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Mitral Valve-in-Ring in a Patient with Medtronic Profile 3D Complete Rigid Ring

INTRODUCTION

Mitral valve-in-ring (MVIR) procedure through a complete rigid annuloplasty ring presents significant challenges due to its inflexible, saddle-shaped structure, which complicates valve alignment and positioning. This case report discusses the challenges and outcomes in such a patient, highlighting the technical considerations and associated risks.

CASE REPORT

A 62-year-old female with severe mitral regurgitation, previously treated in 2020 via minimally invasive mitral annuloplasty using a 32 mm Medtronic Profile 3D complete rigid ring, presented with progressive exertional dyspnea. Transthoracic and transesophageal echocardiography (TEE) revealed central grade 3 mitral regurgitation and a decline in left ventricular ejection fraction (LVEF) from 35% preoperatively to 25% (Video 1). Given her high surgical risk, the multidisciplinary heart team opted for a percutaneous MVIR approach, despite the challenges posed by the rigid ring's structure.

Preprocedural cardiac computed tomography (CT) angiography assessed ring geometry and predicted valve positioning. The neo-left ventricular outflow tract (neo-LVOT) area at 45% systole with a 29 mm virtual valve was 628.9 mm^2 (Figure 1). Under general anesthesia and TEE guidance, a transseptal approach was performed. A Myval 29 mm valve (inflated with an additional 2 cc volume) was selected based on preprocedural sizing (Figure 2, Video 2). Implantation required precise positioning to minimize risks: atrial over-positioning could lead to increased transvalvular gradients, while excessive ventricular positioning risked embolization or paravalvular regurgitation. To address this, fluoroscopic and TEE co-registration was used to determine the optimal depth and coaxiality before deployment. Particular attention was paid to the ring's asymmetric saddle shape during orientation; the delivery system was manipulated to achieve perpendicular alignment with the plane of the mitral ring by rotating and slightly withdrawing the catheter to reduce parallax. The valve was deployed in a stepwise fashion under rapid pacing, and the balloon inflation was deliberately slow and gradual to allow the prosthesis to conform to the non-circular ring anatomy while minimizing the risk of displacement. The atrial edge of the Myval valve was aligned with the anterior curvature of the Medtronic Profile 3D ring, which features a 25% elevation.

Post-implantation evaluation showed the valve adapted to the saddle-shaped ring rather than retaining a circular shape. Despite this, valve apposition was satisfactory, with no LVOT obstruction or paravalvular leak (Figure 3, Video 3). Intraoperative TEE showed a mean transvalvular gradient of 3 mmHg and mild, eccentric central mitral regurgitation, likely due to leaflet pinwheeling from under-expansion (Video 4). At 3-month follow-up, LVEF remained at 25%, but the patient reported significantly improved exercise tolerance.

CASE REPORT

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Figure 1. Pre-procedural computed tomography angiography evaluation showing the neo-left ventricular outflow tract (neo-LVOT) at 29 mm virtual valve with 45% systolic (A) and 75% diastolic (B) area.

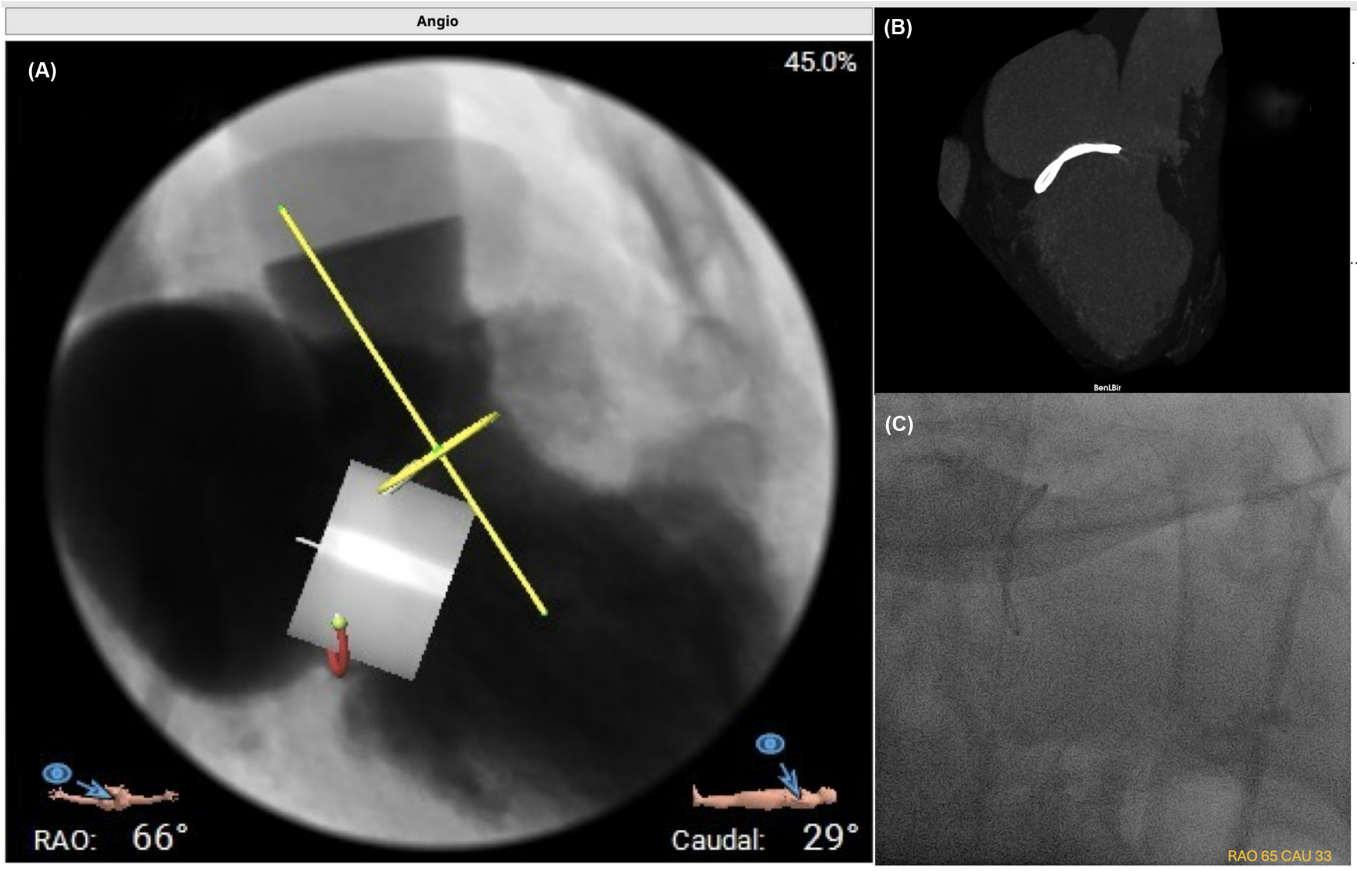


Figure 2. The optimal implantation angle (with the ring viewed in profile) is determined as advanced right caudal based on pre-procedural computed tomography angiography evaluation (A), computed tomography angiography 3D Maximum Intensity Projection (MIP) assessment (B), and fluoroscopy (C), demonstrating consistency across modalities.

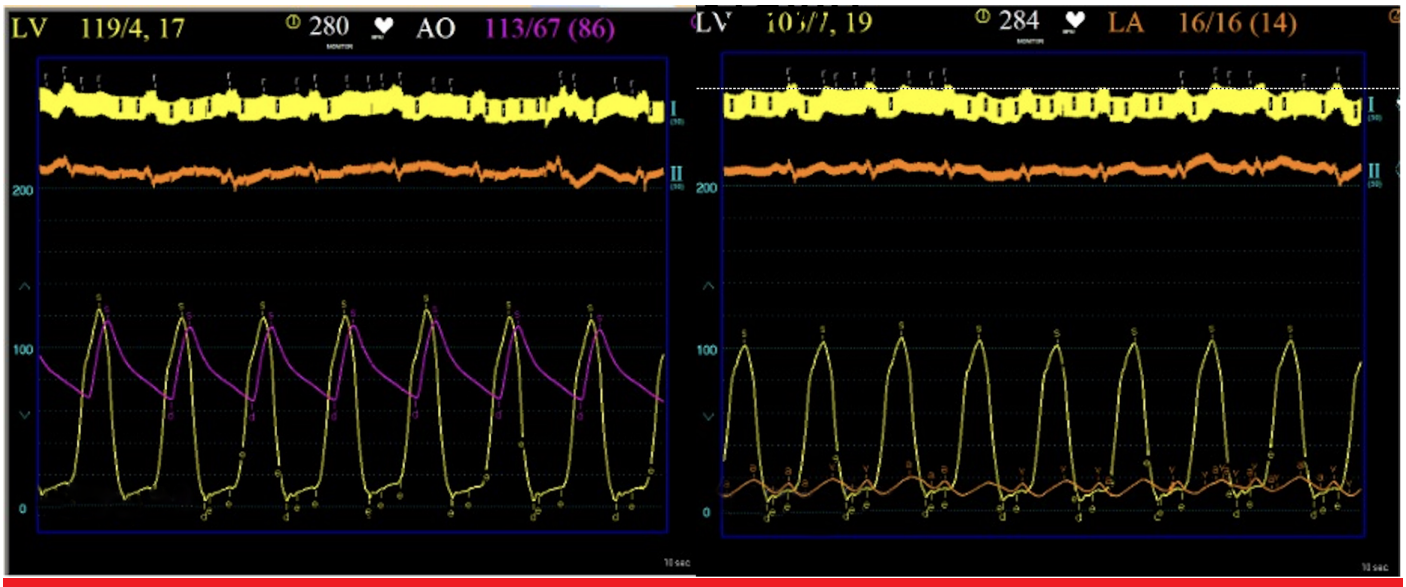


Figure 3. Post-procedural hemodynamic assessment: left ventricle–aorta pressure gradient (A) and left ventricle–left atrium pressure gradient (B).

DISCUSSION

The mitral annulus exhibits a dynamic saddle-shaped geometry, with an anterior elevation and posterior curvature. The Medtronic Profile 3D™ annuloplasty ring mimics this anatomy through a complete, rigid, asymmetric 3D design—featuring 25% anterior and 15% posterior curvature. While this configuration preserves annular geometry, it complicates MVIR procedures due to rigidity and non-circular conformation.[1] These features challenge prosthetic valve alignment and expansion, potentially impacting hemodynamics and long-term durability.

Outcomes of MVIR procedures can vary significantly depending on the type of annuloplasty ring used. Compared to rigid rings, flexible and semi-rigid rings generally allow better valve expansion and seating, which may result in lower transvalvular gradients and less risk of paravalvular regurgitation. As reported by Pirelli et al,[1] the success rate and hemodynamic performance of MVIR tend to be more favorable in flexible or semi-rigid ring configurations, while complete rigid rings—such as the Medtronic Profile 3D—are associated with higher rates of residual mitral regurgitation and technical challenges during deployment. Unfortunately, there are no long-term results in the literature regarding MVIR procedures performed on rigid rings.

In this case, successful valve deployment was achieved without major complications, although mild central mitral regurgitation and under-expansion were observed—likely due to the rigid ring's constraints.

CONCLUSION

Mitral valve-in-ring using complete rigid annuloplasty rings remains feasible in select high-risk patients, though suboptimal outcomes such as leaflet pinwheeling, under-expansion, and potential thrombosis must be anticipated.[2] In this context, "feasible but suboptimal" refers to technical and anatomical limitations imposed by the complete rigid ring, including incomplete circular expansion of the transcatheter valve, non-uniform apposition, and an increased risk of residual mitral regurgitation. These limitations may compromise valve durability, increase the risk of gradient elevation, and reduce long-term procedural success compared to MVIR performed in flexible or semi-rigid rings. Careful preprocedural planning, valve sizing, and intraoperative imaging are essential to mitigate these risks.

We did not use any artificial intelligence–assisted technologies (such as Large Language Models [LLMs], chatbots, or image creators) in the production of submitted work.

Informed Consent: Informed consent was obtained from the patient.

Declaration of Interests: The authors have no conflicts of interest to declare.

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Video 1: Pre-procedural echocardiographic assessment.

Video 2: Percutaneous mitral valve-in-ring procedure.

Video 3: Post-procedural 3D MIP CTA evaluation showing valve positioning.

Video 4: Post-procedural echocardiographic assessment.

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