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EDITORIAL COMMENT

Sudden Hemodynamic Collapse After Transcatheter Aortic Valve Replacement

Think Quick and Right*

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Transcatheter aortic valve replacement (TAVR) is indicated for the treatment of symptomatic severe aortic stenosis (AS) and has promptly taken a central role in the treatment of older patients and those at high risk or unsuitable for surgery despite slight differences between European and American guidelines.[1,2] Recent data also support TAVR use in lower-risk categories of patients with severe AS. The latest progress in device platforms and procedural techniques (eg, cusp overlap to reduce pacemaker implantation rate or commissural alignment to facilitate coronary reaccess), together with the central role of heart team case discussion for proper patient selection and procedural planning, helped reduce early mortality for patients undergoing TAVR in the most recent experience. Thus, TAVR now has a prominent place in the lifetime management of AS at all ages of AS diagnoses and at all risk profiles.[3] However, TAVR remains burdened by the risks of acute complications for which prompt diagnosis and a timely intervention are becoming fundamental "skills" for TAVR operators. One major difference for intraprocedural complications between TAVR and surgical aortic valve replacement is that during surgery the chest is opened and the heart is under direct visual observation, whereas during TAVR complications have to be promptly diagnosed by imaging and the knowledge of the phase of the procedure during which the complication occurred.

In this regard, hemodynamic collapse represents 1 of the most common complications occurring during TAVR procedures. Multiple underlying conditions may cause hypotension during the different phases of the procedure, which range from relatively benign to some life-threatening ones requiring immediate diagnosis and therapy (**Figure 1**). Diagnosis and then appropriate intervention are enhanced by the interventional team experience (cardiology/cardiac surgery operators, anesthesiologists, and nurses) and are often implied by the phase of the procedure (eg, vascular access management, valvuloplasty, or device implantation); the most life-threatening causes of hypotension should be quickly diagnosed and treated.

In this issue of *JACC: Case Reports*, the case described by Torrado et al[4] of abrupt hemodynamic collapse leading to cardiac arrest occurred immediately after TAVR deployment (26-mm SAPIEN 3, Edwards Lifesciences). At first, the patient was treated with inotropes and prolonged external chest compression with a dedicated device. Using imaging with emergent transesophageal echocardiography, an immediate diagnosis of dynamic left ventricular outflow tract obstruction was made. Based on this diagnosis and the lack of response to medical treatment, venoarterial extracorporeal membrane oxygenation was positioned and the hemodynamics restored, allowing the conclusion of the procedure and the transfer of the patient to the intensive care unit (ICU). A recurrence of hemodynamic collapse in the ICU with the same underlying cause was promptly addressed, and the patient ultimately survived the procedure. The fundamental mechanism of this severe complication of TAVR implantation is linked to a reduced left ventricular size, hyperdynamic

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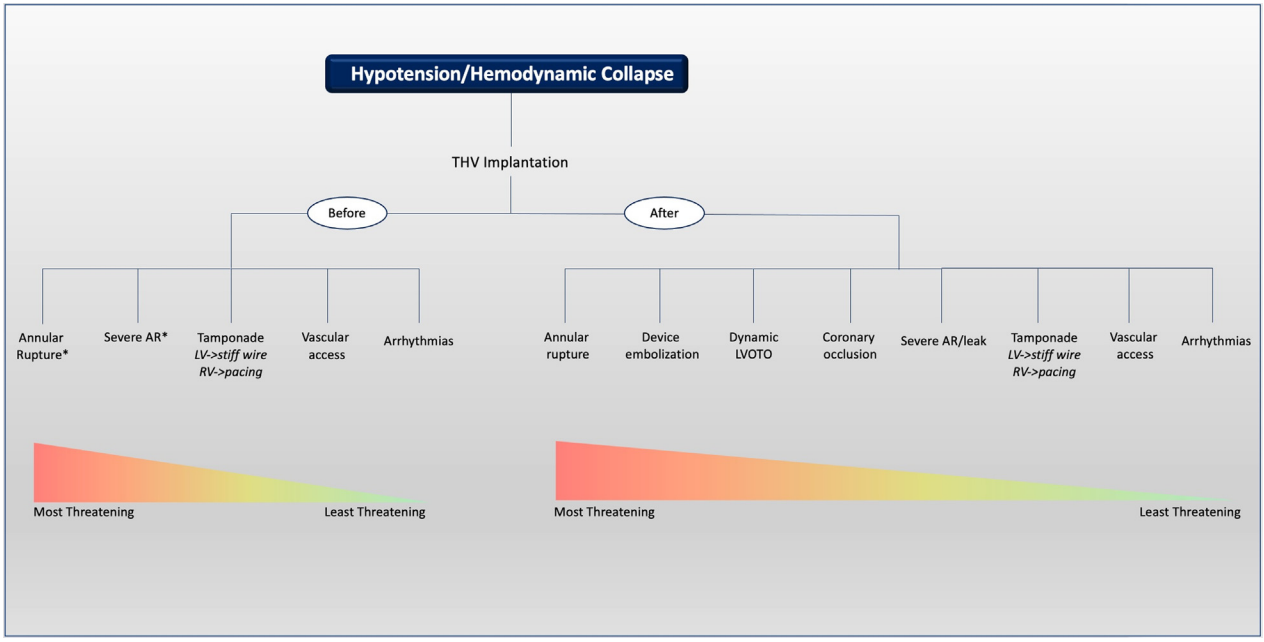
FIGURE 1 **Possible Underlying Causes of Hypotension/Hemodynamic Collapse During Transcatheter Aortic Valve Replacement Intervention**



*In case of balloon valvuloplasty. AR = aortic regurgitation; LV = left ventricle; LVOTO = left ventricle outflow tract obstruction; RV = right ventricle; THV = transcatheter heart valve.

ventricular function, or marked ventricular afterload reduction post-AS relief, yielding systolic anterior motion of the mitral valve and obstruction of the left ventricular outflow tract that in extreme cases has been called the "suicide left ventricle." The precise frequency of left ventricular outflow tract obstruction post-TAVR is poorly known because it has been mostly demonstrated in case reports.[5] This complication is not a prerogative of TAVR, and similar mechanisms yield similar consequences after surgical aortic valve replacement, although intraoperative control of circulation by cardiopulmonary bypass prevents irreversible hemodynamic collapse. Nevertheless, this complication may require late reoperations after surgical aortic valve replacement.[6]

Although the heroic efforts of the team in charge to save the patient warrant congratulations, several factors in the management of the patient demonstrate the potential for medical management to exacerbate this complication. The patient presented with severe congestive heart failure that was intensively treated, resulting in marked weight loss caused by the elimination of volume overload. Such volume shifts may predispose to left ventricular outflow tract obstruction and may have been avoided by reimaging pre-TAVR. Second, an intra-aortic balloon pump was placed to support the hemodynamics during the stay in the ICU, but it turned out that by yielding decreased ventricular afterload, it had the detrimental effect of reinitiating the left ventricular outflow tract obstruction. Thus, careful management may have avoided both instances of the complication.

The case raises several important points in the current management of severe AS. First, careful preprocedural planning is fundamental; patients and imaging details might be important not only to guide the procedure but also to predict possible complications and be prepared for their treatment. Second, although technically TAVR procedures have markedly improved and are performed in many and often small centers, the ability to successfully manage complications and provide low procedural risk is highly dependent on the volume of practice and experience for TAVR and surgical aortic valve replacement.[7,8] Third, the role of the multidisciplinary heart team goes beyond the selection of the most appropriate treatment option between surgery and transcatheter approach. Its role is critical in the preprocedural planning, the intraprocedural phase, and the follow-up of these patients. In particular, the role of the

heart valve clinic integrating multiple specialties (eg, structural heart interventions operators, interventional imagers, and specialized anesthesiologists) is becoming a key feature and represents an essential organizational model to offer the best therapies for patients with complex heart valve disease. Finally, although the trend of TAVR candidates is moving toward low-risk and younger patients, this case is a clear reminder that TAVR might be burdened by multiple life-threatening complications, and, consequently, risks and benefits should be carefully weighed for both TAVR and surgery, especially for low-risk and young patients.[3]

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