Emergency Transcatheter Aortic Valve Implantation for Decompensated Aortic Stenosis

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ABSTRACT: We report the case of an 84-year-old male presenting with syncope and dynamic ST-T wave changes due to decompensated severe valvular aortic stenosis undergoing successful emergency transcatheter aortic valve implantation.

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Key words: syncope, percutaneous structural intervention, valvular heart disease

Cardiac decompensation caused by critical valvular aortic stenosis is associated with a dismal prognosis. Until recently, balloon aortic valvuloplasty (BAV) and emergent surgical aortic valve replacement (SAVR) have been the only therapeutic options for relief of the mechanical obstruction. While the periprocedural mortality rate in this setting amounts up to 16% in SAVR,[1] BAV exposes the patients to a substantial risk of stroke, relevant aortic regurgitation, and recurrence, rendering it a bridging rather than a destination therapy.[2] Due to encouraging results of transcatheter aortic valve implantation (TAVI) in recent trials and registries treating high-risk or inoperable patients, this novel treatment strategy has been incorporated in the latest version of the guidelines.[3] The optimal treatment for patients with decompensated valvular aortic stenosis and cardigenic shock, however, remains to be determined. In contrast to BAV, TAVI has the potential to provide a comprehensive and definitive solution.

Case Description

An 84-year-old male was transferred from a referring hospital for urgent percutaneous coronary intervention (PCI) due to a history of sudden loss of consciousness after preceding lightheadedness. On clinical presentation, the patient was asymptomatic and reported occasional chest tightness on exertion during the course of the previous week. A blood pressure of 103/44 mm Hg and a heart rate of 70 bpm were recorded.

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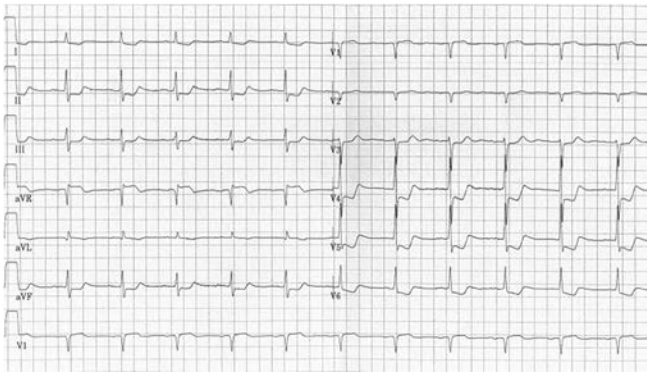

Figure 1. *Electrocardiogram at the time of hospital admission showing significant ST-segment elevation in lead aVR, and 2-3 mm descending ST-segment depression in leads V3-V6.*

Physical examination was remarkable for a 4/6 systolic ejection murmur in the absence of a second heart sound, pulmonary rales, and jugular venous distension. Electrocardiogram showed significant ST-segment elevation in lead aVR, and 2-3 mm descending ST-segment depression in leads V3-V6 (Figure 1). Coronary angiography revealed normal coronary arteries (Figure 2). After difficult passage of the aortic valve by means of a straight 0.035" Terumo guidewire, a mean transvalvular gradient of 64 mm Hg was documented (Figure 3), and an aortic valve area of 0.4 cm^2 was calculated using the Gorlin formula. Left ventricular ejection fraction amounted to 35% with global hypokinesia and a markedly elevated left ventricular end-diastolic pressure (LVEDP) of 40 mm Hg. Due to worsening congestive heart failure as well as deterioration of the hemodynamic condition resulting in cardiogenic shock with need of intravenous vasopressors, an urgent intervention of the aortic valve was indicated. The critical condition and the therapeutic options were immediately discussed with a cardiac surgeon. Emergency surgical aortic valve replacement was rejected due to an excessive surgical risk (EuroSCORE II, 20.3%; log EuroSCORE I, 57.1%; STS score, 32.2%). The only remaining therapeutic option was balloon dilatation of the aortic stenosis with or without subsequent TAVI. In the absence of relevant comorbidities and good quality of life until recently, there was consensus to proceed with emergency TAVI. After angiographic assessment of the dimensions of the aortic annulus and iliofemoral vessel diameters, a temporary right ventricular pacemaker was inserted followed by balloon dilatation using a Z-med balloon (4.0 x 22) under rapid ventricular pacing (180 bpm) with simultaneous aortic root

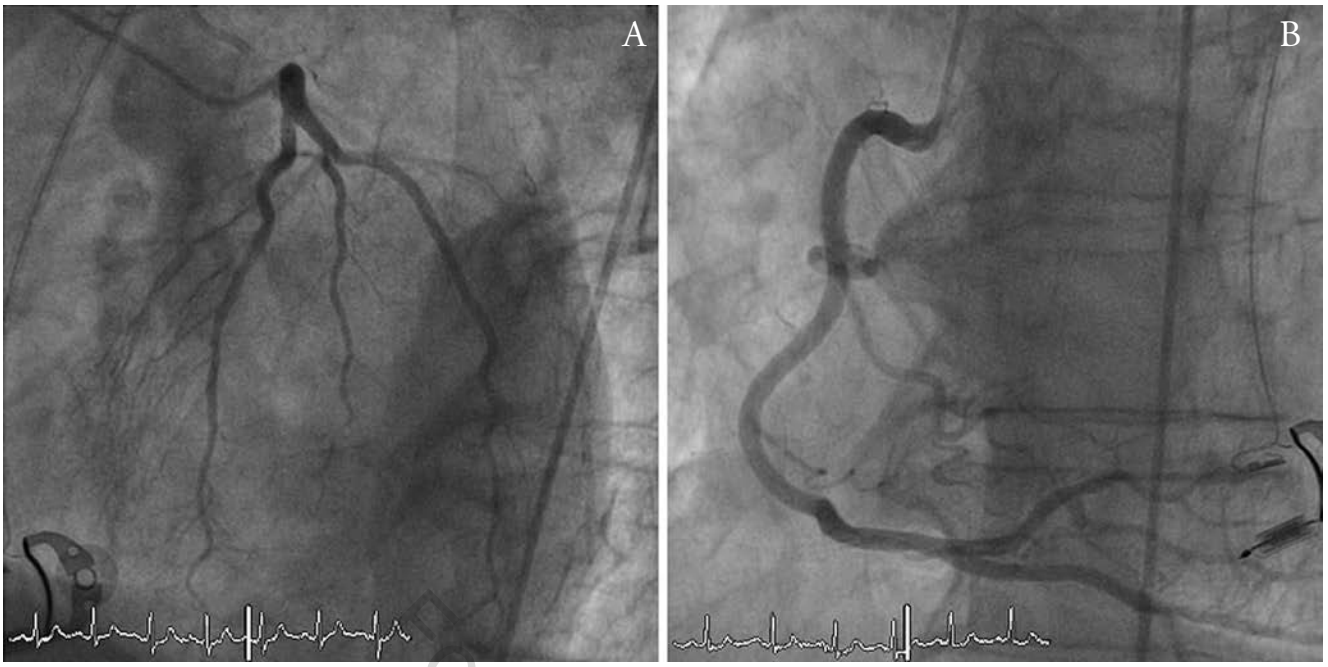

Figure 2. *Coronary angiograms showing normal left* **(A)** *and right* **(B)** *coronary arteries.*

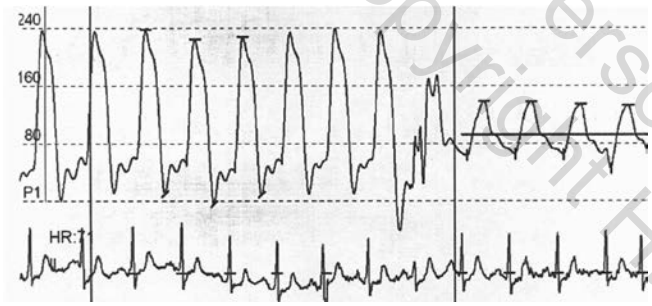

Figure 3. *Pressure curve in the left ventricle (top left) and ascending aorta (top right) revealing a mean transvalvular pressure gradient of 64 mm Hg.*

injection for the evaluation of a potential risk of occlusion of the coronary ostia and for invasive sizing of the aortic annulus. After successful balloon dilatation, a Medtonic CoreValve bioprosthesis (29 mm) was advanced through an 18 Fr sheath, which was introduced over the existing right transfemoral access and deployed successfully in correct position (Figure 4). The hemodynamic condition improved rapidly and final aortography demonstrated only mild (grade I) aortic regurgitation with a simultaneously measured transvalvular mean pressure gradient of 5 mm Hg. Subsequent hospital course and clinical follow-up were uneventful. At 1 month, the patient was in New York Heart Association functional class I without any chest pain. Transthoracic echocardiography 3 months after the procedure demonstrated mild paravalvular regurgitation.

Discussion

This case illustrates a rare presentation of critical valvular aortic stenosis successfully treated with emergency TAVI.

Decompensated valvular aortic stenosis presenting with cardiogenic shock is associated with a high mortality rate and substantially increases the risk of SAVR.[1] BAV has been reported to offer an immediate relief of the valvular obstruction and can be performed successfully within few minutes as a bail-out procedure without cardiopulmonary bypass. However, in our experience such an effect could not be reproduced. The high rate of documented immediate recurrence[2] renders this intervention questionable even as a temporary solution. The advent of TAVI combines the rapid approach of BAV with the definitive solution of aortic valve replacement and offers a promising approach for the emergency treatment of elderly patients with cardiogenic shock due to decompensated valvular aortic stenosis. Even though detailed evaluation of anatomical suitability for transfemoral TAVI by means of transesophageal echocardiography and computed tomography angiography has been stressed, no detailed imaging of the access site is mandatory in cases with large diameters of the femoral vessels, and the size of the annulus can be estimated by means of angiography and invasive sizing using the balloon for dilatation. In this particular case, we observed mild residual aortic regurgitation despite complete balloon inflation. As a consequence, we have chosen a self-expanding TAVI bioprosthesis covering an annulus between 23 and 27 mm (Medtronic Corevalve 29 mm). In combination with the angiographic measurement of 25 mm, this size and type of valve appeared appropriate. Moreover, a self-expanding device would even provide the possibility to retrieve the valve in case of undersizing.

Of note, the optimal view for size estimation and valve implantation is of paramount importance for a successful procedure. The aim is to have the three cusps aligned

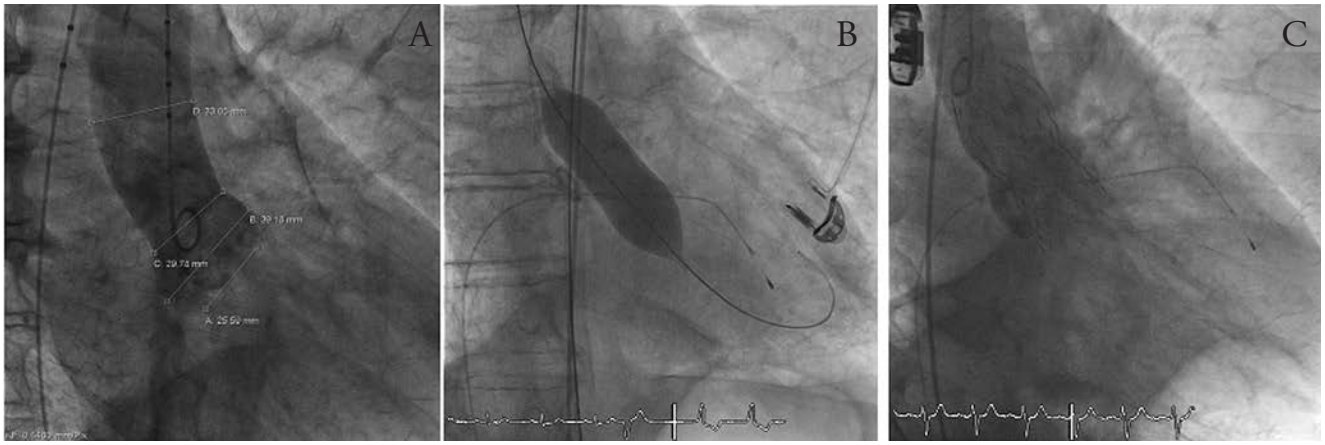

Figure 4. (A) *Depiction of the aortic root as seen in aortography for measurement of the aortic annulus.* **(B)** *Balloon dilatation using a Z-med balloon (4.0 x 22) under rapid ventricular pacing.* **(C)** *The final result after implantation of a Medtronic CoreValve bioprosthesis (29 mm).*

and one line of calcification, which is most frequently achieved in a left anterior oblique caudal view. The use of a balloon-expandable TAVI device would also have been possible, since a 26 mm Edwards bioprosthesis covers an annulus range from 21.5 mm to 25 mm. The feature of retrievability of a self-expanding system, however, appeared more feasible as well as the risk of potential risk of coronary occlusion in the absence of a computed tomography scan evaluation with an exact measurement of the distance between the native valvular level and the take-off of the coronaries. Latter potential disadvantages of a balloon-expandable device, however, can be overcome by a simultaneous dye injection into the aortic root during valvuloplasty, which outlines nicely the upward movement of the native leaflets and confirms sufficient flow to the coronaries. Last but not least, an emergency transesophageal echocardiogram measurement of the native annulus would provide additional information about the aortic root anatomy and should be considered if there is sufficient time.

This case summarizes the potential of TAVI to restore normal hemodynamics and valvular function in a short procedure without detailed preprocedural exams. In a case of large femoral arteries, the insertion of an 18 Fr sheath can be achieved rapidly after preclosing with a dedicated device. The aortic root anatomy can be assessed with an aortic root injection and the size of the aortic root is assessed by invasive sizing using the balloon for predilatation. For emergent cases, this approach appears feasible and is associated with a favorable outcome. On the contrary, for elective TAVI cases, a thorough evaluation of the aortic root anatomy using computed tomography scan and three-dimensional transesophageal echocardiography is helpful for the selection of the optimal device type and size as well as the access route.

Conclusion

Emergency TAVI by means of a pure percutaneous approach for patients with cardiogenic shock due to critical valvular aortic stenosis is feasible and appears more attractive than BAV and SAVR in selected patients.

References

1. Melby SJ, Zierer A, Kaiser SP, et al. Aortic valve replacement in octogenarians: risk factors for early and late mortality. *Ann Thorac Surg*. 2007;83(5):1651-1656; discussion pp. 1656-1657.
2. Doguet F, Godin M, Leberton G, et al. Aortic valve replacement after percutaneous valvulopasty — an approach in otherwise inoperable patients. *Eur J Cardiothorac Surg*. 2010;38(4):394-399.
3. Vahanian A, Alfieri O, Andreotti F, et al. Guidelines on the management of valvular heart disease (version 2012). *Eur Heart J*. 2012;33(19):2451-2496.