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EDITORIAL COMMENT

Patient-Prosthesis Mismatch After Aortic Valve Intervention

Another Win for Transcatheter Aortic Valve Replacement*

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First described by Rahimtoola (1) in 1978, implantation of an undersized prosthetic valve relative to the anatomic characteristics of the recipient patient, so called patient-prosthesis mismatch (PPM), is frequently observed following surgical aortic valve replacement (SAVR) and is associated with adverse long-term outcomes. Significant PPM (defined as a low effective orifice area indexed to the patient's body surface area [BSA]: moderate $\leq$0.85 cm^2/m^2, severe $<$0.65 cm^2/m^2) results in obstruction of left ventricular outflow that reduces the impact of afterload reduction and the benefits associated with left ventricular mass regression, improved subendocardial perfusion, and symptom relief. Furthermore, shear stress resulting from residual turbulent flow across the prosthetic valve induces platelet activation (2), which may in turn induce premature structural valve deterioration (3), accompanying symptoms, and potential need for a second intervention.

These adverse outcomes associated with PPM following SAVR were confirmed in a meta-analysis of 34 studies (including 6 Asian studies, all Japanese) that demonstrated the relative frequency of both moderate and severe PPM (34.2% and 9.8%, respectively) and their significant separate and collective association with all-cause mortality. In particular, severe PPM was strongly associated with excess risk for cardiovascular death (hazard ratio: 6.46) (4).

Similar pathophysiological considerations might be anticipated after transcatheter aortic valve replacement (TAVR). However, accurate valve sizing using gated computed tomography or transesophageal echocardiography is standard practice before TAVR and appears to reduce the frequency of PPM. Furthermore, consistent radial force and the absence of a sewing ring (plus the fact that the valve in certain self-expanding devices is located in a supra-annular position) result in a larger indexed effective orifice area, improved valve hemodynamics, and lower frequency of PPM after TAVR compared with SAVR (5). Remarkably, even when present, PPM following TAVR does not appear to affect mortality, unlike PPM following SAVR (hazard ratios: 0.736 [p = 0.024] and 1.43 [p = 0.005], respectively) (5,6).

Patients with low body mass index (BMI) demonstrate higher mortality after TAVR (7), the so-called obesity paradox, which may relate to reduced physiological reserve and an increased risk for major complications, including bleeding, vascular events (as a result of difficulties accommodating a delivery sheath >14-F in diameter), and problems relating to a small aortic root (including annular rupture and coronary occlusion). Considerations concerning PPM are of particular relevance in this group, and those with small aortic annuli (<20 mm) appear to benefit most from TAVR over SAVR (6,8). Patients of small stature (many of whom have heavily calcified, bicuspid aortic valves) are frequently encountered in Asia, where TAVR has demonstrated remarkable growth in a very short time span with results that comfortably match those in Western populations (9).

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In a study reported in this issue of *JACC: Cardiovascular Intervention*, Miyasaka et al. (10) use the resources of the OCEAN-TAVI (Optimized Transcatheter

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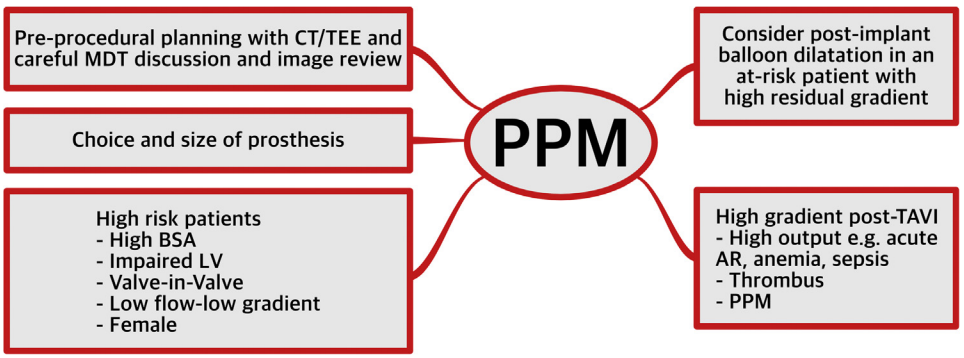
FIGURE 1 Clinical, Anatomic, and Procedural Contributors to the Syndrome of Patient-Prosthesis Mismatch in Transcatheter Aortic Valve Replacement Recipients



AR = aortic regurgitation; BSA = body surface area; CT = computed tomography; LV = left ventricle; MDT = multidisciplinary team; PPM = patient-prosthesis mismatch; TEE = transesophageal echocardiography.

Valvular Intervention-Transcatheter Aortic Valve Implantation) registry to assess the prevalence, predictors, and midterm outcomes of PPM among 1,546 patients undergoing TAVR at 14 established Japanese centers between October 2013 and July 2016. Rates of moderate and severe PPM (8.9% and 0.7%, respectively) were low in comparison with previous surgical published reports and predicted by younger age, larger BSA, smaller aortic valve and annular areas, no balloon post-dilatation, and use of the Edwards S3 balloon-expandable valve (perhaps because of the presence of a sealing skirt, as these patients exhibited a higher device-to-annulus ratio). Those with aortic annular areas <385 mm^2 (especially if BSA ≥ 1.41 m^2) were at highest risk. Reassuringly, there was no impact of PPM on all-cause or cardiovascular mortality at 1-year follow-up ($p = 0.41$ and $p = 0.21$, respectively), although both moderate and severe PPM were independently associated with the need for rehospitalization.

Although mean BMI and BSA were lower in the study cohort compared with Caucasian populations (1.43 m^2 vs. 1.75 to 1.91 m^2), lower rates of PPM were also observed. This group may in fact provide a more accurate estimation of PPM incidence, as mismatch severity can be overestimated in obese patients because of indexing of the new effective orifice area to the patient's BSA (thereby negating the adverse impact of PPM). Consistent with this observation, patients with larger BMI and BSA were more likely to develop PPM in this study. Stroke volume and cardiac output are higher in overweight patients, but these differences are eliminated when indexed for BSA (11); this allometric relationship may help us understand why larger patients are more susceptible to PPM.

Kaminishi et al. (12) reported almost identical rates of moderate to severe PPM (8.5%) in 3,609 Japanese patients undergoing SAVR. The average BSA and BMI in this study were approximately 1.58 m^2 and 23 kg/m^2, respectively, lower than expected for Western patients undergoing SAVR. It appears that the reported incidence of PPM in Japanese patients undergoing either surgical or TAVR is lower than Western patients undergoing similar types of procedures. Physical differences may play an important role in the observed incidence of PPM between Japanese and Western patients undergoing aortic valve intervention.

This study therefore provides further assurance that TAVR is a safe and effective alternative to SAVR and may in fact offer particular advantages in populations at identified risk for PPM. Indeed, despite small annular dimensions, patients of small stature are at lower risk for PPM, provided that meticulous valve sizing is incorporated into pre-procedural imaging protocols (**Figure 1**). Consistent with recent European guidelines (13), such anatomic considerations should be incorporated into heart team discussions concerning the optimal treatment option for all patients with aortic stenosis at increased surgical risk.

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