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Hybrid Staged Management Of Redo Multiple Valve Disease

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Case Report

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Abstract

Background:

Redo multiple valve surgery carries high operative risk, with mortality up to 13% and poor long-term survival. In high-risk patients, single-stage triple valve replacement may be prohibitive. This report describes a successful hybrid staged approach combining redo mitral and tricuspid valve replacement followed by transcatheter aortic valve implantation in a patient with rheumatic multivalvular disease.

Case presentation:

A 68-year-old woman with prior mitral, aortic, and tricuspid surgery presented with recurrent prosthetic stenoses (MVA 0.81 cm^2, AVA 0.7 cm^2), severe tricuspid regurgitation, and pulmonary hypertension (mean PAP 42 mmHg, PVR 6.6 WU). Risk scores predicted EuroSCORE II 9.7% and STS mortality 18%. Transcatheter mitral valve replacement was excluded because of a small neo-LVOT (49.7 mm^2). A staged hybrid plan was adopted: redo mitral valve replacement and tricuspid valve replacement, followed one month later by transfemoral TAVI.

After redo MVR/TVR, echocardiography showed normalized mitral valve area (2.8 cm^2) and elimination of tricuspid regurgitation, but persistent severe aortic stenosis (peak gradient 52 mmHg). Following TAVI, AVA increased to 1.5 cm^2, mean gradient 16.9 mmHg, and sPAP decreased from 70 to 37.7 mmHg. The six-minute walking distance improved from 192 m (39% predicted) to 334 m (70%), and NYHA class improved from III to II without residual murmur or paravalvular leak.

CONCLUSIONS:

A hybrid staged, “mitral-first” strategy followed by TAVI achieved excellent hemodynamic and functional recovery in this prohibitive-risk redo triple-valve patient. Sequencing guided by valve pathology and physiology can transform inoperable multivalvular disease into successful outcomes. Staged hybrid management should be considered when single-stage surgery carries excessive risk.

Background

Surgical intervention for multiple valve disease is technically demanding and carries significant operative risks. Reported mortality rate for triple valve surgery are approximately 13%, with a 10-year survival rate of only 61%.[1] These outcomes are notably worse in redo settings, where mortality is significantly higher. [2] In high-risk patients, performing a single-stage triple valve replacement may be prohibitive due to excessive risks. Prolonged cardiopulmonary bypass and aortic cross-clamp times required for such complex procedures further increase perioperative danger. To mitigate these risks, staged or hybrid treatment strategies—combining traditional surgery with transcatheter techniques—have been advocated for carefully selected high-risk patients. [3] This report presents a successful hybrid staged approach for a patient with rheumatic multivalvular disease and prior surgical history. The strategy

involved a "mitral-first" redo surgical mitral and tricuspid valve replacement, followed by a staged TAVI, to transform a prohibitive-risk case into a successful therapeutic outcome.

Case presentation

A 68-year-old Asian female with a history of rheumatic heart disease presented with severe aortic stenosis (AS) and mitral valve stenosis (MS), complicated by pulmonary hypertension (PH), tricuspid regurgitation (TR), and atrial fibrillation (AF). She weighed 42 kg, was 150 cm tall, with a BMI of 18.9 kg/m².

She underwent mitral valve replacement (MVR) with a 27# Perimount bioprosthetic valve, aortic valve replacement (AVR) with a 19# Magna Ease valve, tricuspid valve repair with De Vega's annuloplasty, left atrial appendage closure, and a Maze procedure via right minithoracotomy on June 25, 2014. Pathology revealed valvular calcification, degeneration, and papillary fibroelastoma.

In July 2024, bradycardia due to complete AV block required temporary pacemaker (TPM) placement, later converted to permanent pacemaker (PPM, VVIR mode). Follow-up echocardiography showed MVA decreased from 1.4 to 0.81 cm², AVA decreased from 2.4 to 0.7 cm², with severe TR and severe PH.(Fig 1) Cardiac catheterization revealed patent coronary arteries, mean PAP 42 mmHg, PAWP 29 mmHg, PVR 6.59 WU, consistent with WHO Group 2 PH. Six-minute walking distance was 192 m (39% predicted). EuroSCORE II predicted operative mortality of 9.72%, and STS estimated operative mortality 18%, morbidity/mortality 51%.

We had considered TAVI, however, LVOTO risk was high due to small neo-LVOT area: 49.7 mm². Lampoon procedure was also discussed, but gave up due to too difficult to engage in this post-double valve replacement patient.

Besides, we had chosen 19# Magna Ease valve due to small aortic root in the past, the iEOA would be about 0.96, a borderline data. Aortic Root enlargement should be considered if re-open surgery for AVR, otherwise, Balloon dilation and fracture for prosthesis valve would be another choice. Because of her cardiac cachexia and high surgical risk, after discussion, we decided on a staged operation.

She subsequently underwent a redo operation via median sternotomy on November 11, 2024: MVR with 27# Edwards Perimount Magna Mitral Ease, removal of the PPM lead with conversion to epicardial pacing wire, and TVR with 33# Edwards Perimount Magna Mitral Ease. Pathology again showed degeneration of the prosthetic mitral valve and tricuspid valve.(Fig. 2)

Postoperative echocardiography revealed MVA 2.8 cm² but persistent severe AS (aortic valve peak gradient 52 mmHg). On December 11, 2024, she underwent TAVI with a 23 mm Evolut FX device. Post-TAVI echo demonstrated AVA 1.5 cm², mean gradient 16.9 mmHg, sPAP 37.7 mmHg.(Fig 3) Six-minute walking distance improved to 334 m (70.2% predicted). Clinical symptoms improved from NYHA III to II, and the grade II–III/VI systolic murmur resolved.(Table 1)

Discussion

Triple valve operations are technically demanding, associated with an operative mortality of approximately 13% and a 10-year survival of only 61% [1]. Outcomes are even worse in redo settings, where mortality rates are significantly higher [2]. Because prolonged cardiopulmonary bypass and aortic cross-clamp times further increase perioperative risk, staged or hybrid treatment strategies have been advocated for carefully selected high-risk patients [3].

One such approach is the “TAVR-first” strategy, which has gained traction based on hemodynamic reasoning, safety considerations, and emerging outcome data. Approximately 10% of patients undergoing TAVR present with concomitant mitral stenosis (MS), and severe MS has been identified as an independent predictor of adverse one-year outcomes [4]. Nevertheless, TAVR remains a reasonable option for patients with AS and concomitant moderate-to-severe MS [5]. Importantly, Kato and colleagues showed that in patients with combined AS and MS, surgical AVR increased mitral valve area in about half of cases, representing “pseudo-MS” that resolved with improved forward flow. In contrast, patients with “true MS” had persistently severe stenosis and significantly worse long-term survival [6].

In elderly high-risk patients, double-valve replacement via sternotomy carries much higher operative mortality than isolated valve surgery. For individuals deemed inoperable with combined aortic and mitral disease, staged management has been explored: TAVR performed first may stabilize hemodynamics and improve end-organ function, followed by definitive mitral intervention. One series reported that this sequence was associated with no in-hospital or one-year mortality [7].

On the other hand, some patients require an MVR-first approach—particularly when the mitral pathology is the main driver of hemodynamic compromise and severe pulmonary hypertension. In such scenarios, surgical MVR or repair can be performed first, followed by TAVR as a staged “second hit.” This sequence is rational when the mitral lesion is structural and unlikely to improve after correction of the aortic valve.

Pulmonary hypertension (PH) plays a decisive role in this decision-making. In patients with combined AS and mitral valve disease, severe PH usually reflects advanced, decompensated left-heart failure [8]. This PH is commonly the result of long-standing MS or MR, which elevate left atrial pressure. PH often improves after correction of the mitral lesion, although it may not normalize completely. Crucially, persistent severe PH after aortic intervention is associated with poor outcomes: one study showed that residual severe PH after TAVR predicted higher one-year mortality, even more strongly than baseline PH [9]. Therefore, when PH is primarily driven by the mitral valve lesion, there is a strong physiologic rationale for treating the mitral valve first. By relieving inflow obstruction or regurgitation with MVR, left atrial pressure decreases, pulmonary pressures improve, and the patient becomes more stable for subsequent TAVR.

Another important factor is technical interaction between valves. During TAVR, balloons or stent frames may impinge on prosthetic mitral discs, causing mechanical interference [10]. Despite these challenges, TAVR has been successfully performed in patients with prior surgical MVR (SMVR). Registry data

indicate that such patients experience comparable 30-day outcomes, only a modest increase in one-year mortality, and no greater incidence of early paravalvular leak compared with those without SMVR [11]. These findings support the view that previous mitral surgery is not an absolute contraindication to TAVR when patients are carefully selected.

Hybrid management becomes particularly relevant when simultaneous double-valve surgery carries prohibitive risk. A “mitral-first” approach—surgical MVR followed by staged TAVR—is often preferred when the mitral lesion is severe, structural, and unlikely to regress after aortic correction, such as in degenerative or rheumatic MS. Addressing the mitral valve first prevents residual obstruction or regurgitation, conditions known to worsen outcomes in patients undergoing TAVR [12].

TAVR in patients with mitral prostheses, however, is inherently more complex and demands detailed pre-procedural imaging and planning. Implantation depths of less than 8 mm have been recommended to minimize prosthesis–prosthesis interference [13]. In rheumatic patients with progressive multivalve disease, staged MVR followed by TAVR has been reported as a pragmatic and effective solution [14]. Furthermore, the first documented case of simultaneous transcatheter double-valve replacement employed a mitral-first sequence: a transapically delivered inverted Sapien 3 valve was implanted in the mitral position before deployment of the aortic prosthesis during the same session [15].

Larger cohort studies provide further support. The STS/ACC Transcatheter Valve Therapy (TVT) registry analysis of more than 1,000 patients with prior mitral surgery undergoing TAVR demonstrated that short-term outcomes—including 30-day mortality (~5%), stroke, myocardial infarction, and acute kidney injury—were equivalent to those without prior mitral intervention. Rates of paravalvular leak and technical complications were also not elevated, confirming that TAVR can be performed safely after mitral surgery in appropriately selected patients [11].

In our case , a single-stage redo triple valve replacement would have entailed prohibitive cross-clamp and bypass times with high early mortality risk, as consistently reported in surgical literature. The patient’s hemodynamics were dominated by fixed prosthetic mitral stenosis with elevated LA pressure and secondary PH. Correcting the mitral inflow lesion first reduced left atrial and pulmonary pressures, creating a more favorable substrate for subsequent aortic intervention. Severe TR was also addressed at the same sitting; guidelines recommend surgical correction of significant TR when left-sided surgery is performed, since untreated TR leads to progressive right-sided failure

Although a “TAVR-first” approach has been advocated in selected frail patients [5,7], it is best suited when concomitant mitral pathology is functional or flow-dependent. In fixed, structural MS—as in this case—TAVR alone risks worsening transmitral gradients and failing to relieve pulmonary hypertension [6,8].

Moreover, delaying mitral intervention would have left severe TR and LA hypertension uncorrected. Besides, the frame height of transcatheter aortic valve would sacrifice the working length of ascending

aorta in open surgery, increased the surgical difficult for aortic cross clamp, caridoplegia infusion site and cannulation site.

Thus, a “mitral-first” approach was both physiologically and prognostically superior.

Performing TAVR after prior mitral or tricuspid prostheses carries theoretical risks of prosthesis–prosthesis interaction. However, registry data and case series confirm feasibility and safety, with 30-day outcomes similar to standard high-risk TAVR cohorts, only modest increases in one-year mortality, and no excess in paravalvular leak.

The staged approach achieved excellent hemodynamic and functional improvement. After redo MVR/TVR, mitral valve area normalized and TR was eliminated. Following TAVR, AVA improved, and sPAP decreased, 6MWD nearly doubled, and NYHA class improved from III to II. These results align with reports that staged correction of multiple valve lesions, rather than partial therapy, leads to superior symptomatic and functional recovery

A redo triple valve replacement in one session was rejected due to prohibitive operative risk. A TAVR-first sequence was deemed inappropriate due to fixed MS and severe PH. A purely transcatheter double-valve strategy was not anatomically feasible, given prosthetic degeneration and severe TR requiring surgical correction. Thus, the hybrid staged plan offered the most balanced risk–benefit profile.

Conclusion

This case illustrates how evidence-based hybrid sequencing can transform prohibitive risk into an achievable therapeutic pathway in complex redo triple valve disease. By correcting the inflow (MVR) and right-sided lesion (TVR) first, followed by definitive outflow correction via TAVR, the Heart Team matched physiology with procedural sequencing. The result was normalization of valve areas, regression of pulmonary hypertension, improved exercise capacity, and symptomatic relief—outcomes consistent with contemporary registry findings and pathophysiologic rationale .

For high-risk patients with multivalvular disease, staged hybrid management should be considered when single-session surgery is prohibitive, with the sequence tailored to the dominant lesion. In cases of fixed MS with pulmonary hypertension, a mitral-first approach remains the rational choice. Larger registries and prospective studies are needed to refine patient selection and optimize sequencing strategies in this challenging population.

Declarations

Ethics approval and consent to participate

This study was approved by the Institutional Review Board of MacKay Memorial Hospital, Taipei, Taiwan, (Approval No. 26MMHIS012e). Written informed consent was obtained from all participants prior to enrollment in the study

Consent for publication

Written informed consent was obtained from the patient for publication of this abstract and any accompanying images.

Availability of data and materials

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

All authors contributed to the study conception and design. Material preparation, data collection, and analysis were performed by C-SY. The first draft of the manuscript was written by C-SY, and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Table

Table 1

	pre-op	post-op 3mon	post-op 1y
MVA(cm^2)	0.81	2.7	4.58
AVA(cm^2)	0.55-0.7	1.5	1.5
esPAP(mmHg)	85.5	37.7	52
LVEF(%)	77	53.8	40
6-min walking test (m)	192/497	334/475	-
expected distance	39%	70%	-
Cardiopulmonary exercise test peak oxygen uptake(ml/kg/min)	-	13.09	16.00
expected distance	-	49% predicted	60 % predicted

Figures

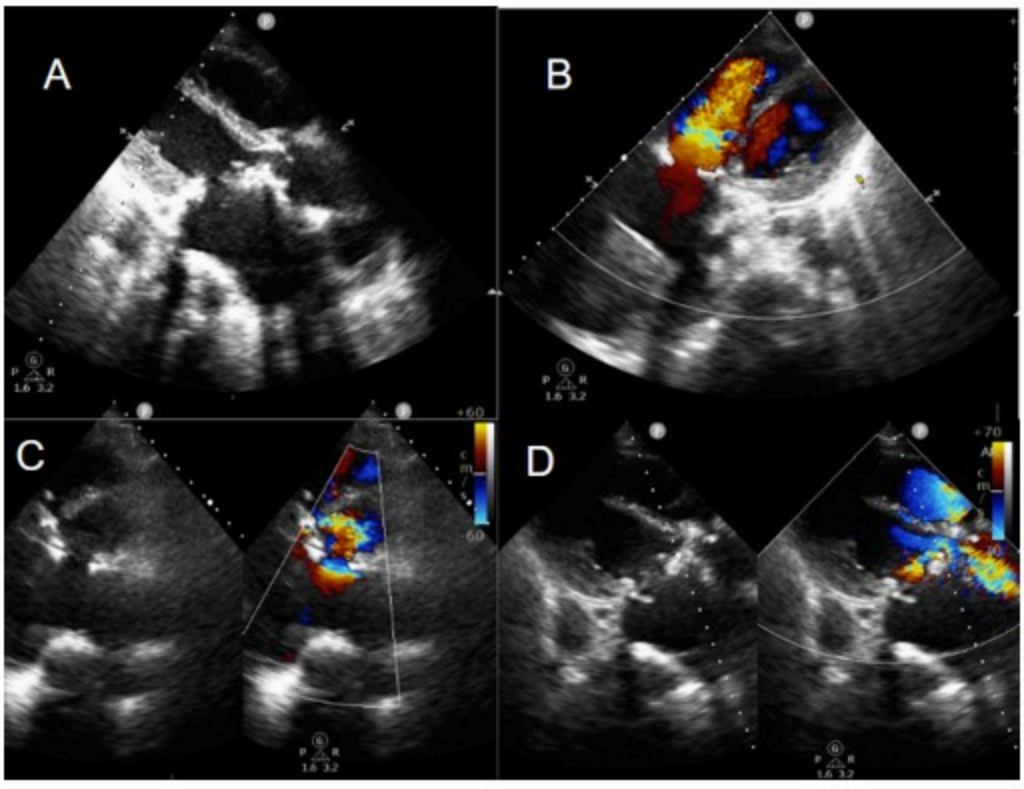


Figure 1

Preoperative cardial echo. A Aortic valve stenosis and mitral valve stenosis. B Severe TR. C Severe MS. D Severe AS.



Figure 2

removal of previous mitral prosthesis with degenerated change.

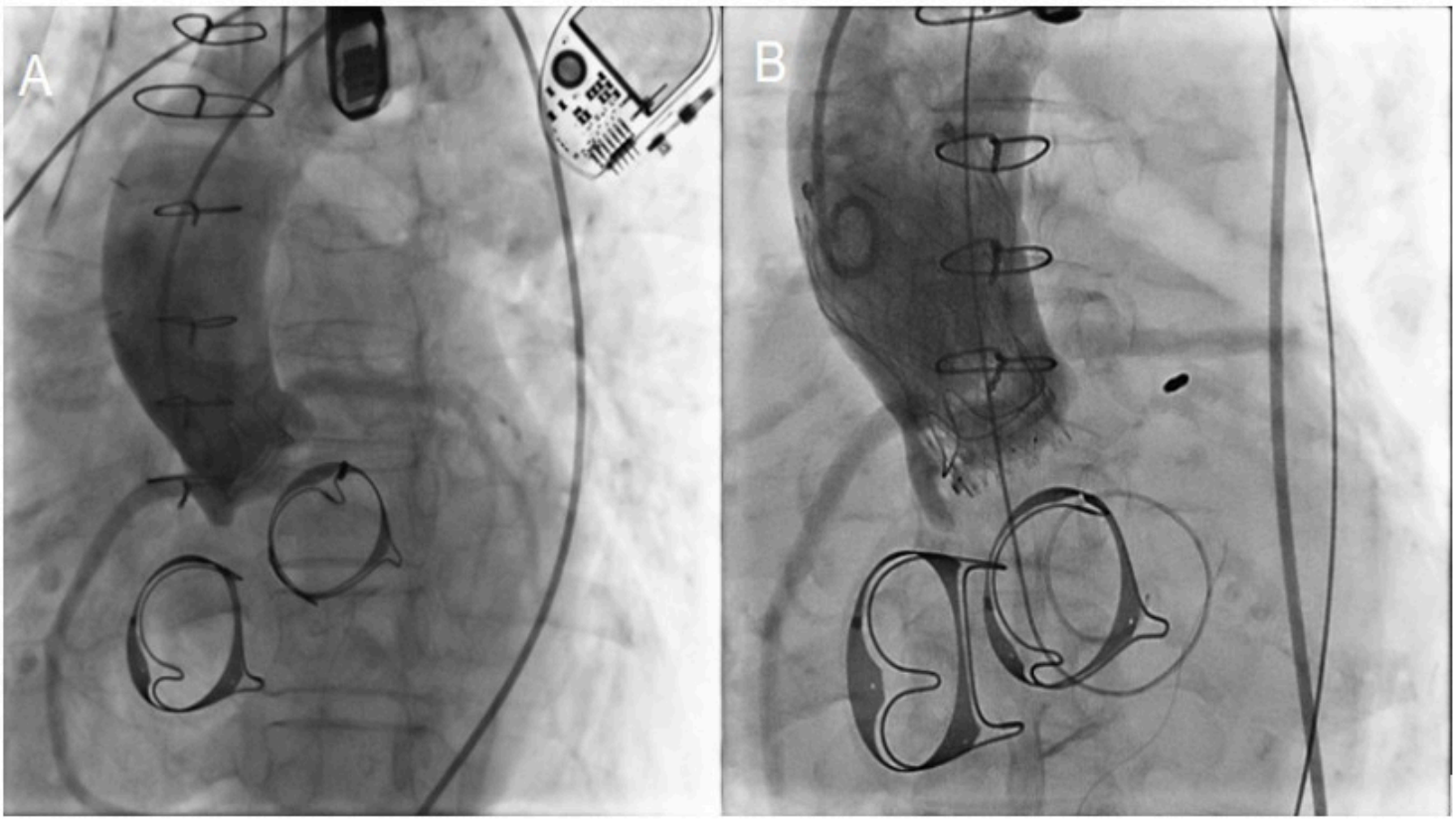


Figure 3

A Pre-TAVI aortography, LV:134/6 mmHg, Ao: 108/45 mmHg. B Post-TAVI aortography, LV 143/3 mmHg, Ao: 135/53 mmHg, no AR