Case Reports

Delayed-Onset Left Main Coronary Artery Obstruction

More than 24 Hours after Balloon-Expandable Transcatheter Aortic Valve Replacement

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Coronary obstruction during or after transcatheter aortic valve replacement is a rare and catastrophic sequela that occurs most frequently just after valve implantation. Even rarer is the delayed clinical presentation, in some few patients, of coronary obstruction on the day after self-expandable valve implantation. Here we describe a case of balloon-expandable (not self-expandable) transcatheter aortic valve replacement, followed by partial obstruction of the left main coronary artery on the day after that procedure in a 93-year-old man, despite normal left ventricular contraction just after valve implantation. Visual evaluation of the echocardiogram for left ventricular wall motion was not sufficient, by itself, to achieve early diagnosis of the obstruction.

We performed emergency percutaneous coronary intervention. Ninety days after the procedure, the patient was in New York Heart Association functional class I. ***(Tex Heart Inst J 2016;43(5):441-5)***

Key words: *Aged, 80 and over; aortic valve stenosis/therapy; heart valve prosthesis implantation/adverse effects/methods; male; predictive value of tests; risk factors; treatment outcome*

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Coronary obstruction during or after transcatheter aortic valve replacement (TAVR) is a rare and often catastrophic sequela, which generally occurs shortly after the implantation.[1] Yet in some patients who have undergone TAVR, the clinical presentation of coronary obstruction is delayed until as late as the first day after implantation. To date, most of these cases with delayed presentation have involved the implantation of self-expandable valves.[1]

We describe a case of balloon-expandable TAVR complicated by delayed clinical presentation of partial left main coronary artery (LMCA) obstruction—evident on the first day after TAVR in an elderly patient, despite normal left ventricular (LV) contraction immediately after valve implantation. Mere visual evaluation of the echocardiogram for LV wall motion was unable to achieve early diagnosis of LMCA partial obstruction.

Case Report

A 93-year-old man presented at our hospital with severe aortic stenosis and New York Heart Association (NYHA) functional class III symptoms, including exertional dyspnea and syncope. His medical history included chronic renal failure and pacemaker implantation for sick sinus syndrome. An echocardiogram showed a narrowed aortic valve (0.62-cm^2 area by the continuity equation), with a 75-mmHg mean gradient, a 131-mmHg peak gradient, and an LV ejection fraction of 0.70.

The patient was evaluated for surgical aortic valve replacement but was declined by our heart team because of his high surgical risk (logistic EuroSCORE, 7.42%; Society of Thoracic Surgeons mortality risk, 19.1%; Clinical Frailty Scale score,[2] 3). A computed tomographic (CT) scan and transthoracic echocardiography suggested conditions suitable for transfemoral TAVR, although the CT scan revealed large calcium nodules on the left and noncoronary leaflet tips (Fig. 1). The aortic annular area on CT was 4.16 cm^2 (Fig. 2), suitable for the implantation of a 26-mm Edwards Sapien XT valve (Edwards Lifesciences LLC; Irvine, Calif). The area-derived and perimeter-derived virtual diameters were 23 and 23.7 mm, respectively. The sinus of Valsalva was 33.8 mm in diameter (the sinus plane was defined as the plane perpendicular to the center line that shows the largest cusp dimensions).[3] Results of a CT evaluation showed coronary ostial heights (defined as the distance relative to the annular plane: 17.7 mm for the right coronary artery (RCA) and 11.9 mm for the LMCA) (Fig. 3). The right and left coronary leaflet lengths were 16.2 and 13.4 mm, respectively (Fig. 4). Anatomic characteristics from CT findings suggested that the patient was at a high risk of coronary obstruction, because the left coronary leaflet length was longer than the height of the LMCA. After obtaining the patient's consent, we implanted an Edwards SAPIEN XT valve via femoral access with the use of general anesthesia and with the aid of fluoroscopic and transesophageal echocardiographic guidance. Before valvuloplasty with a 23-mm balloon, we confirmed the LMCA occlusion with the aid of simultaneous supra-aortic angiography (Fig. 5). We then advanced, under fluoroscopic guidance, a Neo's Soft soft-tipped guidewire (Asahi Intecc; Nagoya, Japan) into the left anterior descending coronary artery (LAD) for LMCA protection (Fig. 6). After a guidewire was introduced into the distal LAD,

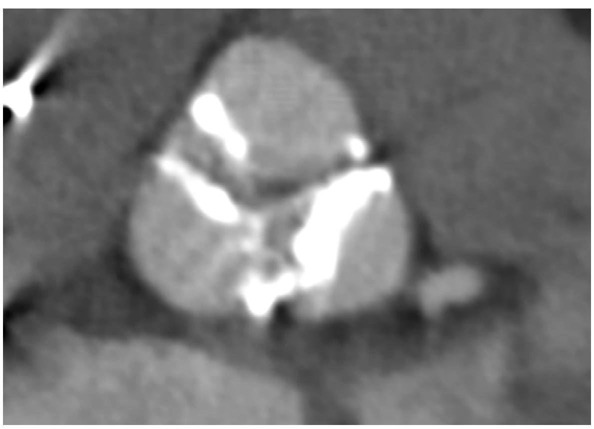

Fig. 1 *Computed tomography confirmed the presence of large calcium nodules on the tips of the left and noncoronary leaflets.*

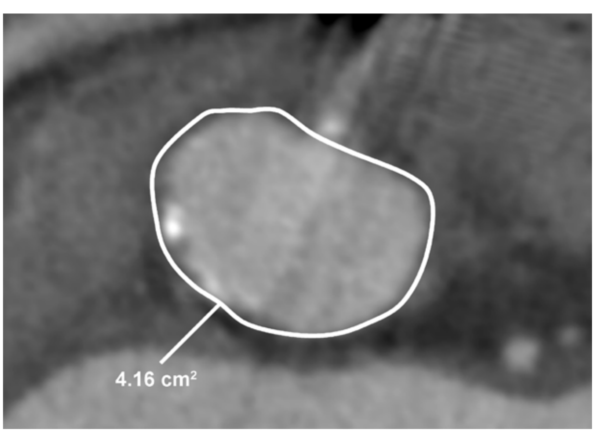

Fig. 2 *The annular dimensions were approximated via computed tomography by estimating minimum and maximum diameters, with subsequent averaging (26 × 18.6 mm), to obtain a perimeter (74.7 mm) or cross-sectional area (4.16 cm²), followed by the calculation of derived diameters.*

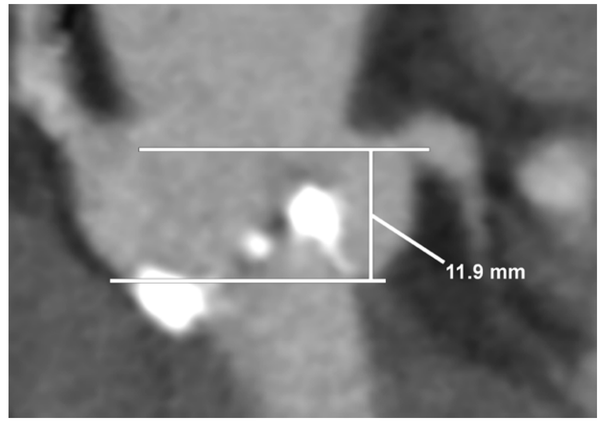

Fig. 3 *The height of the left main coronary ostium was 11.9 mm, by computed tomography.*

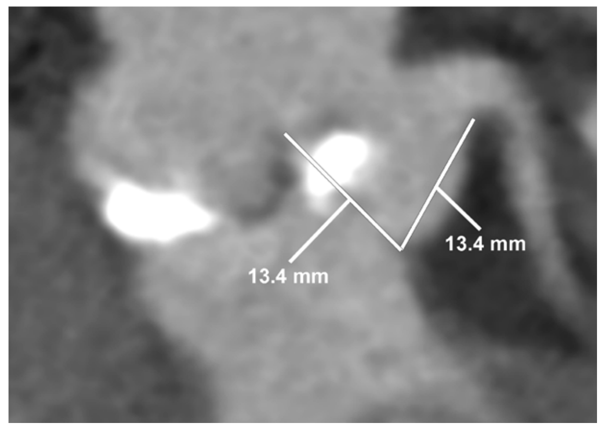

Fig. 4 *Each side of the left coronary leaflet was 13.4 mm long, by computed tomography.*

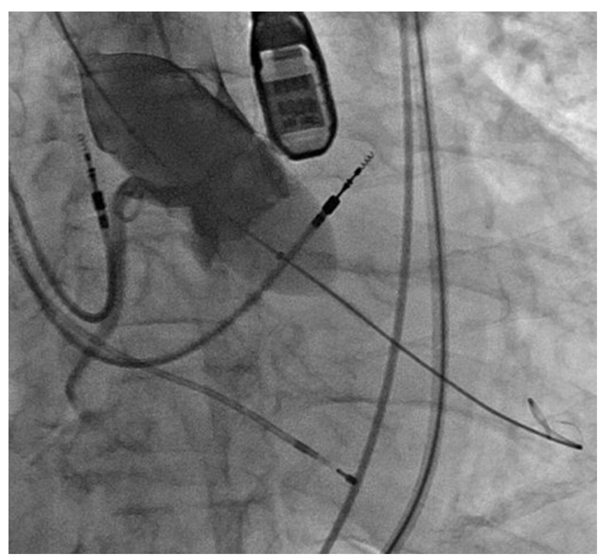

Fig. 5 *Supra-aortic angiography, performed during balloon aortic valvuloplasty to evaluate coronary artery perfusion, suggests a high risk of left main coronary artery occlusion because of that artery's lack of visibility.*

Supplemental motion image is available for Figure 5.

the valve was implanted by our underfilling a balloon (intentionally) to 1.5 mL, under rapid pacing. Fluoroscopy confirmed that the valve was well positioned and well seated. Although supra-aortic angiography after the TAVR procedure showed a fainter image of the left coronary artery (LCA) than of the RCA, we completed the procedure because LV contraction was preserved on both angiography and transesophageal echocardiography (TEE) with no episodes of ventricular tachycardia or ventricular fibrillation (Fig. 7).

Because of the patient's impaired renal function, we did not perform selective coronary angiography before ending the TAVR procedure. However, the patient suddenly developed nonsustained ventricular tachycardia and congestive heart failure (CHF) approximately 3 hours after valve implantation. At this point, his electrocardiographic findings did not suggest coronary ischemia, and an echocardiogram did not reveal ischemic regional hypokinesis in LV wall motion. However, on the day after TAVR, his serum creatine kinase (CK) level was elevated to 7,014 U/L, with a CK-MB isozyme level of 1,050 U/L. An echocardiogram showed regional anterior, lateral, and posterior hypokinesis with normal inferior wall function. These findings indicated the presence of a LMCA occlusion, despite a well-functioning prosthesis, with a 2.2-cm^2 area and 7-mmHg mean gradient. In the presence of CHF with LV regional hypokinesis and elevated CK, we attempted emergency coronary angiography. Our attempts then failed to engage the LMCA coaxially, because native-valve calculus lay between the ostium of the LMCA and the guiding catheter. The left coronary sinus injection showed that native-valve calculus almost sealed the LMCA ostium—with the calculus compressed behind the prosthesis and coronary flow maintained (Fig. 8).

Emergency percutaneous coronary intervention was performed. A 4 × 18-mm bare-metal stent was deployed from the body of the LMCA. A final angiogram revealed an acceptable outcome (Fig. 9). After 1 month of CHF treatment, the patient was discharged from the hospital in good health. His NYHA class status had improved from class III before TAVR to class I at his 90-day follow-up examination.

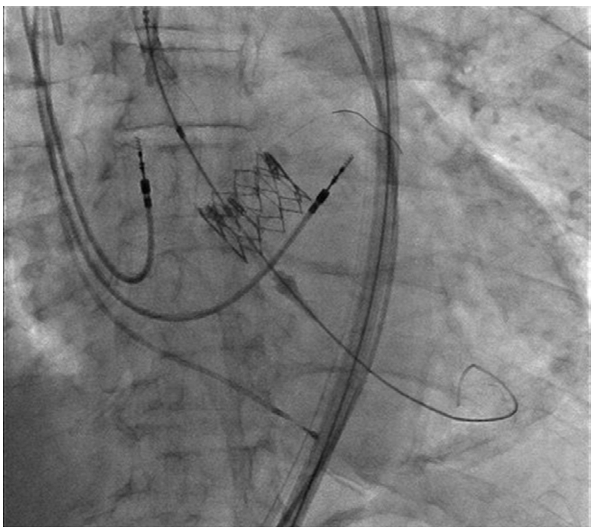

Fig. 6 *Under fluoroscopic guidance, a soft-tipped guidewire was advanced through the left main coronary artery (LMCA) into the left anterior descending coronary artery during valve implantation. Note that the guiding catheter is disengaged far above the LMCA ostium.*

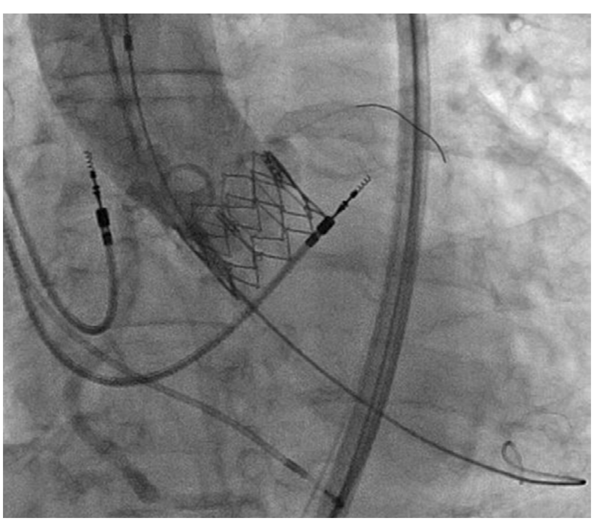

Fig. 7 *Angiogram just after valve implantation shows well-preserved left ventricular contraction.*

Supplemental motion image is available for Figure 7.

Fig. 8 *Coronary angiogram shows calcification of the left coronary cusp that nearly blocked the left main coronary ostium.*

Supplemental motion image is available for Figure 8.

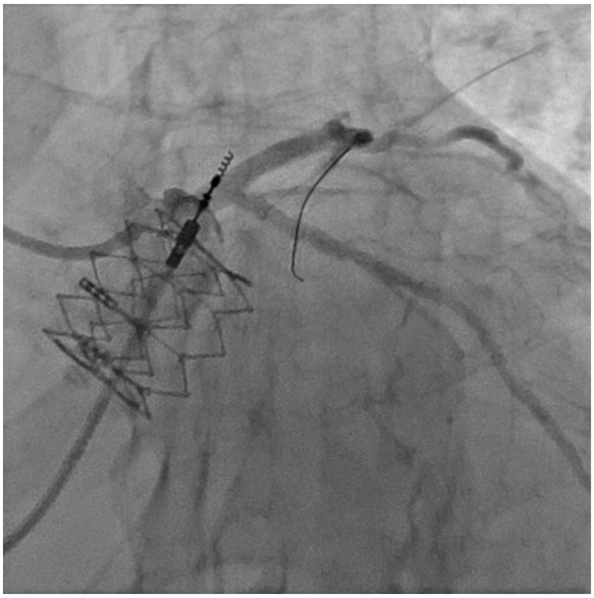

Fig. 9 *Final angiogram reveals an acceptable outcome. Supplemental motion image is available for Figure 9.*

Discussion

We found 2 important clinical issues. Despite normal LV contraction just after valve implantation, ischemic regional hypokinesis in LV wall motion can become evident more than 24 hours after balloon-expandable TAVR because of partial LMCA obstruction. Echocardiographic evaluation of LV wall motion by vision alone sometimes cannot detect the ischemic regional hypokinesis that immediately follows an occurrence of LMCA obstruction.

The timing of the clinical presentation of coronary obstruction after TAVR is of great concern because it most frequently occurs after dilation, after balloon valvuloplasty, or after valve implantation.[1] However, in approximately 10% of cases, it does not occur during or just after the procedure, but within the first 2 days after TAVR. We should note that these late-onset cases occurred in association with a self-expandable CoreValve® (Medtronic, Inc.; Minneapolis, Minn),[1] probably indicating that further expansion of the nitinol stent frame in the 48 hours after TAVR can play a role. On the other hand, the present case underscores that late partial LMCA obstruction can also occur with a balloon-expandable valve, probably because of intermittent contact between the bulky calculus of the left coronary cusp and the LMCA ostium during the cardiac cycle. Consequently, intermittent coronary flow limitation might cause a delayed clinical presentation of partial LMCA obstruction.

In retrospect, we realize that partial LMCA obstruction (not enough to cause immediate hemodynamic compromise) might have caused slightly poor contrast enhancement of the LCA just after implantation. Indeed the present case suggests a time lapse between the angiographic partial obstruction and the development of hemodynamic compromise. To more rapidly identify partial LMCA obstruction, we should have paid more attention to the differences between the LCA and RCA angiographic images during supra-aortic angiography. However, even that might have been insufficient. Considering the lethal consequences of LMCA obstruction, we now believe that formal coronary angiography should have been performed to detect an obstruction—despite the patient's poor renal function.[4] Moreover, for cases with a high likelihood of LMCA obstruction, as shown here, it is advisable to insert a folded stent into the LAD before valve implantation, to enable immediate LMCA snorkel stenting. If introduced, repositionable and retrievable valves might be yet another option when treating high-risk cases.

The visual evaluation of LV wall motion by echocardiography alone sometimes cannot detect the presence of ischemic regional hypokinesis caused by partial LMCA occlusion. Indeed we did not identify this phenomenon until the day after the procedure. Although TEE is useful for detecting this potential sequela, visual evaluation alone is insufficient. The potential of a TEE "aliasing" phenomenon upon LMCA color-mapping or peak diastolic velocity should have been considered after valve implantation, because these parameters are reported to be useful in detecting critical ostial LMCA stenosis.[5,6]

Conclusion

In reporting a case of late-onset LMCA partial obstruction after balloon-expandable TAVR, we illustrate the difficulty of evaluating LV wall motion echocardiographically by visual means only. Delayed presentation of late-onset partial obstruction can occur in patients who have undergone either self-expandable or balloon-expandable TAVR.

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