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In-Series Transcatheter Aortic Valve Replacement-in-Transcatheter Aortic Valve Replacement: ACURATE neo Transcatheter Heart Valve Degeneration Successfully Managed with Myval, Avoiding Coronary Flow Obstruction—A Case Report

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Introduction

Redo transcatheter aortic valve replacement (TAVR) is increasingly being performed, as a result of expanding indications to younger subjects.[1] Redo-TAVR is an option for the treatment of a failing transcatheter heart valve (THV), but carries substantial risk of impaired coronary flow and access due to sinus sequestration or to excessive valve frame.[2]

ACURATE neo (Boston Scientific, Marlborough, Massachusetts, USA) is a self-expanding, supra-annular, nitinol THV, with porcine pericardium leaflets (Figure 1), currently on its second generation; while Myval (Meril, India) is a balloon-expandable, intra-annular THV made of nickel and cobalt, with bovine pericardium leaflets.

We report a case of structural valve degeneration (SVD) complicating ACURATE neo THV with aortic insufficiency and describe the treatment with Myval THV, aiming to mitigate risks of coronary obstruction and high residual gradient.

Case Presentation

A 73-year-old female was admitted to our hospital in July 2022 with sudden chest pain and breathlessness. Cardiac examination revealed a new diastolic murmur.

In February 2019, she underwent TAVR with a 25 mm ACURATE neo THV to treat severe symptomatic aortic stenosis. ACURATE neo was selected due to low height of the left coronary artery (6.8 mm). Patient had been asymptomatic under regular follow-up.

Transesophageal echocardiography now showed disruption of the posterior leaflet, causing severe central insufficiency. There were no signs of pannus or thrombosis. Ejection fraction was preserved (74%) and left ventricular dimensions were increased, with systolic and diastolic diameters of 35 mm and 62 mm, respectively. There were no signs or symptoms compatible with acute or subclinical endocarditis. Blood cultures were negative.

Computed tomography showed THV commissural posts above sinotubular junction (STJ) level, with one of them in front of the right coronary artery (RCA), displaying severe commissural misalignment, precluding the possibility of preemptive bioprosthetic aortic scallop intentional laceration to prevent iatrogenic coronary artery obstruction (BASILICA). Furthermore, valve-to-RCA distance was nonexistent and its

Abbreviations: BASILICA, bioprosthetic aortic scallop intentional laceration to prevent iatrogenic coronary artery obstruction; RCA, right coronary artery; STJ, sinotubular junction; SV, structural valve degeneration; TAVR, transcatheter aortic valve replacement; THV, transcatheter heart valve.

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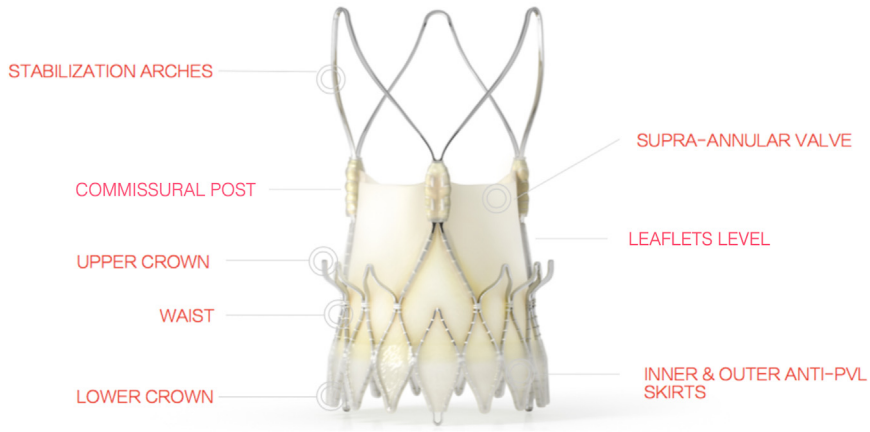

Figure 1. **ACURATE neo features.**

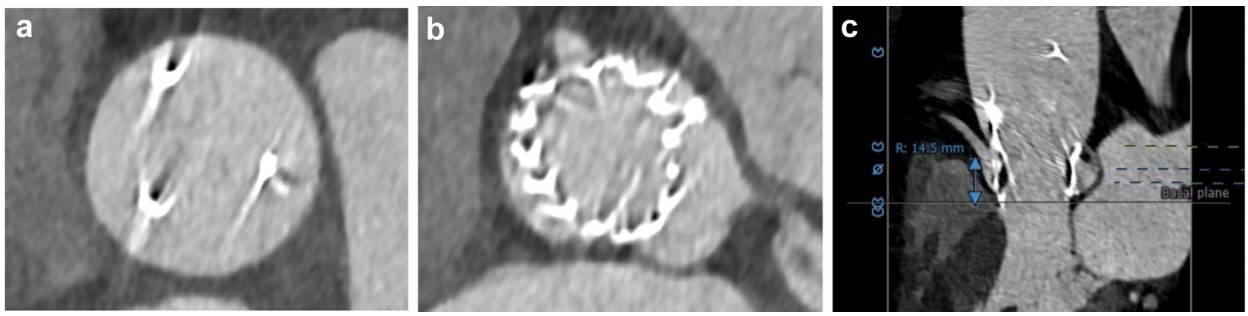

Figure 2. (a) Commissural posts above sinotubular junction level. (b) Valve to right coronary artery (RCA) distance nonexistent. (c) Vertical takeoff of RCA. Blue arrow indicates right coronary artery height.

take off was acute, which could result in under expansion or malapposition of a stent implanted with chimney technique during TAVR-in-TAVR (Figure 2a-c). Valve to left coronary distance was huge and there was adequate space between THV and STJ above the left sinus (Figure 3a and b). Annulus and left ventricular outflow tract had similar dimensions (Figure 4a and b).

We decided to implant balloon expandable Myval THV below the nadir of the leaflets of the degenerated THV, using the upper crown of ACURATE neo as reference (Figure 5), creating 2 valves in series (Figure 6), solving central insufficiency and avoiding acute obstruction of RCA, as the leaflets of ACURATE neo would not pin in an open position. As there are few similar cases reported and the result could be unpredictable, RCA was protected with an undeployed 4.0 × 23 mm stent.

Procedure was performed under general anesthesia and transthoracic echocardiography. Angiogram showed severe aortic insufficiency and THV was crossed as usual, followed by a partially insufflated 20 × 40 mm Mammoth balloon (Meril, India) to confirm central crossing (Movies 1 and 2). Myval 26 mm THV was implanted in right anterior oblique view, with an oversizing to the annulus of 12.3%, just below the upper crown of ACURATE neo, keeping the alignment with the upper part of Myval, as only the lower part is the one that shows foreshortening during deployment (Movie 3). Echocardiogram showed mean gradient of 3 mmHg, angiogram confirmed patency of coronary arteries, and no residual aortic insufficiency (Movie 4). Patient was discharged home on day 2. At 1 month follow-up, the patient remained asymptomatic and transthoracic echocardiogram revealed good result (mean gradient: 9 mmHg, valve area: 2.3 cm^2, and no leaks).

Discussion

THV failures due to SVD, during extended follow-up, are expected among younger patients undergoing TAVR. Redo-TAVR is a relatively safe and effective treatment option, although high residual gradient is the main reason for failure.[1] Challenges include correct positioning of the second THV to avoid coronary obstruction and impaired coronary access, as well as the choice of its type and size. One should also take into account the underlying mechanism of the first THV dysfunction, its type and size, and the aortic root anatomy. Hence, the first step when

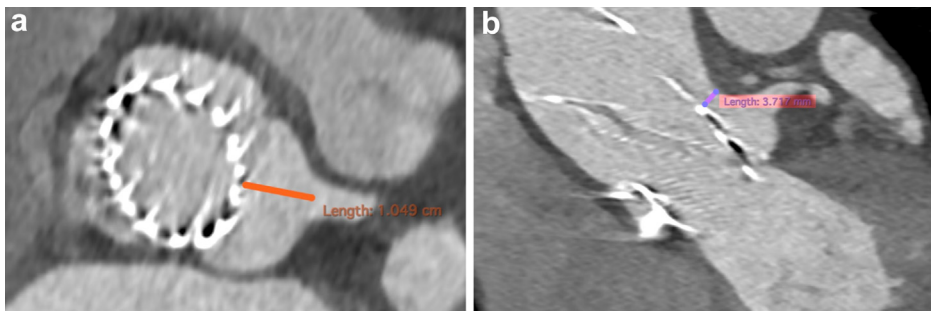

Figure 3. (a) Valve to left coronary artery distance. (b) Valve-to-aorta distance above left sinus.

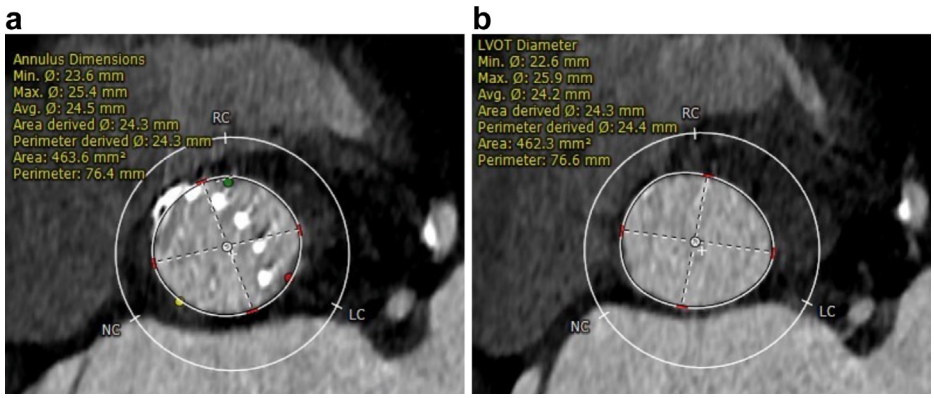

Figure 4. (a) Annulus dimensions. (b) Left ventricular outflow tract dimensions. Abbreviations: LC, left coronary; NC, non-coronary; RC, right coronary.

approaching such a case is to confirm diagnosis to exclude any reversible causes and make planning measurements by imaging methods, like echocardiography and tomography.

There are few reports of ACURATE neo THV degeneration and its management with a balloon expandable THV.[3,4] Mostly, a smaller THV is chosen, because nitinol frame allows enlargement. This could raise questions about final gradient, as there is a maximum diameter limitation and concerns regarding predictability of valve-to-coronary or valve-to-STJ distances, when post dilatation is needed.[5]

THV size choice was made upon measurements of the native annulus, resulting in oversizing greater than 10% and the indication of a THV bigger than the first one. This seemed safe, as there were no other predictors of annular rupture. Severe commissural misalignment and vertical takeoff of RCA were the main reasons for low implantation. Anticipating the risk of coronary flow obstruction, this resulted in 2 valves in series.

The impact of this strategy to treat aortic insufficiency on THV durability is unknown, especially because of the very low position of the second THV and the regurgitant jet affecting the cusps during the cardiac cycle. In a recent bench model,[6] where different implantation depths of a balloon-expandable THV inside a self-expanding one were studied, even the lower position showed good hydrodynamic perfomance that could hypothetically predict an acceptable SVD incidence.

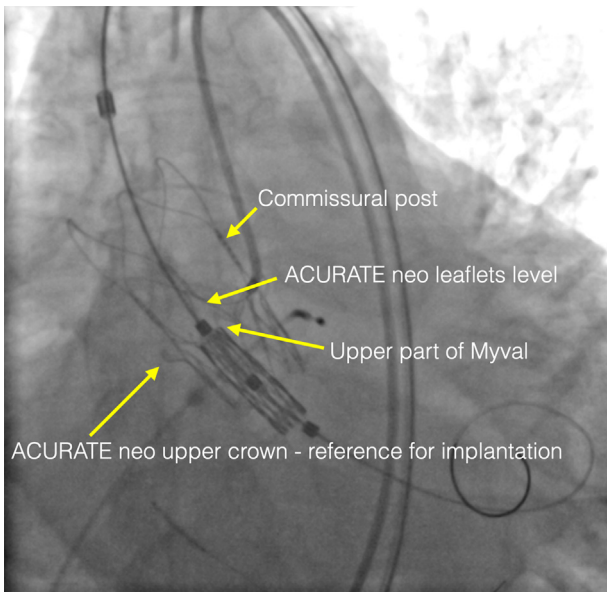

Figure 5. Schematic fluoroscopy imaging prevalve implantation.

On the other hand, another important consideration is leaflet overhang from the original THV over the new device and its correlation with predictors of SVD. A recent bench study[7] showed that low implantation of a 26 mm balloon-expandable THV inside a Large ACURATE neo2 resulted in a greater degree of leaflet overhang, when compared to higher implant positions and valve sizes. The study hypothesized that treating a degenerated and stenotic THV with a low implant position of a new THV, could result in residual new outflow obstruction, impaired flow and, ultimately, greater potential for thrombosis due to significant leaflet overhang.

Nevertheless, 2 valves in series was a feasible approach to solve severe central regurgitation without stenosis. Although the impact on THV durability is still unknown, acute clinical and hemodynamic results were satisfactory.

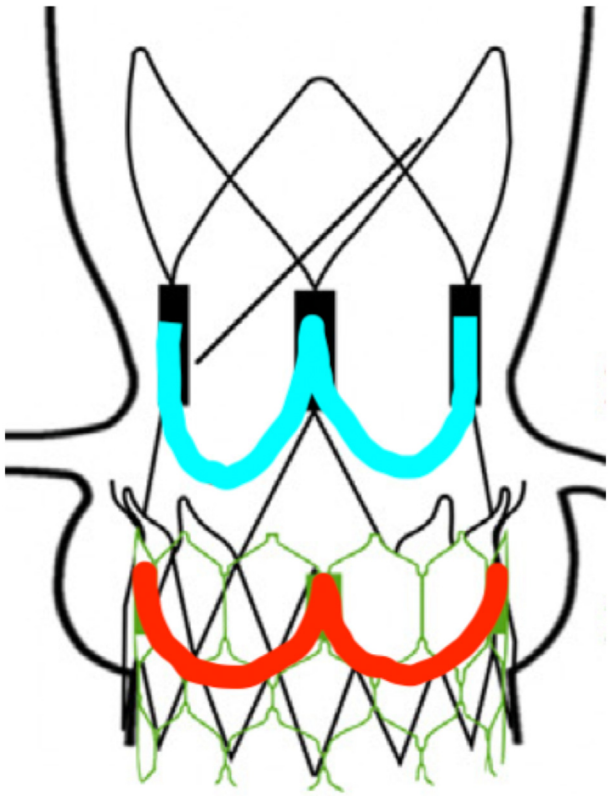

Figure 6. Two valves in series. Blue line indicates ACURATE neo leaflets and red line indicates Myval leaflets.

Conclusion

In the setting of Redo-TAVR due to SVD, in series TAVR-in-TAVR approach to treat aortic insufficiency without stenosis, with a larger balloon-expandable THV inside a self-expanding one, proved safe, had no negative impact on coronary flow, and resulted in very low pressure gradient.

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Consent Statement

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Disclosure Statement

J.F.B.T. is a proctor for Meril Life. The remaining authors have no conflicts of interest to declare.

Supplementary Material

Supplemental data for this article can be accessed on the publisher's website.

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