TITLE: THE PREVALENCE OF PATIENT-PROSTHESIS MISMATCH CAN BE REDUCED USING THE TRIFECTA AORTIC PROSTHESIS.

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BACKGROUND: Some important studies have shown that patient-prosthesis mismatch is a frequent situation after surgical aortic valve replacement that impairs survival. The Trifecta valve has a special architecture designed to achieve the best hemodynamic profile. Our aim was to know the prevalence of mismatch using this prosthesis

METHODS: We studied 1302 patients at 3 months after surgery. 339 patients with a Trifecta prosthesis and 963 with a Mitroflow aortic valve, which were used as control group. Multinomial multivariate logistic regression was calculated to estimate the association between the Trifecta prosthesis and moderate/severe patient-prosthesis mismatch.

RESULTS: Any degree of mismatch was present in 5.9% of the Trifecta group and 42.4% in the Mitroflow group. Moderate patient-prosthesis mismatch was present in 3.8% of the patients with a Trifecta valve and 32.6% in the Mitroflow group. Severe mismatch was present in 2.1% of the patients with a Trifecta prosthesis and in 9.8% of the patients with a Mitroflow valve. All differences were statistically significant ($p<0.001$). The odds ratio of the Trifecta prosthesis as protector against mismatch was 16.9 (IC95% 9.5-30.4) and 11.9 (IC95% 5.3-26.7) for the moderate or severe degree respectively.

CONCLUSIONS: The prevalence of patient-prosthesis mismatch using the Trifecta aortic prosthesis is extraordinary low. This finding may have great clinical repercussions in patients undergoing surgical aortic valve replacement.

INTRODUCTION

Patient-prosthesis mismatch (PPM) is defined as "the situation in which the prosthetic valve area, after insertion into the patient, is less than that of a normal human valve" (1). After aortic valve replacement (AVR), moderate PPM has been reported to be present in 20-70% of patients and severe in 2-20% (2-4). Recent meta-analysis showed that PPM produces an increase between 30% and 150% in short and long-term mortality and this impact increases with increasing severity of the mismatch (2-4). Moreover, older patients are more prone to develop PPM than younger patients (2-4).

While some important randomized trials (5,6) have shown that PPM was less common after transcatheter AVR (TAVR) than after surgical AVR (SAVR), some authors (7) have identified the higher percentage of PPM after SAVR as responsible for the better 2-year clinical outcomes of transcatheter procedures and find arguments to prefer these techniques to conventional SAVR.

In light of these meta-analysis and randomized trials (2-6) it can be concluded that severe PPM should be always avoided whereas moderate PPM should not appear in patients presenting vulnerability factors to PPM.

Compared with mechanical prosthesis, the use of biological valves increases almost 3 times the risk for PPM (4). The Trifecta aortic valve (St Jude Medical Inc, St Paul, Minnesota, USA) is a stented bovine bioprosthesis approved in 2011 that incorporates ethanol-based anticalcification technology. With a small sewing ring and a single sheet of bovine pericardial tissue externally mounted on a titanium stent, its special architecture has been designed to achieve the best haemodynamic profile (8-10). Recent reports have documented satisfactory early term clinical and hemodynamic performance (8-10). However, its ability to avoid PPM has not yet been well documented. Our aim was to know the prevalence of PPM using the Trifecta aortic

valve and its ability to avoid PPM comparing with other externally mounted bovine pericardial bioprosthesis, the Mitroflow aortic valve (Sorin Group Inc, Mitroflow Division, Vancouver, Canada), which was used as control group.

METHODS

All patients who underwent SAVR between January 2006 and December 2015 at our institution with the Mitroflow (models 12A and LX) or Trifecta prosthesis were included in this study. All data were prospectively collected using an electronic database.

All patients underwent 2-dimensional and Doppler transthoracic echocardiographic examinations preoperatively and 3 months after the operation. The latter was used for PPM evaluation. PPM was defined as follows: Moderate PPM when the indexed effective orifice area (IEOA) was $\leq 0.85 cm^2/m^2$ and $> 0.65\ cm^2/m^2$ and severe PPM $\leq 0.65 cm^2/m^2$ (11). Body surface area (BSA) was calculated using the DuBois Formula. Effective orifice area (EOA) and other echocardiographic parameters were estimated according to the American Society of Echocardiography (12).

Surgical technique:

All the patients underwent full median sternotomy and cardiopulmonary bypass. Myocardial protection was provided by perfusion of intermittent antegrade and retrograde crystalloid cold cardioplegia immediately after aortic cross-clamping. Specific measuring devices were used for each valve and the largest possible prosthesis was implanted always in supraanular position. The final decision as to the type of prosthesis to be implanted was made by the surgeon at the time of operation. All prostheses were implanted in the same manner in supraanular position. Horizontal

mattress stitches with PTFE pledgets were passed from ventricular size of annulus to aortic surface.

Statistical analysis

Descriptive statistics were reported as number and percentage for categoric variables and mean ± standard deviation for continuous variables. Continuous variables were compared using Student-Fisher test after analyzing Levene equal variance test. Ordered categories were compared calculating the Mantel-Haenszel test for linear trend and unordered categories were compared using chi-square test.

Using the Mitroflow prosthesis as the control group, we aimed to know the impact of the Trifecta prosthesis on the prevalence of moderate/severe PPM. To do that, we created a multinomial logistic regression analysis. To control for cofounding variables we took into account the formula of the IEOA=EOA/BSA. EOA depends on (1) the size of the implanted prosthesis, which depends on the diameter of the annulus or, as estimation, left ventricular outflow tract diameter (LVOTD) [as reported by Ugur M et al. (9)], (2) the calcification or stiffness of the annulus, which is difficult to control but older and patients with diabetes have been identified as risk factors for more calcified annulus (4,11) and finally (3) the type of the prosthesis. So, the complete model was formed by the next covariates: type of prosthesis, LVOTD, age, diabetes and BSA.

Once the regression analysis was performed, any cofounding factor was considered to be removed if two conditions are met: (1) that variable did not cause an important modification [| (OR – ORadjusted)/ORadjusted | >0.10] over the association type of prosthesis (Trifecta/Mitroflow) and risk of PPM and (2) similar or smaller standard error was achieved for that OR (13). Statistical significance of independent

variables was assessed using the Wald and the likelihood ratio test. Finally, outliers or influence points, linearity between covariates and logits, colinearity and over-dispersion were checked. All tests were two-sided.

The Institutional Review Board approved this research project.

Statistical analysis was performed by using STATA v.14.1 (STATA Corp., TX, USA) and SPSS v.20 (IBM Corp, NY, USA).

RESULTS

Preoperative, intraoperative and postoperative data.

1413 patients underwent SAVR with a Mitroflow or Trifecta bioprosthesis during the study period at our institution. Figure 1 of the Supplementary Material shows the number of prostheses implanted over the study period. 1052 received Mitroflow prosthesis and 361 received Trifecta valves. Of these 1413 patients, 1108 (78.6%) had pure aortic stenosis. Mean age was 76.9 ± 5.0 years and 677 (47.9%) were women. The baseline characteristics of the 1436 patients and their preoperative echocardiographic findings according to the type of the implanted prosthesis are detailed in Table 1. The mean BSA was 1.78 ± 0.17 m^2 in the Trifecta group and 1.76 ± 0.18 m^2 in the Mitroflow group (p=0.021). Weight and height were also greater in the Trifecta group (p=0.023 and p=0.022). Body mass index was similar: 28.9 ± 4.5 Kg/m^2 and 28.7 ± 4.1 Kg/m^2 in the Trifecta and Mitroflow group respectively (p=0.45). Moreover, LVOTD was similar 22.1 ± 2.3 mm versus 22.1 ± 2.3 mm (p=0.99).

Concomitant mitral surgery and cross-clamping times were greater in the Trifecta group. New need for permanent pacemaker was less frequent in patients with Trifecta than those with Mitroflow (0.9% vs 3.7%, p=0.025). 30-day and 3-month mortality were similar 6.1% vs 7.7% (p=0.34) and 6.1% vs 8.6% (p=0.15). Other

intraoperative and postoperative data are summarized in Table 2.

Prevalence of PPM. Ability of the Trifecta prosthesis to avoid mismatch.

1311 patients survived the immediate postoperative period (<30 days). Of these, 8 patients in the Mitroflow group died between 30 and 90 days after the operation and 1 patient of the Trifecta group had endocarditis during this period and had to be removed from the analysis.

1302 patients were alive with the same prosthesis at 3 months after surgery. 339 patients with a Trifecta prosthesis and 963 with a Mitroflow aortic valve. Any degree of PPM was present in 5.9% (CI95% 3.6-8.9%) (n=20) of the Trifecta group and 42.4% (CI95% 39.2-45.6%) (n=408) of the patients with a Mitroflow valve. Moderate PPM was present in 3.8% (CI95% 2.1-6.5%) (n=13) of patients with a Trifecta valve and 32.6% (CI95% 29.7-35.7%) (n=314) in the Mitroflow group. Severe PPM was present in 2.1% (CI95% 0.8-4.2%) (n=7) of the patients with a Trifecta prosthesis and in 9.8% (CI95% 7.9-11.8%) (n=94) of the patients with a Mitroflow valve. All differences were statistically significant ($p<0.001$). Table 3 shows the prevalence of PPM for each valve and size. Figures 1-3 show the distribution of the EOA, IEOA and mean transvalvular gradient for each prosthetic size.

IEOA was weakly correlated with mean transaortic gradient ($r=-0.4$, $p<0.001$). Figure 4 shows the correlation between IEOA and mean transaortic gradient.

The assumption of linearity between LVOTD as continuous variable and logit was not fulfilled (Figure 2 and 3 of Supplementary Material). To make the model more flexible, this variable was divided into quintiles.

The complete multinomial regression model was also the best model since this guaranteed the smaller standard error for the association type of prosthesis and PPM.

The OR of the Trifecta prosthesis was 0.06 (CI95% 0.03-0.11) for moderate PPM versus no PPM indicating an OR as protector against moderate PPM of 16.9 (CI95% 9.5-30.4). The OR of the Trifecta valve for severe PPM versus no PPM was 0.08 (CI95% 0.04-0.19) indicating a protector OR against severe mismatch of 11.9 (CI95% 5.3-26.7). LVOTD quintiles were tested using the likelihood ratio test as chunk-test. The greater the LVOT diameter, the lower the likelihood of moderate and severe PPM ($p<0.001$). Beta coefficients and other parameters of the model are shown in Table 4.

COMMENT

The main finding of this work is that, using the Trifecta prosthesis, PPM can be moved from a frequent circumstance to a rare complication after SAVR. Only 4% and 2% of these valves produced moderate or severe PPM respectively.

These findings are of great clinical importance. Recently some meta-analysis have shown that even moderate PPM produces an increase in short and long-term mortality after SAVR (2-4). Both the PARTNER and CoreValve randomized trials demonstrated that PPM was less common after TAVR than after SAVR (5,6) and suggested that less PPM after TAVR was in part responsible for the better 1- to 2-year clinical outcomes after TAVR versus SAVR. In addition, the more aggressive nature of the conventional operation makes surgical patients more vulnerable to the clinical consequences of PPM (7).

Studying 196 patients with an implanted Trifecta aortic valve, Ugur M et al (9) showed an excellent hemodynamic profile. Data regarding EOA, IEOA and mean gradients for each size are similar to ours. However, their data were obtained in the pre-discharge echocardiography and prevalence of PPM was not reported.

Anselmi A et al (10), without control group and based on the hemodynamic findings obtained immediately before discharge, found that severe PPM was present in 5% for patients with the 19mm, 1% for the 21mm and 1% for the 23mm. There is growing consensus to accept that the evaluation of PPM should be carried out several months after the operation (14). With 339 Trifecta prostheses evaluated at 3 months after surgery, we have found 10%, 1% and 0% of severe PPM for 19, 21 and 23 mm respectively. In the Mitroflow group, we found more than double the prevalence of severe PPM in the 19 mm group and more than 10 times in the 21 mm group.

Interestingly, the association between mean transaortic gradients and the IEOA was not robust and small differences in mean gradients between both prostheses led to great differences in the prevalence of PPM.

As can be drawn from the calculated confidence intervals, while the Trifecta prosthesis produces at most 9% of PPM, the Mitroflow valve leaves at least 40% of the patients with some degree of PPM. The protective behavior of the Trifecta has been corroborated in the multinomial multivariate logistic regression analysis. So, the odds of presenting moderate or severe PPM is 17 or 12 times higher respectively with the Mitroflow aortic valve than with the Trifecta prosthesis.

With a small stent and a single sheet of bovine pericardium mounted externally around it, both prostheses are designed with the same architecture. Therefore, it is quite difficult to explain why there is so much difference in the valve area. However, some differences in the morphology can be identified. Tissue leaflets in the Trifecta valve are extended a few millimeters beyond the stent post, which makes this valve taller than the Mitroflow. So, total height for 19, 21 and 23 mm is 15, 16 and 17 mm for the Trifecta and 11, 13 and 14 mm for the Mitroflow aortic valve. In addition, no stitch is present at the top of the Trifecta leaflet commissures. Moreover, width is also greater in the

Trifecta prosthesis. Sewing ring width for 19, 21 and 23 mm is 24, 26 and 28 mm for the Trifecta and 21, 24 and 26 mm for the Mitroflow aortic valve respectively (15,16). So, the Trifecta prosthesis is clearly bulkier. While a Trifecta valve of size 21 has the same width as a Mitroflow of 23 mm, its area is similar to a Mitroflow of size 25 mm or bigger. Therefore, reasons for the large difference observed in the EOA of both prostheses may be mixed. On the one hand, due to the absence of the stitch at the top of the Trifecta commissures, leaflets could open more easily and widely. On the other, this valve is bigger than the Mitroflow prosthesis.

Before the appearance of the Trifecta aortic valve, the Perimount Magna prosthesis (Edwards Lifesciences, Irvine, California, USA) had shown to be in multiple studies the one with the best hemodynamic profile (17,18). However, recent works have concluded that the Trifecta valve leaves less gradients, bigger EOA and less rates of PPM than the Perimount Magna (9,19). So, in view of this and other studies (9,19), the Trifecta valve appears to be the surgical prosthesis that currently leaves less percentage of PPM and may be even lower than that of transcatheter prosthesis.

In contrast to the majority of other risk factors affecting outcomes of patients undergoing SAVR, PPM is a potentially modifiable parameter. Our study confirms that the simplest and most effective way to prevent mismatch is to correctly choose the type of prosthesis (11).

In conclusion, the Trifecta aortic valve, compared with other bioprosthesis, leaves around ten times less percentage of PPM. Using prosthesis of size 21 mm or more, the problem of PPM in SAVR almost disappears.

Limitations

Although some meta-analysis (2-4) have shown that PPM increases long-term mortality, we cannot conclude this is going to occur in our single-center study.

Several reasons are responsible for the great differences observed between studies regarding the prevalence of PPM. Most of them have to do with the definition of PPM. It is generally accepted that ex vivo measurements based on the internal diameter of the prostheses overestimate the real EOA values (11). There is not a perfect way to detect PPM. If we take the EOA from published in vivo reference values, we are not taking into account possible variations between individuals. Some experts found that the best moment for PPM evaluation is between 6 and 12 months after surgery (14). However, patients who die in this interval due to PPM won't be taken into account and prevalence of PPM may be undervalued (11).

Concomitant mitral surgery was performed more frequently in the Trifecta group. This type of operation can distort the aortic annulus so gradients and EOA of the Trifecta could be even better.

CONCLUSIONS

The prevalence of patient-prosthesis mismatch using the Trifecta aortic valve is extraordinary low. With valves ≥ 21 mm this problem almost disappears. This can have great clinical repercussions and modify the prognosis of patients undergoing surgical aortic valve replacement.

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TABLES

Table 1

Clinical data	***Trifecta***	***Mitroflow***	***p value***
Women	192 (53.3)	508 (48.3)	0.57
Age, years	76.8 ± 5.7	77.0 ± 4.8	0.62
Weight, kg	73.2 ±11.6	74.8±12.5	0.023
Height, cms	159.7 ± 8.8	160.9 ± 8.7	0.022
Systemic hypertension	290 (0.3%)	767 (73.8)	0.01
Diabetes	93 (25.8%)	286 (27.5)	0.055
Dyslipidemia	187 (51.8)	470 (45.2)	0.049
Body surface area (m2)	1.78 ± 0.17	1.76 ± 0.18	0.021
Body mass index (kg/m2)	28.9 ± 4.5	28.7 ± 4.1	0.45
Chronic obstructive pulmonary disease	57 (15.8)	177 (16.9)	0.59
Creatinine clearance (ml/min)	62.1 ± 20.8	60.6 ± 19.9	0.33
Previous stroke	15 (4.2)	68 (6.5)	0.15
Poor mobility	8 (2.2)	22 (2.1)	0.64
Extracardiac arteriopathy	38 (10.5)	121 (11.7)	0.85
Previous cardiac surgery	12 (3.3)	27 (2.6)	0.13
Critical preoperative state	3 (0.8)	27 (2.6)	0.055
Cardiac data			
Active endocarditis	15 (4.2)	35 (3.4)	0.47
History of supraventricular arrhythmia	73 (20.2)	215 (20.7)	0.88
Concomitant coronary disease	121 (33.5)	405 (38.5)	0.07
Previous acute myocardial infarction <3 months	9 (2.5)	34 (3.3)	0.33
Functional class NYHA			
NYHA I	11 (8.3)	54 (5.2)	
NYHA II	48 (36.4)	523 (50.2)	
NYHA III	65 (49.2)	381 (36.6)	
NYHA IV	8 (6.1)	84 (8.1)	
			0.004
Echocardiographic parameters			
Left ventricular ejection fraction			
>50%	309 (85.6)	872 (83.1)	
>30% y ≤50%	40 (11.1)	139 (13.2)	
≤30% y >20%	12 (3.3)	34 (3.2)	
≤20%	0 (0)	5 (0.5)	
			0.46
Interventricular septum > 17mm	61 (16.9)	288 (27.6)	<0.001
Left ventricular outflow tract diameter, mm	22.1 ± 2.3	22.1 ± 2.3	0.99
Systolic pulmonary pressure >55 mmHg	51 (14.1)	81 (7.8)	0.003
Aortic pathology			
Pure stenosis	280 (77.6)	826 (78.8)	
Pure insufficiency	41 (11.4)	93 (8.9)	
Double lesion	40 (11.1)	129 (12.3)	
			0.23
Mean gradient, mmHg	48.7 ± 13.9	46.9 ±14.1	0.066
Peak gradient, mmHg	80.7 ± 20.6	80.0 ± 23.7	0.58

Baseline characteristics of 1413 patients who underwent surgery with a Mitroflow or Trifecta prosthesis. NYHA: New York Heart Association.

Table 2

Operation characteristics	***Trifecta***	***Mitroflow***	***p value***
Urgency			
Elective surgery	267 (73.9)	845 (80.3)	
Surgery on the current admission	89 (24.7)	181 (17.2)	
Surgery < 24 hours	5 (1.4)	24 (2.3)	
Requiring cardiopulmonary resuscitation	0 (0)	2 (0.2)	
			0.083
Prosthetic size			
19mm	64 (17.7)	190 (18.1)	
21mm	139 (38.5)	443 (42.1)	
23mm	117 (32.4)	335 (31.8)	
25 o 27mm	41 (11.4)	84 (7.9)	
			0.101
Mitral surgery	54 (14.3)	76 (7.2)	<0.001
Tricuspid surgery	8 (2.2)	15 (1.4)	0.35
Proximal aortic surgery	17 (4.7)	36 (3.4)	0.23
Number of aortocoronary grafts			
None	246 (68.1)	701 (66.6)	
1	63 (17.5)	170 (16.2)	
2	33 (9.1)	122 (11.6)	
3	16 (4.4)	52 (4.9)	
4 or more	3 (0.8)	7 (0.7)	
			0.48
Cardiopulmonary bypass time	95.2 ± 37.3	93.2 ± 38.2	0.38
Cross-clamping time	76.8 ± 29.5	68.5 ± 26.4	<0.001
Aortic root enlargement	15 (4.2)	39 (3.7)	0.701
EuroSCORE II	4.7 ± 5.8	5.2 ± 6.7	0.64
Logistic EuroSCORE	10.9 ± 9.4	10.7 ± 9.9	0.82
Mortality and postoperative complications			
Pre-discharge mortality or < 30 days	22 (6.1)	81 (7.7)	0.34
3-month mortality	22 (6.1)	89 (8.6)	0.15
Oro-tracheal intubation > 24 hours	48 (13.3)	231 (21.9)	<0.001
Stroke	11 (3.1)	33 (3.1)	0.93
Acute myocardial infarction	30 (8.3)	102 (9.7)	0.80
New need of permanent pacemaker	3 (0.9)	36 (3.7)	0.025
Supraventricular arrhythmia without effective cardioversion	63 (17.5)	151 (14.5)	0.057

Intraoperative and postoperative characteristics.

Table 3

Variables	*Trifecta (n=339)*	*Mitroflow (n=963)*	*p value*
Number 19	59 (17.4)	178 (18.5)	
Prevalence of PPM			
No PPM	47 (79.7)	72 (40.5)	
Moderate PPM	6 (10.2)	69 (38.8)	
Severe PPM	6 (10.2)	37 (20.8)	
			<0.001
Mean gradient, mmHg	14.7 ± 6.2	19.3 ± 7.1	<0.001
EOA, cm^2	1.6 ± 0.4	1.3 ± 0.2	<0.001
IEOA, cm^2/m^2	1.0 ± 0.3	0.8 ± 0.2	<0.001
Number 21	129 (38.1)	403 (32.7)	
Prevalence of PPM			
No PPM	124 (96.1)	209 (51.9)	
Moderate PPM	4 (3.1)	148 (36.7)	
Severe PPM	1 (0.8)	46 (11.4)	
			<0.001
Mean gradient, mmHg	11.7 ± 4.9	16.1 ± 6.5	<0.001
EOA, cm^2	2.1 ± 0.3	1.5 ± 0.2	<0.001
IEOA, cm^2/m^2	1.2 ± 0.2	0.9 ± 0.2	<0.001
Number 23	111 (32.7)	307 (31.9)	
Prevalence of PPM			
No PPM	108 (97.3)	207 (67.4)	
Moderate PPM	3 (2.7)	89 (28.9)	
Severe PPM	0 (0)	11 (3.6)	
			<0.001
Mean gradient, mmHg	9.4 ± 3.8	14.0 ± 5.3	<0.001
EOA, cm^2	2.4 ± 0.4	1.7 ± 0.3	<0.001
IEOA, cm^2/m^2	1.3 ± 0.2	0.9 ± 0.2	<0.001
Number 25-29	40 (11.8)	75(7.8)	
Prevalence of PPM			
No PPM	40 (100%)	67 (89.3%)	
Moderate PPM	0 (0%)	8 (10.7%)	
Severe PPM	0 (0%)	0 (0%)	
			<0.033
Mean gradient, mmHg	6.4 ± 2.2	10.3 ± 3.2	<0.001
EOA, cm^2	2.6 ± 0.3	2.1 ± 0.3	<0.001
IEOA, cm^2/m^2	1.4 ± 0.2	1.2 ± 0.2	<0.001

Prevalence of PPM for 1302 patients at 3 months after surgery. EOA: Effective Orifice Area. IEOA: Indexed Effective Orifice Area. PPM: Patient-prosthesis Mismatch

Table 4

PPM	*Beta coefficient*	*SE*	*z*	*p >z*	*95% Confidence interval*
Moderate PPM					
Trifecta	-2.833	0.297	-9.53	<0.001	-3.415 - -2.250
BSA	2.983	0.473	6.31	<0.001	2.055 – 3.910
Diabetes	0.039	0.158	0.25	0.806	-0.271 – 0.348
Edad	0.004	0.014	0.26	0.799	-0.025 – 0.032
LVOTD					
20,951	-0.252	0.224	-1.13	0.260	-0.691 – 0.186
21,843	-0.514	0.230	-2.24	0.025	-0.965 - -0.064
23,003	-0.767	0.234	-3.28	0.001	-1.225 - -0.308
25,368	-1.314	0.251	-5.22	<0.001	-1.807 - -0.821
Constant	-5.533	1.463	-3.78	<0.001	-8.399 - -2.666
Severe PPM					
Trifecta	-2.474	0.413	-5.98	<0.001	-3.284 - -1.664
BSA	5.308	0.729	7.28	<0.001	3.879 – 6.737
Diabetes	-0.143	0.257	-0.56	0.577	-0.647 - -0.360
Edad	0.0242	0.024	1.02	0.308	-0.022 – 0.071
LVOTD					
20,951	-1.081	0.313	-3.45	0.001	-1.696 - -0.467
21,843	-1.022	0.303	-3.37	0.001	-1.617 - -0.428
23,003	-3.295	0.533	-6.18	<0.001	-4.340 - -2.250
25,368	-3.152	0.465	-6.78	<0.001	-4.063 - -2.240
Constant	-11.633	2.380	-4.89	<0.001	-16.298 - -6.967

Multinomial logistic regression. Dependent variable: No PPM vs Moderate PPM/ Severe PPM. LVOTD: Left Ventricular Outflow Tract Diameter. PPM: Patient-prosthesis Mismatch.

FIGURE LEGENDS

Figure 1: Box-plot showing the distribution of the effective orifice area for each prosthetic size. EOA: Effective Orifice Area.

Figure 2: Box-plot showing the distribution of the indexed effective orifice area for each prosthetic size. IEOA: Indexed Effective Orifice Area.

Figure 3: Box-plot showing the distribution of the mean transaortic gradients for each prosthetic size.

Figure 4: Relationship between mean transaortic gradient and indexed effective orifice area. IEOA: Indexed Effective Orifice Area.