



Oral Communication Abstract

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Building a Prediction Model for Postoperative Acute Kidney Injury using Machine Learning

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Objectives: Postoperative acute kidney injury (AKI) is associated with increased mortality and morbidity in patients undergoing surgeries performed under general anesthesia. There are several models that predict postoperative AKI risk, but most are single-center studies that need external validation.

Methods: In this retrospective cohort analysis, we included noncardiac surgeries performed between 2009 and 2019 at 7 university hospitals in South Korea. Postoperative AKI was defined as an increase of serum creatinine at least 1.5 times the baseline value or initiation of renal replacement therapy within 30 days of the postoperative period. We tested 6 machine learning prediction models: deep neural networks (DNN), logistic regression, decision tree, random forest, light gradient boosting machine (GBM), and naïve Bayes, and compared model performance using area under the curve (AUC) of the receiver-operating characteristic.

Results: A total of 239,267 surgeries were included, and 7,935 postoperative AKI events (3.3%) occurred. The 6 different statistical analysis methods were run on various combinations of 36 independent preoperative predictors that we had selected (Table 1). Model 1 included all variables, Model 2 included variables that had been significantly associated with postoperative AKI in previous studies, and Model 3 included variables that were found significant on multivariate analysis. Among



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them, Model 1 run on DNN (AUC = 0.821) and light GBM (AUC = 0.823) and Model 3 run on DNN (AUC = 0.807) demonstrated the best prediction performance.

Conclusions: We have developed a high-performance risk prediction system for postoperative AKI that can be easily applied using preoperative patient characteristics and laboratory data.

Table 1. Performance metrics of postoperative AKI prediction models.

Analysis	Model	AUC	Accuracy	Precision	Specificity	F1 score
DNN	Model 1 *	0.821	0.955	0.375	0.998	0.041
	Model 2 **	0.806	0.966	0.407	0.999	0.021
	Model 3 ***	0.807	0.955	0.380	0.999	0.032
Logistic Regression	Model 1	0.811	0.955	0.363	0.998	0.054
	Model 2	0.784	0.966	0.333	1.000	0.007
	Model 3	0.802	0.955	0.310	0.998	0.043
Decision Tree	Model 1	0.672	0.956	0	1.000	0
	Model 2	0.666	0.967	0	1.000	0
	Model 3	0.672	0.956	0	1.000	0
Random Forest	Model 1	0.803	0.956	0.571	1.000	0.007
	Model 2	0.767	0.967	0.440	1.000	0.010
	Model 3	0.778	0.956	0.455	1.000	0.009
Light GBM	Model 1	0.823	0.955	0.360	0.998	0.053
	Model 2	0.803	0.966	0.356	1.000	0.014
	Model 3	0.801	0.955	0.328	0.998	0.037
Naïve Bayes	Model 1	0.780	0.861	0.145	0.881	0.218
	Model 2	0.766	0.884	0.112	0.902	0.171
	Model 3	0.782	0.895	0.162	0.921	0.218

*Model 1: Age, Sex, SBP, DBP, BMI, CKD, DM, HTN, CVD, CAD, COPD, LC, emergency operation, operation duration, ARB usage, NSAIDs usage, serum creatinine, eGFR, total protein, albumin, AST, ALT, BUN, sodium, potassium, chloride, calcium, CPK, LDH, CRP, glucose, hemoglobin, hematocrit, WBC, urine specific gravity, urine protein
 ** Model 2: Age, sex, emergency operation, operation duration, DM, ARB usage, albumin, Hemoglobin, Sodium, eGFR, urine protein
 ***Model 3: Age, Sex, SBP, DBP, operation duration, serum creatinine, eGFR, albumin, sodium, potassium, chloride, glucose, LDH, urine protein