Catheter Ablation of Atrial Fibrillation

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Atrial Fibrillation

- 5-6% of population ≥ 60 y
- 5x increased risk for thrombo-embolism (stroke)
- Antiarrhythmic drug therapy often not successful

Wolf et al. Stroke 1991
Atrial Fibrillation

*Increased prevalence in the elderly*

Growing Epidemic of Atrial Fibrillation

Miyasaka et al, Circulation 2006
Willem Einthoven and Sir Thomas Lewis
The first ECG in 1903
Willem Einthoven (Leiden/NL)
First ECG Documentation of „Auricular“ Fibrillation

“Dear Professor Einthoven,

By this post I am sending you some curves, experimental and clinical.

Please treat the curves I send as if they were your own.”

Sir Thomas Lewis,
London, January 30, 1910
The Nature of Auricular Fibrillation

Definition:

“conspicuous and continuous oscillations of varying form and dimensions, and of auricular origin, in ECG leads from the limbs.”

Sir Thomas Lewis, Heart 1921; 8: 193-227
Pulmonary Vein = Trigger

Extrasystole from pulmonary vein → Initiation of atrial fibrillation

High-Density Mapping of Pulmonary Veins

- Intracardiac registration with 64- poles **Basket-Catheter** (35 Pts)
- **Short coupling interval** of extrasystole from pulmonary vein induces **atrial fibrillation**

Goal of AF Ablation:
Electrical Isolation of Pulmonary Veins

Muscle fibers = electrical connection between left atrium and pulmonary veins

Catheter ablation of muscle fibers with radiofrequency energy

Electrical isolation of pulmonary veins

Steerable Ablation Catheter
(uni-/bi-directional)
Circular Mapping Catheter
Procedural Endpoint: Pulmonary Vein Isolation
Pulmonary Vein Isolation: Cornerstone of AF Ablation

- Point-by-point RF lesions
- Encircling 2 left and 2 right PVs
- Irrigated RF ablation catheter
- Circular mapping catheter
- 3-dimensional mapping system
- Integration of pre-acquired MRI/CT image of left atrium/PVs

Targeted Myocardial Injury by Ablation

Table 1  Troponin T elevation in all patients vs. patients receiving a direct current cardioversion

<table>
<thead>
<tr>
<th></th>
<th>Number patients</th>
<th>Mean troponin T (μg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Pre-procedure (n = 30)</td>
</tr>
<tr>
<td>All patients</td>
<td>60</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Patients with DCCV</td>
<td>12</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

DCCV, direct current cardioversion.
*P > 0.05 (patients with DCCV vs. all patients)

20x increased troponin T after AF ablation

Transseptal Puncture

„Door“ to the left atrium and the pulmonary veins
Transseptal Puncture
Electro-Anatomical Mapping System

„GPS Navigation System in the Heart“

3D-Mapping and Image Integration

CARTO™

Posterior view
Electrical Isolation of Pulmonary Veins

Posterior View
Left lower pulmonary vein
Electrical Isolation of Pulmonary Veins

Posterior View
Left lower pulmonary vein
Success Rates?
RF Ablation versus AAD

- n=167
- 19 hospitals
- Paroxysmal AF
- ≥ 1 AAD failed
- After 9 months: no AF

66% in ablation arm
16% in AAD arm

- 1 pericardial effusion
- 1 pulmonary oedema
- 1 pneumonia
- 2 life-threatening arrhythmia

Success Rate of AF Ablation

• 206 patients (230 procedures, 89% outpatients)
  • 56 years old, 74% male
  • 171 paroxysmal / 35 persistent AF
  • Duration 7.6 years

• 86% with significant reduction (>90%) of symptomatic AF

• Complication rate 3% (1 TIA and 6 pericardial tamponade)

Metaanalysis: Efficacy of AF Ablation

Calkins H et al. Treatment of Atrial Fibrillation With Antiarrhythmic Drugs or Radiofrequency Ablation: Two Systematic Literature Reviews and Meta-Analyses. Circ Arrhythm Electrophysiol 2009;2;349-361
Risks of AF Catheter Ablation

- **Pericardial tamponade (1-2%)**
  Percutaneous drainage

- **Thromboembolism (1%)**
  TEE beforehand, anticoagulation during and after procedure

- **Pulmonary vein stenosis (<1%)**
  Avoidance of ablation inside of PV

- **Atrio-esophageal fistula (<1:10.000)**
  Esophageal monitoring during procedure, energy reduction, PPI

- **Vascular access complication**

- **Left-atrial flutter (Pro-arrhythmia)**
  Redo procedure

→ Total = 2-4 %

Bertaglia et al. Heart Rhythm 2007
TEE before Ablation
USZ Clinical Care Track for AF

Pre
- CT or MRI heart
- Echo and TEE

Abl
- PVI ± substrate modification
- Monitoring esophagus

Post
- F/U 3, 6 and 12 months incl Holter
- OAC ≥ 3 months
Double Transseptal Puncture

Table 1

<table>
<thead>
<tr>
<th>Patient characteristics</th>
<th>n = 243</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>56.6 ± 9.3</td>
</tr>
<tr>
<td>Sex (male)</td>
<td>183 (75%)</td>
</tr>
<tr>
<td>Type of AF</td>
<td></td>
</tr>
<tr>
<td>Paroxysmal AF</td>
<td>195 (80.3%)</td>
</tr>
<tr>
<td>Persistent AF</td>
<td>45 (18.5%)</td>
</tr>
<tr>
<td>Permanent AF</td>
<td>3 (1.2%)</td>
</tr>
<tr>
<td>Duration of AF (years)</td>
<td>7.4 ± 6.2</td>
</tr>
<tr>
<td>Left ventricular ejection fraction (%)</td>
<td>57.9 ± 7.1</td>
</tr>
<tr>
<td>Left atrial diameter (mm)</td>
<td>43.3 ± 5.4</td>
</tr>
</tbody>
</table>

Table 2

<table>
<thead>
<tr>
<th>Procedural statistics</th>
<th>n = 269</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average procedure time (min)</td>
<td>201 ± 31</td>
</tr>
<tr>
<td>Fluoroscopy time (min)</td>
<td>41.3 ± 13.0</td>
</tr>
<tr>
<td>Major complications</td>
<td></td>
</tr>
<tr>
<td>(i) Thromboembolic event and stroke</td>
<td>1 (0.4%)</td>
</tr>
<tr>
<td>(ii) Pericardial tamponade</td>
<td>7 (2.6%)</td>
</tr>
<tr>
<td>(iii) Major vascular access complication (requiring surgery or blood transfusion)</td>
<td>none</td>
</tr>
<tr>
<td>Minor complications</td>
<td></td>
</tr>
<tr>
<td>(i) Reversible air embolism</td>
<td>1 (0.4%)</td>
</tr>
<tr>
<td>(ii) Bazold-Jarish-like reflex</td>
<td>1 (0.4%)</td>
</tr>
</tbody>
</table>

Good Candidates for AF Ablation?
AF Ablation for Patients $> 65$ y

<table>
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<tr>
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<tbody>
<tr>
<td>Inclusion age (years)</td>
<td>$\geq 65$</td>
<td>$\geq 80$</td>
<td>$\geq 80$</td>
<td>$65-74$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$70-79$</td>
<td>$75-69$</td>
<td>$\geq 75$</td>
</tr>
<tr>
<td>Mean age (years)</td>
<td>$69 \pm 3.5$</td>
<td>$82 \pm 2$</td>
<td>$84 \pm 5$</td>
<td>$68 \pm 3$</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$75 \pm 4$</td>
<td>$77 \pm 4$</td>
<td></td>
</tr>
<tr>
<td>Patients (n)</td>
<td>45</td>
<td>35</td>
<td>49</td>
<td>185</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>151</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>177</td>
<td></td>
</tr>
<tr>
<td>Procedures (n)</td>
<td>53</td>
<td>35</td>
<td>53</td>
<td>228</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>174</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>209</td>
<td></td>
</tr>
<tr>
<td>Paroxysmal AF (%)</td>
<td>87</td>
<td>46</td>
<td>55</td>
<td>62</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>53</td>
<td>53</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>Ablation strategy</td>
<td>PVI $\pm$ linear lesions</td>
<td>PVI $\pm$ linear lesions</td>
<td>PVI</td>
<td>PVI</td>
</tr>
<tr>
<td>Mean F/U (months)</td>
<td>6</td>
<td>12</td>
<td>18</td>
<td>27</td>
</tr>
<tr>
<td>Periprocedural complication rate (%)</td>
<td>1.9</td>
<td>2.8</td>
<td>0.2</td>
<td>0.4</td>
</tr>
<tr>
<td>- Pericardial tamponade</td>
<td>0</td>
<td>0</td>
<td>0.7</td>
<td>0.8</td>
</tr>
<tr>
<td>- Deep venous thrombosis</td>
<td>0</td>
<td>0</td>
<td>0.7</td>
<td>0.8</td>
</tr>
<tr>
<td>- CVA/TIA</td>
<td>0</td>
<td>0</td>
<td>0.9</td>
<td>0</td>
</tr>
<tr>
<td>- Retroperitoneal bleeding</td>
<td>0</td>
<td>0</td>
<td>0.7</td>
<td>0.8</td>
</tr>
<tr>
<td>- Pseudoaneurysm/AV fistula</td>
<td>0</td>
<td>0</td>
<td>0.5</td>
<td>2.7</td>
</tr>
<tr>
<td>Freedom of AF (%)</td>
<td>74</td>
<td>78</td>
<td>70</td>
<td>84</td>
</tr>
</tbody>
</table>
Cryoballoon Catheter

Arctic Front® (Medtronic CryoCath LP Ltd.)
Risk of X-Ray for Patient and Staff
Risk of X-Ray for Patient and Staff

- Single AF ablation confers an additional lifetime risk for fatal cancer of 0.2% for patient \(^1\)

- Lifetime risk for fatal cancer following a 15-year X-ray exposure is 0.5% for operator \(^2\)

- Birth defects

- Cataracts

\(^1\) Lickfett L et al. Circulation 2004
Minimize Radiation Exposure!

• **Complex procedure** (double TSP, extensive RF application)

• Often **CT scan** beforehand (alternatively MRI !)

• Sometimes invasive **coronary angiograms**

• **Repeated procedures** (cumulative dose !)
The USZ Zero-Fluoroscopy AF Ablation

University Hospital Zurich
The USZ Zero-Fluoroscopy AF Ablation

Intra-cardiac echo

University Hospital Zurich
Laser Energy

Visually Guided Energy Delivery

Magnetic Catheter Steering System
Early Care in AF

EAST Trial

- 3000 patients
- 200 European centers
- Follow-up 4 years

Switzerland  
Laurent Haegeli, Zurich
Belgium  
Hein Heidbuchel, Leuven
Czech Republic  
Josef Kautzner, Prague
Denmark  
Axel Brandes, Odense
France  
Etienne Aliot, Nancy
Germany  
Stephan Willems, Hamburg
Great Britain  
John Morgan, Southampton
Italy  
Michele Gulizia, Catania
Sakis Themistoclakis, Venice
Netherlands  
Isabelle van Gelder, Groningen
Poland  
Lukasz Szumowski, Warsaw
Spain  
Lluis Mont, Barcelona
Indications for Catheter Ablation of AF

- Symptomatic patients with paroxysmal and persistent atrial fibrillation!
Indications for Catheter Ablation of AF

- **Symptomatic patients** with paroxysmal and persistent atrial fibrillation!

- After **one** antiarrhythmic drug failure

- **No** indications are:
  - *asymptomatic patients with AF*
  - *patient wish to discontinue anticoagulation*
AF Ablation Therapy

• **Success rates** for paroxysmal atrial fibrillation are **70-90%** (with 1-2 procedures)

• Major complications occur in **2-3 %**
Thank you!
Questions?