

Predictive Analytics and Clinical Decision Support for Acute Type A Aortic Dissection : A Machine Learning Approach to 30-Day Mortality Prediction

Authors: Chi-Ching Huang, MD, Bo Yang MD, PhD, Alexander Hsieh, MD, Carol Lin, PhD

Study Objective

- **Our objective is to develop a robust machine learning algorithm.**
- **This algorithm aims to predict 30-day mortality in ATAAD patients with high precision.**
- **Such predictive capability could significantly inform clinical decision-making.**

Methods Overview

- **Data were sourced from Michigan Medicine's comprehensive Aortic Dissection database, with a study period spanning from January 1996 to February 2023.**

Methods Overview

- We utilized a Random Forest (RF) algorithm, processing data through multiple imputation and normalization techniques.
- The dataset was split into an 80:20 training and testing ratio.

Feature Selection and Model Development

- Initial model development used 42 features, leveraging the full breadth of collected data.
- 5-fold cross-validation was employed for model validation.
- Feature selection was refined to the top 10 features based on mean impurity decrease.

Results - Original Model

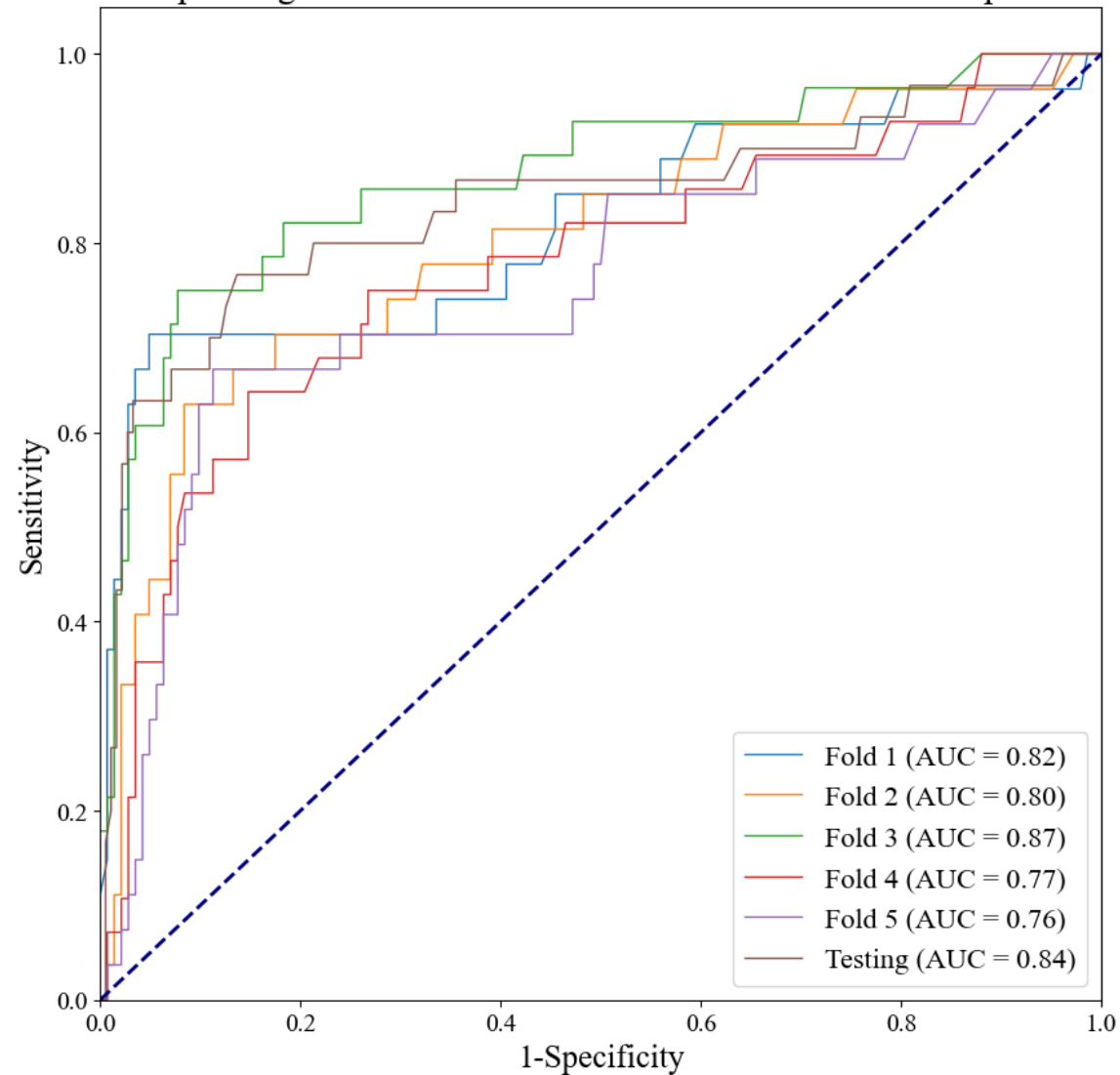
- The original model achieved an AUROC of 0.825, indicating strong predictive power.
- A Brier score of 0.099 reflects the model's accuracy.
- Key predictive features included patient demographics, clinical markers, and dissection characteristics.

Results - New Model with Top Features

- Focusing on the top 10 features, the new RF model improved the AUROC to 0.841.
- Although the Brier score slightly increased to 0.101, the model's simplicity and performance represent a significant enhancement."

Receiver Operating Characteristic (ROC) Curve

Receiver Operating Characteristic of Random Forest Model with Top ten Features



Conclusions

- **The study underlines the RF model's high predictive accuracy for 30-day mortality in ATAAD.**
- **Incorporating this model into pre-operative evaluations may enhance surgical outcomes.**
- **However, predictive modeling should complement, not replace, clinical judgment.**

Future Directions and Acknowledgments

- **Future research will focus on external validation to generalize findings.**