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# Transcatheter aortic valve implantation and its under-estimated coronary artery disease (CAD) risk

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## Introduction

Coronary artery disease (CAD) is the leading cause of mortality among aortic stenosis (AS) patient populations due to common pathogenetic factors such as ageing, atherosclerotic plaques, multi-morbid risks including diabetes, hypertension and dyslipidaemia, or procedural related coronary access obstruction, with the revolution of transcatheter aortic valve implantation (TAVI). (1) The prevalence of atherosclerotic cardiovascular disease (ASCVD) post-TAVI aortic stenotic individuals has become an increasing trend, but its evidence remains debated. (15)

### Take Home Messages

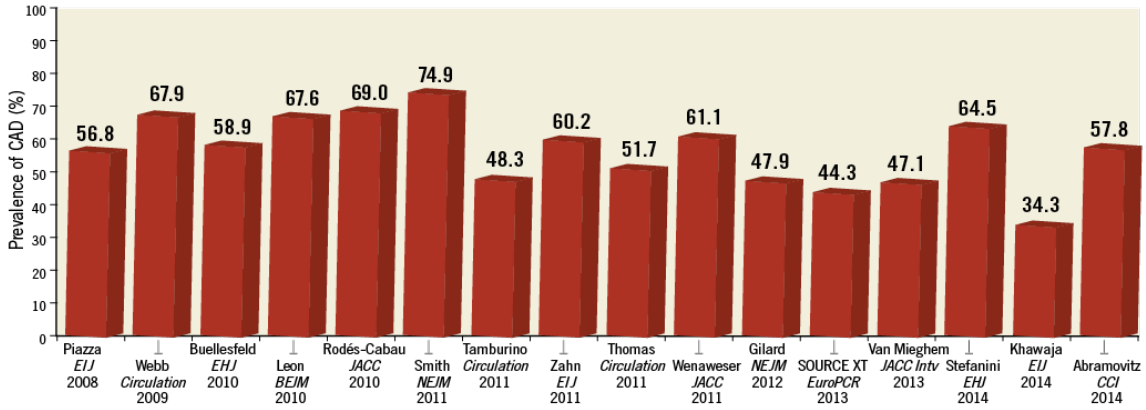
- Coronary artery Disease (CAD) is the is leading cause of mortality among patients with aortic stenosis (AS) following transcatheter aortic valve implantation (TAVI)
- Prevalence of CAD post-TAVI: its estimated prevalence is at >70 % in high-risk elderly patients due to shared common pathogenetic factors, or procedural related hemodynamic risks, following transcatheter aortic valve implantation (TAVI)
- Evaluation of CAD risk : Potential role of pre-procedural evaluation of coronary obstruction and its future challenges of revascularization is important for CVS risk prevention following TAVI (14,15)
- Future primary research is warranted to establish new recommendations for unexplained CAD risks and its management to reduce in-hospital procedural or patient-related outcomes following TAVI.

## Prevalence of CAD

In severe aortic stenosis(AS) with high-risk profile undergoing TAVI, the prevalence of CAD was found to be high at more than 70%, although its prevalence among the younger cohort with fewer cardiovascular risk factors is estimated to be around 30% . (2) It is noteworthy that the prevalence of CAD rises to 60% in elderly patients with severe aortic stenosis undergoing

transcatheter aortic valve implantation (TAVI). (2) As per recent data, the overall trends of coronary artery disease in patients with aortic stenosis undergoing TAVI are summarized in figure 1. (2-9)

Figure 1 : Prevalence of coronary artery disease (CAD) in patients undergoing transcatheter aortic valve implantation (TAV)) (Copyright Permission Taken) (2-9).




## Coronary Events following transcatheter aortic valve implantation (TAVI)

### *Pathophysiology*

Understanding the underlying pathophysiology behind the coronary events occurring after transcatheter aortic valve replacement/implantation (TAVI) is crucial with the rapid evolution of ageing population and the increased prevalence of patients with degenerative aortic stenosis across the globe.

It is highlighted the fact that the vast majority of the coronary events or coronary artery disease occurring after transcatheter aortic valve implantation (TAVI) are potentially related to an atherothrombotic event(10) , attributed by two mechanisms:

(1) due to progression of pre-existing coronary artery disease (CAD), or

(2) due to the failure of revascularization techniques (percutaneous coronary intervention)prior to the TAVI procedures.

Furthermore, it is noteworthy of other potential contributing mechanisms, ranging from an impaired coronary flow dynamic, coronary hypoperfusion related to the transcatheter aortic valve

implantation (TAVI) bio-prosthesis, to a coronary embolic event related to subclinical leaflet thrombosis in bioprosthetic aortic valve leaflets ,etc. (10).

Overall, it is suggested that further studies are required to better understand the underlying pathophysiological mechanisms behind coronary events after TAVI and to capture the full extent of the type and frequency of coronary events following TAVI procedures.

## Coronary Access Challenges Post-TAVI

In recent decades, it is important to understand the challenges of future diagnosis of coronary artery disease in patients with aortic stenosis following transcatheter aortic valve implantation (TAVI). It is highlighted that the presence of a bio-prosthetic aortic valve device could potentially make the selective coronary ostia catheterization difficult and challenging or even impossible for proceeding coronary angioplasty or intervention if needed.

### *Coronary obstruction*

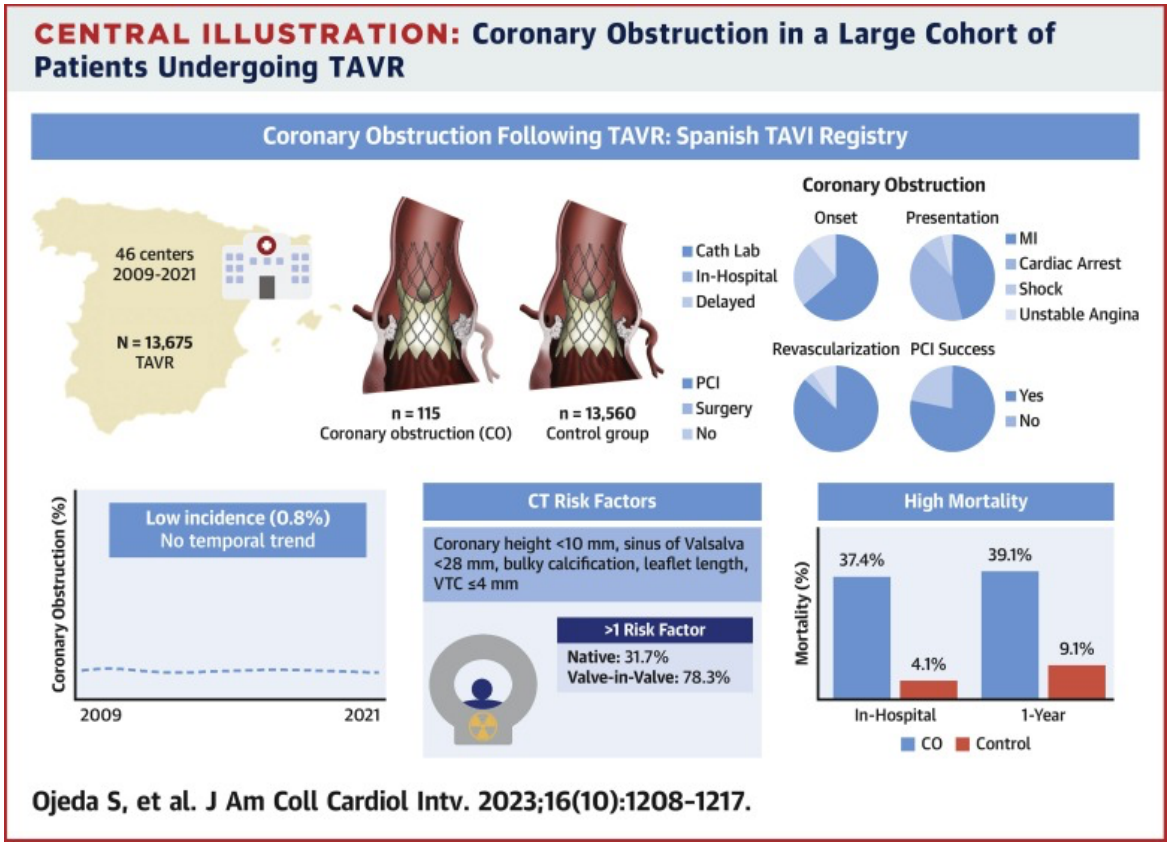
Coronary obstruction is defined as the evidence of a new, partial or complete, obstruction of a coronary ostium or ostia, detected during angiographically or echocardiography , due to the proposed mechanisms, either by the prosthetic valve itself, or the native valve leaflets, including calcifications, or dissection , which occurred during or after transcatheter or aortic valve implantation. (4) In other words, the coronary obstruction( known as acute CAO), following TAVI typically manifests as abrupt haemodynamic instability with rapid progression to cardiogenic shock and sudden cardiovascular deaths due to ventricular arrhythmias. Its incidence is under-estimated and its association with pre-existing coronary artery disease (CAD) has been poorly understood.(12)

A large multi-centre registry (14) has reported the 30-day cardiovascular deaths of 22 % in patients successfully treated with revascularization (percutaneous coronary intervention , PCI ) following acute coronary obstruction (CAO) after the valvular replacement procedures. A further 50 % of patients with CAO were reported as treated with urgent coronary by-pass grafting (CABG) and unfortunately, a striking 100 % mortality rate within 30-days among patients with acute coronary obstruction, who have unsuccessfully revascularized with percutaneous coronary intervention (PCI).(14)

The recent largest nationwide TAVI registry, (13) has analysed the incidence of coronary obstruction (CO) after TAVI with its in-hospital and one-year clinical outcomes . Of 13,675 patients undergoing TAVI, it is noted that the 0.8 % (115) patients presented with CO, mainly during the procedure. Its central illustration of real-world incidence of coronary obstruction has been illustrated in figure 2. Pre-implantation computed tomography(CT) risk factor analysis helps guide future revascularization and implantation choice. (13)

Overall, it has been highlighted the fact that coronary obstruction, is a rare, but fatal complication that did not decrease over time. It is important to elaborate the predisposing factors in a subset of patients undergoing TAVI and the frequently challenging treatment of coronary revascularization in future. (13)

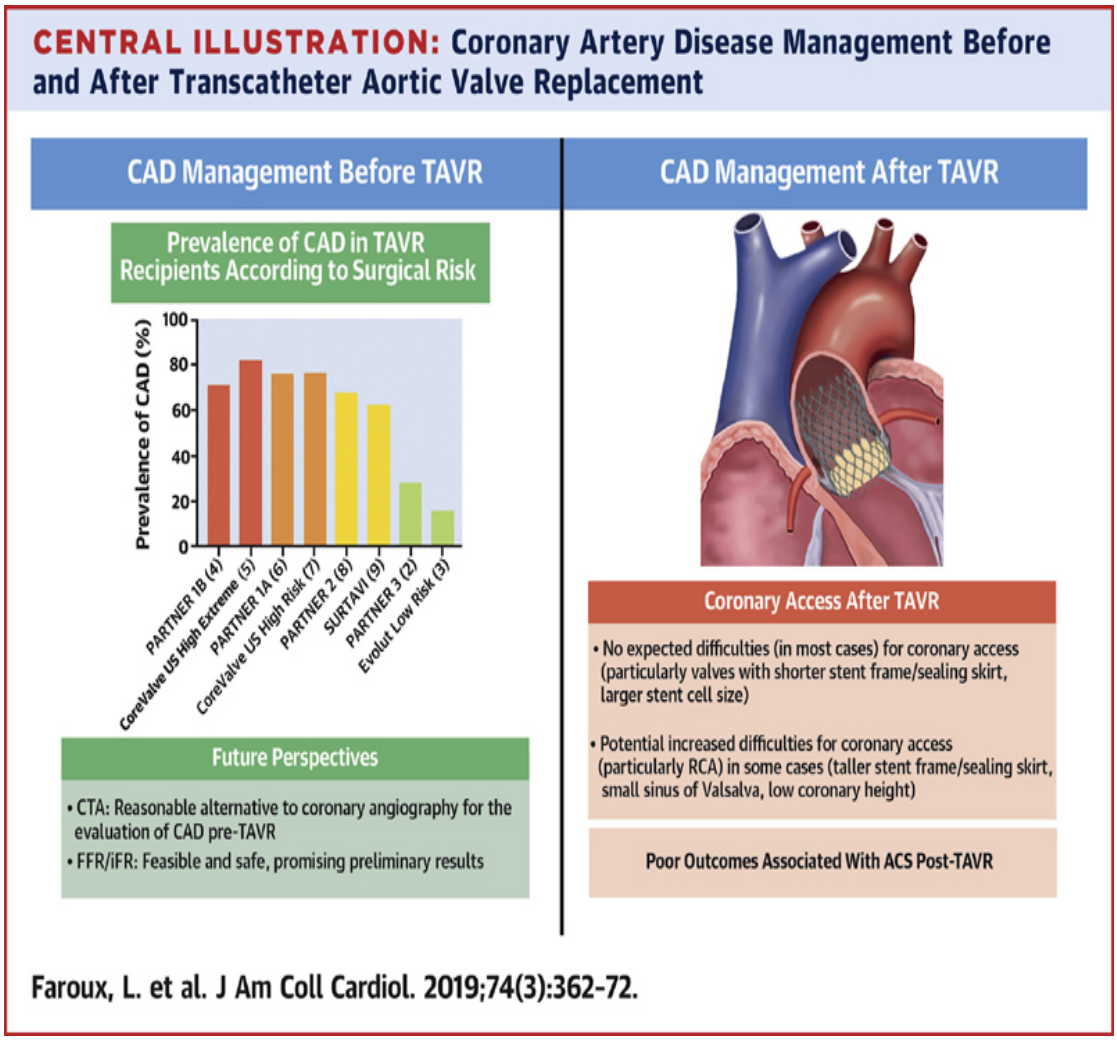
**Figure 2: Central illustration of 'Coronary obstruction' in a large cohort of patients undergoing transcatheter aortic valve implantation (TAVI) (copyright permission taken)** [13] (13)



### *Role of CAD management*

One state-of-art-review (15) highlighted the role of CAD management before and after TAVI (summarized in figure 3 ) with potential new guidelines on its secondary atherosclerotic risk assessment in recent years. Most of the patients with coronary events following TAVI are treated in centres with no TAVI experience and this has clearly highlighted the importance of new guidelines regarding selective revascularization strategy and careful evaluation of management option in this high-risk population

**Figure 3 demonstrates coronary artery disease management before and after transcatheter aortic valve implantation (TAVI) (copyright permission taken) (15)**



**Conclusion and Future Perspectives**

Coronary artery disease (CAD) remains one of the most common but challenging co-morbidities among patients undergoing transcatheter aortic valve implantation (TAVI). Apart from better understanding the pathophysiology and establishing the most appropriate treatment strategy , more robust studies are needed to understand coronary access and coronary obstruction following TAVI. Overall, this editorial highlight the importance of establishing clear recommendations regarding unexplained coronary artery disease risk with the recent revolution of transcatheter aortic valve implantation (TAVI).

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