MitraClip Implantation for the Treatment of New-Onset Systolic Anterior Motion of the Mitral Valve After Transcatheter Aortic Valve Replacement

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New-onset systolic anterior motion of the anterior mitral valve leaflet in patients undergoing transcatheter aortic valve replacement is a rare pathophysiologic mechanism leading to postprocedural development of mitral regurgitation and, eventually, left ventricular outflow obstruction. We report the first human case of successful MitraClip implantation to treat new-onset systolic anterior motion of the mitral valve after transcatheter aortic valve replacement causing severe obstruction to left ventricular outflow that was unresponsive to standard medical therapy.

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Systolic anterior motion (SAM) of the anterior mitral valve leaflet after surgical aortic valve replacement has been reported previously in the literature [1]. New-onset SAM has been also described in patients undergoing transcatheter aortic valve replacement (TAVR), representing a rare (2 cases in 129 patients [1.6%]) but not negligible pathophysiologic mechanism leading to significant degree of postprocedural mitral regurgitation (MR) and left ventricular outflow tract (LVOT) obstruction [2]. We report the first human case of severe LVOT obstruction after TAVR that was unresponsive to standard medical therapy and was treated effectively with percutaneous edge-to-edge mitral valve repair using the MitraClip system (Abbott Vascular, Santa Clara, CA).

A 77-year-old woman with severe symptomatic aortic stenosis in New York Heart Association (NYHA) functional class III, affected by polycythemia vera under oncocarbide therapy and with a previous retinal vein thrombosis event, was referred to our institution for treatment. Despite an intermediate- to low-risk profile according to conventional surgical risk score (Society of Thoracic Surgeons score mortality of 2.7%), the patient was declined by the surgical team because of the high risk of thrombosis and bleeding events in the presence of polycythemia vera.

The baseline transthoracic echocardiogram confirmed the presence of severe aortic stenosis (peak gradient and mean gradient of 114 and 70 mm Hg, respectively) with preserved left ventricular (LV) function, small LV systolic dimensions (22 mm), severe concentric LV hypertrophy (diastolic inter-ventricular septum and posterior wall diameters of 18 of 15 mm, respectively), severe mitral annular calcification, thickened mitral leaflets causing mild mitral stenosis (mean gradient 6 mm Hg, mitral valve area by three-dimensional echo of 3.4 cm^2) and mild regurgitation. Despite a small LV cavity and severe septal hypertrophy, no intraventricular gradient and SAM of the anterior mitral leaflet were recorded.

According to the heart team decision, the patient underwent uncomplicated transfemoral TAVR with a 29-mm Evolut-R (Medtronic, Minneapolis, MN), post-dilated with a 28/40 mm Nucleus balloon (Numed Canada, Cornwall, Ontario, Canada; Fig 1). The angiography confirmed proper valve position and mild paravalvular leak. The postprocedural echocardiogram, performed 2 h after TAVR, showed good prosthesis performance (correct leaflet motion and mild para-valvular leak) with new onset of SAM causing severe dynamic LVOT obstruction (peak gradient = 98 mm Hg; Fig 2A) and concomitant severe MR. These findings were confirmed during subsequent transesophageal echocardiographic examination (Fig 2B). Despite optimized medical therapy (titrated β-blocker and closely monitored hydration), LVOT obstruction was unchanged with the patient experiencing recurrent episodes of pulmonary edema. The heart team reassessed the patient, and MitraClip implantation appeared to be a reasonable and feasible bailout approach to counteract SAM while reducing the MR grade and LVOT obstruction.

At day 14, the patient underwent MitraClip implantation using the regular setup (general anesthesia with transesophageal echocardiographic guidance). The clip was deployed in A2-P2 position in a nonstandard fashion. Maintaining the clip opened into the LV, the anterior leaflet was dragged toward the posterior leaflet, and grasping was performed as close as possible in proximity of the posterior mitral annulus with the goal of stabilizing the leaflet and keeping it away from the LVOT (Fig 2C–E). The intraoperative echocardiogram showed disappearance of SAM, LVOT obstruction, and intraventricular gradient with mild residual MR. The device was

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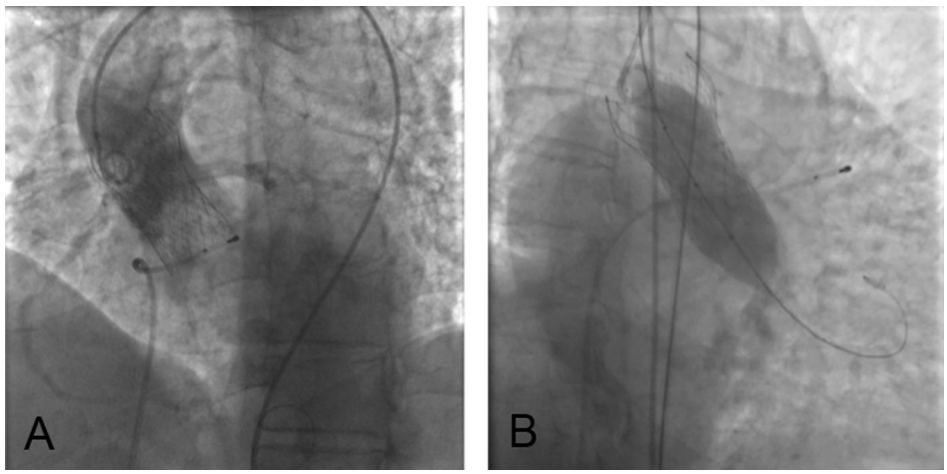

Fig 1. Transcatheter aortic valve replacement procedure. (A) Evolut-R implantation. (B) Postdilation of the valve.

successfully released after a careful assessment of transmitral valve gradients. The aortic prosthesis did not interfere with grasping and clip release maneuvers. The postoperative course was uneventful, and the patient was discharged home the following day in good hemodynamic compensation.

At 1-month follow-up, the patient was asymptomatic (NYHA class I), and the transthoracic echocardiogram confirmed the absence of SAM, the presence of mild aortic paravalvular leak, mild residual MR (mitral valve area by three-dimensional echo of 2.5 cm^2 and mean gradient of 7 mm Hg), and no evidence of LVOT obstruction (Fig 2F).

Comment

Mechanisms leading to SAM with severe LVOT obstruction after TAVR are complex and partially

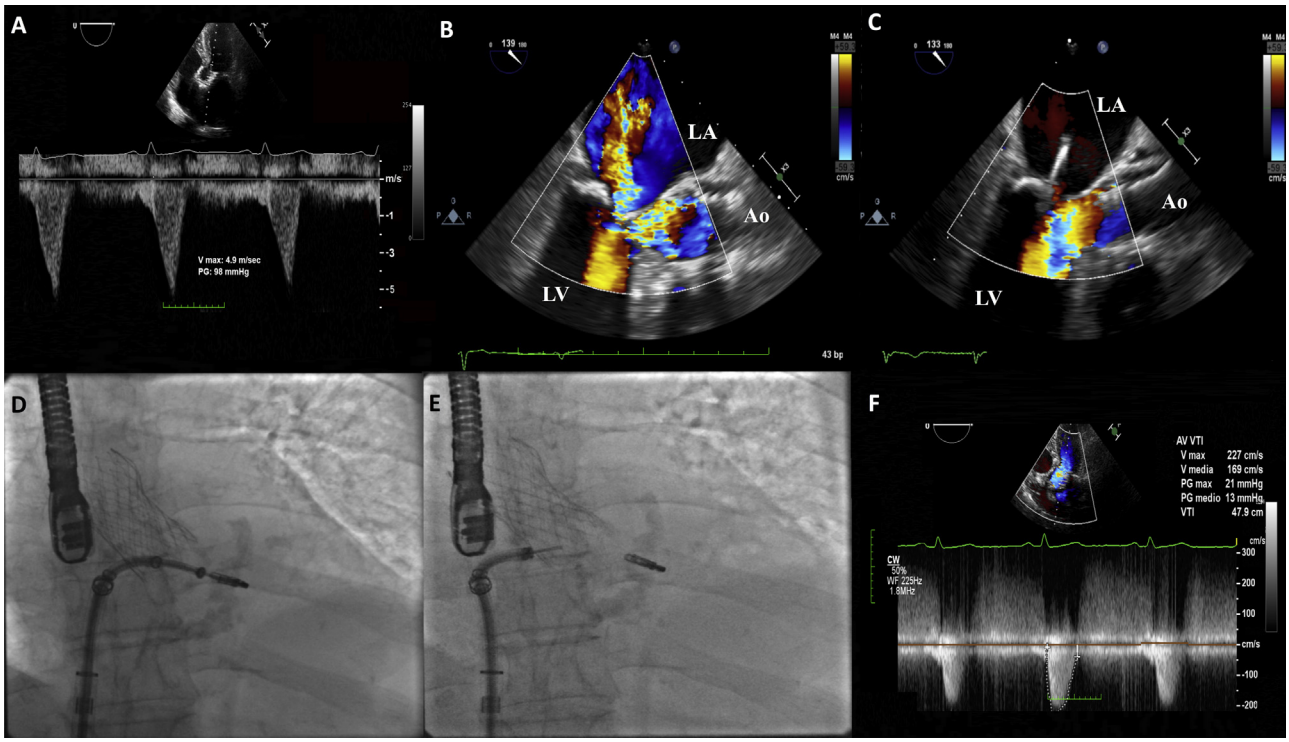

Fig 2. (A) Severe dynamic LV outflow tract obstruction (B) Severe mitral regurgitation with eccentric jet owing to systolic anterior motion (SAM) of the anterior mitral valve leaflet. (C) Successful grasping of mitral valve leaflets with disappearance of SAM (D, E) final grasping maneuvers and release of one single clip. (F) Doppler echocardiography showing low systolic velocities with absence of significant intraventricular gradients. (Ao = aorta; LA = left atrium; LV = left ventricle.)

understood. Severe aortic stenosis imposes a significant afterload to the LV that is counteracted by increased LV intraventricular pressures to keep adequate forward stroke volume. High pressures in the LVOT avoid excessive septal inward motion while keeping the LVOT unobstructed. Following relief of the obstruction with aortic valve replacement, LVOT pressure drops with consequent reduction in LVOT cross-sectional area and local decrease in pressure because of higher blood flow velocities (Bernulli's theorem). This mechanism creates a pressure gradient between the left atrium and the LVOT and pushes the anterior mitral leaflet toward the LVOT, thus creating LV outflow obstruction. Mitral valve anatomy (depth of the anterior mitral leaflet, abnormal tension of the chordae tendineae, calcification of the mitral annulus) and hemodynamic balance (filling state, LV contractility, and systemic vascular resistance) are additional factors that determine the final degree and severity of obstruction.

Previous experience with MitraClip therapy to counteract SAM-induced LVOT obstruction has been reported in patients affected by hypertrophic obstructive cardiomyopathy [3]. In this group of patients, MitraClip has effectively reduced SAM and the degree of LVOT obstruction while improving clinical symptoms. In addition, Agricola and colleagues [4] also showed that MitraClip implantation could be an effective therapeutic strategy for the treatment of late postoperative SAM after surgical mitral valve repair.

In this particular case, MitraClip implantation was attempted despite a preoperative mitral valve area of 3.4 cm^2 (less than actually recommended preoperative area $\geq$ 4 cm^2). However, this was a bailout approach, and a careful monitoring of mitral valve gradients during grasping maneuvers was performed to avoid clip deployment in the presence of a sudden increase of transmitral gradients. Moreover, the A2-P2 position was deemed appropriate because SAM disappeared completely after grasping. In the authors' opinion, there is not an ideal positioning of the clip, but the procedural approach should be tailored to obtain SAM resolution.

To the best of our knowledge, this is the first human case description of severe LVOT obstruction after TAVR secondary to new-onset SAM that was effectively treated with MitraClip implantation. In view of the expanding field and growing indications of TAVR, this rare complication could be encountered more frequently in clinical practice. In this clinical scenario, MitraClip implantation could represent a safe and effective therapeutic option.

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