New Technologies - AI and Single Cell Sequencing

Interpretable Machine Learning Improves Prediction of Early Allograft Failure After Liver Transplantation

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Background

A quantitative marker of coronary artery disease is warranted for accurate detection of early allograft failure (EAF) after liver transplantation. We developed and evaluated a quantitative EAF marker derived from probabilities of interpretable machine learning prediction model.

Methods

In this cohort study, we developed and validated an EAF-predictive machine learning model using calculated biomarker variables within 7 days liver transplantation surgery from 1,312 consecutive cases in Hong Kong (930 males [70.9%];median age 52 years [IQR 45-58]) from Sep 1995 to Dec 2020, and assessed predicted probabilities as *in-silico* scores for EAF (*ISEAF*; range 0 [lowest probability] to 1 [highest probability]) in patients from an external cohort (N=206, 150 males [73.5%]; median age 58 years [IQR 48.7-63.4]) and a prospective cohort (N=84, 50 males [59.5%];median age 56 years [IQR 44.8-60]). We measured the association of *ISEAF* with clinical outcomes—namely, 3-month EAF.

Findings

The best model with HK cohort predicted EAF after liver transplantation with an area under the receiver operating characteristic curve (AUC) of 0·94 [95% CI 0·91–0·98], and 0·76 [0·65–0·88] in the holdout validation and external sets, respectively, and 0·92 [0·76–0·99] in the prospective set. ISEAF captured EAF risk from known risk factors in clinical scores such as EAD, MEAF, and LGrAFT-7 scores, using a model interpretation module. Three-month EAF risk increased quantitatively with ascending *ISEAF* quartiles (increase per quartile of 12 percentage points). Hazard ratios (HRs) and prevalence of 3-month EAF risk increased stepwise over *ISEAF* deciles.

Interpretation

Machine learning was used to generate an *in-silico* marker for EAF risk prediction after liver transplantation that can non-invasively quantify complication risk on a continuous spectrum.