

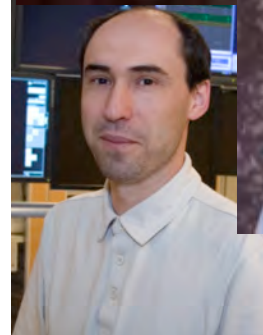


DBP: Image Analysis for Atrial Arrhythmias

Rob MacLeod, PhD
SCI Institute, Dept. of Bioengineering
CVRTI, CARMA
University of Utah



Driven (Crazy?) by Doctors



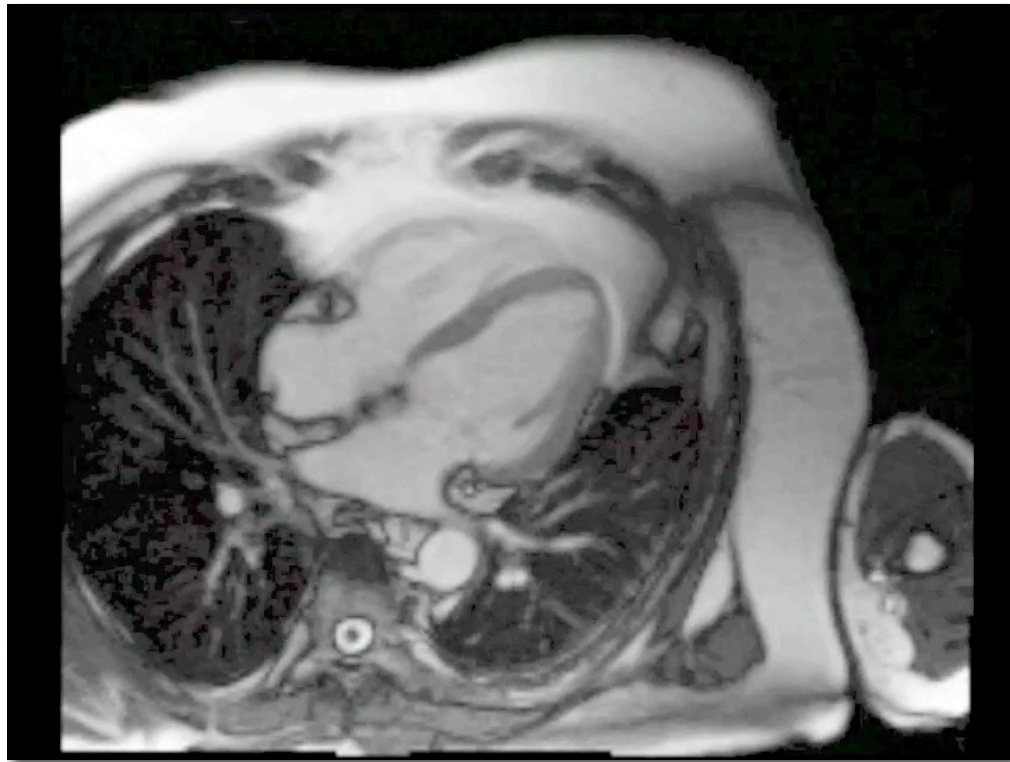
The CARMA Team



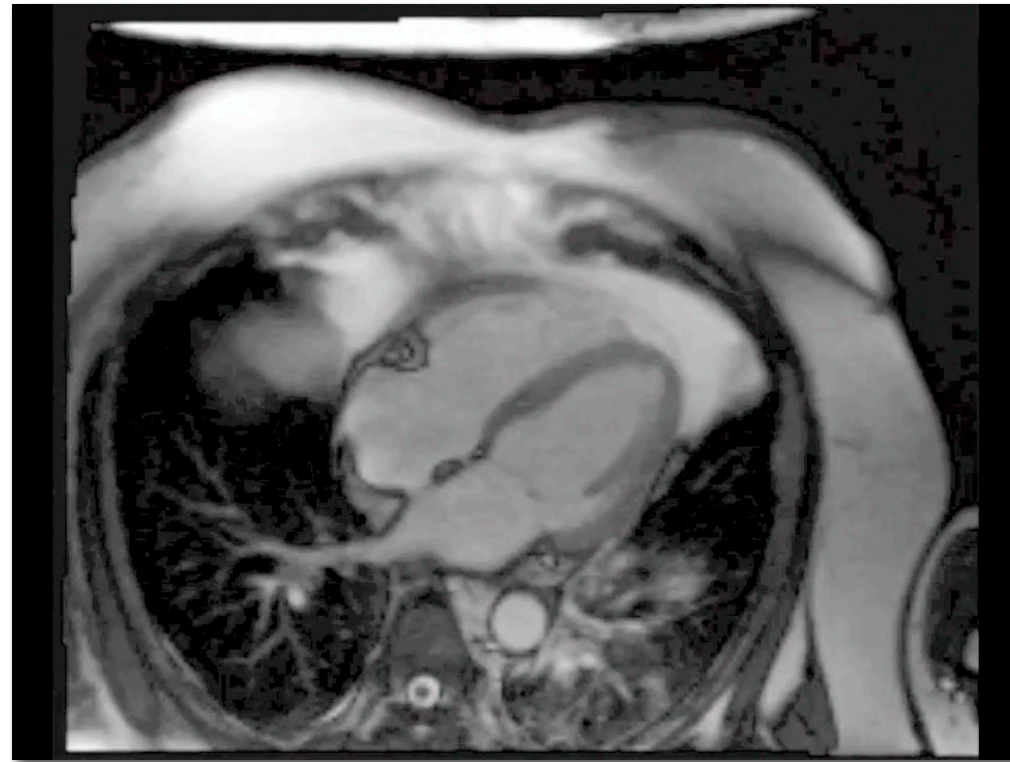


CARMA = Comprehensive Arrhythmia Research and MAnagement

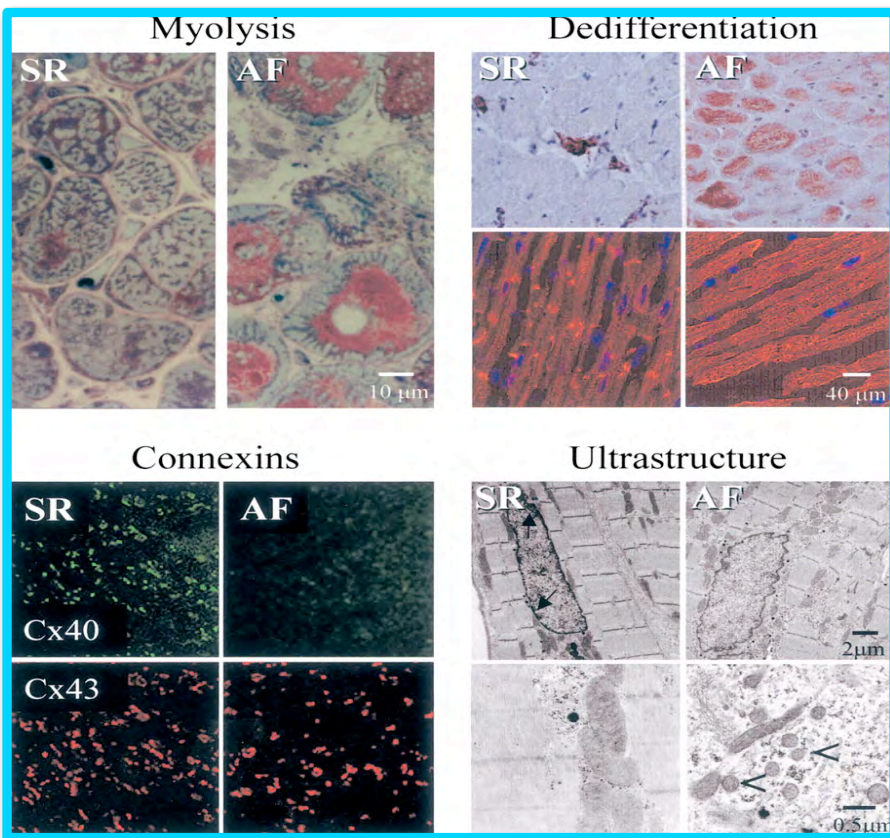
Normal Contraction



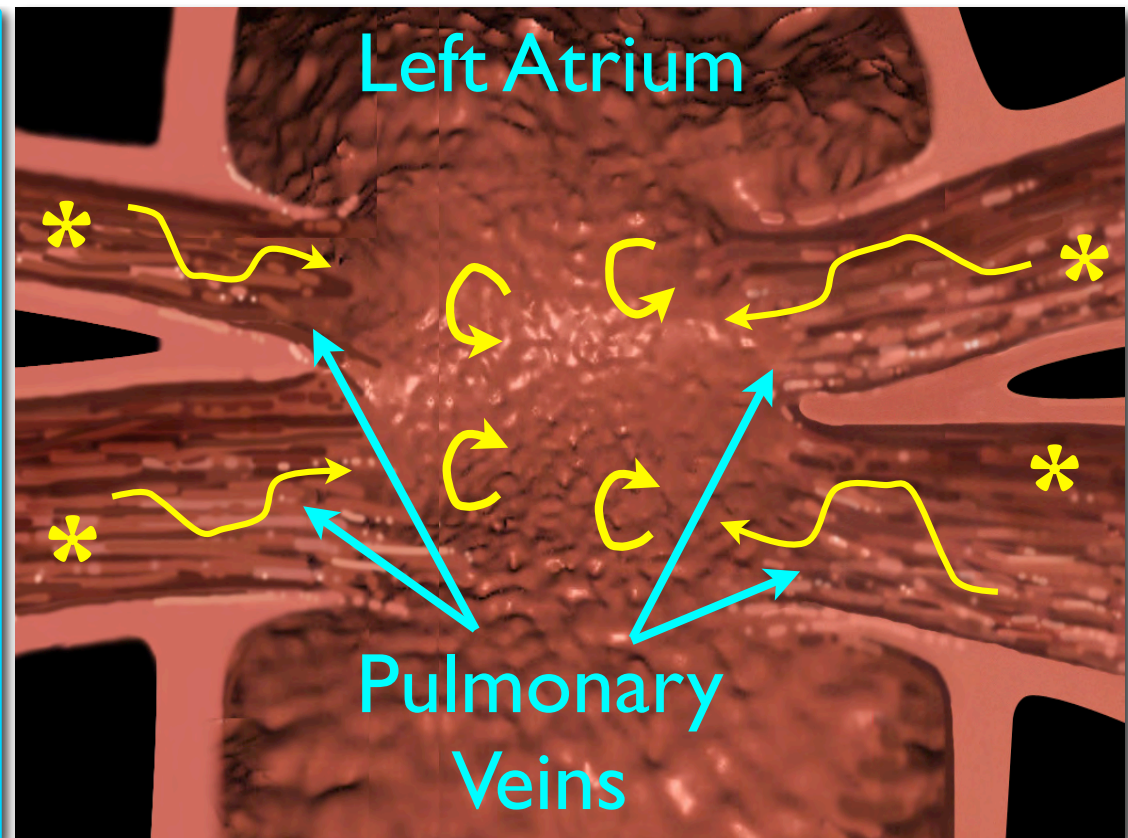
Atrial Fibrillation



What We Know About AF

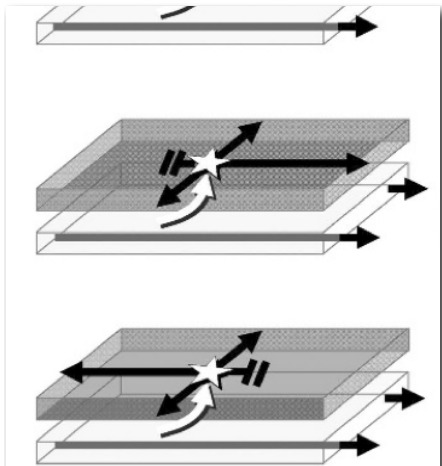


Substrate

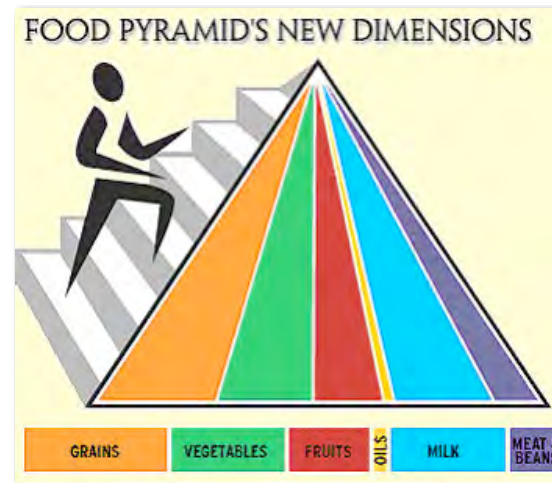


Triggers

What We Do Not Know about AF: Everything Else



ift, A small portion of the atrial wall in cross section is shown. The wave is propagated from the epicardial layer. The site of EB is indicated by a star. The spread of activation from the breakthrough site is represented as a single syncytium of cells.



Mechanisms

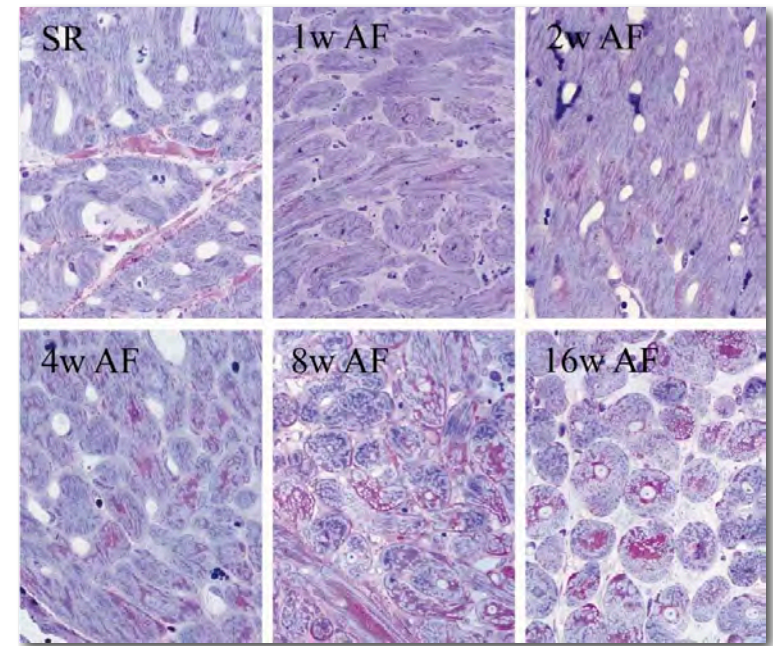
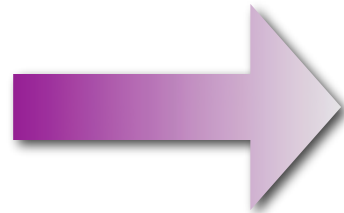
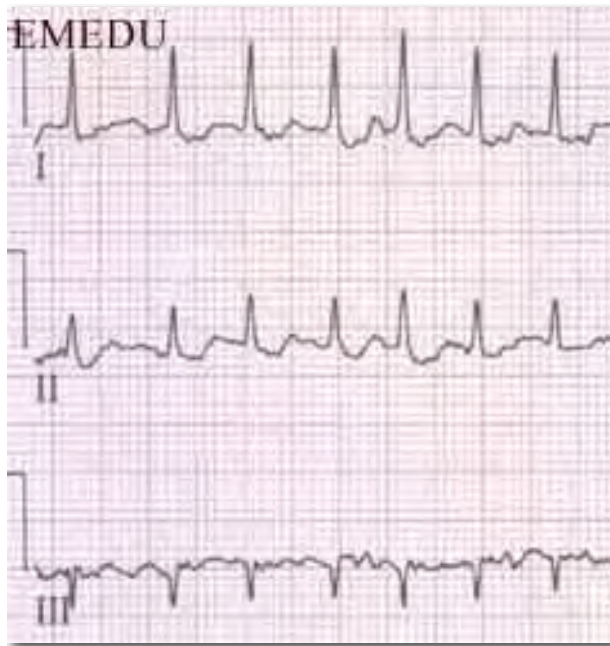
Time Course

Environmental
Factors

Genetics

The Million \$ Mechanistic Question

Afib begets Afib



Afib is a

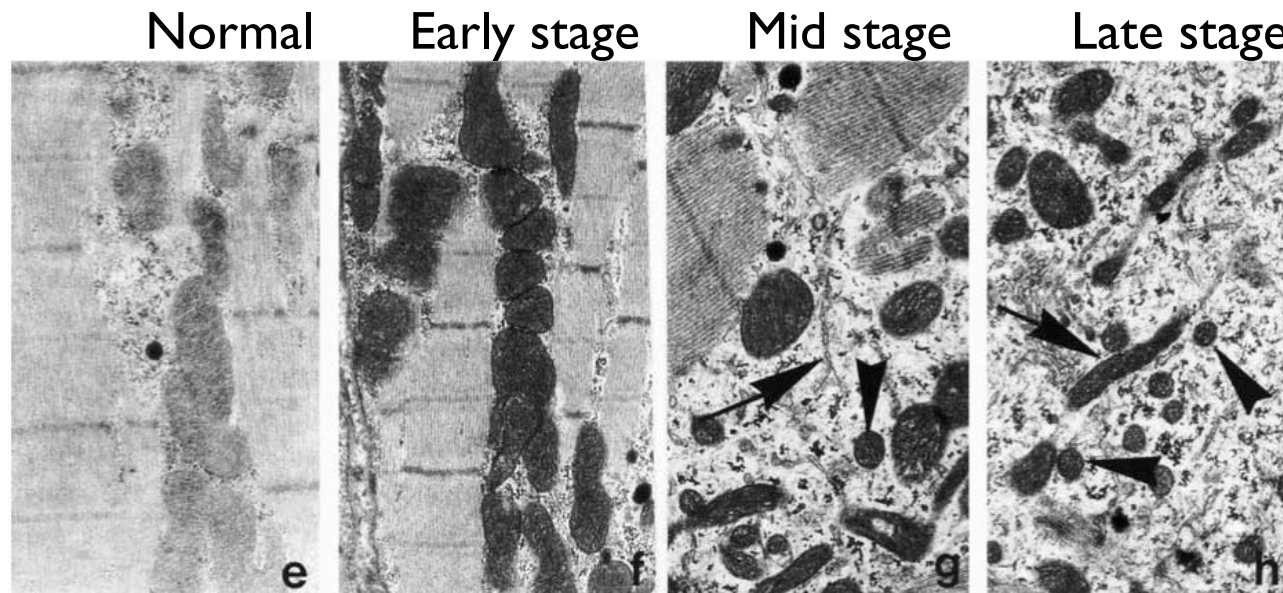
tissue disease

Structure is Important



The CARMA Mantra

“AF is a heart tissue disease”

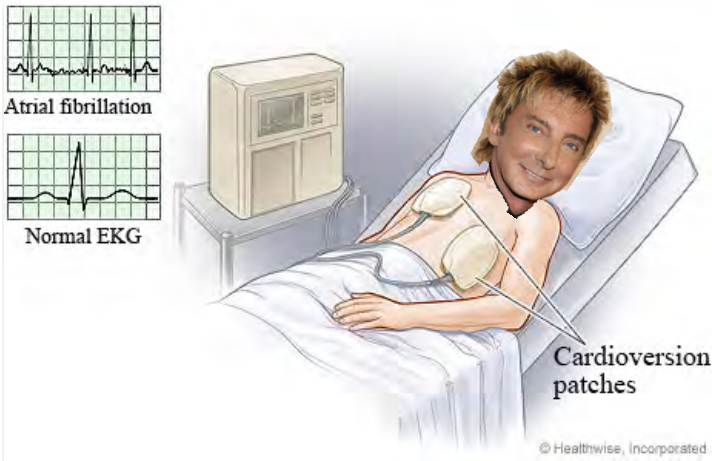
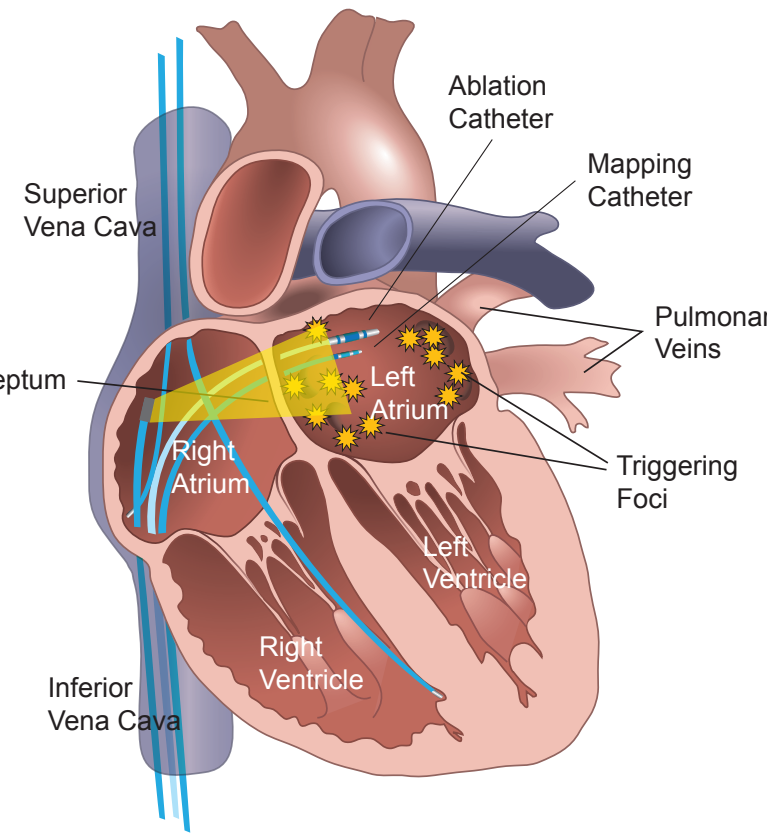
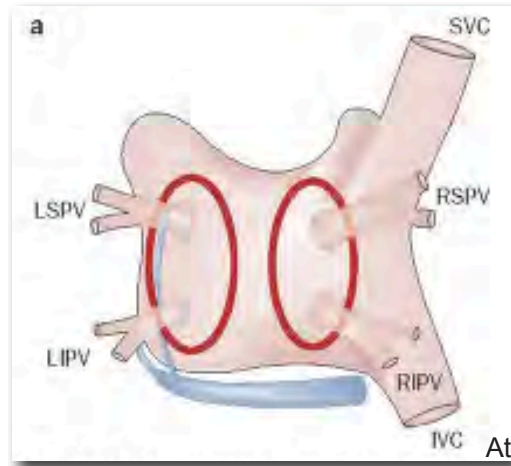


Ausma J, ...Allessie M ...J mol Cell Cardiol. 2001: 2083.

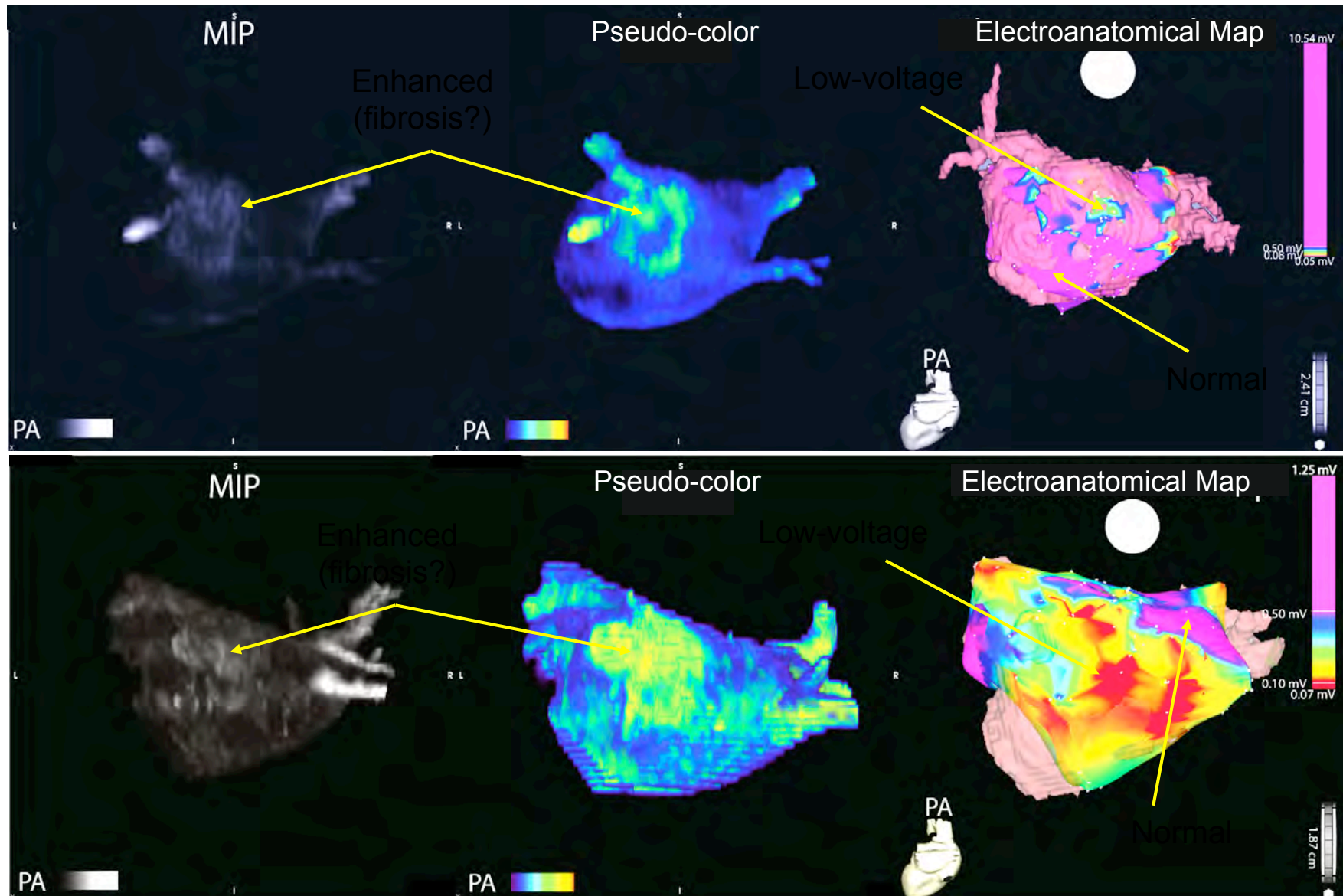
“Fibrotic Atrial Cardiac Myopathy
(FACM)”

Kottkamp H: J Cardiovasc Electrophysiol 2012;23:797-799

Effective Treatment of AF Eventually Involves Intervention



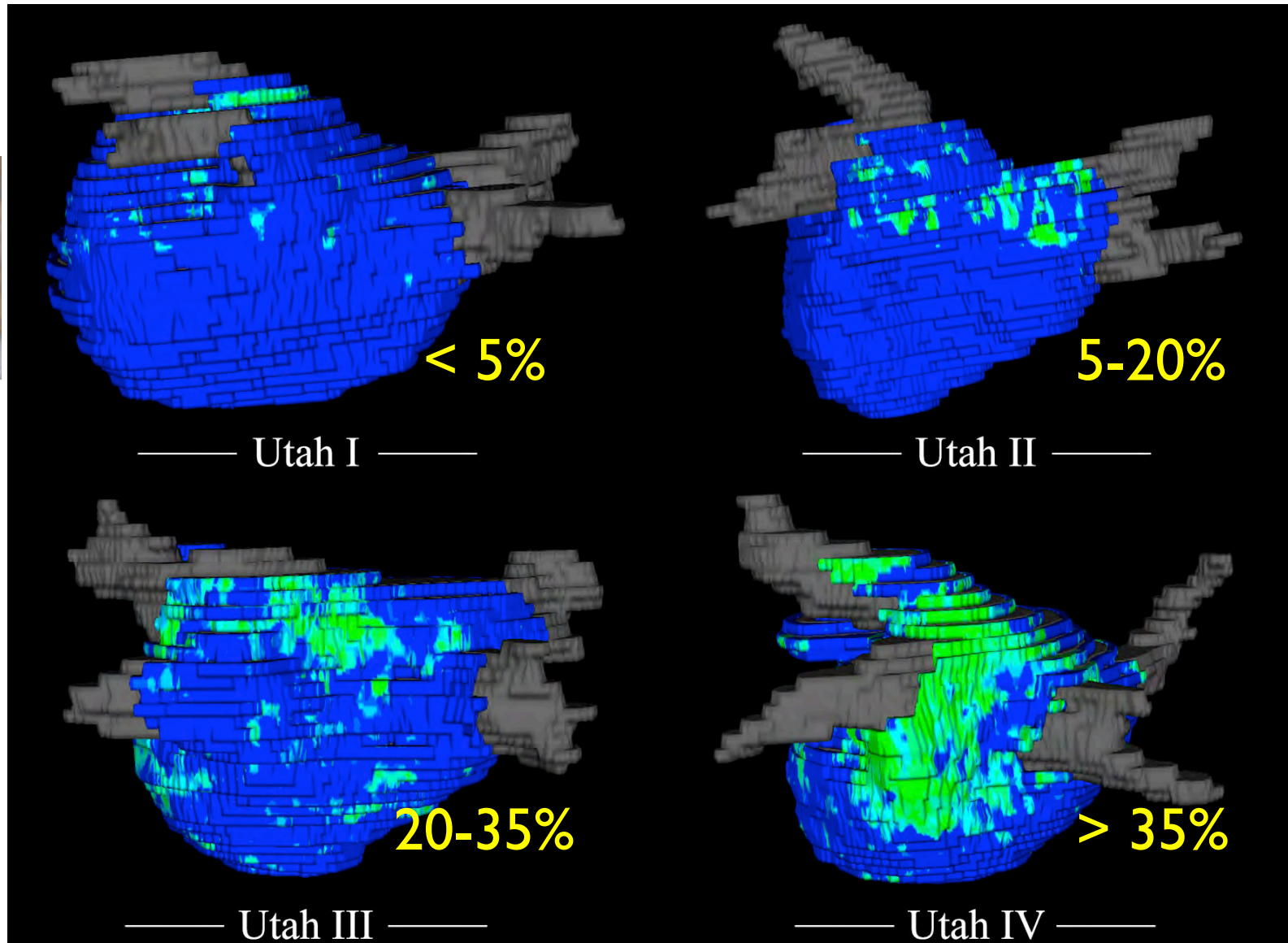
CARMA Started Here



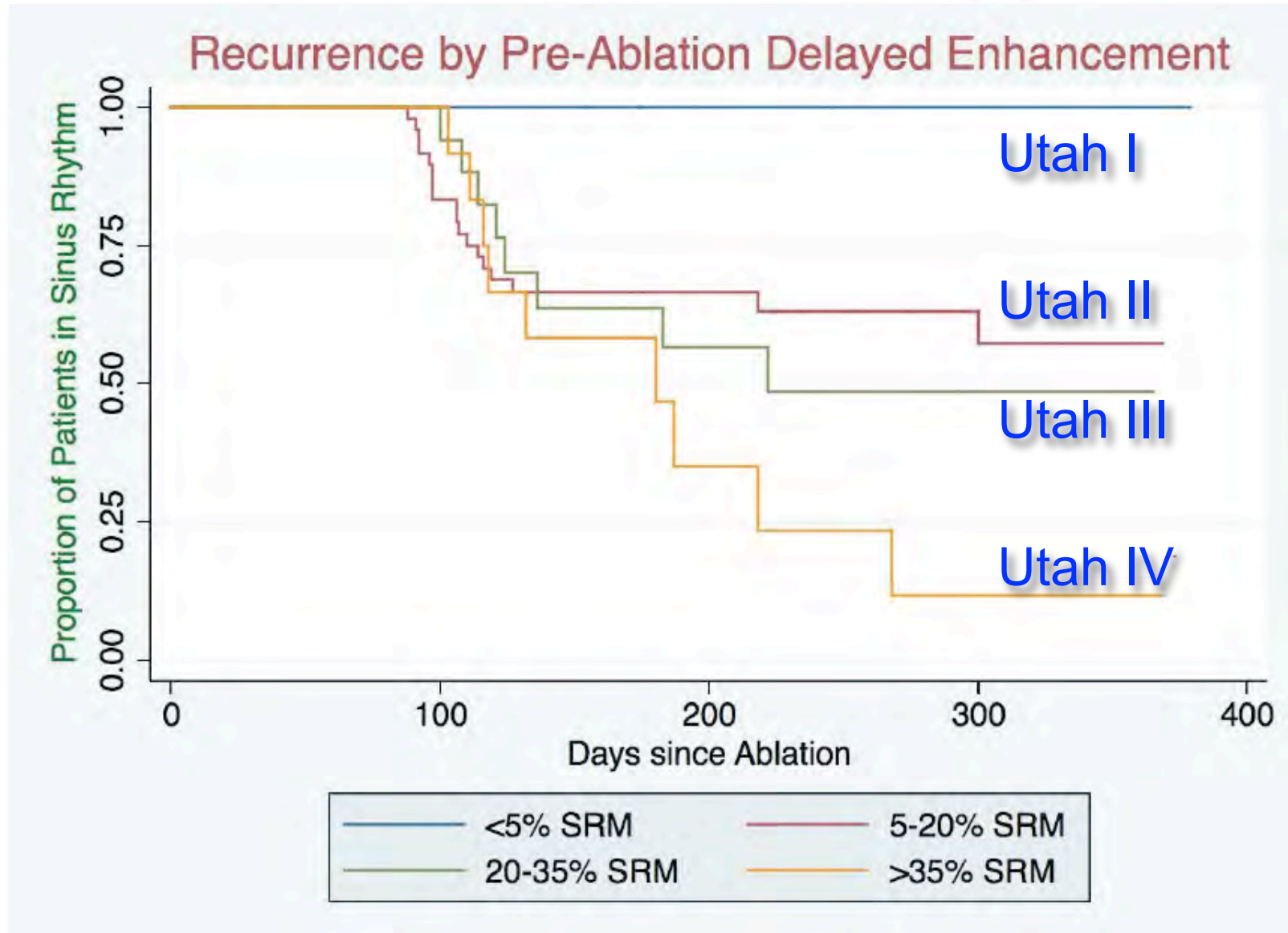
Utah Scoring Scheme: 2011



Nazem Akoum



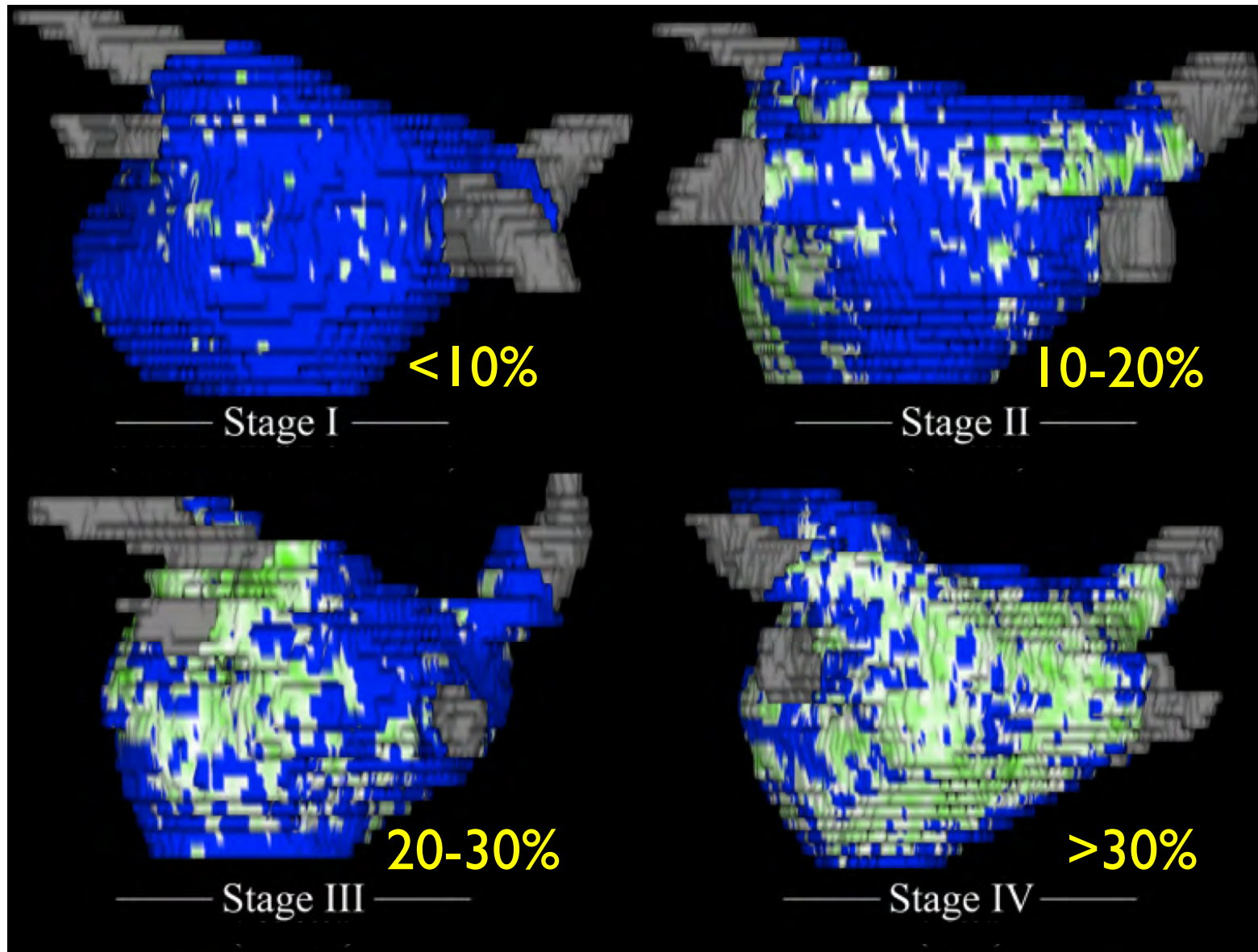
Fibrosis Predicts Outcome of Ablation Therapy



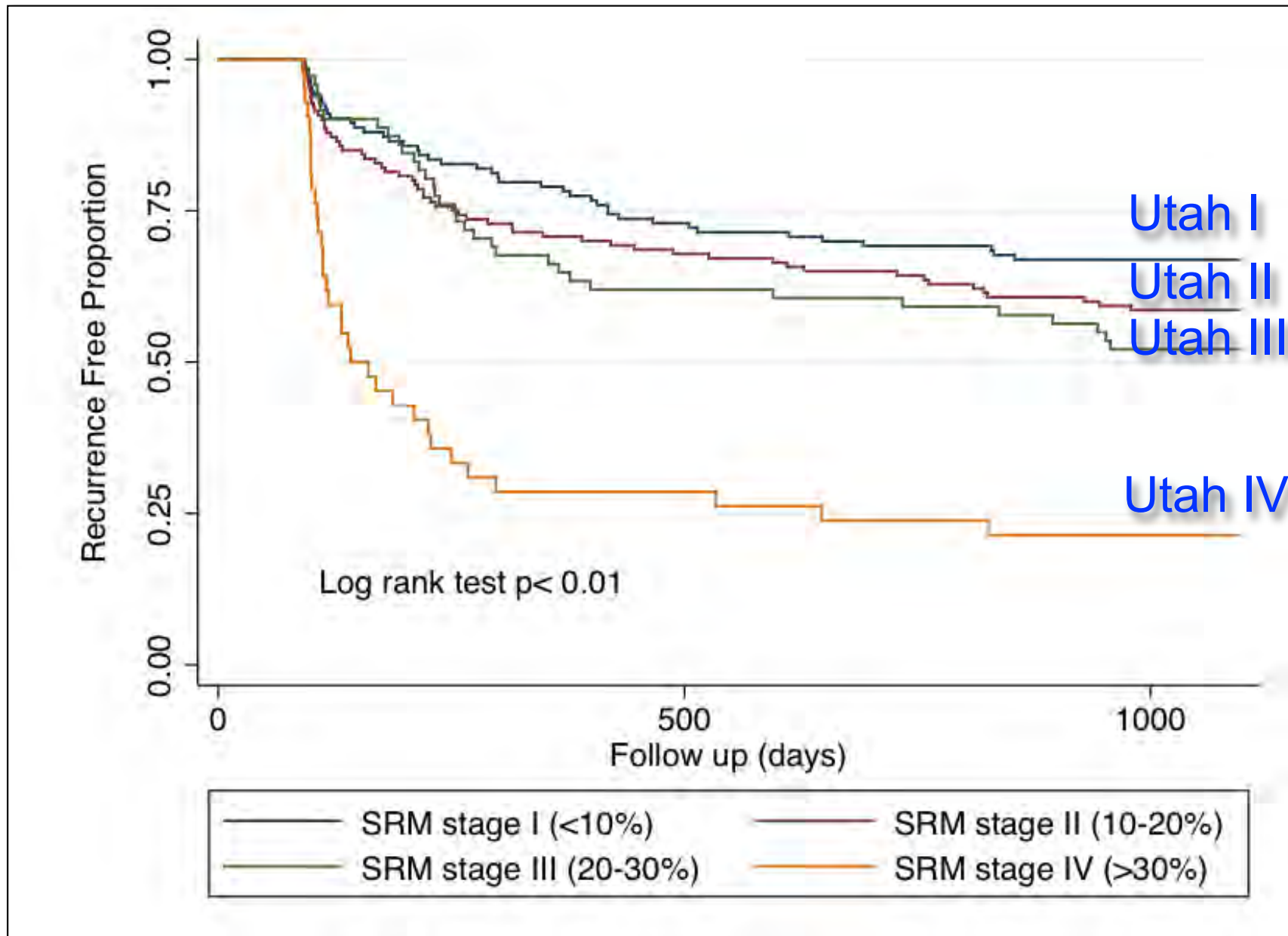
Utah Stages: Latest Edition



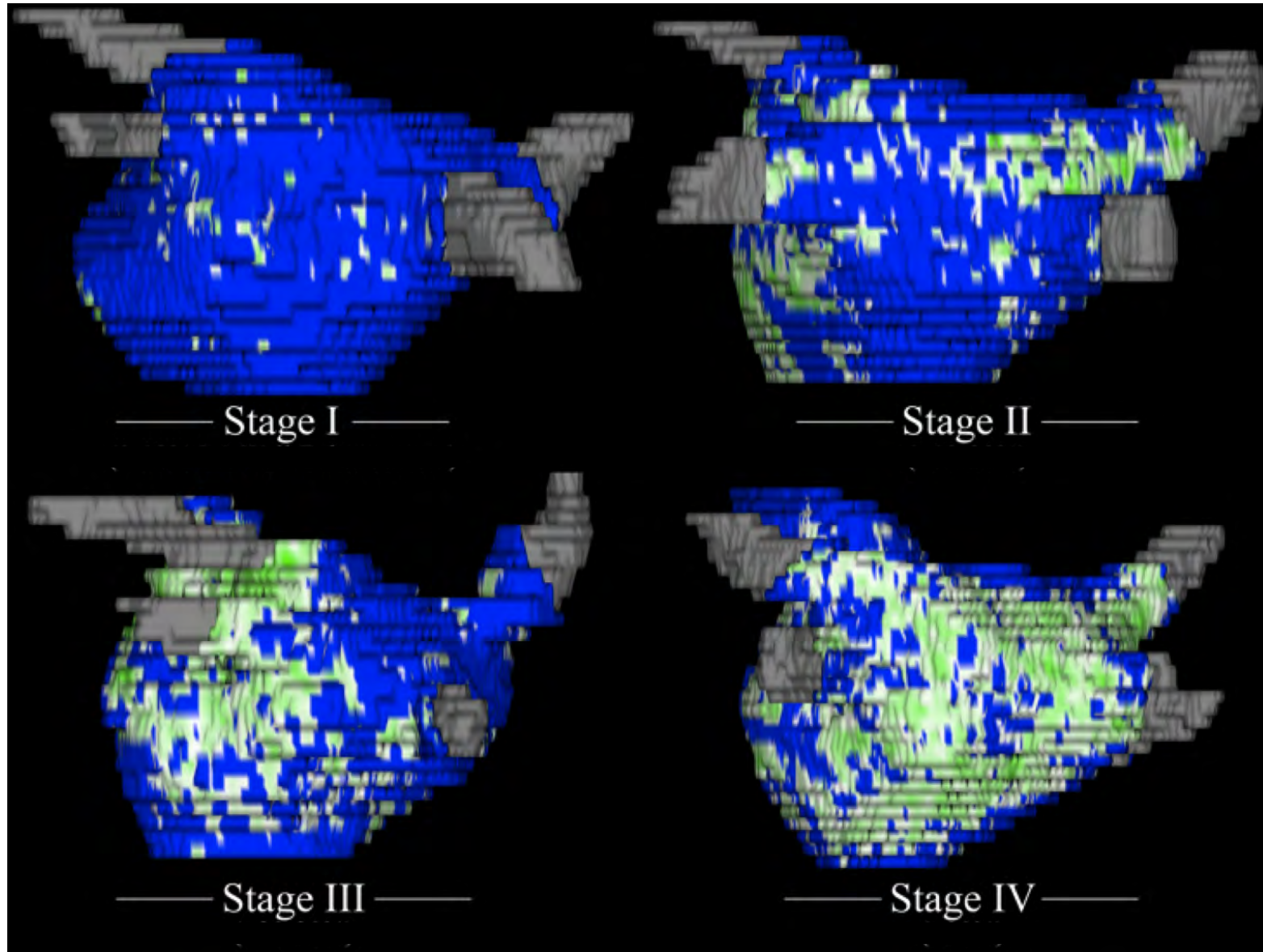
Chris McGann



Utah Stages: Latest Edition



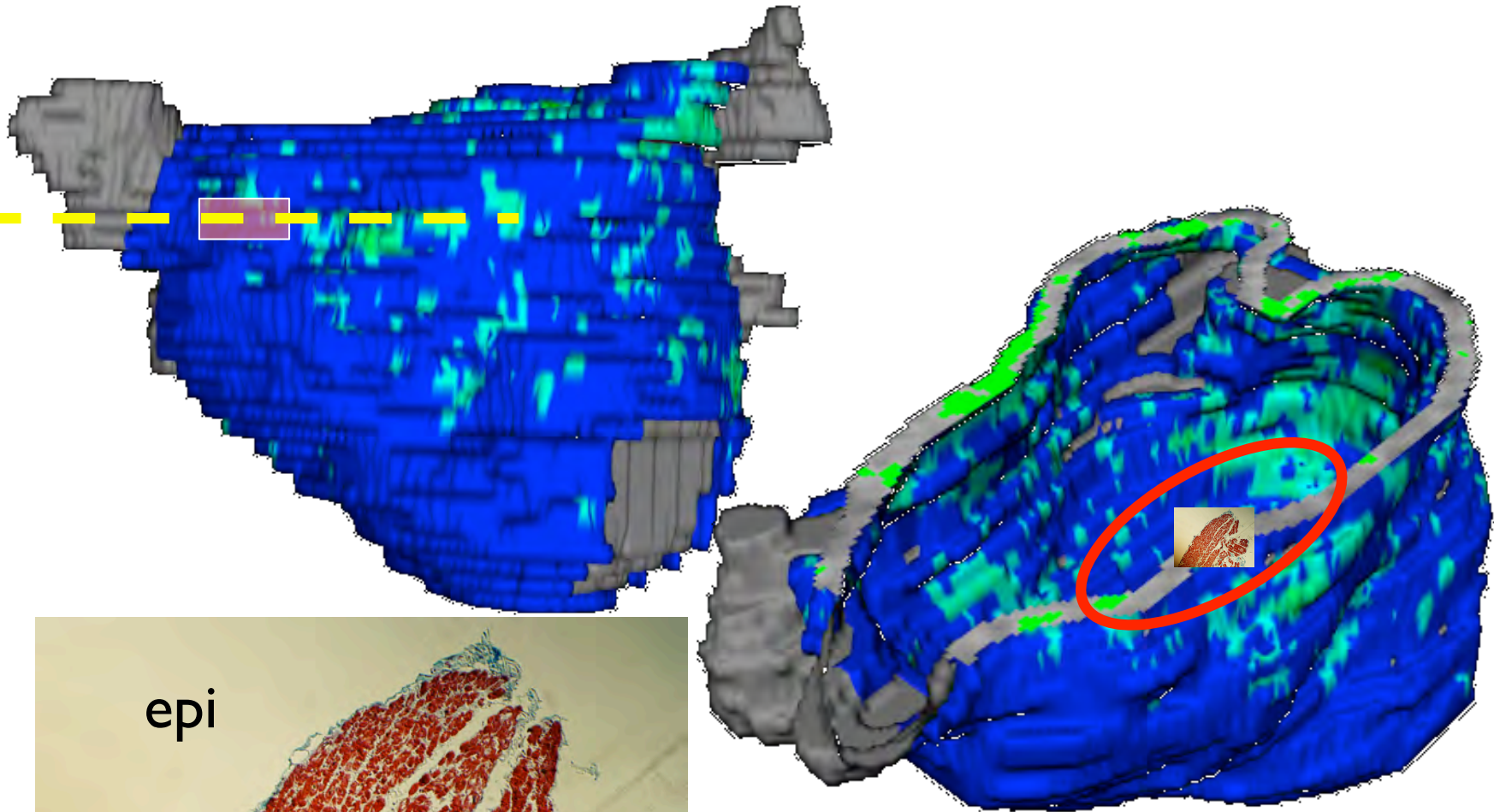
It is MRI but is it Real?



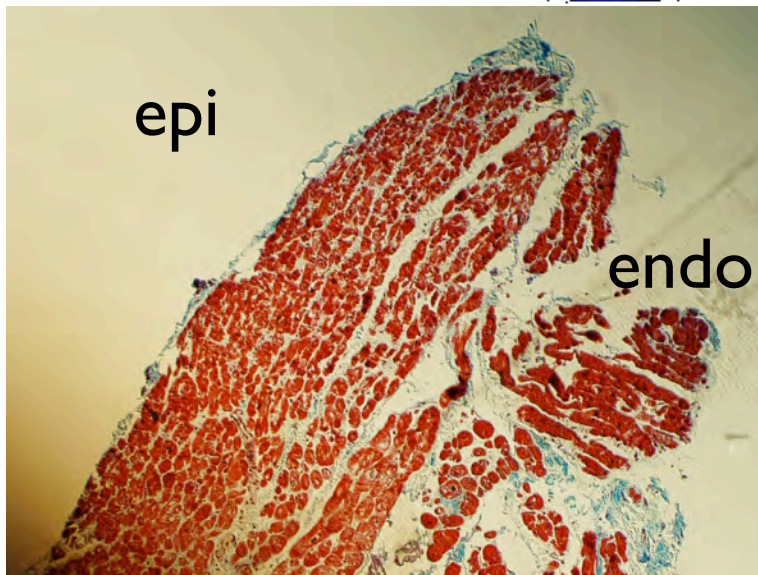
Blue is Normal



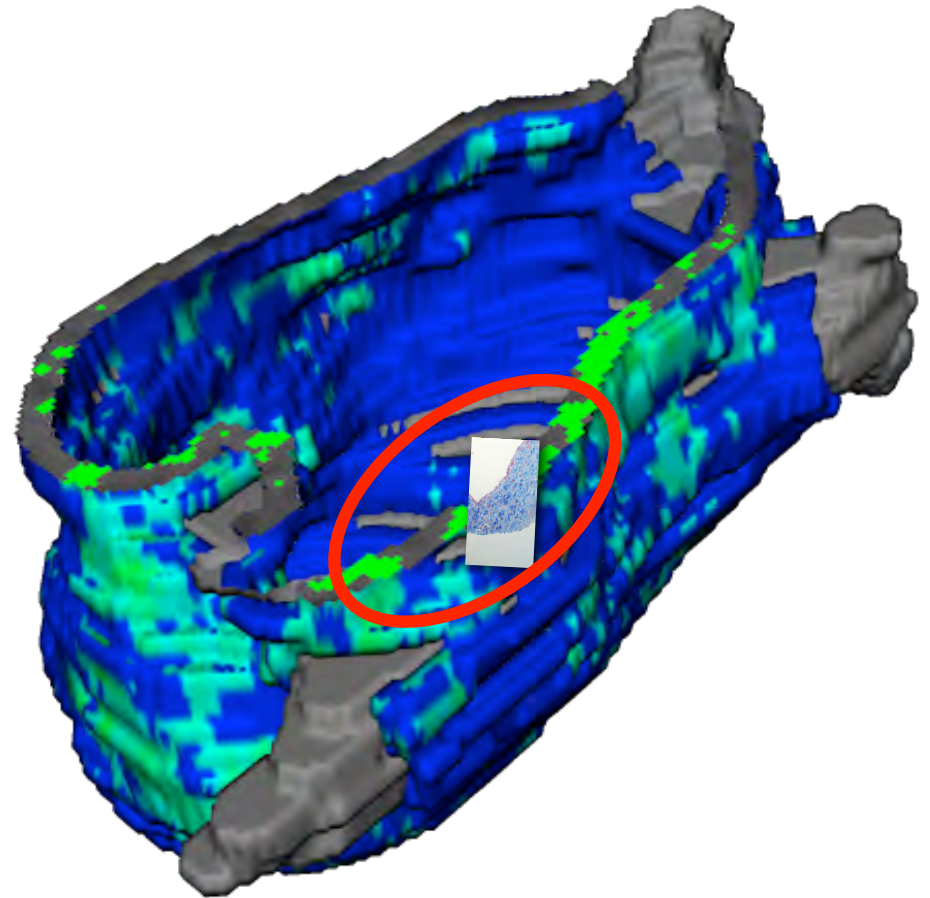
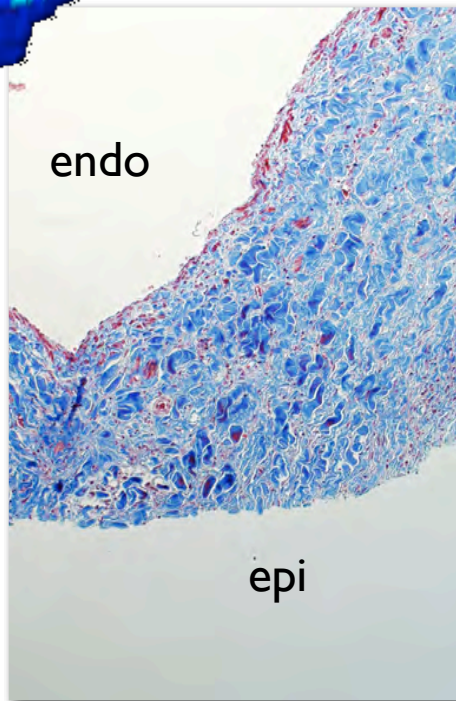
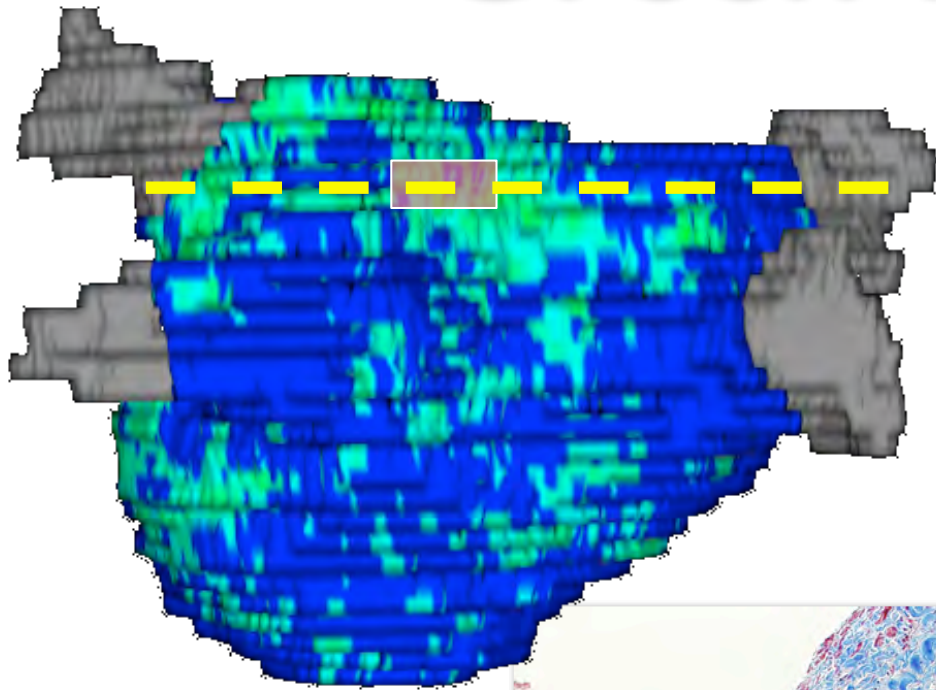
Chris
McGann



Amit
Patel



Green is Fibrosis

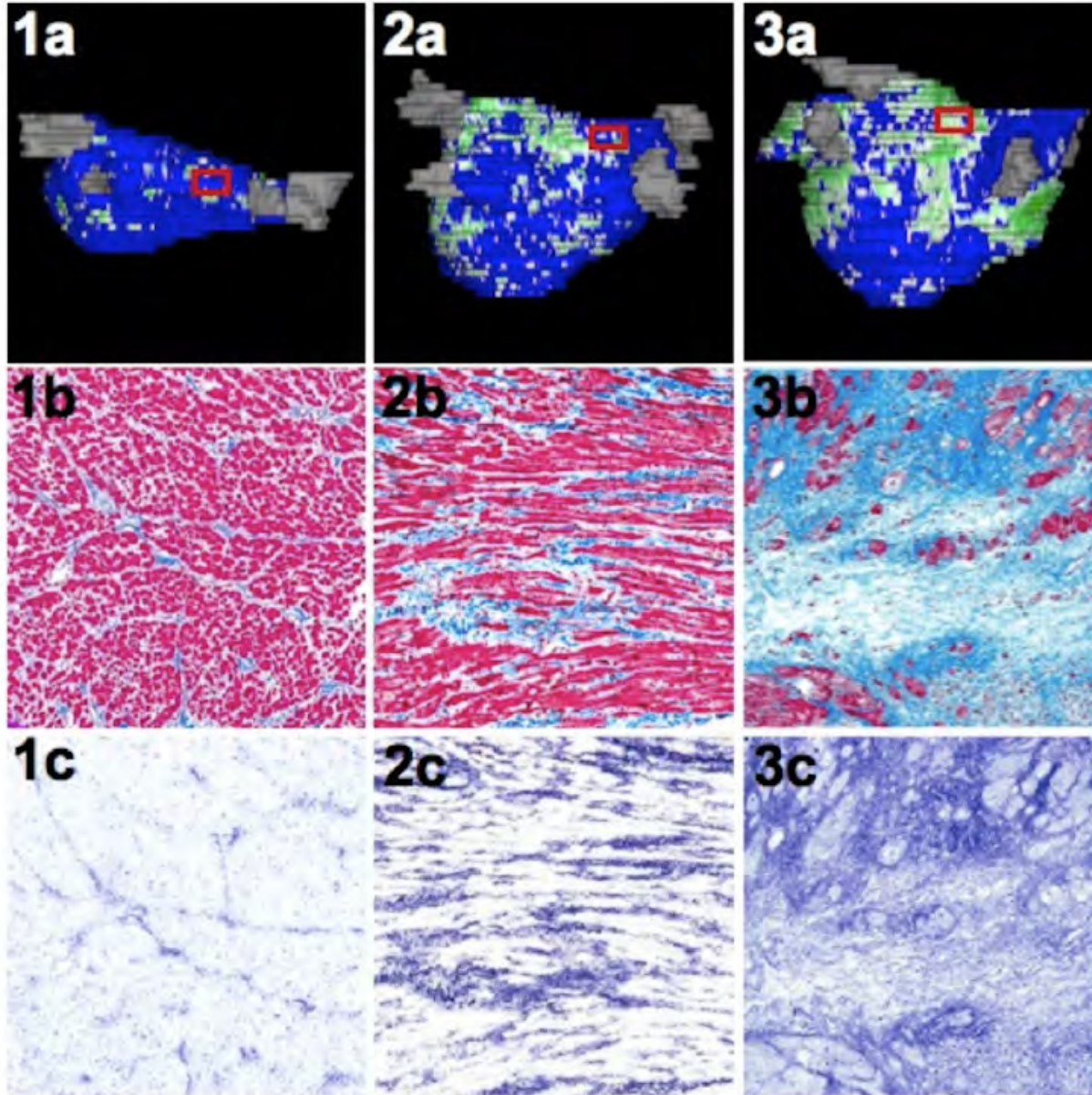


Histology Summary

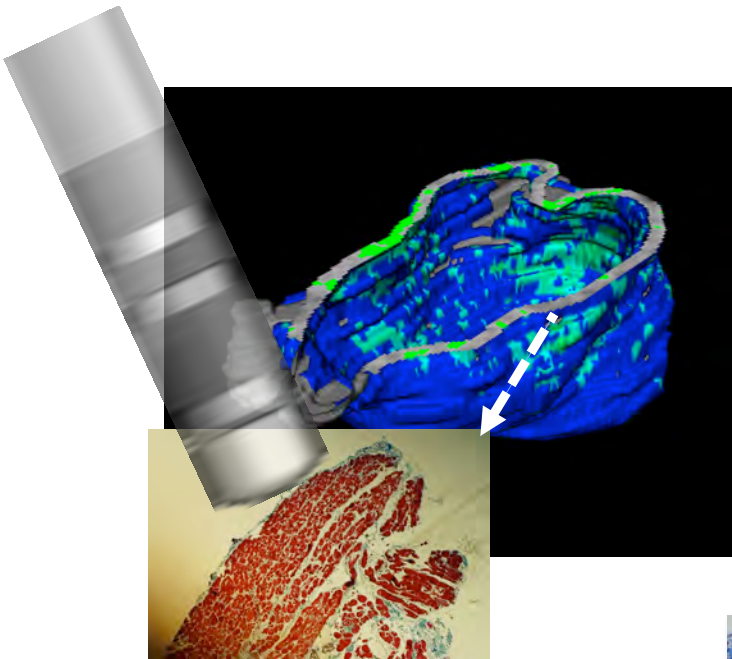
Control

AF-mix

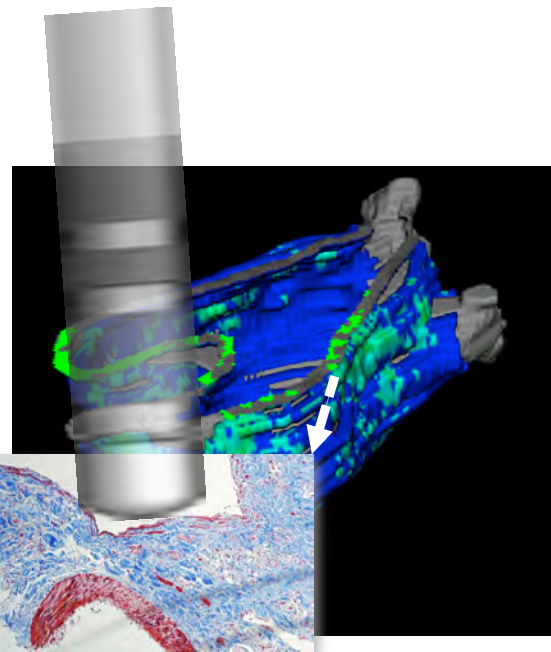
AF-fibrosis



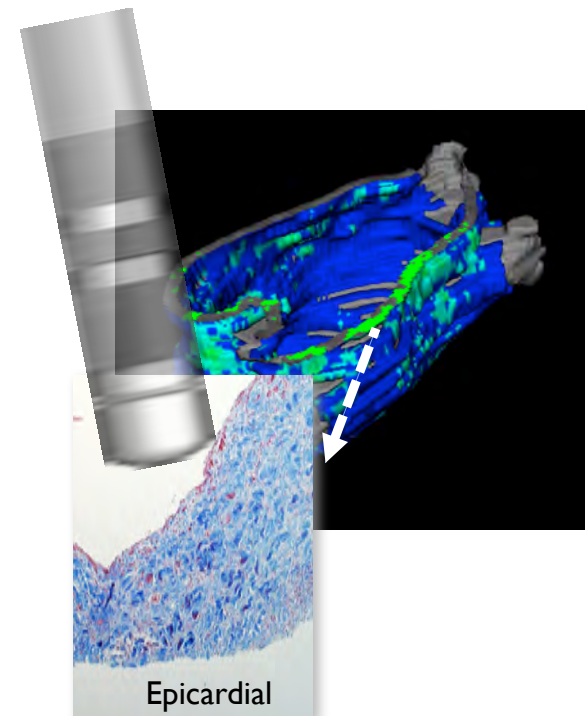
Not All Lesions Can Be Effective



Likely Effective



Potentially Effective

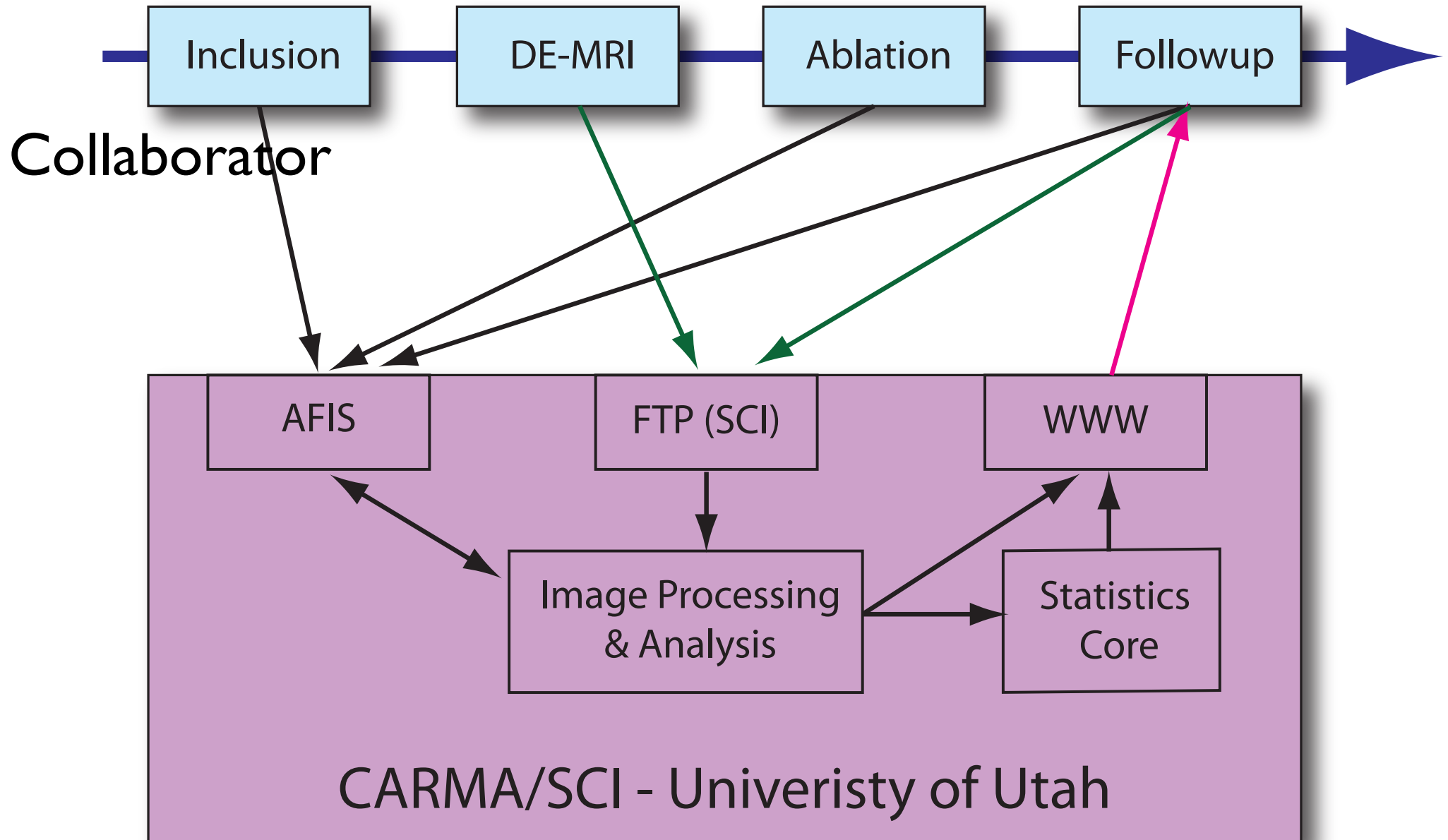


Not Effective



DE-MRI Determinant of Successful Catheter Ablation of Atrial Fibrillation (DECAAF)

DECAAF Organization





Late Breaking Abstract at American College of Cardiology Meeting



Along Came NAMIC

AF Specific Aims

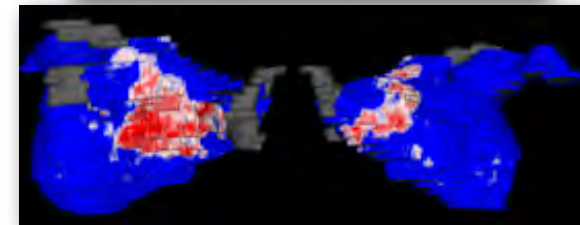
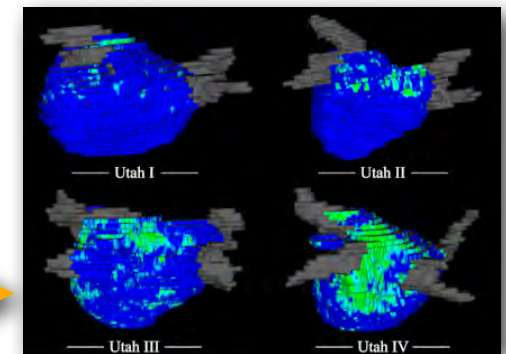
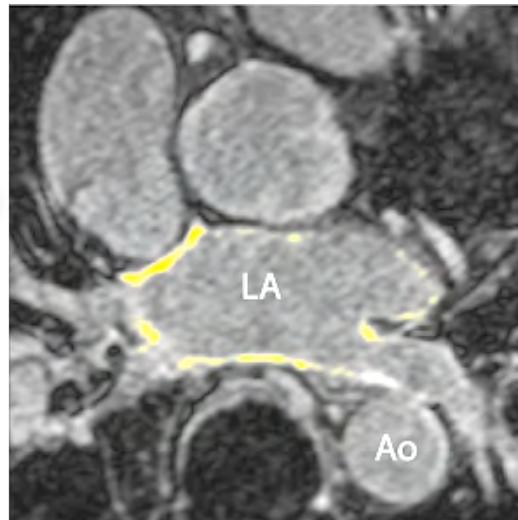
Registration

Segmentation

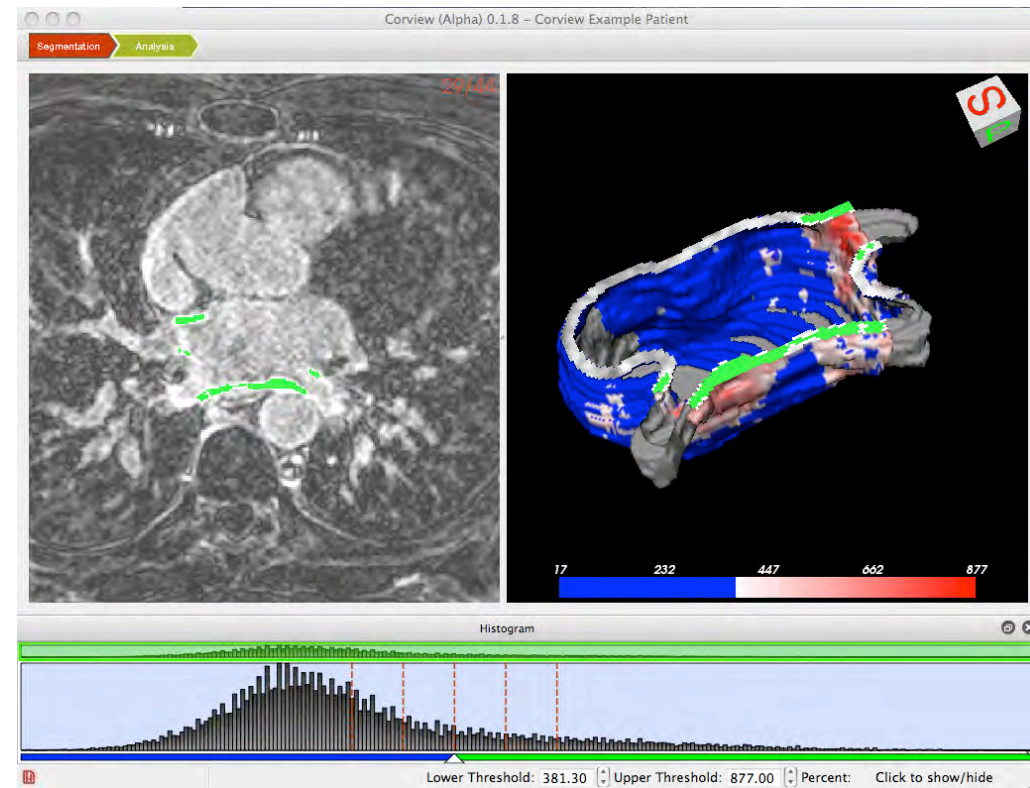
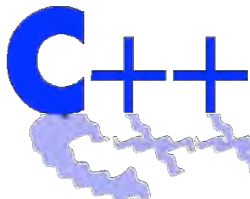
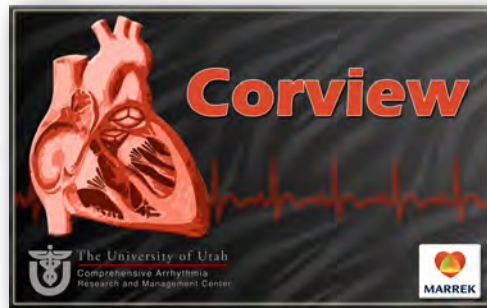
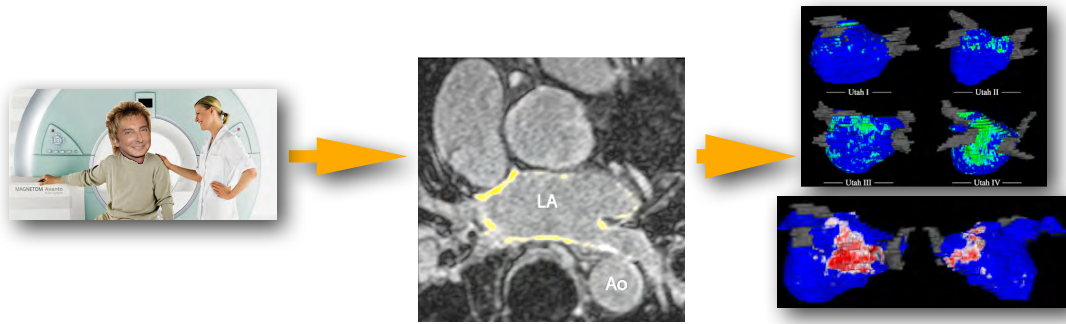
Quantification

	Year 1	Year 2	Year 3
Aim 1	Evaluate existing algorithms	Integrate linear and nonlinear registration into prototype workflow	Optimize tools, tests, and validation, documentation
Aim 2	Evaluate existing and implement new tools for atrial wall segmentation and for tissue characterization	Joint segmentation of pre- and post-treatment data; efficient implementations through software and hardware acceleration	Refine segmentation tools, tests and validation, integrate post-treatment image segmentation into clinical workflow, documentation
Aim 3	Design of segmentation and registration workflow and application-specific GUI	Prototype workflow system for integrated registration and segmentation, pre-/post-analysis and visualization. Tests on existing database.	Tests on image data shared with other labs, establish database also with nonimage information for prototypical scoring system, training, and dissemination.

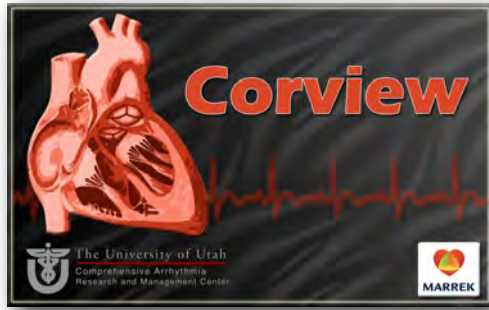
The CARMA AF Workflow



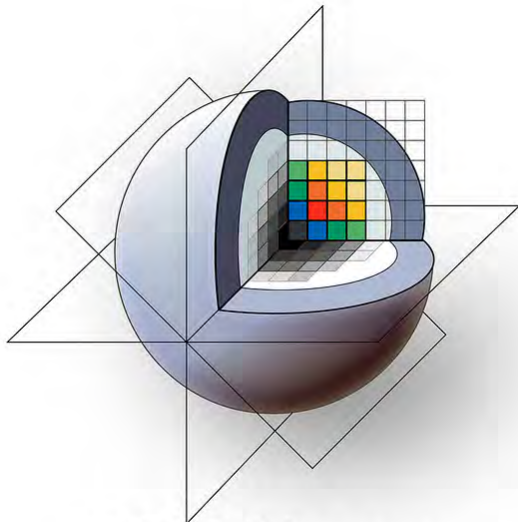
Implementing the Workflow



Corview to Slicer



Commercialization

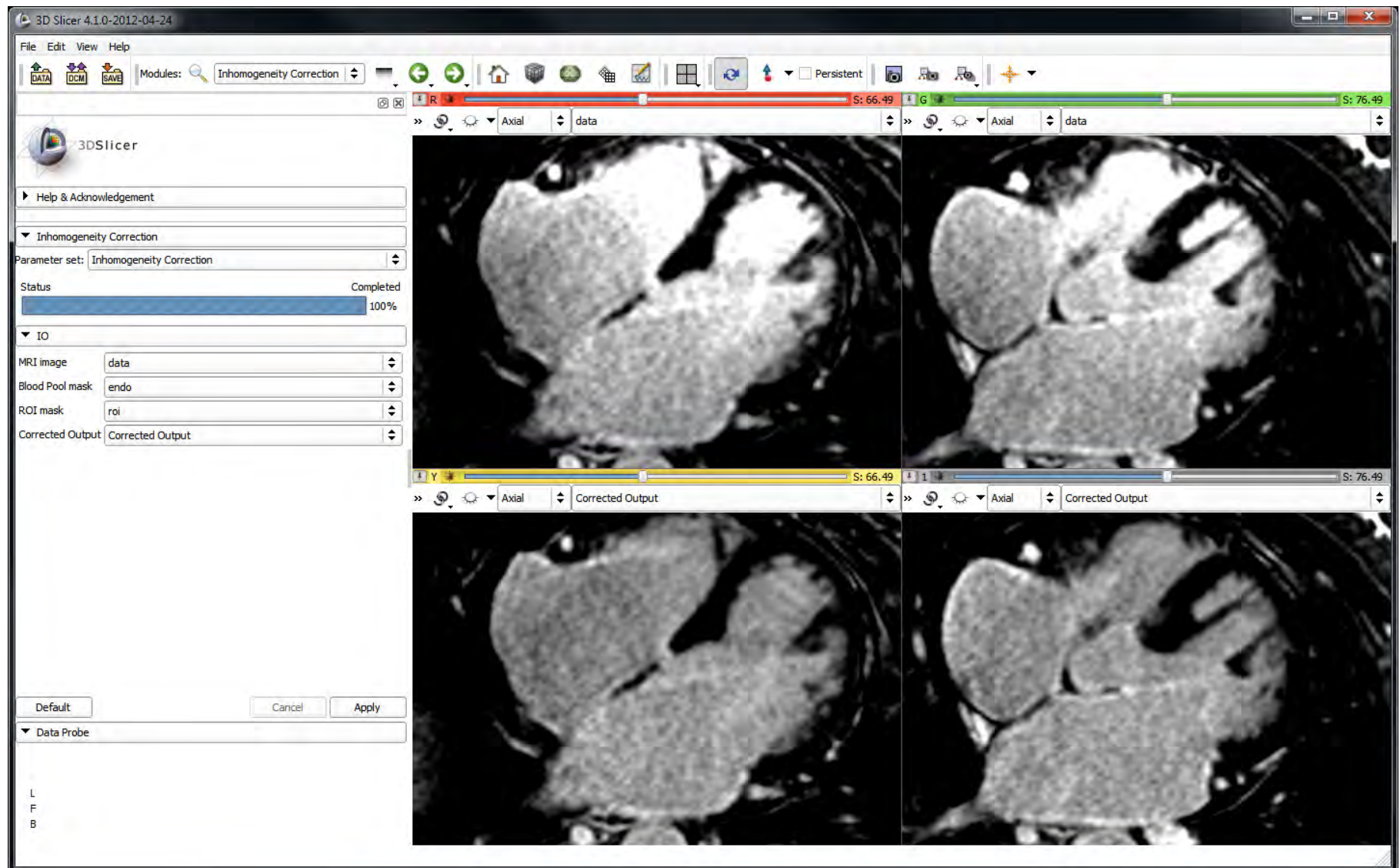


3DSlicer



Research

Slicer: Intensity Correction



Slicer: Registration

The screenshot displays the 3D Slicer 4.1.1 interface with the Carma Registration module active. The main window shows a 3D view of a brain MRI slice with a registration box. The left sidebar contains the registration control panel with various parameters and a data probe section.

3D Slicer 4.1.1

Modules: Carma Registration

3DSlicer

Help & Acknowledgement

Reload

Register Volume

Image Volume One (Fixed): pre_lgemri

Image Volume Two (Moving): 3mo_lgemri

Output Image Volume: Registered Volume

Imaging Modality: LGE-MRI to LGE-MRI

Image volumes are cropped to area around LA

Apply Registration

Advanced Registration Parameters

Select the Type of Registration: PipelineRigid

Select the Type of Metric: MattesMI

Select the Type of Initialization: ImageCenters

Select the Type of Interpolation: Linear

Enter the Maximum Number of Iterations: 100

Sampling Ratio (Accuracy of Registration): 0.05

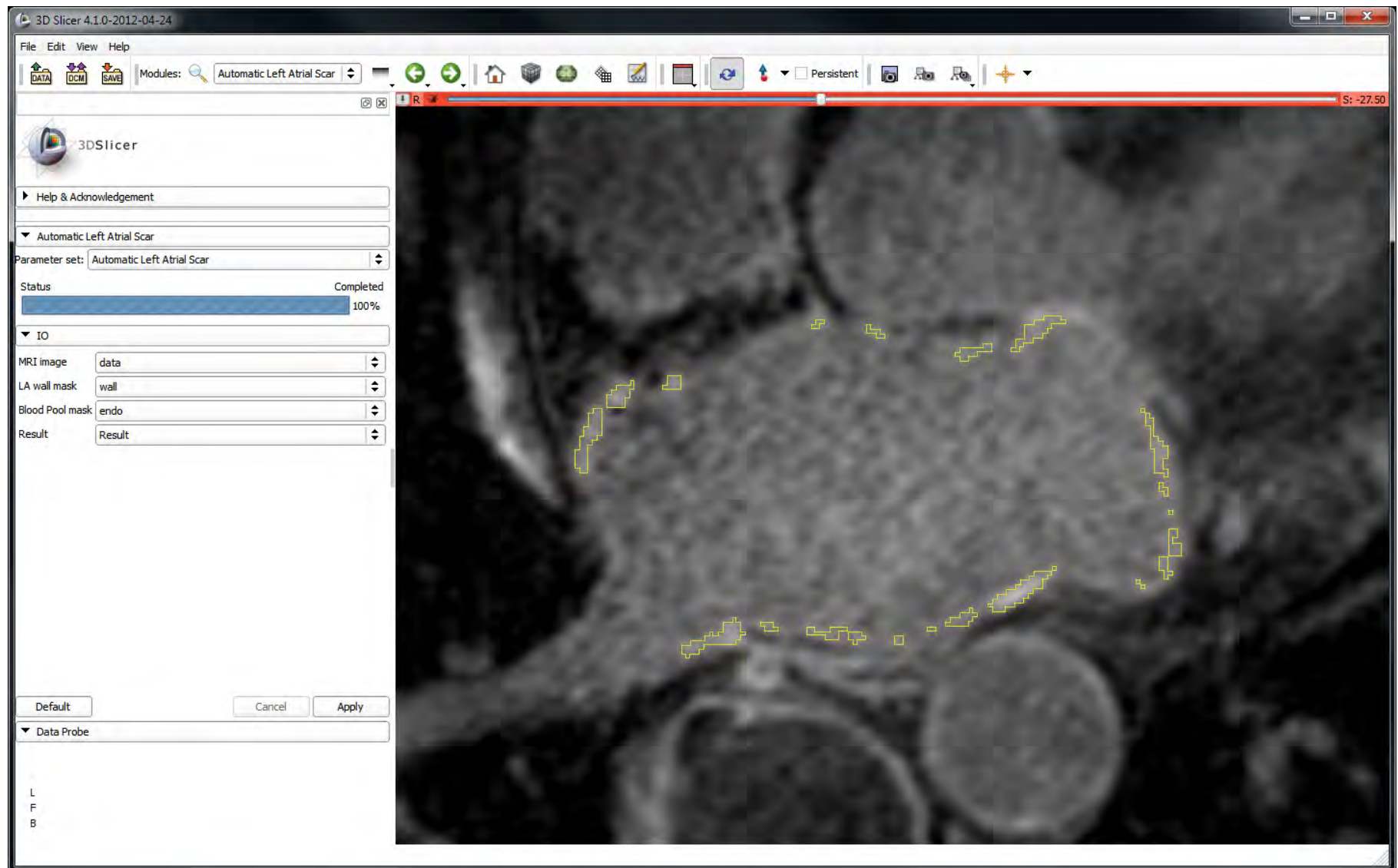
Sample from fixed/moving image overlap

Data Probe

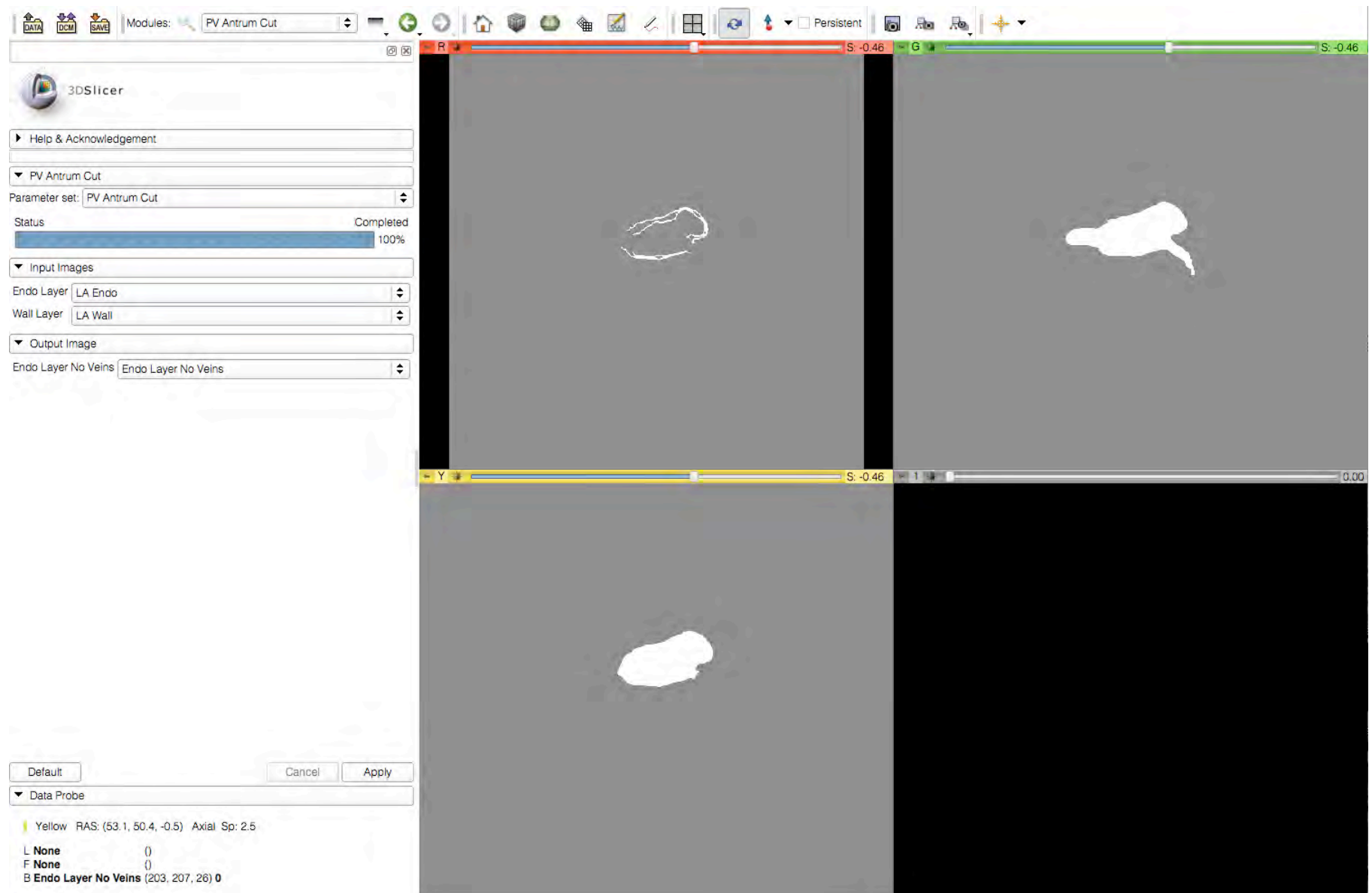
L
F
B

R -12.98 Y S: -12.96 G S: -12.96

Slicer: Scar Detection

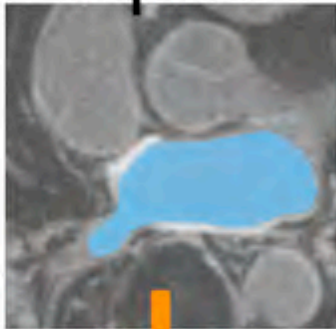


Slicer: Pulmonary Vein Removal

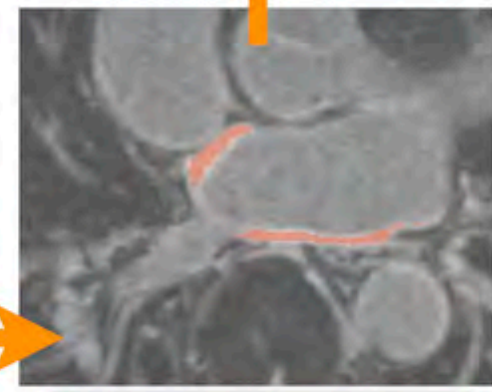
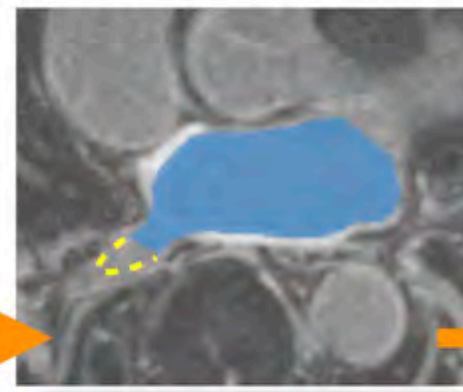
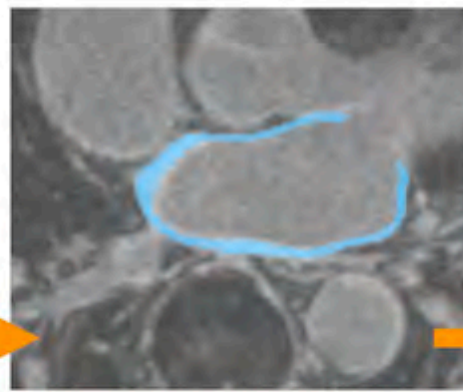
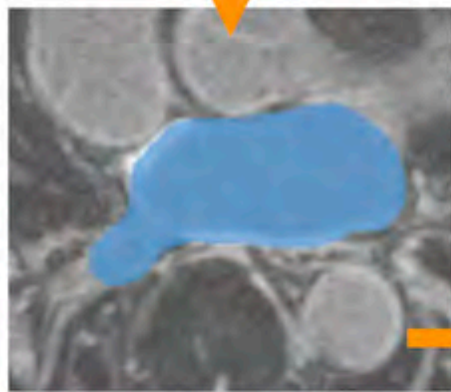
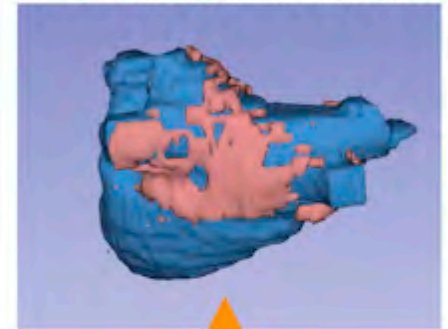


Slicer: CARMA Workflow

Inputs



Visualization



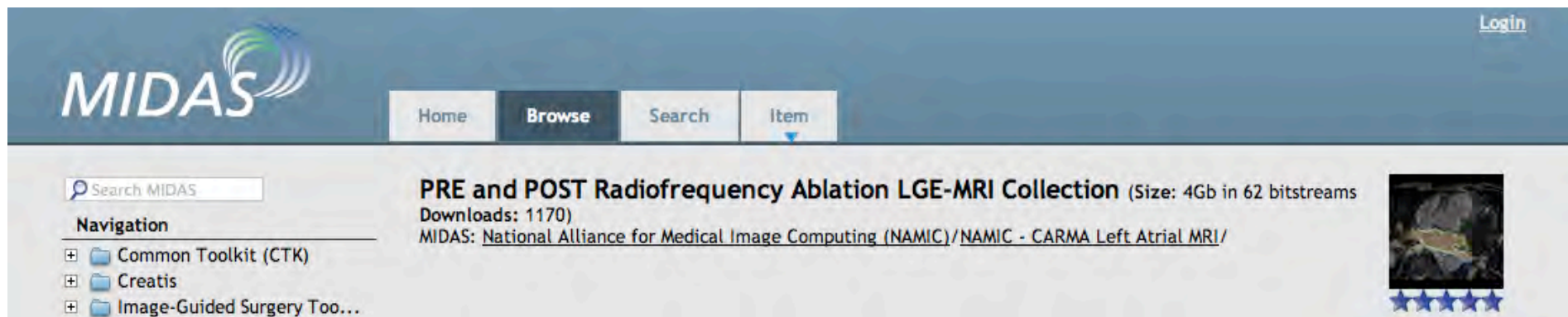
2D Dilation

Segment
Wall

PV Antrum
Cut

Scar
Detection

CARMA Makes Data Available!



The screenshot shows the MIDAS website interface. At the top left is the MIDAS logo. To the right of the logo are navigation buttons: Home, Browse (highlighted), Search, and Item. In the top right corner, there is a 'Login' link. Below the navigation bar, there is a search bar labeled 'Search MIDAS'. To the left of the search bar is a 'Navigation' section with a list of folders: Common Toolkit (CTK), Creatis, and Image-Guided Surgery Too... To the right of the search bar, the main content area displays a search result for 'PRE and POST Radiofrequency Ablation LGE-MRI Collection'. The result includes the text '(Size: 4Gb in 62 bitstreams Downloads: 1170)' and a link to 'MIDAS: National Alliance for Medical Image Computing (NAMIC)/NAMIC - CARMA Left Atrial MRI/'. To the right of the text is a small thumbnail image of an MRI scan, and below it are five blue stars.

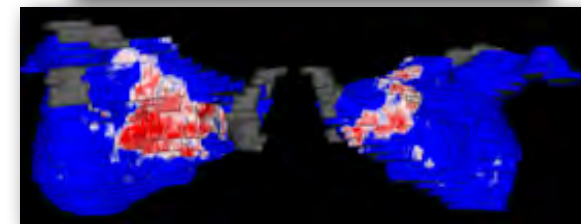
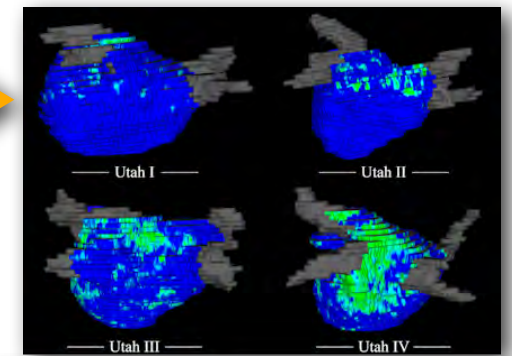
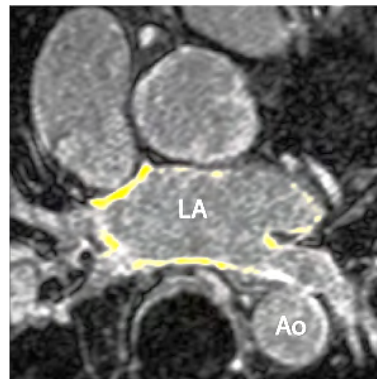
60 Patients with multiple MRI scans

<http://www.insight-journal.org/midas>

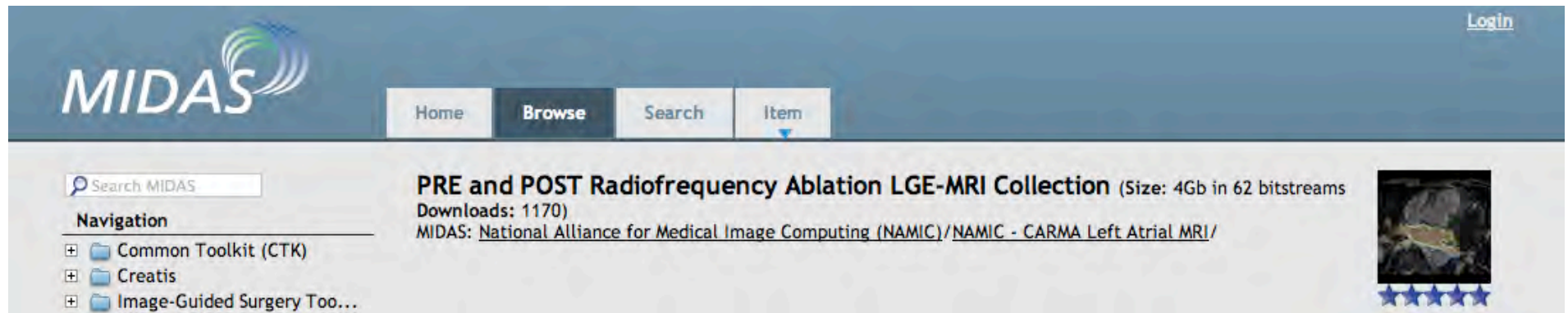


What Does CARMA Bring to NA-MIC?

Access to Image Based Medicine



Access to Data



MIDAS [Login](#)

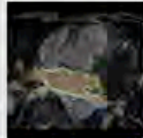
Home Browse Search Item

Search MIDAS

Navigation

- Common Toolkit (CTK)
- Creatis
- Image-Guided Surgery Too...

PRE and POST Radiofrequency Ablation LGE-MRI Collection (Size: 4Gb in 62 bitstreams
Downloads: 1170)
MIDAS: [National Alliance for Medical Image Computing \(NAMIC\) / NAMIC - CARMA Left Atrial MRI/](#)



★★★★★

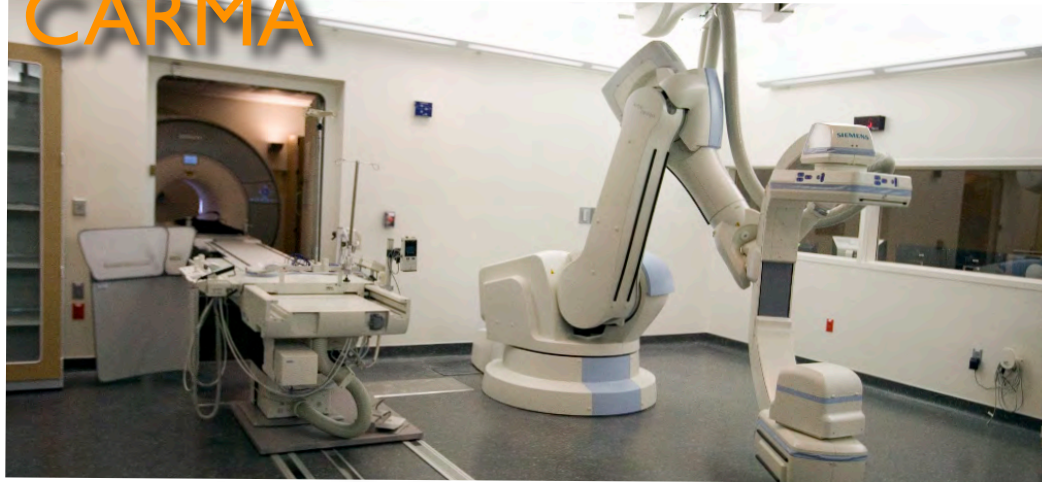


Real World Testing

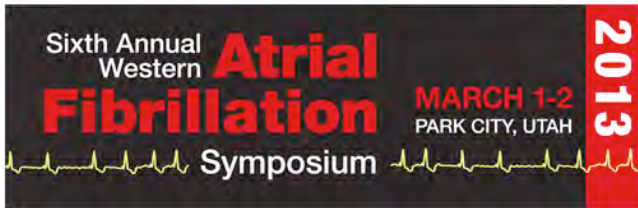


Dissemination

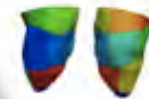
CARMA



Sixth Annual Western Atrial Fibrillation Symposium



7TH INTERNATIONAL CONFERENCE ON
FUNCTIONAL IMAGING AND MODELING OF THE HEART



LONDON, JUNE 20-22



Heart Rhythm SocietySM

EMBC 2014 - 2014 36th Annual International Conference of the IEEE
Engineering in Medicine and Biology Society (EMBC)

