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Wake-up Stroke Outcome Prediction by Interpretable Decision Tree Model

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Abstract. Outcome prediction in wake-up ischemic stroke (WUS) is important for guiding treatment strategies, in order to improve recovery and minimize disability. We aimed at producing an interpretable model to predict a good outcome ($NIHSS_{7\text{-}day}$<5) in thrombolysis treated WUS patients by using Classification and Regression Tree (CART) method. The study encompassed 104 WUS patients and we used a dataset consisting of demographic, clinical and neuroimaging features. The model was produced by CART with Gini split criterion and evaluated by using 5-fold cross-validation. The produced decision tree model was based on NIHSS at admission, ischemic core volume and age features. The predictive accuracy of model was 86.5% and the AUC-ROC was 0.88. In conclusion, in this preliminary study we identified interpretable model based on clinical and neuroimaging features to predict clinical outcome in thrombolysis treated wake-up stroke patients.

Keywords. Wake-up stroke, Predictive modeling, Clinical outcome, Classification and Regression Tree

1. Introduction

Ischemic stroke is nowadays highly treatable with thrombectomy and intravenous thrombolysis reperfusion treatments, also in case of wake-up stroke (WUS) [1]. Outcome prediction for acute ischemic stroke treatment is still challenging and only a few studies focused on WUS. National Institutes of Health Stroke Scale (NIHSS) measured on the 7th day after the ischemic event ($NIHSS_{7\text{-}day}$) can be used as an outcome measure of acute ischemic stroke treatment [2]. The Classification and Regression Tree (CART) models provide better interpretability and practical usability important especially in emergency setting such as ischemic stroke. This preliminary study aimed at producing an interpretable model to predict a good outcome ($NIHSS_{7\text{-}day}$<5) in thrombolysis treated WUS patients by CART.

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2. Methods

The study was conducted on 104 WUS patients admitted to the Stroke Unit of the University Medical Hospital of Trieste, Italy, who underwent thrombolysis treatment. In this study, we used a dataset consisting of 27 demographic, clinical and neuroimaging features. Good outcome class was defined with $NIHSS_{7\text{-day}}<5$, while bad outcome class with $NIHSS_{7\text{-day}} \geq 5$. The model was produced by CART with Gini split criterion. The model was evaluated by using 5-fold cross-validation.

3. Results

The produced decision tree model is reported in Figure 1a. The model is based on NIHSS at admission, ischemic core volume and age features. The evaluated model accuracy was 86.5%, the confusion matrix is reported in Figure1b. The area under the ROC curve (AUC) was 0.88.

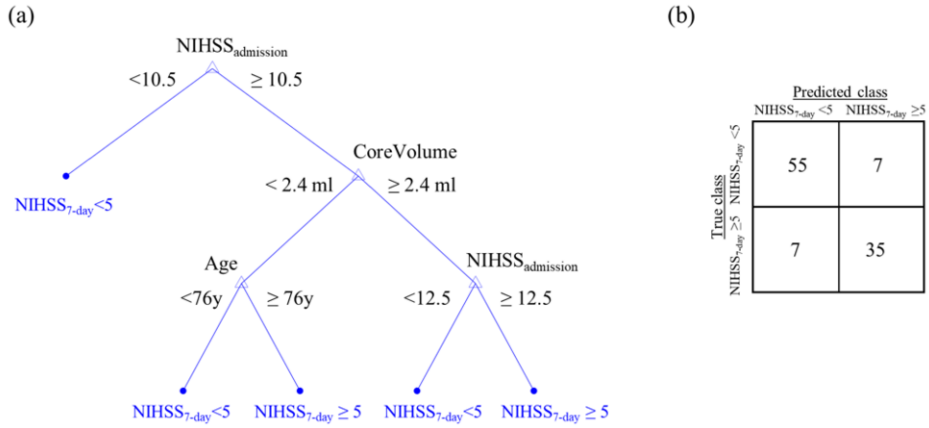

Figure 1. (a) The produced decision tree model (b) Confusion matrix.

4. Conclusions

In conclusion, in this preliminary study we identified an interpretable model to predict clinical outcome in thrombolysis treated wake-up stroke patients. If confirmed in a larger sample size, these findings provide an interpretable tool for early post-stroke prognosis, which is essential to guide therapeutic and rehabilitation strategies.

References

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