Persistent AF Ablation guided by non-invasive mapping

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Advisory Board: Medtronic
PERSISTENT AF PHYSIOPATHOLOGY BEGINS WITH INITIATING TRIGGERS...

SPONTANEOUS INITIATION OF ATRIAL FIBRILLATION BY ECTOPIC BEATS ORIGINATING IN THE PULMONARY VEINS

Michel Haïssaguerre, M.D., Pierre Jaïs, M.D., Dipen C. Shah, M.D., Atsushi Takahashi, M.D., Meleze Hocti, M.D., Gilles Quiniou, M.D., Stéphane Garrigue, M.D., Alain LeMouroux, M.D., Philippe Le Metayer, M.D., and Jacques Clementy, M.D.


RAPID FIRING (REPETITIVE SHORT BURSTS) EMANATING FROM ATRIAL FOCI

MOSTLY LOCALIZED IN PULMONARY VEINS AT THE EARLY STAGE OF AF
PERSISTENT AF PHYSIOPATHOLGY... WHICH PROMOTE PERPETUATING DRIVERS

Treatment of Atrial Fibrillation by the Ablation of Localized Sources
CONFIRM (Conventional Ablation for Atrial Fibrillation With or Without Focal Impulse and Rotor Modulation) Trial
Sanjiv M. Narayan, MD, PtD,‡ David E. Krummen, MD,‡ Kalynan Shivkumar, MD, PtD,‡ Paul Clopton, MS,‡ Wouter-Jan Rappel, PtD,§ John M. Miller, MD||

Driver Domains in Persistent Atrial Fibrillation
Michel Haissaguerre, MD; Meleze Hocini, MD; Arnaud Denis, MD; Ashok J. Shah, MD; Yuki Komatsu, MD; Seigo Yamashita, MD; Matthew Daly, MD; Sana Amraoui, MD; Stephan Zellerhoff, MD; Marie-Quitterie Picat, MD; Adam Quoib, PhD; Laurence Jesel, MD; Han Lirm, MD; Sylvain Ploux, MD; Pierre Bordachar, MD; Guillaume Attuel, PhD; Valentin Meillet, MSc; Philippe Ritter, MD; Nicolas Derval, MD; Frederic Sacher, MD; Olivier Bernus, PhD; Hubert Cochet, MD; Pierre Jais, MD; Remi Dubois, PhD
(Circulation. 2014;130:530-538.)
NONINVASIVE MAPPING TECHNIQUE
GLOBAL PANORAMIC MAPPING = ECVUE

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**AF mapped from the surface**

**Foci**

**Reentries**

**Multiple wavelets**

Signal processing reconstructing Epicardial Egm
Beat to beat mapping
Spatial precision of 6-10mm
AF drivers are Multiple, Instable and Anatomically Clustered
AF drivers, ‘rotors’ are short lived (2,3 rotation), meandering.
AF drivers recurred in multiple regions: mean 4.3
FOCAL DISCHARGES
Mainly observed from PVs (60 % of pts)
LAA or RAA

AF DRIVER DISTRIBUTION
Strong link of AF drivers with specific metrics of structural heterogeneities

Linked to macroscopic PV, LAA orifices inferior LA (Haissaguerre, Hocini et al)

Anchored at distinct parts of MRI fibrosis (Cochet et al)

Driver domains harbor a part of CFAE areas (Ammar, Deisenhofer et al)

Patient specific simulations showing anchoring of reentries at specific topologic metrics (Boyle, Trayanova et al)

More of AFCL 71% versus 47%, \( P < 0.001 \)
ABLATION TECHNIQUE
Transform rapid complex signals into slower organized signals
Transform rapid complex signals into slower organized signals
EARLY-STAGE PERSISTENT ATRIAL FIBRILLATION

FREQUENTLY ASSOCIATED WITH OPTIMAL SIGNAL CONDITIONS

<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td>AGE</td>
<td>58 years</td>
</tr>
<tr>
<td>AF HISTORY</td>
<td>68 months</td>
</tr>
<tr>
<td>EPISODE MAX. DURATION</td>
<td>3 months</td>
</tr>
<tr>
<td>LEFT APPENDAGE CYCLE LENGTH (LAA-CL)</td>
<td>160 ms</td>
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</table>

SMALL LEFT ATRIAL VOLUME = 160 mL

ATRIAL SURFACE-ECG VOLTAGE = MILD
EARLY-STAGE PERSISTENT ATRIAL FIBRILLATION
FREQUENTLY ASSOCIATED WITH OPTIMAL SIGNAL CONDITIONS

ECVUE MAPPING

NUMBER OF DRIVER’S AREAS = 2
LOCATION OF DRIVER’S AREAS = Left antrum - Septum

RF TIME TO AF TERMINATION = 3 mins
LAA-CL JUST BEFORE TERMINATION = -
LAA-CL MAXIMUM INCREASE = -
TERMINATION DIRECTLY TO SINUS RHYTHM = Yes
EARLY-STAGE PERSISTENT ATRIAL FIBRILLATION

AS DEMONSTRATED BY THE PROCEDURAL COURSE

Sinus rhythm at the 1st «hot-spot» after 73s...

AF mechanically induced at the 2nd «hot-spot»

Common flutter at the 1st «hot-spot» after 132s...
- **Population**: 613 pts with persistent AF
  - Pers AF in SR - Ps AF <12 mths - LL PsAF >12mths
  - SHD in 54% of cases – No exclusion criteria

- **Ablation**
  Atrial driver ablation in hierarchical order
  Dominant PV antrum drivers –start by WACA (10% AF term)

- **Procedural EndPoint**
  Termination of AF and secondary AT - then PVI
PERSISTENT ATRIAL FIBRILLATION

WITH A MORE DIFFUSE DISTRIBUTION OF THE DRIVERS

ECVUE MAPPING

NUMBER OF DRIVER’S AREAS = diffuse
LOCATION OF DRIVER’S AREAS = Left antrum - Posterior – Septum – Right lateral

RF TIME TO AF TERMINATION 37 mins
LAA-CL JUST BEFORE TERMINATION 190 ms
LAA-CL MAXIMUM INCREASE +30 ms
TERMINATION DIRECTLY TO SINUS RHYTHM Yes
MIDDLE-STAGE PERSISTENT ATRIAL FIBRILLATION

ESSENTIAL ROLE OF THE ABLATION ENDPOINT

Left antrum local organisation post-ablation

Posterior wall local organisation post ablation

Septum local organisation post ablation

Back to sinus rhythm after right atrium ablation
HOW TO IMPROVE OUTCOME?
1. **Earlier Ablation** (few months of PsAF)
Restoration of **SR** prior to AF ablation in longer lasting AF  
(Arentz et al - Rivard et al - Steinberg et al)

2. **AADrugs ?** (Prolong short AF CLCL)
What to do when AF persists after driver ablation?

1. Is local endpoint achieved?

Check driver regions (including PV antra) to ensure abolition of rapid/disorganized egms

- Left antrum local organisation post-ablation
- Posterior wall local organisation post ablation
- Septum local organisation post ablation
- Back to sinus rhythm after RA ablation
What to do when AF persists after driver ablation?

2. Unability to achieve local endpoint?
What to do when AF persists after driver ablation?

Ablation in the right atrium

1. ~ 40% RA drivers can disappear with LA ablation (RA projection of LA drivers- RAfoci/ triggered activity – RA mirror of LA rotors)

2. RA Ablation is performed after LA ablation; with persistent RA drivers & Short AFCL in RA
AF Re mapping during Ablation

Driver abolished

Persistent driver

New Driver
AF Termination Targeting Driver Regions

- Persistent in SR: 86%
- Persistent (1-3m): 60%
- Persistent (4-6m): 30%
- Persistent (7-9m): 12%
- Persistent (10-12m): 0%
- Long Lasting: 0%

PV alone < 10% of AF term

Term
118 persistent patients (<12mo) at 8 EU centers
Demonstrate feasibility & reproducibility of a new & improved approach to mapping and ablation of Ps AF

Knecht et al Europace 2016
68% Of Atrial Tachycardias Occurred At The Same Sites As AF Drivers
RF Duration for AF termination: Driver vs Stepwise ablation

Mean Minutes of RF

SR 1-6 mon 7-12 mon >12 mon
Persistent AF

Approximately - 50% - 38% - 27%

P < 0.001
## Clinical Outcome

<table>
<thead>
<tr>
<th></th>
<th>Sinus Rhythm, n (%)</th>
<th>Atrial Tachycardia</th>
<th>Atrial Fibrillation</th>
<th>AF-Free, *%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Paroxysmal</td>
<td>Persistent</td>
<td>Paroxysmal</td>
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<tr>
<td><strong>Based on continuous AF duration</strong></td>
<td></td>
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<tr>
<td>Presenting in sinus rhythm (n=23)</td>
<td>17 (74)</td>
<td>1</td>
<td>1</td>
<td>4</td>
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<tr>
<td>AF ≤6 mo (n=25)</td>
<td>17 (68)</td>
<td>1</td>
<td>3</td>
<td>3</td>
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<tr>
<td>AF 7–12 mo (n=22)</td>
<td>14 (64)</td>
<td>3</td>
<td>2</td>
<td>1</td>
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<tr>
<td>AF &gt;12 mo (n=20)</td>
<td>10 (50)</td>
<td>0</td>
<td>3</td>
<td>1</td>
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<tr>
<td>Total</td>
<td>58</td>
<td>14</td>
<td>18</td>
<td></td>
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<tr>
<td><strong>Based on AF termination</strong></td>
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<tr>
<td>Termination (n=71)</td>
<td>47 (66)</td>
<td>5</td>
<td>8</td>
<td>9</td>
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<tr>
<td>Nontermination (n=19)</td>
<td>11 (58)</td>
<td>0</td>
<td>1</td>
<td>0</td>
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<td>Total</td>
<td>58</td>
<td>14</td>
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Conclusions

1. AF drivers are Meandering and ShortLasting in regions of Structural heterogeneities and Complex egms.

2. Their ablation allows AF termination in most PSAF with lesser RF delivery –early PsAF/SR- but AT recurrence remains substantial

3. Remapping can confirm elimination or persistence of drivers or show new drivers (requiring further ablation) thus increasing rate of AF termination.

4. Further improvement expected with panoramic mapping of AT and new ablation catheters and better definition of local ablation endpoint