Strategy for Index Ablation Procedure in Persistent AF: PVI is Enough

- Cons -

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Disclosures : Non
Background

- The natural history of AF is a progression from PAF to PeAF and then to Permanent AF over time.
- Persistent AF includes huge kinds of spectrums of AF
  1) Paroxysmal atrial fibrillation (PAF),
  2) Persistent AF (PeAF), long Standing PEAF (LSPeAF),
  3) Permanent AF even
- Undoubtedly, pulmonary vein (PV) isolation is cornerstone but we should consider more non-PV foci, and substrate modification
PAF develops into PeAF with overall rate of 5.5% per year.

“Is PVI isolation alone enough for termination of persistent AF?”
PV Isolation: Unsatisfactory for persistent AF

Possible Lesion set for Ablation in PeAF patients.

- CPVI (Circumferential PV isolation)
- Linear ablation (LA roof, mitral isthmus)
- Non-PV triggers initiated with high dose isoproterenol
- Complex fractionated atrial electrograms (CFAEs)
- Other thoracic veins (SVC, coronary sinus)
- Stepwise approach (PVI, CFAEs, roof, mitral isthmus, CS)
- Phase mapping for rotors/focal sources (FIRM)
- Autonomic inputs
Additional LA linear ablation reduces recurrence of AF

Impact of Linear ablation on clinical outcomes in PeAF - meta-analysis

- **Fassini** ④ (2005) 187 12 RCT SC 33 PVI (92)  PVI + ML (95)  -

- **Willems** ① (2006) 62 16 RCT SC 100 PVI + CTI (30)  PVI + CTI + RL + ML (32)  -

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>Weight</th>
<th>M-H, random, 95% CI</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fassini</td>
<td>20.7%</td>
<td>0.38 [0.20, 0.74]</td>
<td>2005</td>
</tr>
<tr>
<td>Willems</td>
<td>23.0%</td>
<td>0.39 [0.23, 0.67]</td>
<td>2006</td>
</tr>
<tr>
<td>Gaita</td>
<td>27.6%</td>
<td>0.72 [0.54, 0.97]</td>
<td>2008</td>
</tr>
<tr>
<td>Verma 2015</td>
<td>28.6%</td>
<td>1.20 [0.96, 1.50]</td>
<td>2015</td>
</tr>
</tbody>
</table>

Total (95% CI) 100.0% 0.64 [0.37, 1.09]

Total events
Heterogeneity: $\chi^2 = 24.23$, $df = 3$ ($P < 0.0001$); $I^2 = 88$
Test for overall effect: $Z = 1.66$ ($P = 0.10$)

CFAE ablation in addition to PVI on clinical outcomes in PeAF - meta-analysis

<table>
<thead>
<tr>
<th>Study (year)</th>
<th>Patient no.</th>
<th>Mean/median follow-up time (months)</th>
<th>Design</th>
<th>Persistent AF (%)</th>
<th>Ablation strategies</th>
<th>Ablation endpoint and for LALA acute success of block across line</th>
<th>CFAE ID or acute LALA block</th>
<th>CFAE/linear ablation sites</th>
<th>Endpoint used in meta-analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verma 2007</td>
<td>200</td>
<td>12</td>
<td>CCS SC</td>
<td>40</td>
<td>PVI (100)</td>
<td>PVI + CFAE (100)</td>
<td>Visual</td>
<td>LA septum/ anterior wall</td>
<td>AF/AT beyond 2 months</td>
</tr>
<tr>
<td>Elayi 2008</td>
<td>144</td>
<td>16</td>
<td>RCT MC</td>
<td>100</td>
<td>PVI (48)</td>
<td>PVI + CFAE (49)</td>
<td>Visual</td>
<td>LA/RA/CS</td>
<td>AF/AT &gt; 1 min beyond 2 months</td>
</tr>
<tr>
<td>Lin 2009</td>
<td>60</td>
<td>19</td>
<td>PCS SC</td>
<td>100</td>
<td>PVI + RL + ML (30)</td>
<td>PVI + RL + ML + CFAE (10)</td>
<td>Auto</td>
<td>LA/CS</td>
<td>Off AADs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>Weight</th>
<th>Risk ratio M-H, random, 95% CI</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verma 2007</td>
<td>8.3%</td>
<td>0.64 [0.27, 1.47]</td>
<td>2007</td>
</tr>
<tr>
<td>Elayi</td>
<td>16.3%</td>
<td>0.64 [0.42, 0.98]</td>
<td>2008</td>
</tr>
<tr>
<td>Lin</td>
<td>11.8%</td>
<td>0.50 [0.27, 0.93]</td>
<td>2009</td>
</tr>
<tr>
<td>Oral</td>
<td>19.4%</td>
<td>1.03 [0.76, 1.39]</td>
<td>2009</td>
</tr>
<tr>
<td>Verma 2010</td>
<td>4.1%</td>
<td>0.26 [0.07, 1.00]</td>
<td>2010</td>
</tr>
<tr>
<td>Dixit</td>
<td>19.0%</td>
<td>1.39 [1.01, 1.90]</td>
<td>2012</td>
</tr>
<tr>
<td>Verma 2015</td>
<td>21.1%</td>
<td>1.13 [0.90, 1.42]</td>
<td>2015</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td>100.0%</td>
<td>0.86 [0.64, 1.16]</td>
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</table>

**Total events**

- Heterogeneity: $\tau^2 = 0.10$; $\chi^2 = 20.15$, df = 6 ($P = 0.003$); $I^2 = 70\%$
- Test for overall effect: $Z = 1.00$ ($P = 0.32$)

In certain PeAF patients, PVI alone may be adequate (SARA Study)

- Exclusion Criteria
  - Long-standing persistent AF (> 1yr)
  - Structure heart disease (HCMP, valvular heart disease, etc)
  - LVEF < 30%
  - LAA diameter > 50 mm

Ablation of persistent AF – where to ablate:
STAR-AF II trial

The NEW ENGLAND JOURNAL OF MEDICINE

ORIGINAL ARTICLE

Approaches to Catheter Ablation for Persistent Atrial Fibrillation

Atul Verma, M.D., Chen-yang Jiang, M.D., Timothy R. Betts, M.D., M.B., Ch.B., Jian Chen, M.D., Isabel Deisenhofer, M.D., Roberto Mantovan, M.D., Ph.D., Laurent Macle, M.D., Carlos A. Morillo, M.D., Wilhelm Haverkamp, M.D., Ph.D., Rukshen Weerasooriya, M.D., Jean-Paul Albenque, M.D., Stefano Nardi, M.D., Endrij Menardi, M.D., Paul Novak, M.D., and Prashanthan Sanders, M.B., B.S., Ph.D., for the STAR AF II Investigators*

- 589 Patients were randomized in a 1:4:4 ratio to PVI alone, PVI + CFAE ablation, or PVI + linear ablation

NEJM 2015;372:1812-22
STAR AF II – Less may be more?

- No significant difference in arrhythmia recurrence among the three arms during 18 months.
No benefit of atrial substrate ablation in patients with persistent AF ??

1. Varieties of spectrum
: huge varieties of patients in same definition of persistent AF
   only Ic drug refractory, multiple drugs challenges
   and/or multiple cardioversions with high dose of amiodarones...

2. Definition of Persistent AF

**STAR-AF II**
- Between November 2010 and July 2012
- Exclusion criteria:
  1) paroxysmal atrial fibrillation,
  2) sustained atrial fibrillation lasting more than 3 years, LAD of 60 mm or greater.
Definition of AF

2006, 2010 ESC/AHA/ACC guideline

First diagnosed episode of atrial fibrillation

- Paroxysmal AF (usually ≤48 h) or 7 days
- Persistent AF (>7 days or requires CV)

2014 AHA/ACC/HRS guideline

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tr>
<td>Paroxysmal AF</td>
<td>• AF that terminates spontaneously or with intervention within 7 d of onset.</td>
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<tr>
<td></td>
<td>• Episodes may recur with variable frequency.</td>
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<tr>
<td>Persistent AF</td>
<td>• Continuous AF that is sustained &gt;7 d</td>
</tr>
<tr>
<td>Long-standing persistent AF</td>
<td>• Continuous AF &gt;12 mo in duration.</td>
</tr>
<tr>
<td>Permanent AF</td>
<td>• The term “permanent AF” is used when the patient and clinician make a joint decision to stop further attempts to restore and/or maintain sinus rhythm.</td>
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<td></td>
<td>• Acceptance of AF represents a therapeutic attitude on the part of the patient and clinician rather than an inherent pathophysiological attribute of AF.</td>
</tr>
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<td></td>
<td>• Acceptance of AF may change as symptoms, efficacy of therapeutic interventions, and patient and clinician preferences evolve.</td>
</tr>
</tbody>
</table>
AF ablation site and outcomes in our hospital (2009. 3 ~ 2015. 12)

- Procedure number = 1121 procedures (redo: 147 /13.1%)
- Follow up duration : mean 35.2 months
- Type of AF:
  - Paroxysmal: 583 (52.0%)
  - Persistent: 538 (48.0%)
Our center data: Recurrence-free survival - de novo procedure (2009.3~2015.12)

- 2-year arrhythmia freedom rate:
  - Paroxysmal AF: 79.6%
  - Persistent AF: 67.0%

- AAD discontinuation rate for persistent AF:
  - 24.9% including BB
  - 49.5% excluding BB
Ablation strategies for persistent AF in our center

- Frequencies…

- Only PVI*
- Roof line: 78.4%
- Inferior line: 52.1%
- PMI: 43.4%
- Ant line: 40.9%
- CTI: 90.9%
- SVC isolation: 19.4%
- VOM ablation: 29.8%
- CFAE: 3.8%

*Patients with concomitant CTI ablation are included
Non-PV foci of AF

1) Vein of Marshall, Persistent Lt SVC (PLSVC)
2) LA post wall
3) Ant septal trigger,
4) CS, CS os
5) Mitral annulus
6) SVC
7) CT, Eustachian ridge,
Non-PV foci of AF

Pasqale S, Heart Rhythm 2017;14:1087-1096
48/M, PeAF for 3yrs. HBP, DM, EF 62%, LA : 41mm

After PVI
Fluoroscopic figures of VOM

- Patients who had still AF after PV isolation
Vein of Marshall
VOM electrocardiogram other patients
AF termination
55/M, PeAF for 6yrs. HBP, EF 66%, LA: 46mm
After PVI

Ant. Septum
Aorta attachment site

Ant. Septum
AF termination
Ablation site
68/F, PEAf for 3-4 yrs

- HBP, EF: 64%. LAD: 48mm, CHADS VASC: 3

After all PV isolation
After Roof ablation

Post Wall
During Inf. line ablation

Post Wall
Termination of AF

Post Wall
Recurrence free survival: De novo procedure

2-year arrhythmia freedom rate:
- Paroxysmal AF: 79.6%
- Persistent AF: 67.0%
Recurrent type vs free survival: Redo procedure

- Overall 2-year sinus rhythm maintenance: 79.4%
- In patients showing recurrent AT, after prior AF ablation, redo RFCA can result in greater long term success.
Conclusions

1. PV isolation alone may only be effective in selected patients, whereas the majority requires an additional substrate modification.

2. Alternative more patient-specific approaches including extra PV foci and additional lines to substrate modification should be developed.
Thank you for your attention.