Supplementary

Table S1 Feature set used for classification algorithms

Feature name	Feature type	Categorical/numerical
Sex	Demographic	Categorical
Race is White	Demographic	Categorical
Age	Demographic	Numerical
Systolic Blood Pressure	Echo	Numerical
Diastolic Blood Pressure	Echo	Numerical
Calculated Body Mass Index	Demographic	Numerical
Heart Rate	Echo	Numerical
Left Ventricular End Diastolic Volume	Echo	Numerical
Left Ventricular End Systolic Volume	Echo	Numerical
End Diastolic Volume Index	Echo	Numerical
Left Ventricular Ejection Fraction	Echo	Numerical
Left Ventricular Mass Index	Echo	Numerical
Pulmonary Artery Systolic Pressure (mmHg + 5 mmHg)	Echo	Numerical
Pulmonary Artery Acceleration	Echo	Numerical
Left Atrium Volume (ml)	Echo	Numerical
E Velocity (m/s)	Echo	Numerical
E Duration (msec)	Echo	Numerical
A Velocity (m/s)	Echo	Numerical
A Duration (msec)	Echo	Numerical
E/A Ratio	Echo	Numerical
Mitral Valve Deceleration Time (msec)	Echo	Numerical
IVRT	Echo	Numerical
S Velocity (m/s)	Echo	Numerical
D Velocity (m/s)	Echo	Numerical
Color M-mode Propagation velocity	Echo	Numerical
S_average	Echo	Numerical
E' septal (m/s)	Echo	Numerical
A' septal (m/s)	Echo	Numerical
S' Integral Average	Echo	Numerical
E' Lateral (m/s)	Echo	Numerical
A' Lateral (m/s)	Echo	Numerical
E/e'	Echo	Numerical
Ln Blood Natriuretic Peptide	Lab	Numerical

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Table S2 Hyperparameters tuned in the training process for the six machine learning algorithms

Algorithm	Hyperparameter	Values
Logistic regression	C	0.01, 0.1, 1, 10, 100, 1000, 5000, 10000
K-nearest neighbors	n_neighbors	3, 5, 7
	metric	Euclidean, correlation
Support vector machine	C	0.1, 1, 10, 100
	gamma	0.001, 0.01, 0.1
Random forest	max_features	0.1, 0.2, 0.4, 0.8
	max_depth	4, 8, 12
Gradient boosting	n_estimators	100, 500
	max_depth	2, 3, 4
	learning_rate	0.01, 0.05, 0.1
	subsample	0.33, 0.66, 1

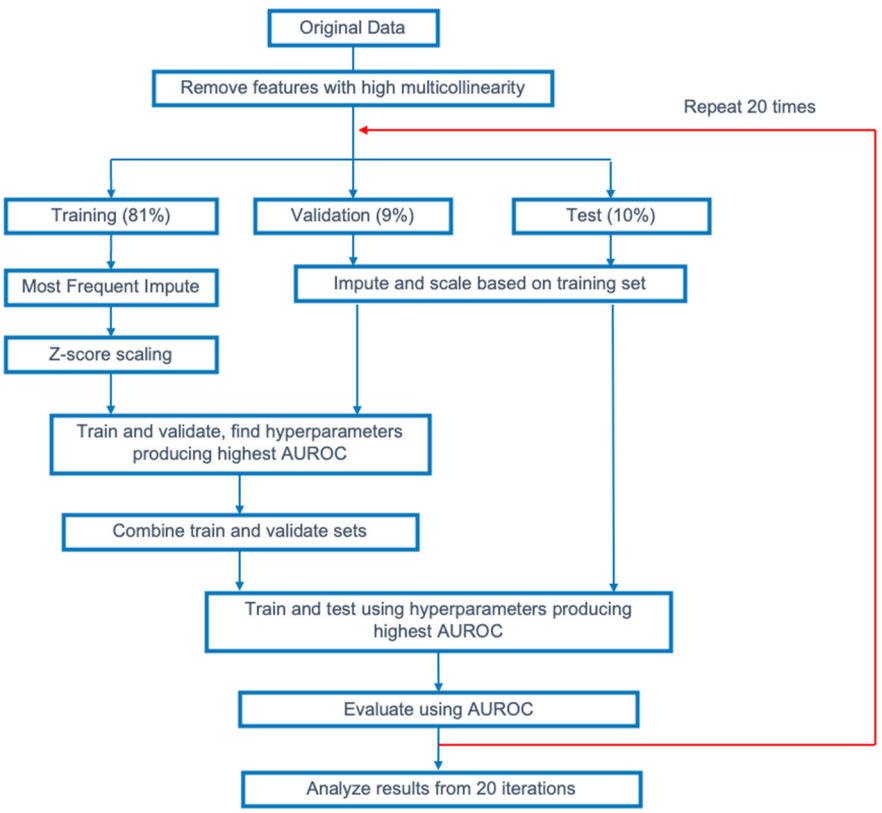

Figure S1 Workflow illustrating the training, validation, and testing processes. The data was randomly split into training, validation, and test sets. Over 20 iterations, the training and validation sets were used to determine the hyperparameters producing the highest AUROC, then combined to train the final models. Performance on the test sets was assessed and reported. AUROC, area under the receiver operating characteristic curve.

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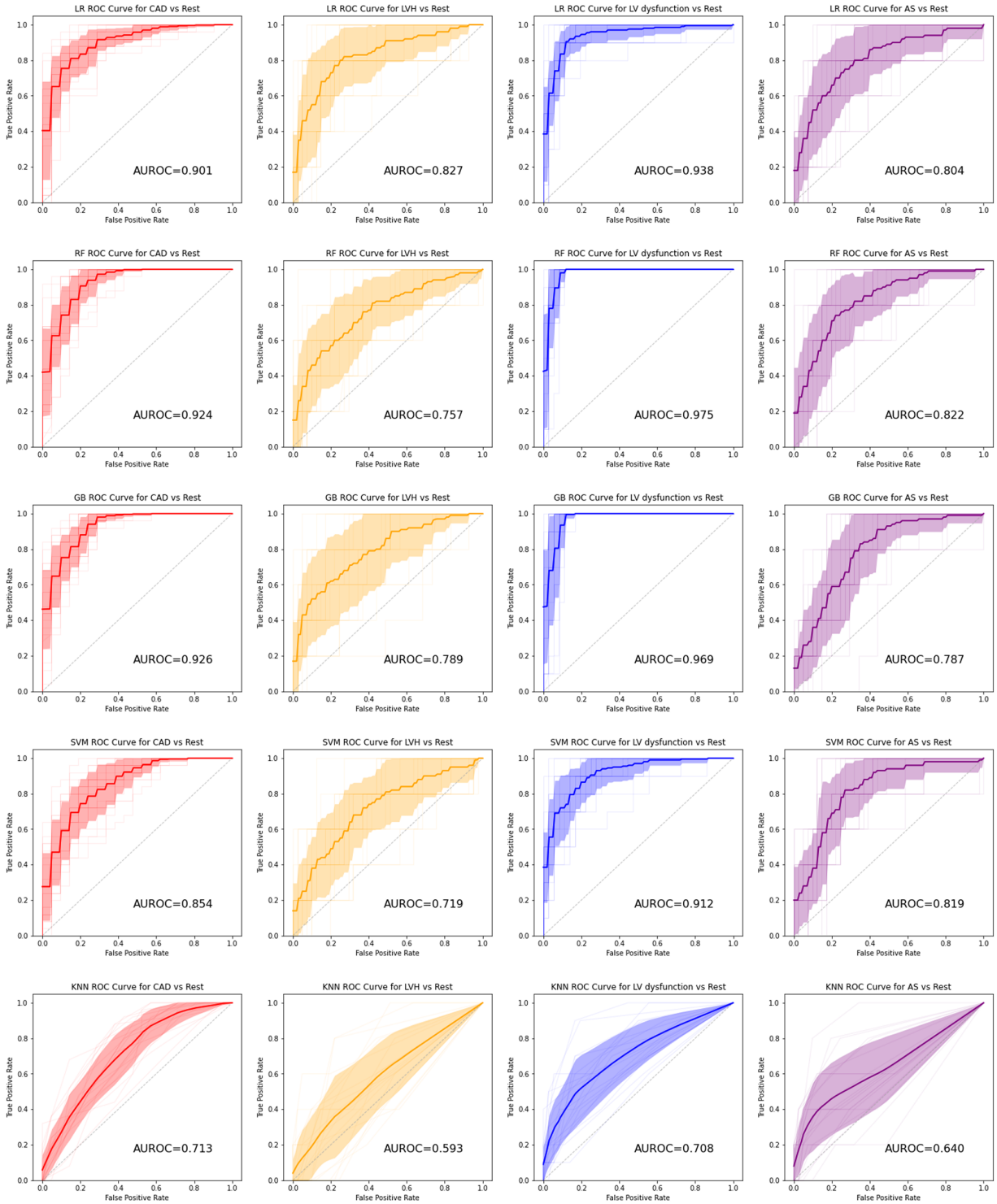

Figure S2 Cardiac condition classification results. The lines with faint colors show the ROC curve for each of the 20 iterations, and the lines with saturated colors show the average ROC curve across those 20 iterations. Dashed gray lines show the baseline performance of AUROC =0.5. AUROC, area under the receiver operating characteristic curve; LR, logistic regression; RF, random forest; GB, gradient boosting; SVM, support vector machine; KNN, K-nearest neighbors; CAD, coronary artery disease; LVH, left ventricular hypertrophy; LV dysfunction, left ventricle dysfunction; AS, aortic stenosis; ROC, receiver operating characteristic.

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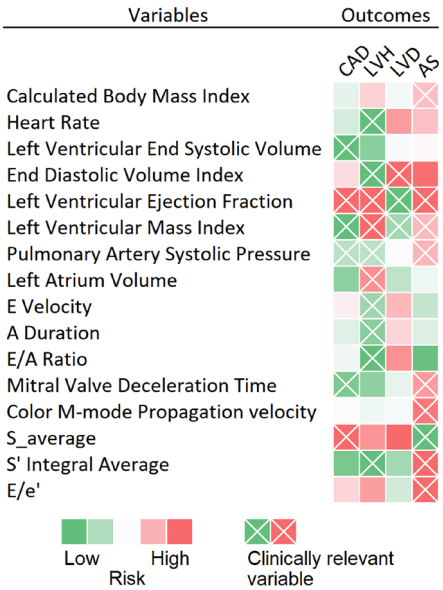

Figure S3 Clinically relevant variables for at least one cardiac condition (denoted using a white cross) detected with logistic regression for multiclass classification of cardiac conditions. The cardiac conditions included are CAD, LVH, LVD, and AS. The colors indicate if a higher value of the variable was associated with a more likely (red) or a less likely (green) prediction of that cardiac condition. CAD, coronary artery disease; LVH, left ventricular hypertrophy; LVD, left ventricle dysfunction; AS, aortic stenosis.

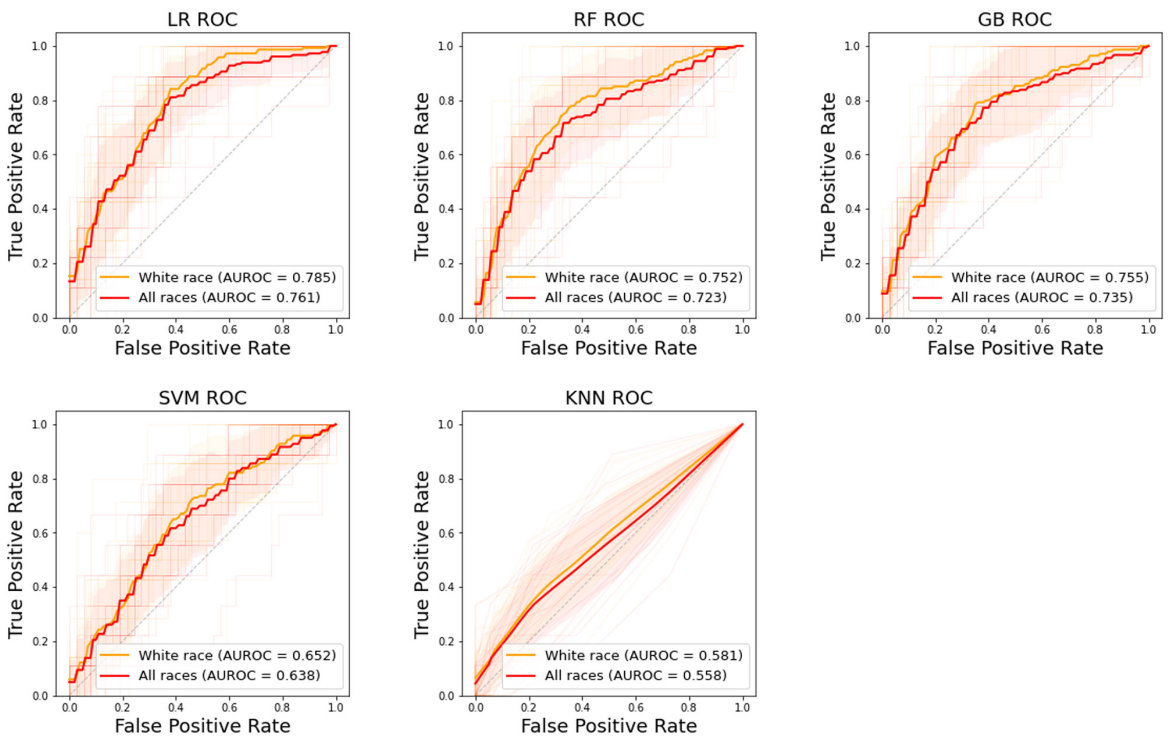

Figure S4 Race subgroup analysis using all races versus white race alone for LVEDP classification (>20 *vs.* ≤20 mmHg). LR, logistic regression; RF, random forest; GB, gradient boosting; SVM, support vector machine; KNN, K-nearest neighbors; ROC, receiver operating characteristic; AUROC, area under the receiver operating characteristic curve; LVEDP, left ventricular end-diastolic pressure.

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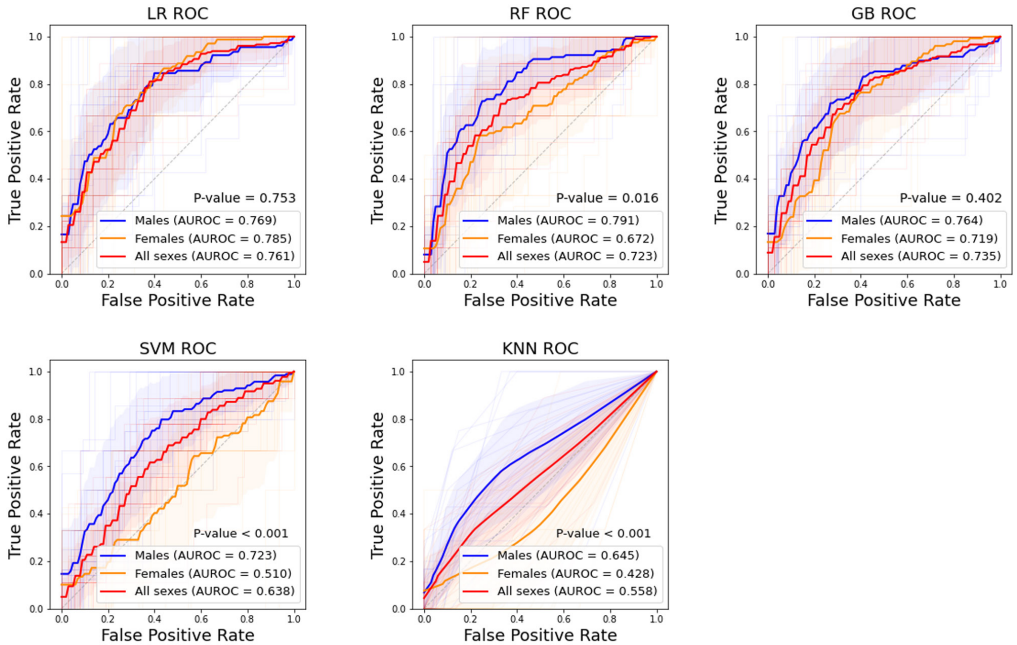

Figure S5 Sex subgroup analysis for LVEDP classification. P values were computed using two-sided paired *t*-test for male *vs.* female subgroups. LR, logistic regression; RF, random forest; GB, gradient boosting; SVM, support vector machine; KNN, K-nearest neighbors; ROC, receiver operating characteristic; AUROC, area under the receiver operating characteristic curve; LVEDP, left ventricular end-diastolic pressure.

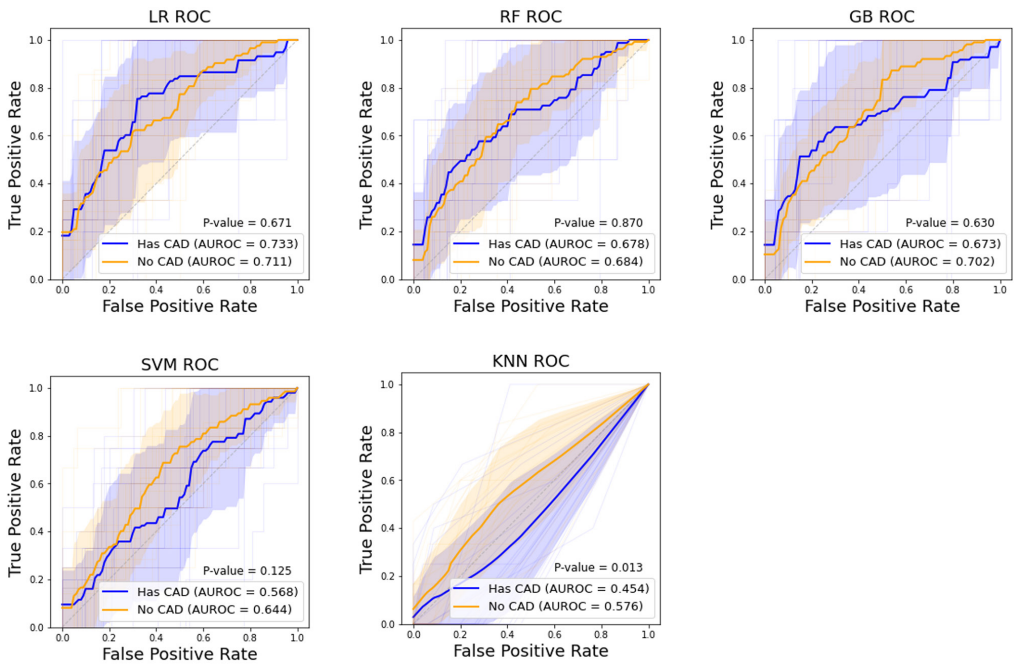

Figure S6 CAD-stratified LVEDP prediction performances of the algorithms. P values were computed using two-sided paired *t*-test. LR, logistic regression; RF, random forest; GB, gradient boosting; SVM, support vector machine; KNN, K-nearest neighbors; ROC, receiver operating characteristic; AUROC, area under the receiver operating characteristic curve; CAD, coronary artery disease; LVEDP, left ventricular end-diastolic pressure.

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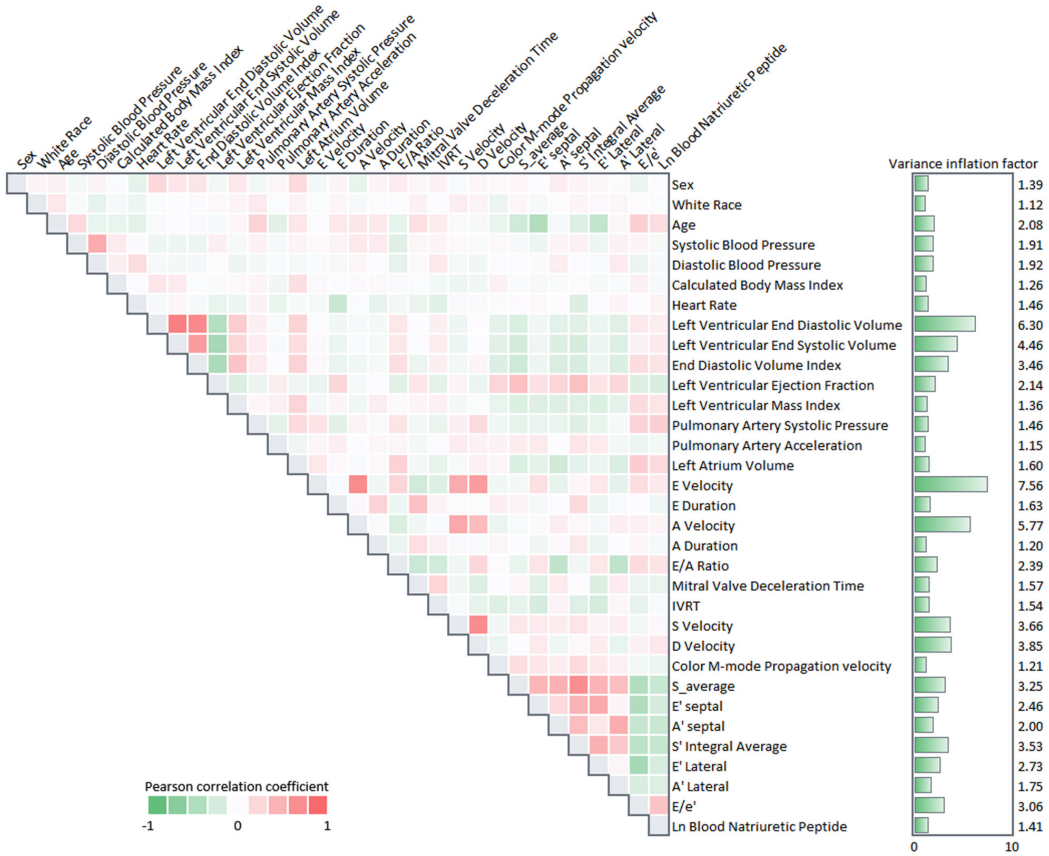

Figure S7 Multicollinearity detection using VIF analysis. The heatmap shows the pair-wise Pearson correlation coefficient of the features, and bar plot shows the final VIF values. VIF, variance inflation factor.

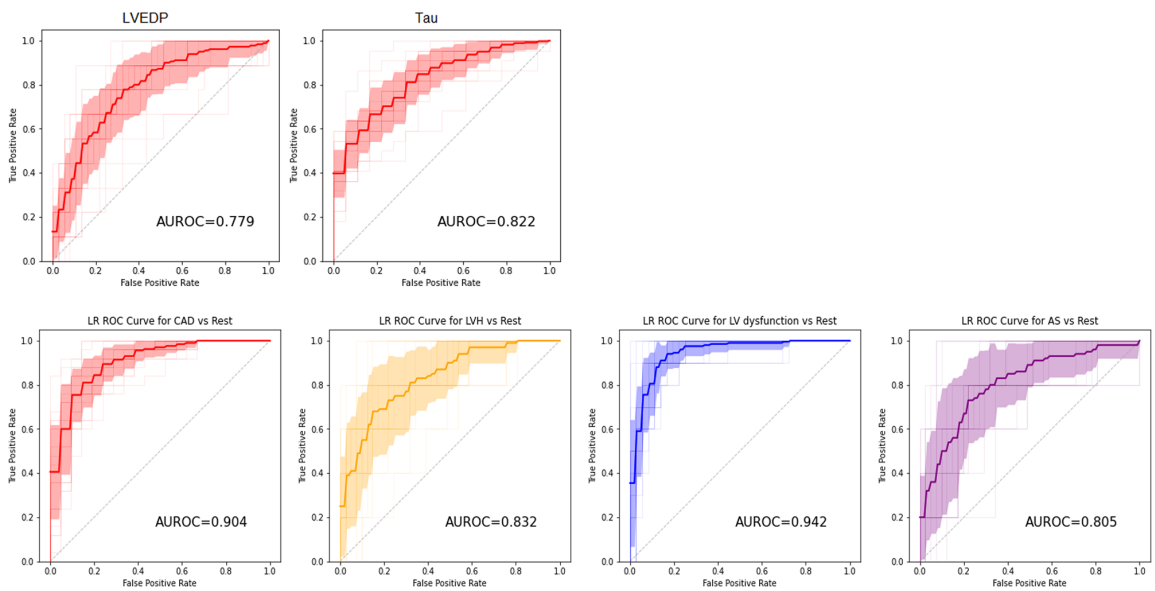

Figure S8 Logistic regression model performance for elevated LVEDP, elevated Tau, and 4 cardiac conditions without removing the variables with high multicollinearity. CAD, coronary artery disease; LVH, left ventricular hypertrophy; LV dysfunction, left ventricle dysfunction; AS, aortic stenosis; ROC, receiver operating characteristic; AUROC, area under the receiver operating characteristic curve; LVEDP, left ventricular end-diastolic pressure.

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