predict PPM after surgical aortic valve replacement may be hampered by the shift of practice toward catheter-based technologies.

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Commentary: The problem of valve prosthesis–patient mismatch revisited

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In 1978, Shahbudin Rahimtoola published a review article in *Circulation* titled “The Problem of Valve Prosthesis–Patient Mismatch,” described as “when the effective prosthetic valve area, after insertion into the patient, is less than that of a normal human valve.”¹ He observed that although this was usually mild to moderate and often of no immediate clinical significance, it was occasionally a severe problem that left the patient hemodynamically and symptomatically worse after valve replacement. In this landmark review, Dr Rahimtoola articulated 3 themes that

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CENTRAL MESSAGE

The indexed effective orifice area may not accurately predict elevated prosthetic valve gradients.

have become dogma: (1) correcting effective valve area for body size; (2) assessing valve prostheses during exercise, not just at rest; and (3) what he depicted as an almost exponential relationship between valve area and transvalvular gradient. Similar to coronary obstruction, this implied that relatively large reductions in surface area result in minimal incremental obstruction until the effective orifice is reduced to <35% of normal, when small incremental reductions result in precipitous rises in gradient.

Almost 2 decades later, based on a series of 61 patients, Pibarot and colleagues^{2,3} quantified the prosthesis–patient mismatch, indexing prosthetic valve effective orifice area (iEOA) to patient body surface area, defining mismatch as iEOA $\leq 0.85 \text{ cm}^2/\text{m}^2$ and later defining severe mismatch

as iEOA $\leq 0.65 \text{ cm}^2/\text{m}^2$. Despite numerous subsequent observational series and meta-analyses, the definitions and importance of prosthesis–patient mismatch remain controversial; however, these cutoffs and the exponential relationship between orifice area and gradient are enshrined in charts used to guide prosthesis selection based on patient body surface area and manufacturer valve size.

In this issue of the *Journal*, Vriesendorp and colleagues⁴ challenge this 40-year old paradigm of prosthesis–patient mismatch, suggesting that the exponential relationship between iEOA and transvalvular gradient does not exist. In this study, the authors pooled 5 contemporary randomized clinical trials in which surgical stented bioprostheses were implanted, analyzing core laboratory-validated echocardiographic images from 2171 patients at 1 year postimplantation to quantify the relationship between iEOA and transvalvular gradient. Based on the aforementioned cutoffs, the incidence of moderate prosthesis–patient mismatch was 50%, and up to 22% of patients met the criteria for severe mismatch. However, instead of the exponentially shaped curve described by the previous groups, Vriesendorp and colleagues report an almost linear relationship between iEOA and mean gradient. If correct, this finding is important because, as the authors state, “the selection of any cutoff value becomes an arbitrary process.”

The study has several limitations. First, 5 different trials were pooled, creating a heterogeneous cohort that included elderly high-risk patients and younger low-risk patients, and differences in patient–prosthesis mismatch between these subgroups are unclear. Second, the authors evaluated only stented bioprostheses, which precludes generalization of their findings to stentless, sutureless, and transcatheter valves, which now represent the most commonly used prostheses.⁵ Finally, the study provides no data on which iEOA values are associated with adverse outcomes.

Despite these limitations, however, these findings still challenge a longstanding conceptual framework of prosthesis–patient mismatch. Taken together with analyses questioning the consistency of manufacturer-provided valve sizes and orifice areas, these data suggest that projected iEOA charts based on valve sizes do not accurately predict clinically significant prosthesis–patient mismatch.⁶

The key to preventing unacceptable postoperative gradients remains implanting the largest valve possible, supported by judicious use of aortic root enlargement and prostheses with superior hemodynamics—particularly in younger, more active, and larger patients.^{7,8} In an era where younger patients are increasingly receiving biological prostheses, this strategy may improve left ventricular remodeling; mitigate structural valve deterioration, thereby reducing the early need for valve reintervention; and facilitate eventual transcatheter valve-in-valve replacement.⁷⁻¹⁰ This valuable contribution by Vriesendorp and colleagues underlines the importance of implanting the largest aortic prosthesis possible, and the uncertainties of accurately predicting the problem of valve prosthesis–patient mismatch 40 years on.

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