Artificial Neural Network for Predicting Cardiovascular Autonomic Reflex Tests from Inflammatory Markers

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Context: The cardiovascular autonomic reflex tests (CARTs), first proposed by Ewing and Clark in 1982 and later reviewed by Spallone et al. (2011), are widely considered the standard measure of autonomic function. These tests comprise five objective measures that evaluate both parasympathetic and sympathetic branches of the autonomic nervous system. The results of each CART are categorized as normal, borderline, or abnormal. CARTs provide critical information on the progression of Cardiac Autonomic Neuropathy (CAN), which is vital for precise diagnosis and treatment planning.

Methods: The purpose of this study is to propose a multi-class classification model for predicting the outcomes of the five CARTs through the use of patients' inflammatory markers. The data set used in this study, consisting of 2621 entries of patients, was obtained from a rural diabetes screening clinic at *Charles Sturt University (CSU)* (DiabHealth), Albury, Australia, between the years 2002 to 2015. The data underwent normalization and removal of outliers, following which an Artificial Neural Network (ANN) was utilized as the classification model. The parameters of the ANN were optimized to obtain the most favourable performance.

Results: ANN showed high performance when predicting the individual CART features with F1-values of 0.968, 0.904, 949, 0.949 and 0.926. The models also exhibited high AUC scores. A variable importance analysis was conducted, and the outcomes showed that IGF-1 and IL-1Beta were the most significant inflammatory markers in predicting HG-BP and LS-BP, correspondingly. Additionally, these markers demonstrated higher importance in predicting sympathetic function tests compared to parasympathetic function tests.

Results of the ANN classification

	Accuracy	Precision	Recall	F1
LS-HR	0.969	0.968	0.969	0.968
DB-HR	0.905	0.905	0.905	0.904
VA-HR	0.947	0.951	0.947	0.949
HG-BP	0.926	0.926	0.926	0.926
LS-BP	0.951	0.949	0.951	0.949

Conclusion: The proposed ANN model, based on the relationship between inflammation and CAN progression, has the potential as a valuable tool for medical practitioners in the precise diagnosis of CAN and timely treatment planning.