Aortic valve prosthesis-patient mismatch: Pro pane lucrando? Res non verba!

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Aortic prosthesis-patient mismatch (PPM) has been registered and logged as one of the most powerful predictors for poor prognosis at a long-term follow up after aortic valve replacement. New and more recent prosthtetic models have reached such a perfection that the obtained gradients are increasingly lower. Such is the case between the 19 mm monostrut mechanical aortic heart valve and SJM Regent (0.8 cm2 vs 1.6 cm2, respectively). We show one case herein about a female patient underwent mitral and aortic mechanical replacement plus tricuspid annuloplasty. Over 19 years, she developed impairment in NYHA funcitonal class III. Important patient-prosthesis mismatch was identified. With no other alternative than simple re-replacement (because of the mitral prosthesis in situ), the 19 mm monostrut mono-leaflet prosthesis was taken away and a 19 mm bileaflet SJM Regent was inserted instead of. Patient course was uneventful with no important gradient or any mismatch aortic valve-relate. Patient prosthesis relationship highly improved from 0.47 up to 0.94. This simple case illustrates very well how important is the preliminary calculation of the patient-prosthesis match befofe operation.

Key words: Aortic valve; Heart valve prosthesis; Patient-prosthesis mismatch; Left ventricle.

La desproporción aórtica prótesis-paciente (DPP) se ha identificado y registrado coo uno de los predictores más fuertes de peor pronóstico en el seguimiento a largo plazo en el reemplazo valvular aórtico. Los nuevos modelos protésicos más recienes han logrado un grado de perfección tal que los gradientes obtenidos son cada vez más bajos. Tal es el caso entre la prótesis mecánica aórtica de un solo disco 19 mm y la SJM Regent de dos valvas 19 mm (0.8 cm2 vs 1.6 cm2, respectivamente). Presentamos aquí el caso de una paciente femenina sometida a reemplazo protésico mitro-aórtico y anuloplastía tricuspídea. Después de 19 años, presentó deterioro de la clase funcional III de la NYHA. Se identificó una DPP importante. Sin otra alternativa más que el simple recambio protésico (dado que tenía prótesis mitral in situ), se retiró la prótesis aórtica de un disco 19 mm y se substituyó por otra SJM Regent de dos valvas 19 mm. la evoluciòn fue sin complicaciones, y sin gradiente importante ni DPP. La DPP mejoró notablemente de 0.47 hasta 0.94. Este caso pone de manifiesto la importancia del cálculo preliminar de la relación prótesis-paciente antes de la cirugía.

Palabras clave: Válvula aórtica; Prótesis valvulares cardiacas; Desproporción prótesis-paciente; Ventrículo izquierdo.

Prosthesis-patient mismatch (PPM) is defined as the minimum value to avoid the development of a trans-valvular gradient impacting several aspects such as LV mass regression, early and late mortality, cardiac events, and hemodynamic function. Broadly speaking, in aortic position it has been defined as ≤ 0.85 cm^2/m^2. Getting in a bit more detail, aortic mild-moderate PPM is between ≤ 0.85 cm^2/m^2 and > 0.65 cm^2/m^2; aortic severe PPM is ≤ 0.65 cm^2/m^2 [1]. In mitral position, this valve has been identified as ≤ 1.2 cm^2/m^2.

This has a direct impact on the pulmonary arterial pressure after surgery [2]. As a matter of fact, first attention about PPM was focused on mitral position by Rahimtoola et al. [3]. In this context, we can figure out that up to 71% of the patients in mitral valve replacement series have some degree of PPM [2].

We present herein one case of aortic valve replacement showing PPM since de beginning after initial operation. Long term outcome was unsatisfactory with imparment in functional class requiring a further aortic re-replacement aimed at improving the prosthesis-patient match by means of a newer and better mechanical prosthesis model with larger effective

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Figure 1. SJM Regent on the left, and monoleaflet mechanical prosthesis on the right. Of note, both of them are 19 mm. A wider funcitonal area can be observed on the SJM Regent.

orifice area (EOA).

CASE REPORT

A 43 years-old female patient was operated on 19 years before for mitral and aortic mechanical valve replacement plus tricuspid annuloplasty. A 31 mm mitral mechanical mitral prosthesis (mono-leaflet), and a 19 mm mechanical aortic valve replacement (mono-leaflet), plus tricuspid annuloplasty altogether were performed. Despite aortic PPM was evident since the beginning, initial postoperative course was uneventful. It is necessary to highlight that indexed EOA for the initial aortic mechanical prosthesis model was 0.8 cm2/m2. When indexing for the patient BSA (1.7 m2), it is obtained 0.47, which is too smaller than 0.85 cm2/m2, even smaller than 0.65 cm2/m2 (severe PPM).

Nineteen years later, she was studied because of impairment in functional class, NYHA III, with no improving with medical management. Echocardiographic study showed a very important transaortic prosthetic gradient of more than 40 mmHg. All the rest of findings were normal. Hence, severe PPM in aortic position was diagnosed. Need for aortic EOA augmentation turned out to be absolutely indicated. Several choices were explored. Traditional aortic root enlargements like Manouguian or Nicks techniques were ruled out because of previous prosthetic mitral replacement. Whereafter aortic valve re-replacement using a newer prosthetic model with a larger EOA with the same size number of 19 mm was selected to be carried out. In this way, no additional aortic root enlargement was needed. For this purpose, a 19 mm SJM Regent mechanical prosthesis (EOA = 1.6 cm2/m2) was selected (**Fig. 1**) .

Reoperation for exchanging the aortic mechanical prosthesis model (same number 19 mm) was sucessfully carried out. The old mono-leaflet prosthetic model (19 mm) was taken away and the newest SJM Regent (19 mm) mechanical prosthesis was inserted. No complications in the postopera-

tive course. Five months later, an echocardiographic study demonstrated that the transaortic prosthetic gradient dropped down to less than 10 mmHg. Current prosthesis-patient match ranges now around 0.94. No PPM was observed anymore. Patient recovery is now more than evident in NYHA functional class I, with no additional medication.

COMMENT

In the light of the foregoing, PPM must be anticipated since the very beginning at the time of the preoperative period by calculating the correct prosthesis size for a given patient. The final idea is to avoid any PPM in mitral or aortic position, at the outset, in terms of the body surface area.

It is essential to follow the next three steps in order to avoid any big mistake:
i) Calculate the BSA of the patient.
ii) Get the effective orifice area (OEA) of the prosthesis, usually recorded by the manufacturer at the prosthesis pack information.
iii) Divide the OEA value by BSA

The obtained value must be ideally ≥ 0.8 cm2/m2 in order to avoid any aortic PPM. Most of the patients will range between 21 and 23 mm aortic valve prosthesis. It represents values going from 1.3 to 1.8 cm2/m2 depending of the valve model, among many other things. In turn, most of the patients can be located between 1.6 and 2 m2 of BSA. Hence, particular attention must be paid on the critical value of ≥ 0.85 cm2/m2. A more specific focus must be targeted on patients with LVEF < 40%. The worst outcome is observed when both factors PPM as well as impaired LV function coexist at the same time.

In aortic position, PPM has an important impact on early mortality as well as late mortality. It is an independent predictor for worse early and late survival. Aortic PPM has a direct relationship with the relative risk for in-hospital mortality of 2.1 in moderate PPM, whereas 11.4 in severe PPM [4]. It is worth emphasizing that the worst early outcomes were observed when coinciding aortic severe PPM and impaired LVEF < 40%, with 67% of mortality rate. With this framework, aortic severe PPM should be avoidable with special emphasis in patients with LV dysfunction [4]. For late mortality, when indexed EOA is ≤ 0.75 cm2/m2 is an independent predictor for death [5]. After adjusting the late mortality in the multivariate analysis, severe PPM is found as an independent risk factor for death [6].

What we exemplify here with this case is the high importance of getting the best prosthesis-patient match since the beginning, even aortic as well as mitral position. Especially care must be taken into aortic position, given the fact that it may be more usual than in mitral position. Perhaps, anatomic findings in the native annulus such as calcification, or shrinking tissue in rheumatic cases which in turn finishes in some 19 mm or 21 mm aortic prosthesis in place. Thus, best prosthetic models with larger EOA should be choosen as far as possible [1].

After analyzing all this above, we are driven to wonder if aortic root enlargement might be necessary in any case. It must be taken in mind that such techniques for root enlargement are of higher risk than usual aortic valve replacement ones [7]. Although p value is not significant, operative mortality was higher with aortic root enlargement (5.6% vs 2.9%, p= 0.0324) [8].

What we are seeing is that the most effective the newest prostetic models with larger EOA, the more rare are the old aortic root enlargement techniques.

Prosthesis-patient mismatch was associated with a statistically significant increase in all-cause mortality (HR = 1.34, 95% CI: 1.18-1.51). Analysis by severity of PPM demonstrated that both moderate and severe PPM increased all-cause mortality (HR = 1.19, 95% CI: 1.07-1.33 and HR = 1.84, 95% CI: 1.38-2.45) and cardiac-related mortality (HR = 1.32, 95% CI: 1.02-1.71 and HR = 6.46, 95% CI: 2.79-14.97) [9].

To sum up, all efforts must be made in order to avoid any PPM since the beginning, at the outset.

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