뇌신경재활

발표일시 및 장소: 10 월 19 일(토) 10:30-10:40 Room B(5F)

OP2-3-4

Development and validation of a machine learning-based prognostic model for post-stroke dysphagia

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Background

A machine learning-based prognostic model for long-term functional recovery of post-stroke dysphagia has been rarely investigated. The aim of this study was to investigate the clinical and radiologic prognostic factors predicting swallowing recovery, and to develop and validate a prognostic model predicting a swallowing functional outcome using the selected prognostic factors.

Methods

Consecutive patients (n=137) diagnosed as acute ischemic stroke who were referred for swallowing examinations were investigated in this study. The 6-month time duration of post-stroke dysphagia was analyzed by Kaplan-Meier method and Cox regression model for clinical and radiologic factors. Bayesian network models were developed using the selected clinical and radiologic factors to classify patients with good (<6 months) and poor (≥6 months) prognoses of swallowing function, and compared with other benchmark machine learning algorithms. To reduce the error cost possibly caused by class imbalance, adaptive synthetic sampling, called ADASYN, was implemented as an oversampling algorithm. In learning and validation process, 5-fold cross validation was used during oversampling by generating synthetic samples only for training partitions to avoid overfitting and over-optimistic estimates.

Results

Among the patients with post-stroke dysphagia, 24 (17.5%) patients showed persistent dysphagia with mean duration of 65.6 (confidence interval [CI], 54.8-76.5) days. The time duration of post-stroke dysphagia significantly differed by clinical factors: initial ASHA NOMS swallowing scale≤3 (P<0.001), clinical dysphagia scale≤20 (P=0.001), and male sex (P=0.010), and radiologic factors: contralateral lesion at basal ganglia/internal capsule/corona radiata (P=0.001) and severe white matter hyperintensities (P=0.007). In multivariate analysis using Cox regression model, corona radiata (hazard ratio, 1.72; 95%

CI, 1.16-2.53; P=0.007), initial ASHA NOMS swallowing scale≤3 (hazard ratio, 7.24; 95% CI, 3.72-14.12; P<0.001), and severe white matter hyperintensities (hazard ratio, 2.11; 95% CI, 1.27-3.52; P=0.004) were significant predictive factors for poor recovery of swallowing function. The Bayesian network classifier which was developed using the selected factors based on the survival model showed an area under the ROC curve of 0.808, F1 score of 0.898, and Matthews correlation coefficient of 0.637, which was superior to other benchmark machine learning-based classifiers including support vector machine and random forest.

Conclusions

The proposed Bayesian network model can provide the impact of clinical and radiologic factors on swallowing prognosis, and be useful to predict long-term functional recovery of post-stroke dysphagia in clinical practice.

Acknowledgment :This study was supported by grant No. 0420170660 from the SNUH Research Fund.

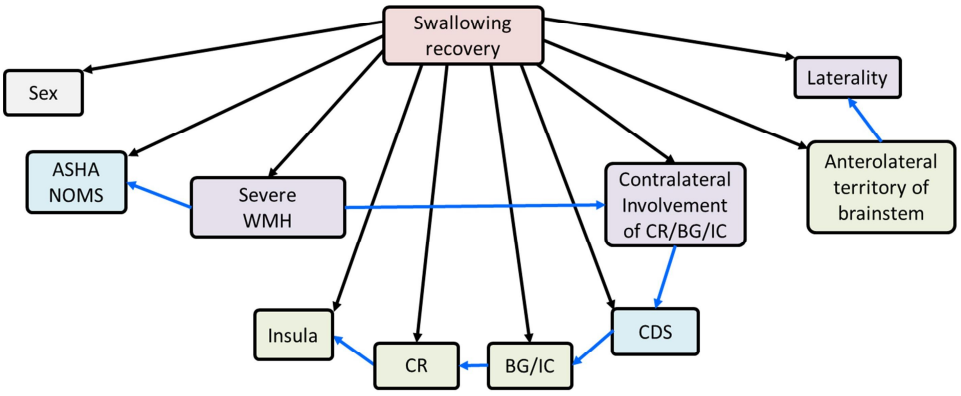

Fig. 1 The graphical representation of a Bayesian network model to predict poor recovery of swallowing function in patients with ischemic infarction