Stress in the time of transcatheter aortic valve replacement

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Central Message

Evolution of transcatheter aortic valve design features can affect durability of the valve and requires investigation.

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As the love for transcatheter aortic valve replacement (TAVR) increases among some surgeons, one should wonder whether this newfound love will endure the test of time. One point of concern is whether the design features, such as a thin stent profile, compressibility and deformability of the stent, or addition of a sealing skirt, would impose abnormal stresses on the thin pericardial leaflets and lead to their structural deterioration and dysfunction. In this issue of the *Journal*, Xuan and colleagues¹ from University of California San Francisco present their investigation of the stent and leaflet stresses in a 26-mm third-generation Edwards SAPIEN valve (Edwards Lifesciences, Irvine, Calif) by means of computational modeling. In this new generation valve, an outer sealing skirt was added to the previous generation valve to reduce paravalvular leakage, which has the potential to change interaction between the stent and the calcified native valve leaflets surrounding it. Xuan and colleagues¹ found that the peak stresses in the stent occurred just below the commissural stent posts and in the crosslinking stents adjoining the commissure, whereas the leaflet stresses were concentrated in the commissural sections. Compared with the designs from previous generations of the same valve, stress in the stent and the leaflets in this new generation of the SAPIEN valve seem to be higher according to this study.

TAVR valve design is currently a moving target, with design features evolving in response to the complications encountered in clinical trials of earlier generations. As TAVR continues to be expanded to more patients, including patients potentially at lower surgical risk and even those

with reduced calcific burden, the interaction between the design changes and patient pathologies will determine the durability. Computational modeling of these conditions is the only reasonable way to study these interactions and educate future design evolutions and regulatory bodies. There is also a need, however, to shift from computational models that study the valve in isolation to valves that are studied in varied patient geometries. Because the interaction between the valve and the anatomy is of critical importance, such studies may unearth earlier failure modes that may not be entirely evident by studying the valve alone.

Nonetheless, Xuan and colleagues¹ are to be congratulated for this nicely done study that continues to educate us on the potential pitfalls associated with current TAVR designs.

Reference

1. Xuan Y, Dvir D, Wang Z, Mizoguchi T, Ye J, Guccione JM, et al. Stent and leaflet stresses in 26-mm, third-generation, balloon-expandable transcatheter aortic valve. *J Thorac Cardiovasc Surg*. 2019;157:528-36.