Afib and Cardiac Function

Normal Contraction  Atrial Fibrillation

DBP: Atrial Fibrillation
Everyone Should Worry about Afib

AF Prevalence by Age and Gender

- Women (n=7,801)
- Men (n=10,173)


AF Prevalence Is Increasing Rapidly

Miyasaka et al. Circulation. 2006;112:119-125
Afib and the Brain


15% of All Strokes

AF prevalence
Strokes attributable to AF

Age Range (years)

AF prevalence
Strokes attributable to AF

What is AF?

AF = Substrate + Trigger
Treating AF

Drugs + Defibrillation
- Antiarrhythmics
- Anticoagulants
- Side effects
- Life long burden

Intervention
- Maze procedure
- Ablation

Drugs + Defibrillation
- Antiarrhythmics
- Anticoagulants
- Side effects
- Life long burden

Ablation of AFib
Imaging Modalities in AF

What is Image Analysis in AF?

Identifying structures
Marking structures (segmentation)
Measuring structures
Quantifying changes in structure (and function)
Quantifying Enhancement in Patients

DE-MRI with Segmented Epicardial and Endocardial Borders
Enhancement Detection

Pre-Ablation Imaging

Contrast Enhanced MRI Input - Myocardial Contours Region of Interest - Left Atrial Wall

Output - Detected Enhancement Overlaid on DE-MRI Three Standard Deviation Threshold Detected Enhancement Histogram of Pixel Intensity
Diagnostic Analysis

Successful vs. Unsuccessful Ablation

Successful

- Enhanced (fibrosis?)
- Low-voltage
- Normal

Unsuccessful

- Enhanced (fibrosis?)
- Low-voltage
- Normal
Utah AFib Staging

Utah I
0-5% Enhancement

Utah II
>5-20% Enhancement

Utah III
>20-35% Enhancement

Utah IV
>35% Enhancement

Post Ablation Analysis
Scar Mapping

Patient #1

Patient #2

Quantifying Scar

Pre-procedural MRI Scan

Follow-Up: <24 h

Follow-Up: 3 Months
### Post Treatment Evaluation

<table>
<thead>
<tr>
<th>Patient 1</th>
<th>Patient 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incomplete Isolation</td>
<td>Incomplete Isolation</td>
</tr>
<tr>
<td>First PVAI - Posterior Left</td>
<td>First PVAI - Posterior Left</td>
</tr>
<tr>
<td>Complete Isolation</td>
<td>Complete Isolation</td>
</tr>
<tr>
<td>Second PVAI - Posterior Left</td>
<td>Second PVAI - Posterior Left</td>
</tr>
</tbody>
</table>

McGann et al. JACC 52(15): 1263-1272, 2008

### The NA-MIC Goals

**Aim 1.** Develop and validate image-based longitudinal diagnostic indices for AF.

**Aim 2.** Develop automatic segmentation methods for the atrium and adjacent structures.

**Aim 3.** Develop an AF scoring scheme
The Data

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Pre</th>
<th>3 month</th>
<th>3 month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient 1</td>
<td>2D MRI</td>
<td>3D MRI</td>
<td>2D MRI</td>
<td>3D MRI</td>
</tr>
<tr>
<td>Patient 2</td>
<td>2D MRI</td>
<td>3D MRI</td>
<td>2D MRI</td>
<td>3D MRI</td>
</tr>
<tr>
<td>Patient 3</td>
<td>2D MRI</td>
<td>3D MRI</td>
<td>2D MRI</td>
<td>3D MRI</td>
</tr>
</tbody>
</table>

The Shapes
### NA-MIC Timetable

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