Comparison of RCF scoring system to clinical decision for the Rey complex figure using machine-learning algorithm

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Abstract

Background: The interpreting of RCF scoring requires the standard RCF scoring system and the clinical decision, based on clinical dementia rate (CDR) by clinicians. The interpretation of RCF using clinical decision might not be accurate in the detection of mild cognitive impairment (MCI), or dementia patients in comparison to the RCF scoring system. For this reason, a machine-learning algorithm was used to demonstrate that scoring RCF using clinical decision was not as accurate as the RCF scoring system in predicting MCI or dementia patients from healthy subjects.

Method: The RCF dataset, which consisted of 2,232 subjects, was collected from formal neuropsychological assessments at Chung-Ang University Hospital. The RCF dataset was classified according to different criteria, where the first dataset had normal and abnormal subjects. They were grouped depending on the threshold cutoff point of 16%, based on the RCF scoring system. The second dataset had normal, MCI, and dementia subjects, classified depending on the clinical decision from patient CDR scores. The models were trained using a convolutional neural network (CNN) for machine learning, and an artificial neural network algorithm Tensorflow was implemented to distinguish the prediction accuracies of cognitive states of two models: the first model (Normal, Abnormal), and the second model (Normal, MCI, and Dementia).

Result: The trained model’s accuracy for predicting cognitive states was as following; 96% and 88% were from the first and second models, respectively. The first model had the sensitivity for detecting abnormal of 85% with an area under the receiver operating characteristic (ROC) curve of 0.847, and the second model had the sensitivity for detecting MCI or Dementia of 78% with an area under the ROC curve of 0.778.

Conclusion: The first model, trained using a machine learning algorithm for predicting abnormal patients, was more accurate in comparison to the second model for predicting MCI or Dementia. Based on these results, the RCF scoring system has the potential of presenting better accurate criteria in distinguishing cognitive impairment among patients in comparison to the clinical decision.