

# Interrater concordance of collateral arterial flow in large vessel occlusion CT angiography



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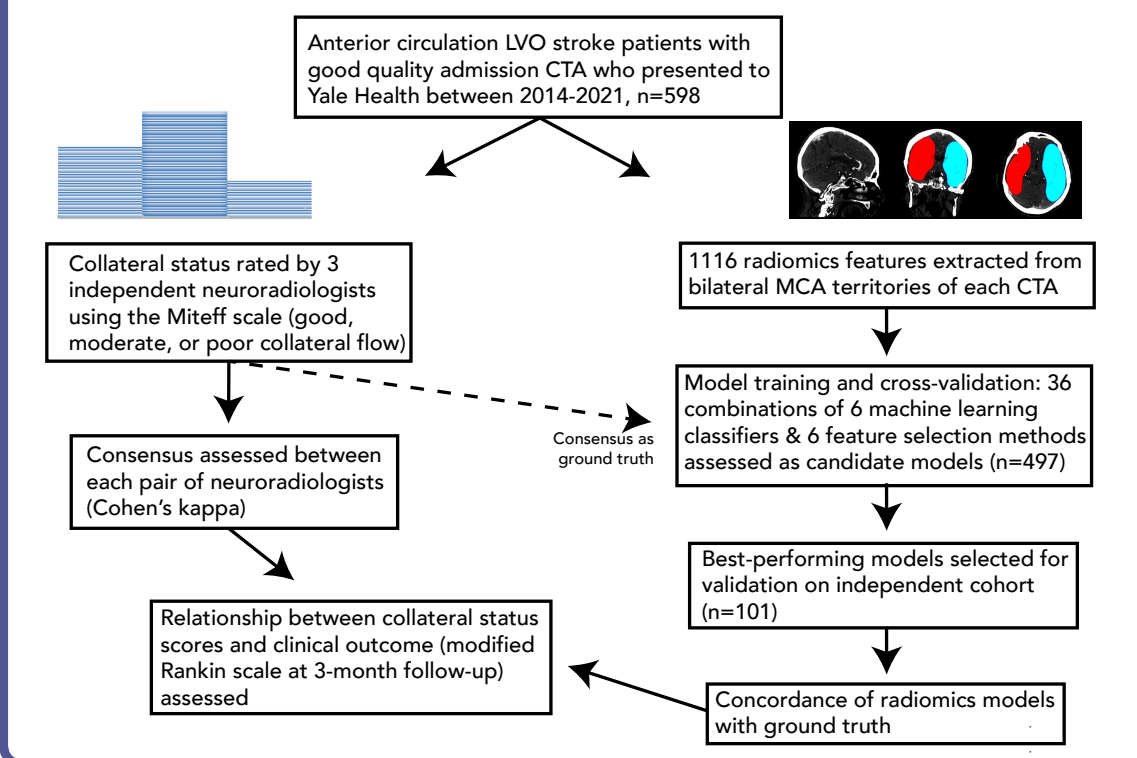
## Introduction

Following large vessel occlusion (LVO) stroke, collateral arterial circulation beyond the site of occlusion is thought to modify individual extent of neurological damage.

Quantitative collateral status is increasingly used for acute LVO decision-making, including endovascular thrombectomy eligibility, but remains poorly standardized.

We aimed to 1) assess concordance of collateral status ratings among neuroradiologists, and 2) compare radiologist performance to a CTA radiomics-based model

## Methods



## Discussion

Interrater concordance of collateral status among neuroradiologists was poor, despite individual rater's scores being predictive of clinical outcome.

Current measures of collateral status are not reliable in the real-world setting, especially when used as a marker for endovascular thrombectomy eligibility or other decision-making in acute LVO.

Further development of automated machine-learning models may help provide objective, consistent collateral status quantification.

## Interrater concordance

### Neuroradiologist #1 vs #2

		Neuroradiologist #1		
		Good	Mod.	Poor
Neuroradiologist #2	Good	163	97	15
	Mod.	47	96	29
	Poor	9	37	98

Cohen's kappa = 0.39 60%

### Neuroradiologist #1 vs #3

		Neuroradiologist #1		
		Good	Mod.	Poor
Neuroradiologist #3	Good	67	29	9
	Mod.	142	195	98
	Poor	10	6	35

Cohen's kappa = 0.21 50%

### Neuroradiologist #2 vs #3

		Neuroradiologist #2		
		Good	Mod.	Poor
Neuroradiologist #3	Good	77	19	9
	Mod.	188	146	101
	Poor	10	7	34

Cohen's kappa = 0.17 43%

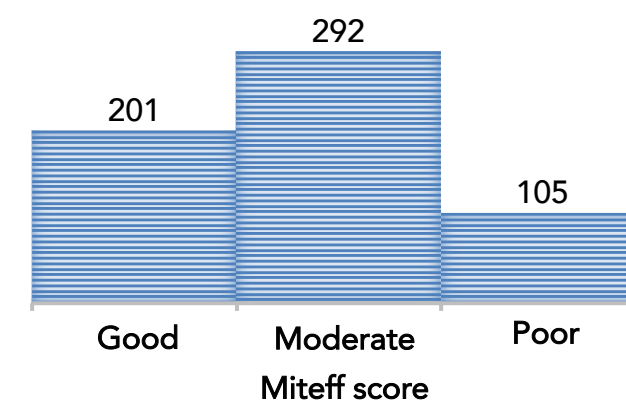
3-rater kappa = 0.22, p<0.001

### Radiomics model vs consensus

		Radiomics		
		Good	Mod.	Poor
Consensus	Good	27	7	3
	Mod.	12	10	13
	Poor	9	8	12

Cohen's kappa = 0.22 49%

### Consensus score distributions



## Relationship with clinical outcome

	Correlation with mRS (rho)	Multivar. logistic regression coeff.
Neurorad. #1	0.35, p<0.001	0.64, p=0.0120
Neurorad. #2	0.28, p=0.00509	0.15, p=0.532
Neurorad. #3	0.13, p=0.134	0.28, p=0.04
Consensus	0.31, p=0.00196	0.48, p=0.0535
Radiomics	0.45, p<0.001	0.87, p=0.0183

mRS=modified Rankin scale at 3-month follow up

Individual rater and radiomics model collateral status scores were significantly correlated with clinical outcome (mRS) and were independent predictors of clinical outcome  
Multivariate logistic regression controlled for age, sex, stroke severity, and reperfusion success

## Radiomics model performance

497 subjects were included in the training cohort, and best-performing models from cross-validation were applied to an independent cohort of 101 subjects

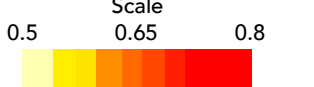
### Prediction of Collateral Status 1/2 vs 3\*

	RF	EINet	SVM_sig	SVM_rad	NB	XGB	
noFS	0.657	0.659	0.598	0.507	0.536	0.685	noFS
PCA	0.601	0.601	0.576	0.592	0.572	0.595	PCA
Hclust	0.561	0.593	0.582	0.579	0.576	0.582	Hclust
Ridge	0.675	0.661	0.665	0.671	0.660	0.689	Ridge
pMIM	0.657	0.670	0.650	0.670	0.631	0.669	pMIM
MRMR	0.650	0.657	0.653	0.662	0.637	0.654	MRMR

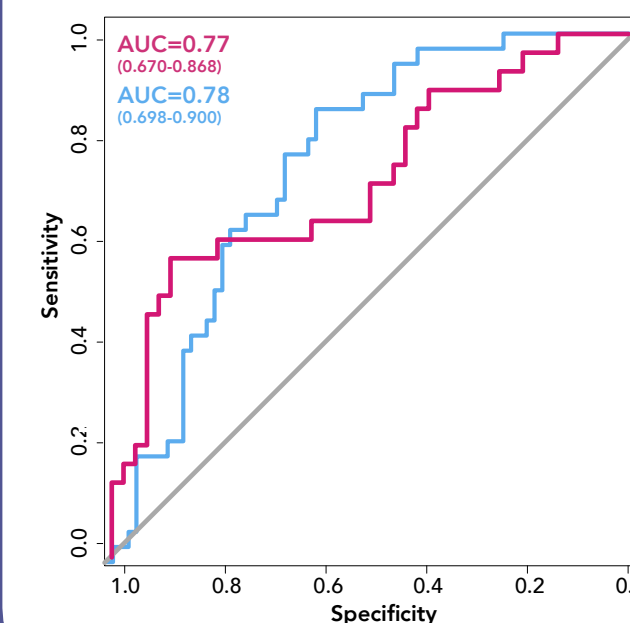
### Prediction of Collateral Status 1 vs 2/3\*

	RF	EINet	SVM_sig	SVM_rad	NB	XGB	
noFS	0.775	0.717	0.578	0.497	0.521	0.788	noFS
PCA	0.651	0.584	0.533	0.570	0.550	0.632	PCA
Hclust	0.658	0.653	0.584	0.627	0.564	0.650	Hclust
Ridge	0.803	0.733	0.725	0.762	0.727	0.787	Ridge
pMIM	0.786	0.714	0.674	0.748	0.719	0.768	pMIM
MRMR	0.755	0.704	0.690	0.726	0.705	0.750	MRMR

\*The collateral status ratings were determined as poor (1), intermediate (2), or good (3)



### Independent validation, n=101



### Legend

- A. Poor vs moderate/good
- B. Poor/moderate vs good

Models successfully predicted collateral status in cross-validation and independent validation

Model scores were significantly correlated with outcome and were an independent predictor of outcome in multivariate logistic regression

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