Comparison of non-invasive and invasive cardiac damage staging in patients with clinically significant aortic stenosis

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Background: Cardiac damage staging derived from transthoracic echocardiography (TTE) is an additive clinical tool to enhance risk stratification and therapeutic decision making in patients with clinically significant (i.e. ≥moderate) aortic stenosis (AS). However, it is not able to differentiate prognosis among patients in Stage 3 and 4. The optimal strategy and timing of intervention in patients with moderate and asymptomatic severe (m/asAS) remains controversial.

Purpose: To compare the accuracy in risk stratification of the cardiac damage staging derived from TTE and right heart catheterization (RHC) in patients with clinically significant AS, divided in those with m/asAS and those with symptomatic severe AS (ssAS). At first, all stages were considered; then, we focused on patients in stage 3 and 4.

Methods: Observational cohort study of patients with clinically significant AS undergoing TTE and RHC from 2016-2020. AS grading was based on current guidelines evaluating the TTE closest to the RHC (maximum time interval 3 months). Patients were divided in those with m/asAS and ssAS. Cardiac damage staging (Stage 0-4) was derived both from TTE and RHC. Kaplan-Mayer (KM) curves and log-rank tests were used to compare the survival according to each cardiac damage stage in both cohorts. Area under the receiver-operating characteristics curve (AUC) analysis and Delong’s test were used to compare the accuracy in prognostic stratification.

Results: 432 patients were included (183 with m/asAS and 249 with ssAS). According to TTE-derived cardiac damage staging, 42 (9.7%) patients were classified in Stage 0; 99 (22.9%) in Stage 1; 160 (37%) in Stage 2; 68 (15.7%) in Stage 3 and 63 (14.6%) in Stage 4. Median follow-up was 3.1 [2-6.1] years. KM curves showed the validity of cardiac damage staging in both cohorts (p<0.01 in patients with masAS and p=0.01 in those with ssAS). Overall, there was no statistically significant difference in prognostic accuracy between the cardiac staging system derived from TTE and RHC in both cohorts (AUC 0.713, 95%CI 0.63-0.80 for TTE and AUC 0.733, 95%CI 0.64-0.83 for RHC in m/asAS, p=0.758 and AUC 0.633, 95%CI 0.56-0.71 for TTE and AUC 0.677, 95%CI 0.60-0.75 for RHC in ssAS, p=0.258). Considering only patients in Stage 3 and 4, RHC-derived cardiac staging system showed significant higher diagnostic accuracy than TTE-derived in both cohorts (AUC 0.782, 95%CI 0.66-0.91 for RHC and AUC 0.540, 95%CI 0.38-0.71 for TTE in m/asAS, p=0.01 and AUC 0.699, 95%CI 0.58-0.81 for RHC and AUC 0.51, 95%CI 0.38-0.65 for TTE in ssAS, p=0.02).

Conclusions: Compared to the TTE-derived, RHC-derived cardiac staging system showed a similar accuracy in stratifying the prognosis of both patients with m/asAS and ssAS, being significantly more accurate in patients in Stage 3 and 4. The evaluation of right heart chambers appears to be pivotal in risk stratification of patients with clinically significant AS.

Survival curves of study population
Cardiac damage staging – Stages 0 to 4

Moderate and Asymptomatic Severe AS

Symptomatic Severe AS

Cardiac damage staging – Stages 3 to 4

Moderate and Asymptomatic Severe AS

Symptomatic Severe AS

ROC curves of TTE and RHC stratification