Valve-in-valve using a self-expandable valve with intra-annular leaflets in balloon expandable valves

Valve-in-valve utilizando una válvula autoexpandible con valvas intraanulares en válvulas expandibles con balón

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ABSTRACT

The expansion of indications for transcatheter aortic valve implantation (TAVI) to younger and lower-risk patients has increased the need for long-term strategies, including new transcatheter aortic valve procedures in previously implanted TAVI valves (TAV-in-TAV). The management of degeneration in balloon-expandable transcatheter aortic valves (BE-TAVs) presents unique challenges, particularly regarding coronary access, hemodynamic performance, and procedural feasibility.

We describe three consecutive cases of valve-in-valve procedures aimed to treat severe structural valve deterioration (SVD) of previously implanted BE-TAVs. All cases were managed with an annular self-expanding transcatheter aortic valve (SE-TAV), NAVITOR® (Abbott, Illinois, USA), via a transfemoral approach. Procedural success was achieved without major complications. Post-procedural echocardiographic evaluation showed favorable hemodynamic outcomes with low transvalvular gradients and minimal paravalvular leak. Notably, there were no instances of coronary obstruction or conduction disturbances.

Valve-in-valve with an intra-annular SE-TAV may offer an optimal strategy in cases of BE-TAV failure by enabling annular expansion, preserving coronary access, and ensuring a favorable hemodynamic profile. Compared to supra-annular SE-TAVs, this approach minimizes the risk of coronary obstruction while preserving the possibility of a future third TAV-in-TAV procedure, if needed.

These cases highlight the feasibility and advantages of using intra-annular SE-TAV for TAV-in-TAV procedures in degenerated BE-TAVs. This approach ensures procedural safety, facilitates future interventions, and may mitigate the risks associated with coronary obstruction in TAVI reinterventions.

Keywords: TAVR, aortic valve-in-valve, reintervention, SAPIEN valve.

RESUMEN

La expansión de las indicaciones de reemplazo valvular aórtico transcatéter (TAVI) a pacientes más jóvenes y de menor riesgo ha incrementado la necesidad de estrategias a largo plazo, incluyendo los nuevos procedimientos de válvula aórtica transcatéter en válvulas previamente implantadas por TAVI (TAV-in-TAV). El manejo de la degeneración de las válvulas aórticas transcatéter expandibles con balón (BE-TAVI) presenta desafíos únicos, en particular en lo que respecta al acceso coronario, el rendimiento hemodinámico y la viabilidad del procedimiento.

Describimos tres casos consecutivos de procedimientos valve-in-valve realizados para tratar el deterioro estructural valvular (DEV) grave de BE-TAV previamente implantadas. Todos los casos se manejaron con una válvula aórtica transcatéter autoexpandible anular (SE-TAV), NAVITOR® (Abbott, Illinois, EE.UU.), mediante un abordaje transfemoral. El éxito del procedimiento se logró sin complicaciones mayores. La evaluación ecocardiográfica posterior al procedimiento demostró resultados hemodinámicos favorables con gradientes transvalvulares bajos y fuga paravalvular mínima. Es importante destacar que no se observó obstrucción coronaria ni alteraciones de la conducción.

El valve-in-valve con una SE-TAV intraanular puede ofrecer una estrategia óptima en caso de insuficiencia de una BE-TAV, al permitir la expansión anular, preservar el acceso coronario y asegurar un perfil hemodinámico favorable. En comparación con las TAV-SE supraanulares, este enfoque minimiza el riesgo de obstrucción coronaria y mantiene la posibilidad de un tercer procedimiento TAV-in-TAV si fuera necesario en el futuro.

Estos casos resaltan la viabilidad y las ventajas de utilizar SE-TAVI intraanulares para procedimientos TAV-in-TAV en BE-TAVI degeneradas. Este enfoque garantiza la seguridad del procedimiento, facilita futuras intervenciones y puede mitigar los riesgos asociados a la obstrucción coronaria en escenarios de reintervención con TAVI.

Palabras clave: TAVI, valve in valve aórtico, reintervención, válvula SAPIEN.

Revista Argentina de Cardioangiología Intervencionista 2025;16(1):19-22. https://doi.org/10.30567/RACI/202501/0019-0022

INTRODUCTION

Recent guidelines on valvular heart disease[1, 2] have expanded the indications for transcatheter aortic valve implantation (TAVI) to younger patients with lower surgical risk. As a result, the number of procedures will increase in the coming years, with long-term strategies for TAVI replacement. We present three consecutive cases of balloon-expandable transcatheter aortic valve (BE-TAV) (Edwards SAPIEN®, Edwards Lifesciences LLC, Irvine, CA, USA) degeneration treated with self-expanding annular TAV (SE-TAV) (NAVITOR®, Abbott, IL, USA).

CASE 1

An 87-year-old woman was admitted to the hospital after a syncopal episode. The subsequent assessment revealed severe structural valve deterioration (SVD) characterized by a combination of severe stenosis and grade II regurgitation in a 26-mm Edwards SAPIEN 3® BE-TAV that had been implanted 7 years earlier. The patient had a history of hypercholesterolemia and diabetes mellitus for over 20 years. A successful implantation procedure was performed using a 29-mm intra-annular NAVITOR® SE-TAV (**Figure 1**) via transfemoral access, along with additional post-dilation (with a 25-mm Edwards balloon) at 0 mm above the degenerated valve. The electrocardiogram (ECG) showed no changes in the first-degree atrioventricular block. No other adverse events were reported. Echocardiographic evaluation showed a mean gradient of 14 mmHg across the aortic valve after TAVI.

CASE 2

A 71-year-old male patient presented with severe aortic valve disease characterized by a combination of severe

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Conflicto de intereses: Dres. Léo Cuenin y Julien Adjedj declaran ser proctors de Laboratorios Abbott.

Received: 01/03/2025 | Accepted: 18/04/2025

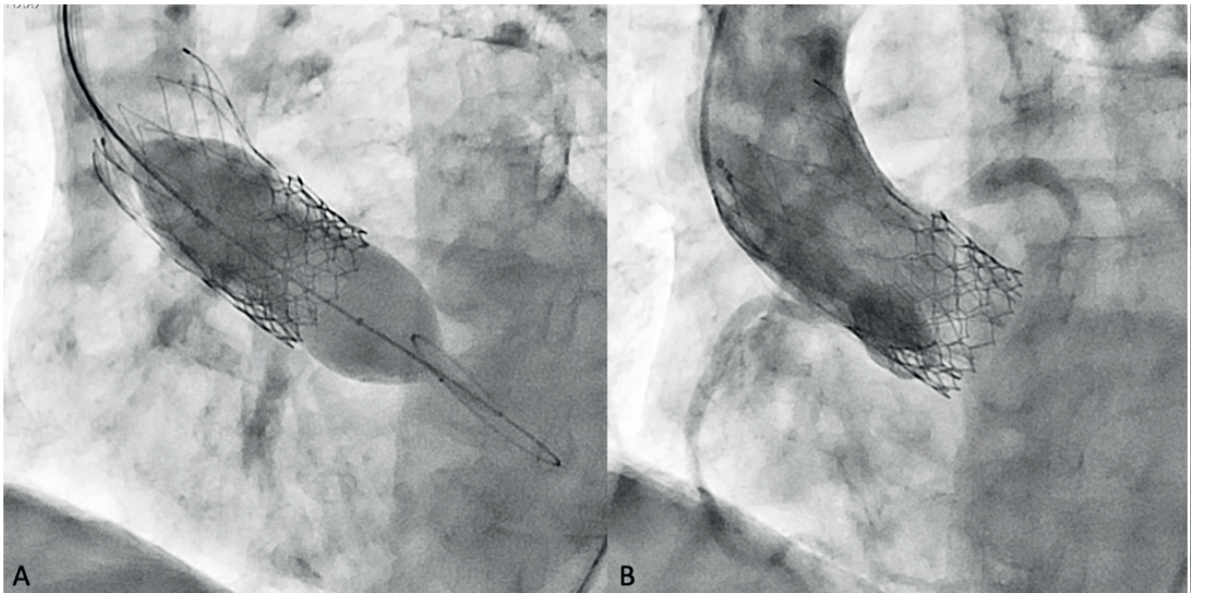

Figure 1. *A 29-mm transcatheter aortic valve (TAV) was implanted 0 mm above the degenerated valve. A balloon was inflated for post-dilation (A); there was no evidence of leak after the procedure (B).*

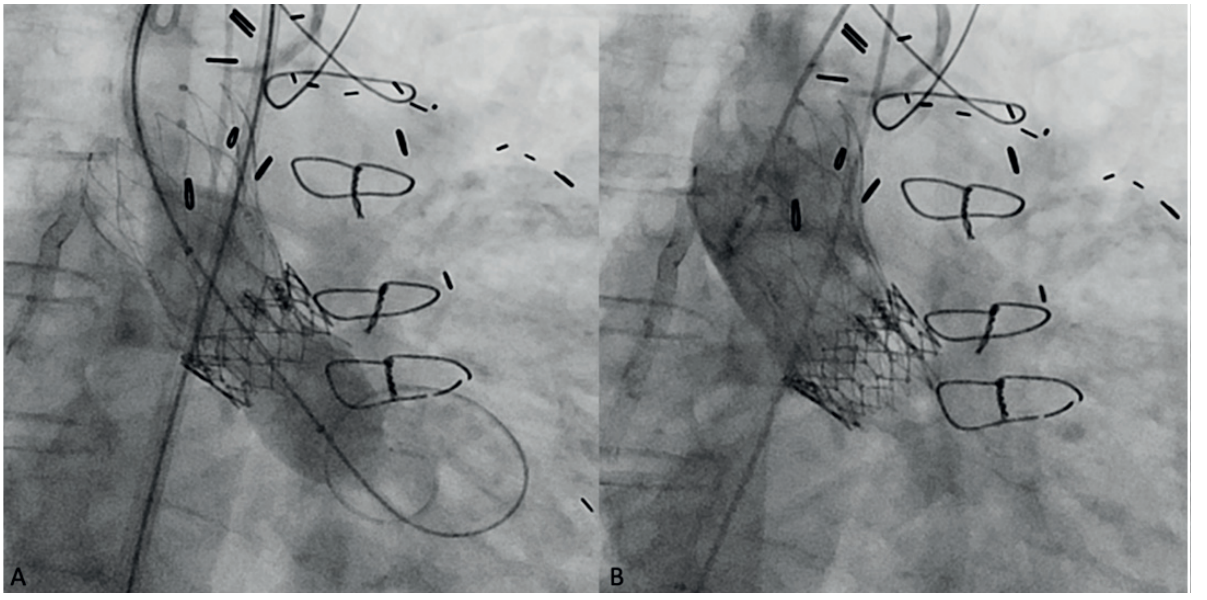

Figure 2. *A 25-mm SE-TAV was implanted and post-dilated with a balloon (A); trivial leak was observed after the procedure (B).*

stenosis and grade II–III regurgitation in a 23-mm Edwards SAPIEN XT® BE-TAV implanted 9 years earlier. The patient had a history of hypertension, diabetes mellitus, and dyslipidemia for more than a decade. Additionally, he had undergone several interventions for severe coronary artery disease, including stent implantation and coronary bypass surgery with four grafts to the left anterior descending artery, the left circumflex artery, and the right coronary artery, which were functioning normally at the time of assessment. After thorough preparation, a TAVI procedure was conducted with a 25-mm intra-annular NAVITOR® SE-TAV. The successful implantation of the new bioprosthesis was achieved via the transfemoral access. Post-dilation was performed with a 23-mm Edwards balloon, resulting in minimal paravalvular leak (**Figure 2**). There were no conduction abnormalities. Post-procedural cardiac catheterization and echocardiography revealed mean gradients of 6 mmHg and 9 mmHg across the aortic valve, respectively, after TAVI.

CASE 3

A 58-year-old short-height female presented with severe aortic valve disease characterized by severe stenosis and grade II regurgitation in a 23-mm Edwards SAPIEN XT® BE-TAV implanted 7 years earlier. Notably, she had what seemed to be a porcelain aorta due to thoracic irradiation during childhood. The TAVI procedure was complex due to the significant calcification of the ascending aorta and the prior bioprosthesis, requiring the use of a support snare. Ultimately, a 23-mm intra-annular NAVITOR® SE-TAV was successfully implanted 2 mm below the degenerated valve via femoral access, with both pre- and post-dilation using a 20-mm Edwards balloon (**Figure 3**). There was minimal para-

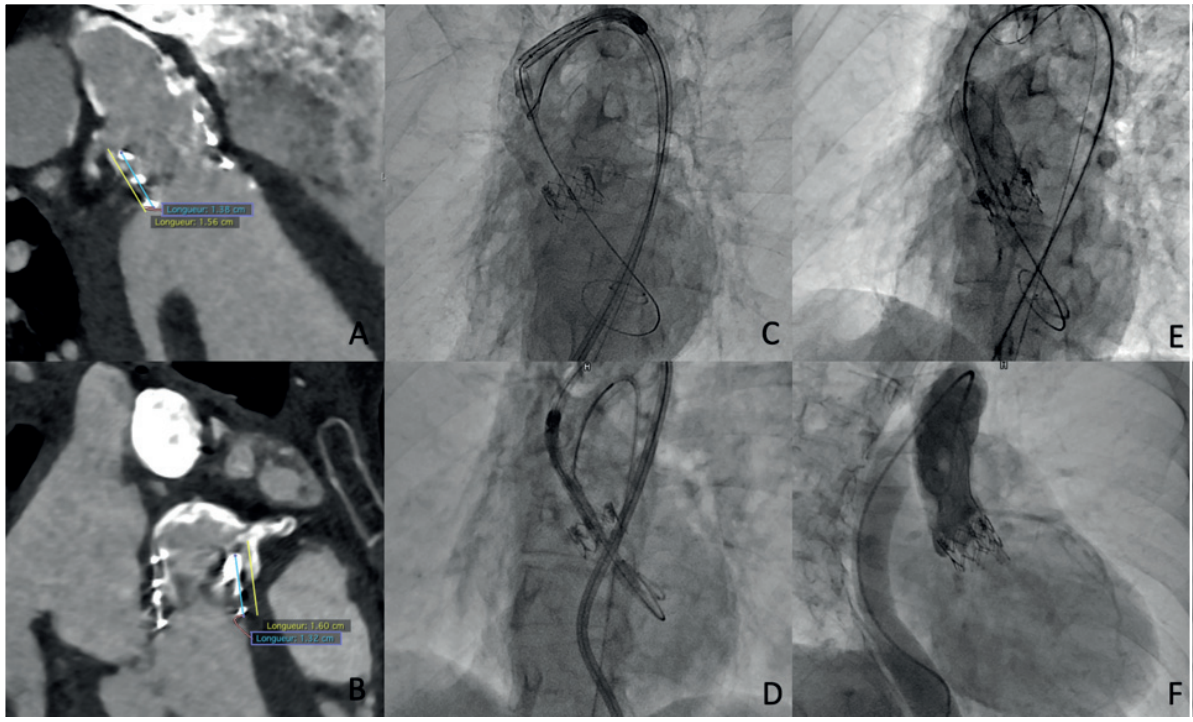

Figure 3. *Height of the prior bioprosthetic valve and left (A) and right (B) coronary arteries; intra-annular valve implanted with snare support (C, D); final result with trivial PVL after post-dilation (E, F).*

valvular leak (PVL), with no instances of conduction disturbance or coronary obstruction. Post-TAVI cardiac catheterization revealed mean gradients of 7 mmHg across the aortic valve, while echocardiography indicated a mean gradient of 5 mmHg.

DISCUSSION

The widespread adoption of TAVI in younger and lower-risk patients demands careful long-term treatment planning, accounting for valve durability and the potential need for future interventions. As patients live longer after TAVI, SVD (structural valve deterioration) becomes an increasing concern. Current evidence supports valve-in-valve as a viable strategy for the treatment of degenerated bioprostheses, but specific considerations must be addressed, particularly when dealing with the failure of BE-TAVs. TAVI reintervention procedures pose several challenges, including those described below. 1) Valve expansion and hemodynamics: BE-TAVs, such as the Edwards SAPIEN series, are designed with a rigid cobalt-chromium frame that limits annular expansion. The use of an intra-annular self-expanding TAV can help optimize the hemodynamic profile by dilating the annulus and maintaining acceptable gradients. 2) Coronary access and obstruction risk: One of the main concerns in valve-in-valve procedures is coronary obstruction, particularly when supra-annular SE-TAVs are implanted. By using an intra-annular SE-TAV such as NAVITOR®, coronary access was preserved while eliminating the need for advanced coronary protection strategies such as BASILICA or chimney stent implantation. 3) Conduction disturbances: TAV-in-TAV procedures carry an inherent risk of conduction disturbances. In this series, the implantation of an intra-annular SE-TAV did not increase the incidence of new conduction abnormalities, potentially reducing the need for permanent pacemaker implantation. 4) Durability and future TAV-in-TAV strategies: The choice of an intra-annular SE-TAV in this context allows for future implantation of a supra-annular valve, if needed. This sequential planning is crucial in young patients who may require multiple interventions during their lifetime.

Our experience suggests that intra-annular self-expanding valves (TAVs) offer an optimal balance between hemodynamics, procedural feasibility, and planning for future interventions.

The expansion of TAVI indications to younger patients means that TAV-in-TAV will be a promising future strategy starting from the first TAVR procedure. We present three cases of TAV-in-TAV using an intra-annular self-expanding valve that results favorable gradients and coronary access, with the possibility of performing a third TAV-in-TAV procedure using a supra-annular self-expanding valve in the future. Compared to TAV-in-SAVR, TAV-in-TAV allows for the expansion of the prior balloon-expandable TAV and annular dilation to create space for the intra-annular self-expanding TAV. Due to the higher risk of coronary obstruction associated with using a supra-annular self-expanding TAV, -expandable TAV is preferred in cases where a future TAV-in-TAV procedure can be anticipated[3-6]. We report the feasibility and excellent outcomes of this strategy, which does not require complex coronary protection strategies such as chimney or leaflet laceration[7, 8] prior to the second TAVI.

CONCLUSIONS

In these 3 patients, valve-in-valve intervention with an intra-annular self-expanding valve proved to be a safe and effective strategy for the treatment of BE-TAV degeneration, providing favorable hemodynamics with low gradients

and minimal paravalvular leak. This approach facilitates coronary access and minimizes the risk of coronary obstruction compared to supra-annular SE-TAVs, reducing the need for complex coronary protection strategies. The ability to expand the annulus and maintain a favorable hemodynamic profile could allow for a third valve-in-valve procedure in the future, making it a valuable strategy for younger patients who may require multiple valve replacements over their lifetime. Further studies are needed to assess the long-term durability of this approach and its impact on coronary access and reintervention feasibility. These findings reinforce the importance of strategic valve and implantation technique selection to optimize outcomes in patients undergoing TAVI reintervention.

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