Successful MitraClip Implantation in a Barlow's Valve: A Feasible Alternative?

Brian P. Kelley, MD, Casey Gazda, MD, Joseph A. Sivak, MD, John P. Vavalle, MD, and Thelsa T. Weickert, MD, *Chapel Hill, North Carolina*

INTRODUCTION

Mitral regurgitation (MR) represents one of the most common valvular lesions, affecting more than 2 million people in the United States.[1] It can be classified into primary MR and secondary (or functional) MR. Degenerative mitral valve (MV) disease is among the etiologies of primary MR and encompasses two related, yet distinct, phenotypes—fibroelastic deficiency and Barlow's disease.[2] The latter is characterized by redundant valvular tissue and excess leaflet billowing motion. These hallmark features of Barlow's valves make for a challenging surgical repair and are classically not considered feasible for transcatheter MV repair (TMVr) using MitraClip (Abbott Vascular, Abbott Park, IL).

Transcatheter MV repair with the MitraClip system first received FDA approval in the United States in 2013 for use in patients with primary MR and persistent heart failure symptoms despite medical therapy who were at prohibitive surgical risk.[3] Based on the surgical Alfieri edge-to-edge repair, the procedure involves the utilization of a cobalt-chromium clip covered with a polypropylene fabric that grasps both the anterior and posterior MV leaflets to increase the coaptation between the regurgitant valve leaflets, thereby reducing the degree of MR.[2] Depending on the degree of valve degeneration and valve anatomy, multiple clips may be required to adequately reduce the MR severity.

Despite increasing popularity and expanded FDA approved indications, as well as improved success with procedural experience, MitraClip continues to be considered less favorable than surgical repair due to the complex anatomy associated with a Barlow's valve.

We describe a case of severe MR secondary to Barlow's disease and concomitant systolic anterior motion (SAM) that was managed with the MitraClip NTR device system with the use of a single clip. To the best of our knowledge, this is the first case description of Barlow's disease complicated by SAM and severe MR to be effectively treated with a single MitraClip.

CASE PRESENTATION

A 62-year-old man with a past medical history of atrial fibrillation, tachy-brady syndrome status post-dual-chamber pacemaker, degenerative MV disease, and reported amiodarone-induced cirrhosis presented to an outside hospital with an episode of atrial fibrillation with rapid ventricular response and progressive dyspnea on exertion. He was not on anticoagulation due to a history of gastrointestinal bleeding. The patient had known MV prolapse complicated by severe MR. He had recurrent hospitalizations related to atrial fibrillation and endorsed New York Heart Association class III symptoms despite medical therapy.

A transesophageal echocardiogram (TEE) performed at the outside hospital revealed severe prolapse of the posterior MV leaflet (7 mm above the annular plane) with severe MR. There was also evidence of basal septal hypertrophy, measuring approximately 1.6 cm. However, there was no evidence of significant LV outflow tract (LVOT) obstruction noted. Although initially scheduled for surgical MV repair and Maze procedure, he was later deemed too high risk for surgery, largely due to his history of cirrhosis and perioperative bleeding risk. The patient was subsequently transferred to our facility to undergo evaluation for TMVr with MitraClip.

His vital signs on arrival included a temperature of 36.5°C, blood pressure 113/49 mm Hg, heart rate 69 beats per minute, and oxygen saturation 95% while breathing ambient air. Physical exam was notable for a holosystolic murmur heard loudest at the apex. His laboratory studies were notable for a hemoglobin of 9.7 g/dL and platelet count of 105,000/mm^3. The remainder of his renal and hepatic

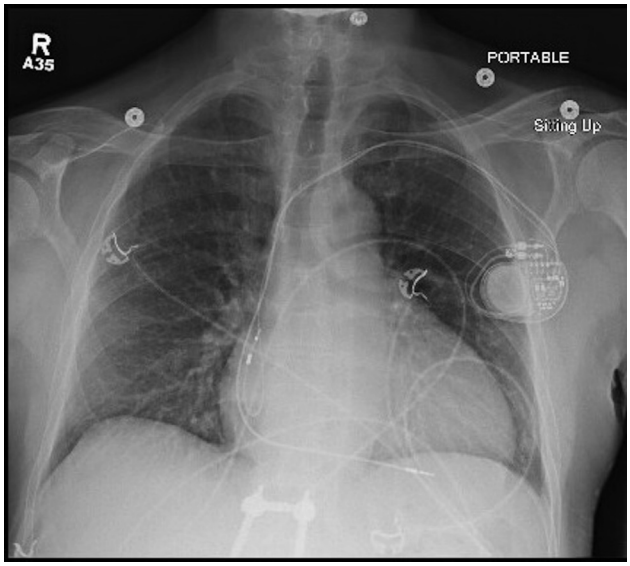

Figure 1 Chest x-ray demonstrating mild cardiomegaly with a dual-chamber pacemaker but otherwise radiographically clear lung fields.

From the Department of Medicine (B.P.K.) and Division of Cardiology (C.G., J.A.S., J.P.V., T.T.W.), University of North Carolina Hospitals, Chapel Hill, North Carolina.

Keywords: Transcatheter mitral valve repair, MitraClip, Barlow's disease, Mitral regurgitation, Systolic anterior motion

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflicts of Interest: The authors reported no actual or potential conflicts of interest relative to this document.

2468-6441

https://doi.org/10.1016/j.case.2020.10.011

VIDEO HIGHLIGHTS

Video 1: Intraoperative TEE demonstrating moderately thickened, redundant MV leaflets with posterior leaflet prolapse as well as SAM and resultant severe MR.

Video 2: Postoperative TEE showing a well-positioned clip with significant reduction of the MR to trace (1+).

View the video content online at www.cvcasejournal.com.

function labs were within normal limits. His troponin and pro-brain natriuretic peptide levels were not elevated. His chest x-ray revealed mild cardiomegaly, a dual-chamber pacemaker, and radiographically clear lungs (Figure 1). His electrocardiogram showed an atrial-paced rhythm (Figure 2). Given his significant heart failure symptoms and lack of MV surgical repair as an option, the decision was made to pursue percutaneous repair of the valve with the MitraClip NTR device system.

Intraoperative TEE demonstrated moderately thickened, redundant MV leaflets with severe posterior leaflet prolapse consistent with Barlow's disease, as well as SAM of the anterior MV leaflet and resultant severe MR (Figure 3, Video 1). The annulus was enlarged and dilated with a three-dimensional valve area >8 cm^2 and intercommissural distance of 4.6 cm. There was at least some degree of aliasing encountered on pulsed-wave Doppler. However, there was no evidence of significant LVOT obstruction noted with a peak LVOT velocity of approximately 1.3 m/sec (Figure 4).

With TEE guidance, the MitraClip was advanced into the left ventricle and bileaflet capture was performed with the first grasp attempt. Successful capture of both leaflets was confirmed on TEE, and the clip was deployed. Significant reduction of the mitral insufficiency to trace (1+) was noted postdeployment (Figure 5, Video 2). Postoperative TEE showed a well-positioned clip with a mean MV gradient of 2 mm Hg. The patient tolerated the procedure well and reported significant symptomatic improvement. Transthoracic echocardiogram the day after the procedure revealed mild residual MR and no significant LVOT gradient (Figure 6).

DISCUSSION

Barlow's disease represents a type of MV degeneration characterized by excessive myxomatous tissue. It was first described in the 1960s by Dr. John B. Barlow who investigated the relationship between apical murmurs associated with mid-late systolic clicks and MV pathology.[4] Since then, the Barlow's valve has been further affiliated with pronounced annular dilatation, accentuation of annulus saddle shape, bileaflet prolapse and/or billowing, elongated chordae, and the presence of thick, spongy leaflets.[5,6] Although surgery has been the gold standard when repair is indicated, it is still regarded as particularly challenging due to this anatomy.

For those at prohibitive surgical risk due to the presence of comorbidities, such as severe liver disease with a history of gastrointestinal bleeding episodes in our patient, the development of TMVr has become an alternative to surgery over recent years.[7] Of the TMVr devices, MitraClip is currently the only one that is FDA approved in the United States.[2] Coaptation is improved by grasping the leading edges of the leaflets and bringing them closer together. However, the anatomical challenges associated with Barlow's disease have rendered MitraClip a less favored option relative to surgical repair, which remains the default approach in the management of those with severe MR.

Systolic anterior motion, which refers to the dynamic movement of the anterior MV leaflet into the LVOT during systole, is commonly

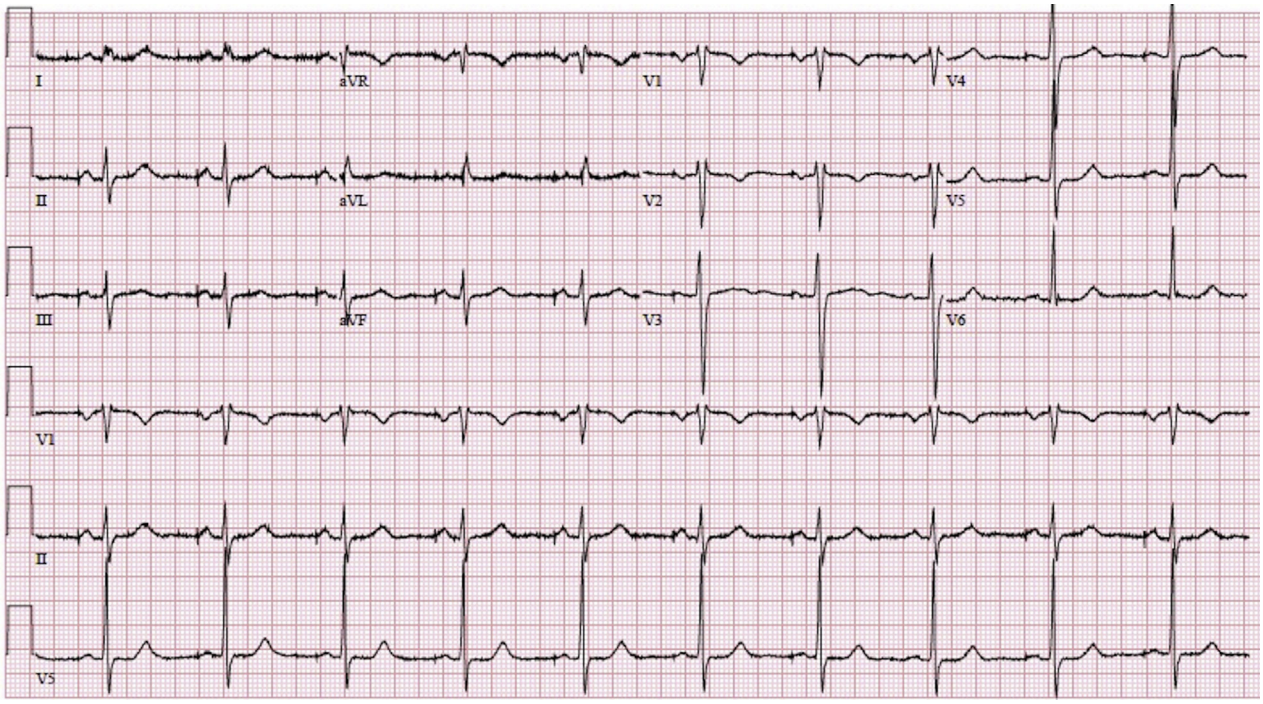

Figure 2 ECG showing an atrial-paced rhythm at 61 beats per minute.

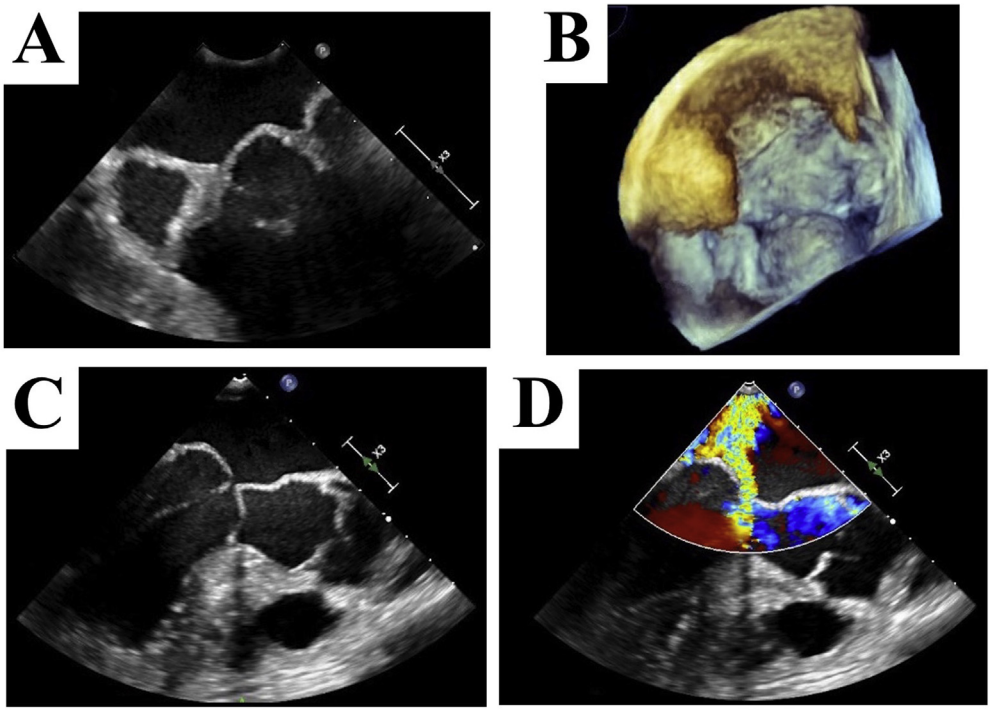

Figure 3 Pre-MitraClip TEE. Midesophageal four-chamber view at 0° **(A)**, three-dimensional surgeon's view **(B)**, and midesophageal long-axis view and color Doppler at 145° **(C, D)** demonstrating Barlow's MV disease, severe posterior leaflet prolapse, SAM, and severe MR.

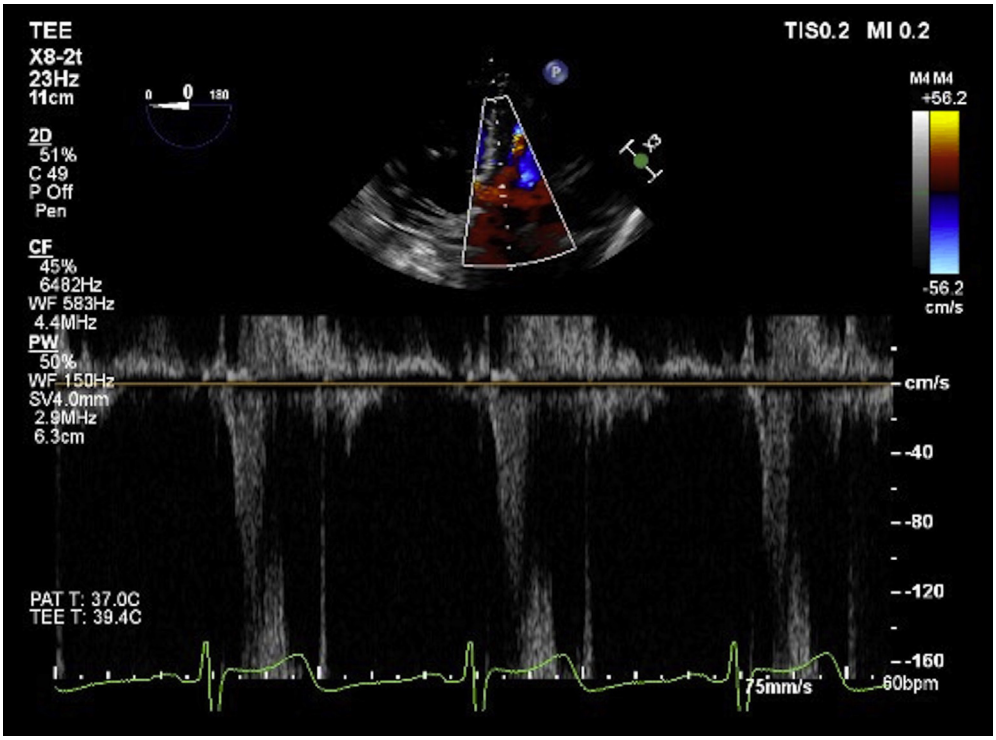

Figure 4 Pulsed-wave Doppler showing a peak LVOT velocity of approximately 1.3 m/sec but limited by aliasing.

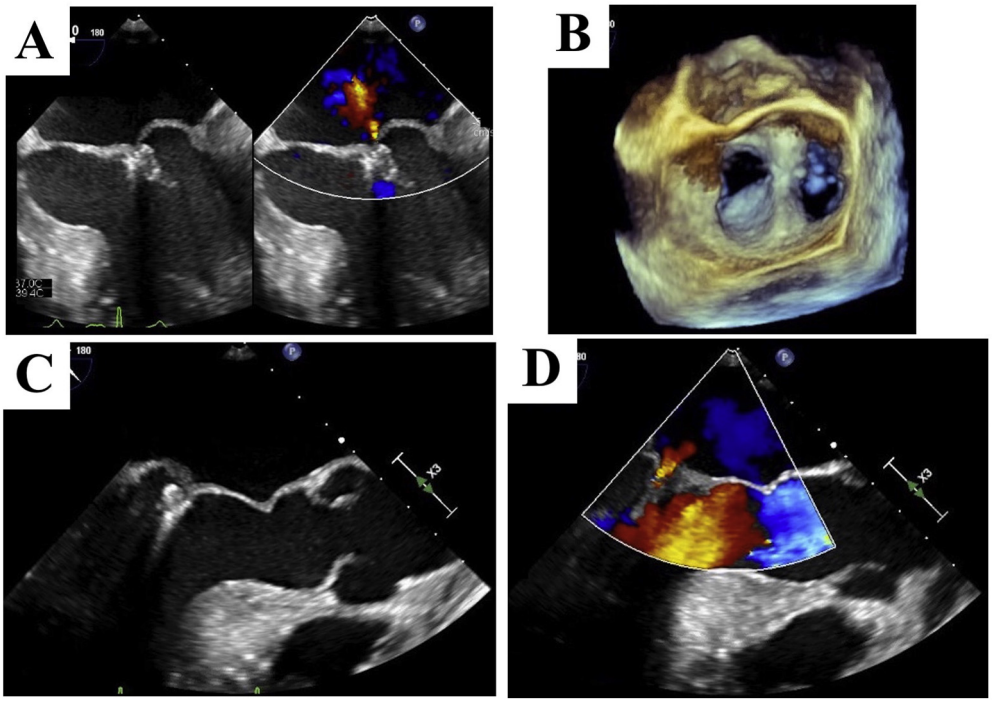

Figure 5 Post-MitraClip TEE. Midesophageal four-chamber view at 0° **(A)**, three-dimensional surgeon's view **(B)**, and midesophageal long-axis view and color Doppler at 135° **(C, D)** demonstrating resolution of SAM and MR with a single clip in the A2-P2 position.

associated with asymmetric basal septal hypertrophy such as seen in hypertrophic cardiomyopathy.[8] The patient had evidence of isolated basal septal hypertrophy with a sigmoid septum. The selective and asymmetric hypertrophy of this segment results in narrowing of the subaortic channel, which is further narrowed by the Venturi effect (given the redundancy of the leaflets in Barlow's disease).[9] This results in suctioning of the anterior leaflet and is manifested by SAM of the MV. The mechanisms by which it arises are complex and incompletely understood, but it has been shown to occur in 9%-11% of patients with Barlow's disease after surgical MV repair, possibly related to leaflet elongation.[10,11] It has an association with hypertrophic obstructive cardiomyopathy due to the MV being more susceptible to positioning within the LVOT. Wong *et al.*[12] report the effectiveness of MitraClip in the management of MR and SAM in the setting of hypertrophic obstructive cardiomyopathy. Despite the isolated basal septal hypertrophy and marked SAM of the MV, the patient was not noted

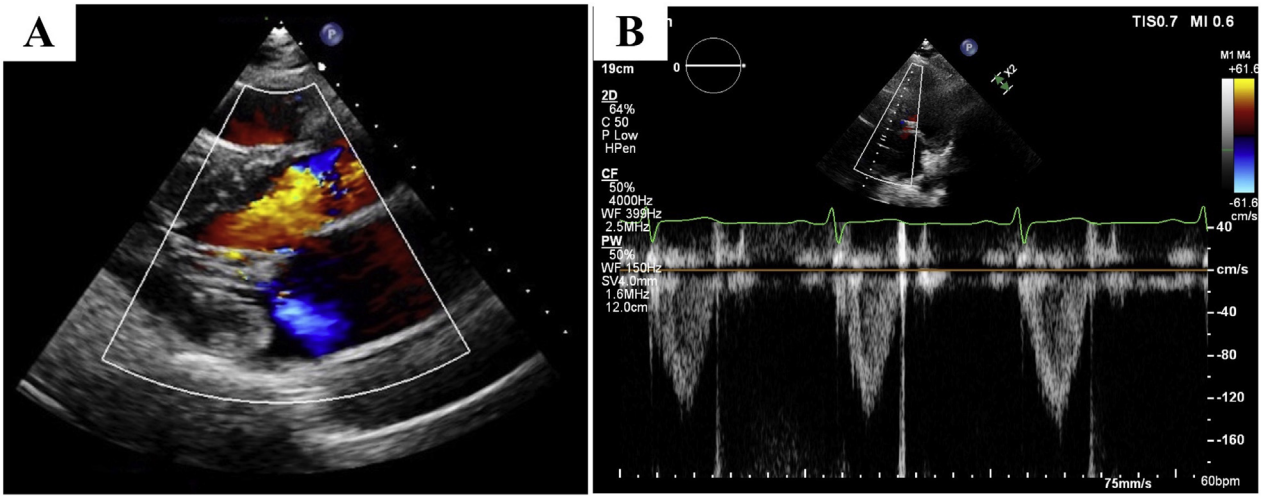

Figure 6 Post-MitraClip TTE. Color Doppler over the MV in the parasternal long-axis view **(A)** and continuous wave spectral Doppler in the apical four-chamber view **(B)** showing mild residual MR and no significant LVOT obstruction.

to have significant LVOT obstruction. Therefore, septal reduction therapy (e.g., alcohol septal ablation) was not considered in our patient.

We believe our experience in the use of a single clip to effectively treat SAM and severe MR in a Barlow's valve is unique. On review of the literature, there are a few cases described in which MitraClip has been attempted for this valvulopathy, all of which involved patients with a challenging MV anatomy and required multiple clips.[13-15] Since this was a case of a Barlow's valve, we had expected the possibility of needing multiple clips to help eliminate the MR. However, during the procedure it was noted that the regurgitation was mainly being driven by the SAM of the MV. Hence, a single clip was able to eliminate the SAM and markedly improve the degree of MR. This emphasizes the point that a careful preprocedural assessment as to the factors that are contributing to the regurgitation can help predict the need for a single clip versus multiple clips.

CONCLUSION

Transcatheter MV repair with MitraClip has been established as a safe and effective option for the treatment of both primary and secondary MR in patients at prohibitive surgical risk due to comorbidities, although patients with Barlow's disease have generally not been considered favorable candidates for the MitraClip procedure. Our case highlights the importance of identifying SAM and recognizing the role it plays in MR, even in the severely degenerative valves seen in Barlow's disease. Our experience in this case suggests that MitraClip may be an effective option in the management of Barlow's disease when SAM is present, as the SAM may be the main driver of MR.

SUPPLEMENTARY DATA

Supplementary data related to this article can be found at https://doi.org/10.1016/j.case.2020.10.011.

REFERENCES

1. Enriquez-Sarano M, Akins CW, Vahanian A. Mitral regurgitation. Lancet 2009;373:1382-94.
2. Herrmann HC, Maisano F. Transcatheter therapy of mitral regurgitation. Circulation 2014;130:1712-22.
3. Glower DD, Kar S, Trento A, Lim DS, Bajwa T, Quesada R, et al. Percutaneous mitral valve repair for mitral regurgitation in high-risk patients: results of the EVEREST II study. J Am Coll Cardiol 2014;64:172-81.
4. Barlow JB, Pocock WA, Marchand P, Denny DM. The significance of late systolic murmurs. Am Heart J 1963;66:443-52.
5. Antoine C, Mantovani F, Benfari G, Mankad SV, Maalouf JF, Michelena HI, et al. Pathophysiology of degenerative mitral regurgitation: New 3-dimensional imaging insights. Circ Cardiovasc Imaging 2018;11:e005971.
6. Lawrie GM. Barlow disease: simple and complex. J Thorac Cardiovasc Surg 2015;150:1078-81.
7. Catalan FC, Alora PA, Garcia MG, Miranda A, Co-Sia M, Dy T. Percutaneous mitral valve repair of mitral valve prolapse using Mitraclip. Cardiovasc Disord Med 2017;2:1-4.
8. Raut M, Maheshwari A, Swain B. Awareness of "systolic anterior motion" in different conditions. Clin Med Insights Cardiol 2018;12:1-2.
9. Nagueh SF, Bierig SM, Budoff MJ, Desai M, Dilsizian V, Eidem B, et al. American Society of Echocardiography clinical recommendations for multimodality cardiovascular imaging of patients with hypertrophic cardiomyopathy. J Am Soc Echocardiogr 2011;24:473-98.
10. Agricola E, Maurizio T, Marini C, Montorfano M, Godino C, Alfieri O, et al. First-in-man MitraClip implantation to treat late postoperative systolic anterior motion. Circ Cardiovasc Interv 2014;7:860-2.
11. Levine RA, Schwammenthal E, Song JK. Diastolic leading to systolic anterior motion: New technology reveals physiology. J Am Coll Cardiol 2014;64:1996-9.
12. Wong N, Hamid N, Tang HC, Yeo KK. Killing two birds with one stone—MitraClip for flail P2 and systolic anterior motion of mitral valve: a case report mitral valve: a case report. Eur Heart J Case Rep 2018;2:1-5.
13. Lee CW, Sung SH, Huang WM, Tsai YL, Hsu CP, Shih CC. Clipping Barlow's mitral valve to rescue a patient with acute biventricular failure. AsiaIntervention 2019;5:64-76.
14. Singh GD, Smith TW, Rogers JH. Multi-MitraClip therapy for severe degenerative mitral regurgitation: "Anchor" technique for extremely flail segments. Catheter Cardiovasc Interv 2015;86:339-46.
15. Capretti G, Agricola E, Montorfano M, Chieffo A. A complex valve anatomy for Mitraclip: forme fruste of Barlow's disease with cleft. Cardiol J 2018;25:416.