Afib and Cardiac Function

Normal Contraction  Atrial Fibrillation
DBP: Atrial Fibrillation
Everyone Should Worry about Afib

AF Prevalence by Age and Gender

AF Prevalence Is Increasing Rapidly


Projected Number of Persons With AF (millions)

<table>
<thead>
<tr>
<th>Year</th>
<th>Current age-adjusted AF incidence</th>
<th>Increased age-adjusted AF incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>5.1</td>
<td>5.1</td>
</tr>
<tr>
<td>2005</td>
<td>5.6</td>
<td>5.6</td>
</tr>
<tr>
<td>2010</td>
<td>6.7</td>
<td>6.1</td>
</tr>
<tr>
<td>2015</td>
<td>7.7</td>
<td>6.8</td>
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<tr>
<td>2020</td>
<td>8.9</td>
<td>7.5</td>
</tr>
<tr>
<td>2025</td>
<td>10.2</td>
<td>8.4</td>
</tr>
<tr>
<td>2030</td>
<td>11.7</td>
<td>9.4</td>
</tr>
<tr>
<td>2035</td>
<td>13.1</td>
<td>10.3</td>
</tr>
<tr>
<td>2040</td>
<td>14.3</td>
<td>11.1</td>
</tr>
<tr>
<td>2045</td>
<td>15.2</td>
<td>11.7</td>
</tr>
<tr>
<td>2050</td>
<td>15.9</td>
<td>12.1</td>
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</table>
Afib and the Brain
Afib and the Brain

15% of All Strokes

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

- Antiarrhythmics
- Anticoagulants
- Side effects
- Life long burden
Ablation of AFib
Imaging Modalities in AF

Ultrasound

Fluoroscopy

MR Angiography

Electroanatomical

Real Time MRI
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 Ablation:
- Enhanced (fibrosis?)
- Low-voltage
- Normal

Unsuccessful Ablation:
- Enhanced (fibrosis?)
- Low-voltage
- Normal

MIP: Maximal Intensity Projection
Pseudo-color
Electroanatomical Map
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
Pre
Post

Patient #2
Quantifying Scar

- Pre-procedural MRI Scan
- Follow-Up: <24 h
- Follow-Up: 3 Months

PRE          POST (3 mo)

RA          Ao
LA         PV
PV         PV
Post Treatment Evaluation

**Patient 1**
- Incomplete Isolation
- First PVAI - Posterior Left
- Second PVAI - Posterior Left

**Patient 2**
- Incomplete Isolation
- First PVAI - Posterior Left
- Second PVAI - Posterior Left

McGann et al. JACC 52(15): 1263-1272, 2008
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>3D MRI</th>
<th>3 month</th>
<th>2D MRI</th>
<th>3D MRI</th>
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</thead>
<tbody>
<tr>
<td><strong>Patient 1</strong></td>
<td></td>
<td></td>
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<tr>
<td><strong>Patient 2</strong></td>
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<tr>
<td><strong>Patient 3</strong></td>
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</table>
## 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>
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<tr>
<td>Aim 2</td>
<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>
</tr>
<tr>
<td>Aim 3</td>
<td>Design of segmentation and registration workflow and application-specific GUI</td>
<td>Prototype workflow system for integrated registration and segmentation, pre-/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>
</tr>
</tbody>
</table>
More Information

www.carmacenter.org

www.na-mic.org/pages/DBP:Atrial_Fibrillation
Enjoy Utah!!