Machine learning models for predicting long-term cardiovascular outcomes in kidney transplant recipients

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Background:

Clinical decision support tools to accurately predict cardiovascular events in kidney transplant recipients (KTR) are lacking. This study aims to develop machine learning (ML) models to predict the long-term cardiovascular outcomes in KTR.

Methods:

We included adult KTR (age 18 years) transplanted at Saint Louis University Hospital between January 2015 and December 2023. 454 features were recorded including demographic, clinical, and laboratory values as well as cardiac ischemic evaluation and revascularization data. We studied the following outcomes: all-cause mortality, cardiovascular death, hospitalization for heart failure (HFH), and non-fatal myocardial infarction (MI). We compared twelve different ML models for each outcome with five-fold cross validation. Data was split 80% for training and 20% for validation.

Results:

Among 518 patients in the cohort, the mean age was 57.0 +/- 13.8 years, 56.9% were men, 46.9% were White and 47.6% were African American. The best ML model had Area Under Curve (AUC) of 79.2%, 65.4%, 86.5%, and 83.3% for all-cause mortality, cardiovascular death, HFH, and non-fatal MI, respectively. The ML model for cardiovascular death had the lowest AUC at 65.4%, whereas HFH had the highest at 86.5%. Figure 1 shows standardized heatmaps of the most important features for each outcome graded by their p-values.

Conclusion:

ML models can be developed to predict cardiovascular outcomes in KTR with reasonable accuracy.

Clinical Implications:

Machine learning models can predict post kidney transplant cardiovascular outcomes which in turn may guide strategies for intensive posttransplant monitoring and risk factor modification.

Figure 1: Heatmaps of Cardiovascular Outcomes Graded by their p-values

