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Assessing the risk for coronary obstruction after transcatheter aortic valve implantation and the need to perform BASILICA: the VIVID classification

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Short title: Assessing the risk for coronary obstruction: the VIVID classification

Abbreviations:

TAVI: Transcatherter Aortic Valve Implantation

BASILICA: Bioprosthetic or native Aortic Scallop Intentional Laceration to prevent Iatrogenic Coronary Artery obstruction

MDCT: multidetector computed tomography

VTC: virtual transcatheter heart valve to coronary ostium

STJ: sinotubular junction

VTSTJ: virtual transcatheter heart valve to STJ

Introduction

The risk for coronary obstruction after TAVI (Transcatheter Aortic Valve Implantation) is high in cases where a deflected failing aortic valve leaflet is positioned in close proximity to a coronary ostium [1,2]. BASILICA (Bioprosthetic or native Aortic Scallop Intentional Laceration to prevent Iatrogenic Coronary Artery obstruction) is a novel technique in which splitting of that aortic valve leaflet can reduce that risk [3]. Although multidetector computed tomography (MDCT) and aortic root angiography are the primary imaging modalities to evaluate the anatomic relationship between the aortic valve and the coronary ostia to determine that risk, no systematic classification exists to determine if coronary obstruction risk is elevated and whether preventive techniques, such as BASILICA, could be of benefit. VIVID (Valve-in-Valve International Data) registry investigators convened in Paris, France in May 2019 in response to a need for standardization. We propose here a simplified classification that may guide operators on the risk for coronary obstruction during TAVI and

the possible need for BASILICA. Each coronary artery ostium would need to be evaluated, and subsequently classified, separately.

Methods and results

VIVID classification

Key consideration in this classification is the estimation of the most upper and lateral location of the deflected failed valve leaflet position, after TAVR (Figure 1). In many cases, we can predict the location of this top deflection by defining the plane with the top of the commissures in native valves or top of the posts of the failed stented bioprosthetic valve, assuming that the deflected leaflet would not rise significantly above that plane. In some failed bioprosthetic valves these leaflets can extend towards the top of the posts (e.g. Mitroflow, Sorin Group USA Inc, Arvada, CO, USA) while in others it would be relatively low (e.g. Epic, Abbott, Santa Clara, CA, USA). Although data from the VIVID registry reveals that VTC<4mm is associated with high risk of coronary obstruction with high sensitivity and specificity (85% and 89%, respectively), the actual threshold that will put coronary flow at risk depends also on the bulkiness of the deflected leaflet, the magnitude of coronary flow (dominancy, supply by bypass vessels, etc) and the actual lateral leaflet deflection, all of which can be occasionally difficult to predict [1]. There are other conditions in which exaggerated focus on VTC / VTSTJ may lead to overestimation of the risk for obstruction.

Discussion

Figure 1 illustrates different types of aortic root anatomies. Type I anatomy consists of a failed valve leaflet that extends fully below the coronary ostia plane and therefore the risk of

coronary obstruction is close to none; no BASILICA is necessary and conventional TAVI can be performed safely. In Type II anatomy, the failed valve leaflet may extend above part of the coronary ostium, but not near the sinotubular junction (STJ).

In Type II, if the sinus has large capacity it may accommodate the deflected failed valve leaflet without reducing blood flow to the coronary artery and the risk of obstruction would be low (type IIA). On the other hand, if the sinuses are effaced (virtual transcatheter heart valve to coronary ostium, VTC, [2] distance is <4 mm) (Type IIB) then BASILICA should be considered. In rare scenarios, in which the failed valve leaflet deflects minimally below the level of the STJ, the diagonal and vertical distances between the highest and most lateral leaflet deflection towards the STJ should be measured as well and in cases of a short distance (<2.5-3.5mm) BASILICA should be considered.

Type III anatomy represents the most complex anatomy, in which the failed valve leaflet can either extend above the STJ plane, or below the STJ plane but very near it (<2mm). Many cases of surgical valves with type III anatomy would be at risk for coronary obstruction. If the VTC is <4mm (Type IIIB), then BASILICA is recommended. If VTC ≥4 mm, then there is a need to examine whether obstruction can occur in the inflow to the sinus (the STJ level). If the virtual transcatheter heart valve to STJ (VTSTJ) distance is sufficient to allow diastolic flow to the coronaries (Type IIIA), then conventional TAVI can be performed with low risk of obstruction. There is currently no scientifically derived threshold that defines what should be considered a too narrow VTSTJ. That cutoff will probably depend on the size of the post TAVI STJ residual non-obstructed crescent area and magnitude of the coronary blood supply. If the VTSTJ distance is short (Type IIIC), then BASILICA should be

considered. VTSTJ <2.5mm is widely considered to be high risk in Type III anatomy, while VTSTJ between 2.5 and 3.5mm is considered a borderline condition.

Limitations

The current classification is limited by lack of clinical validation. We are currently retrospectively and prospectively evaluating cases that needed BASILICA to validate this model and hope that the data will provide more specific understandings of cases at risk for coronary obstruction and BASILICA-favorable anatomy.

Conclusion

Based on the above classification, we outline a treatment algorithm identifying which root anatomy may benefit from BASILICA (Figure 2). Based on the proposed algorithm, in Type I anatomy there is no need to measure the VTC/VTSTJ and in Type II there is no need to measure the VTSTJ, since in these anatomies even short distances would not result obstruction by conventional mechanism. We believe that our classification would allow for unified terminology of aortic roots that will be beneficial for patient evaluation and can help guide whether the BASILICA technique should be performed concomitantly during TAVI.

Impact on daily practice

This report describes a novel anatomical classification of aortic root types according to the risk for coronary obstruction during TAVI. This classification scheme would help unify terminology, guide operators on how to evaluate the risk for coronary obstruction and the need to utilize prevention techniques, such as BASILICA.

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Figure 1. VIVID classification. Anatomic classification of the aortic root and valve leaflet position to determine the possible need for BASILICA during transcatheter aortic valve implantation (TAVI). Each coronary artery ostium would need to be classified separately.

Figure 2. Proposed algorithm to determine aortic root anatomy and indication for BASILICA. *****Either above, at, or up to 2mm below the plane of the STJ. †The threshold to define a narrow VTSTJ is unknown and is currently considered as <2.5-3.5mm (<2.5mm is a high-risk condition and 2.5-3.5mm

Figure 1.

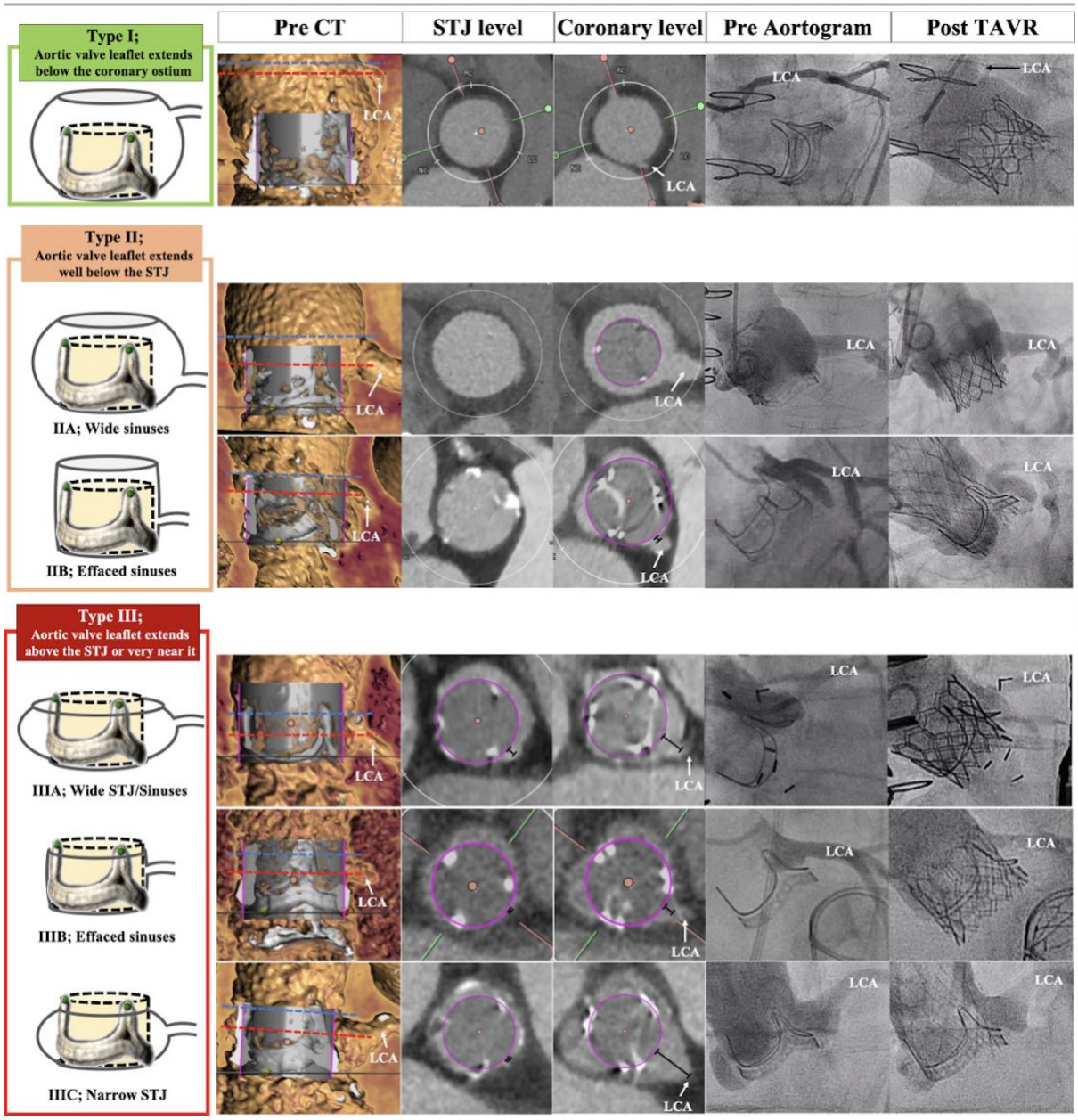

Figure 2.