Prediction tool of renal adaptation after living kidney donation using interpretable machine learning

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Objectives: Post-donation renal outcome is a crucial issue in living kidney donors for careful judgement of donation eligibility and overall management for better renal outcome. We aimed to develop a prediction model for renal adaptation after living kidney donation through interpretable machine learning.

Methods: A total of 823 living kidney donors who received donor nephrectomy in Samsung Medical Center from 2009 to 2020 were included. AutoScore, a machine learning-based clinical score generator, was used for developing a prediction model and ‘shiny’ R package for easy web application. Fair renal adaptation and good renal adaptation were defined as post-donation estimated glomerular filtration rate (eGFR) ≥ 60 mL/min/1.73 m² and ≥ 65% of pre-donation eGFR, respectively.

Results: Mean age was 45.2 years and 51.6% was female. Pre-donation eGFR, age, sex, body mass index, GFR of remaining kidney measured with DTPA, CT volume percentage of remaining kidney, and the CT volume of remaining kidney/body weight were selected as significant factors. Cystatin C eGFR were added for fair renal adaptation. Creatinine clearance, 24-hour urine volume, and serum creatinine were added for good renal adaptation as significant factors. Areas under the receiver operating characteristic were 0.847 (95% confidence interval, 0.769–0.924) and 0.632 (0.546–0.718), and areas under the precision-recall curve were 0.967 (0.946–0.979) and 0.708 (0.656–0.781) for fair and good renal adaptation, respectively. An interactive clinical decision support system entitled 'Renal Adaptation Prediction Tool prior to Operation (RAPTO)' was developed.

Conclusions: Our prediction tool of post-donation renal adaptation showed good predictive capability and may help clinical decision through web-based easy application.