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A deep-learning based model for identification of prognostic factors and prediction of graft survival in kidney transplant patients

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Introduction: Kidney transplantation has been known as the ideal treatment for patients with end-stage renal disease. Graft function and survival are key aspects in post-transplant outcomes but it is rather difficult to predict such outcomes due to multifactorial components contributing to patients post-operative course. We attempted to incorporate a deep-learning based model to identify most important prognostic factors that correlate closely with graft function and survival in kidney transplant patients.

Methods: We collected clinical information of 4036 patients who underwent kidney transplantation between 2000 and 2017 at Asan Medical Center. Out of 39 retrospectively collected parameters, 29 parameters were selected as data sets. Using machine-learning algorithms, we made a computerized model to identify potential important features associated with the graft failure. We performed comparative analysis of logistic regression (LR) and machine-learning algorithms [XG boost (eXtreme Gradient Boosting), neural network, support vector machines (SVM)]. AUROC (area under receiver operating curve), accuracy, F1 score , precision and recall were used to evaluate the predictive performance of each model.

Results: Delayed graft function, positivity of T-flow and B-flow cytometry, presence of donor-specific antibody, HLA mismatch were identified as the most important prognostic factors with regard to graft survival (Fig. 1). Recipients factors including comorbidities such as diabetes, hypertension, high BMI and ABO incompatibility were also identified as contributing features for graft failure. In addition, serum creatinine measured at two years postoperatively was found to be an important predictor of the graft survival. Our results show that all logistic regression, XG boost, neural network, support vector machines have high predictive power (AUROC of 0.835, 0.851, 0.828, 0.815, respectively. The best performing model was XGBoost with accuracy (0.86), F1-score (0.91), precision (0.89), and recall (0.94).

Conclusion: With the help of machine-learning algorithms, it was possible to identify predictive factors associated with graft survival after kidney transplantation.