KSN 2020
FULLY VIRTUAL MEETING

**Abstract Type : Oral**
**Abstract Submission No. : OR-1512**

# The Risk Assessment of Premature Mortality in Hemodialysis Patients: Machine Learning approach using a Nation-wide Prospective Cohort in Korea

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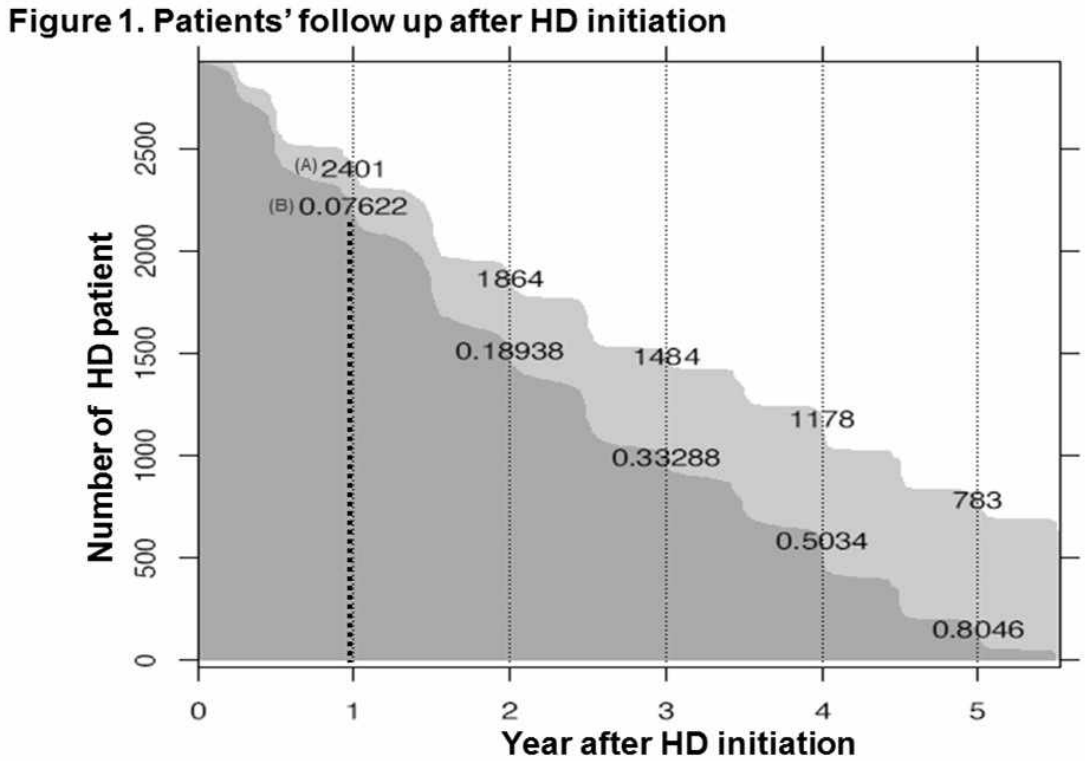
**Objectives:** Early mortality after hemodialysis (HD) initiation is an obstacle to improve the longevity of HD patients. We aimed to clarify the effect size of risk factors on mortality in HD patients using machine learning methods.

**Methods:** A total of 3,284 HD patients in the CRC-ESRD prospective observation cohort from 2008 to 2014 were enrolled. Mortality risk model was validated for classification task with using logistic/ridge/lasso regression, decision tree(DT) as single model, bagging and random forest as ensemble model, and using survival statistics for hazard ratio (HR) prediction task in survival models.

**Results:** We analyzed records of 1,750 prevalent and 1,534 incident HD patients, among which we used 21 independent attributes. The mean age was 58.4±13.6 years, and 59.3% were men. Crude mortality rate was 19.3% during median 66.2 months follow-up (**Figure 1**), and mean dialysis duration was 54.5±1.01 months. Among the classification models for 1 year mortality, best performance was random forest with weighting method (AUC 0.887), and survival bagging model reached highest predictability in survival models (C-index 0.812). From a range attribute of DT model for 1-year predicted mortality, dialysis duration was found in first node, and cutoff value was 9.2 months (AUC 0.763). Patients with short dialysis duration under 9.2 months showed increased mortality, according to the modified Charlson comorbidity index (mCCI), serum calcium, phosphorus, and body mass index. The first year mortality was estimated up to 90.2% in patients with low phosphorus (<2.5mg/dl) and low BMI (<24.6kg/$m^2$). For HR prediction, survival DT with imputation analysis presented that whether HD patients with dialysis duration over 1 year and younger than 62.5 years old, survival HR was predicted as only 0.97 in DT using survival statics (C-index 0.769).

**Conclusions:** These machine learning approaches showed that dialysis duration and mCCI were interrelated as notable risk factors for mortality in Korean HD patients.

Figure 1. Patients' follow up after HD initiation




(A) Number of patients at the year of follow up at 1 year after dialysis initiation
(B) Ratio of non-survivor and survivor at 1 year after dialysis initiation