Received: 15 August 2024 | Accepted: 24 September 2024

DOI: 10.1002/ccd.31256

CASE REPORT

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A new simple technique for stabilizing the guidewire position within the left ventricle during transcatheter mitral valve-in-valve implantation

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Abstract

Transcatheter mitral valve-in-valve implantation is a preferred treatment for degenerating mitral bioprosthetic valves in high-risk surgical patients. A balloon-expandable transcatheter heart valve delivered through a postero-inferior trans-septal puncture is deployed within the prosthesis over a guidewire secured in the left ventricle. Patients with aneurysmal left atrium and altered angulation between the planes of atrial septum and mitral prosthesis have unstable position of the guidewire that flips out of the left ventricle into the left atrium when the valve delivery system is advanced. Instead of a transapical access to snare the guidewire and create a railroad in such instances, we report a new technique of transarterial retrograde snaring of the guidewire in the left ventricle for stabilization.

KEYWORDS

mitral bioprosthetic valve, paravalvular leak, tissue valve degeneration, transcatheter heart valve, transcatheter mitral valve replacement, transseptal puncture

1 | INTRODUCTION

Transcatheter mitral valve-in-valve (TMViV) replacement is preferred over a re-do surgery for degenerating mitral bioprosthetic valves in high-risk patients.[1–3] The procedure involves a postero-inferior transseptal puncture to gain an access to the mitral bioprosthesis. After parking a stabilizing guide-wire in the left ventricle (LV), a balloon-expandable valve is deployed within the bioprosthetic valve.[4] An appropriate guide-wire trajectory is mandatory to allow a smooth advancement of the valve-delivery system assembly. If the left atrium (LA) is aneurysmally dilated, the LV gets pushed more anteriorly thereby altering the orientation of the bioprosthetic annulus to the atrial septum. In these cases, it is challenging to obtain a stable guide-wire position as the guide-wire flips into the LA when the valve assembly is advanced through the bioprosthetic valve. Apical puncture to snare the transseptal guidewire and formation of a rail-road overcomes this issue, but is associated with higher risk of bleeding.[5] We introduce a new technique to stabilize the guidewire within the LV using a snare advanced retrograde from an arterial access. This simple step stabilizes the guidewire and prevents it from flipping away from the LV when the valve delivery system is advanced toward the mitral inflow.

2 | CASE 1

A 33-year-old lady underwent three heart surgeries including pericardial patch closure of oval fossa defect at 5 years of age, mitral valve ring annuloplasty for prolapse at 10 years of age and mitral valve replacement(MVR) with a 25 mm Biocor bioprosthetic valve (St Jude Medical) along with tricuspid valve annuloplasty at 11 years of age. A mechanical prosthesis was not used, as the parents did not agree for initiating monitored Coumadin therapy at 11 years of age. When progressive prosthetic valve degeneration led to severe mitral regurgitation and pulmonary hypertension, the patient opted for a TMViV. Transesophageal echocardiography

(TEE) confirmed degenerated prosthesis and ruled out infective endocarditis (Figure 1). Preprocedural computed tomographic (CT) assessment showed valve internal diameter of 23 mm, aortomitral angle of 33° and predicted neo LV outflow area of 1.94 cm^2 with a 24.5 mm valve.

Under mechanical ventilation, a postero-inferior transseptal puncture was performed from right femoral venous access under TEE guidance. The mean LA pressure was significantly elevated to 37 mmHg with tall “v” waves of 70 mmHg. There was severe pulmonary hypertension with mean pressures of 60 mmHg. A 8.5F Agilis

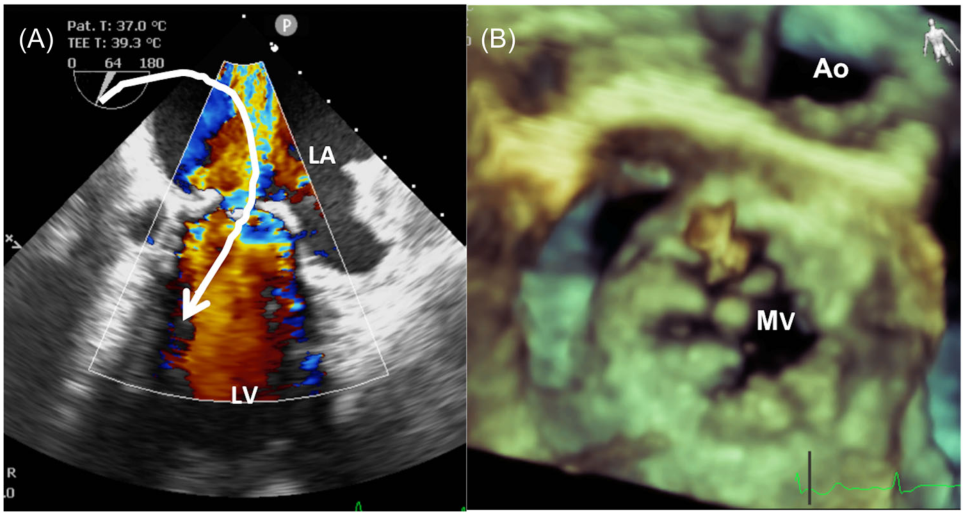

FIGURE 1 Transesophageal echocardiogram (A) shows dilated left atrium (LA), degenerated mitral prosthetic valve with severe regurgitation and a marked malalignment between the planes of atrial septum and mitral annulus. The guidewire should take a marked tortuous course to stabilize in the left ventricle (LV). Three dimensional volume rendered image (B) shows thickened valve leaflets. [Color figure can be viewed at wileyonlinelibrary.com]

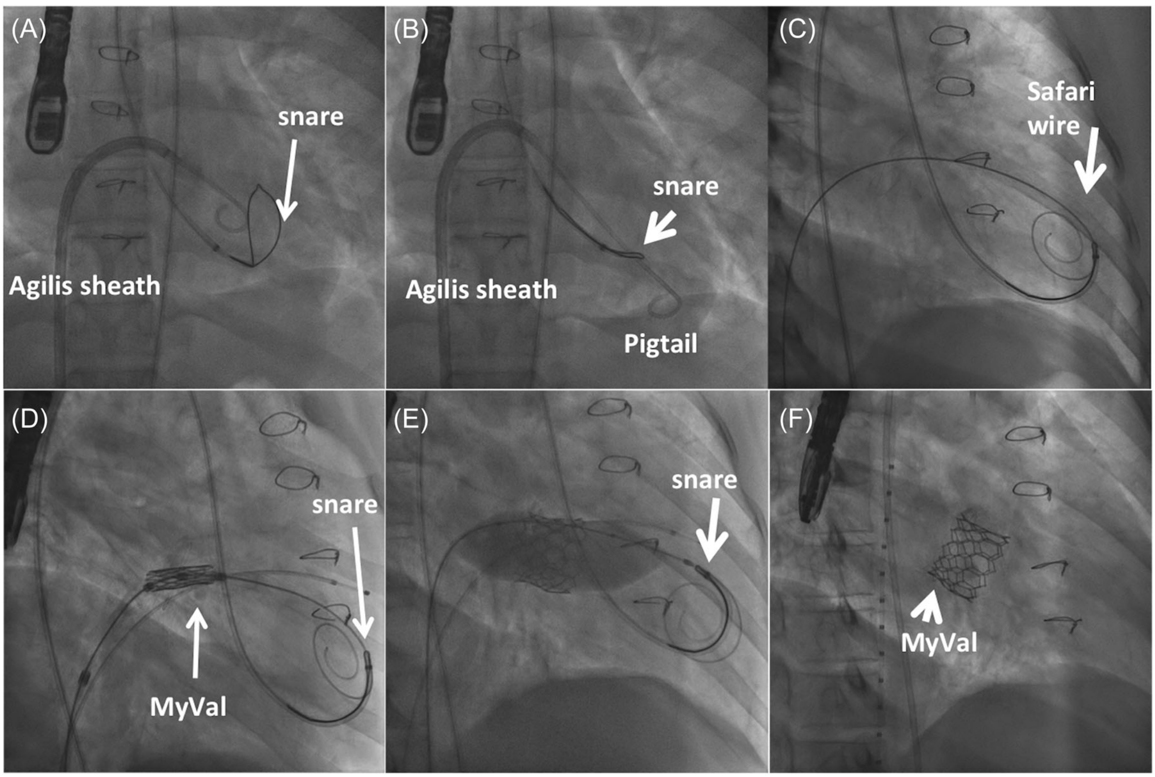

FIGURE 2 Tip of transseptal Agilis sheath (A) is steered toward the mitral prosthesis to advance a pigtail catheter toward the loop of snare placed through a retrograde arterial sheath. The pigtail catheter is snared (B) and exchanged to a Safari guidewire (C). The snare stabilizes the guidewire (D) to advance the MyVal transcatheter heart valve and expand it (E). This facilitates the procedure (F).

sheath (Abbott) was advanced into the LA and steered toward the mitral prosthesis to aid a pigtail catheter to cross the tissue valve. A Safari extra-small curve guidewire (Boston Scientific) could not be advanced through this pigtail catheter. As the dilated LA caused an acute angulation between the planes of the interatrial septum and the mitral annulus, the pigtail catheter repeatedly flipped out of the LV and precluded a stable guidewire position. To stabilize the guidewire in the LV, a 6 F braided Flexor Shuttle sheath (Cook medical) with a 5F Judkins right coronary Launcher guide catheter (Medtronic) was advanced from the left femoral arterial access into the LV. A 25 mm gooseneck snare passed through this guide catheter was used to snare the shaft of the pigtail catheter advanced from the Agilis sheath. As the snare stabilized the pigtail catheter, the Safari guidewire could easily be advanced into the LV. The snare was loosened to remove the pigtail to allow it to tighten on the straight part of the guidewire (Figure 2).

After predilating the septal puncture with a 14 mm Armada balloon (Abbott Vascular), a 24.5 Myval transcatheter heart valve (Meril Life Sciences) was advanced toward the mitral valve, which was easier since the wire was stabilized by the snare. The valve was deployed and post-dilated with a 24 mm Atlas Gold (Bard peripheral vascular) balloon to achieve complete expansion. The Safari wire was released from the snare over a pigtail catheter and removed. The mean LA pressure reduced to 18 mmHg and there was no trans-mitral gradient.

3 | CASE 2

A 30-year-old lady underwent surgical atrial septal defect closure and MVR with a bovine bioprosthetic valve at 17 years of age. A mechanical prosthesis was not chosen to avoid Coumadin, as its teratogenicity might hinder future pregnancies. An early degeneration of the prosthesis within 3 years warranted a second MVR with a 25 mm Biocor bioprosthetic valve. Identification of adhesions between the right ventricular wall and posterior sternal table on CT forced the second surgery through a right anterolateral thoracotomy. When postoperative echocardiogram identified two paravalvular leaks (PVL) along the left lateral mitral annulus, they were closed using a rectangular 10 × 4 mm PVL device (Occlutech) and a 10 mm Amplatzer Vascular Plug II (Abbott medical) after 1 year of the second surgery. She developed worsening of dyspnea in the last 1 year when clinical evaluation showed permanent atrial fibrillation with controlled ventricular rates, severe bioprosthetic valve degeneration with mean mitral inflow gradient of 13 mmHg and moderate valvar regurgitation. In addition, there was a new additional 5 mm PVL posterior to the previous devices (Figure 3). Permanent atrial fibrillation warranted initiation of Coumadin, but recurrent menorrhagia due to dysfunctional uterine bleeding was managed by cyclical discontinuation of anticoagulation. She also had a labile international normalized ratio on coumadin therapy. So the Heart team opted for TMViV

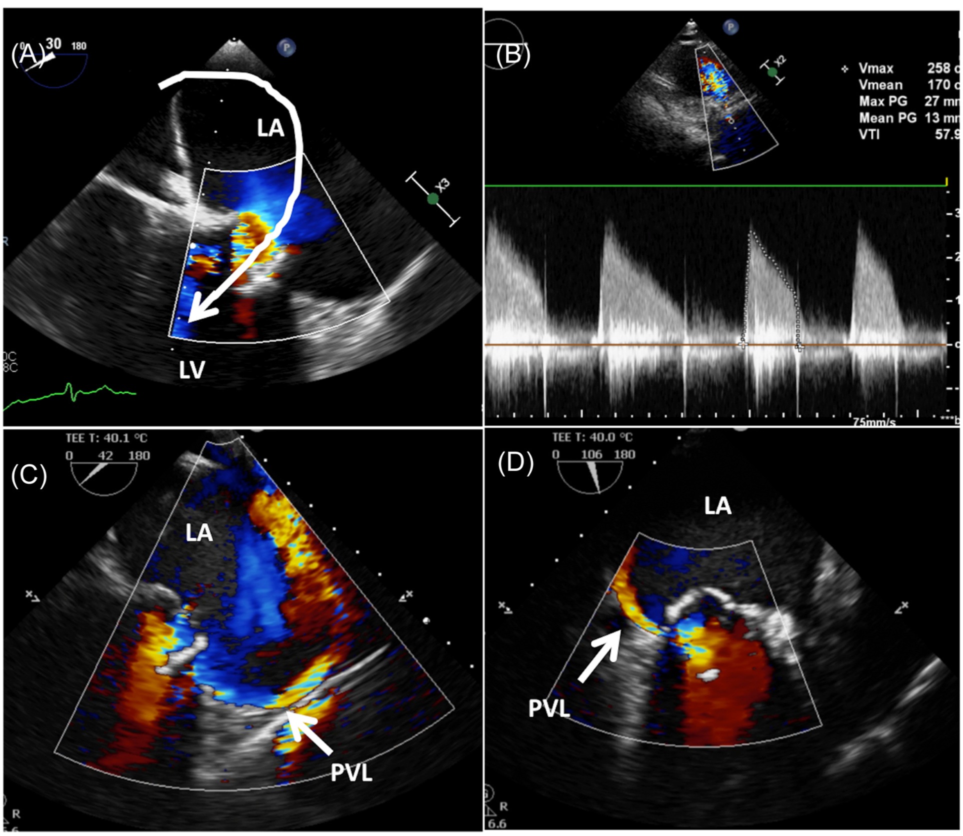

FIGURE 3 Transesophageal echocardiogram (A) shows dilated left atrium (LA), tortuous trajectory for a guidewire to reach the degenerated mitral prosthesis from the interatrial septum. Doppler trace across the mitral prosthesis (B) shows a high gradient of 13 mmHg. Color Doppler jet of a posterolateral paravalvular leak (PVL) is shown in short (C) and long (D) axis views. [Color figure can be viewed at wileyonlinelibrary.com]

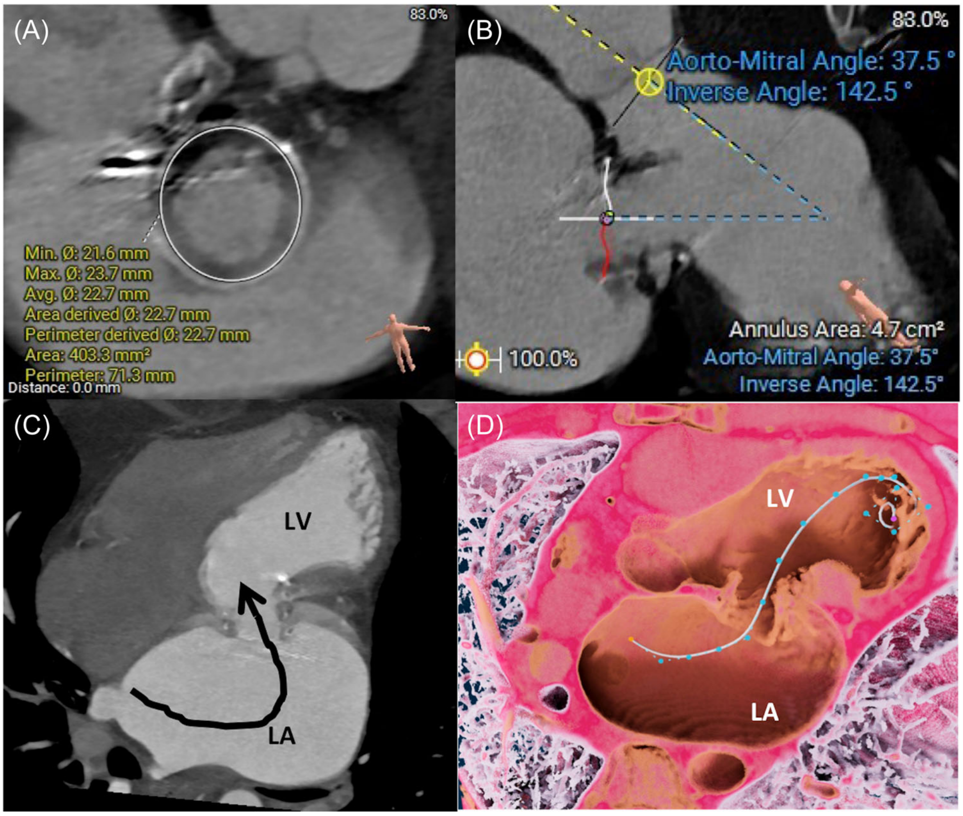

FIGURE 4 Computed tomographic reformatted image (A) shows mitral prosthesis internal diameter of 22.7 mm and aortomitral angle (B) of 37.5°. Reformatted four-chamber view (C) and volume rendered virtual reality image (D) show a tortuous trajectory from the septal puncture to the mitral prosthesis. [Color figure can be viewed at wileyonlinelibrary.com]

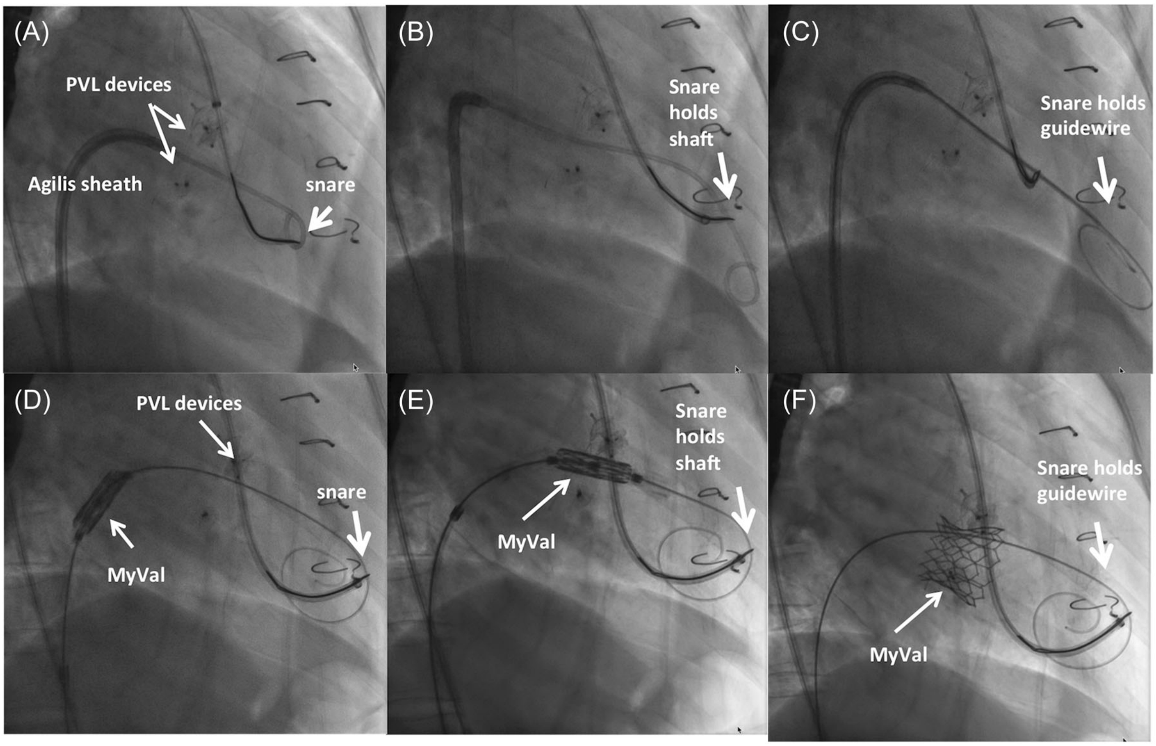

FIGURE 5 Tip of a transseptal Agilis sheath (A) is steered toward the mitral prosthesis to advance a pigtail catheter that is snared by a retrograde arterial sheath. Two paravalvular leak (PVL) devices are seen. The snare loop is moved to the shaft of the pigtail catheter (B) that is exchanged to a guidewire (C) before advancing a MyVal transcatheter heart valve (D). The snare-stabilized guidewire allows easy advance of the MyVal (E) to facilitate its deployment (F).

rather than a mechanical prosthesis to allow reduction of Coumadin dose during menorrhagia.

Cardiac CT showed aneurysmal left atrium that altered the mitral annular plane at an unfavorable angle from the interatrial septum. The prosthetic internal diameter was 22.7 mm, aortomitral angle was 37.5° and predicted neo LVOT area was 6.1 cm^2 with a 24.5 mm valve. Since the trajectory of the safari wire needed was angulated, snare-assisted technique was considered essential for wire stabilization (Figure 4).

The PVL was crossed retrogradely from left femoral arterial access using a Judkins left guide catheter and closed using a 8 mm Amplatzer vascular plug II. A postero-inferior transseptal puncture through the scarred pericardial patch of interatrial septum needed electro-cautery under TEE guidance. The LA pressure was 18 mmHg. As described earlier, a 20 mm gooseneck snare was advanced through a Judkins right catheter and 6F shuttle sheath into the LV from femoral arterial access. A transseptal Agilis sheath was used to direct a pigtail catheter through the mitral prosthesis. The pigtail catheter was snared to stabilize it in the LV before advancing a Safari extra-small guidewire. The pigtail catheter was withdrawn while the snare gripped the Safari wire. After flossing the atrial septum using a 14 mm Atlas gold balloon, a 24.5 mm Myval transcatheter heart valve was advanced through the prosthetic valve before its deployment. After postdilating the valve with a 24 × 40 mm Atlas Gold balloon, the mean LA pressure reduced to 10 mmHg. There was no gradient across the mitral valve (Figure 5).

4 | DISCUSSION

TMViV using balloon expandable valves is increasingly performed in recent times with high success rates.[1,3,4] Technical success of TMViV in degenerating mitral prosthesis was 94.4% and higher compared to prosthetic rings and mitral annular calcification in the multicenter transcatheter MVR registry.[5,6] As the success rate increased over time, transseptal approach replaced transapical approach.

One of the challenges during TMViV is to secure a stable guidewire position in the LV. The difficulty increases when the mitral annular plane is not aligned for the transseptally advanced guidewire. If guidewire is unstable, it flips out of the LV into the dilated aneurysmal LA when a rigid balloon-expandable transcatheter heart valve delivery system is advanced toward the mitral prosthesis. In such cases, an apical puncture is taken percutaneously or through a limited left anterior thoracotomy.[3] This apical access allows snaring of the guidewire to form an apico-transseptal rail-road, thus providing stability for advancing the valve delivery system toward the mitral inflow. If an apical puncture is electively planned, this can be achieved before heparinisation. However after observing lack of stability of the guidewire, aiming for an emergency apical access is challenging, as the procedure should be done on full heparinisation.

In a multicenter registry, the need for such an apical rail-road formation was documented in 3.1% of cases.[5] We describe a novel technique to stabilize the guidewire in the LV by snaring the wire shaft through a retrograde arterial catheter advanced from femoral arterial access. A forward push of the arterial sheath with the tightened snare loop pushes the guidewire toward the LV apex thereby securing and stabilizing it within the LV. The small 6F arterial access is unlikely to lead to any additional vascular complications.

As the tightened snare loop maintains the guidewire within the apex of the LV, it facilitates an appropriate trajectory that is needed for advancing the valve delivery system coaxially. Creating an arterio-venous loop is not an option since the wire loop will have an acute angulation at the aortomitral junction across the three pillars of bioprosthetic valve.[7] This novel technique will be of assistance for a challenging TMViV procedure when guidewire stability in the LV cannot be achieved. Preprocedural CT can identify patients who either have aneurysmal left atrium or an inappropriate orientation of mitral annular plane in relation to the interatrial septum.

5 | CONCLUSION

TMViV procedure performed in degenerating prosthetic valves needs a stable guidewire position in the LV before advancing the valve delivery system through the mitral inflow. If the mitral annular plane is not in alignment to the interatrial septum especially in aneurysmally dilated LA, advancing the valve delivery system will be challenging as the guidewire flips out of the LV. In such cases, instead of obtaining an apical access to achieve a railroad, our new technique is a simple way to achieve a stable position of guidewire in the LV. This simple technique of transarterial retrograde snare-assisted stabilization of pigtail and guidewire achieves a stable LV guidewire position.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

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How to cite this article: Sivakumar K, Sagar P, Thejaswi P, Pavithran S. A new simple technique for stabilizing the guidewire position within the left ventricle during transcatheter mitral valve-in-valve implantation. *Catheter Cardiovasc Interv*. 2024;1-6. doi:10.1002/ccd.31256