Predictors of quality of life improvement in patients undergoing catheter ablation for atrial fibrillation: a cluster-based analysis

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Introduction: Traditional classification of Atrial Fibrillation (AF) based on temporal patterns doesn't fully encompass the condition's complexity. Unsupervised cluster analyses have been used for classifying patients into groups with similar comorbid profiles. However, inconsistent comorbidity patterns have been found across different cohorts. Bayesian profile regression, a semi-supervised machine learning technique, may improve the precision of clustering by integrating outcome data, diminishing the variability observed with previous methods. Since quality of life (QoL) primarily drives the indication for AF ablation, we utilized the AF Effect on QualiTy-of-Life (AFEQT) questionnaire to cluster patients.

Purpose: Our aim is to use patient-reported outcome measures to identify clinically relevant phenotypes of AF that benefit the most from catheter ablation.

Methods: We implemented a single center follow-up (FUP) program for patients with AF referred for ablation since august 2020, including scheduled visits and remote monitoring through a digital health platform. AFEQT score reported by patients was analyzed using a non-linear mixed model and change in AFEQT by month 12 was used as outcome. Comorbidities, echocardiographic data, and biomarkers were collected. Profile regression mixture modelling guided by QoL improvement was performed to create clinically relevant patient groupings. Penalized multinomial logistic regression model was used for validation.

Results: From the 466 ablations performed, 354 patients were enrolled until July 2023. 211 patients had FUP > 12 months (age 59±10 years, 31% female, 80% paroxysmal). The overall AFEQT questionnaire completeness rate was 72%. Patients were classified into 3 clusters: 1) patients with long duration AF, left heart cavities enlargement and diastolic dysfunction (n=57); 2) patients with self-reported anxiety/depression (n=50); and 3) patients with low rates of comorbidities (n=104). For clinical application, 8 variables (dyslipidemia, AF type and duration since diagnosis, mitral E/A ratio, systolic pulmonary arterial pressure, left ventricle ejection fraction, and PROMIS T-score for anxiety and depression) were sufficient for classifying patients (85% accuracy in internal cross-validation). Patients with higher depressive and anxiety burden (cluster 2) had worse baseline AFEQT score (median: 46, IQR: 39-60) and derived less benefit (median improvement: 21, IQR: 12-32), while patients with low comorbid burden (cluster 3) displayed higher baseline (median: 58, IQR: 48-62) and final QoL (median improvement: 28, IQR: 21-36, p<0.01).

Conclusion: Our analysis identified 3 reproducible clinically relevant phenotypes of AF using widely available clinical data. These clusters have distinct associations with QoL, underscoring the heterogeneity of AF and importance of comorbidities and substrates. This approach may allow for the prediction of which patients are most likely to benefit from treatment.