Structural Heart 8 (2024) 100281

Articles and Issues Available at ScienceDirect

Structural Heart

journal homepage: www.structuralheartjournal.org

Research Correspondence

A Comparative Study of Transcatheter Aortic Valve Implantation Views for Two Different Self-Expanding Aortic Valves

Vilhelmas Bajoras, MD [a,b,c,*,1], Ivan Wong, MD [a,1], Xi Wang, MD [a], Kamilė Čerlinskaitė-Bajorė, MD [a,b,c], Gintautas Bieliauskas, MD [a], Ole De Backer, MD, PhD [a]

[a] The Heart Centre, Rigshospitalet, Copenhagen University Hospital, Copenhagen, Denmark
[b] Clinic of Cardiac and Vascular Diseases, Institute of Clinical Medicine, Faculty of Medicine, Vilnius University, Vilnius, Lithuania
[c] Centre of Cardiology and Angiology, Vilnius University Hospital Santaros Klinikos, Vilnius, Lithuania

ARTICLE INFO

Article history:
Submitted 16 October 2023
Revised 29 December 2023
Accepted 8 January 2024
Available online 19 February 2024

Keywords:
Aortic stenosis
MSCT
TAVI

Introduction

When performing transcatheter aortic valve implantation (TAVI), the fluoroscopic projection view is important for accurate valve implantation depth. An optimal C-arm projection to implant a transcatheter aortic valve (TAV) removes the parallax of TAV delivery system and tilts in the aortic annulus plane. This projection has been defined as the double S-curve crossing point[1] and can be determined from the preprocedural computed tomography (CT) and applying a real-time intraprocedural determination of two fluoroscopic views in which there is no TAV parallax. However, this requires additional CT software, which is not routinely available to most physicians.

The use of right-left (R-L) cusp overlap view, which is typically obtained in a right anterior oblique (RAO) and caudal (CAU) fluoroscopic projection, has been suggested as an alternative to the double S-curve crossing projection. The advantages of the RAO-CAU fluoroscopic projection include that the TAV and the aortic annulus are more likely to be aligned with the imaging, as well as important foreshortening of the left ventricular outflow tract can be avoided (Figure 1a). As the R-L cusp overlap view can be easily determined preprocedurally by standard CT analysis and is often close to the double S-curve crossing point,[1] it has been a pragmatic choice to use the R-L cusp overlap view as the optimal fluoroscopic projection for implantation of the Evolut TAV (Medtronic, USA). This has been supported by recent studies indicating that this projection mitigates the risk of new conduction abnormalities when using the self-expanding Evolut TAV.[2]

The same rationale may be applicable for deployment of the self-expanding Navitor TAV (Abbott, USA). However, the Navitor delivery system (FlexNav) is more flexible than the Evolut delivery system (EnVeo), which may impact the location of the double S-curve crossing point. Therefore, the aim of this study was to compare the difference between the R-L cusp overlap view and double S-curve crossing point for both self-expanding TAV platforms.

Methods

This study includes 100 consecutive patients who underwent transfemoral TAVI using Evolut R/PRO+ (N = 50) or Navitor (N = 50) devices at Rigshospitalet, Copenhagen, Denmark. Patients with bicuspid aortic valve or prior surgical aortic bioprosthesis were excluded. For every single TAVI case, the R-L cusp overlap view and double S-curve crossing point were determined. The fluoroscopic projection corresponding with the R-L cusp overlap view was determined at preprocedural cardiac CT analysis. The double S-curve crossing point was determined by using

Abbreviations: CAU, caudal; CRA, cranial; CT, computed tomography; LAO, left anterior oblique; LCC, left coronary cusp; NCC, noncoronary cusp; RAO, right anterior oblique; RCC, right coronary cusp; TAV, transcatheter aortic valve; TAVI, transcatheter aortic valve implantation.

[1] Drs Vilhelmas Bajoras and Ivan Wong contributed equally and are joint first authors.

* Address correspondence to: Vilhelmas Bajoras, MD, Department of Interventional Cardiology, Vilnius University Hospital Santaros Clinics, Santariskiu St. 2, 08661, Vilnius, Lithuania.

E-mail address: vbajoras@gmail.com (V. Bajoras).
Twitter Handle: @vbajoras (V. Bajoras)

https://doi.org/10.1016/j.shj.2024.100281

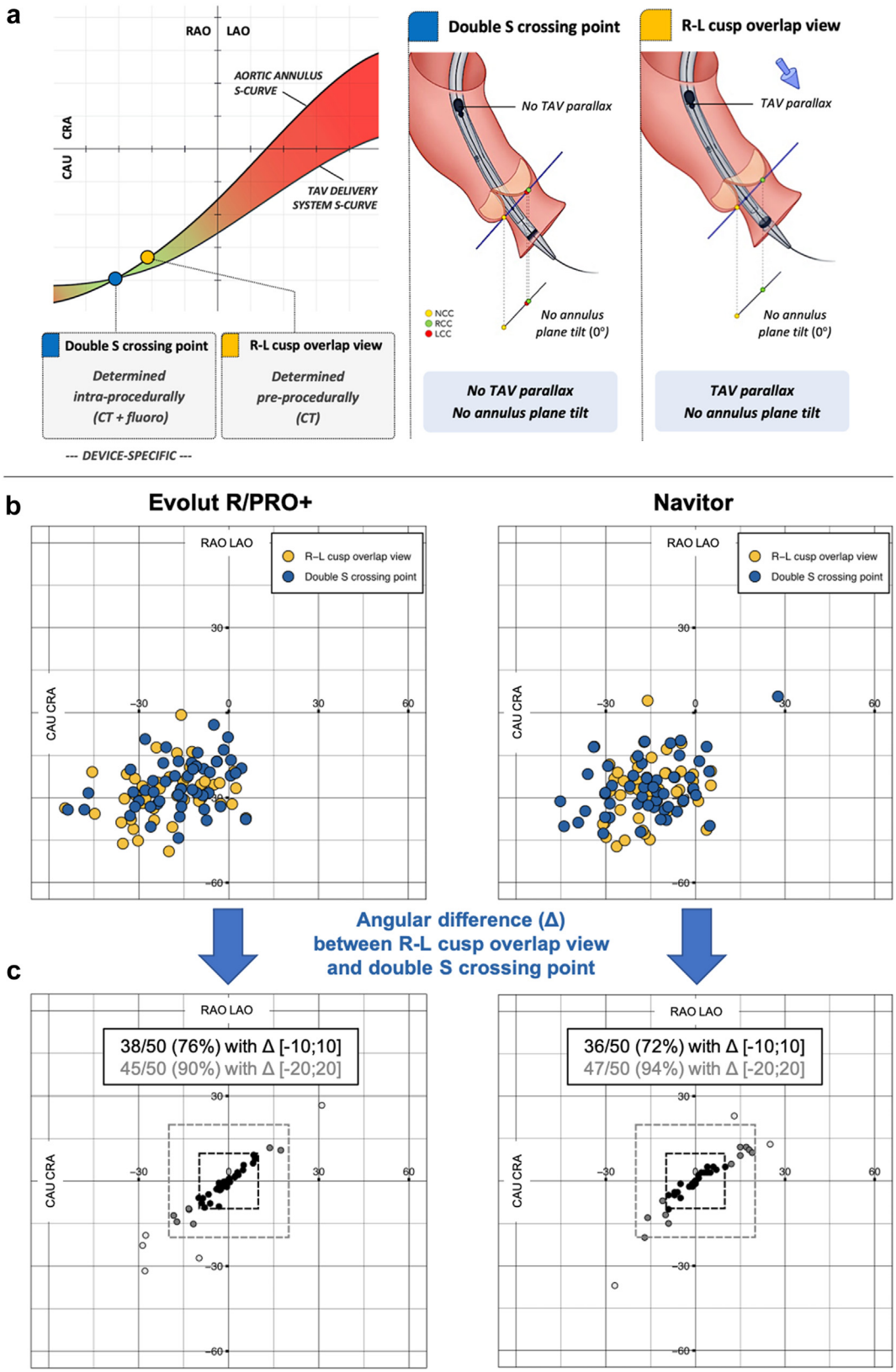

Figure 1. R-L cusp overlap view and double S-curve crossing point. (a) The R-L cusp overlap view is solely defined by the native aortic valve anatomy. The double S-curve crossing point is defined by both the aortic annulus and TAV delivery system S-curves and, hence, is device-specific. (b) The upper scatter plots show the R-L cusp overlap view and double S-curve crossing point as determined for all TAVI cases. (c) The lower scatter plots show the fluoroscopic angular difference (Δ in degrees) between the R-L cusp overlap view and double S-curve crossing point for every single TAVI case performed with either the Evolut (left plots) or Navitor (right plots) TAV.

Abbreviations: CAU, caudal; CRA, cranial; CT, computed tomography; LAO, left anterior oblique; LCC, left coronary cusp; NCC, noncoronary cusp; RAO, right anterior oblique; RCC, right coronary cusp; TAV, transcatheter aortic valve; TAVI, transcatheter aortic valve implantation.

intraprocedural fluoroscopy. After advancing the TAV delivery catheter across the aortic annulus, two different fluoroscopic views of the TAV delivery catheter without parallax (i.e., aligned ring marker) were determined in a left anterior oblique and RAO projection at least 30° apart. These two fluoroscopic projections were collected and retrospectively combined with the native aortic annulus S-curve to define the double S-curve crossing point using Fluoro-CT software 3.2 (Circle CVI, Canada) (Figure 2). Based on these data, scatter plots showing the spatial distribution of both fluoroscopic views were composed for all cases performed with either the Evolut or Navitor TAV.

Results

In the Evolut group, the R-L cusp overlap view and double S-curve crossing point were located in the RAO-CAU quadrant in 92% and 90% of cases, respectively. In Navitor cases, these same fluoroscopic views were located in the RAO-CAU quadrant in 90% and 90% of cases, respectively (Figure 1b). The angular difference between the R-L cusp overlap view and the double S-curve crossing point was ≤10° in 76% and ≤20° in 90% of TAVI cases in the Evolut group. In comparison, the C-arm angular deviation between both fluoroscopic views was ≤10° in 72% and ≤20° in

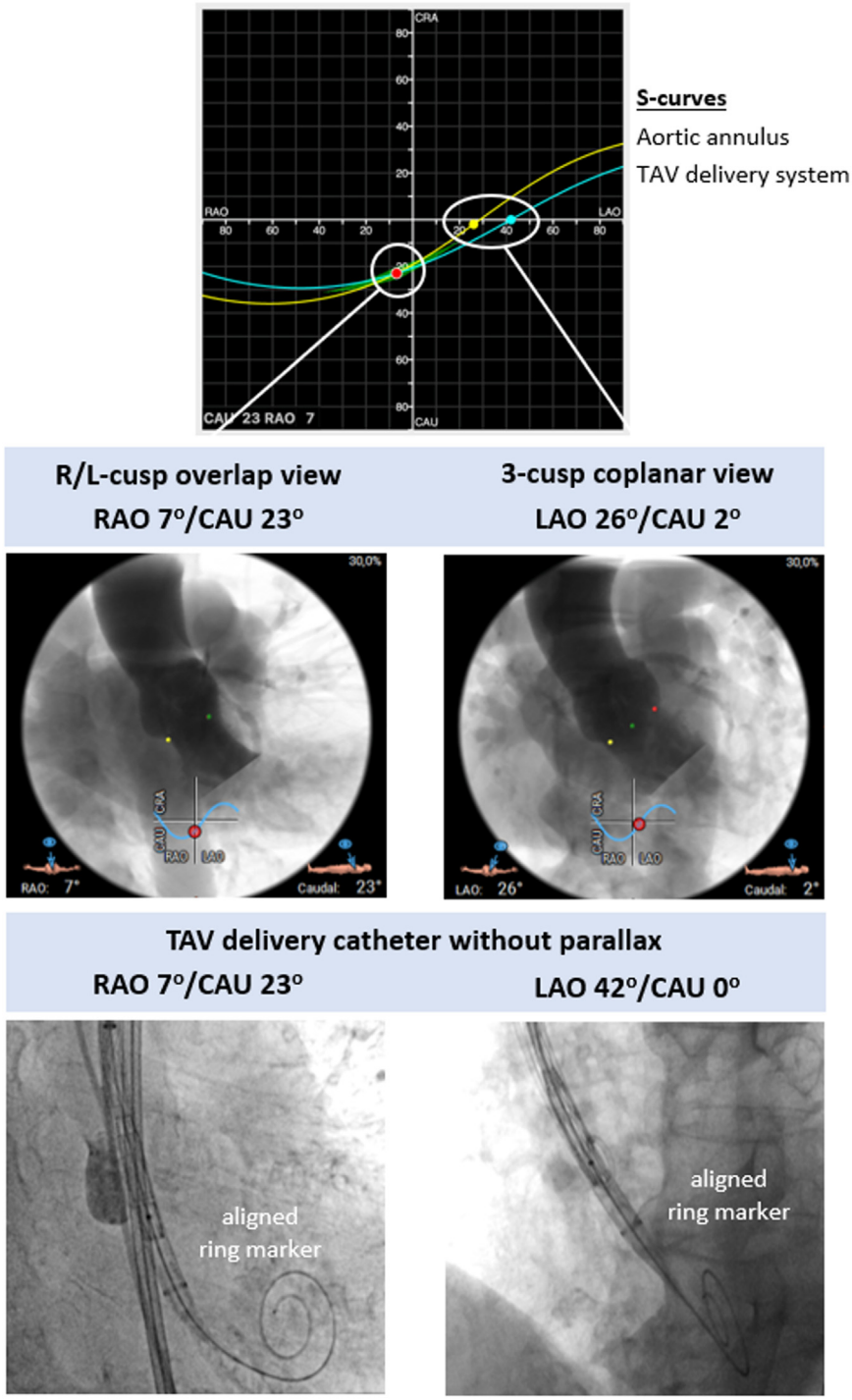

Figure 2. Case example with Navitor TAV.
Abbreviations: CAU, caudal; CRA, cranial; LAO, left anterior oblique; RAO, right anterior oblique; TAV, transcatheter aortic valve.

94% of Navitor cases (Figure 1c). Hence, there was no significant difference between the Evolut and Navitor groups in terms of the spatial angular difference between both fluoroscopic views ($\leq 10°$, $p = 0.820$; $\leq 20°$, $p = 0.712$).

Discussion

Use of the R-L cusp overlap view has become the gold standard for implantation of the Evolut valve, as it can result in a more accurate assessment of the implant depth and consequently mitigate the risk of conduction disturbances.[3,4] In addition, use of this fluoroscopic view can facilitate the assessment of neo-commissural alignment.[5]

This is the first study to describe the spatial relationship and concordance of the R-L cusp overlap view and double S-curve crossing point when using the self-expanding Navitor valve. The results in this study are in line with a previous study reporting on the close spatial proximity of both fluoroscopic views when using the Evolut platform, as well as providing additional explanatory data supporting the use of the R-L cusp overlap view for implantation of the Navitor valve.[4]

Limitations

Important limitations of this study are its single-center design and lack of generalizability to other TAV platforms. The study does not account for the impact of delivery system stiffness on the fluoroscopy projection of the S-curve for the aortic annulus plane, as determined from the preprocedural CT.

Conclusions

The study findings suggest that the R-L cusp overlap view may be a proper surrogate for the double S-curve crossing point—theoretically, an optimized fluoroscopic view for the deployment of self-expanding TAVs—and this for both the Evolut and Navitor platforms, circumventing the need for intraprocedural image processing using dedicated software.

ORCIDs

Vilhelmas Bajoras https://orcid.org/0000-0002-0917-1442
Kamilė Čerlinskaitė-Bajorė https://orcid.org/0000-0002-6753-9356
Ole De Backer https://orcid.org/0000-0002-9674-0278

Ethics Statement

The research reported has adhered to the relevant ethical guidelines.

Funding

The authors have no funding to report.

Disclosure Statement

O. De Backer, G. Bieliauskas, and L. Sondergaard have received institutional research grants and consulting fees from Abbott and Medtronic. V. Bajoras received consulting fees from Medtronic. The remaining authors declare no conflicts of interest.

References

1 Ben-Shoshan J, Alosaimi H, Lauzier PT, et al. Double S-curve versus cusp-overlap technique: defining the optimal fluoroscopic projection for TAVR with a self-expanding device. *JACC Cardiovasc Interv*. 2021;14:185-194.
2 Tang GHL, Zaid S, Michev I, et al. "Cusp-Overlap" view simplifies fluoroscopy-guided implantation of self-expanding valve in transcatheter aortic valve replacement. *JACC Cardiovasc Interv*. 2018;11:1663-1665.
3 Mendiz OA, Noč M, Fava CM, et al. Impact of cusp-overlap view for TAVR with self-expandable valves on 30-day conduction disturbances. *J Interv Cardiol*. 2021;2021, 9991528.
4 Wang X, Wong I, Bajoras V, et al. Impact of implantation technique on conduction disturbances for TAVR with the self-expanding portico/navitor valve. *Catheter Cardiovasc Interv*. 2023;101:431-441.
5 Bieliauskas G, Wong I, Bajoras V, et al. Patient-specific implantation technique to obtain neo-commissural alignment with self-expanding transcatheter aortic valves. *JACC Cardiovasc Interv*. 2021;14:2097-2108.