Masters of Cardiothoracic Surgery

Coronary protection in transcatheter aortic valve replacement: when, how and critical decision making

Emad Uddin Hakemi[1], Mariusz Wolbinski[1], Rebecca Hahn[1], Susheel Kodali[1], Isaac George[2]

[1]Department of Medicine, [2]Department of Surgery, Columbia University Medical Center, New York, NY, USA

Correspondence to: Isaac George, MD. Department of Surgery, Division of Cardiothoracic Surgery, Columbia University Medical Center, New York Presbyterian Hospital, Milstein Hospital Building, 177 Fort Washington Avenue, New York, NY, USA. Email: ig2006@cumc.columbia.edu.

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Clinical vignette

An 85-year-old female presented to our center with symptomatic severe aortic valve stenosis (AS). She had a past medical history of coronary artery disease with right coronary artery (RCA) stenting. Her echocardiography showed normal left ventricular ejection fraction (LVEF) with moderate mitral valve regurgitation and severe AS (mean gradient 33 mmHg, peak velocity 3.8 meters/second, aortic valve area 0.7 cm^2, and dimensionless index of 0.23). A recent cardiac catheterization showed no new obstructive coronary artery disease, and severe pulmonary hypertension (mean pulmonary arterial pressure of 61 mmHg and cardiac index of 1.97 liters/minute/$meter^2$). Cardiac computed tomography (CT) during mid-to-late systolic phase showed annular area of 354 mm^2 and diameter of 19×23 mm. The left main coronary artery (LMCA) and RCA heights were 9 mm and 10 mm, respectively. Her calculated Society of Thoracic Surgeons risk score for isolated aortic valve replacement was 5%. After a multidisciplinary valve team discussion with the patient, it was decided to proceed with transcatheter aortic valve replacement (TAVR). Due to low height of both her LMCA and RCA, we planned for sequential right then left aortic valve leaflet laceration using the BASILICA technique with cerebral protection, followed by 23 mm Sapien 3 (Edwards Lifesciences, Irvine, CA, USA) valve deployment and possible salvage percutaneous coronary intervention (PCI).

Surgical technique

Preparation & exposition

The patient was intubated and the procedure was performed under fluoroscopic and transesophageal echocardiography guidance. A temporary pacing lead was positioned in the right ventricle for rapid pacing during valve deployment. Sentinel device (Boston Scientific, Marlborough, MA, USA) was used for cerebral protection. Arterial access was obtained in bilateral common femoral arteries (CFA) and two Perclose Proglide devices (Abbott Vascular, Chicago, IL, USA) were deployed in both arteries in preparation for a 14 Fr. Edwards eSheath in the right CFA and a 14 Fr. DrySeal sheath (Gore, Newark, DE, USA) through the left CFA. Therapeutic anticoagulation was achieved using intravenous heparin, with intravenous Cangrelor as the planned antiplatelet strategy for salvage PCI.

Operation

The steps of the BASILICA technique are described in prior publications (1). Briefly, a 6 Fr. multipurpose guide catheter was used to position a 20 mm goose neck snare (Medtronic, Minneapolis, MN, USA) in the left ventricular outflow tract (LVOT). An 8 Fr. multipurpose guide catheter was positioned over the right aortic leaflet (RAL), delivering an electrified 300 cm Astato XS 20 (Asahi, Japan) wire insulated within a Piggyback catheter (Teleflex, Wayne, PA, USA). The wire was used to pierce through the RAL as basal as possible, then snared into the 6 Fr. multipurpose guide catheter. The Piggyback catheter was withdrawn back over the wire, then a "V" shaped bend was made on the wire and the coating shaved to facilitate electrocautery energy delivery. The "V" bend was advanced through the pierced leaflet, and the wire ends were secured in place with multiple torquers. The same sequence was repeated to prepare for left aortic leaflet (LAL) laceration using

a 6 Fr. multipurpose guide catheter and an 8 Fr. Amplatz Left 2 guide catheter. Guides used to lacerate the RAL were introduced through the 14 Fr Edwards sheath and those used to lacerate the LAL were introduced through the 14 Fr. DrySeal sheath. With infusion of Dextrose 5% in all guides, the RAL was first lacerated by attaching an electrocautery pencil to the back end of the Astato wire, delivering 70 watts of cutting energy. Guides used to lacerate the RAL were removed and a pigtail catheter was positioned through the 14 Fr. Edwards sheath into the left ventricle to minimize time to valve deployment after LAL laceration. Using the same technique, we lacerated the LAL and both guides were removed. There was hemodynamic instability with a decrease in systolic blood pressure to 70 mmHg, and a 23 mm Sapien 3 valve was promptly inserted and deployed over a stiff 0.035-inch wire under rapid pacing. Coronary angiography confirmed patency of flow into the RCA and partial obstruction of flow to the LMCA by a displaced LAL. Access to the LMCA was secured using a 0.014-inch coronary wire, over which intravascular ultrasonography confirmed impingement of blood flow into the LMCA ostium. A 4.5×15 mm stent was deployed across LMCA ostium protruding into left aortic sinus to push away the displaced LAL and preserve flow into LMCA.

Completion & clinical course

Bilateral arterial access hemostasis was obtained using the already deployed Perclose Proglide closure devices. The patient was extubated in the operating room and discharged the following day on aspirin and Plavix. An echocardiogram at 18 months follow-up showed normal LVEF, aortic bioprosthetic valve mean gradient of 12 mmHg and mild mitral regurgitation.

Comments

Acute coronary occlusion (ACO) during TAVR is a rare event with catastrophic consequences. The reported incidence is less than 1% in native aortic valves and 3.5% in valve-in-valve TAVR (2,3). ACO predominantly involves the LMCA (88%) through displacement of aortic valve-calcified leaflets towards the corresponding coronary ostium (3,4). Important anatomical factors that could predict ACO include coronary height (<12 mm), sinus of valsalva diameter (<30 mm), and distribution of leaflet calcification (3). Anatomical factors to consider during valve-in-valve TAVR include sinotubular junction diameter and height, stentless bioprosthetic valves like Mitroflow (Sorin, Italy) and Trifecta (Abbott), coaxiality of bioprosthetic valve with aortic root, and valve-to-coronary ostium distance (high risk <4 mm) (4,5). Clinical manifestations include refractory hypotension, ST segment elevations, ventricular arrythmias, and new left ventricular systolic dysfunction (3). With concern for ACO, valve selection is of high importance, with preference towards devices that can be recaptured and repositioned like the LOTUS Edge valve (Boston Scientific). Preventive coronary wiring and stent positioning into threatened coronary vessels during valve deployment is a commonly used technique that aims to maintain access to a threatened coronary artery. If ACO occurs, the stent is pulled back and deployed through the coronary ostium, protruding proximally into the point of obstruction in the aortic sinus to preserve blood flow. This technique was associated with low rates of stent thrombosis in recent analysis (5). BASILICA is another preventative method by which lacerating aortic valve leaflets can provide a path for blood to fill aortic sinuses after valve deployment to maintain coronary perfusion (1). With reported intraprocedural death of 15% and 40% at 1 month follow-up, recognizing anatomical risk factors for ACO and implementing preventive techniques are of paramount importance (3).

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Footnote

Conflicts of Interest: IG is a medical consultant for Atricure, MitreMedical, cardioMech, VDyne. The other authors have no conflicts of interest to declare.

References

1. Khan JM, Greenbaum AB, Babaliaros VC, et al. The

BASILICA trial: prospective multicenter investigation of intentional leaflet laceration to prevent TAVR coronary obstruction. JACC Cardiovasc Interv 2019;12:1240-52.
2. Dvir D, Webb J, Brecker S, et al. Transcatheter aortic valve replacement for degenerative bioprosthetic surgical valves: results from the global valve-in-valve registry. Circulation 2012;126:2335-44.
3. Ribeiro HB, Webb JG, Makkar RR, et al. Predictive factors, management, and clinical outcomes of coronary obstruction following transcatheter aortic valve implantation: insights from a large multicenter registry. J Am Coll Cardiol 2013;62:1552-62.
4. Dvir D, Leipsic J, Blanke P, et al. Coronary obstruction in transcatheter aortic valve-in-valve implantation: preprocedural evaluation, device selection, protection, and treatment. Circ Cardiovasc Interv 2015. doi: 10.1161/CIRCINTERVENTIONS.114.002079.
5. Palmerini T, Chakravarty T, Saia F, et al. Coronary protection to prevent coronary obstruction during TAVR: a multicenter international registry. JACC Cardiovasc Interv 2020;13:739-47.

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