Contribution of Three-Dimensional Transesophageal Echocardiography to Diagnosis and Management of Thrombosis of a St. Jude Mechanical Prosthesis in the Aortic Valve Position

Prosthetic valve thrombosis (PVT) is a serious complication after cardiac valve replacement and usually requires urgent management with either thrombolysis or surgery.[1] A 38-year-old woman with history of ischemic stroke and multiple valvular surgeries including aortic St. Jude mechanical valve replacement (St. Jude Medical, St. Paul, Minnesota) presented with new-onset dyspnea on exertion. Transthoracic echocardiography and 2-dimensional transesophageal echocardiography (TEE) suggested an abnormally high gradient across the aortic valve (Figure 1) but could not determine the cause of the stenosis (Figure 2, Video 1). Three-dimensional (3D) TEE showed a small mobile thrombus attached to 1 disc of the St. Jude valve, resulting in partially restricted disc mobility (Figure 2, Videos 2 and 3). Also, valvular "pannus" formation was minimal, and the mobility of the other disc of the St. Jude mechanical prosthesis was normal. Thrombectomy with a carbon dioxide high-flow mister blower was chosen to eliminate the thrombus. After elimination of the thrombus and scant fibrous tissue on the underside of the valve, the mobility of the affected disc recovered completely. The gradient across valve was normalized (Figure 1). The patient became asymptomatic and was discharged.

PVT can be diagnosed with cine fluoroscopy, transthoracic echocardiography, and TEE. Cine fluoroscopy is effective only at detecting abnormality of leaflet mobility, without providing information on the cause of abnormal leaflet function. Transthoracic echocardiography with Doppler study is used to measure transvalvular pressure gradient but usually has limited accuracy of visualization. TEE is often needed because of its better spatial resolution. However, 2-dimensional TEE has limitations in the assessment of aortic PVT and associated subtle leaflet change, particularly for various mechanical aortic valves.[2] Three-dimensional TEE has been increasingly used and has proved to be a valuable technique that offers comprehensible images and comprehensive information of PVT affecting mitral valves.[3] It can determine thrombus size and location, severity of pannus, and mobility of the affected mechanical disc. However, studies on its role in the diagnosis and management of PVT affecting aortic valve are very rare. Our patient had a history of multiple valvular surgeries. In our patient, 3D TEE provided excellent information on PVT features and the functional status of disc mobility. Thus, this case not only provides unique 3D imaging information on aortic PVT but also highlights the novel role of

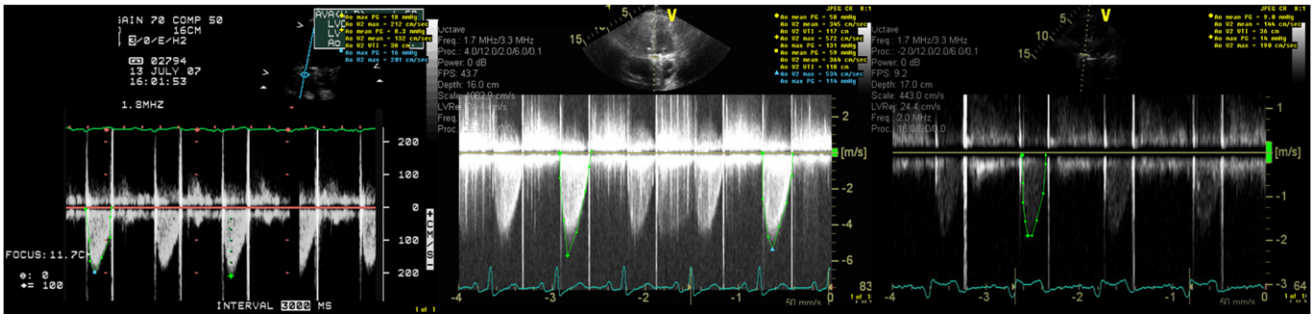

Figure 1. Mean gradient across the mechanical aortic valve measured using continuous-wave Doppler before (10 mm Hg) *(left)* and after (59 mm Hg) *(middle)* thrombus development and after thrombectomy (9 mm Hg) *(right)*.

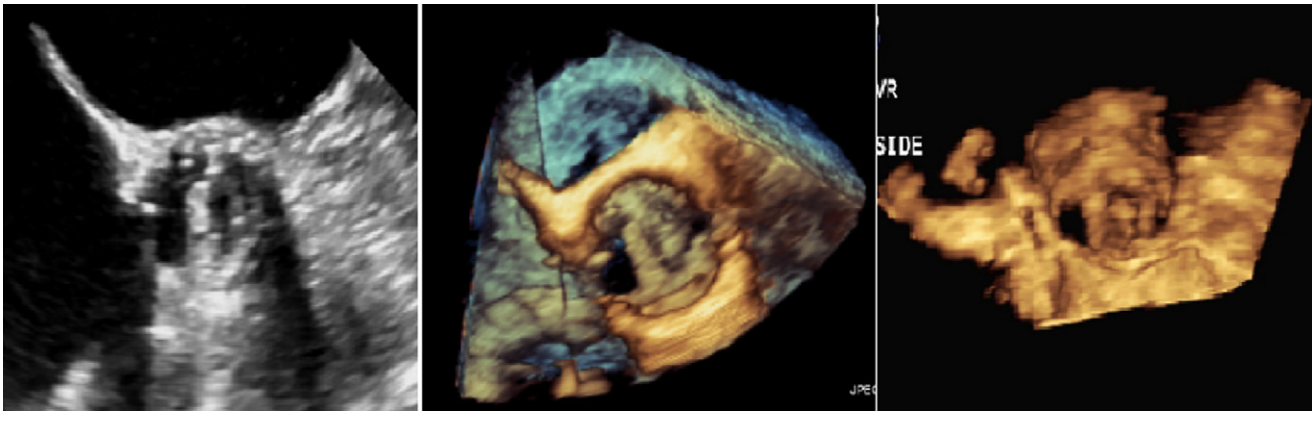

Figure 2. Prosthetic valve thrombosis on 2-dimensional TEE *(left)* and 3D TEE *(middle, right)*.

reconstruction using 3D TEE in the diagnosis and management of certain cardiac emergencies.

Supplementary data

Supplementary data related to this article can be found at doi:10.1016/j.amjcard.2012.09.001

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Non-Invasive Monitoring of Cerebral Perfusion During Transcatheter Aortic Valve Implantation Procedure

We read the report by Nuis et al[1] on the frequency and cause of stroke during and after transcatheter aortic valve implantation (TAVI). The investigators reported a 9% stroke incidence (19 of 214 patients), with early (<24 hours after TAVI) stroke in 8 patients and delayed (>24 hours, mean 3.5 days after TAVI) stroke in 11 patients. They used brain computed tomographic findings to further analyze the cause of stroke. Interestingly, they found that 26% of strokes (5 patients) revealed lacunar lesions, which is widely regarded as caused by cerebral hypoperfusion in the presence of local atherosclerosis. Therefore, the investigators implied that all efforts should be made during TAVI to maintain adequate brain perfusion.

In the study by Nuis et al,[1] the Medtronic CoreValve System (Medtronic, Inc., Minneapolis, Minnesota) was used, which necessitates only short-term use of rapid ventricular pacing (RVP) during valvuloplasty. However, during application of the Edwards Sapien valve (Edwards Lifesciences, Irvine, California), a transient partial cardiac standstill by RVP (180 to 220 beats/min) is induced to minimize cardiac motion and pulsatile transaortic flow. Although RVP is advantageous for valve positioning, the combination of a rapid heart rate and ventricular hypertrophy can induce a complete loss of cardiac output. In most cases, this hemodynamic deficit is well tolerated, most likely because of the brief duration of the RVP. However, in view of these results published by Nuis et al,[1] more attention should be paid to maintain adequate cerebral perfusion (and oxygenation) during TAVI, especially during these RVP periods when using the Edwards Sapien valve.

In recent years, near-infrared spectroscopy (NIRS) has been introduced as a useful noninvasive cerebral monitoring technique assessing the adequacy of cerebral oxygenation.[2] It measures regional cerebral oxygen saturation at the microvascular level (arterioles, venules, and capillaries only). The principle of NIRS is based on the fact that near-infrared light passes through skin and skull readily and is absorbed by certain biologic molecules in the brain. Low cerebral oxygen saturation values (<55%), as measured by NIRS, observed during cardiac surgery have been correlated with worsened postoperative neurologic outcomes.[3]

In recent months, we applied NIRS monitoring during TAVI procedures (using the Edwards Sapien valve), and we did observe an immediate decrease in cerebral oxygen saturation during RVP to 54% (37% to 70%). Moreover, in 1 patient with severe concomitant heart failure, cerebral oxygen saturation remained <55% for 87 minutes (despite ongoing cardiopulmonary resuscitation efforts) and returned to baseline after the institution of extracorporeal membrane oxygenation. The patient's hemodynamic status perfectly stabilized, but unfortunately, the patient was declared brain dead 48 hours later.[4]

Referring to Nuis et al[1] and to our own experience,[4] we should be aware that transcutaneous cardiac interventions, especially those with transient partial cardiac standstill, can induce long-lasting intraprocedural inadequacy of cerebral perfusion, despite immediate restoration of normal blood pressure. Future strategies should therefore be focused on integrating noninvasive continuous cerebral monitoring, such as NIRS, providing real-time estimation of the adequacy of cerebral perfusion, during TAVI procedures.

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Mixing of Confounding and Non-Collapsibility: A Notable Deficiency of the Odds Ratio

We read with interest the report by Chan and Redelmeier[1] about Simpson's paradox in medical studies. Using a hypothetical example, the investigators aimed to draw clinicians' attention to this paradox in medical research. We would like to remind readers that the discrepancy between a crude and a stratified odds ratio (OR) actually conflates 2 different components, namely, a confounding bias and a noncollapsibility effect.[2]

In the investigators' example, patients' activity levels are not balanced between the low and high strata of vitamin D level. It is clear that activity level is a confounder that is associated with vitamin D level and heart disease. Readers might therefore think that the