# Role of CMR in AF Ablation

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## Disclosure

- None

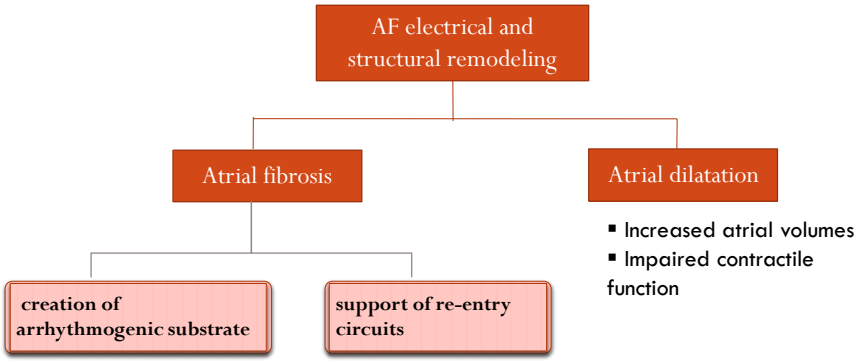
# Introduction

- Atrial fibrillation (AF) is the most common arrhythmia, with a prevalence of 1.0–1.5% in the general population and up to 10% in the elderly [1].
- AF results from and also leads to structural and electrical atrial remodeling.
- Catheter ablation has emerged as a viable option to reduce AF symptoms and to avoid consequences associated with long-term pharmacological therapy.

1. The ATRIA study. JAMA.2001

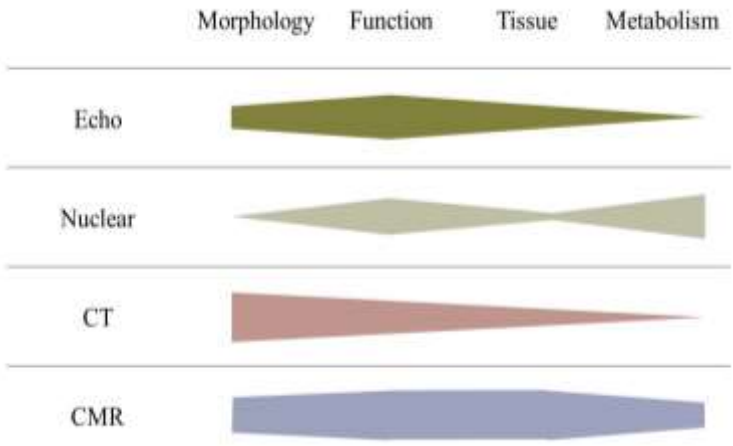
- The outcomes of AF ablation procedure are still controversial and thus it should be optimized, especially given the fact that complications related to AF ablation are not negligible.
- Cardiovascular magnetic resonance (CMR) has become a very attractive imaging tool to help the optimization of the procedure and to improve the outcome.

# Pathophysiology




- Increased atrial volumes
- Impaired contractile function

# Why do we use MRI?



## Why do we use MRI?

- The absence of ionizing radiation adds to the utility of CMR as a tool for long term assessment with serial examinations.

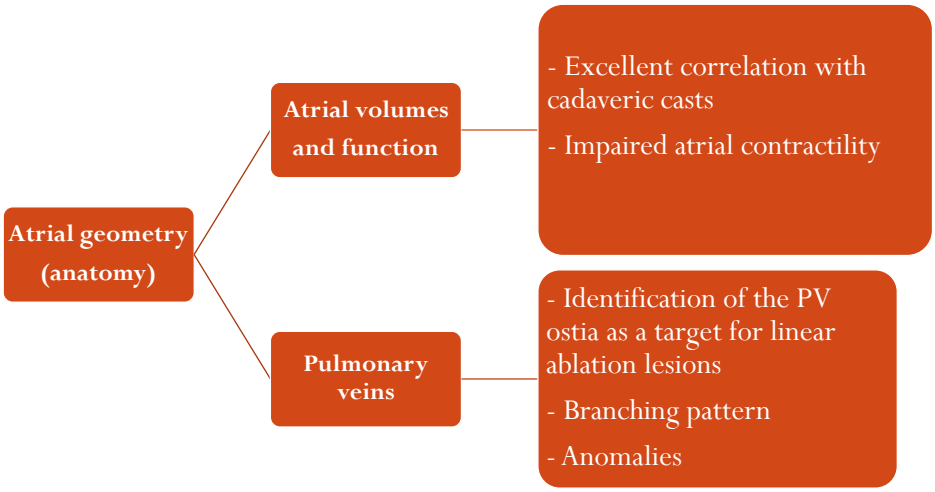
Therefore, CMR can be used to:

- guide patient selection for ablation,
- assess thromboembolic risk,
- provide arrhythmic substrate information before, during, and after catheter ablation

## CMR for the preparation of AF catheter ablation

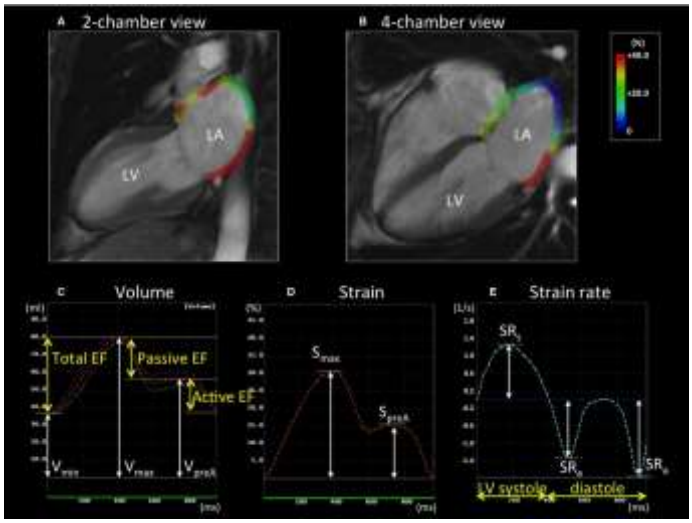
# Pre-ablation CMR

CMR for the assessment of left atrial geometry and function




## Atrial volumes and contractility

**LA measurements (volumes and function) by tissue-tracking CMR**

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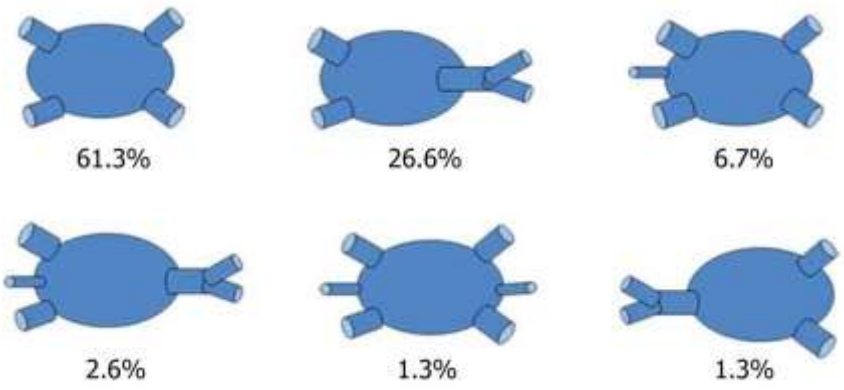
# Pulmonary veins branching pattern

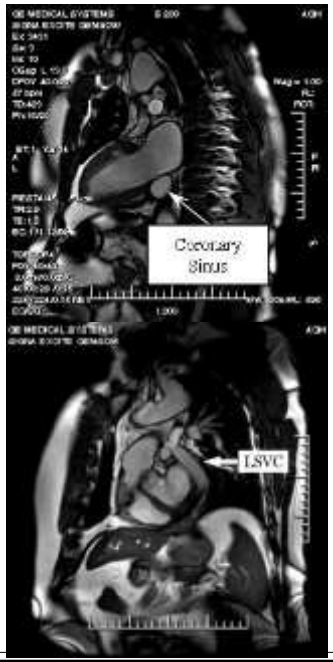
## Anatomical variation of PVs




## Pulmonary veins anomalies

## Persistent Left Svc Complicating Atrial Fibrillation Ablation

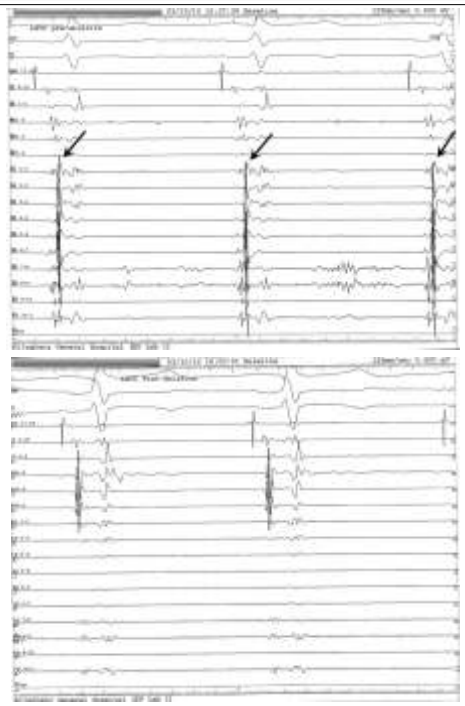
- A 50 year old male with history of persistent AF and three failed attempts of electrical cardioversion over 2 years was evaluated for pulmonary vein isolation (PVI) procedure.
- The day prior to ablation he underwent CMR to identify the 3D anatomy and location of the pulmonary veins in order to assist in the planned PVI procedure.




- Since the pLSVC was adjacent to the left atrial wall and the left superior pulmonary vein, the electrical activity within the pLSVC was able to conduct into these structures initiating AF.
- The pLSVC was rendered electrically inactive after ablation performed within the pLSVC.

Pre-ablation

Post-ablation



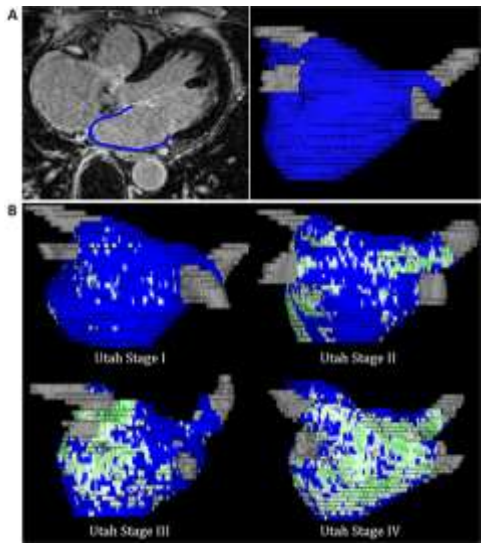
# CMR for the assessment of left atrial myocardial characteristics

- One of the unique features of CMR is the ability to characterize myocardial tissue composition even for thin-walled tissues such as the LA wall.
- Late Gadolinium Enhancement (LGE)CMR is capable of accurate detection and quantification of LA fibrosis prior to the ablation procedure.
- There is a strong association between regions of enhancement and low voltage on electroanatomic maps.

# Left Atrial Fibrosis

- LGE-CMR studies can identify the native fibrosis of the LA.
- Scar represents a potential substrate for AF and could predict ablation results.
- Recently, results from a single-center study showed that extensive LGE predicts poor response to catheter ablation therapy for AF (1).

1- McGann et al., Circ Arrhythm Electrophysiol. 2014



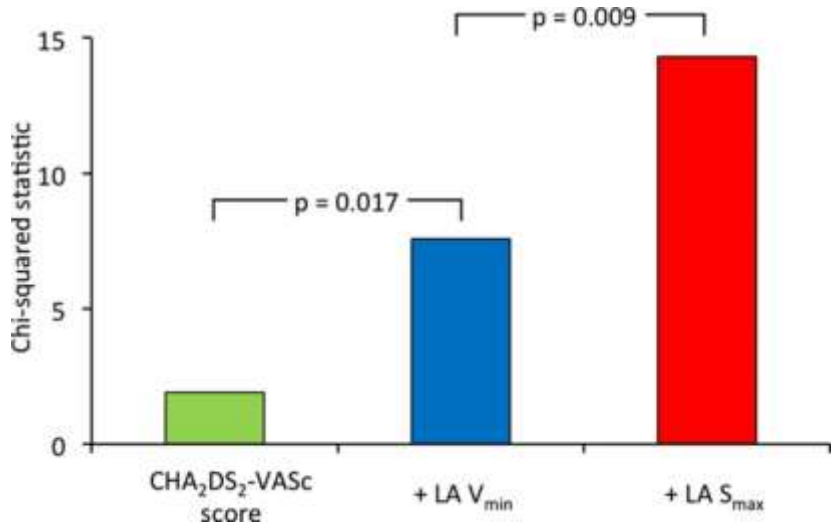

(A) DE-CMR axial slice with the segmented LA wall (left panel) and the resulting three-dimensional reconstruction of the LA wall (right panel). (B) Utah classification of the LA remodeling based on the percentage of enhancement of the LA wall volume: <10% (Utah I), 10–20% (Utah II), 20–30% (Utah III), and >30% (Utah IV).

# CMR and stroke risk in AF patients

- Stroke is one of the most devastating complications of AF.
- Therefore, imaging of the LA and especially the LAA has been established as an additional risk stratification tool for identification of candidates for anticoagulation or appendage exclusion.
- Some reports found that certain LAA characteristics such as extensive trabeculations, assessed by CMR, are associated with increased CVA risk (1,2)

1. Di Biase et al., JACC, 2012
2. Khurram et al., Heart rhythm J, 2013

**Incremental value of left atrial (LA) strain for diagnosis of stroke.**

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# CMR for intra-procedural guidance of AF catheter ablation

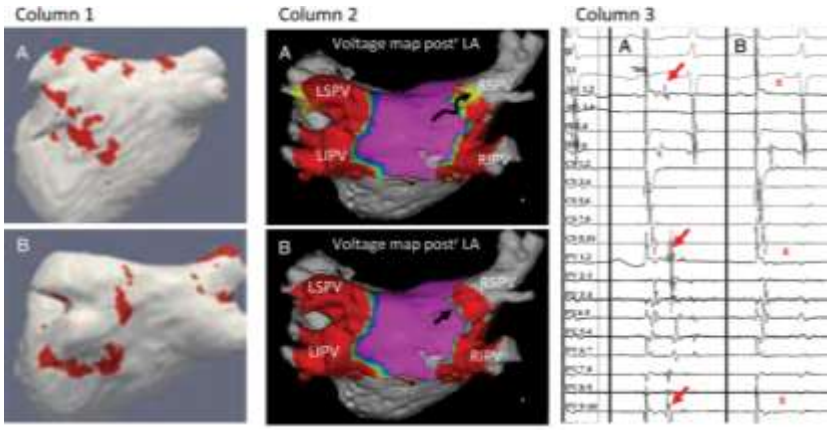
The integration of pre-procedural 3D imaging with electroanatomic map data has been shown to:

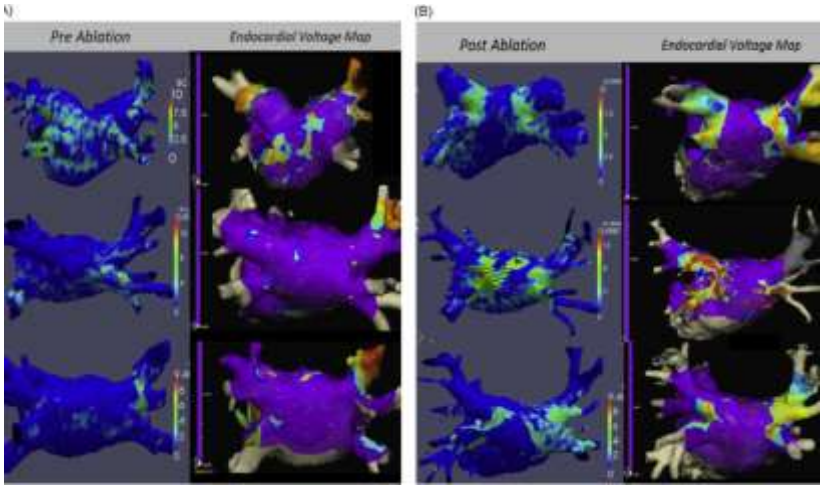
- Reduce fluoroscopy time and radiation exposure.
- Complete isolation of all PVs guided by the imported MR model to identify the scar gaps.
- Improve safety by rapid recognition of complications such as pericardial effusion or damage to adjacent structures.

## CMR for assessment of lesion integrity after AF ablation

## CMR roles post ablation procedure are:

- Assessment of scar formation. AF recurrence was negatively associated with LA scar formation at 3 months post-ablation.
- Evaluation of the effect of ablation on LA geometry and function.
- Identify PV stenosis.






LGE CMR automated atrial scar mapping (left side) obtained (A) before and (B) 3 months after ablation in 3 patients, with corresponding endocardial voltage maps registered to the MRA segmentation of the left atrium (right side). The postablation LGE maps compare well to the corresponding endocardial voltage maps.

# Conclusion

- Non-invasive characterization of the LA and PV anatomy is an important factor for success of AF ablation.
- CMR enables detailed assessments of LA characteristics without exposing the patient to radiation.
- High costs and the expertise required for appropriate image acquisition and analysis limit the routine use of CMR.
- Additional advances to enhance image resolution and analysis may improve the implementation of this technique in the daily practice.

# Thank You