Integrative interpretation of cardiopulmonary exercise tests for cardiovascular risk stratification: a machine learning approach

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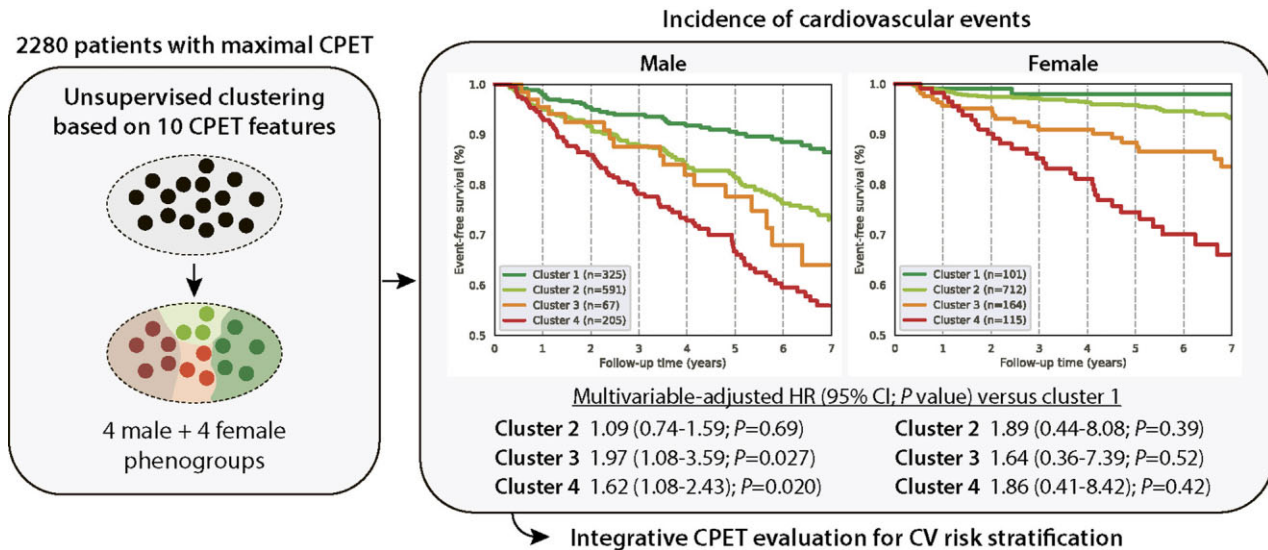[3]Virga Jesse Hospital, Cardiology, Hasselt, Belgium

Background and objectives: Cardiopulmonary exercise testing (CPET) remains underutilized for cardiovascular (CV) risk assessment. Integrative interpretation of CPET results may improve characterization of cardiorespiratory fitness and assessment of CV risk. Therefore, we explored the clinical value of CPET-based phenomapping for CV risk stratification.

Methods: We retrospectively retrieved clinical data from 2280 patients with diverse CV risk (47.9% female) who underwent maximal CPET by cycle ergometry. We derived 18 key CPET indices as well as data on fatal and non-fatal CV events (median follow-up time: 5.3 years). Next, an unsupervised clustering algorithm (Gaussian Mixture modelling) subdivided the cohort in sex-specific phenogroups solely based on differences in CPET metrics. Clinical characteristics were compared across CPET phenogroups and their multivariable-adjusted association with future CV events was determined.

Results: 8 of the 18 CPET metrics were excluded from clustering due to high collinearity (i.e. an absolute Pearson correlation coefficient >0.8). Based on the remaining 10 CPET variables, the clustering algorithm subdivided the cohort in four male and four female CPET phenogroups. In both males and females, the phenogroups differed significantly in age, BMI, spirometric and CPET measurements and prevalence of hypertension, intake of antihypertensive and lipid-lowering drugs, CV disease and CV surgery (P<0.05 for trends). During follow-up, 278 males and 109 females experienced a CV event (43.9 and 16.2 events per 1000 years of follow-up, respectively). Compared to male phenogroup 1, male phenogroups 3 and 4 presented higher risk for incident CV events (multivariable-adjusted hazard ratio: 1.97 and 1.62; P≤0.027). Significant differences in risk for future CV events between the female phenogroups disappeared after adjustment for confounders.

Conclusion: Integrative CPET-based phenogrouping adequately stratified patients according to their risk for future CV events. Such phenomapping may facilitate comprehensive evaluation of CPET results and steer future CV risk management.

Study flow and findings