Development of Machine Learning Models Incorporating Clinical, Demographic, and Echocardiography Variables for Predicting Left Ventricular Systolic Dysfunction in Patients with Isolated Left Ventricular Dilation

Pranav Bhargava[1], Ahmed Saleh[1], Miguel Sotelo[2], Paul Nona[2], Jessica DeFreitas[2], Chris Rogers[2], Julian Booker[1], E. Andrikopoulou[3]
[1]University of Alabama at Birmingham, Birmingham, AL, [2] Tempus AI, Inc., Chicago, IL, [3] University of Washington, Seattle, WA and with Harborview Medical Center, University of Washington, Seattle, WA

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Poster/Abstract #

INTRODUCTION

Left ventricular (LV) dilation is a recognized precursor to LV systolic dysfunction (LVSD), yet the factors that predict this transition remain incompletely understood. Prior studies have identified additional LV indices as potential predictors of LVSD, including sphericity index, contractile reserve, end-systolic dimension, and global longitudinal strain.

We sought to systematically assess the prevalence and risk factors of LV dilation and its progression to LVSD in a contemporary patient population.

METHODS

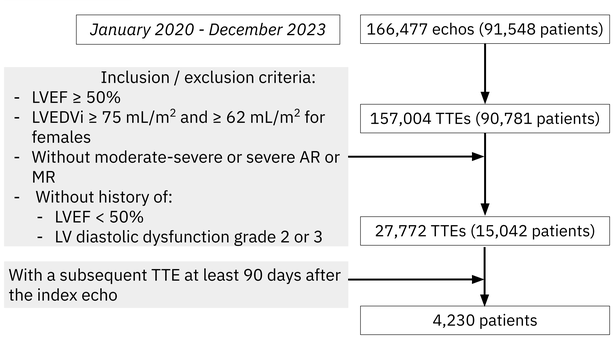

Figure 1. Inclusion and exclusion criteria

Data

De-identified patient records in the Tempus Database. Data were parsed from transthoracic echoes and comorbidities were extracted from clinic notes.

Analysis

- **Endpoint:** newly reduced LVEF (LVEF < 40%)
- **Feature selection:**
  - At least a 70% completeness rate
  - Median Imputed continuous variables with missingness
- **Models** (80:20 data split):
  - L1-regularized regression
  - XGBoost with hyperparameter tuning
  - RF with hyperparameter tuning
  - SVM with hyperparameter tuning (linear vs radial)
  - KNN with hyperparameter tuning
- **Operating point:** maximum of Youden's J statistic
- **Ensemble**: unanimous voter
- **SHAP interpretability** on final model

SUMMARY

- 4,230 patients were analyzed (mean age 75 years, 61% female, 63% white). LVSD was observed in 6.5% (450-day median time to progression). Age, male gender, black race, heart rate, LV end-systolic diameter, and TAPSE were associated with LVSD.
- Patients predicted to develop LVSD had a ~8x higher risk within the observation period (95% CI: 4.4-14.5).
- Our preliminary work sheds light on predictors of new LVSD in patients with ILVD.

RESULTS

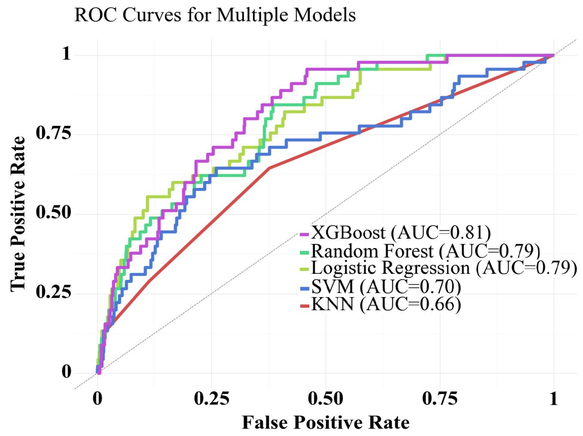

Figure 2. Performance Metrics. Progression was observed in 6.5% of patients, with a 450-day median time to progression. A unanimous voting ensemble model had the highest precision (0.30), specificity (0.94), and accuracy (0.91).

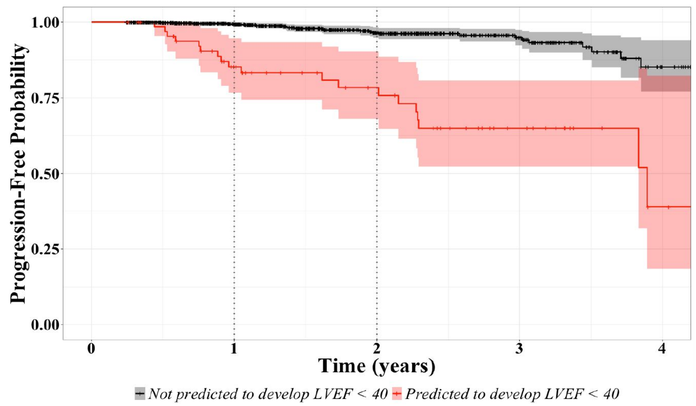

Figure 3. Risk Stratification. Patients predicted to progress had a 7.97x higher risk (unadjusted) of progressing within the observation period (p<0.001).

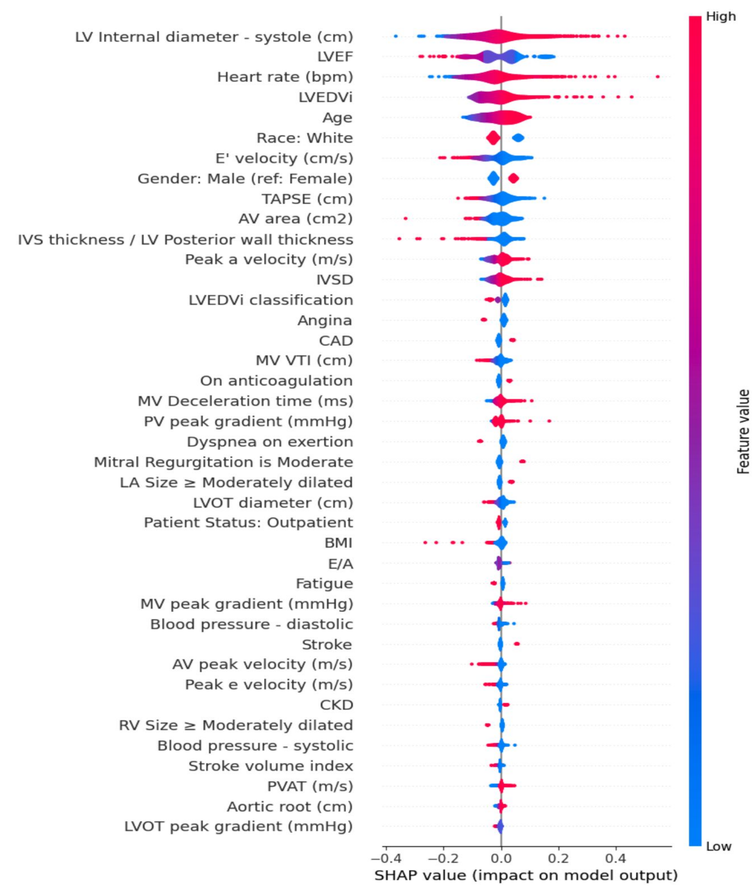

Figure 4. SHAP (SHapley Additive exPlanations) Summary Plot. A higher LVID in systole, heart rate, age, TAPSE, and male gender and black race were associated with a higher model output predicting progression

Correspondence: miguel.sotelomunoz@tempus.com