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Machine Learning Models for Predicting Intradialytic Hypotension

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Objectives: Intradialytic hypotension occurs frequently and is an important prognostic factor in patients with chronic hemodialysis. However, it is difficult to predict intradialytic hypotension with classical statistical model because there are many different factors in intradialytic hypotension. Therefore, we aimed to develop the prediction model for intradialytic hypotension using machine learning methods.

Methods: All hemodialysis sessions from September 2006 to November 2019 in Severance Hospital were screened. Intradialytic hypotension was defined as nadir systolic blood pressure (BP) <90 mmHg (definition 1) or decrease in systolic BP ≥ 20 mmHg compared to the initial BP (definition 2). Demographics, comorbidities, hypertensive medication, laboratory values, electrocardiogram parameters, vascular access, dialyzer, ultrafiltration rate, blood flow, and dialysate flow were used as features. In addition, several features from previous dialysis which contains historical information were created. The area under the receiver operating characteristic curves (AUROC), the area under the precision-recall curves (AUPRC) were observed to compare machine learning models including logistic regression, lasso regression, random forest, XGBoost, deep neural network, and scoring model.

Results: A total of 159,078 hemodialysis sessions were finally collected after excluding sessions having missing variables. The number of sessions in which intradialytic hypotension occurred was 5,978 sessions (3.8%) and 68,668 sessions (43.2%) according to definition 1 and 2, respectively. Compared with other models, the deep neural network model had the best performance to predict nadir SBP <90 mmHg (overall AUROC, 0.921) and XGBoost model had the best performance to predict decrease in SBP ≥ 20 mmHg compared to the initial BP (overall AUROC, 0.778).

Conclusions: Machine learning and deep learning methods can present the risk of intradialytic hypotension in advance before hemodialysis session start.