; therefore, a permanent pacemaker was implanted. The pacemaker wire was inserted about 1.5 cm below the location of the bundle of His on the right ventricular septum, in an area mapped to demonstrate the narrowest QRS complex duration

ABBREVIATIONS AND ACRONYMS

AV = atrioventricular
LV = left ventricular
MC = MitraClip
MR = mitral regurgitation
MV = mitral valve
TEE = transesophageal echocardiogram

FIGURE 1 Baseline 12-Lead Electrocardiogram Showing First-Degree Atrioventricular With Bifascicular Block (Right Bundle Branch Block and Left Anterior Fascicular Block)

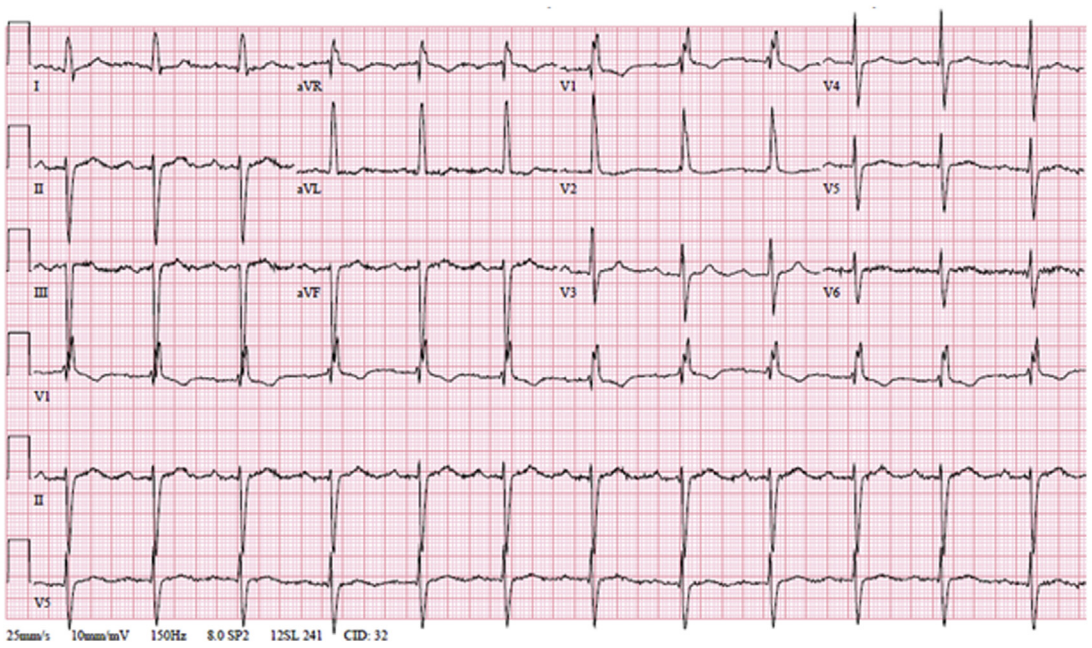
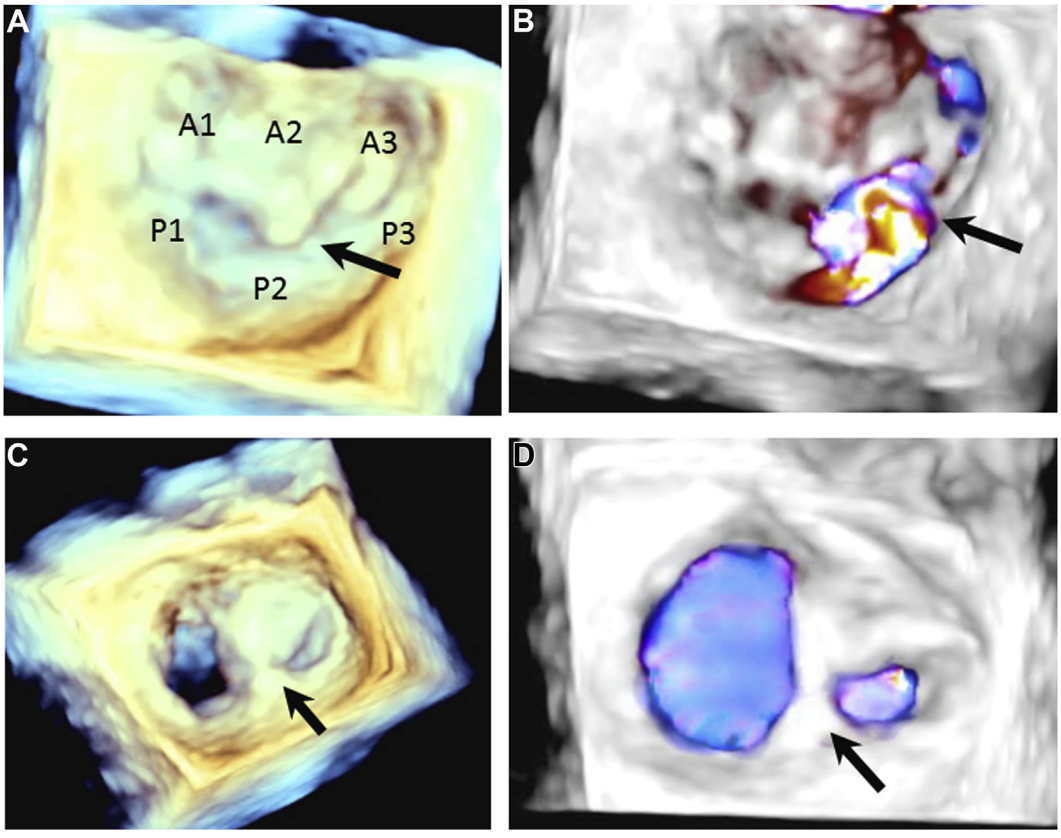


FIGURE 2 3-Dimensional Transesophageal Echocardiography Images



(A) Severe prolapse of A2-A3 segments. **(B)** Posteriorly directed mitral regurgitant jet. **(C and D)** Successful grasp of flail or prolapsed segment with a MitraClip NTR device (Abbott Vascular, Inc., Santa Clara, California).

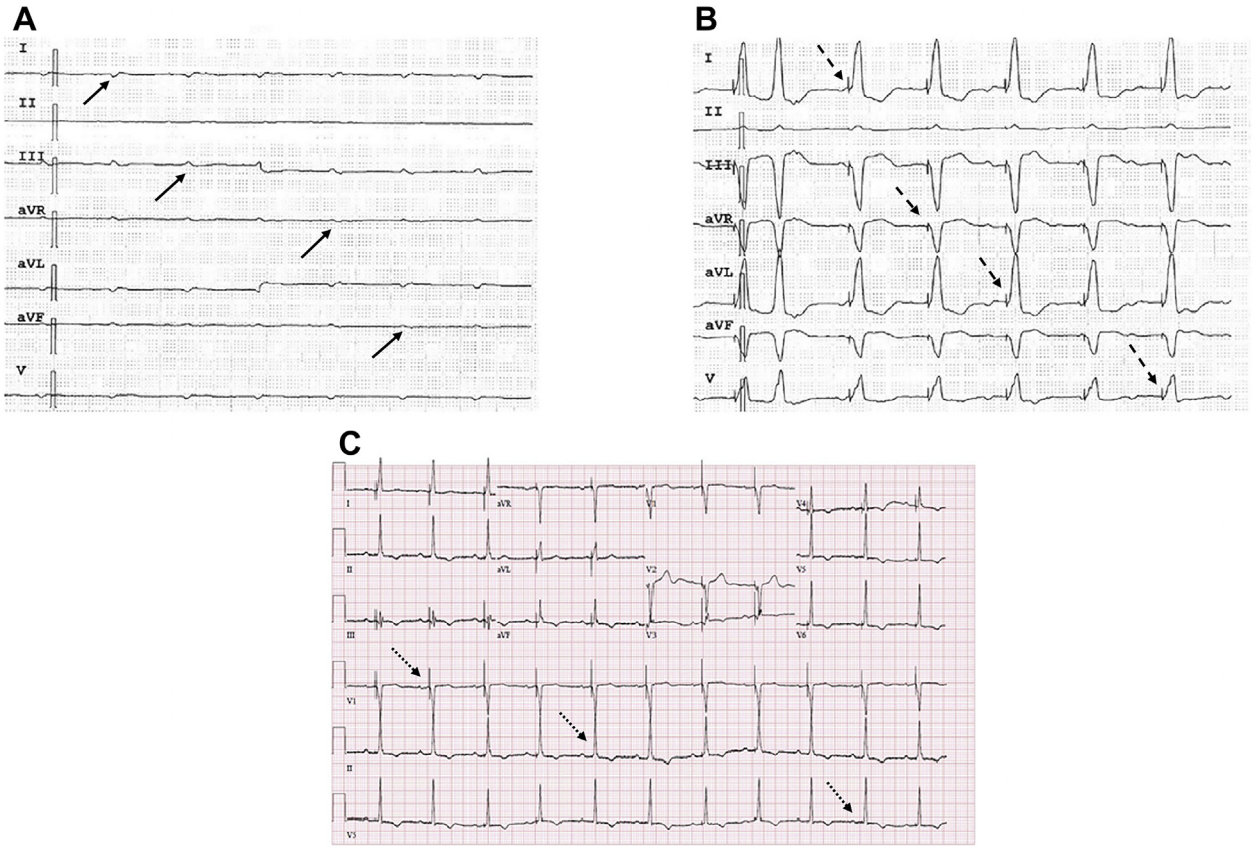
and essentially resulting in selective left bundle branch pacing (**Figure 3C**). A post-operative transthoracic echocardiogram showed minimal MR, a mean MV gradient of 5 mm Hg at a heart rate of 60 to 70 beats/min, and no pericardial effusion (Video 2).

DISCUSSION

Transcatheter MV repair with the MC device has emerged as a viable and minimally invasive procedure for the management of symptomatic severe MR. Recent studies have proven its safety and effectiveness as an alternative to an open surgical approach for the repair of moderate to severe or severe MR in high-risk patients, including patients with heart failure (1,2). Since its approval by the U.S. Food and Drug Administration in 2013, subsequent analysis of the MC system continues to show a favorable safety profile and better clinical outcomes in the current era.

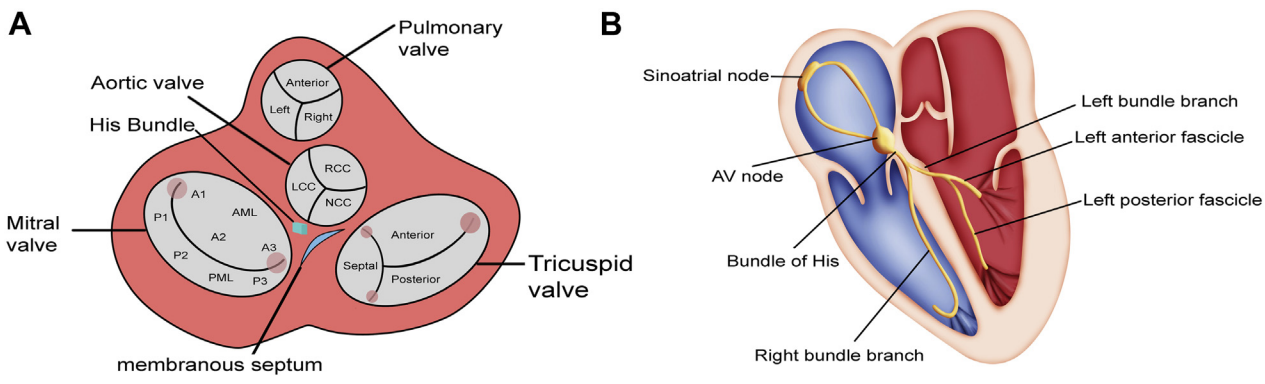
Most published data on the outcomes and safety of the MC procedure originate from outside North America (3). In a prominent study, data from the multicenter TRAMI (TRAnscatheter Mitral valve Interventions) registry were analyzed to assess in-hospital procedural complications in a cohort of 828 patients undergoing MC implantation in Germany (4). The most common major adverse event related to the procedure was bleeding requiring transfusion, occurring in 7.4% of patients, whereas pericardial tamponade occurred in only 1.9% of patients (4). Clip-specific complications occurred at much lower rates; these included partial clip detachment (2%) and thrombus formation on the clip (0.1%) (4). Conduction abnormalities are not a known complication of MC implantation (5).

FIGURE 3 **Post-Procedural Heart Block and Pacing**



(A) Complete heart block with atrial activity **(solid arrows)** and no ventricular escape following crossing of the mitral valve with a MitraClip NTR device (Abbott Vascular, Inc., SantaClara, California). **(B)** Temporary right ventricular pacing **(dashed arrows)**. **(C)** Permanent selective left bundle branch pacing **(dotted arrows)**.

FIGURE 4 **Relevant Anatomic Features**



(A) Short-axis view of the mitral valve in relation to the conduction system. **(B)** Relationship of conduction tissue to the aortic and mitral valves. AML = anterior mitral leaflet; LCC = left coronary cusp; NCC = noncoronary cusp; PML = posterior mitral leaflet; RCC = right coronary cusp.

Eggebrecht et al. (4) reported a 0.2% rate of new pacemaker implantation following MC procedures; however, the reason for the pacemaker was not provided. Notably, pacemaker implantation was not reported in several other studies assessing MC complications. (3,5). Similarly, complete AV block is uncommon following surgical MV repair. A previous study of 115 consecutive patients who underwent surgical MV repair found that 7 (6%) patients developed complete AV block in the immediate postoperative period; 4 of these cases were transient, and the patients recovered before discharge, and 3 were permanent and required permanent pacing (6). There were no independent predictors found for the incidence of AV block following surgery, but AV node stunning during cardioplegic arrest and damage to the AV node artery because it courses near the posterolateral part of the MV annulus were identified as potential causes (6,7)

We report a rare case of AV block complicating MC implantation. The presumed mechanism of AV block was likely mechanical trauma to the left posterior fascicle—the only remaining fascicle—given the proximity of the MC-targeted A2-P2 segments (near the A3 and P3 scallops of the MV) to the conduction system in a small LV cavity (**Figures 4A and 4B**). To the best of our knowledge, there has been only 1 case of complete AV block reported following a different percutaneous MV repair device: Cardioband (Valtech Cardio, Edwards Lifesciences, Irvine, California) (8). The Cardioband is an adjustable, sutureless posterior annuloplasty band designed to reduce the septolateral annular diameter (9). Similar to the MC device, it is delivered through a transvenous, transeptal route, but it requires the insertion of nitinol screws into the atrial aspect of the mitral annulus in a commissure-to-commissure fashion and cinching of the implant to reduce annular dimensions (9). Sorini Dini et al. (8) reported a case of delayed development of complete AV block following Cardioband implantation in a patient with underlying right bundle branch block and left anterior fascicular block (similar to our patient). These investigators proposed that this delayed complication was a result of pressure exerted during cardiac contraction that caused damage to the conduction system around the screws, particularly around the posteromedial junction (8). Although this case was procedurally different from MC implantation, the mechanism of conduction damage in the current case is likely similar given our patient's small LV cavity and the proximity of instrumentation to the posteromedial commissure, which lies close to the AV conduction system (**Figures 4A and 4B**, Supplemental Figure 1).

FOLLOW-UP

The patient was discharged on post-operative day 1, and there was no evidence of AV conduction recovery on day 7 clinic follow-up. The persistence of a conduction defect suggests true structural damage to the left posterior fascicle (in the presence of pre-existing right bundle branch block and left anterior fascicular block) related to the procedure rather than a reversible cause, as would be expected from a complication related to general anesthesia.

CONCLUSIONS

As the use of transcatheter MV therapy becomes more widespread, it is important to anticipate the potential for complications related to the conduction system, especially in patients with underlying conduction disease, as has been the cautious approach for transcatheter aortic valve implantation. Identification of such patients will allow for better preparation for emergency temporary pacing intraoperatively and monitoring in an intensive cardiac unit for a longer time. At our institution, prolonged electrocardiographic monitoring with an ambulatory event monitor is routinely implemented following transcatheter aortic valve implantation. In these high-risk patients undergoing MC implantation who do not have conduction abnormalities intraoperatively, a similar approach may be of clinical utility. However, additional data on long-term outcomes are needed to confirm these suggestions.

FUNDING SUPPORT AND AUTHOR DISCLOSURES

The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

ADDRESS FOR CORRESPONDENCE: Dr. Abdul Hakeem, Division of Cardiovascular Diseases and Hypertension, Rutgers Robert Wood Johnson Medical School, 125 Paterson Street, MEB 578B, New Brunswick, New Jersey 08903, USA. E-mail: ahakeem@gmail.com.

REFERENCES

1. Mauri L, Garg P, Massaro JM, et al. The EVEREST II trial: design and rationale for a randomized study of the evalve MitraClip system compared with mitral valve surgery for mitral regurgitation. Am Heart J 2010;160:23–9.

2. Stone GW, Lindenfeld J, Abraham WT, et al. Transcatheter mitral-valve repair in patients with heart failure. N Engl J Med 2018;379:2307–18.

3. Ailawadi G, Lim DS, Mack MJ, et al. One-year outcomes after MitraClip for functional mitral regurgitation. Circulation 2019;139:37–47.

4. Eggebrecht H, Schelle S, Puls M, et al. Risk and outcomes of complications during and after MitraClip implantation: experience in 828 patients from the German TRAnscatheter Mitral valve Interventions (TRAMI) registry. Catheter Cardiovasc Interv 2015;86:728–35.

5. Gheorghe L, Ielasi A, Rensing BJWM, et al. Complications following percutaneous mitral valve repair. Front Cardiovasc Med 2019;6:146.

6. Meimoun P, Zeghdi R, D'Attelis N, et al. Frequency, predictors, and consequences of atrioventricular block after mitral valve repair. Am J Cardiol 2002;89:1062–6.

7. Berdajs D, Schurr UP, Wagner A, Seifert B, Turina MI, Genoni M. Incidence and pathophysiology of atrioventricular block following mitral valve replacement and ring annuloplasty. Eur J Cardiothorac Surg 2008;34:55–61.

8. Sorini Dini C, Landi D, Meucci F, Di Mario C. Unexpected delayed complete atrioventricular block after Cardioband implantation. Catheter Cardiovasc Interv 2018;92:1201–4.

9. Testa L, Latib A, Montone RA, Bedogni F. Transcatheter mitral valve regurgitation treatment: state of the art and a glimpse to the future. J Thorac Cardiovasc Surg 2016;152:319–27.

KEY WORDS cardiac pacemaker, complication, mitral valve

APPENDIX For supplemental videos and a figure, please see the online version of this paper.