Editorial
Live Longer and Better Without Prosthesis-Patient Mismatch

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In this issue of *The Journal of Heart Valve Disease*, Urso and co-workers (1) analyzed the impact of prosthesis-patient mismatch (PPM) on survival and quality of life following aortic valve replacement (AVR) in 163 patients aged 75 years or more. Elderly patients currently represent a large proportion of the population undergoing AVR, and this proportion is expected to grow exponentially in the near future as the population ages. In this context, it becomes appropriate to determine the exact impact of PPM in this specific population in order to adopt the most appropriate strategies with regards to this age group. Indeed, these patients have often outlived their normal life expectancy, and their main motivation for consenting to surgery may be the expectation of an improved and/or maintained quality of life, rather than a prolonged survival. In this respect, the study by Urso et al. (1) is most interesting as these authors have analyzed the impact of PPM not only on the patients' survival but also on their quality of life. Importantly, they found that, whereas moderate PPM had no impact on mid-term mortality in this cohort of elderly patients, it was nonetheless associated with a significant reduction in the quality of life.

Impact of PPM on survival in the elderly population

It must be emphasized that the number of patients with severe PPM was very small in Urso et al.'s study (n = 2), and that for this reason and the small overall sample size, these data are not sufficient to draw any conclusions with regards to the potential relationship between PPM and mid-term mortality. Nonetheless, the results are consistent with those of several recent studies which have included larger numbers of patients and reported longer periods of follow up (2-4). Indeed, the results of these previous studies have shown that PPM has a significant impact on long-term survival in patients aged <70 years, but not in more elderly patients. This PPM-age interaction may be explained by several factors. First, younger patients are generally more physically active and have a higher basal metabolic demand and thereby a higher cardiac output requirement compared to older patients. Second, younger patients have a longer life expectancy, and are thus exposed to the 'chronic' risk of PPM for a longer period. Third, elderly patients have more comorbidities and concomitant diseases that may outweigh or conceal the effect of PPM on survival.

Older people also deserve a good quality of life

The main objective of AVR in younger patients is to increase longevity. However, such consideration may often be of lesser importance in the elderly for three reasons:

- The survival benefit to be expected is less, given that many patients have exceeded their normal life expectancy.
- Many other fatal diseases may be 'competing' with the valvular disease to affect life expectancy.
- Elderly people with a poor quality of life due to comorbidities often refuse to undergo surgery just for the sake of prolonging life rather than to improve its quality.

Consequently, an improvement in the quality of life is often the foremost consideration in this population when faced with the decision to undergo AVR, or not. However, as elderly people are generally healthier and more physically active than they used to be a few

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Table I: Differential impact of patient-prosthesis mismatch (PPM) on postoperative survival, according to its degree of severity and to the baseline characteristics of the patient.

Parameter	Moderate PPM	Severe PPM
Age <70 years	+	++
LV systolic dysfunction	++	+++
Severe LVH	?	++

Clinical impact: +: mild; ++: moderate; +++: important; ?: unknown.
LV: Left ventricular: LVH: Left ventricular hypertrophy.

decades ago, many will agree to undergo surgery primarily in the hope of improving or maintaining this status. In this context, the findings by Urso et al. - that even moderate PPM may reduce the postoperative quality of life in patients aged 75 years or more - must be considered important and most relevant with regards to this segment of the population (1). These results are also consistent with those of Ennker et al. (5), who reported an independent association between PPM and the quality of life. In contrast, Vicchio et al. (6) were unable to identify any significant relationship between PPM and quality of life in patients aged >70 years. The discrepancies between these studies may be due to differences in the patients' baseline characteristics, to the incidence and severity of the PPM, and to the methods used to assess the quality of life. The patient's quality of life following AVR is, in the large part, determined by his or her functional capacity. There are, however, very few studies that have used an objective method to assess the determinants of functional capacity following AVR. In one of these, Bleiziffer et al. (7) systematically performed a maximum exercise test at six months after AVR in a large series of patients. In this study, PPM was found to be a strong independent predictor of a reduced maximum exercise capacity, providing further evidence that PPM may have a negative impact upon a patient's quality of life.

Individualizing the PPM preventive strategy

In light of the data published elsewhere, it appears that the impact of PPM is not equivalent in all patients (Table I). First, previous studies have shown that the impact of PPM on short- and long-term survival is much more important in patients with a reduced left ventricular (LV) ejection fraction than in those with a preserved LV function (2,8). These findings are consistent with the concept that a ventricle with a depressed systolic function is much more sensitive to an increase in afterload than is a normal ventricle. Along the same lines, Mihaljevic et al. (3) also recently showed that PPM is associated with an excess long-term mortality in patients with severe left ventricular hypertrophy (LVH) prior to AVR. Furthermore, the results of these previous studies (2-4) and of the latest study (1) suggest that the impact of PPM on clinical outcome is more pronounced in younger than in older patients. More importantly, the impact of PPM is highly dependent on its degree of severity, and this severity-effect relationship may be modulated by the baseline characteristics of the individual patient. Severe PPM is generally associated with an adverse outcome, and should ideally be avoided in every patient undergoing AVR. Fortunately, the incidence of severe PPM is low (<10%) and, as exemplified in the study of Urso et al. (1), it has decreased substantially over the past decade due not only to a greater awareness of the problem but also to progress in the design and hemodynamic performance of prosthetic valves. Until now, moderate PPM was thought to be generally well tolerated in older, sedentary patients with a preserved LV function, whereas it has been shown to have a detrimental impact in patients with a depressed LV function and/or severe LVH, regardless of their age. In view of the present results, it is also probable that the preservation of quality of life in the elderly should also become a consideration when discussing the detrimental consequences of moderate PPM.

These observations emphasize the importance of individualizing the PPM preventive strategy according to: (i) the baseline characteristics of the patient; (ii) the anticipated severity of the PPM; and (iii) the estimated risk/benefit ratio of the alternative procedure that is contemplated either to prevent PPM or to reduce its severity (see Table I). Several studies have shown that it is possible to predict the risk and severity of postoperative PPM at the time of surgery by calculating the projected indexed effective orifice area of the prosthesis (9). If the surgeon anticipates a moderate PPM in a vulnerable patient (i.e., a depressed LV function and/or severe LVH, young age, athlete and probably, as per the present results, an elderly patient seeking an enhanced quality of life) or a severe PPM in any given patient, an alternative strategy may be considered including: (i) the implantation of a prosthesis with a better hemodynamic performance (e.g., a newer-generation stented bioprosthesis or a bileaflet mechanical valve implanted in a complete supra-annular position, or a stentless bioprosthesis); or (ii) the realization of aortic root enlargement for the implantation of a larger prosthesis size. The latter procedure should be considered only when PPM - and particularly severe PPM - cannot be avoided by using a prosthesis with a better hemodynamic performance, and when the risk/benefit ratio of aortic root enlargement is considered to be acceptable.

The generalization of a concept to fit the whole population is often misleading in the field of medicine. In light of the data published elsewhere, it is indeed wrong to state that PPM has a detrimental impact in all patients. However, it is also wrong to conclude that PPM is benign in all patients - and especially in all elderly patients. This underscores the need for an individualization of the PPM preventive strategy in the elderly population. On the one hand, it seems reasonable to accept a moderate PPM in elderly, sedentary, patients with good LV function. On the other hand, elderly patients with a depressed LV systolic function may not tolerate even a moderate degree of PPM, and every effort should be made to avoid PPM in these patients.

Finally, beyond the prolongation of life duration - which is, by nature, often limited in the elderly population - we should also pay attention to improvements in the quality of life. Although the prevention of moderate PPM may not necessarily extend the life duration in these elderly patients, it may nonetheless improve their quality of life and well-being. In light of these findings, it seems logical to adopt strategies to prevent PPM in the elderly population, under the condition that these strategies can be accomplished at an acceptable risk/benefit ratio.

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