Patient–prosthesis mismatch after mitral valve replacement: Myth or reality?

Pasquale Totaro, MD,[a] and Vincenzo Argano, MD[b]

Dr Totaro

Objective: Determining the risk of patient–prosthesis mismatch after mitral valve replacement is still controversial. In this study, we aimed to clarify incidence and clinical implications of such a complication. The accuracy of preoperative prediction of patient–prosthesis mismatch using published in vitro hemodynamic parameters was also investigated.

Methods: Ninety-two patients who underwent mitral valve replacement and received Carpentier–Edwards stented bioprosthesis (Edwards Lifesciences, LLC, Irvine Calif) were enrolled. Hemodynamic performances were evaluated at discharge, and the incidence of in vivo patient–prosthesis mismatch (indexed effective orifice area ≤ 1.2 cm^2/m^2) was evaluated. Correlation between in vivo patient–prosthesis mismatch and predicted patient–prosthesis mismatch, based on previously published in vitro hemodynamic parameters, was also investigated.

Results: Five patients died within 30 days of the operation (5.4% mortality). Mean prosthesis size was 29.8 ± 2. Mean postoperative effective orifice area and indexed effective orifice area (2.5 ± 0.8 cm^2 and 1.5 ± 0.4 cm^2/m^2, respectively) compared favorably with those predicted in vitro (2.2 ± 0.7 cm^2 and 1.3 ± 0.5 cm^2/m^2, respectively). In the subgroup of patients receiving prosthesis size of 27 or smaller, the difference reached statistical significance (2.47 ± 0.83 and 1.61 ± 0.7 for postoperative and predicted effective orifice areas, respectively; $P < .001$). Postoperative patient–prosthesis mismatch was recorded in 8 patients (8.6%), comparing favorably with the predicted patient–prosthesis mismatch (39% for overall population and 80% for patients receiving prosthesis size ≤ 27). No significant correlation between size of prosthesis and early hemodynamic and clinical outcomes was shown.

Conclusions: In our study, stented mitral bioprostheses showed satisfactory postoperative hemodynamic performance, even in smaller prosthesis sizes (≤27 mm). Risk of in vivo postoperative patient–prosthesis mismatch seems to be less relevant than preoperative risk prediction based on in vitro data. Further studies are needed to evaluate the potential clinical impact of mitral patient–prosthesis mismatch.

From the Cardiac Surgery Division, Civic Hospital, Brescia, Italy[a]; and the Department of Thoracic and Cardiovascular Surgery, Villa Maria Eleonora Hospital, Palermo, Italy.[b]

Received for publication Feb 2, 2007; revisions received March 19, 2007; accepted for publication April 11, 2007.

Address for reprints: Pasquale Totaro, MD, Via San Vincenzo, 38, 20123 Milan, Italy (E-mail: ptotaro@yahoo.com).

J Thorac Cardiovasc Surg 2007;134:697-701

0022-5223/$32.00

doi:10.1016/j.jtcvs.2007.04.031

The term patient–prosthesis mismatch (PPM) was introduced in the late 1970s by Rahimtoola[1] to describe the condition in which the effective orifice area (EOA) of the prosthetic valve inserted into the patient was not matching the area of the native valve, thus causing an abnormal residual pressure gradient across the valve with obstruction to ventricular outflow or inflow, or both. Since then, several studies have been designed and carried out to better clarify the cutoff value for PPM to occur, as well as the clinical relevance of such a complication. The majority of these studies, however, have concentrated on PPM after aortic valve replacement.[2-7] It is only in the recent era that the clinical consequence of mitral PPM has been considered.[8]

Abbreviations and Acronyms
EOA = effective orifice area
MEOA = mitral effective orifice area
MEOAI = indexed mitral effective orifice area
MVR = mitral valve replacement
PPM = patient–prosthesis mismatch

In this study we evaluate early postoperative hemodynamic performance and early clinical outcomes in patients undergoing MVR with a stented bioprosthesis to better clarify the real risk and the early clinical relevance of mitral PPM.

Patients and Methods

Data from 92 consecutive patients (male 39%, mean age 74 ± 4 years) who underwent MVR with a biologic prosthesis, as an isolated or combined procedure, were prospectively collected. Only emergency operations were excluded and no patients were excluded on the basis of preoperative left ventricular function or pulmonary hypertension.

Two types of Carpentier–Edwards stented bioprostheses (Perimount pericardial and SAV porcine; Edwards Lifesciences, LLC, Irvine Calif) were used according to surgeon preference. Patient characteristics are summarized in Table 1. Preoperative and postoperative hemodynamic performances were recorded for all survivors and compared with the in vitro data published by the manufacturer for the implanted prosthesis. Incidence of postoperative PPM was evaluated and correlated to the predicted incidence of PPM. Finally, postoperative hemodynamic performance and clinical outcome were correlated to the size of bioprosthesis implanted.

Echocardiographic Technique and Definition

Transthoracic echocardiograms performed by an experienced cardiologist, unaware of the size of prosthesis implanted, were obtained preoperatively (within 72 hours before the operation) and postoperatively (30 days after the operation) in all patients. As previously suggested,[9] the postoperative mitral effective orifice area (MEOA) was calculated by the continuity equation method. Indexed MEOA was calculated as MEOAI = MEOA/body surface area. According to the definition previously published,[9] mitral patient–prosthesis mismatch was defined as MEOAI of 1.22 cm^2/m^2 or less. Systolic pulmonary artery pressure was calculated by adding the systolic right ventricular pressure derived from the tricuspid regurgitation to the estimated right atrial pressure. According to previously published data,[10] pulmonary hypertension was defined as moderate for systolic pulmonary artery pressures of 40 mm Hg or greater and severe for systolic pulmonary artery pressures of 60 mm Hg or greater.

Surgical Technique

All procedures were performed through a standard midline sternotomy and full cardiopulmonary bypass. Antegrade cold blood cardioplegia was used as conventional myocardial protection strategy. The mitral valve was approached with a standard left atrial incision. Native posterior leaflet or subvalvular apparatus, or both, were preserved whenever possible. All prostheses were implanted with interrupted everting 2–0 Ethibond (Ethicon Inc, Somerville, NJ) non–pledget-supported sutures (except under specific conditions).

TABLE 1. Patient characteristics

Age (y)	74 ± 4
Sex	
Male	36 (38)
Female	56 (62)
BSA (cm^2/m^2)	1.7 ± 0.2
BMI (kg/m^2)	25 ± 5
Rhythm	
Sinus	36 (38)
AF/flutter	56 (62)
LVEF	
Good (EF > 50%)	28 (30)
Moderate (EF 30%–50%)	48 (52)
Poor (EF < 30%)	16 (18)
Pulmonary hypertension	
Severe (PAP > 60 mm Hg)	19 (20)
Moderate (PAP > 40 mm Hg)	38 (40)
Associated procedures	
MVR + AVR	21 (23)
MVR + CABG	41 (45)

BSA, Body surface area; *BMI,* body mass index; *AF,* atrial fibrillation; *LVEF,* left ventricular ejection fraction; *EF,* ejection fraction; *PAP,* pulmonary artery pressure; *MVR,* mitral valve replacement; *AVR,* aortic valve replacement; *CABG,* coronary artery bypass graft.

Statistical Analysis

Values are expressed as mean ± standard deviation. Noncontinuous parameters were compared by the χ^2 test or Fisher exact test when appropriate. Continuous variables were compared by the Student *t* test for paired and unpaired data when appropriate. Simple least squared linear regression was used to test the association between continuous variables.

Results

Two patients died in the hospital (cumulative early mortality 2.5%), and 3 patients died during 30 days of surveillance (cumulative 30-day mortality 5.4%). Early postoperative outcome (in terms of intensive care unit stay, mechanical ventilation, and cumulative hospital stay) and postoperative hemodynamic performances are summarized in Table 2A. Postoperative hemodynamic performance measured in vivo by transthoracic echocardiography is shown in Table 2B. No significant differences were found comparing the two types of prosthesis (mean EOAI was 1.5 ± 0.4 and 1.4 ± 0.5 cm^2/m^2 for porcine and pericardial prostheses, respectively ($P = .5$). Average EOAI was above the limit for mitral PPM definition and EOAI less than 1.22 was obtained in only 8 patients with a cumulative incidence of PPM of 8.6% (Table 2B). Both postoperative MEOA and MEOAI compared