Imaging Based Analysis of Patients with Atrial Fibrillation

Rob MacLeod, University of Utah
CARMA Center, SCI Institute, CVRTI
Bioengineering Department
The ATRIA
Fibrillation
Flutter

CARMA
What is Atrial Fibrillation?

= Afib = AF

Normal Contraction

Atrial Fibrillation
AF Prevalence

We All Get Older

So What?

20% of Strokes

$20$ billion/year
What Causes AFib?

Substrate + Trigger
Substrate: Fibrosis


Complex Propagation

de Groot, ... Allessie MA. Circ. 2010: 1674-1682.
Substrate: Extension of muscle sleeves

Triggers

Left Atrium

Pulmonary Veins
Clinical Result

Normal conduction

Atrial fibrillation

Normal electrical signals

Disorganized electrical signals

SA Node
Treatment?

Catheter Ablation
Imaging in AF

Imaging Modalities in AF

- Fluoroscopy
- Ultrasound
- Real time MRI
- MR Angiography
- Electroanatomical
Electroanatomical Mapping

MR Angiography

Pre  First Pass  Subtraction
Late Gadolinium Enhancement

Pre-treatment  3 month Post

Patient Workflow

Evaluation → Treatment → Followup
Fibrosis and Outcome

Pseudo-color

Enhanced (fibrosis?)

Low-voltage

Normal

Enhanced (fibrosis?)

Low-voltage

Normal

Utah Scoring Scheme

< 5%

5-20%

20-35%

> 35%

Fibrosis Image Analysis

Past Workflow
Corview

Evaluation

Patient Workflow

Evaluation → Treatment → Followup
Ablation Guidance

MRI Guided Ablation
Real Time MRI

March, 2011

Segmentation for Guidance

March, 2011
Electroanatomical Mapping

Patient Workflow

Evaluation → Treatment → Followup
EAM vs. MRI

Tracking Ablation

LGE (pre)  LGE (<1 hr)  LGE (3 mo)
### Repeat Ablation

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

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

### Open Challenges

- **Evaluation**
- **Treatment**
- **Followup**

Image quality

Signal Acq./Proc.

LA Segmentation

Fibrosis Detection

Scar Detection

Lesion Imaging

Case Simulation
Clinical Impact