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EDITORIAL
Valvular heart disease

Hardware removal is a must with endocarditis

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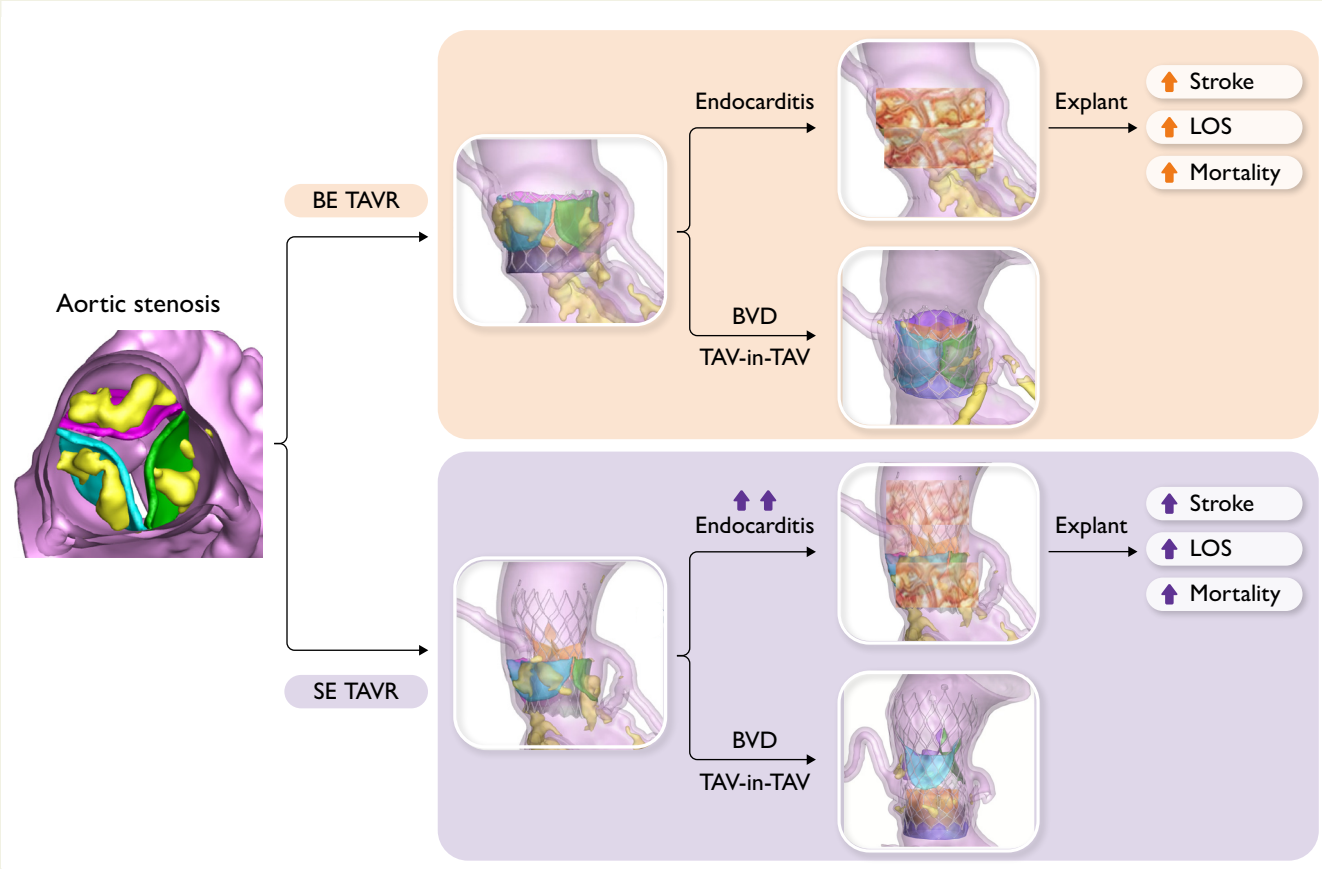
This editorial refers to 'Transcatheter heart valve explant with infective endocarditis-associated prosthesis failure and outcomes: the EXPLANT-TAVR International Registry', by M. Marin-Cuartas *et al.*, https://doi.org/10.1093/eurheartj/ehae292.

Graphical Abstract



Lifetime management of patients with aortic stenosis who undergo TAVR. BEV, balloon-expanding valve; SEV, self-expanding valve; TAVR, transcatheter aortic valve replacement; BVD, bioprosthetic valve dysfunction; TAV-in-TAV, transcatheter aortic valve in transcatheter aortic valve; LOS, length of stay.

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Although the surgical explantation of transcatheter heart valves (THVs) is increasing at a rapid rate, there is still a knowledge gap in patients with THV-associated infective endocarditis (IE) due to limited data. In this issue of the *European Heart Journal*, Marin-Cuartas and colleagues compare outcomes of THV explant for transcatheter aortic valve replacement (TAVR)-associated IE vs. bioprosthetic valve dysfunction (BVD) from the international EXPLANT-TAVR registry.[1] A deeper insight into how the different mechanisms of THV failure influence the clinical outcomes of explant procedures will help further guide clinical practice. In this retrospective, multicentre, international study, patients who had undergone TAVR from 2011 to 2022 were identified. Patients with IE as the clinical reason for THV explant were compared with patients who received a THV explant for other mechanisms of BVD. A total of 184 of 372 patients (49.5%) received THV explant due to IE, and 188 patients (50.5%) underwent THV-explant due to BVD. While the patients with pre-operative IE had a lower Society of Thoracic Surgeons (STS) mortality risk score, they were older at the time of their index TAVR procedure. Patients with IE had longer hospital stays ($P < .05$) and higher stroke rates at 30 days (8.6% vs. 2.9%, $P = .032$) and 1 year (16.2% vs. 5.2%, $P = .01$) compared with those with non-IE BVD. There was no statistically significant difference between adjusted in-hospital, 30-day, and 1-year mortality rates between the two groups. At 3 years, mortality was numerically higher in IE patients (43.9% vs. 29.6%, $P = .16$), but this difference was not statistically significant.

While endocarditis following a TAVR is a rare event, it remains highly lethal, especially since treatment requires surgical intervention in elderly patients. In randomized, adjudicated trials such as the PARTNER 3 study, the incidence of IE at 5 years after TAVR is ~2.5%.[2] The most common infectious microorganisms are enterococci, *Staphyloccus aureus*, and streptococci.[3,4] In a large multicentre registry study, multivariate analysis was conducted and identified two factors associated with a higher rate of IE after TAVR. One of these was the use of a self-expanding THV ($P = .025$) and the other was orotracheal intubation ($P = .021$).[4] The difference in IE between self-expanding and balloon-expanding valves may be explained by the ratio of stent frame to valve leaflet in the design of the two devices.[5] In this current analysis, the authors noted a higher hazard ratio (HR) for endocarditis (HR 1.24) and self-expanding THV (HR 1.19), but neither was statistically significant, possibly due to small patient numbers.

As most TAVR procedures are now performed in standard or hybrid catheterization laboratories, it is possible that initially less attention was paid to infection prevention guidelines compared with procedures being performed in an operating room.[5] This most probably improved over time with enhanced air ventilation parameters in the cardiac catheterization suites. Regardless of sterile procedures, rooms with conventional plenum positive pressure ventilation compared with operating rooms with vertical laminar flow ventilation consistently have increased bacterial counts.[6] Furthermore, the crimping of the THV prior to implantation may lead to microscopic cellular damage that may predispose the valve to inflammation and bacterial organism adhesion.[7] Paravalvular leakage can also facilitate bacterial seeding because thrombus formation can create platelet–fibrin environs that are used by microorganisms to survive and multiply.[5] Additional risk factors for TAVR-related IE are larger THV stent posts, exposure to groin bacteria during the access portion of the procedure, pacemaker lead involvement, and a younger patient age.[5]

IE is one of the main indications for a TAVR explantation procedure. It is also one of the main criteria that would exclude a patient from a TAV-in-TAV procedure.[8] In a study that analysed clinical outcomes of patients undergoing cardiac surgery after TAVR, 26% of the patients underwent a redo surgical aortic valve replacement due to endocarditis.[9] In a separate study analysing the operative characteristics and post-operative outcomes of a TAVR explant cohort, IE accounted for 20.7% of the explanted cases. When the mortality rates between the IE patients and non-IE patients were analysed, there was not a statistically significant difference between them; although the IE patients did account for significantly longer hospital length of stay (15 days vs. 7 days; $P < .01$).[10]

The results of the study by Marin-Cuartas *et al.* need to be considered within the broader context of lifetime management of aortic stenosis. The clinical outcomes of patients with IE who underwent TAVR explant are quite poor, in part due to the urgent nature of surgery, in commonly higher risk and older patients. Correspondingly, they have longer ICU stays, and higher stroke rates at both 30 days and 1 year. Additionally, the adjusted hospital, 30-day, and 1-year mortality rates are high at 12.1, 16.1, and 33%, respectively, for the entire cohort of TAVR explant patients.[1] While this analysis by Marin-Cuartas and colleagues is incredibly informative, the discussion about clinical outcomes between IE and BVD patients who undergo explant needs to be re-contextualized within that paradigm of lifetime management. Regardless of the reasons for TAVR explantation, their research highlights that the clinical outcomes of explant procedures remain consistently not encouraging. This may in part be due to the fact that ~40% of patients with THV-IE were considered at high or extreme risk for surgery prior to the TAVR procedure.[1] In the spirit of shared decision-making with young patients with aortic stenosis, it is important that TAV-in-TAV procedures are not discussed as a guarantee. Due to reasons such as BVD and IE, a young patient who received an index TAVR procedure may not be a candidate for TAV-in-TAV. Furthermore, it is important that the morbidity and mortality of the TAVR explant procedure is also discussed in-depth. It will be important to continue in the refinement for optimal resection of TAVR prostheses in order to minimize poor short- and long-term outcomes.

Due to the growing population of patients receiving TAVR, as well as its indication for expansion into low-risk patients, there is a considerable increase in the number of patients who will eventually require a surgical intervention following their index TAVR procedure.[11] The decision about a patient's index valve intervention (TAVR vs. surgery) is increasingly important for this cohort, as many of the younger patients are likely to require repeat valve interventions in the future.[11] As such, detailed pre-procedural planning that incorporates the lifetime of potential valve procedures is increasingly important (*Graphical Abstract*). Performing a future TAVR explant requires a high level of expertise with referral to dedicated heart teams to manage this complex scenario.[11] In addition to its procedural complexity, we have limited outcome data on the rare instances where surgical explantation was successful. The data we do have are limited to a few case reports and small studies; regardless, they indicate that there is a significantly higher mortality risk.[10] The importance of lifetime management during the pre-procedural planning process will become increasingly evident as we see the number of patients requiring TAVR explant increase due to the increase in young patients undergoing TAVR.[12] Lastly, it is important for clinicians to educate patients on the importance of prophylactic antibiotics prior to dental procedures in TAVR patients such as they do for those undergoing surgical valve replacement.

In conclusion, the authors are to be congratulated for their efforts to enhance our understanding of the difference in stroke rates, hospital length of stay, and mortality rates in patients undergoing TAVR explant for IE vs. BVD. Their work should stimulate the valvular heart disease

community to work to improve clinical outcomes for TAVR explant procedures in addition to standardizing TAVR explant methods and techniques. More broadly, their work illustrates the importance of lifetime management for patients with aortic stenosis. As we see more patients undergoing TAVR explantations due to the increased number of patients receiving native TAVR procedures, we should make an effort to expand this registry and use its data to provide an empirical basis to guide treatment decision paradigms.

Declarations

Disclosure of Interest

V.H.T. is a researcher/consultant with Abbott Vascular, Artivion, Atricure, Boston Scientific, Croivalve, Edwards Lifesciences, Highlife, Jenavalve, Medtronic, and Trisol. He has investment in Dasi Simulations. P.D. has investment in Dasi Simulations. T.S.-B. is a consultant with Dasi Simulations.

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