every single patient in accordance to his aortic contrast medium attenuation.

In this dataset (n = 110), we performed a linear regression model depending on the individual HU threshold and the ratio between the calcium measurements in CTA and nonenhanced scans. The regression line showed a slope of -0.0003 and an intercept with the Y-axis at 0.4065. Hence, the calibration factor (CF) for calcium quantification in CTA scans was calculated as follows:

$$\text{calibration factor} = \frac{1}{(\text{individual HU threshold} \times \text{slope}) + Y\text{-axis intercept}}$$

The derived CTA volumes of aortic calcifications using the +100% HU threshold above the intravascular density were then multiplied by the individual CF. For validation purposes, the accuracy of this approach was determined in additional 100 consecutive patients undergoing CT for TAVR planning (Figure 1A).

Overall, 78 patients (13.3%) presented with SCA_{LVOT}. The composite clinical endpoint occurred more frequently in the SCA_{LVOT} group (Figure 1B). Furthermore, patients with SCA_{LVOT} showed higher incidence of more than mild PVL (2.4% vs. 6.4%, p = 0.046) and were at higher risk of 30-day and 2-year all-cause mortality (2.4% vs. 9.0%, log-rank p = 0.001; 22.6% vs. 32.8%, log-rank p = 0.019, respectively). In multivariate model, SCA_{LVOT} was identified as independent predictor of the 30-day composite endpoint (hazard ratio [HR]: 2.44; 95% confidence interval [CI]: 1.26 to 4.73) and 2-year mortality (HR: 1.86; 95% CI: 1.17 to 2.93).

Although the threshold of 609 mm³ LVOT calcium volume was derived and validated in the same cohort, additional confirmation in an independent population is required. In addition, our results have to be interpreted within the context of a specific contrast protocol on specific scanner platforms. However, by application of this novel standardized method for calcium quantification from CTA images, we were able to confirm SCA_{LVOT} as important risk factor of 30-day adverse events as well as short-term and mid-term mortality in patients undergoing TAVR with BEV. This finding underlines the important clinical role of accurate pre-TAVR assessment and risk stratification by CT taking SCA_{LVOT} into account.

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Obesity Paradox in the Clinical Significance of Effective Prosthetic Orifice Area After Aortic Valve Replacement

The definition of prosthesis–patient mismatch (PPM) remains to be refined to enhance its prognosis insight after surgical aortic valve replacement (SAVR) for severe aortic stenosis, especially in obese patients (1). We aimed at investigating the respective prevalence and prognostic value of effective orifice area (iEOA) and industry-predicted orifice area (iPOA) normalized to body surface area, according to the body weight status after SAVR. We hypothesized that the iEOA would bring increased prognostic insight as compared with the iPOA, regardless of the body weight status.

Between 2009 and 2016, we prospectively explored all consecutive patients referred to our Heart Valve Clinic for a first SAVR who presented severe aortic stenosis and a normal left ventricular ejection fraction (>50%). The iPOA predicted from reference normal value (2) and iEOA calculated by transthoracic echocardiography were assessed at discharge. PPM was defined with current definitions, that is, moderate for 0.65 cm²/m² ≤ iOA ≤0.85 cm²/m² and severe for iOA ≤0.65 cm²/m². Patients were followed for major events (ME), defined as cardiovascular death, hospitalization for heart failure, and stroke.

There were 762 patients included, with the iPOA available in 712 patients (93.4%). The mean age was 70 ± 11 years with 54% male; one-quarter had diabetes. Two-thirds were overweight (37%) or obese (33%). EuroSCORE II were low, 1.36 (Q1: 0.95 to Q3: 2.15), and similar between lean, overweight, and obese patients (p = 0.86). The proportions of biological prosthesis (almost 80%) and concomitant coronary bypass grafting (almost 25%) were the same in the different body status groups (p = 0.81 and p = 0.51, respectively). The mean diameter of the prosthetic valve was 22.5 ± 2.0 mm.

The prevalence of patient without significant PPM was the same using iEOA or iPOA (46.9% vs. 47.5%; p = 0.83). Conversely, severe PPM was almost 3 times more frequently observed with iEOA than with iPOA (20.5% vs. 7.0%; p < 0.0001). with a significant but weak correlation between these 2 parameters (p < 0.0001; r^2 = 0.21).

During a mean follow-up of 4.0 ± 2.5 years, ME occurred in 134 patients (17.6%) with 44 cardiovascular deaths and 100 acute heart failures (n = 73) and strokes (n = 52). PPM as defined with iPOA was barely associated with ME occurrence (**Figure 1A**). Importantly, neither moderate nor severe PPM defined with iPOA (hazard ratio [HR]: 1.44; 95% confidence interval [CI]: 0.99 to 2.09; p = 0.06) were significantly associated with increased occurrence of ME in comparison with the patients free from PPM (HR: 1.55; 95% CI: 0.75 to 3.20; p = 0.16). Conversely, PPM as defined by iEOA was significantly associated with ME occurrence (**Figure 1B**): moderate (HR: 1.97; 95% CI: 1.29 to 2.99; p = 0.0005) and severe PPM (HR: 1.97; 95% CI: 1.20 to 3.24; p = 0.0017) were significantly associated with worse long-term prognosis with versus without PPM. Surprisingly, no prognostic difference was observed between moderate and severe PPM (p = 0.81), questioning the reference value to define PPM. After multivariable adjustment including variables with a p value of <0.10 on Cox univariate analysis (i.e., age, body mass index, diabetes, hypertension, and iEOA), older age (β ± SE = 0.04 ± 0.01; p = 0.0003), high body mass index (β ± SE = 0.04 ± 0.02; p = 0.02), diabetes (HR: 1.95; 95% CI: 1.33 to 2.85; p = 0.0006) and low iEOA (β ± SE = −0.71 ± 0.33; p = 0.03) were independently associated with long-term occurrence of ME. Receiver-operating characteristic curve analysis showed that a cut-off (maximum Youden index criteria) of 0.85 cm²/m² for iEOA had the greater discriminating power to predict ME onset without being a strong prognosticator (area under the curve: 0.58; p = 0.018). An iEOA <0.85 cm²/m² was associated with an increased occurrence of ME in lean (HR: 2.12; 95% CI: 1.01 to 4.48; p = 0.03) and overweight (HR: 1.92; 95% CI: 1.08 to 3.40; p = 0.03), but not in obese patients (HR: 1.47; 95% CI: 0.86 to 2.51; p = 0.17) (**Figure 1C**).

FIGURE 1 Long-Term Prognostic Impact of PPM
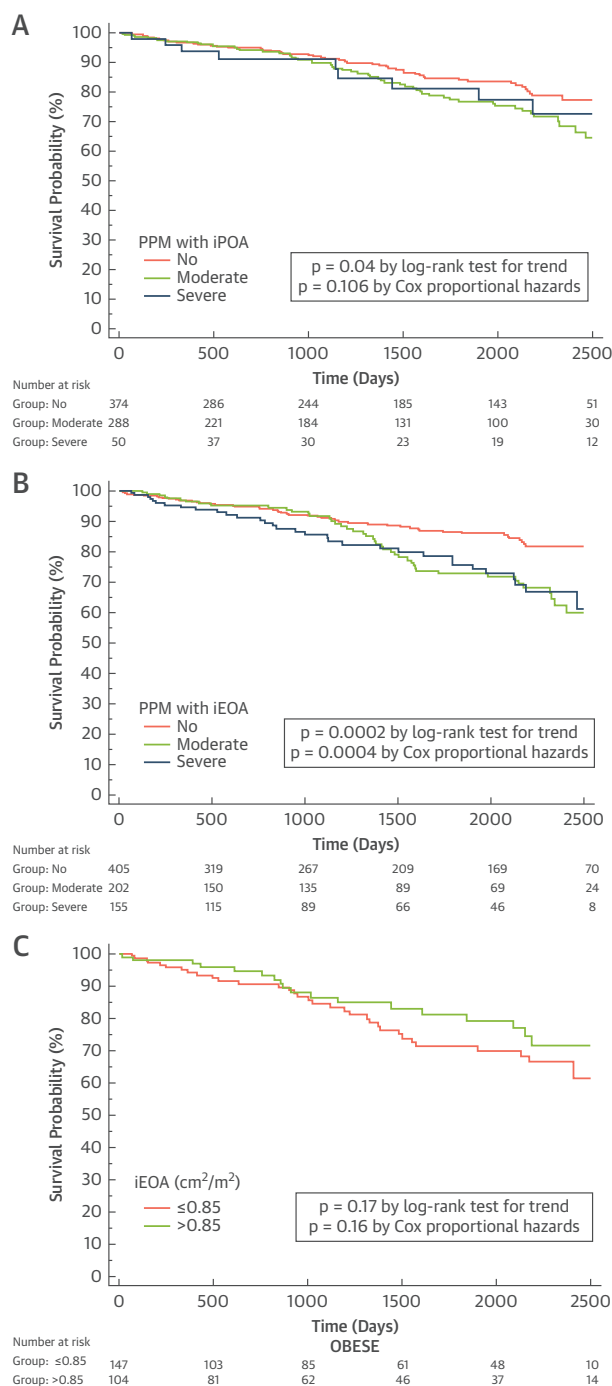
Event-free survival according to the industry-predicted orifice area (iPOA) **(A)** and the effective orifice area (iEOA) **(B)**. Moderate and severe prosthesis–patient mismatch (PPM) were defined according to standard definitions in **A** and **B**. **(C)** Event-free survival according to iEOA in obese patients with PPM defined according to the receiver-operating characteristic curve derived cut-off of 0.85 cm²/m².

To explore further the lack of prognostic insight of iEOA in obese patients, we tested the indexation of EAO by different power of height to refine PPM definition in this group thanks to an accelerated failure time nonlinear model with hazard: $S(t) = \exp(-[\alpha \cdot t]^\gamma)$ and $\alpha = \exp(b0 + b1 \cdot EOA/height^{b2})$; b0, b1, b2, and γ were optimized by NLMIXED SAS procedure (SAS, Inc., Chicago, Illinois).

Surprisingly, EOA normalized to the height elevated to the power of b2 was not significantly associated with ME occurrence in obese patients whatever b2 value, that is, ME after SAVR were not driven by prosthetic orifice area in obese patients, suggesting an "obesity paradox."

To conclude, indexing the EOA derived from TTE measurements by body surface area with the unique cutoff of 0.85 cm^2/m^2 showed the best accuracy to predict ME after SAVR and might be preferred to constructors-generated orifice area reference values. Importantly, a clear association between echocardiography-derived EOA and cardiac events was only observed in lean and overweight patients but not in obese, regardless of the indexation calculation. Further studies are needed to explore the lack of prognostic insight of PPM in obese patients.

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Anatomic Characterization of the Aortic Root in Patients With Bicuspid and Tricuspid Aortic Valve Stenosis

Does Fusion of Doppler-Echocardiography and Computed Tomography Resolve Discordant Severity Grading?

Up to 30% of patients with aortic stenosis (AS) present with discordant grading (aortic valve area [AVA] <1 cm^2, but the mean pressure gradient [MPG] $\geq$40 mm Hg), raising uncertainty regarding the degree of AS severity (1). The aortic root is elliptical and transthoracic echocardiography (TTE)-derived left ventricular outflow tract (LVOT) area may be underestimated as based on a single diameter (TTE_{LVOTd}) (2). Combining computed tomography(CT) measurement of the LVOT area with TTE hemodynamic parameters has been proposed to solve the issue of discordant grading (3).

We enrolled 70 consecutive patients with moderate/severe bicuspid AS and 140 sex-, body surface area-, and MPG-matched patients with moderate/severe tricuspid AS. The AVA_{ECHO} was calculated using the continuity equation as: $\Pi/4 \times (TTE_{LVOTd})^2 \times VTI_{LVOT}/VTI_{AV}$ (where VTI is the velocity-time integral and AV is aortic valve). Using CT scans, from the true double oblique transverse view, maximum (D_{max}) and minimal (D_{min}) diameters, and annulus area ($CT_{LVOTarea}$) were measured and eccentricity index ($1 - [D_{min}/D_{max}]$) was calculated. Fused AVA (AVA_{CT}) was calculated as: $CT_{LVOTarea} \times VTI_{LVOT}/VTI_{AV}$.

The MPG was 53 $\pm$ 15 mm Hg, AVA_{ECHO} was 0.77 $\pm$ 0.20 cm^2, and 180 patients (86%) presented with an AVA <1 cm^2. By design, there was no difference in