IMAGING TO FACILITATE VT ABATION IN STRUCTURAL HEART DISEASE

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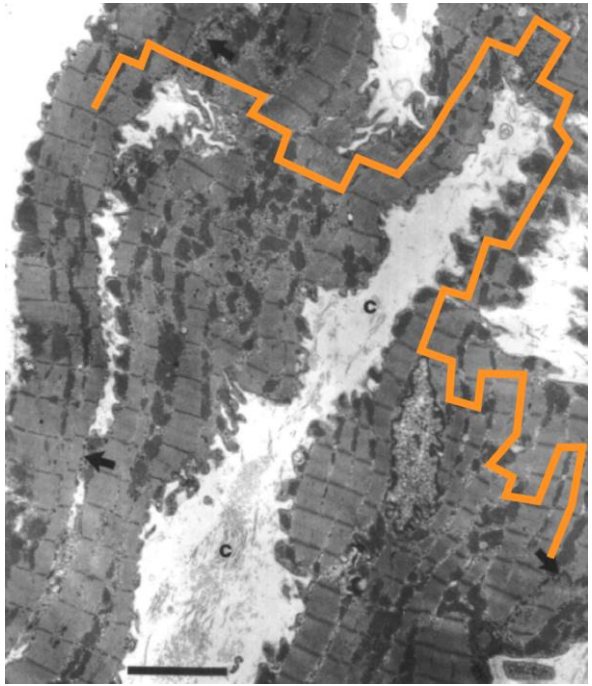
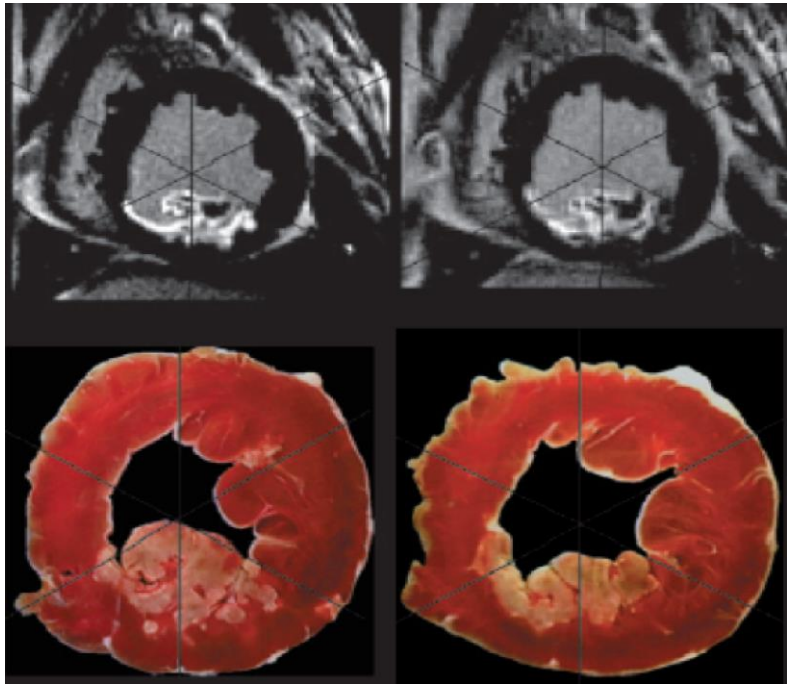
DISCLOSURES

Shareholder:	Co-founder of inHEART
Grant/Research Support:	Siemens Healthineers Guerbet Medtronic
Speaker/Consultant fees:	Siemens Healthineers Biosense Webster Boston Scientific Abbott Fineheart Farapulse

RATIONALE



Ursell PC et al.
Circ Res. 1985;56:436-51



Wagner A et al.
Lancet. 2003;361:374-9

IMAGING AND VT ABLATION

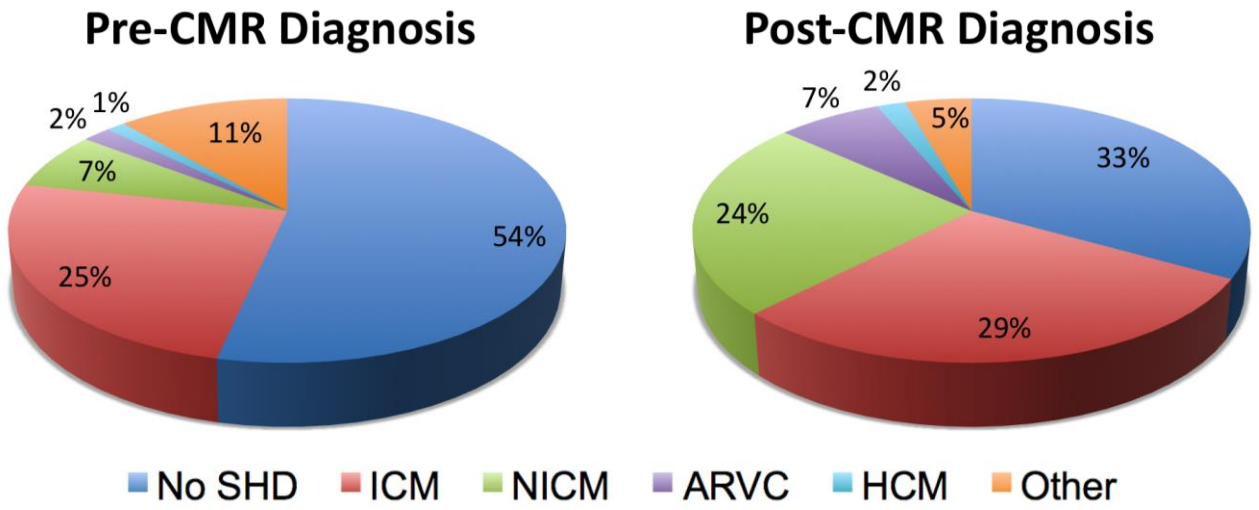
BEFORE THE PROCEDURE

DURING THE PROCEDURE

IMAGING TO IDENTIFY THE UNDERLYING ETIOLOGY

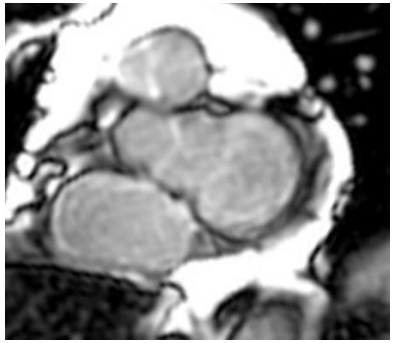
157 pts with VT or VF

CMR alters diagnosis in **38% of pts with** **no history of SHD**
negative echo & angio

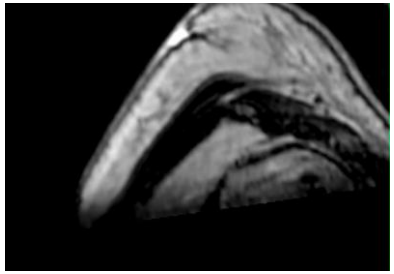


Hennig et al.
Eur Heart J Cardiovasc Imaging

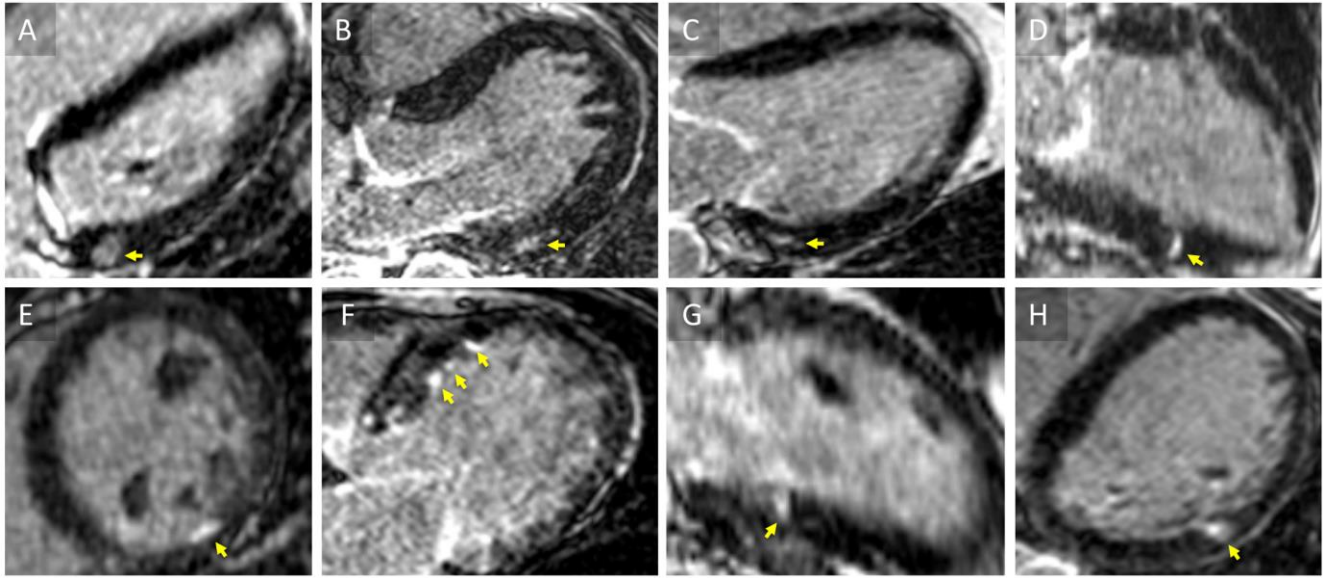
THE SMALLER THE PIXEL THE BETTER



CONVENTIONAL LGE



HIGH-RES. LGE

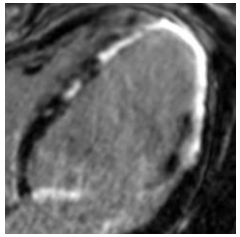


HIGH-RES LGE => better detection of SHD (17% à 38%, P<0.001).

Hennig et al.
Eur Heart J Cardiovasc Imaging

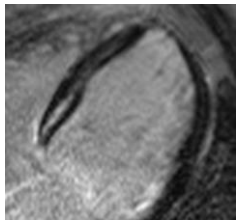
OTHER PRE-PROCEDURAL INFORMATION

ACCESS ROUTE



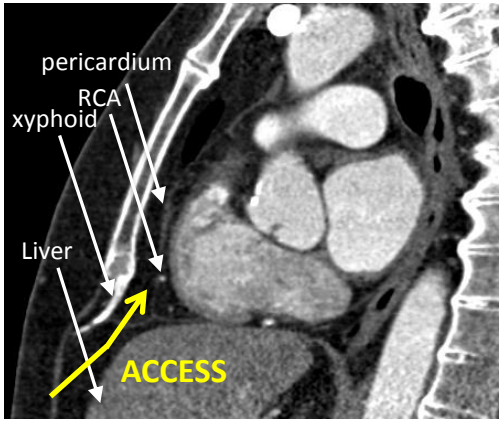
LV endo

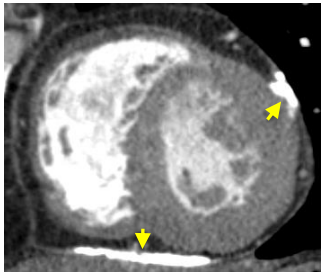
CS?
Epicardial?



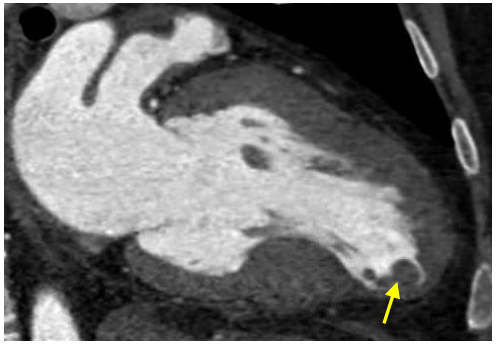
LV+RV endo?
Septal artery?

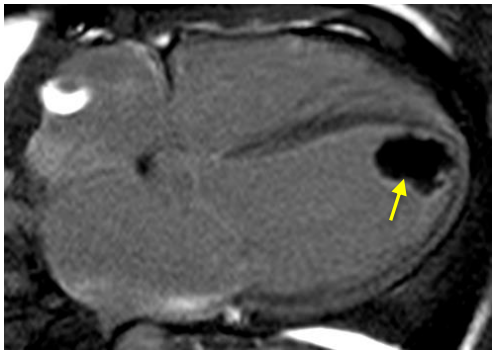
EPICARDIAL ACCESS





THROMBUS



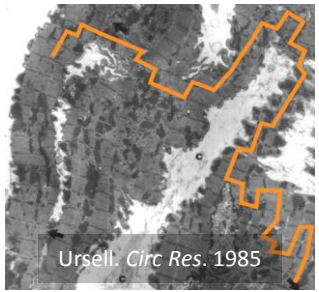


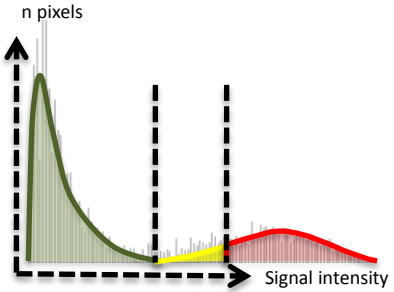
IMAGING AND VT ABLATION

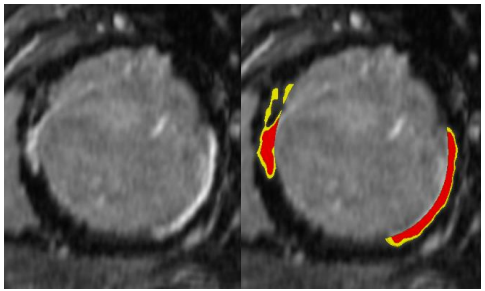
BEFORE THE PROCEDURE

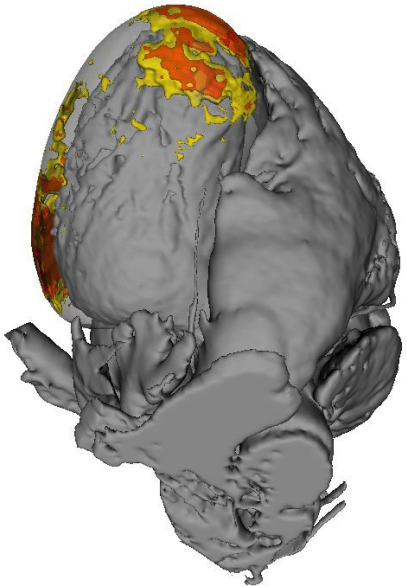
DURING THE PROCEDURE

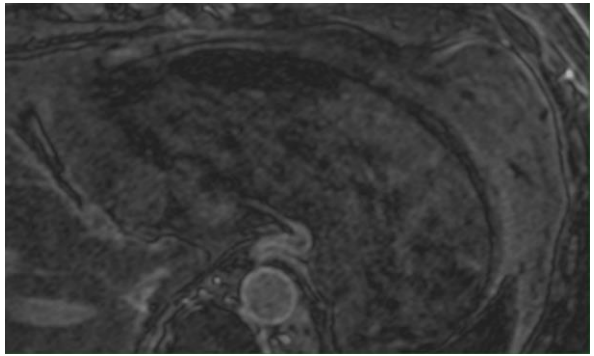
SUBSTRATE MAPPING FROM MRI:
LATE GADOLINIUM ENHANCEMENT

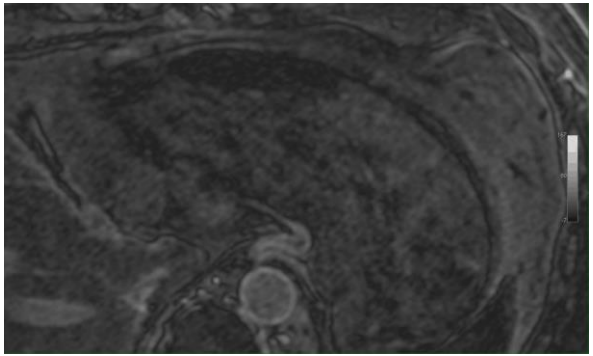






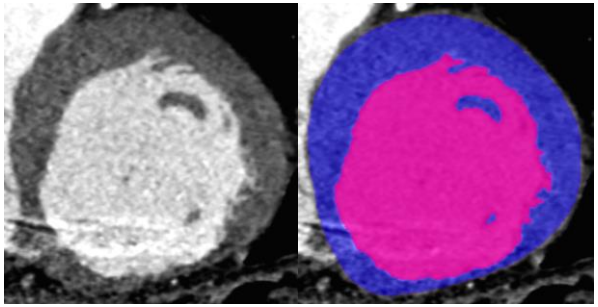




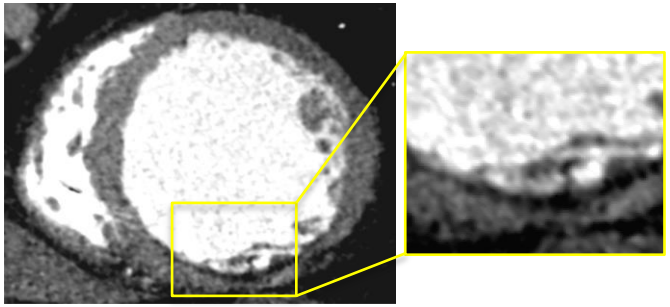


SUBSTRATE MAPPING FROM CT:
MULTI-PARAMETRIC

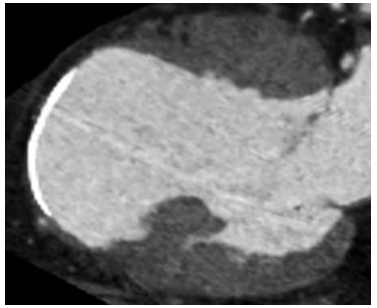
ARTERIAL



Wall thinning

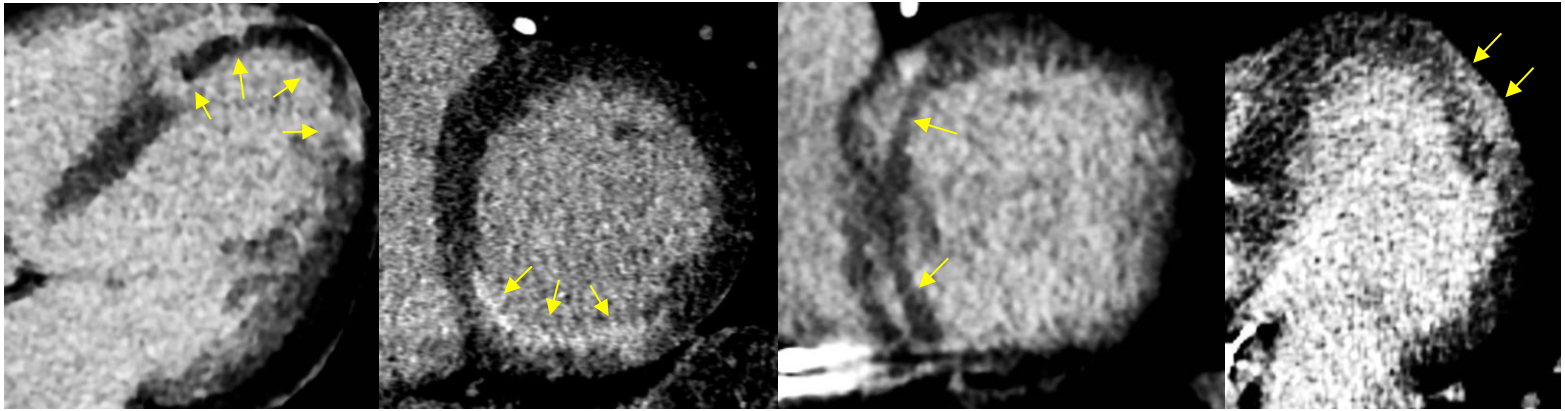


Fat



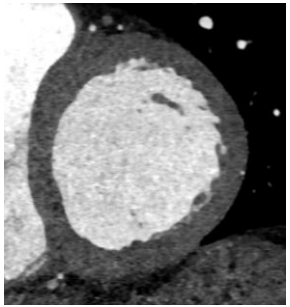
Calcification

LATE

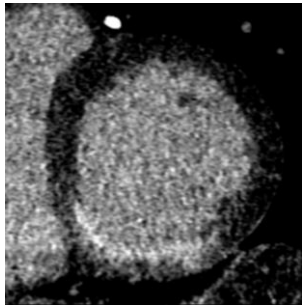


Late iodine enhancement

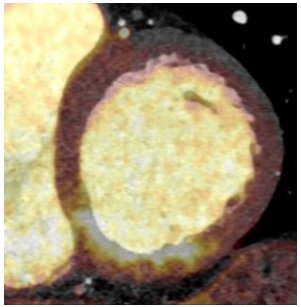
SUBSTRATE MAPPING FROM CT:
EXAMPLE IN POST-MI



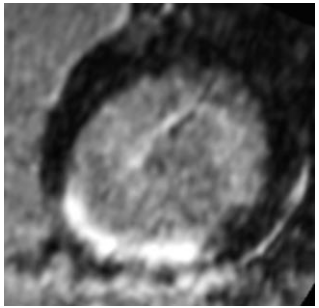
CT arterial



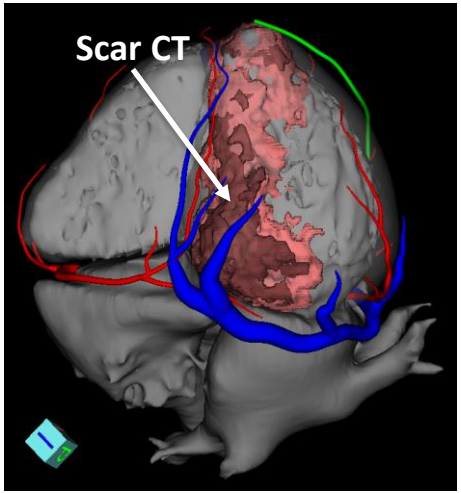
CT late

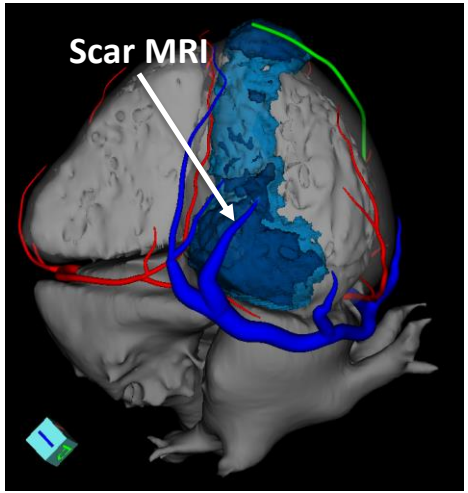


Fusion

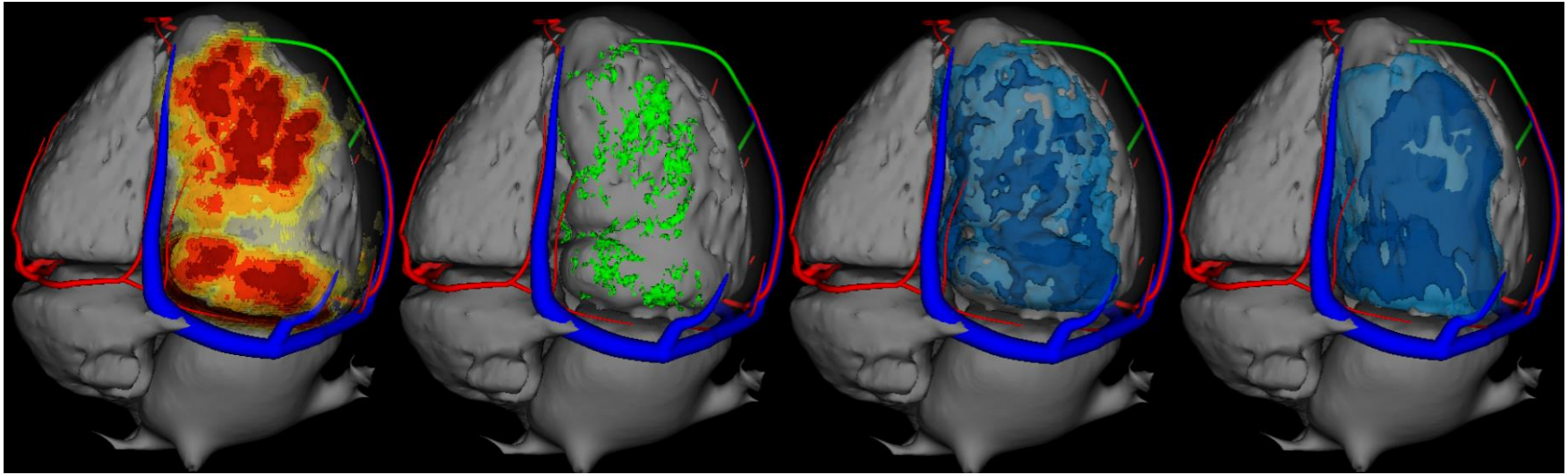


MRI





SUBSTRATE MAPPING FROM CT:
EXAMPLE IN POST-MI



CT-thickness

mm
< 1
< 2
< 3
< 4
< 5

CT-fat

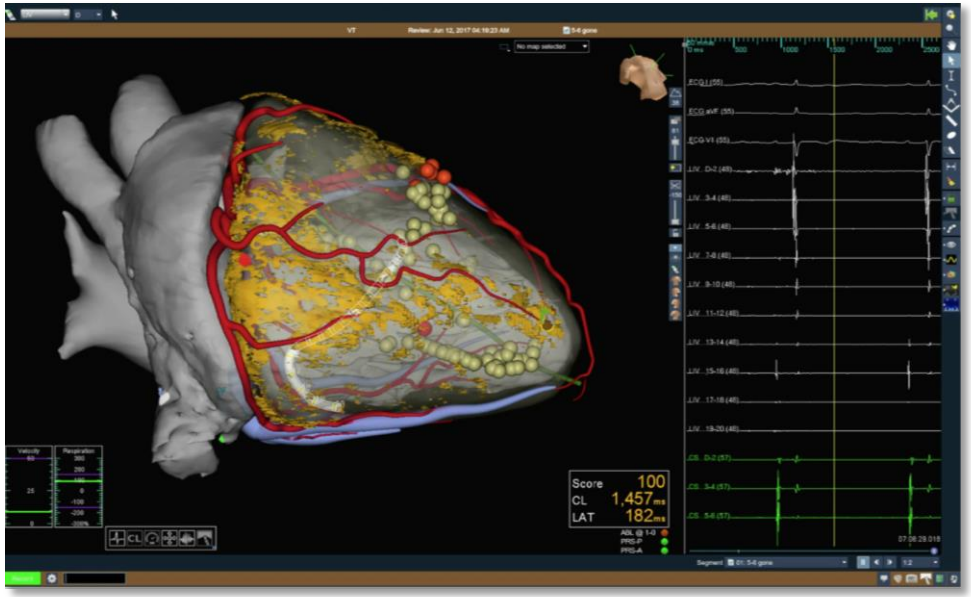
CT-late iodine

Dense scar
Grey zone

MR-late gadolinium

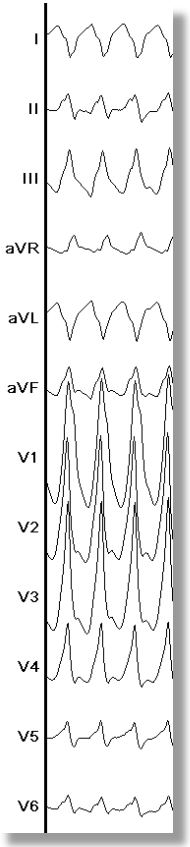
Dense scar
Grey zone

PROCEDURAL INTEGRATION

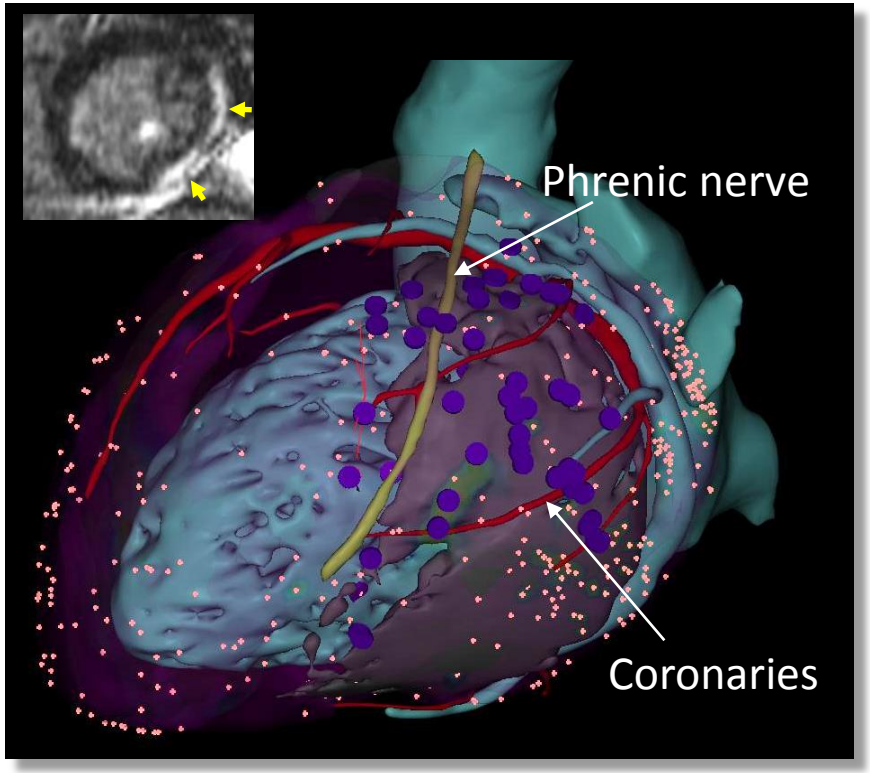


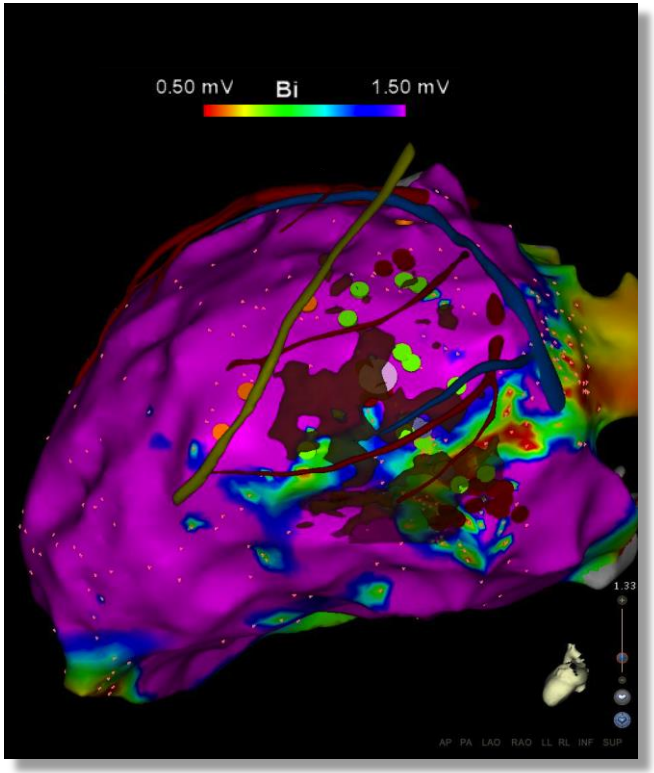
Improved efficacy
Shorter procedures
Simpler & more standardized procedures

IMAGE-GUIDED VT ABLATION



42 yo man with monomorphic VT of suspected epicardial exit.





MUSIC VT NETWORK

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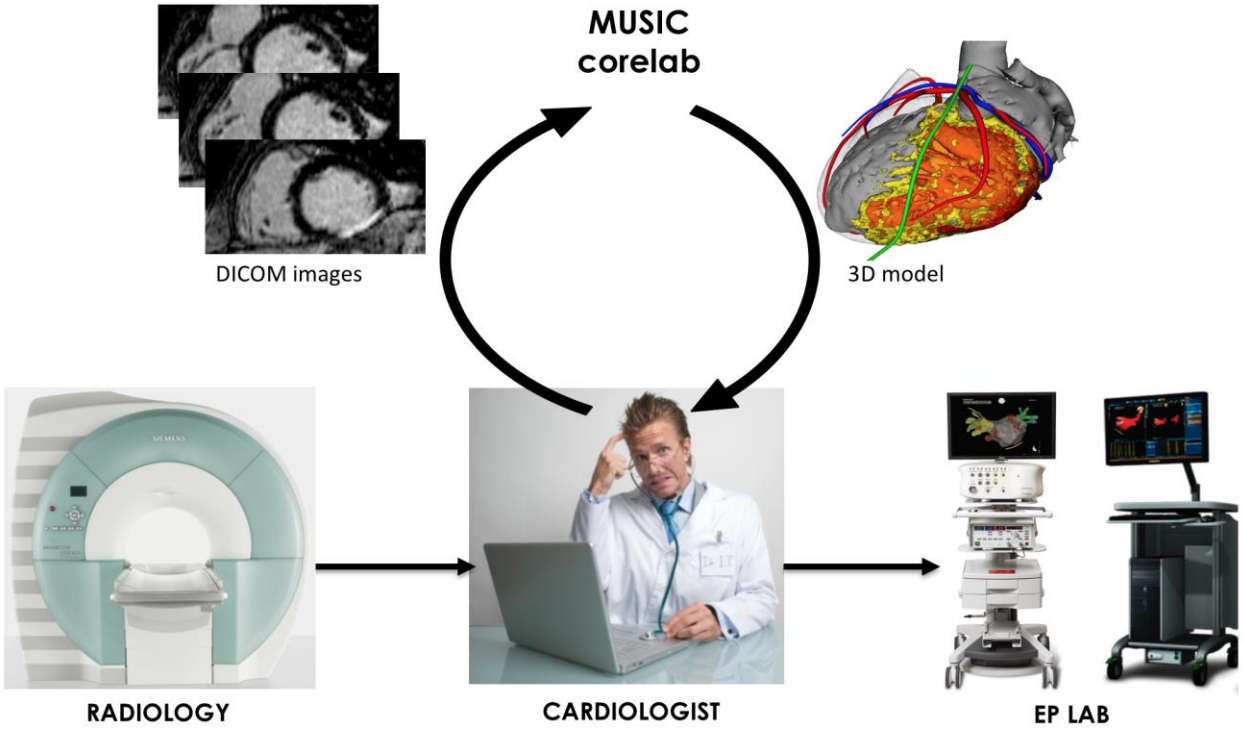


MUSIC VT NETWORK

30 centres, 1200 patients

Outcome at 1 year:

➡ **Post-MI VT**

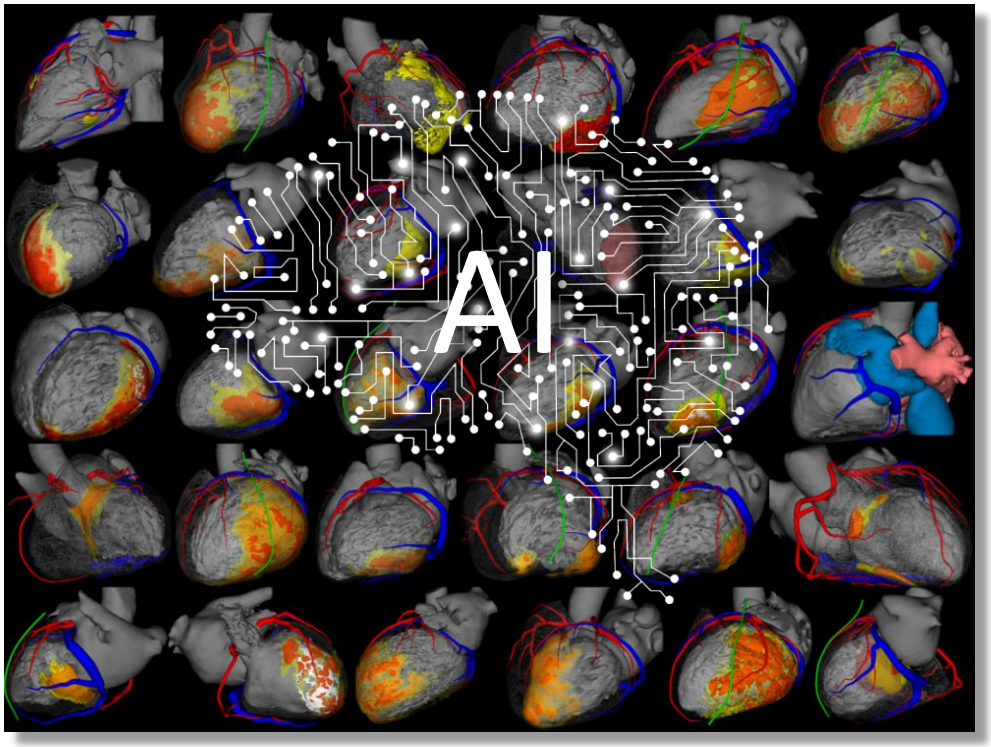
VT-FREE SURVIVAL **79%**

DEATH **2,9%**

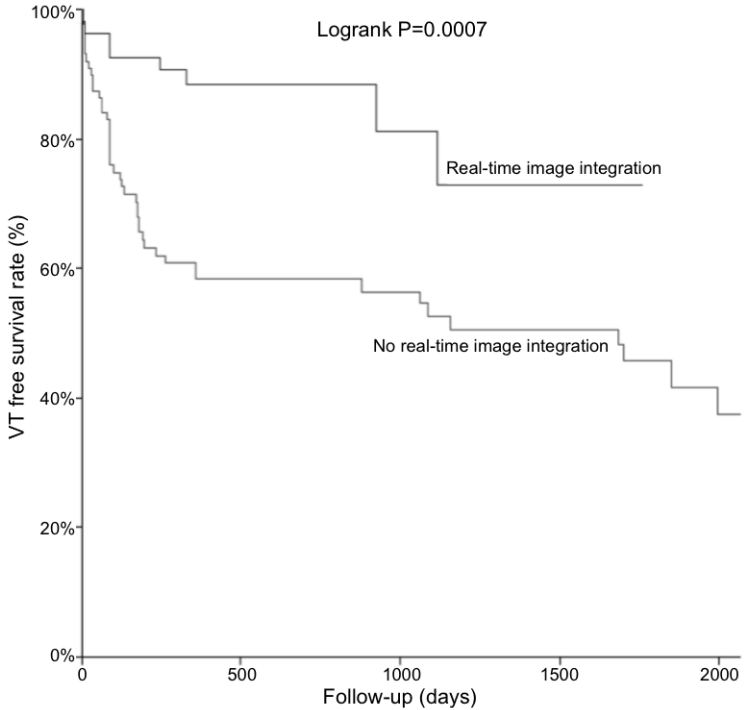
➡ **Non-ischemic VT**

VT-FREE SURVIVAL **65%**

DEATH **2,8%**



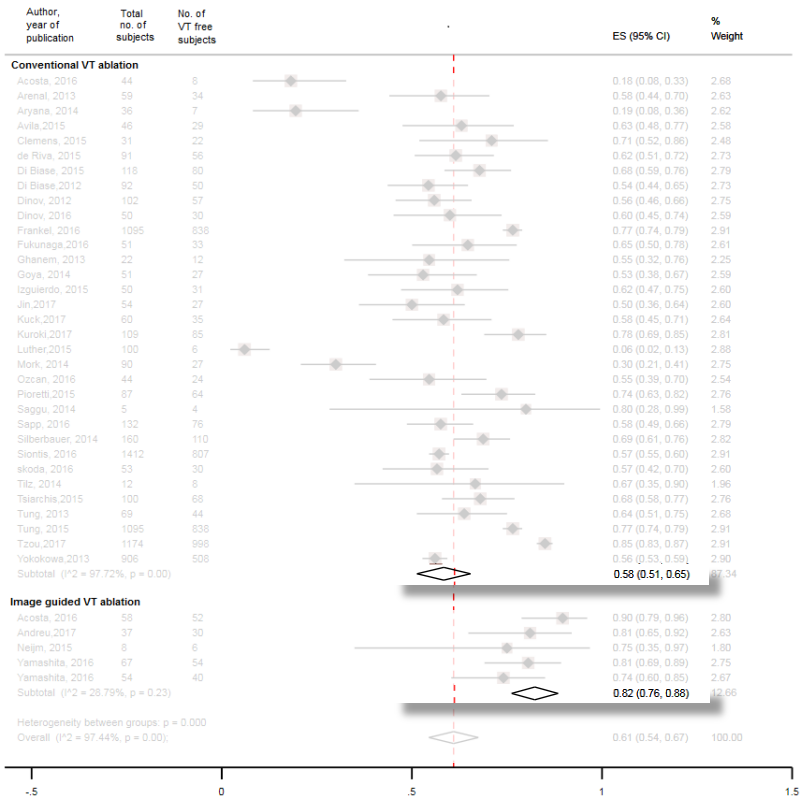
IMPACT ON OUTCOME



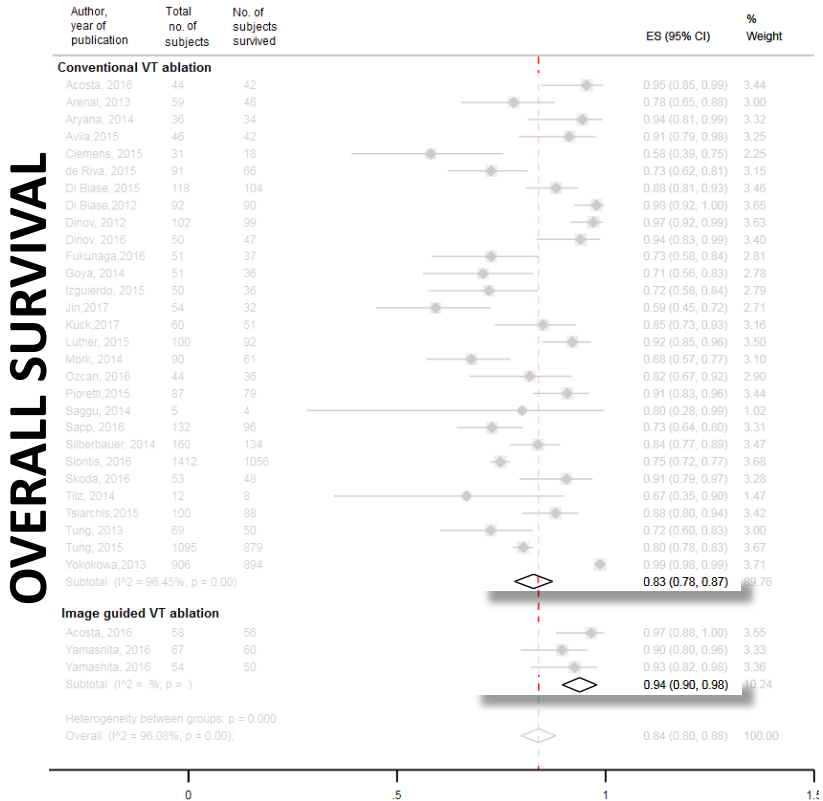
Yamashita S et al. Circ Arrhythm Electrophysiol. 2016 Jul;9(7).

IMPACT ON OUTCOME

VT-FREE SURVIVAL



OVERALL SURVIVAL



Hendriks. EP Europace. 2017 Jun;19(3):483.

IMAGE INTEGRATION STRATEGY

CURRENT: IMAGING TO GUIDE MAPPING

Improved anatomy and substrate definition

- Impact on procedure time +
- Impact on efficacy +

SOON: IMAGING TO DEFINE ABLATION TARGETS

Dedicate the entire procedure to ablation

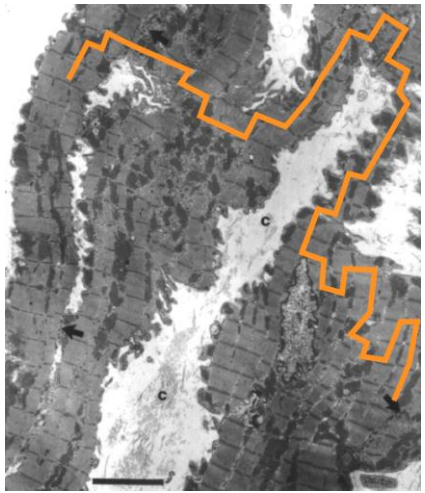
- Impact on procedure time +++
- Impact on efficacy +++
- Simplification / standardization of procedures +++

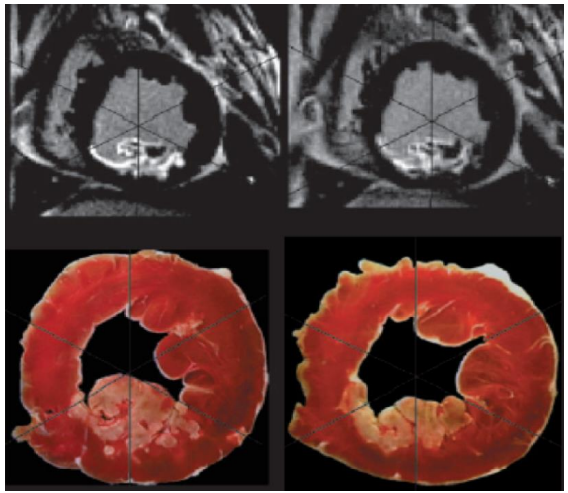
LIMITATIONS OF CMR

Scar-related VT substrate

Surviving fibers within scar

Ursell PC et al. Circ Res. 1985





CMR

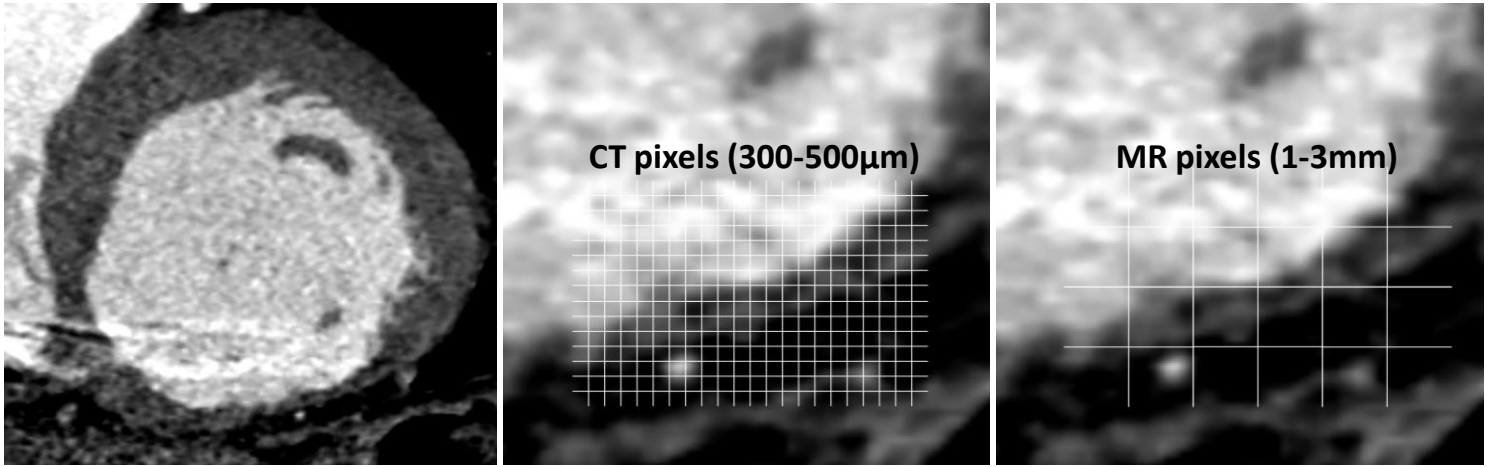
"Gold Standard »

Wagner A et al. Lancet. 2003

CMR ISSUES

- ICD artifacts
- Availability of high-res LGE methods
- Limited spatial resolution (even if high-res…)

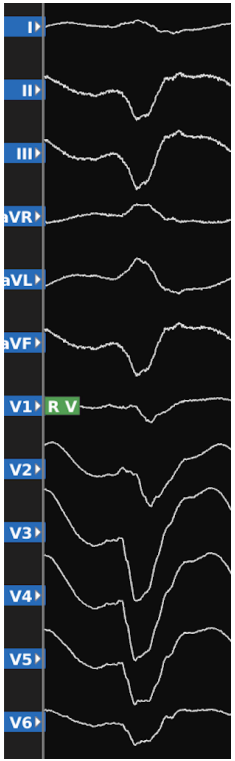
SOLUTION
CT-BASED SUBSTRATE MAPPING



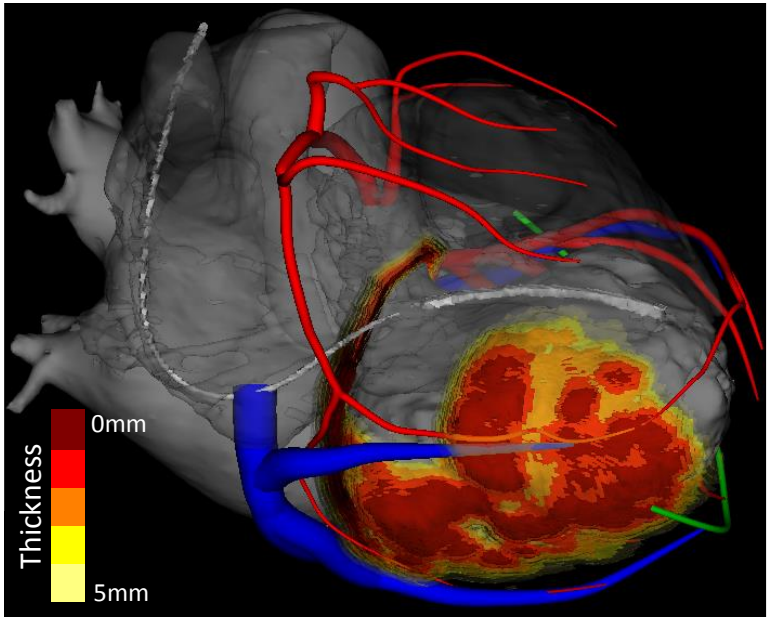
HYPOTHESIS: in chronic infarcts, surviving fibers within scar are more likely present in areas of relatively preserved thickness, while very thin areas will act as conduction block.

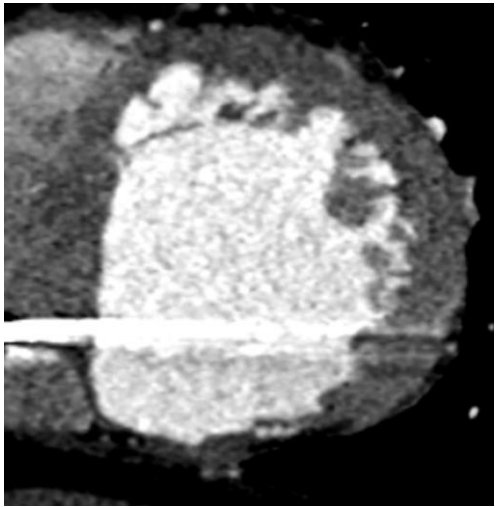
➡ **Mapping thickness within scar can help predict critical VT isthmuses**

CT-THICKNESS CHANNELS
EXAMPLES

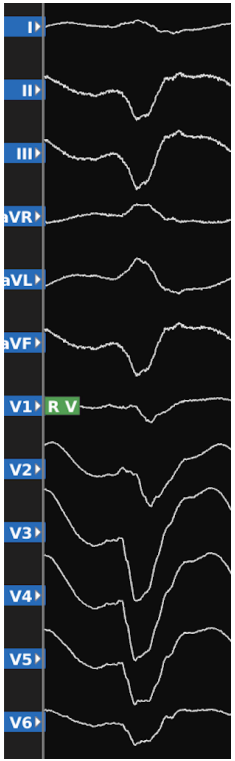


63 yo man with prior infarct in RCA territory
Multiple ICD shocks on monomorphic VT





CT-THICKNESS CHANNELS
EXAMPLES



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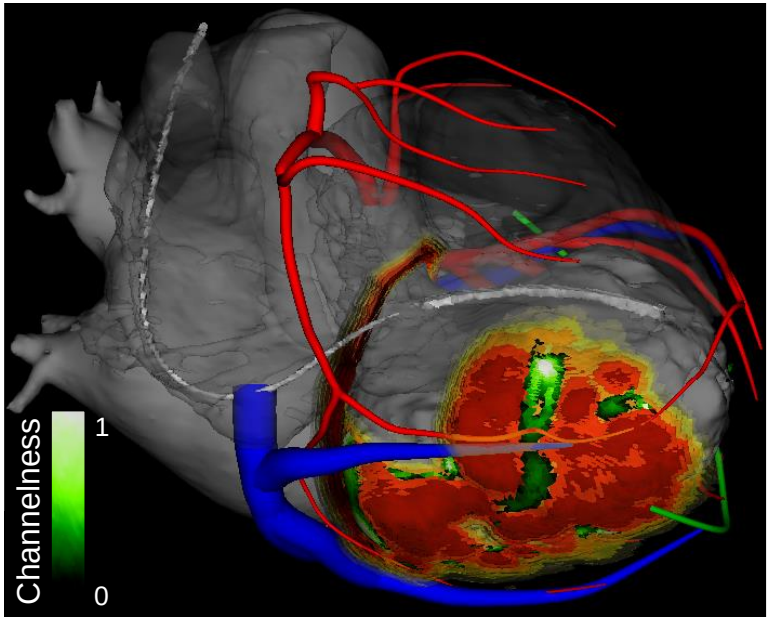
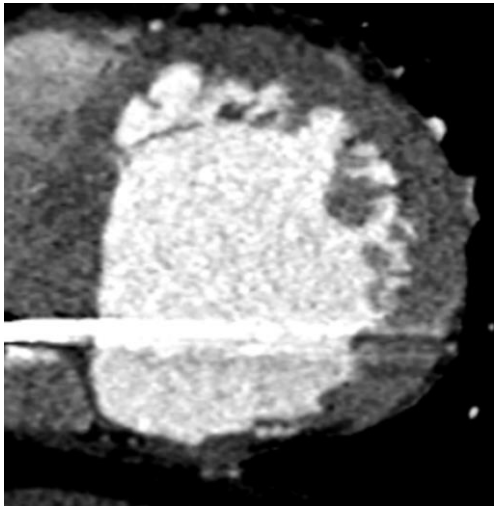
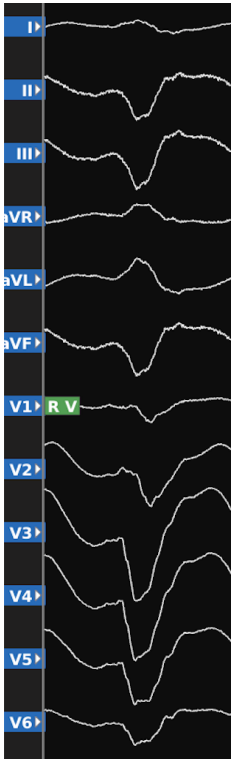




CT-THICKNESS CHANNELS
EXAMPLES



63 yo man with prior infarct in RCA territory
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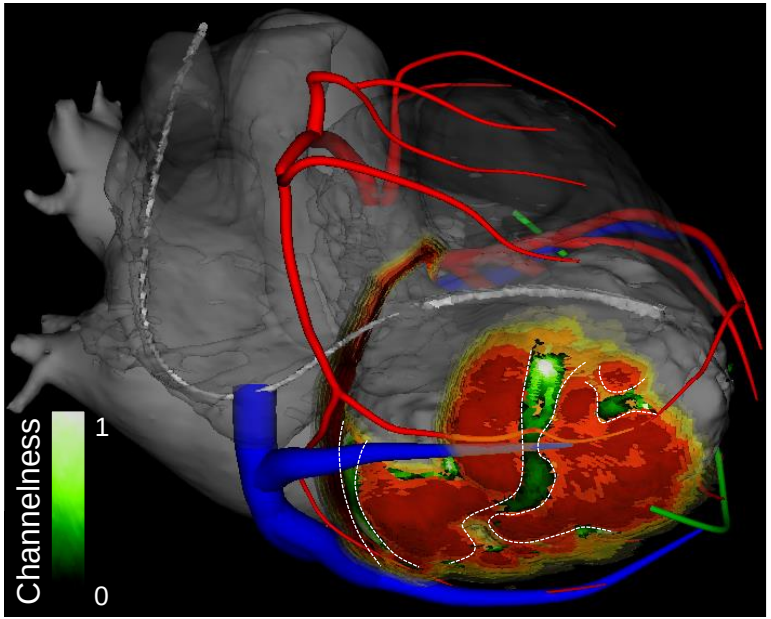
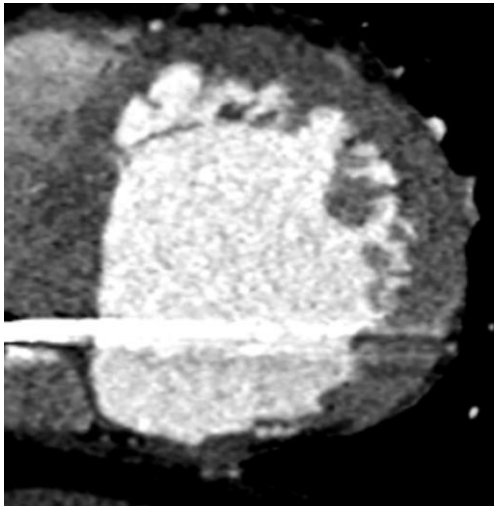
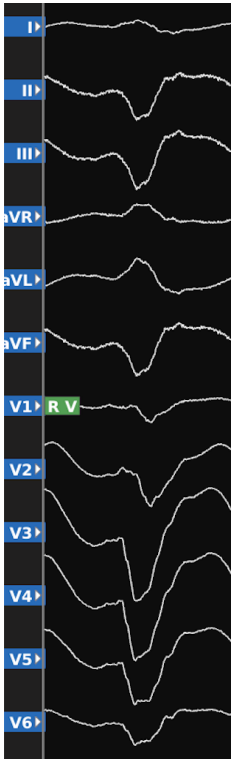
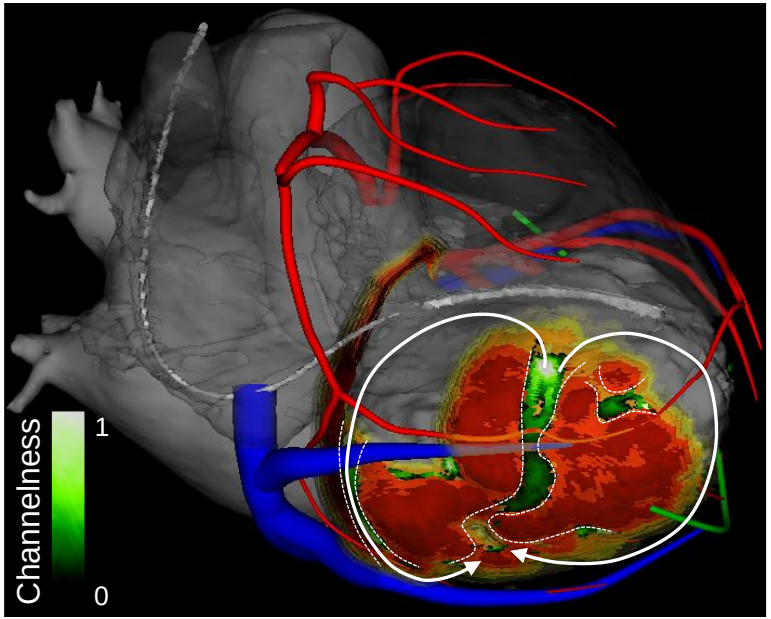


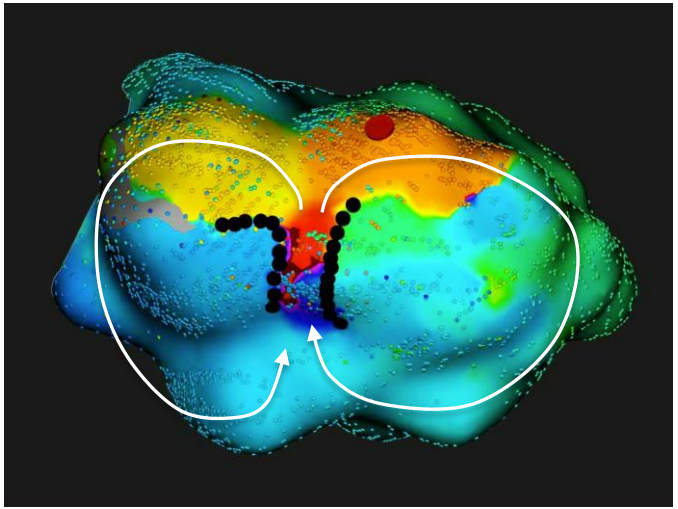


CT-THICKNESS CHANNELS
EXAMPLES



63 yo man with prior infarct in RCA territory
Multiple ICD shocks on monomorphic VT

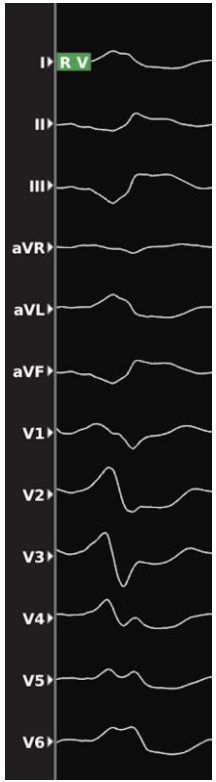


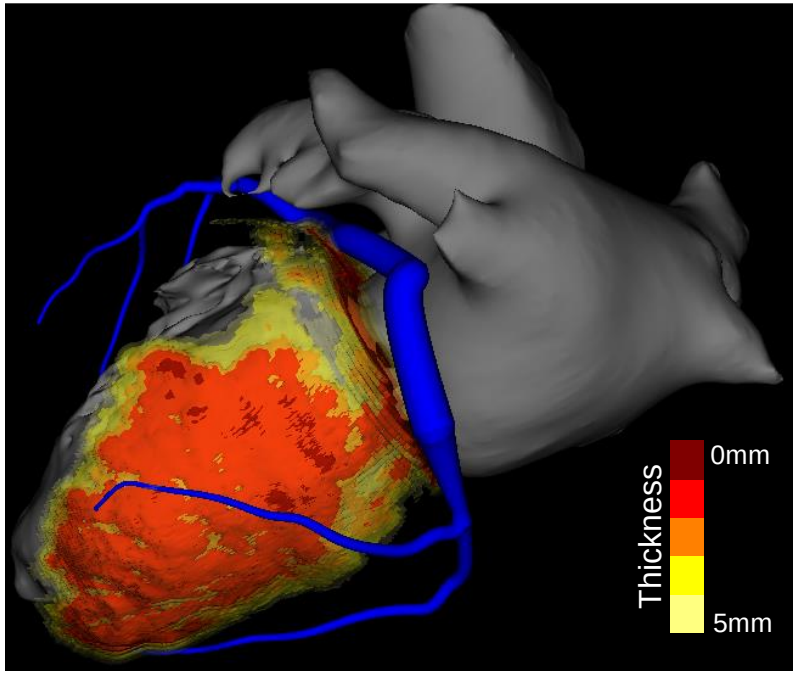


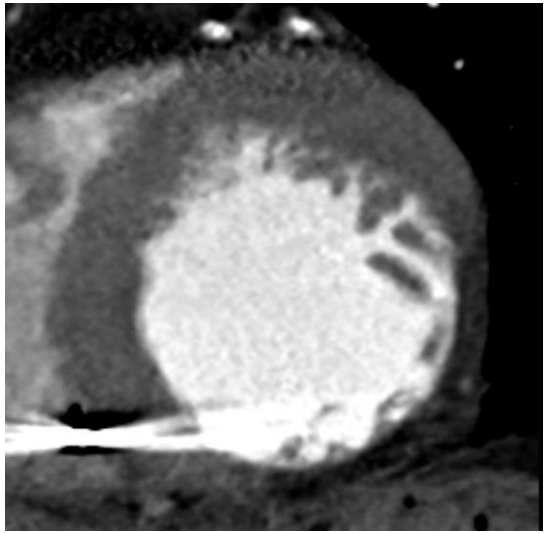
ENDOCARDIAL VT ACTIVATION MAP

CT-THICKNESS CHANNELS
EXAMPLES

62 yo man with prior infarct in CX territory
Multiple ICD shocks on monomorphic VT of RBBB morphology

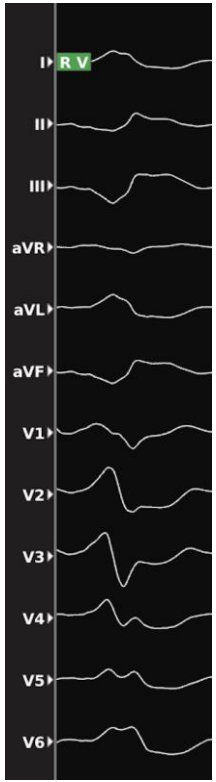


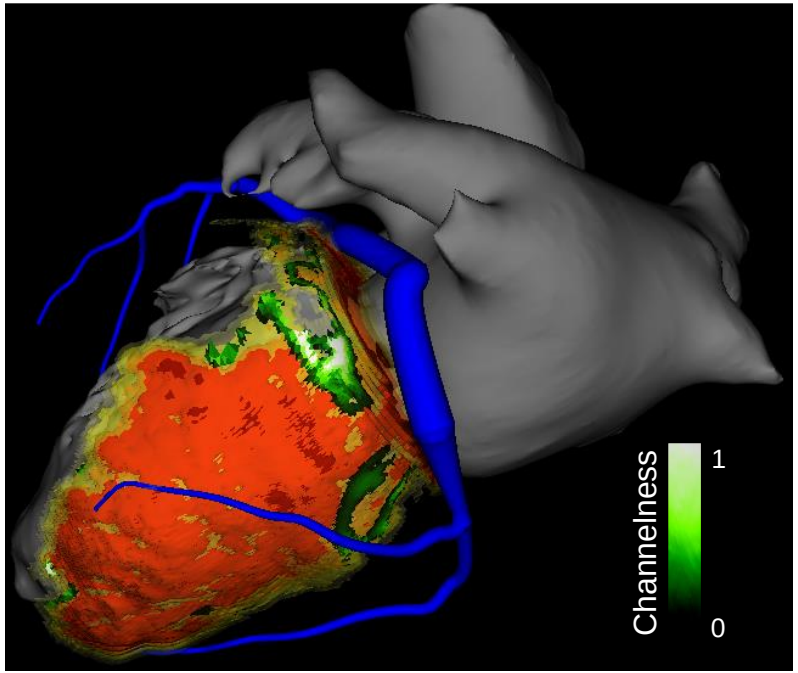


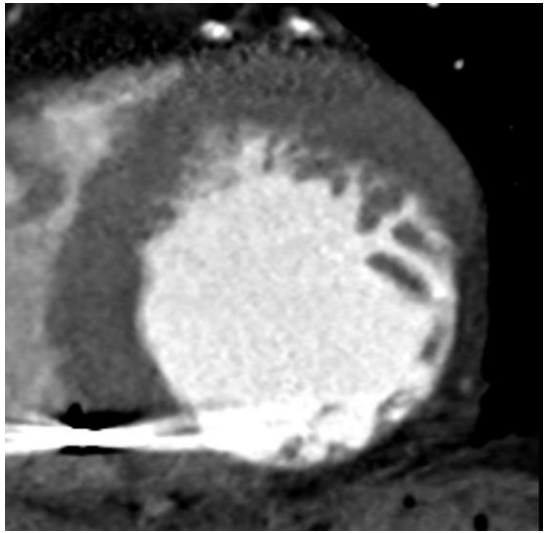


CT-THICKNESS CHANNELS
EXAMPLES

62 yo man with prior infarct in CX territory
Multiple ICD shocks on monomorphic VT of RBBB morphology







CT-THICKNESS CHANNELS
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62 yo man with prior infarct in CX territory
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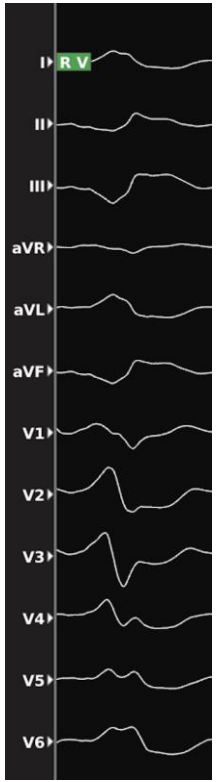

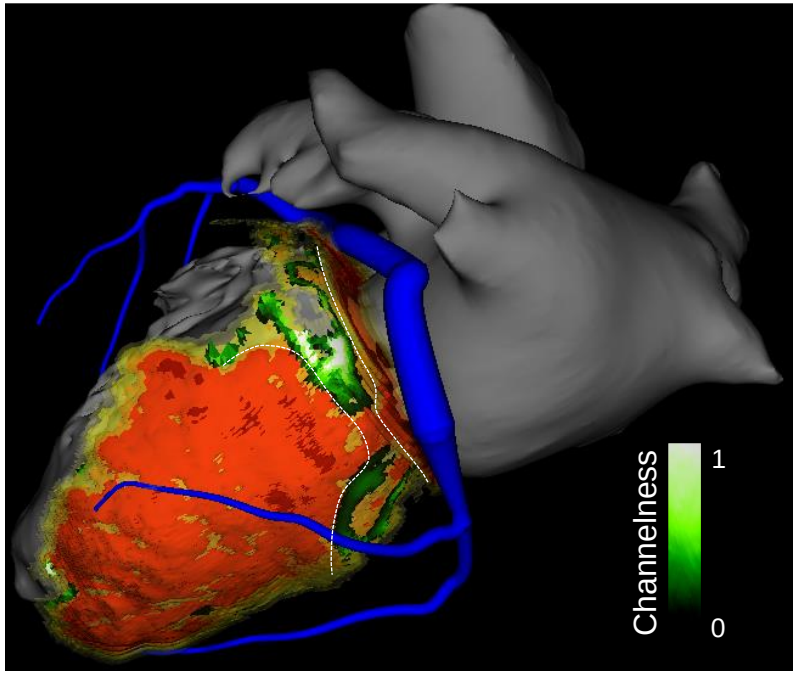

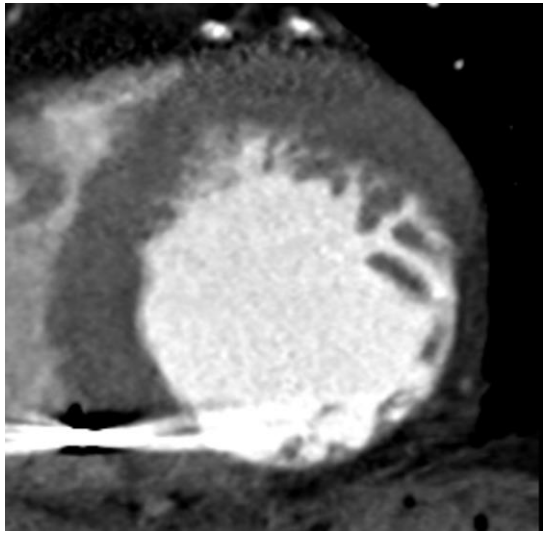

CT-THICKNESS CHANNELS
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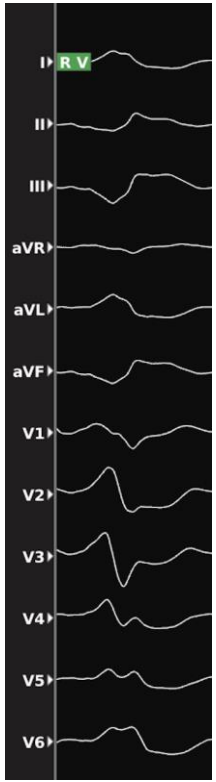
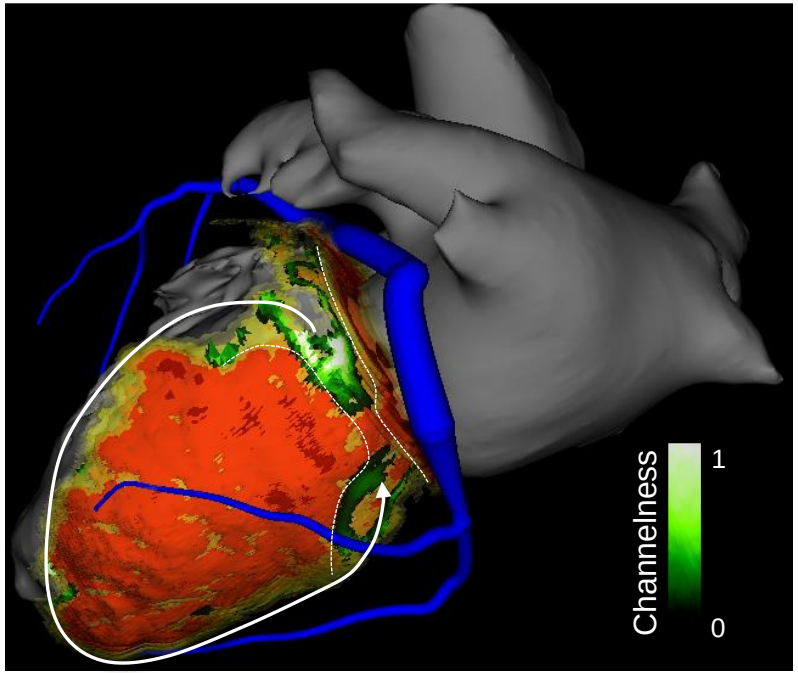
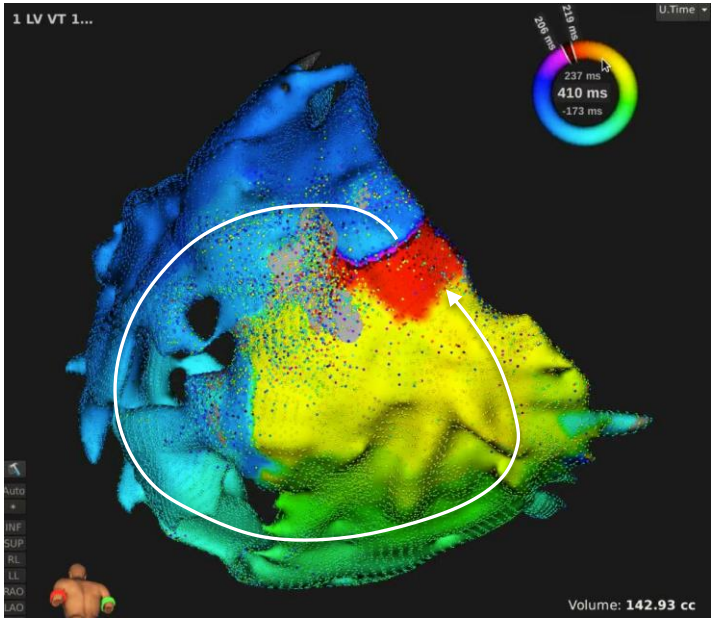
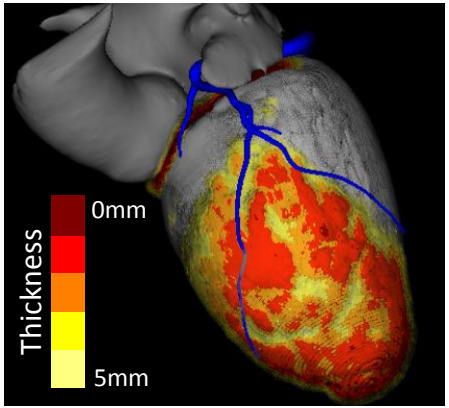


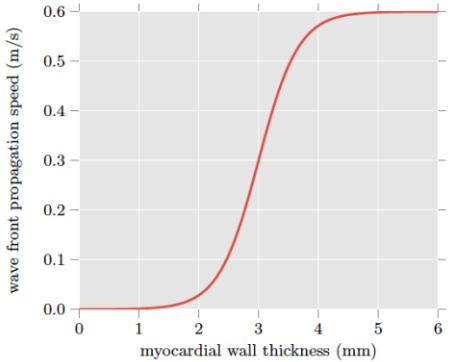




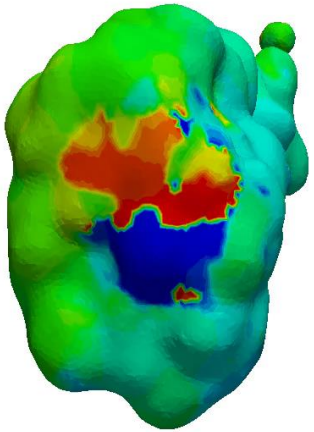
EPICARDIAL VT ACTIVATION MAP

PERSPECTIVE
CT-BASED SIMULATION OF VT

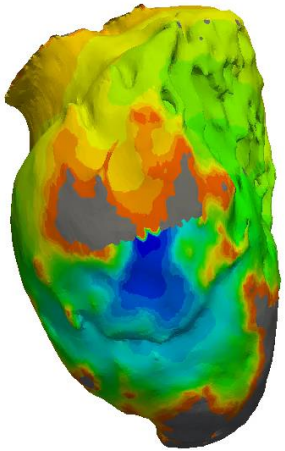




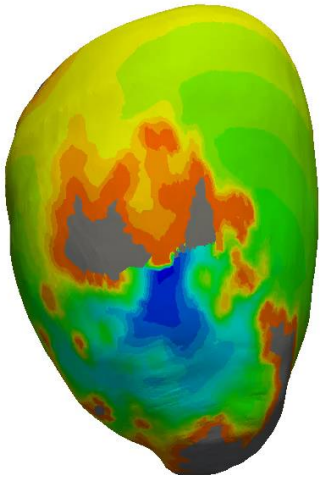
57 yo man with prior infarct in LAD territory
Multiple ICD shocks on monomorphic VT



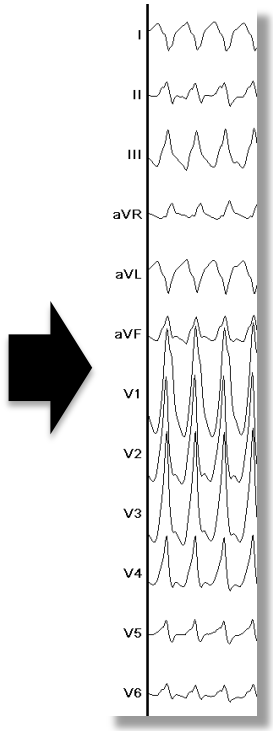
HD VT map



Simulation endo



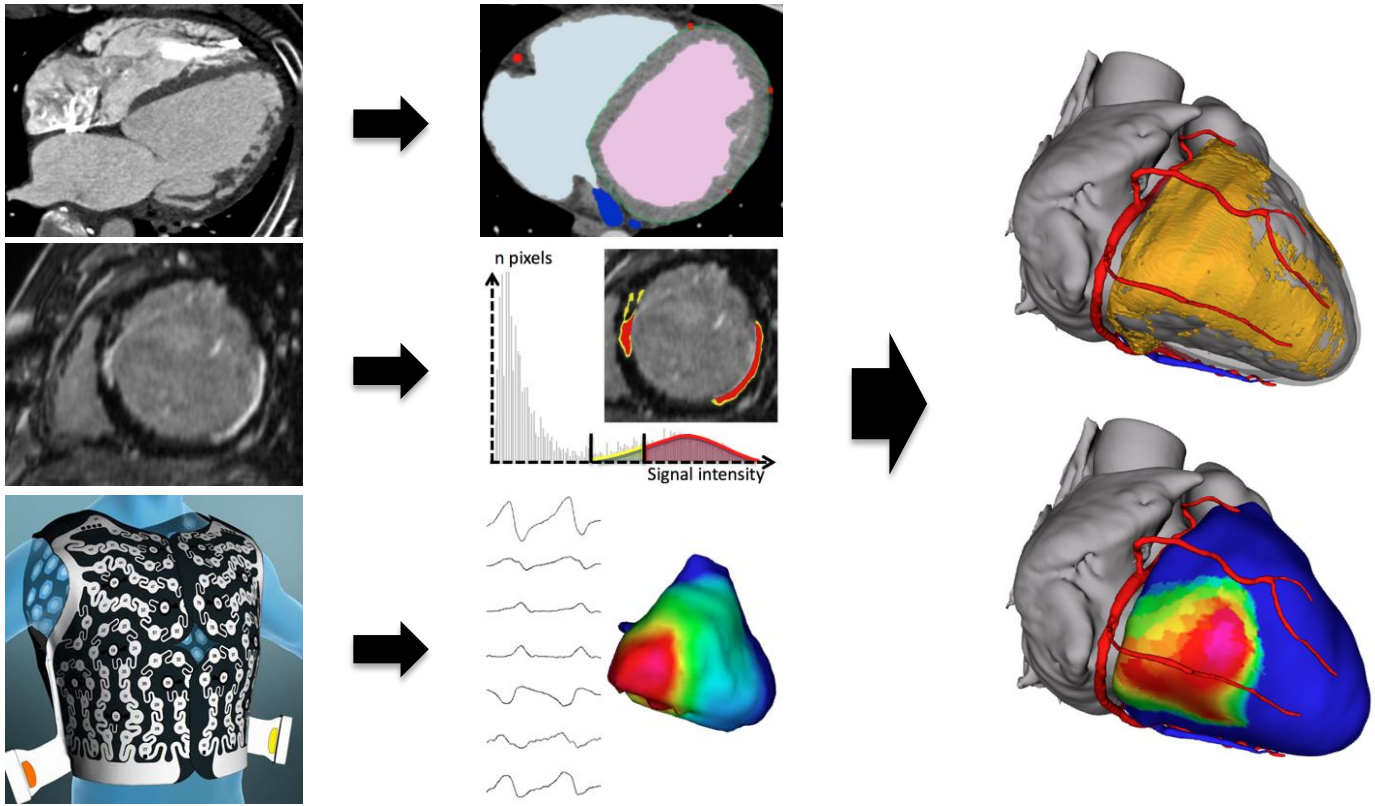
Simulation epi



NON-INVASIVE EP LAB

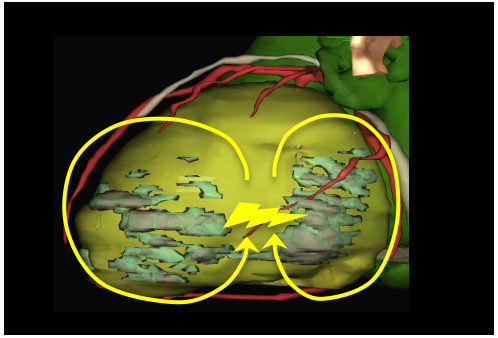
Nicolas Cedilnik et al. Europace 2018

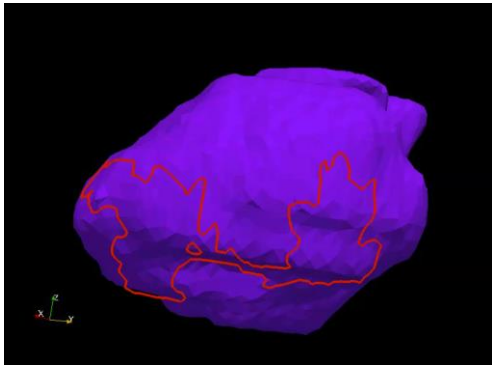
PERSPECTIVE
INTEGRATION OF IMAGING AND ECGI



PERSPECTIVE
INTEGRATION OF IMAGING AND ECGI

70 yo man with DCM. ICD shocks.





PERSPECTIVE
INTEGRATION OF IMAGING AND ECGI

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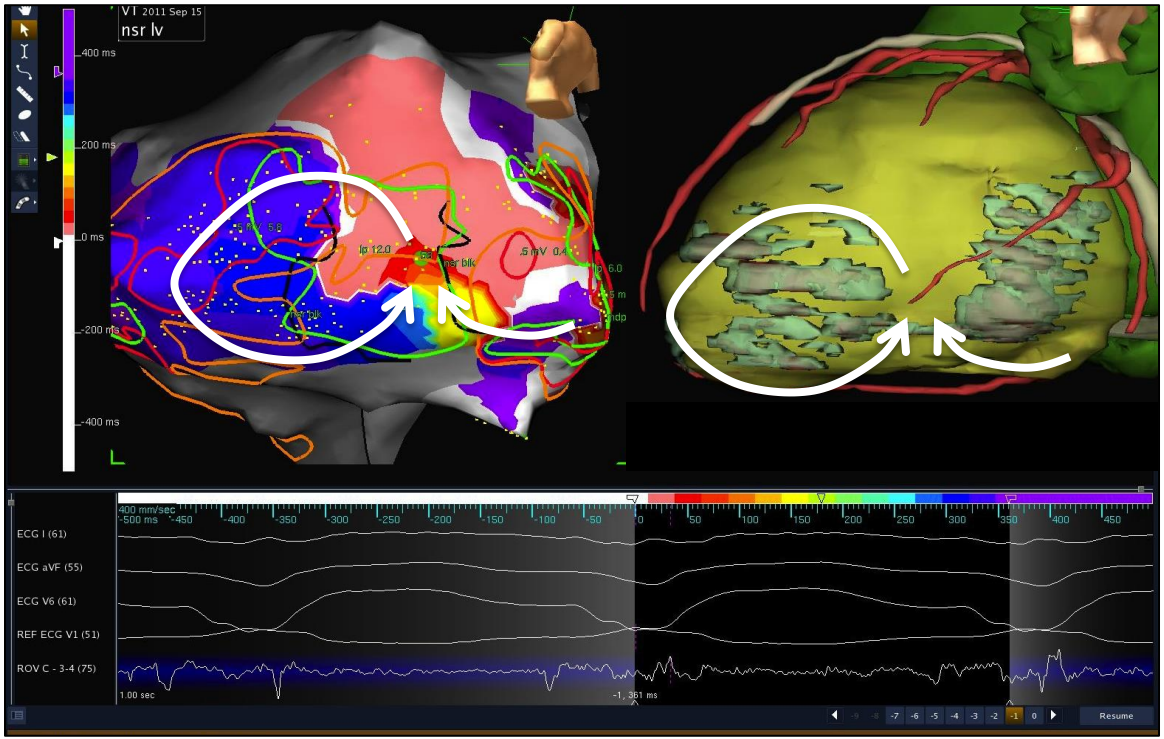
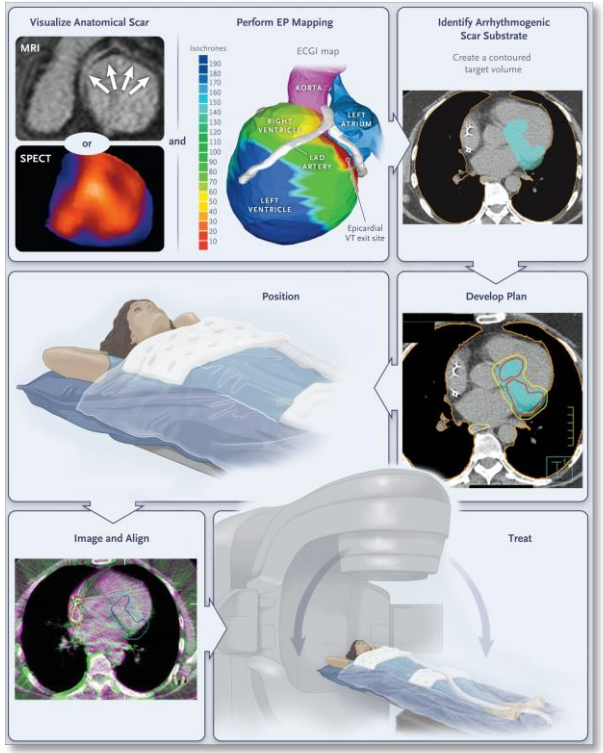
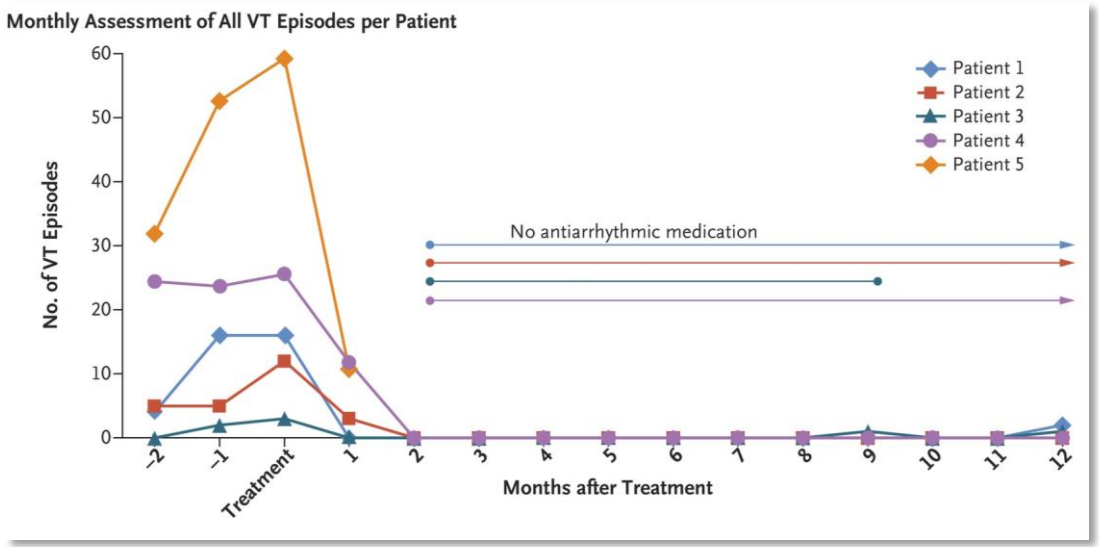


ORIGINAL ARTICLE

Noninvasive Cardiac Radiation for Ablation of Ventricular Tachycardia

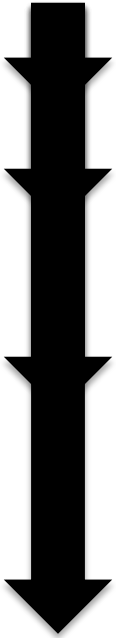
Phillip S. Cuculich, M.D., Matthew R. Schill, M.D., Rojano Kashani, Ph.D., Sasa Mutic, Ph.D., Adam Lang, M.D., Daniel Cooper, M.D., Mitchell Faddis, M.D., Ph.D., Marye Gleva, M.D., Amit Noheria, M.B., B.S., Timothy W. Smith, M.D., D.Phil., Dennis Hallahan, M.D., Yoram Rudy, Ph.D., et al.





CONCLUSIONS

Role of CT/MR imaging in VT



before ablation	diagnosis of underlying etiology
ablation planning	detection of thrombus need for epicardial access challenges of epicardial access
ablation guidance	enhanced definition of substrate & anatomy identifying structures at risk (coronaries, phrenic) direct definition of ablation targets
perspective	fully non-invasive cardiac ablation

TAKE HOME MESSAGES

Ventricular arrhythmia without known structural heart disease?

Get an MRI even if echo and angio are negative

Patient considered for ICD implantation for primary prevention?

Use MRI to measure LVEF because you'll have scar data in case of future shocks

Patient referred for VT ablation?

Develop a close collaboration with your imaging team to obtain CT/MRI

Seek for image processing solutions to get optimal imaging information in the lab