Risk of Coronary Obstruction in Transcatheter Aortic Valve Replacement

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The standard operation for symptomatic severe aortic stenosis (AS) is surgical aortic valve replacement (SAVR). The annual number of isolated SAVR procedures has increased year after year and reached 6,980 in 2012 in Japan. Transcatheter aortic valve replacement (TAVR) has emerged as an alternative treatment for high-risk patients with AS. The balloon-expandable Edwards-SAPIEN XT prosthesis (Edwards Lifesciences, Irvine, CA, USA) and the self-expandable CoreValve revamping prosthesis (Medtronic Inc, Minneapolis, MN, USA) have been approved by the Japanese Circulation Journal Official Journal of the Japanese Circulation Society http://www.j-circ.or.jp

Figure 1. Aortic root anatomy. (Upper left) Of the 3 calcified cusps, 2 are not as calcified or thick. LCC, left coronary cusp; NCC, non-coronary cusp; RCC, right coronary cusp. (Upper right) Annulus size and area. (Middle) Size of Valsalva sinuses. (Lower) Right and left cusps and ostium height, and cusp length. LCA, left coronary artery; RCA, right coronary artery. Preoperative MD-CT showed low take-off of both the right and left coronary arteries (10.9 mm and 10.3 mm, respectively) in addition to small right and left coronary sinuses (23.8 mm and 22.3 mm, respectively). This patient had a high risk of coronary obstruction from transcatheter aortic valve replacement.
Obstruction of the left or right coronary ostium is a rare complication. This lethal complication is caused by a displaced, calcified native leaflet or the transcatheter valve itself. The incidence of coronary artery obstruction was 1.2% in France and 0.4% in Germany in their respective registries. Meta-analysis showed the incidence of coronary obstruction as 0.7% (12/1984) (95% confidence interval: 0.4–1.1%).

A recent multicenter analysis of 6,688 patients from 81 centers in North America, Europe, South America and Asia from January 2007 to January 2013 showed 0.66% (95% confidence interval: 0.46–0.85%) of coronary artery obstruction. Although the incidence was low, 30-day mortality was as high as 40.9%. In that series, percutaneous coronary intervention (PCI) was attempted in 75% of the patients and was successful in 81.8%. The left coronary artery was the most commonly occluded by a bulky calcified leaflet. Other risk factors of occlusion were low take-off of the coronary artery from the annulus, a shallow sinus of Valsalva, and a balloon-expandable valve. Most of the patients (67.9%) who had coronary obstruction had both left coronary height <12 mm and a sinus of Valsalva diameter <30 mm compared with 13.3% of patients in the non-occluded patients (P < 0.001). It is generally accepted that a distance between the coronary ostium and the annulus <10 mm, a sinus of Valsalva diameter <28 mm, and a height of the Valsalva sinus <15 mm are risks for coronary occlusion.

A study in this issue of the Journal demonstrates the coronary orifices and aortic root structures by 64 multidetector-row computed tomography (MDCT) to identify the risk of coronary complication during SAVR with a bioprosthesis or TAVR. A coronary orifice near the commissure was found in 31 cases (78%). The height of the coronary orifice was ≤10 mm in 39 cases (9.8%). For SAVR with a bioprosthesis in patients with the near commissure and low take-off of the coronary orifice, stitch rotation of the stent post with intranipple implantation could avoid coronary flow obstruction. Intraoperative findings of coronary orifice anomaly can modify the implantation technique with or without coronary artery bypass grafting. However, treatment of coronary obstruction could not be prepared in advance without knowing the low take-off of the coronary orifice in TAVR. The mechanism of coronary obstruction in TAVR is that the small Valsalva sinus cannot accommodate the shifted bulky, calcified leaflet, and it compresses the low left coronary ostium. In Japan the incidence of coronary occlusion was 1.5% (24/1620; 95% confidence interval: 0.89–2.0%; unpublished data), which was twice as high as in Western countries. Considering the percentage of low coronary ostia in Japanese was the same as in Western populations, the incidence of a small sinus Valsalva and/or bulky calcified leaflets must be high. However, these issues have not been reported to the best of my knowledge.

Management of coronary artery obstruction after TAVR is PCI or surgical revascularization with or without cardiopulmonary bypass. In a recent systematic review of coronary obstruction, PCI was attempted in 96% of cases and was successful in 91%. Aortic root angiography during pre-implant balloon dilatation of the aortic valve may be helpful to detect the possibility of coronary occlusion. A guidewire should be inserted in the left coronary artery in advance if there is any possibility of coronary obstruction, before transcatheter valve is launched, because it is difficult to insert a guiding catheter once coronary occlusion occurs and hemodynamic instability occurs rapidly.

At the National Cerebral and Cardiovascular Center, an 87-year-old woman became a candidate for TAVR with a SAPIEN XT. She underwent off-pump coronary artery bypass grafting to the left anterior descending artery, posterolateral branches, and the posterior descending artery 12 years ago. Preoperative MD-CT showed low take-off of both right left coronary arteries (10.9 mm and 10.3 mm), in addition to small right and left coronary sinuses (23.8 mm and 22.3 mm). Because she had bypass grafting to all coronary territories, transapical TAVR with SAPIEN XT 23 mm was attempted without a risk of myocardial ischemia even if coronary obstruction occurred. Although the device itself was very close to the left coronary ostium on post-TAVR aortography, the coronary ostium was free from leaflet obstruction because the right and left leaflets were not so bulky. We should consider not only the coronary ostial position but also the size of the Valsalva sinus and aortic valve leaflets. Risk stratification by these 3 factors evaluated by MD-CT is mandatory before TAVR.

Disclosures
The author is a consultant to Edwards Lifesciences.

References
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