

# Left atrial wall heterogeneity – A novel AI-radiomics marker to predict atrial fibrillation recurrence after ablation

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## Background

The ultrastructure of the left atrium (LA) is still poorly understood. This includes:

- Arrangement of myocardial fibers
- Fibrosis
- Fatty infiltration
- Local inflammation
- ...

Assessing these through histology is not feasible in clinical practice.

**A non-invasive more encompassing assessment could represent a powerful tool and more truthful representation of LA heterogeneity?**

## Purpose

We used (artificial intelligence) **AI-derived high-dimensional radiomic signatures** from cardiac CT to perform deep quantitative phenotyping of the LA wall and cavity and predict the **risk of atrial fibrillation (AF) recurrence after ablation**.

## Methods I

### A) Image Acquisition

Cardiac CT images from 37 patients obtained immediately prior to AF ablation were prospectively collected and reviewed.

### B) Image Segmentation

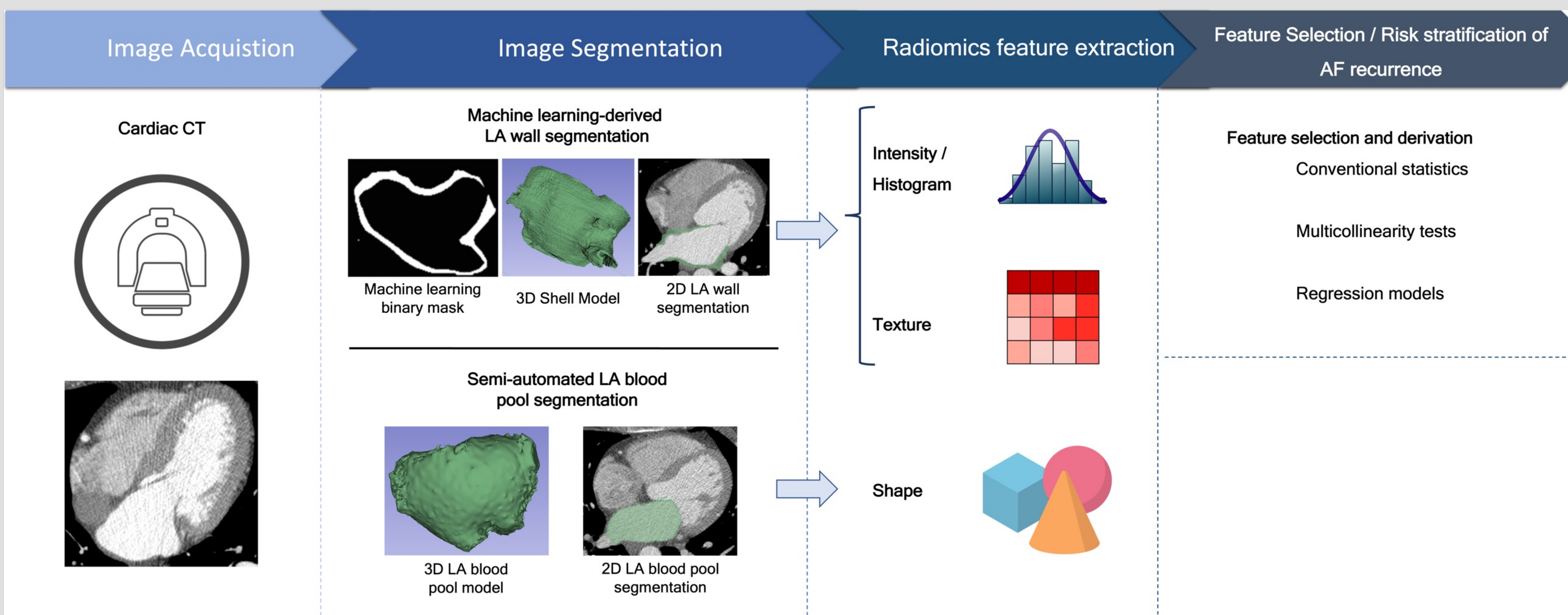
1. **LA wall** was segmented using a machine-learning LA wall segmentation tool with minimal input from the user.
2. **LA cavity** was segmented using a semi-automated tool.

## Methods II

### C) Radiomics feature extraction

A total of 140 radiomics features were extracted (without wavelet decomposition) using PyRadiomics library

- 1. **LA Wall** → pixel intensity; pixel texture
- 2. **LA cavity** → shape



## Results

- **Size zone non-uniformity (SZN)**, an LA wall texture feature, was the **only independent predictor of AF recurrence at 12 months follow-up**
- SZN was significantly higher in patients with AF recurrence  
→ median 24567 [IQR 19729-30286] vs. 18481 [IQR 13485 - 21623],  $p=0.03$
- C-statistics showed good ability in predicting AF recurrence  
→ AUC 0.712 (95%CI 0.539 – 0.886)
- Survival analysis showed a log-rank test with a chi-square of 103 ( $p<0.001$ )

## Conclusions

- We present a novel **non-invasive tool to measure heterogeneous LA tissue**.
- The complex structure of the LA wall through **radiomics conveys information beyond conventional CT imaging**.
- **Heterogenous LA walls are more prone to AF recurrence post-ablation**, likely reflecting a higher susceptibility to re-entry mechanisms, high conduction anisotropy, or a combination of these.

### D) Feature Selection and risk stratification of AF

- Features with a high variance inflation factor were excluded
- A model was built using least absolute shrinkage and selection operator (**LASSO**) regression

**AF recurrence within 12 months**

**SZN measures the variability of size zone volumes in the image.**

**Higher value indicating more heterogeneity in size zone volumes.**

