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Prevention

A NEURAL NETWORK APPROACH TO PREDICTING OUTCOMES IN HEART FAILURE USING CARDIOPULMONARY EXERCISE TESTING

Poster Contributions
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Background: Cardiopulmonary exercise testing (CPX) is widely used to stratify risk in patients with heart failure (HF). Artificial neural networks (ANN) use weighted inputs in multiple layers of mathematical connections in order to predict outcomes from multiple risk markers. This approach has not been applied in the context of CPX to predict risk in patients with HF.

Methods: 2,635 patients with HF underwent CPX and were followed for 29±30 months. The sample was divided randomly into ANN training and testing sets to predict cardiovascular (CV) mortality. Five CPX variables were included in the model: peak VO2, VE/VCO2 slope, heart rate recovery, oxygen uptake efficiency slope, and resting end-tidal CO2 pressure. The predictive accuracy of ANN was compared to more conventional logistic regression (LR) and a multivariate Cox proportional hazards (PH) score. A multi-layer feed-forward ANN was used with a sigmoid activation function, and tested with a single hidden layer containing a varying number of hidden neurons.

Results: There were 291 CV deaths during the follow-up. All CPX variables were significant independent predictors of CV mortality using conventional PH analysis. After training, the ANN was more accurate in predicting CV mortality compared to LR and PH. Results from the testing set comparing the three methods are presented in the table.

Model	ROC Area	ROC, SE	Sensitivity	Specificity	Odds Ratio
ANN	0.72	0.032	0.79	0.63	4.2
Logistic Regression	0.70	0.033	0.71	0.65	2.6
Proportional Hazards	0.69	0.033	0.74	0.53	2.9

Conclusion: ANN improves upon conventional methods for estimating risk using established CPX responses in patients with HF.