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Commentary: Prosthesis–patient mismatch. A blast from the past?

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As surgeons, we do know how important is to avoid the implantation of “small” aortic valve prosthesis. We are also aware that a narrow aortic root may be pose technical challenges and sometimes require aortic annulus–enlargement procedures.

The concept of prosthesis–patient mismatch (PPM) was introduced by Rahimtoola¹ back in 1978: “Mismatch can be considered to be present when the effective prosthetic valve area, after insertion into the patient, is less than that of a normal human valve.” This notion was eventually revised by Pibarot and Dumesnil.² They proposed avoiding an indexed orifice area (EOAi) less than 0.85 cm²/m² to prevent PPM. This was based on the steep increase in the mean gradient if EOAi falls below this cut-off.

In this issue of the *Journal*, Vriesendorp and colleagues³ challenge this concept. They polled data from 2171 patients who underwent aortic valve replacement with surgical bioprosthesis in 5 trials and evaluated the transthoracic echocardiographic images at 1-year follow-up assessing the association between EOAi and mean gradient using the same model applied by Pibarot and Dumesnil.

Of note, Vriesendorp and associates also found that the relation between EOAi and mean transvalvular aortic gradient did not differ between patients with and without obesity; this may support the use of lower cut-off values of EOAi for the population with obesity.

Why this study is important? The concept of PPM so far has been based on the assumption of the exponential relation between EOAi and mean aortic gradient (with a steep increase in the mean gradient when EOAi goes below

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CENTRAL MESSAGE

A linear rather than exponential relation between EOAi and mean gradient may undermine the original categorical definition of PPM. The concept of PPM also should be revised in patients with obesity.

0.85 cm²/m²). Vriesendorp and colleagues found a less-pronounced exponential relationship between EOAi and mean aortic gradient than previously demonstrated by Pibarot and Dumesnil, and this suggests that the current definition of PPM may be overconservative in some case.

This concept is the foundation of the “EOAi charts” that we consult before starting a case to select the appropriate valve size to predict and prevent PPM. This study has some limitations. Perhaps the main limitation is that only echocardiographic measurements were used to analyze the relation between EOAi and mean aortic gradient.

Why this study may be less relevant than what we may expect? Transcatheter aortic valve replacement (TAVR) is becoming the treatment of choice for the majority of patients with symptomatic aortic valve stenosis; some studies are also supporting superiority of TAVR against surgery extending the adoption in low-risk context.⁴

While concerns still exist with regard to TAVR durability and the incidence of postoperative pacemaker, the hemodynamic profile of the new percutaneous valves is outstanding, with trivial transprosthesis mean gradient generally lower than standard surgical valve.^{5,6} This evidence may be set in relation to differences in TAVR design, such as the absence of a sewing ring and the supra-annular profile.

TAVR may be particularly indicated in the patients with obesity to avoid any risk for PPM. With this in mind, in-depth speculation and complex mathematical modeling to

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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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CENTRAL MESSAGE

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

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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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 ≤ 0.85 cm²/m² and later defining severe mismatch