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Multiparametric assessment of diastolic function in heart failure

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Background: The assessment of diastolic function is still challenging in the setting of heart failure (HF). We tested the hypothesis that applying a machine learning algorithm would detect heterogeneity in diastolic function and improve risk stratification in HF population.

Methods: This study included consecutive 279 patients with clinically stable HF referred for echocardiographic assessment, for whom diastolic function variables were measured according to the current guidelines. Cluster analysis, an unsupervised machine learning algorithm, was undertaken on these variables to form homogeneous groups of patients with similar profiles of the variables. Sequential Cox models paralleling the clinical sequence of HF assessment were used to elucidate the benefit of cluster-based classification over guidelines-based classification. The primary endpoint was a hospitalization for worsening HF.

Results: Cluster analysis identified 3 clusters with distinct properties of diastolic function that shared similarities with guidelines-based classification. The clusters were associated with brain natriuretic peptide level ($p < 0.001$, figure A). During follow-up period of 2.6 ± 2.0 years, 62 patients (22%) experienced the primary endpoint. Cluster-based classification exhibited a significant prognostic value ($c2 = 20.3$, $p < 0.001$, figure B), independent from and incremental to an established clinical risk score for HF (MAGGIC score) and left ventricular end-diastolic volume (hazard ratio = 1.677, $p = 0.017$, model c2: from 47.5 to 54.1, $p = 0.015$, figure D). Although guideline-based classification showed a significant prognostic value ($c2 = 13.1$, $p = 0.001$, figure C), it did not significantly improve overall prognostication from the baseline (model c2: from 47.5 to 49.9, $p = 0.199$, figure D).

Conclusion: Machine learning techniques help grading diastolic function and stratifying the risk for decompensation in HF.

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