



Future Perspective of MRI in Cardiology and EP

Roma, October 1st, 2022



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Role of CMR in EP

- Pre-procedural
- Peri-procedural
- Post-procedural

Role of CMR in EP

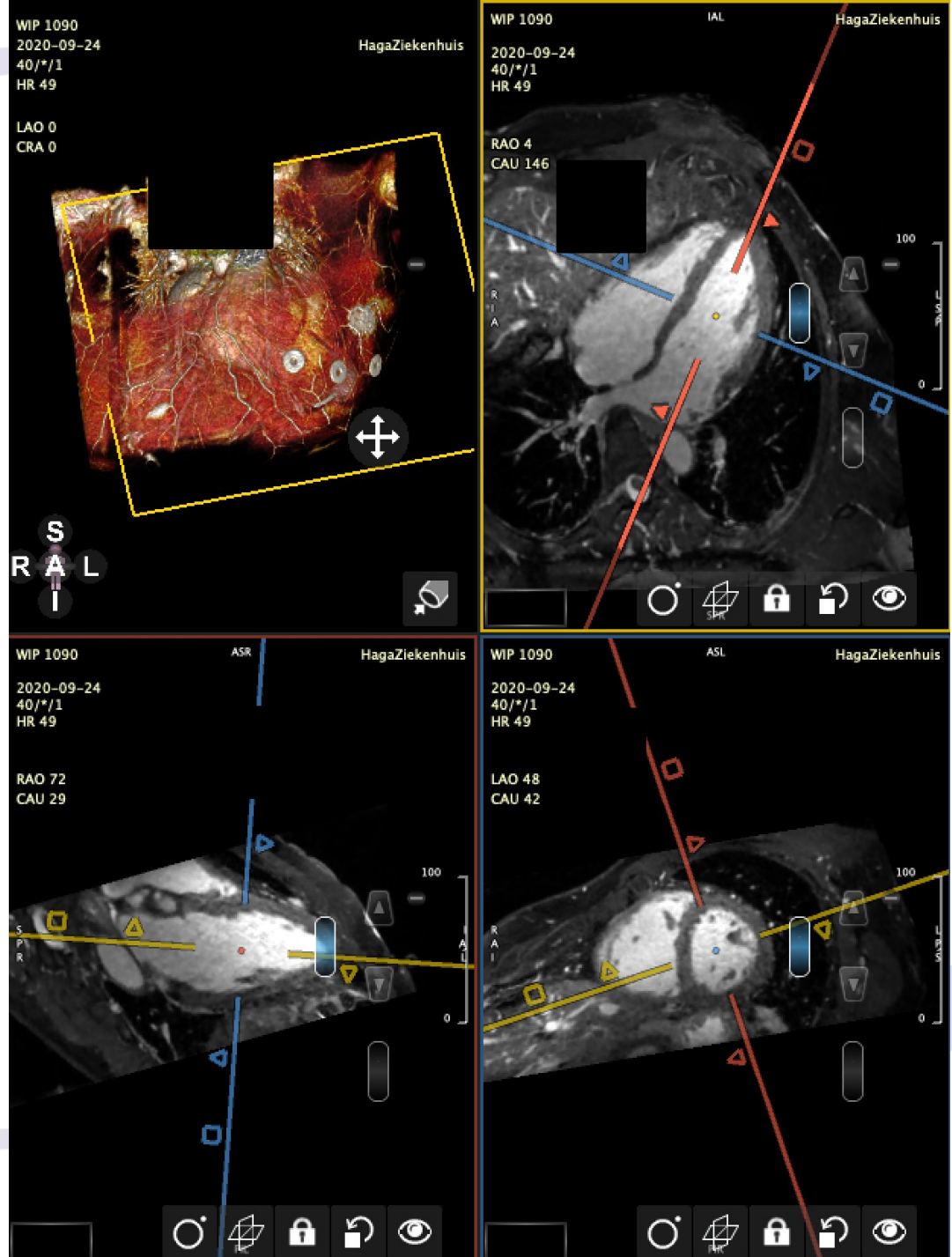
- Pre-procedural
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Role of CMR in EP

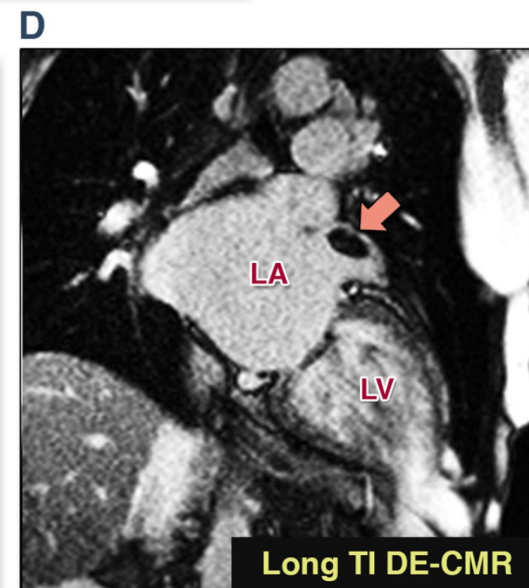
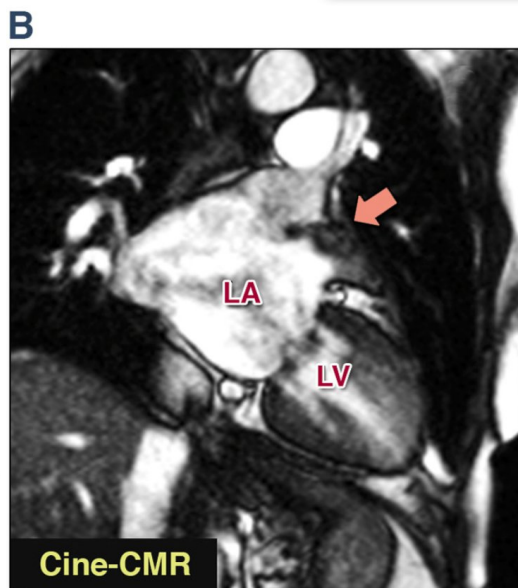
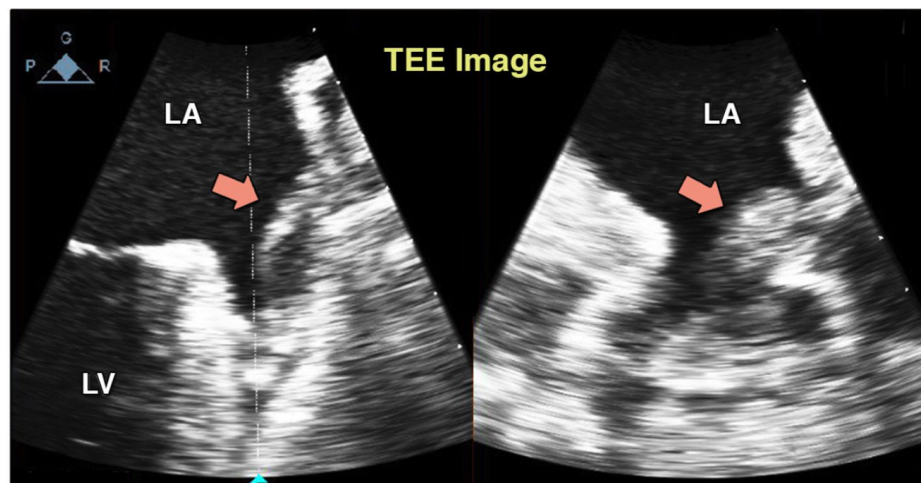
- Pre-procedural

- Anatomy
- Exclusion thrombus LAA
- LAVI/RAVI/atrial function
- LV/RV dimension and function
- Pre-existing fibrosis, tissue characterisation

None contrast enhanced
1 Exam, single modality
No radiation
Free breathing
3D dataset

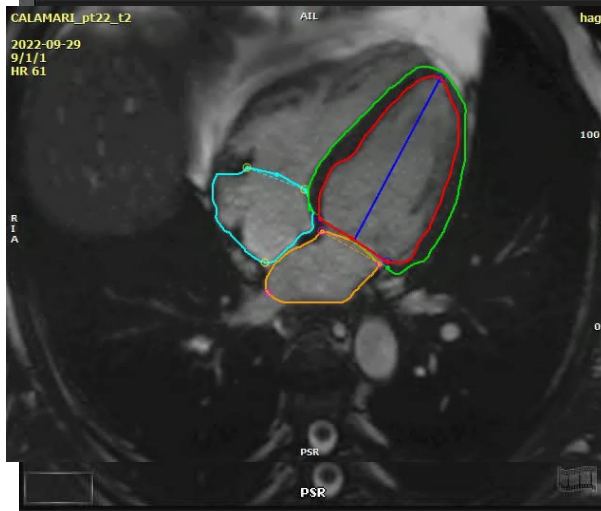
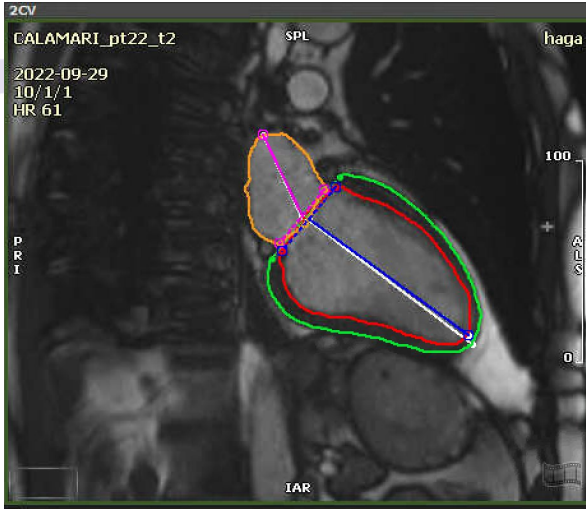


Exclusion of a LAA thrombus



Detection of LA and LAA Thrombus by CMR in Patients Referred for Pulmonary Vein Isolation

JACC: Cardiovascular Imaging
Volume 9, Issue 7, July 2016, Pages 809-818



LV Function Long Axis Strain Atrial Function

Atrial Function

Biplanar LA Function

Left Atrium Vol at LVED: 34.91 ml
Left Atrium Vol at LVES: 77.91 ml
Phase LV Diastole: 25
Phase LV Systole: 10
Min LA Vol: 32.30 ml
Phase Min LA Vol: 24
Max LA Vol: 77.91 ml
Phase Max LA Vol: 10
LA EF: 58.55 %

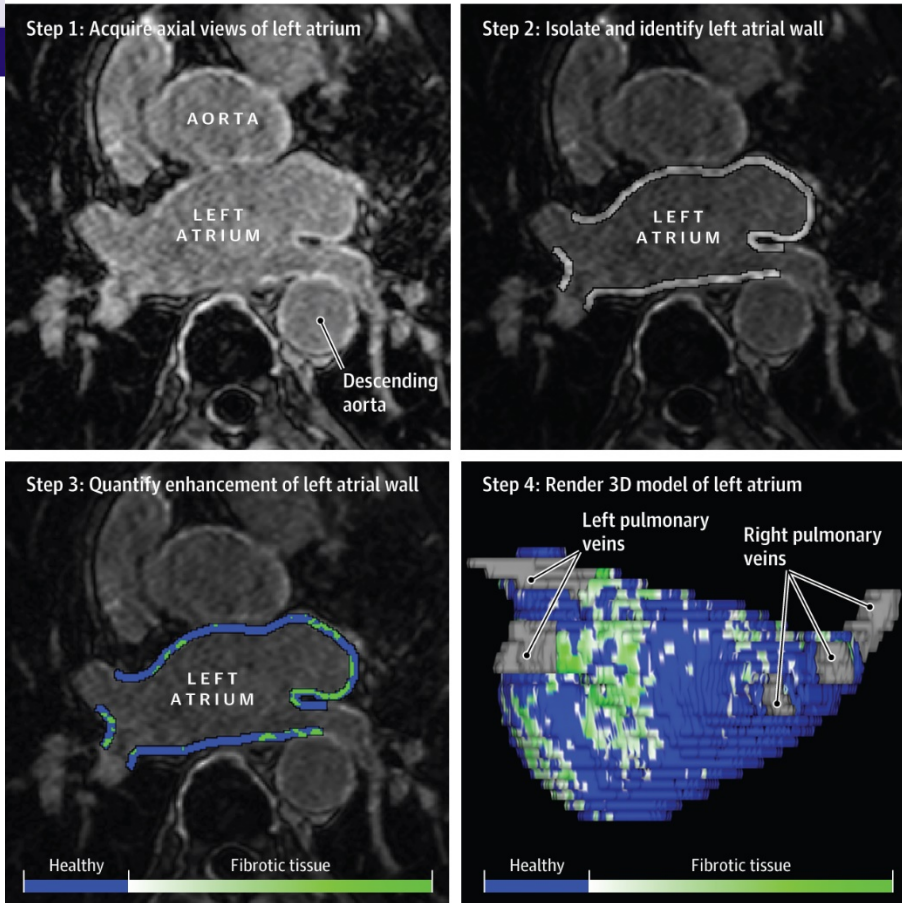
Monoplanar 2CV LA Function

Left Atrium Vol at LVED: 30.87 ml (12.49 cm²)
Left Atrium Vol at LVES: 79.24 ml (23.49 cm²)
Phase LV Diastole: 24
Phase LV Systole: 10
Min LA Vol: 30.87 ml (12.491 cm²)
Phase Min LA Vol: 24
Max LA Vol: 79.24 ml (23.491 cm²)
Phase Max LA Vol: 10
LA EF: 61.04 %

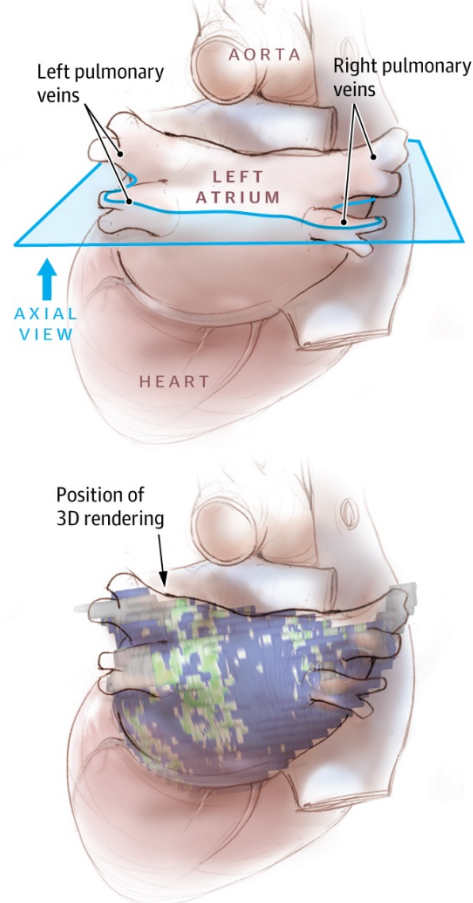
Monoplanar 4CV LA and RA Function

Left Atrium Vol at LVED: 36.79 ml (14.58 cm²)
Left Atrium Vol at LVES: 72.48 ml (21.45 cm²)
Right Atrium Vol at LVED: 50.07 ml (15.46 cm²)
Right Atrium Vol at LVES: 89.70 ml (23.91 cm²)
Phase LV Diastole: 25
Phase LV Systole: 8
Min LA Vol: 33.86 ml (13.741 cm²)
Phase Min LA Vol: 24
Max LA Vol: 76.82 ml (21.942 cm²)
Phase Max LA Vol: 10
LA EF: 55.93 %
Min RA Vol: 43.22 ml (13.992 cm²)
Phase Min RA Vol: 24
Max RA Vol: 93.22 ml (24.582 cm²)
Phase Max RA Vol: 10
RA EF: 53.64 %

A Delayed enhancement magnetic resonance imaging analysis



B Schematic posterior view of left atrium



From: **Association of Atrial Tissue Fibrosis Identified by Delayed Enhancement MRI and Atrial Fibrillation Catheter Ablation: The DECAAF Study**

JAMA. 2014;311(5):498-506. doi:10.1001/j

Process for Quantification of Left Atrial Wall Fibrosis—High-resolution 3D delayed enhancement magnetic resonance imaging (MRI) scans of the left atrium are acquired (step 1). Epicardial and endocardial borders are contoured in each MRI slice to define the left atrial wall segmented region (step 2). Wall segmentations include the 3D extent of both the left atrial wall and the antral regions of the pulmonary veins, but exclude the mitral valve. Quantification of fibrosis is based on relative intensity of contrast enhancement (step 3). The 3D model of the left atrium is rendered from the endocardial (left atrial cavity) and left atrial wall segmentations, and the maximum enhancement intensities are projected on the surface of the model (step 4). Interactive 3D model.

Role of CMR in EP

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- **Peri-procedural**
- Post-procedural



Peri-procedural

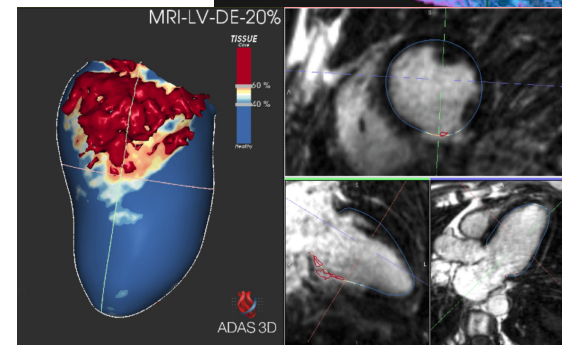
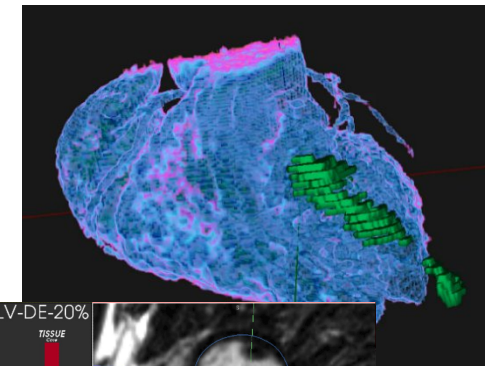
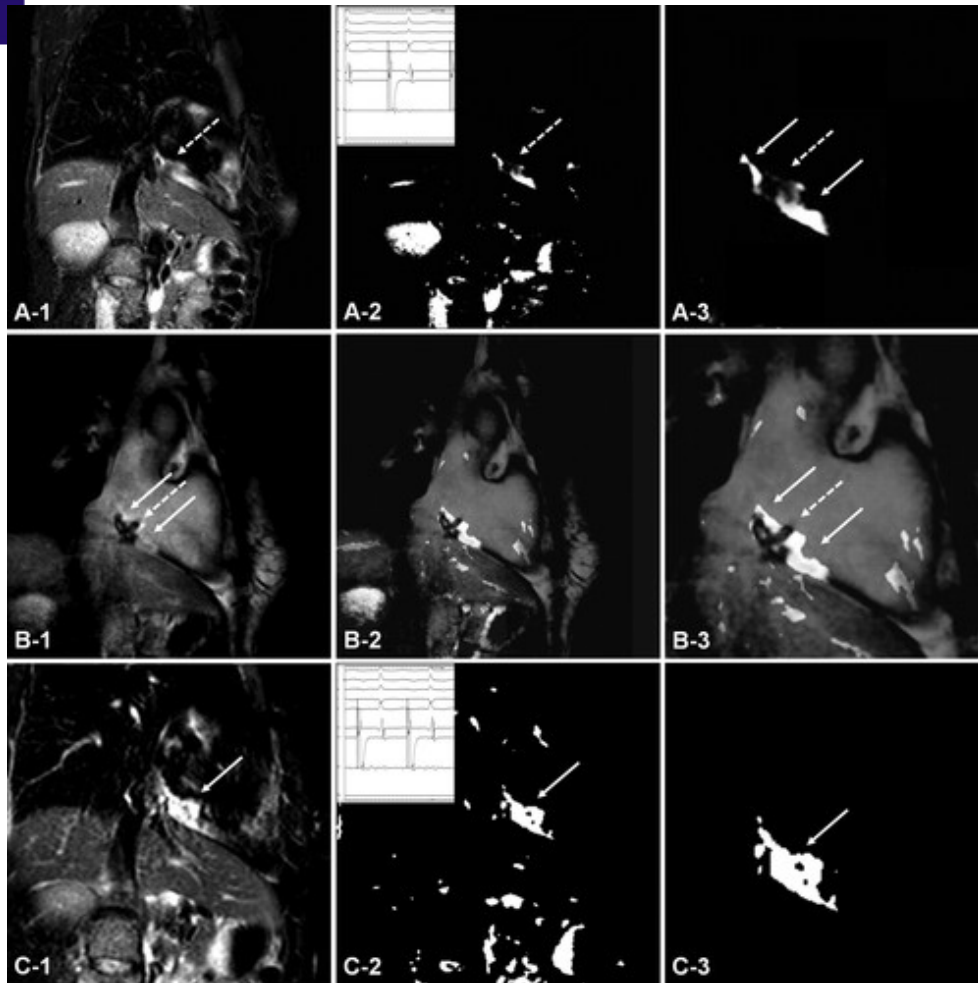
- Lesion formation visualisation
- Edema visualisation
- Thermomapping
- Potential complications



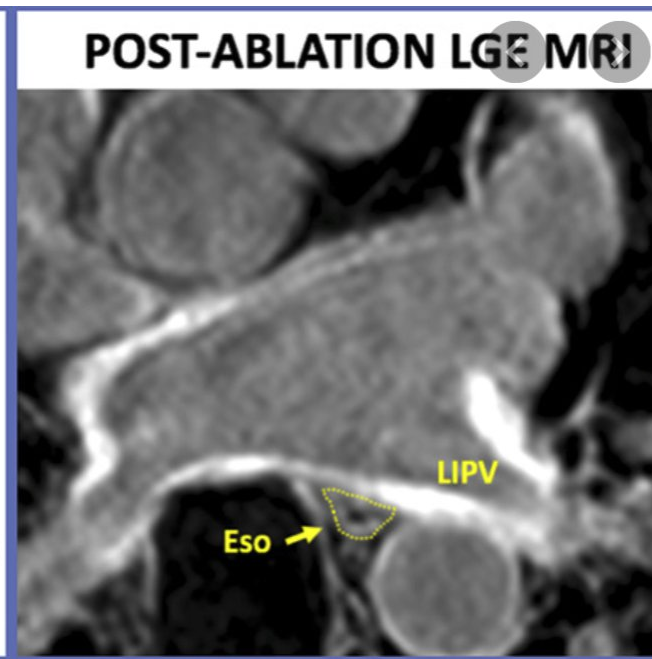
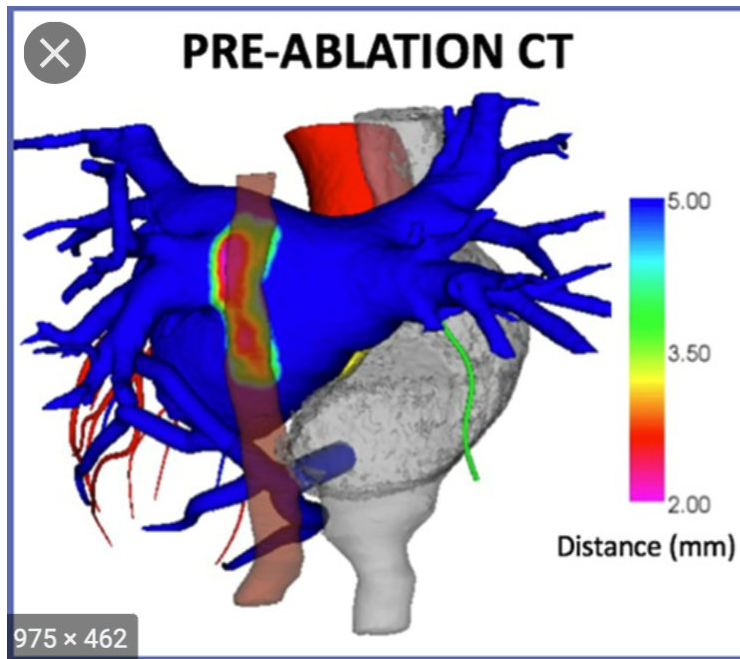
Peri-procedural

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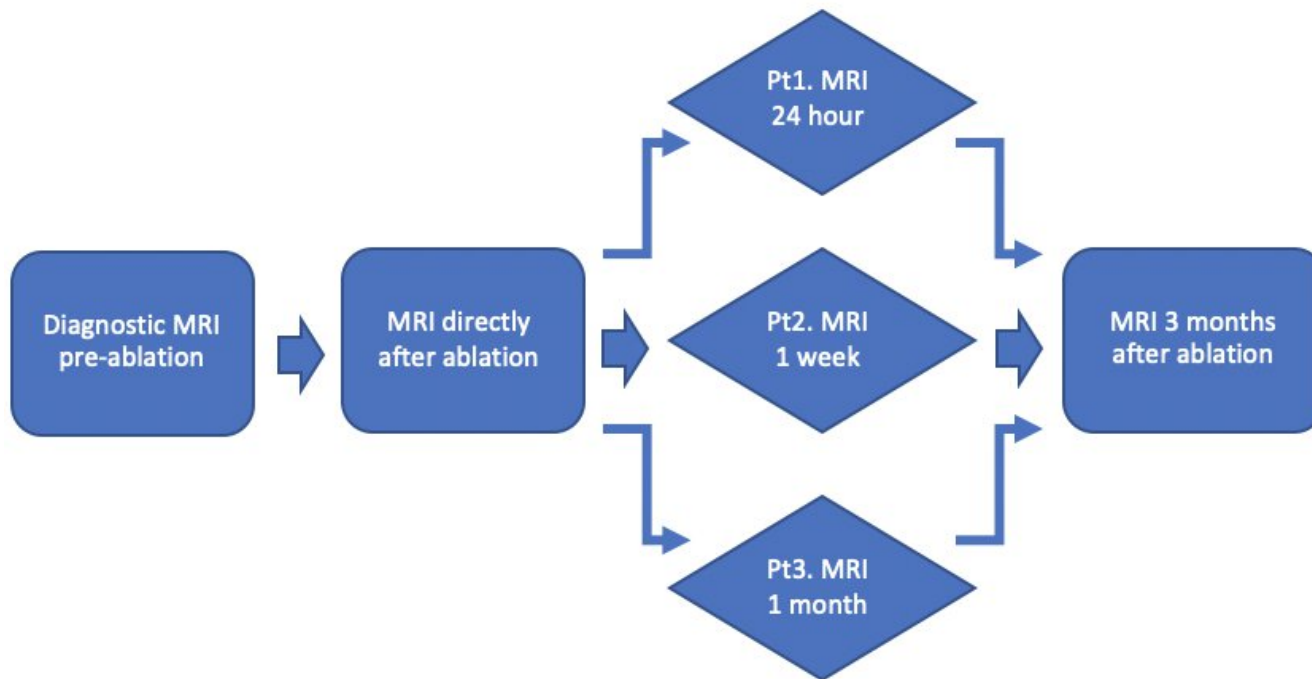
Lesion visualisation



Peter Nordbeck. Circulation: Cardiovascular Imaging. Feasibility of Contrast-Enhanced and Nonenhanced MRI for Intraprocedural and Postprocedural Lesion Visualization in Interventional Electrophysiology, Volume: 4, Issue: 3, Pages: 282-294, DOI: (10.1161/CIRCIMAGING.110.957670)



CALAMARI study







Lesion visualisation

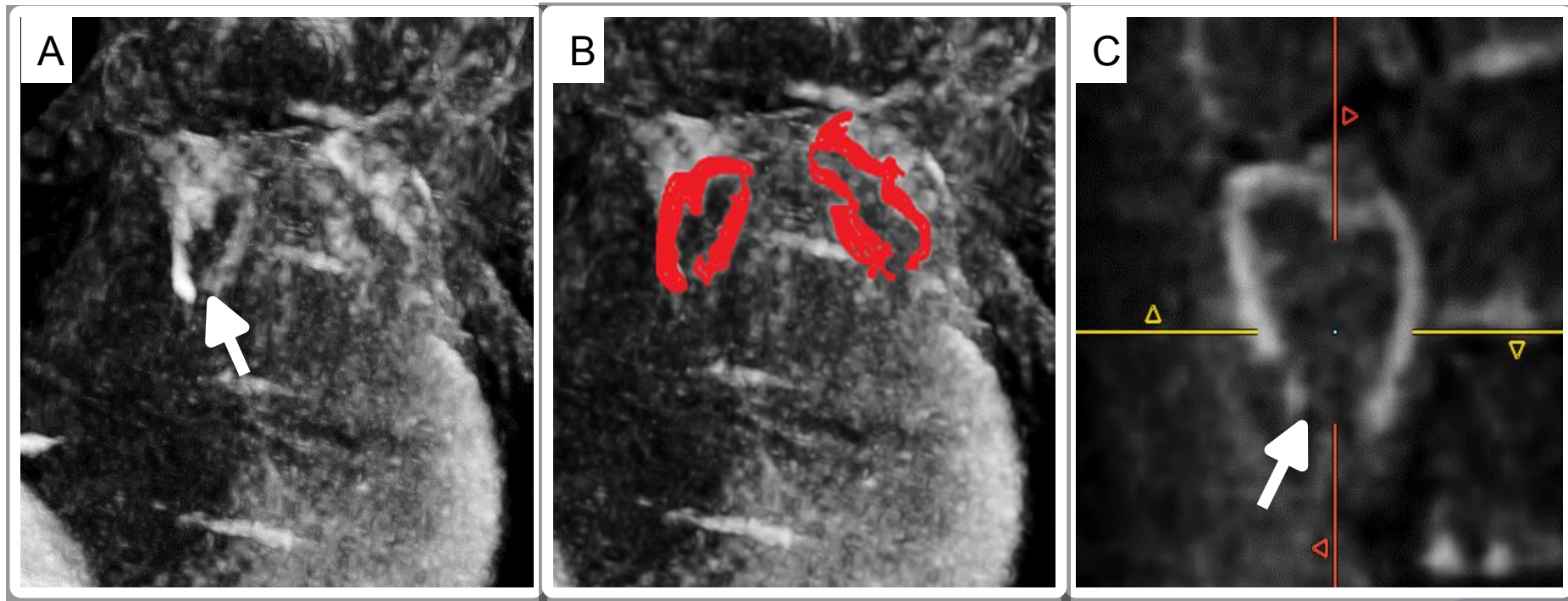
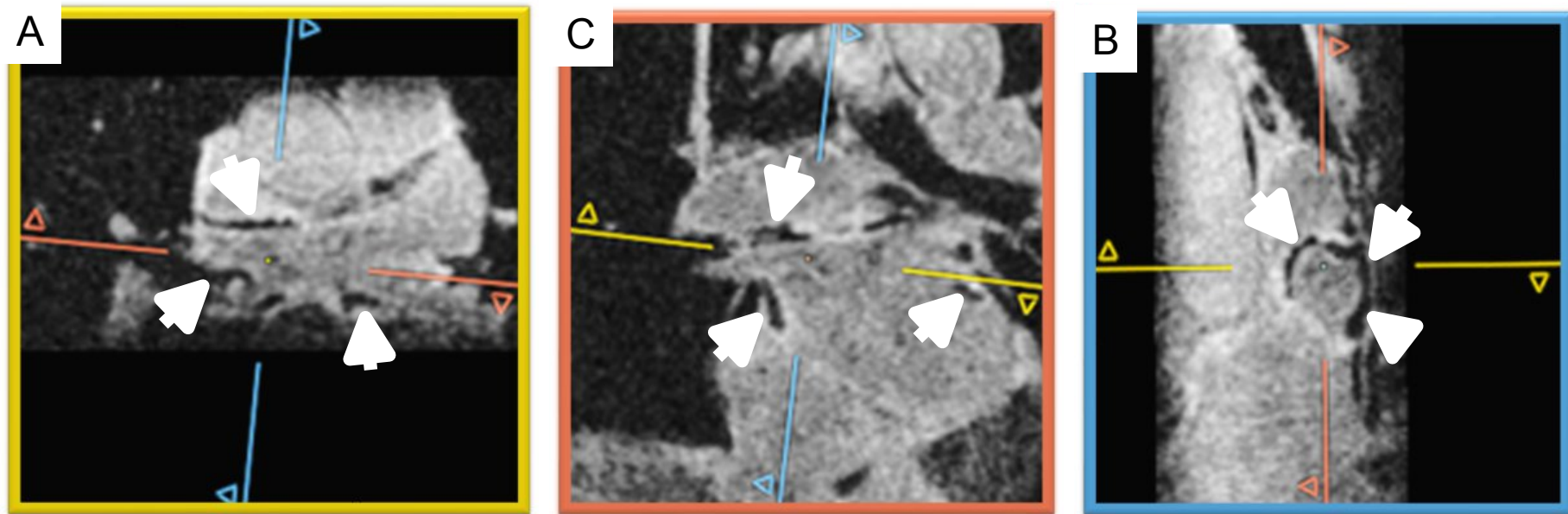
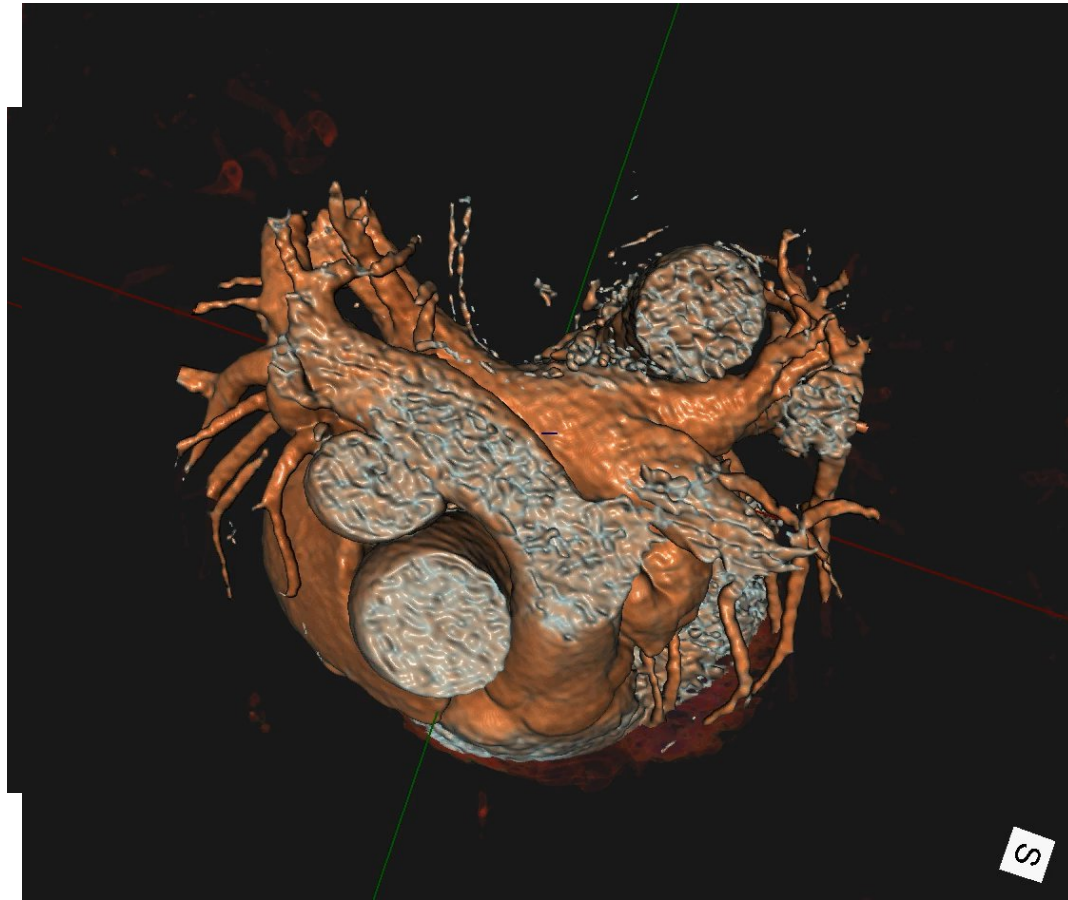
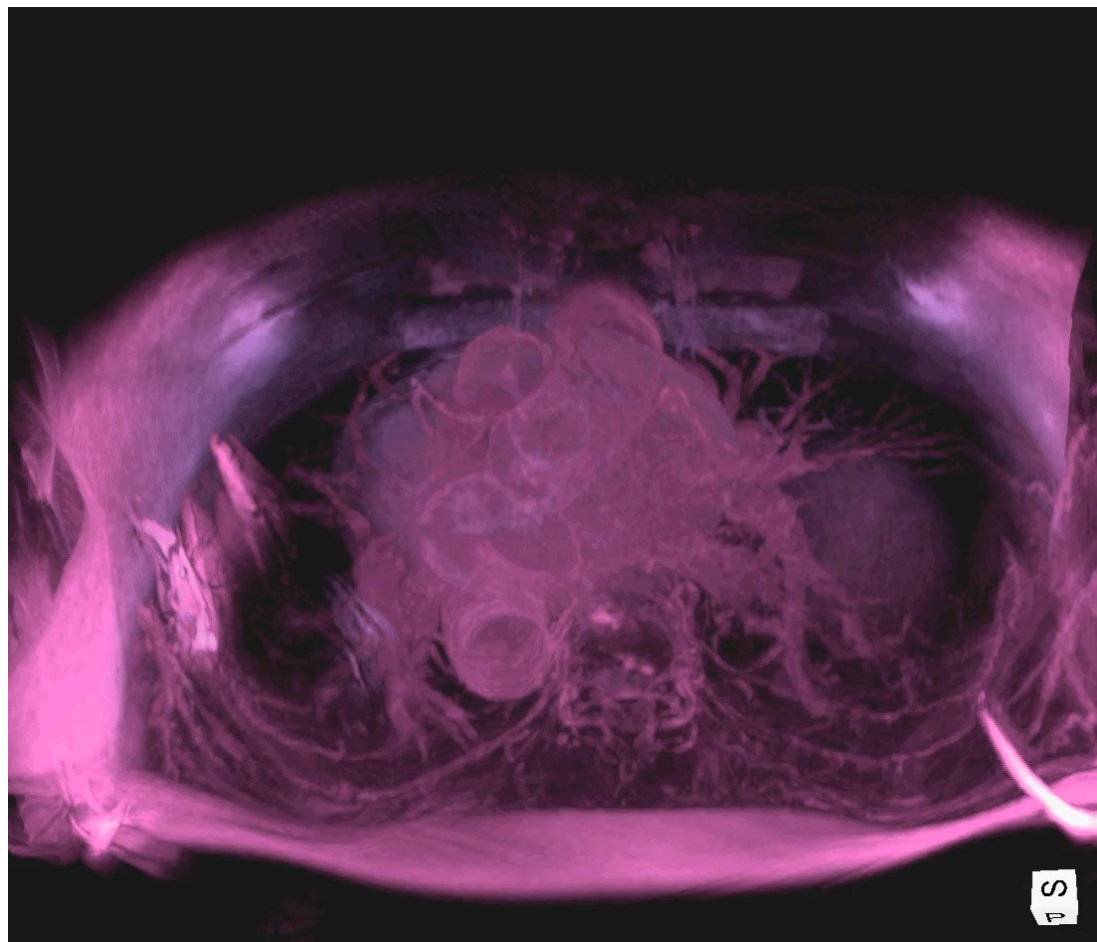
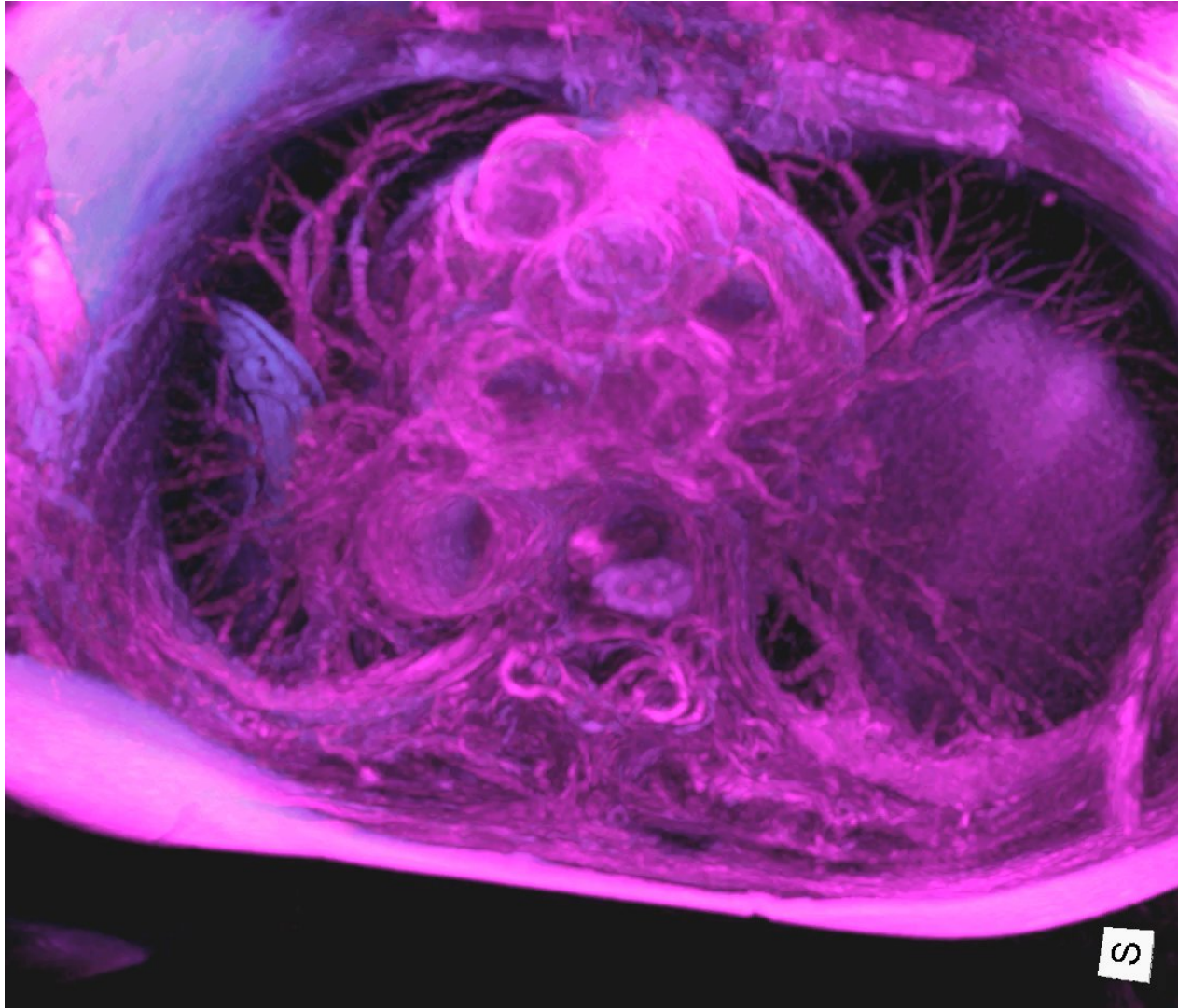


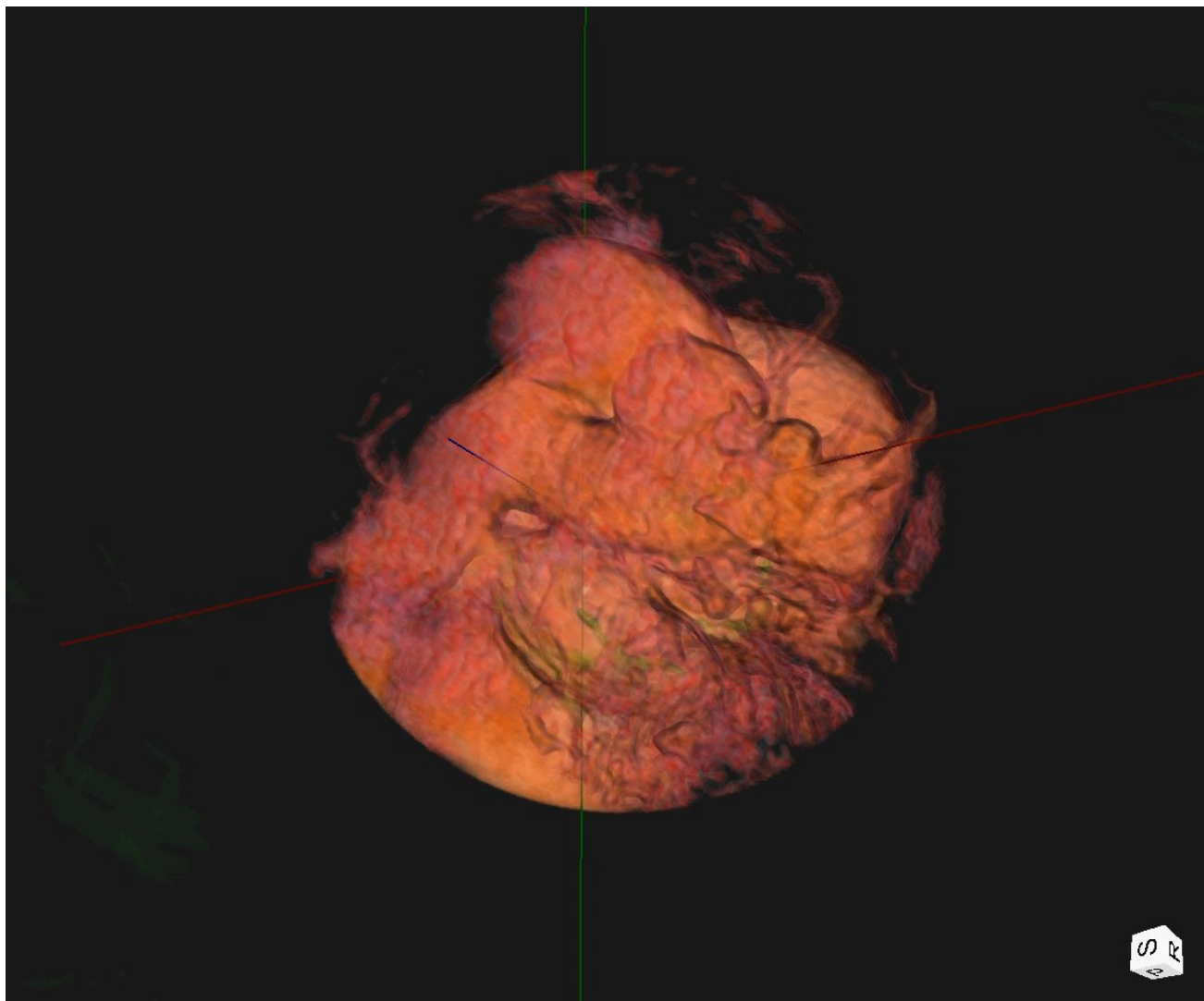
Fig. 3











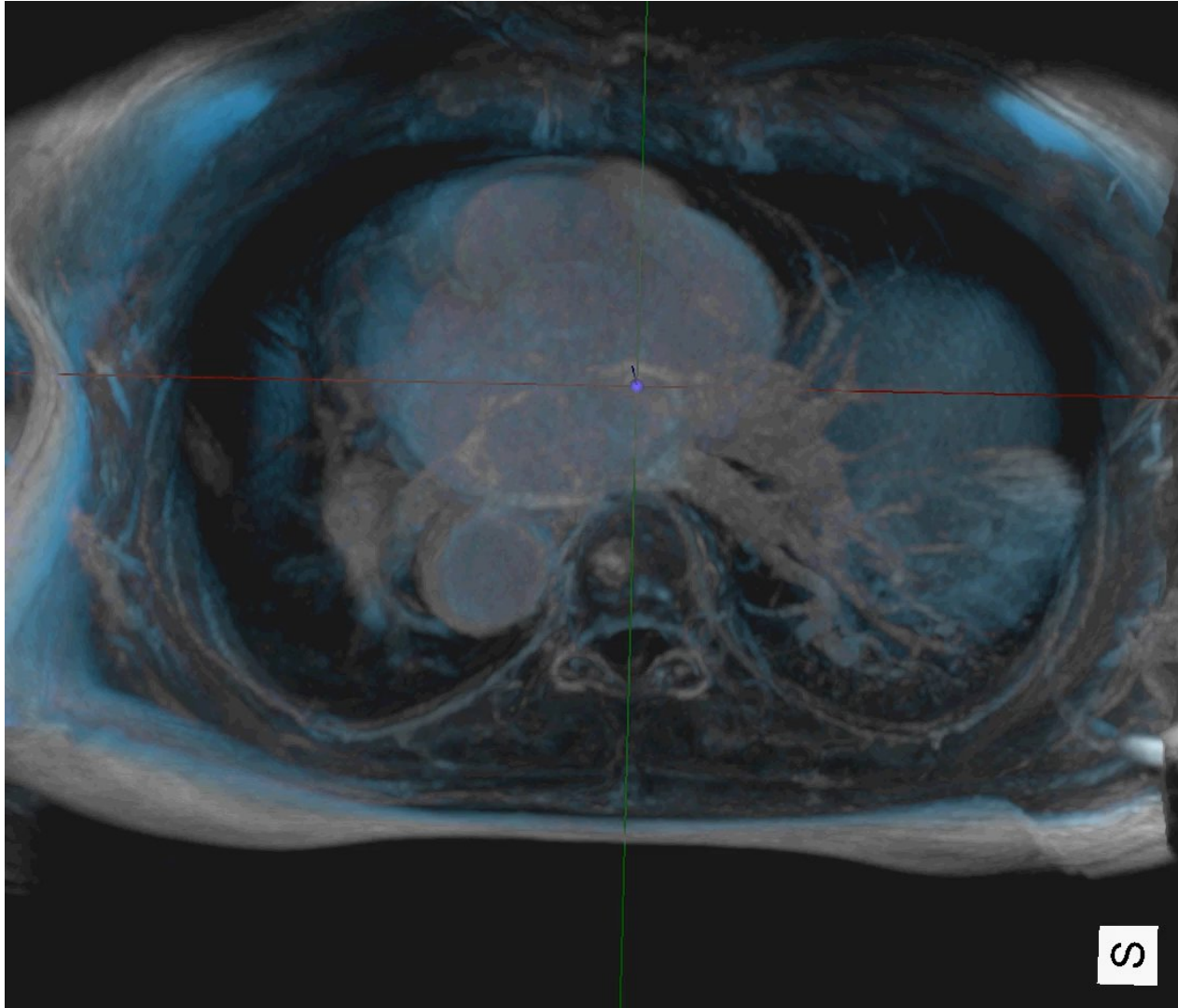
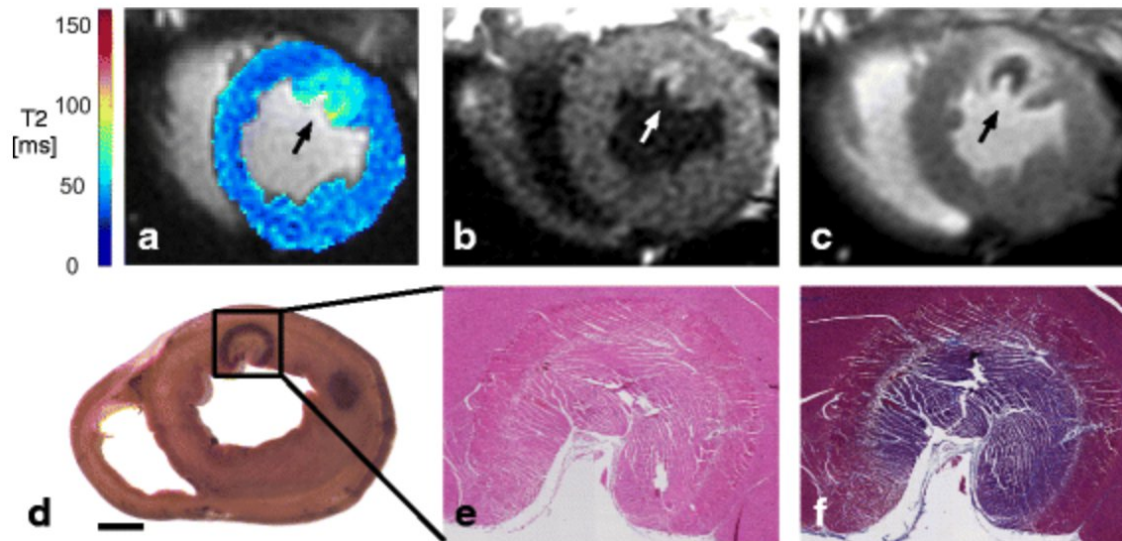


Fig. 2



RF lesion visualization using native-contrast and contrast-enhanced CMR, gross pathology, and histopathology. **a** T₂ map (74 min post-ablation) demonstrating T₂ elevation associated with edema near the ablation site (arrow). **b** IR-SSFP (TI = 730 ms, 81 min post-ablation) demonstrating the hyper-enhanced lesion. **c** MCLE (TI = 805 ms, 106 min post-ablation, approximately 6 min post-Gd injection), demonstrating the dark region of microvascular obstruction, at the lesion centre, with bright surrounding tissue. **d** Gross pathology (with a second lesion slightly out of plane; scale bar = 1 cm). Magnified **(e)** H&E and **(f)** MT stained lesion tissue sections



Periprocedural

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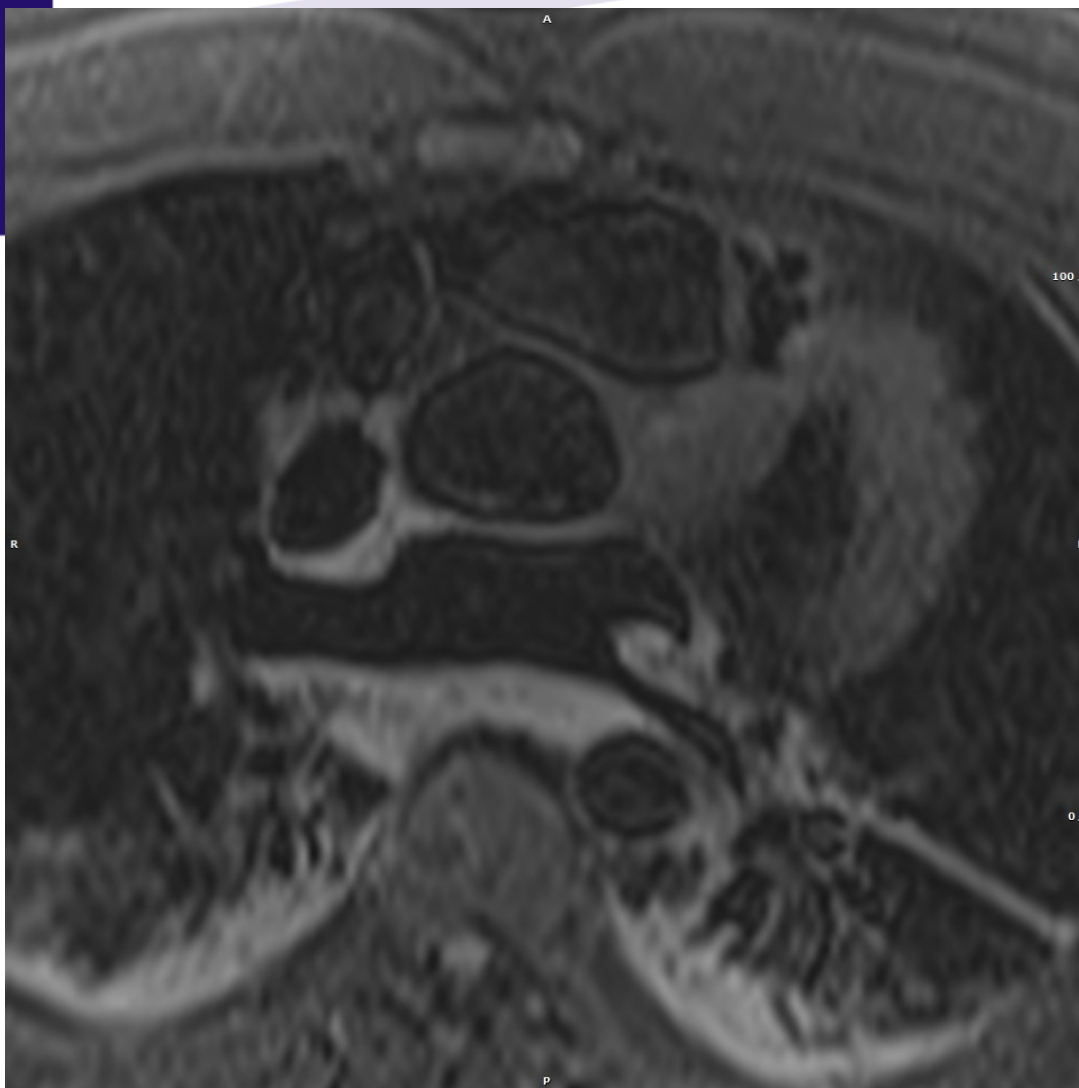


Fig. 1

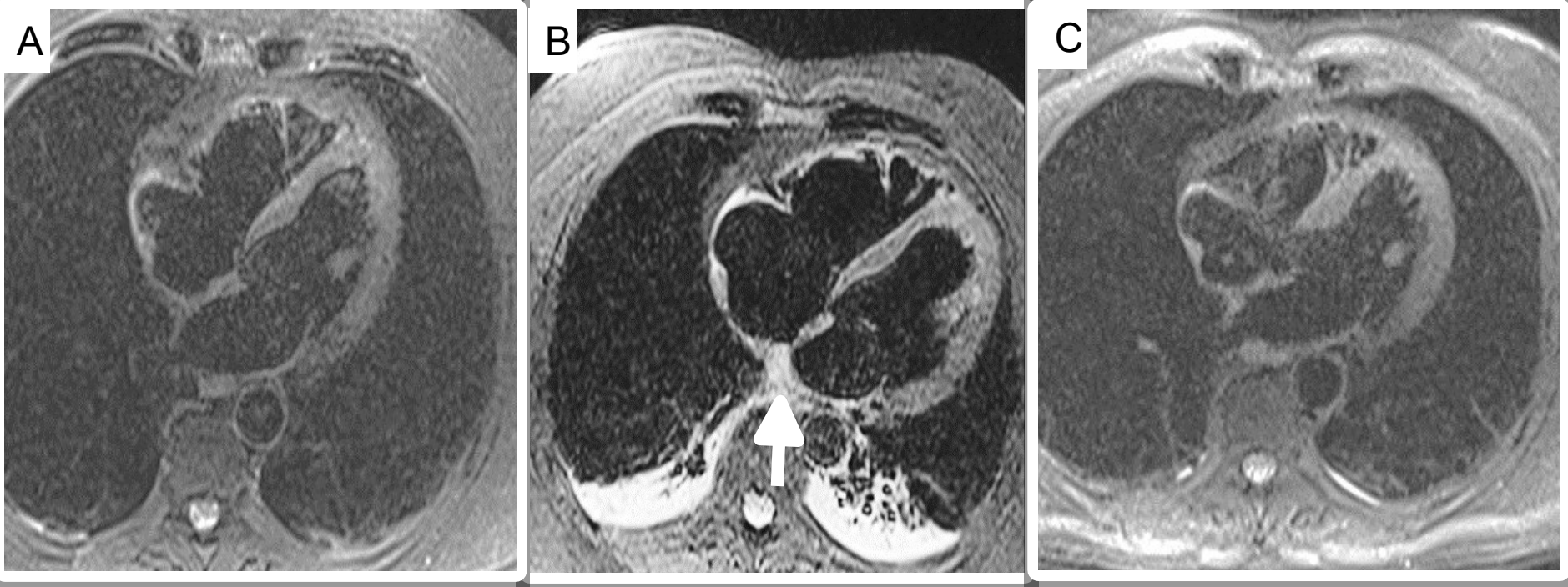
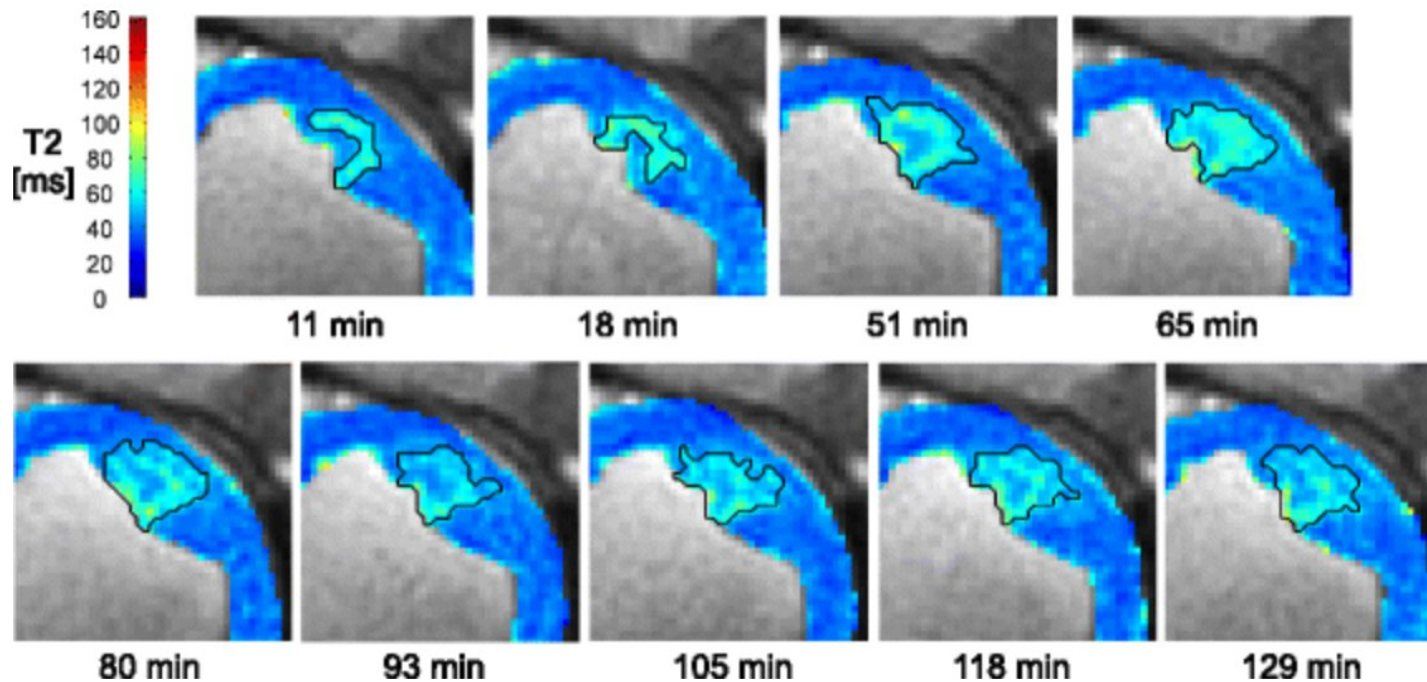


Fig. 3



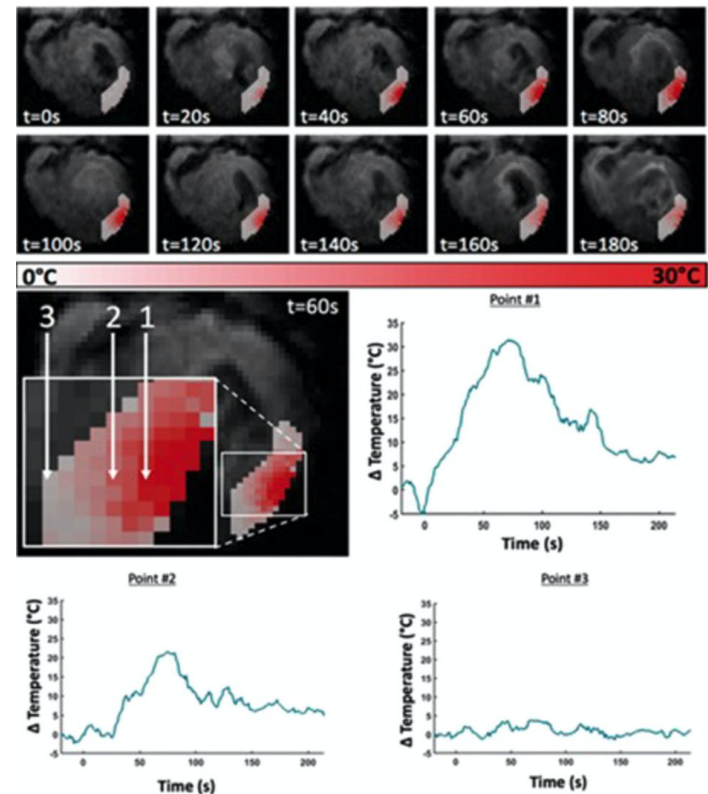
T₂-derived edema development with time post-ablation. Anterior LV wall RF lesion visualization in T₂ maps acquired 11–129 min post-ablation. Black lines delineate segmented T₂-derived edematous regions



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Thermomapping



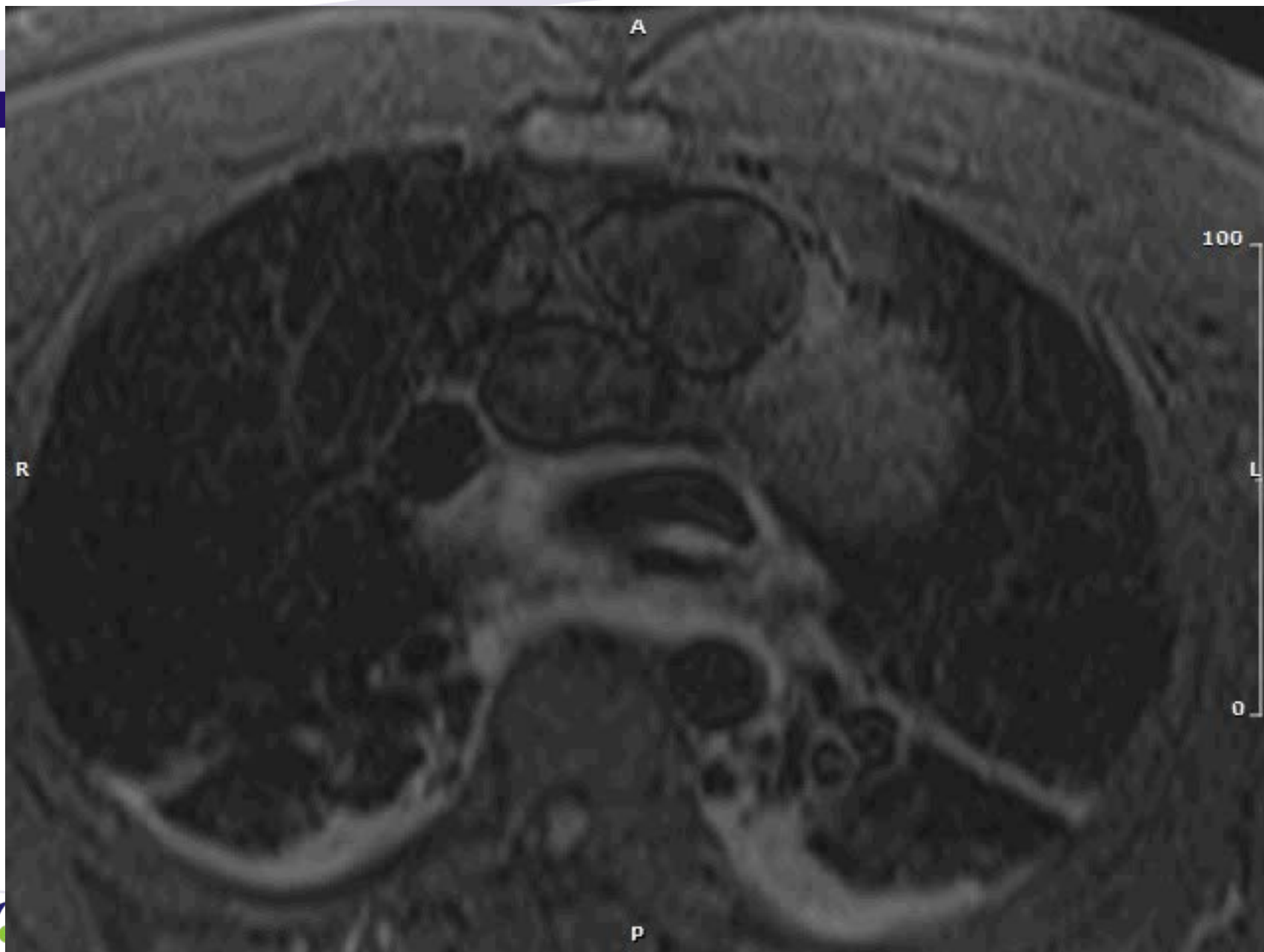
Curr Cardiovasc Imaging Rep (2019) 12: 6

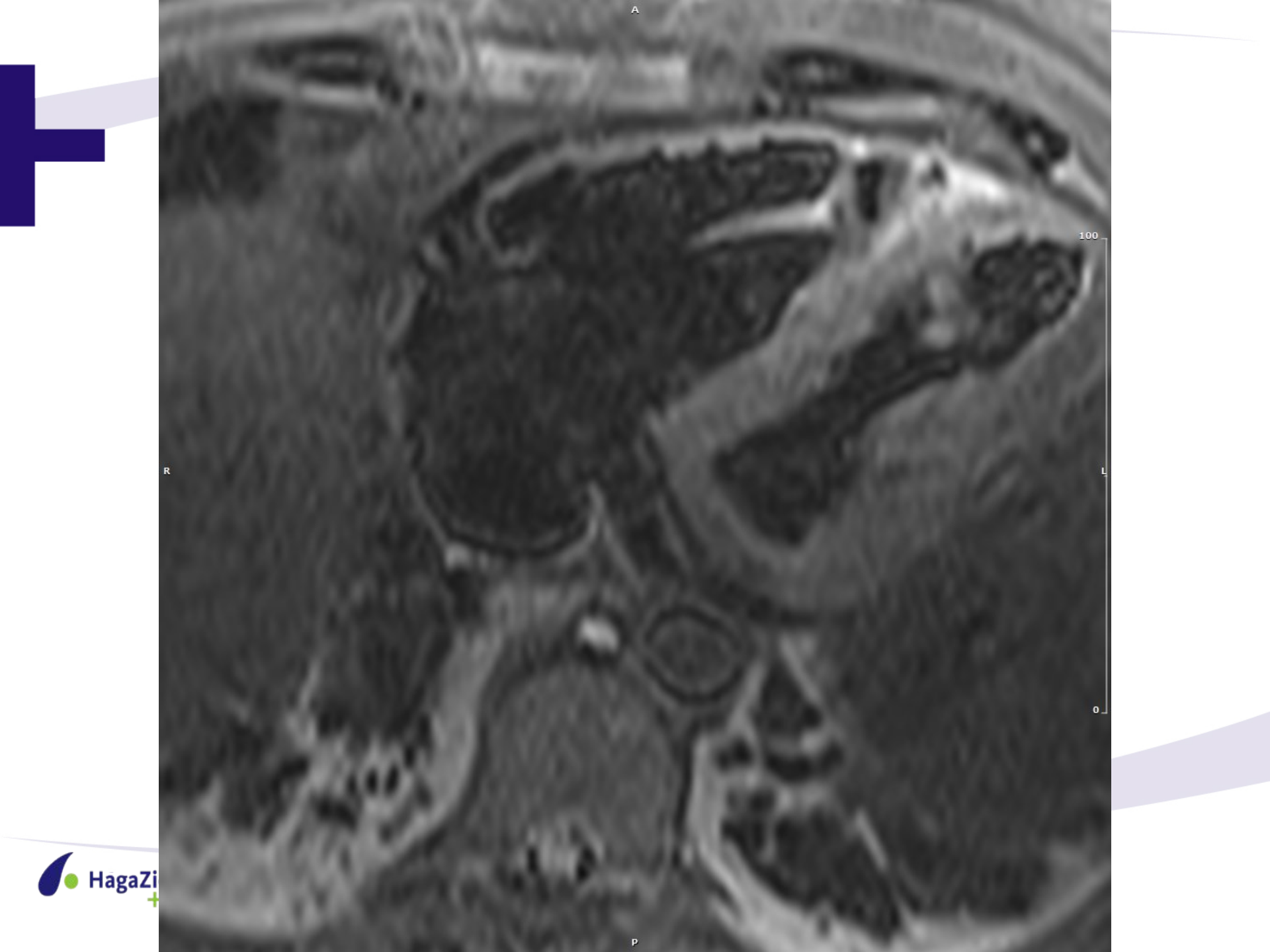


Periprocedural

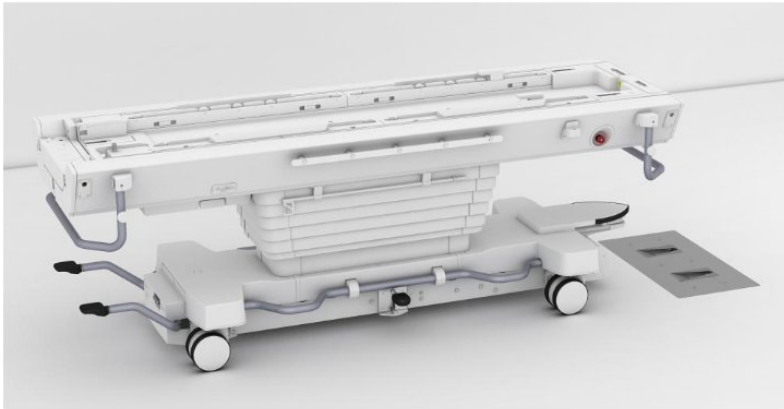
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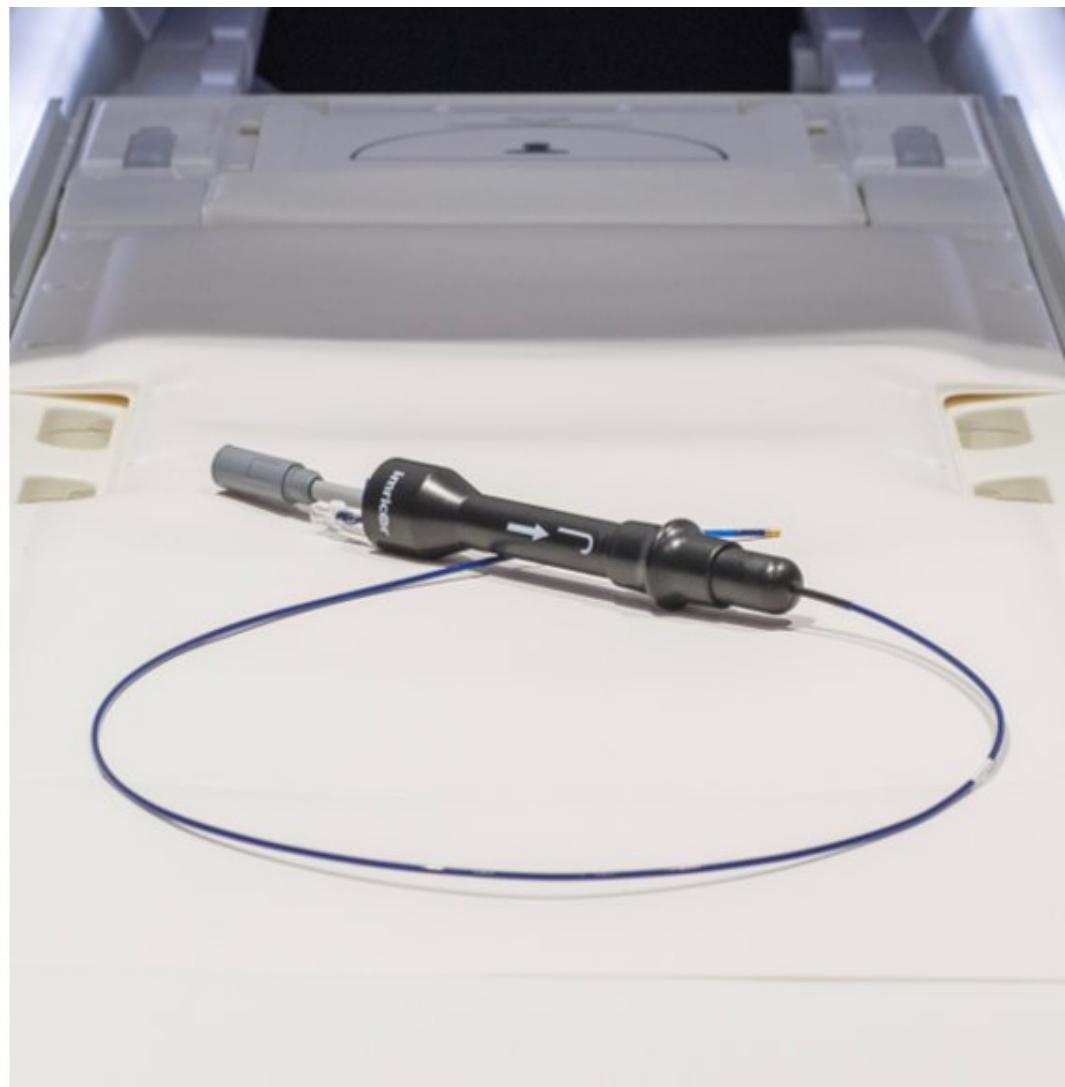


Perspectives

- CTI – Flutter - ablation
- Touch up after PVI
- His Ablation
- VT ablation
- Biopsies



The **first and only** company in the world with a commercially available MR conditional EP system and ablation catheter in the iCMR

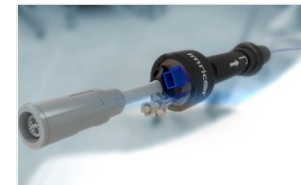
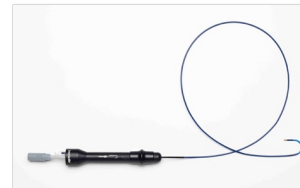


Advantage-MR™ EP Recorder / Stimulator System



- Provides the full functionality of an EP recording system within the MRI environment.
- Handles the display and recording of intracardiac electrograms, as well as pacing and tip temperature monitoring.

Vision-MR™ Ablation Catheter

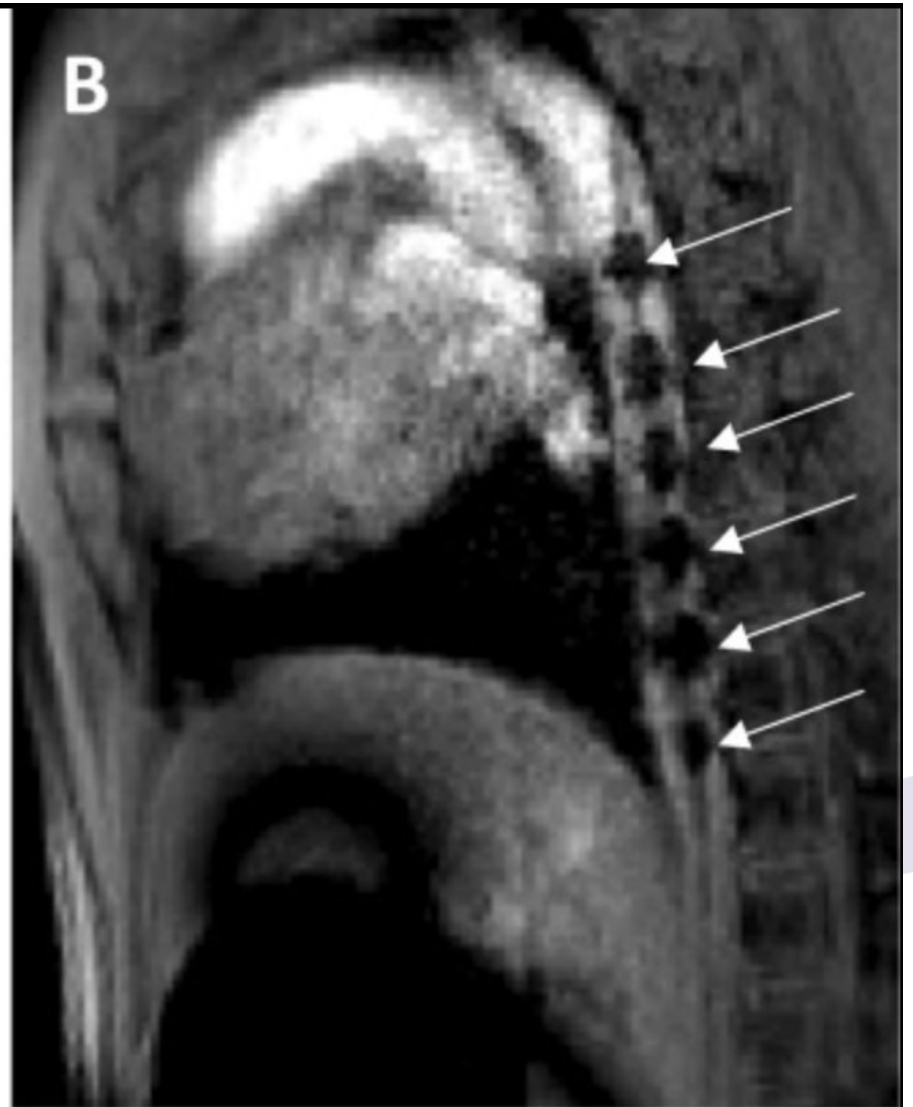


- MR-conditional single use ablation catheter
- 9 Fr. bipole irrigated-tip ablation catheter with two MR receive coils in the distal end for active MR tracking
- Contains patented technology that allows it to be used while the patient is being actively scanned with MRI.
- Fiber optic tip temperature sensing capabilities

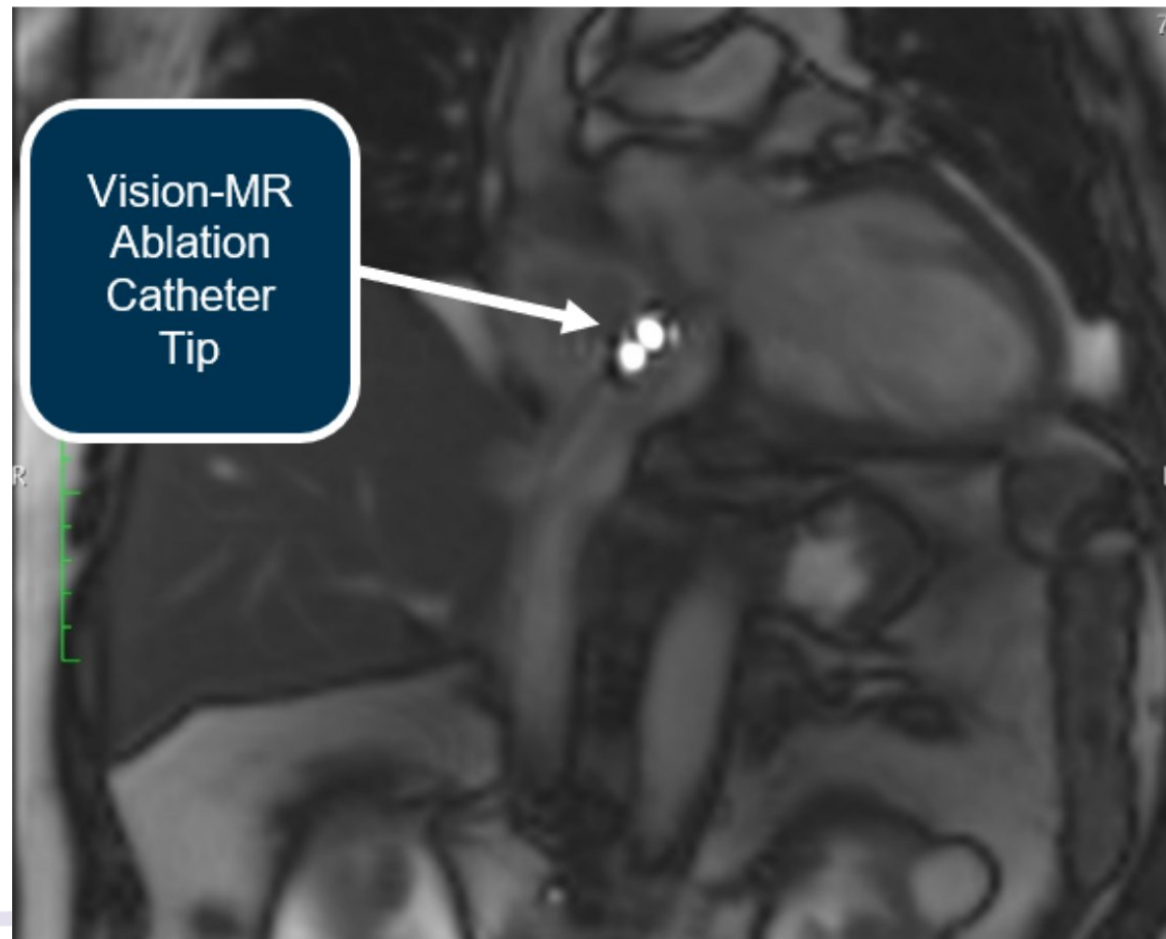
Caution: The Advantage-MR EP Recorder/Stimulator System has received CE mark approval; it has not yet been approved for use in the United States. The Vision-MR Ablation Catheter has been approved as an investigational device for clinical studies in Europe. All other Imricor products are not yet approved for use in humans.

Confidential: For internal use only

Passive tracking



Active tracking

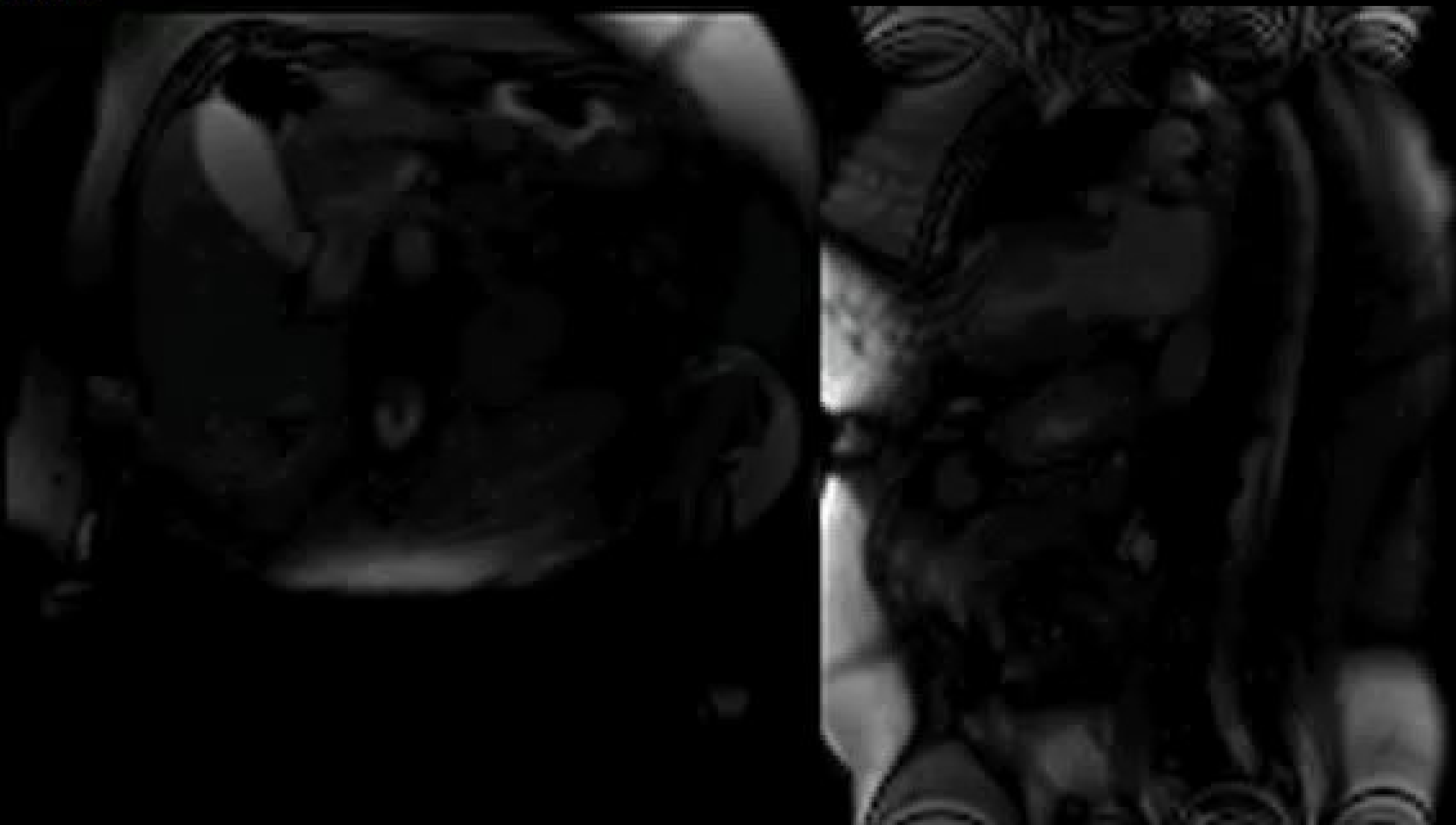




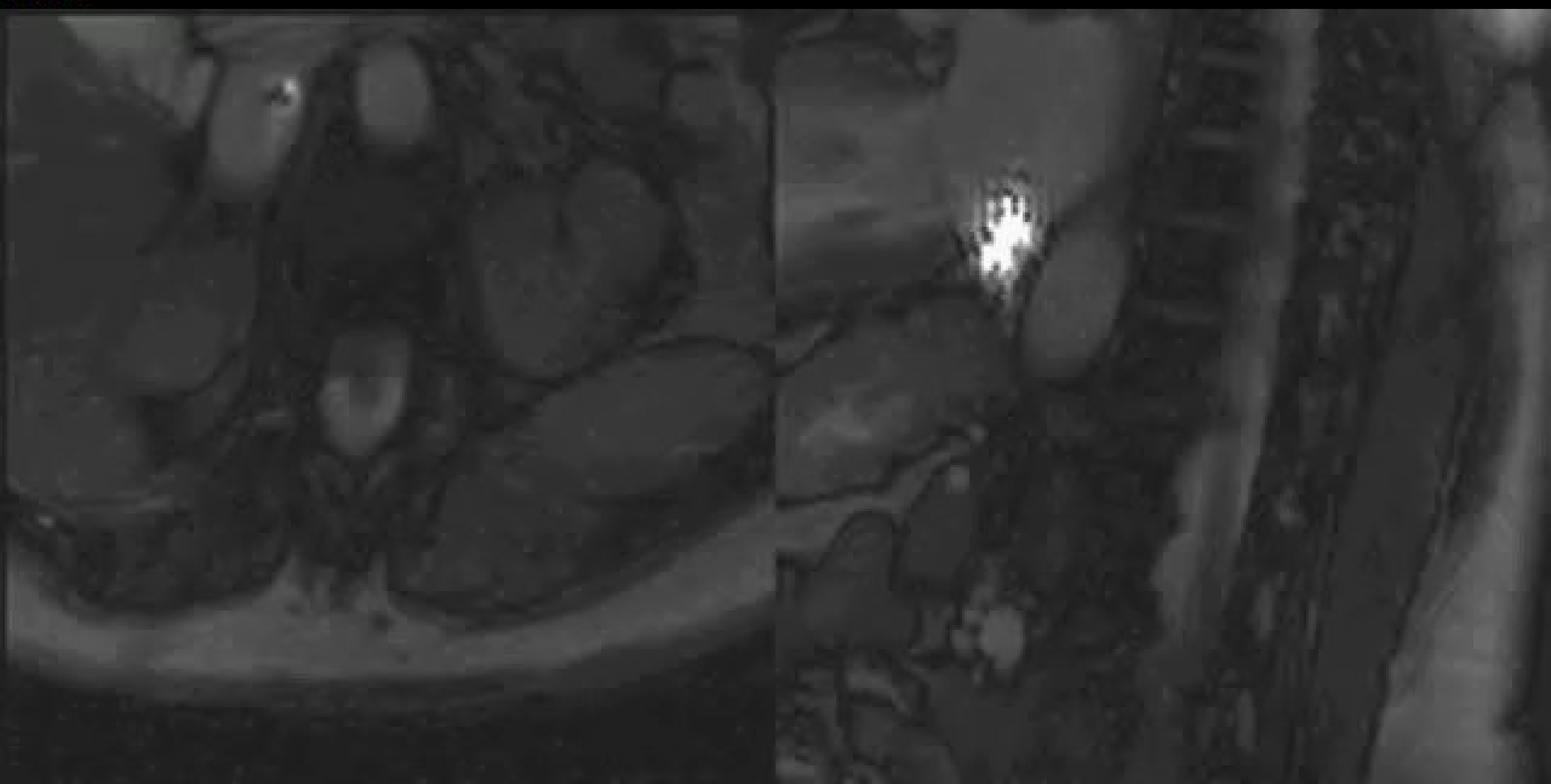
Clinical Cases

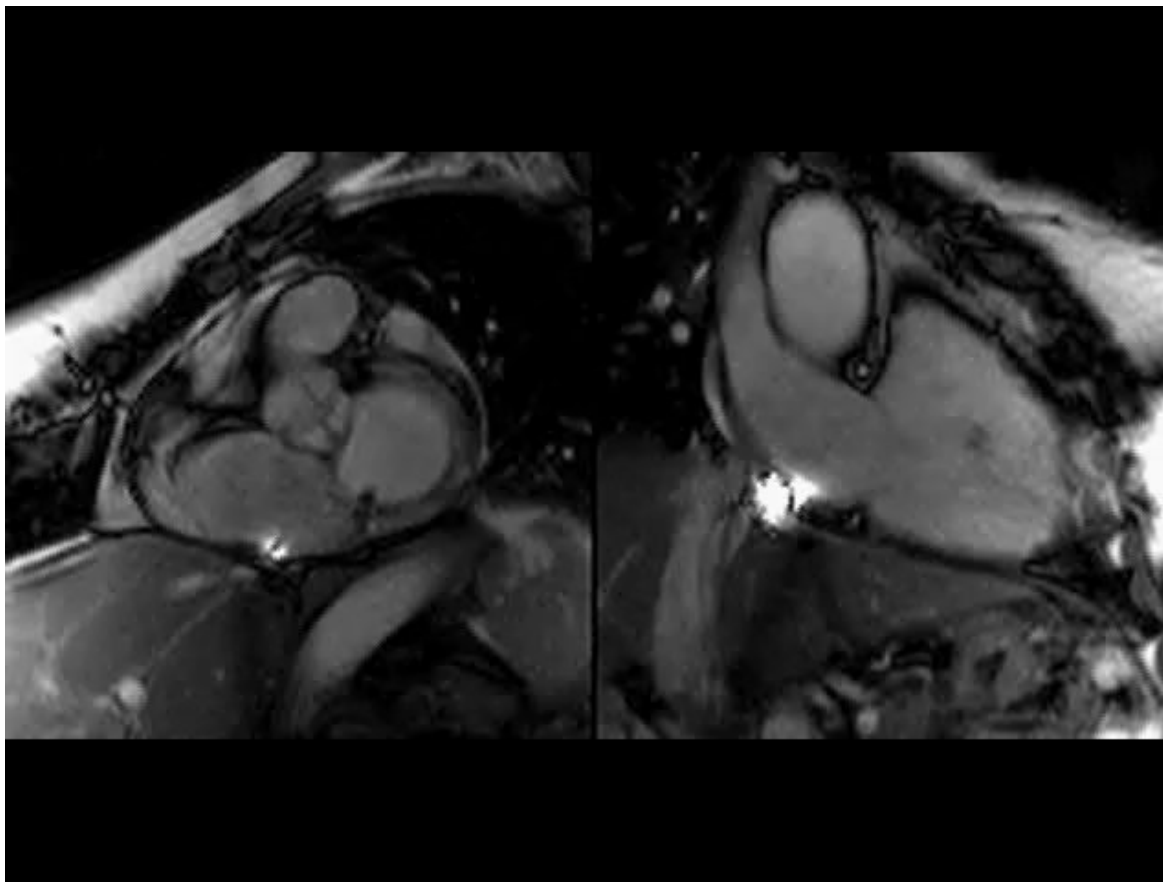


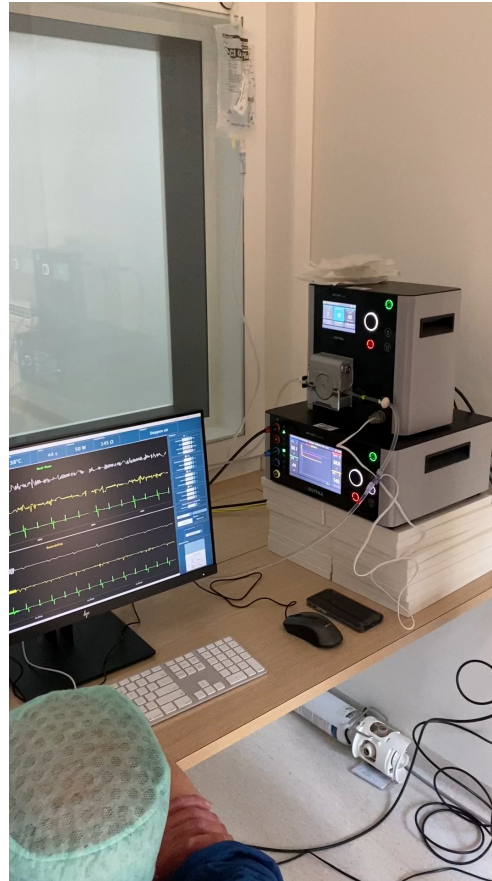
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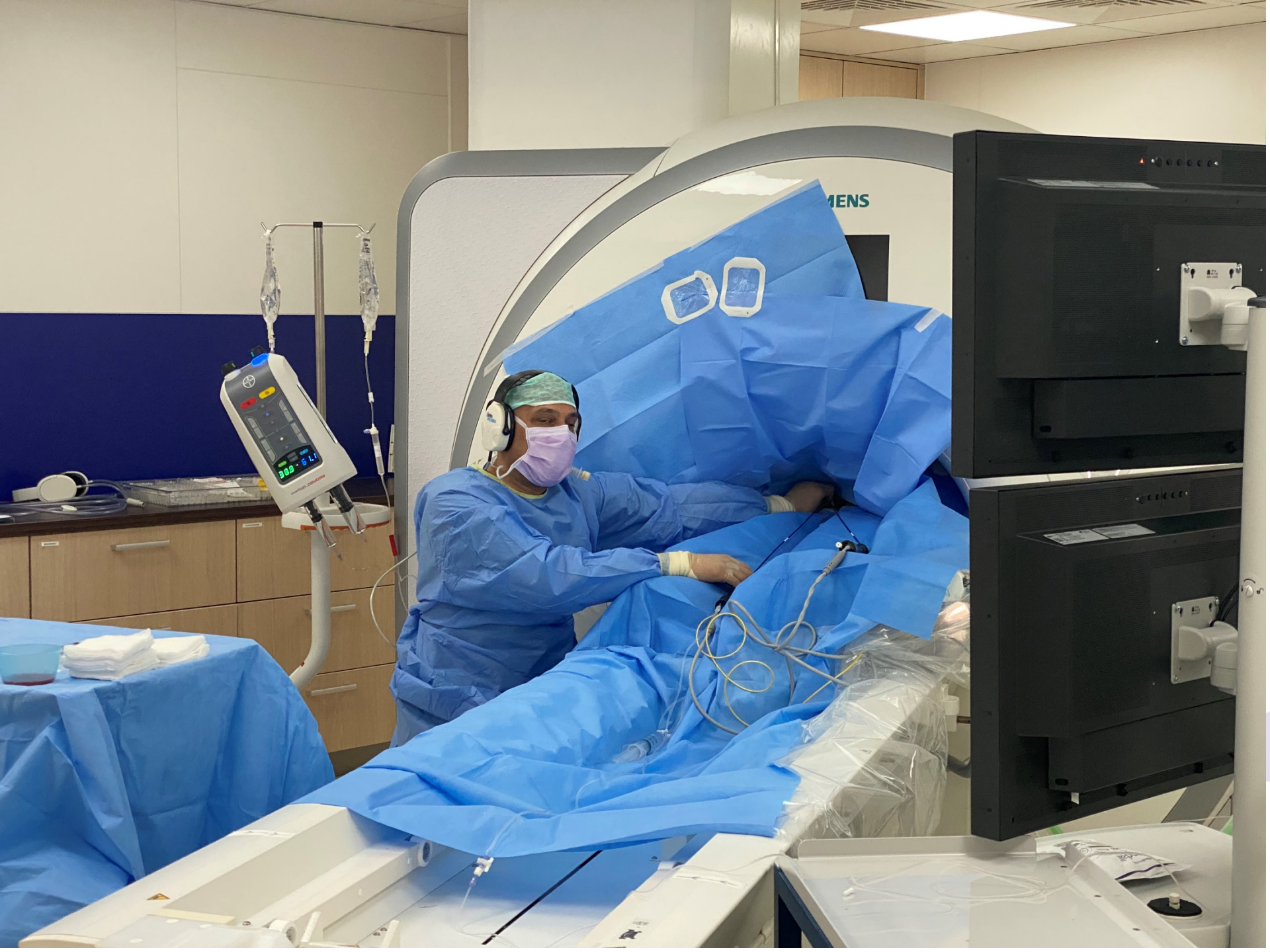














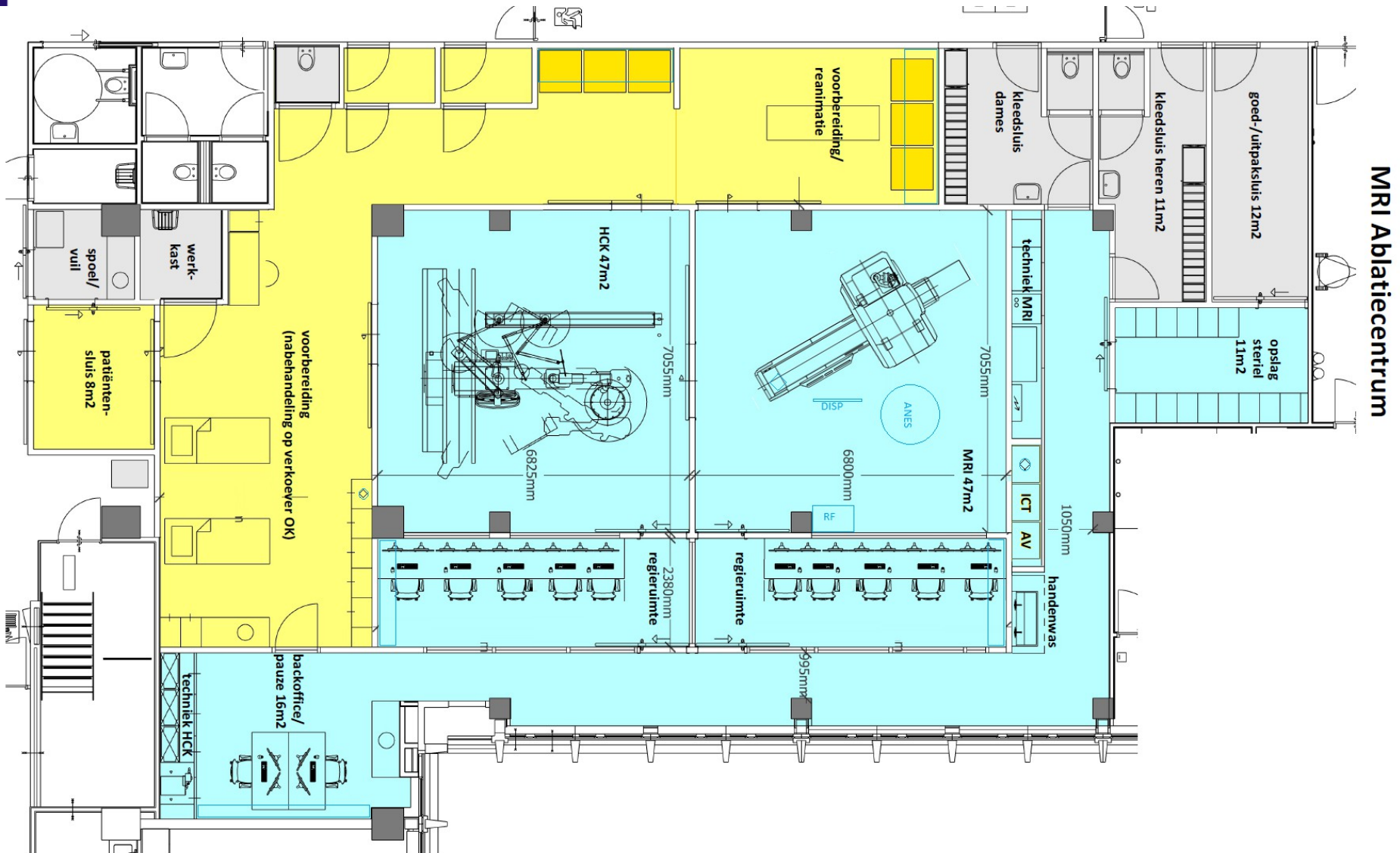




How to build an MRI EP lab

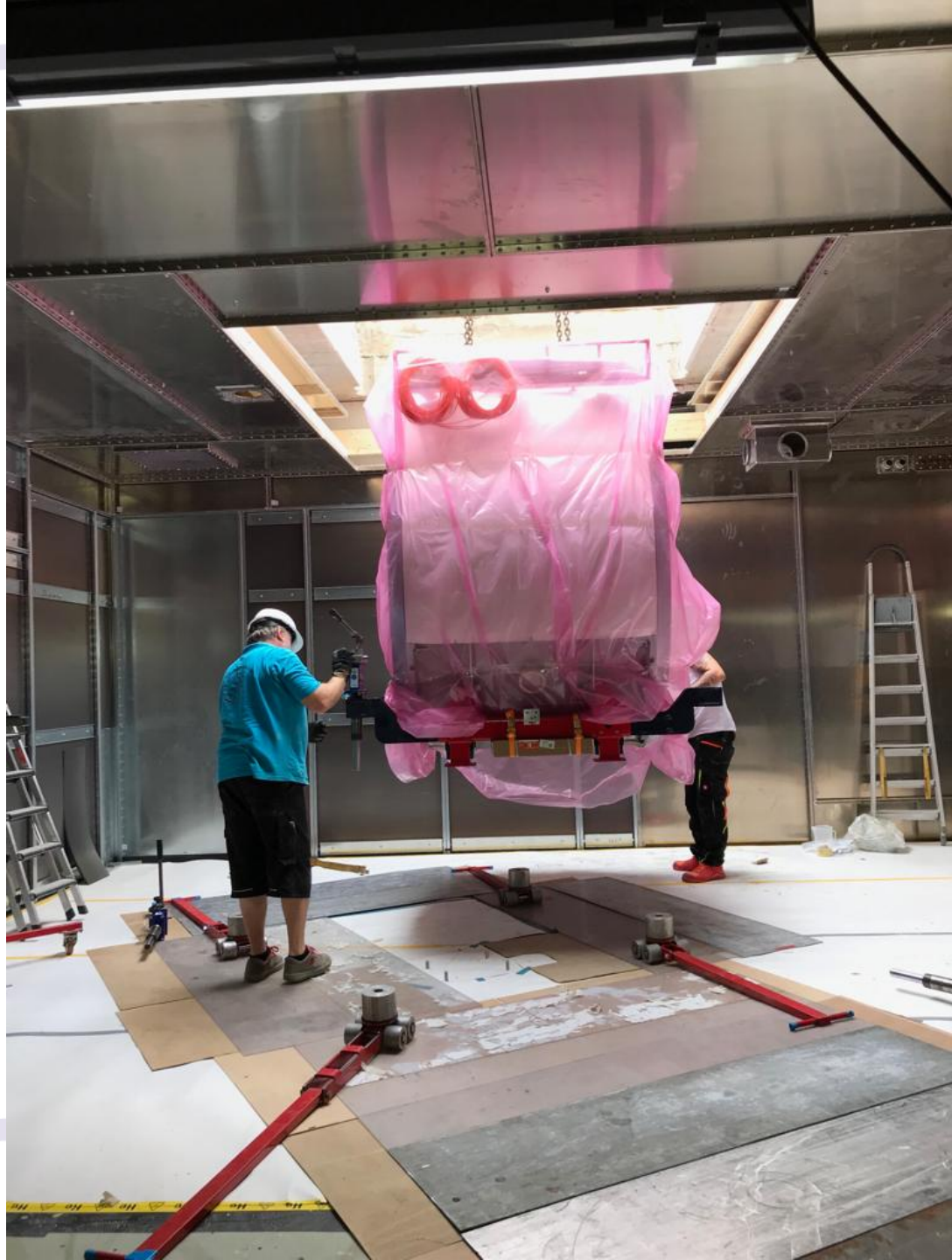


Setup of iCMR lab and program











SIEMENS

MAGNETOM Aera
A Timed Dose System







Questions?

- vanderbilt@cardionetworks.org