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Accuracy of aortic valve calcium volume measurement with contrast enhanced multidetector CT

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THEME: Interventions for Valvular Disease

TOPIC(S): TAVI, Other valvular and structural interventions

AIMS

The extent of aortic valve calcification is an important determinant of procedural success in transcatheter aortic valve implantation (TAVI). It has become common practice to measure aortic valve calcium volume (AVCV) on contrast enhanced multislice computed tomography (MDCT) scans using unadjusted HU-thresholds, which may be erroneous due to over- or underestimation of calcium. Aim of the present analysis was to validate AVCV measurements using different thresholds on contrast enhanced MDCT against non-contrast enhanced studies as reference.

METHODS AND RESULTS

In 142 consecutive patients undergoing transfemoral TAVI, AVCV including adjacent calcifications in the left ventricular outflow tract was determined using a dedicated software (3mensio). Native images were analyzed using a threshold of 130 HU as reference (AVCVHU130). For contrast enhanced scans, applied thresholds were 450 HU (AVCVHU450), 850 HU (AVCVHU850), mean aortic attenuation + 2 SD (AVCVHUAo), and individually adjusted under visual estimation (AVCVHUi).

Compared to AVCVHU130 (1776 mm³ [IQR 1393-2553]), all AVCV measurements on contrast enhanced scans were significantly different ($p < 0.001$ for all comparisons), leading to underestimation in AVCVHUi (453 mm³ [271-644]) and AVCVHU850 (368 mm³ [187-673]), and overestimation in AVCVHUAo (1023 mm³ [711-1645]) and AVCVHU450 (7095 mm³ [2705-9571]). The best approximation to the reference was achieved with AVCVHUi (Pearson correlation: $R = 0.84$, $p < 0.001$; Bland-Altman: mean difference 1476 mm³ [limits of agreement 245;2828]).

In the group that received the balloon-expandable Sapien 3 prosthesis, there was no difference between patients with PVL $\geq 1^\circ$ or those requiring post-dilatation versus the group without PVL or without need for post-dilatation, regardless of the threshold that was applied. Conversely, in the group that was treated with the self-expanding Acurate neo prosthesis, AVCVHU130 (1669 mm³ [IQR 1403-2114] vs. 1324 mm³ [IQR 1162-1498]; $p = 0.001$), AVCVHUi (396 mm³ [IQR 267-578] vs. 255 mm³ [IQR 126-464]; $p = 0.01$) and AVCVHU850 (391 mm³ [IQR 209-889] vs. 204 mm³ [IQR 139-501]; $p = 0.03$) were significantly higher in patients with PVL $\geq 1^\circ$, and AVCVHU130 (1725 mm³ [IQR 1426-2527] vs. 1346 mm³ [IQR 1177-1690]; $p < 0.001$) and AVCVHUi (455 mm³ [IQR 322-697] vs. 264 mm³ [IQR 160-410]; $p = 0.001$) in those requiring post-dilatation.

CONCLUSIONS

Compared with non-contrast enhanced MDCT as reference, measurement of AVCV using contrast enhanced studies with unadjusted thresholds may lead to false estimation of the calcium volume. The use of visually adjusted individual HU-thresholds (AVCVHUi) provides best approximation to the reference and allows for discrimination of PVL $\geq 1^\circ$ or need for post-dilatation in patients receiving a self-expanding prosthesis.

