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Dialysis

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Prediction of the Mortality Risk in Peritoneal Dialysis Patients: Machine Learning approach using a Prospective Cohort in Korea

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Background: Peritoneal dialysis(PD) has several benefits for end-stage renal disease(ESRD) patients compared to hemodialysis(HD) in terms of residual renal function, reducing cardiovascular complications, improving quality of life. However, survival benefit was not consistently shown in all subpopulation. Here, we aimed to quantify the effect of different mortality risk factors in peritoneal dialysis patients using machine learning methods.

Methods: A total of 1,730 PD patients in the Clinical Research Center for ESRD (CRC for ESRD) prospective observation cohort from Aug 2008 to Dec 2014 were enrolled to this study. Mortality risk model was validated by the individual learning algorithms such as survival decision tree, cox regression, survival ridge/lasso regression, and ensemble learning algorithms such as survival bagging and random forest.

Results: We analyze records of 1,127 prevalent and 603 incident PD patients, among which we use 21 independent attributes to learn our models including. The mean age was 52.7 years, and 57.4% were men. The proportions of diabetes were 47.1% in incident patients, and 38.0% in prevalent patients, respectively. Survival tree algorithm had presented the most accurate prediction model, and it outperforms a conventional method such as Cox regression (Concordance index 0.832 vs. 0.798, respectively). Among various survival decision tree models, age at the dialysis initiation and Charlson Comorbidity index(CCI) were selected in common for the best predictor of mortality. PD patients under 51.5 years at dialysis initiation have low CCI (<3), survival hazard ratio (HR) was predicted as only 0.08 compared to overall study participants(C-index 0.832). In patient with 70yrs old, if CCI is 5 or more, the survival HR is rising at 5.8. Survival HR is only 2.1, if CCI is 4 or less at the same age. Consequently, low risk patients who under 59.5 years and CCI < 3 were depend on serum calcium level and systolic blood pressure for survival HR (C-index 0.784).

Conclusion: We propose machine learning based models with estimated-death risks for presenting more accurate than conventional models. In our final model, age at dialysis initiation and CCI were interrelated as notable risk factors for mortality in Korean PD patients.

Keywords: peritoneal dialysis, survival