Machine Learning-based Models Predict Long-term Outcomes of Heart Failure Patients Implanted Cardiac Resynchronization Therapy

Shengwen Yang  
Shangyu Liu  
Zhimin Liu  
Yiran Hu  
Ran Jing  
Wei Hua

Introduction: Cardiac resynchronization therapy (CRT) reduces morbidity and mortality in drug-refractory heart failure patients with ventricular dyssynchrony delay. However, up to one-third of individuals do not benefit from CRT. We assessed the utility of machine learning (ML) algorithms to develop and validate models for predicting long-term outcomes using variables collected before the implantation.

Methods: Models were developed with six machine learning algorithms to predicts all-cause mortality and heart transplantation from January 2010 to December 2017 in Fuwai hospital. Ten-fold cross-validation was used for evaluation each ML model's performance.

Result: The best performing model was the Random Forest model with all 53 variables collected before the implantation [the receiver operating characteristic area under the curve (AUC): 0.75±0.09]. The model could significantly discriminate the risk of all-cause mortality or heart failure hospitalization (log-rank p<0.001, respectively).

Conclusion: A machine learning algorithm, by integrating multiple pre-implantation parameters, can produce a good model for meaningful stratification of long-term outcomes in heterogeneous heart failure patients following CRT.