

Novel Ultrasound-based Imaging and Global Dipole Density Mapping: Feasibility in Persistent Atrial Fibrillation

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Introduction

Contact electrograms are the diagnostic norm. AcQMap (Acutus Medical, San Diego, CA) derives the local charge-sources (dipole density from noncontact voltage and displays them as a color map on a 3D ultrasound reconstructed anatomy.

Methods

Patients scheduled for AF ablation were consented and mapped using a basket catheter with 48 ultrasound transducers and 48 electrodes. Dipole density is inversely calculated to subtract the effect of distant sources and display a more localized map of activation. Conduction is displayed as a retrospective moving color-map. Red is the present location of the leading-edge, while other color-bands represent earlier locations in time. Historical persistence of the leading edge enables visualization of complex conduction patterns. Ultrasound anatomies and pre-/post-ablation maps were obtained.

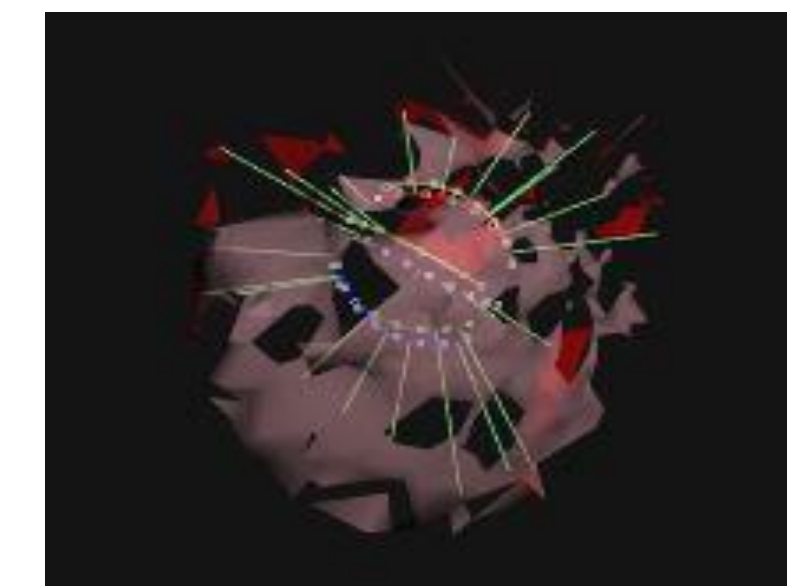
Disclosures

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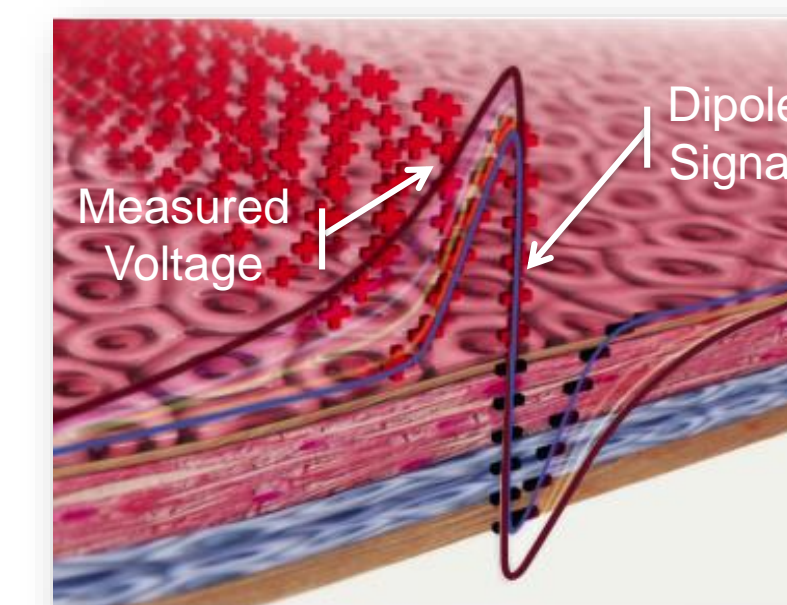
AcQMap System



Console and Workstation

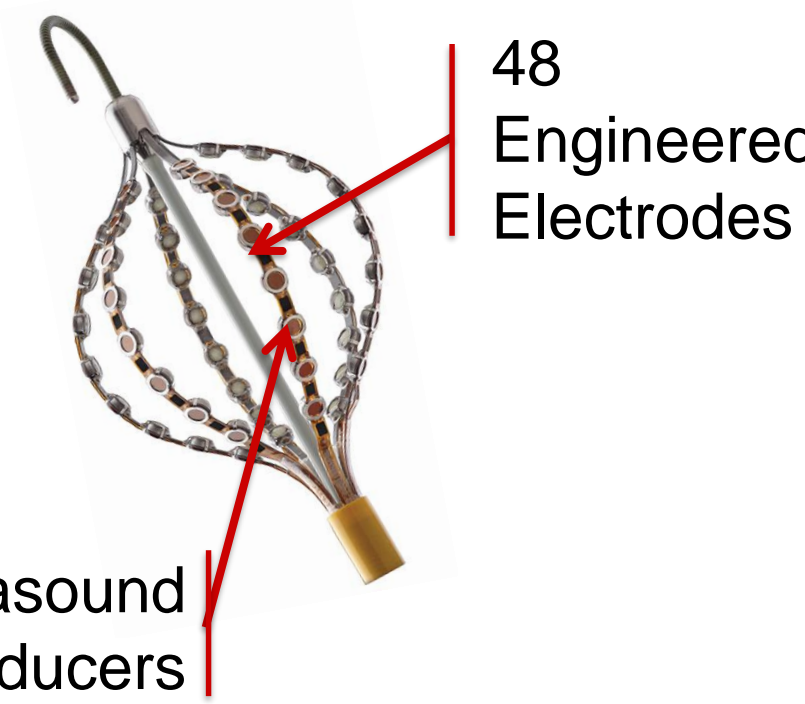


Ultrasound pings the chamber wall

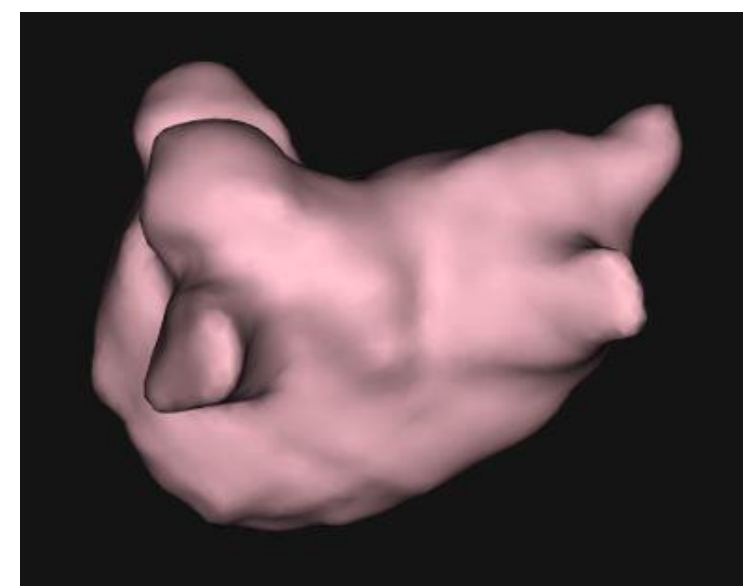


An inverse solution is used to calculate Dipole Density from the Voltages measured on the basket

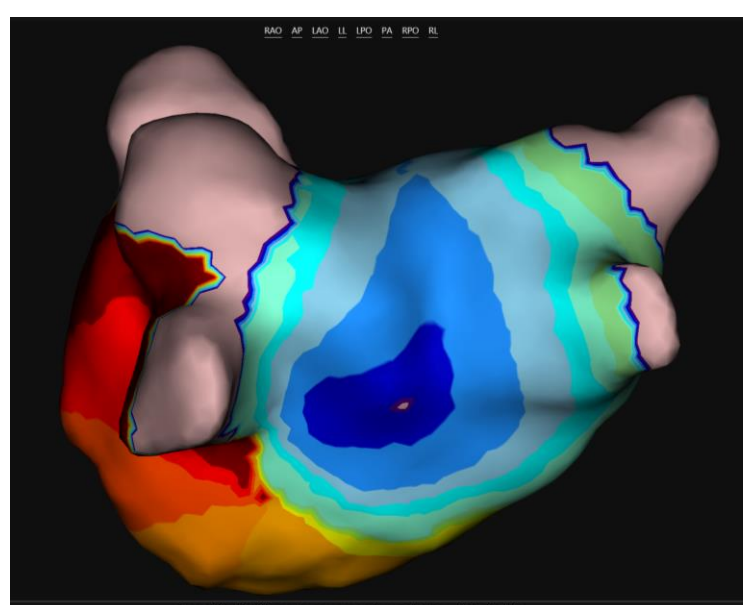
AcQMap Catheter



48 Ultrasound Transducers



Processed surface anatomy



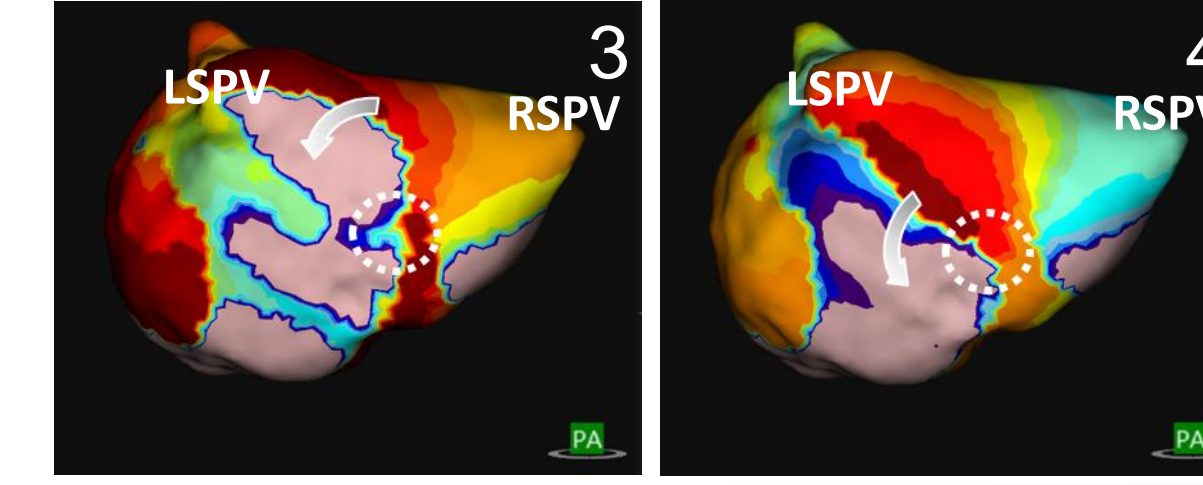
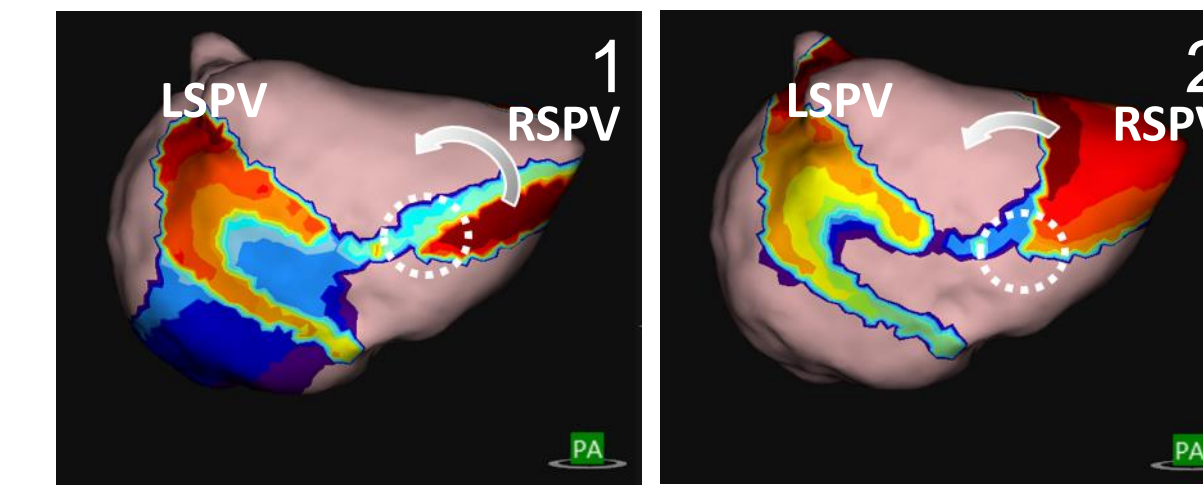
Dipole Density (or Voltage) is overlaid on the surface anatomy

Results

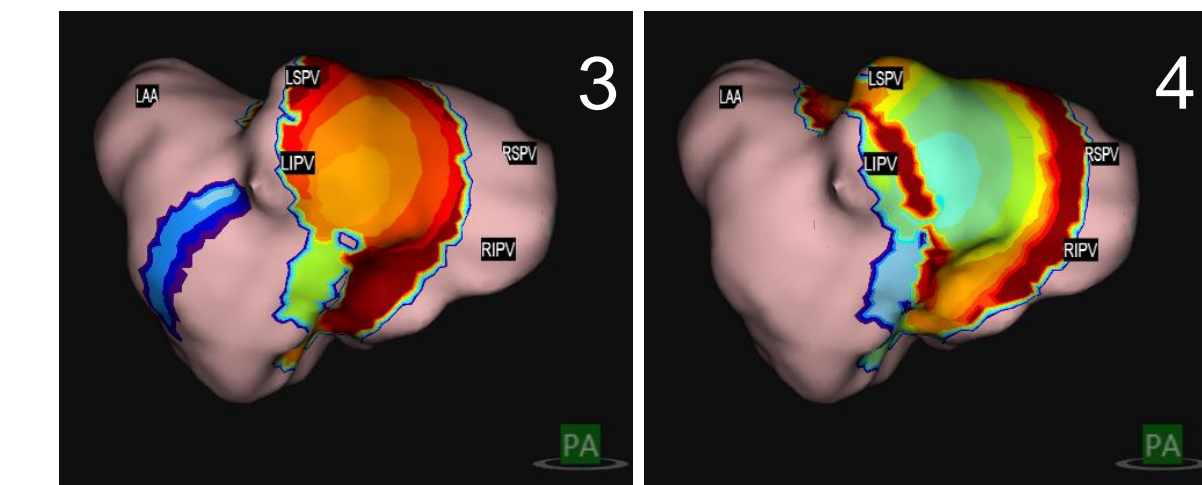
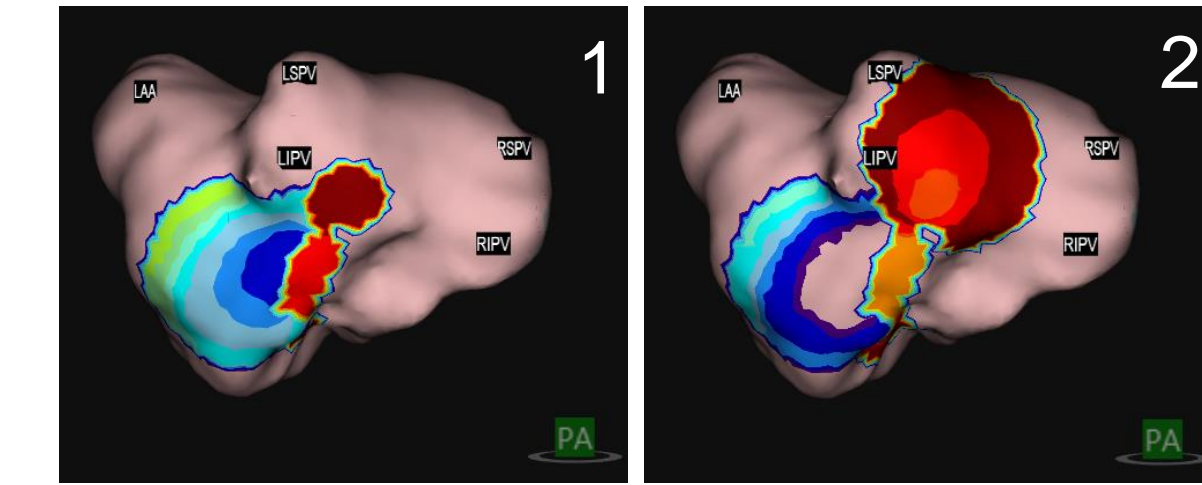
N: 12 subjects
Mean Age: 58 years (45-74)
BMI: 29 (25-39)
AF Duration: 4.6 years (2-10)

- A total of 112 sec of left atrial AF was mapped (42 maps: 1 to 3 seconds of AF per map)
- Multiple waves spread out from focal sites and short-lasting zones of rotation
- Higher complexity was observed in the septum and region between the antral junctions of the pulmonary veins, including irregular short-radius reentry and patient specific central paths of rotation

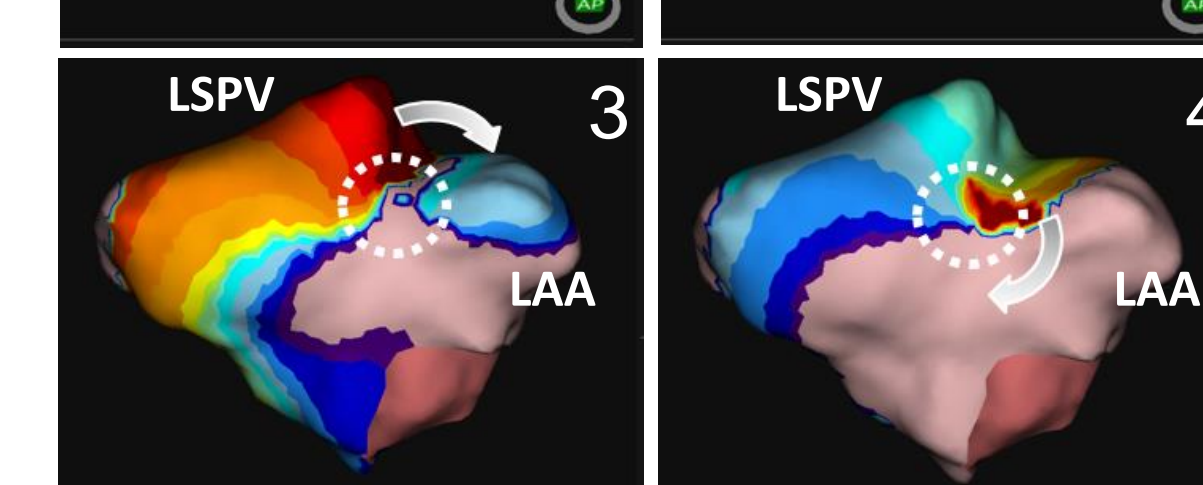
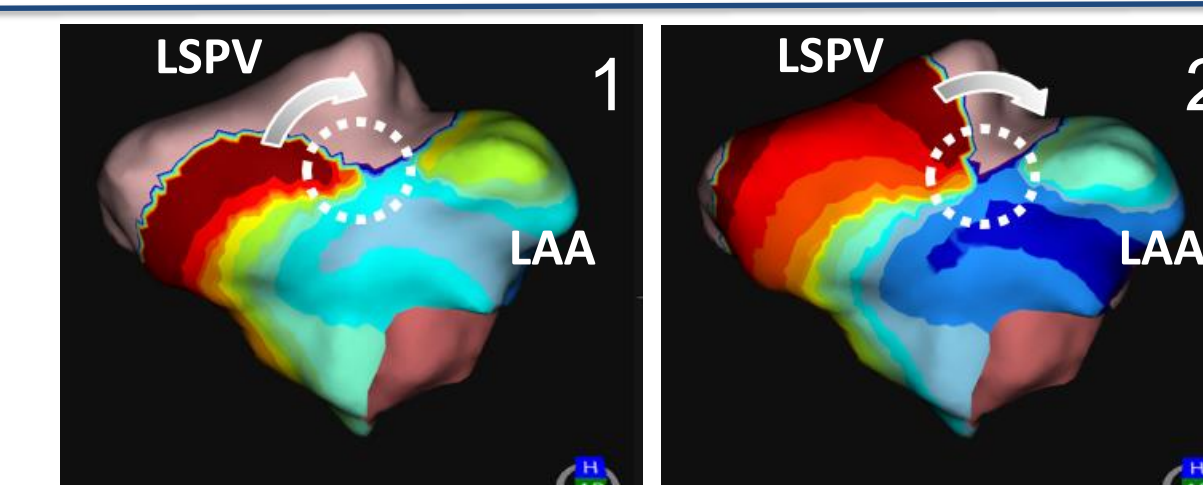
Examples of Activation Patterns and Locations in Atrial Fibrillation



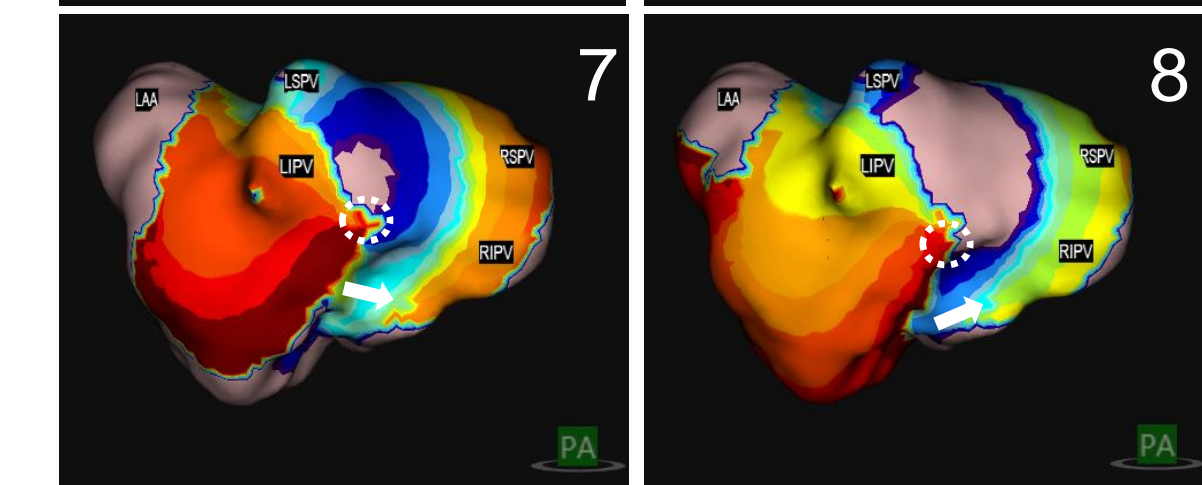
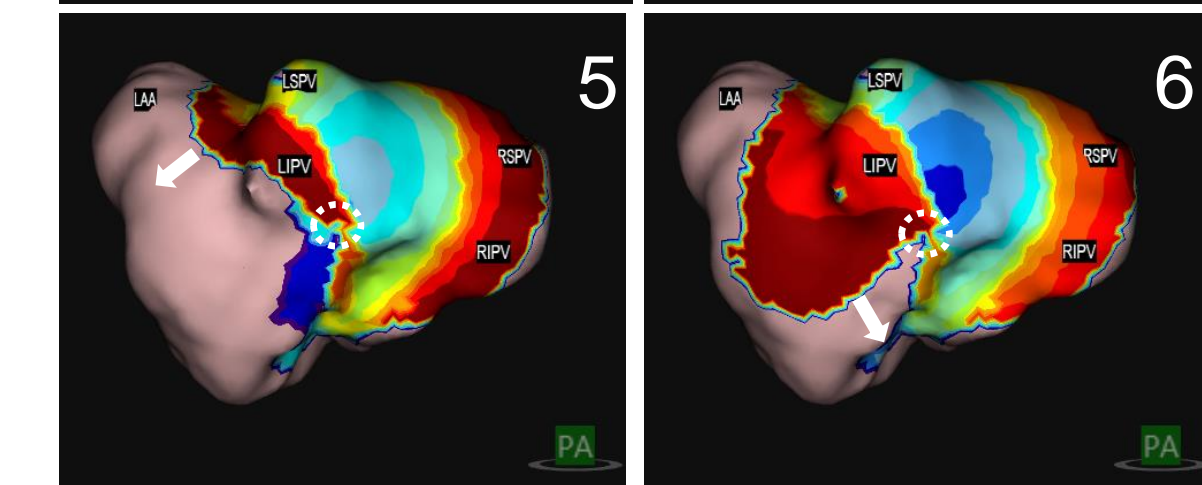
Counterclockwise rotational activation on the posterior wall near the RIPV at four instances in time



Focal activation on the posterior wall near the LIPV



Clockwise irregular-rotational conduction at the ridge between the LSPV and base of LAA



Followed by counterclockwise rotational activation at the LIPV

Conclusions

- Ultrasound-based imaging and dipole density mapping is feasible in persistent AF.
- It may enable more detailed visualization of propagation patterns and potential therapeutic targets.
- Further clinical studies are needed to determine clinical benefit