Stand alone maze: when and how?

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HVSI

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Type of atrial fibrillation

- First diagnose AF
- Paroxysmal AF: self-terminating < 48h
- **Persistent AF: > 7d, cardioversion, drugs**
- **Long-standing persistent AF: > 1y**
- Permanent AF: accepted by patients
Treatment

• Medical treatment
• Catheter ablation  
  – Ready for first-line therapy
• **Surgical treatment**  
  – Conventional  
  – Minimal invasive maze  
  – Hybrid procedure
Surgical treatment

- The Cox-Maze III procedure
- The Cox-Maze IV procedure
- Minimal invasive surgery
  - Bilateral thoracoscopic approach
  - Right-side thoracoscopic approach
  - Right-side thoracotomy approach
  - Exclusion/excision of the left atrial auricle
Indications for surgery

- Based on the HRS/EHRA/ECA expert consensus statement

- **Symptomatic** AF patients
  - Who prefer a surgical approach
  - Who have *failed one or more catheter ablation*
  - Patients who have developed a *contraindication to warfarin*
  - Patients who will benefit from *the elimination of LAA*
  - Patients with a left atrial *thrombus* (contraindicated to catheter ablation)
  - **Large left atria > 5cm (relative indication)**
Ideal procedure

- Less invasive
- Hybrid
- More effective

- Sinus rhythm
- No drugs
- Atrial reverse remodeling
Effectiveness

Minimal invasive

Conventional
The Cox-Maze Procedure

James L. Cox

The Cox-Maze Procedure: A Single-Center Experience Over 2 Decades

Timo Weimar, Stefano Schena, Marc S. Bailey, Hersh S. Maniar, Richard B. Schuessler, James L. Cox and Ralph J. Damiano, Jr

Circ Arrhythm Electrophysiol. 2012:5:8-14; originally published online November 17, 2011:
doi: 10.1161/CIRCEP.111.963819

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Cox-Maze III procedure
Cox-Maze IV procedure
Results

Table 3. Late Follow-up

<table>
<thead>
<tr>
<th>Variable</th>
<th>CMP III (n=112)</th>
<th>CMP IV (n=100)</th>
<th>CMP III + IV (N=212)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Follow-up, median (IQR), y</td>
<td>5.9 (2.5–7.8)</td>
<td>1.0 (0.74–1.9)</td>
<td>2.2 (0.9–6.2)</td>
</tr>
<tr>
<td>Freedom from AF*</td>
<td>96 (86–98)</td>
<td>90 (81–95)</td>
<td>93 (87–96)</td>
</tr>
<tr>
<td>Freedom from AF off antiarrhythmics*</td>
<td>83 (68–88)</td>
<td>82 (71–89)</td>
<td>82 (75–87)</td>
</tr>
<tr>
<td>Freedom from warfarin*</td>
<td>86 (75–92)</td>
<td>74 (62–83)</td>
<td>80 (72–86)</td>
</tr>
<tr>
<td>Late stroke (&gt;30 d), no. (%)</td>
<td>1 (0.8)</td>
<td>0</td>
<td>1 (0.4)</td>
</tr>
</tbody>
</table>

*Data are given as mean (95% CI).*
### Table 2. Perioperative Variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>CMP III (n=112)</th>
<th>CMP IV (n=100)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPB time, median (IQR), min</td>
<td>163 (145–183)</td>
<td>129 (113–150)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>CCT, mean (95% CI), min</td>
<td>90 (73.5–105)</td>
<td>39 (33.2–46.7)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>30-d Mortality</td>
<td>2 (2)</td>
<td>1 (1)</td>
<td>0.625</td>
</tr>
<tr>
<td>Early ATAs</td>
<td>38 (34)</td>
<td>40 (40)</td>
<td>0.732</td>
</tr>
<tr>
<td>Pacemaker implantation ≤90 d</td>
<td>9 (8)</td>
<td>7 (7)</td>
<td>0.776</td>
</tr>
<tr>
<td>Major complication rate</td>
<td>11 (10)</td>
<td>1 (1)</td>
<td>0.003</td>
</tr>
<tr>
<td>Reoperation for bleeding</td>
<td>3 (3)</td>
<td>0</td>
<td>…</td>
</tr>
<tr>
<td>Early stroke ≤30 d</td>
<td>1 (1)</td>
<td>1 (1)</td>
<td>…</td>
</tr>
<tr>
<td>Renal failure</td>
<td>2 (2)</td>
<td>0</td>
<td>…</td>
</tr>
<tr>
<td>Mediastinitis</td>
<td>1 (1)</td>
<td>0</td>
<td>…</td>
</tr>
<tr>
<td>Intra-aortic balloon pump</td>
<td>4 (4)</td>
<td>0</td>
<td>…</td>
</tr>
</tbody>
</table>
Minimally Invasive Stand-Alone Cox-Maze Procedure for Patients With Nonparoxysmal Atrial Fibrillation

Niv Ad, MD, Linda Henry, PhD, Ted Friehling, MD, Marc Wish, MD, and Sari D. Holmes, PhD

Inova Heart and Vascular Institute, Falls Church, Virginia

On pump via right mini–thoracotomy

Background. Catheter-based ablation for atrial fibrillation (AF) performed percutaneously is shown to be limited in patients with nonparoxysmal AF (non-PAF). The full Cox-Maze surgical procedure demonstrated good success with non-PAF, but concerns were raised regarding increased morbidity eliminating the effect of the success rate. This study assessed the safety and efficacy of a stand-alone on-pump Cox-Maze procedure for non-PAF.

Methods. Since 2005, 104 stand-alone Cox-Maze procedures for non-PAF were performed through a right minithoracotomy (6 cm) with femoral cannulation. Patients were monitored prospectively through our AF registry. Rhythm was verified by electrocardiogram and 24-hour Holter monitoring. Health-related quality of life (SF-12 Health Survey, Quality Metric, Lincoln, RI) and AF symptoms were assessed.

Results. Patients were a mean age of 55.9 ± 9.0 years, and 78% had long-standing persistent AF. Patient outcomes included no operative (30 days) deaths or renal failure, 1 pacemaker, and 1 transient ischemic attack. The return to sinus rhythm at 6, 12, 24, 36 months was 94%, 94%, 92%, 92%, and off antiarrhythmic drugs was 87%, 87%, 79%, 80%, respectively. The success rate at 6 months after the initial 20 patients improved from 89% to 94%. Multivariate analysis found duration of AF predicted rhythm at 6 months (odds ratio, 1.15; 95% confidence interval, 1.01 to 1.31; p = 0.04). Significant improvement was noted for health-related quality of life and decreased AF symptoms at 1 year.

Conclusions. The long-term success rate after the Cox-Maze III procedure in a challenging group of non-PAF patients is acceptable. Our experience suggests the development of educational strategies to overcome the initial learning curve and patient selection criteria for AF surgical ablation.

Return to sinus rhythm

![Graph showing percentage of patients returning to sinus rhythm at 6M, 12M, 24M, and 36M.](chart)

- 6M: Overall 94%, Off AAD 87%
- 12M: Overall 94%, Off AAD 87%
- 24M: Overall 92%, Off AAD 79%
- 36M: Overall 92%, Off AAD 80%
Total thoracoscopic ablation
Thoracoscopic ablation

• Easy pulmonary vein isolation
  – Bipolar: transmurality
  – Shorter time, narrow ablation lines
  – May result in early LA function restoration.

• Epicardial ablation
  – Marshall vein, GP, Superior, inferior lines
  – LA resection
  – Stapling, LA clip (several types)

• Minimal invasive (3mm instruments)
Ideal thoracoscopic ablation
## Thoracoscopic maze procedure

### Previous Studies With a Similar Surgical Technique

<table>
<thead>
<tr>
<th></th>
<th>Edgerton et al.(^2)</th>
<th>Krul et al.(^4)</th>
<th>Sirak et al.(^3)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of study</strong></td>
<td>Prospective</td>
<td>Prospective</td>
<td>Retrospective</td>
</tr>
<tr>
<td><strong>Number of cases</strong></td>
<td>30</td>
<td>31</td>
<td>32</td>
</tr>
<tr>
<td><strong>Age (mean in years)</strong></td>
<td>58</td>
<td>57</td>
<td>61.5</td>
</tr>
<tr>
<td><strong>Gender; male (%)</strong></td>
<td>86</td>
<td>81</td>
<td>65.6</td>
</tr>
<tr>
<td><strong>Body mass index (mean)</strong></td>
<td>NA</td>
<td>29 kg/m(^2)</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Diabetes mellitus (%)</strong></td>
<td>NA</td>
<td>3</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Hypertension (%)</strong></td>
<td>NA</td>
<td>32</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Stroke (%)</strong></td>
<td>NA</td>
<td>3</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Duration of atrial fibrillation (years)</strong></td>
<td>NA</td>
<td>8</td>
<td>7.7</td>
</tr>
<tr>
<td><strong>Type of atrial fibrillation</strong></td>
<td>Persistent</td>
<td>Paroxysmal (52%) or persistent</td>
<td>Persistent</td>
</tr>
<tr>
<td><strong>Previous catheter ablation (%)</strong></td>
<td>NA</td>
<td>45</td>
<td>12.5</td>
</tr>
<tr>
<td><strong>Left atrial diameter (cm)</strong></td>
<td>5.2</td>
<td>4.7</td>
<td>4.8</td>
</tr>
<tr>
<td><strong>Mortality</strong></td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Duration of hospital stay (median)</strong></td>
<td>NA</td>
<td>6 days</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Conversion to sternotomy (%)</strong></td>
<td>NA</td>
<td>10</td>
<td>3</td>
</tr>
<tr>
<td><strong>Duration of monitoring</strong></td>
<td>2–3 weeks</td>
<td>24 hours</td>
<td>1 week</td>
</tr>
<tr>
<td><strong>Duration of follow up</strong></td>
<td>6 months</td>
<td>1 year</td>
<td>6 months</td>
</tr>
<tr>
<td><strong>Cases completed follow up (%)</strong></td>
<td>100</td>
<td>71</td>
<td>75</td>
</tr>
<tr>
<td><strong>Success rate (%)</strong></td>
<td>58.3</td>
<td>86</td>
<td>87.5</td>
</tr>
</tbody>
</table>

\(^a\)Additional ablation lines were done in persistent atrial fibrillation only (45%).
Hybrid Thoracoscopic Surgical and Transvenous Catheter Ablation of Atrial Fibrillation

Laurent Pison, MD,† Mark La Meir, MD,† Jurren van Opstal, MD, PhD, Yuri Blaauw, MD, PhD, Jos Maessen, MD, PhD,† Harry J. Crijns, MD, PhD

Maastricht, the Netherlands

• 26 consecutive patients
  – 42% with persistent atrial fibrillation
• 23% patients needed endocardial touch-up.
• 22 patients showed NSR at 1 year (holter)
PVI with GP ablation, LA resection

- 30 patients
  - 19 paroxysmal, 8 persistent, 3 long standing
  - Mean duration of Af: 79 months
  - Mean LA diameter: 42mm
  - 13 patients (43%) had prev. RFCA

- Freedom from Af (11.6 months)
  - Paroxysmal: 84%  
  - Persistent: 76%  
  - Long standing: 33%

Yilmaz et al. EJCTS
Indications of our institute:

- Persistent atrial fibrillation
- Failed RFCA
- Contraindication to warfarin
- AF after ASD device closure
- Stroke history associated with AF
- Enlarged left atrium (>50mm)
Hybrid approach

Post-procedural confirmation

Simultaneous procedures

NEEDS HYBRID OR Start. Dec 2014

3 days
Check previous PVI

RSPV

LSPV

RIPV

LIPV
CTI ablation
Confirmation of PVI

RSPV

LSPV

RIPV

LIPV
Exit block tests
Ablation of residual PV potential
Termination of AFL during CTI ablation
Additional endocardial ablation

n = 11 of 54 patients (20%)
Common patterns of PVs

A: LSPV, LIPV, RSPV, RIPV
B: LSPV, LIPV, RSPV, RIPV
C: LSPV, LIPV, RSPV, RIPV
D: LSPV, LIPV, RSPV, RIPV
E: LSPV, LIPV, RSPV, RIPV
F: LSPV, LIPV, RSPV, RIPV
Rhythm changes

Baseline  Operation  Ward  Discharge

AF (n=54)  \rightarrow  AF/AFL (n=10)  \rightarrow  SR (n=44)  \rightarrow  SR (n=25)  \rightarrow  SR (n=24)  \rightarrow  SR (n=46)

AF/AFL (n=10)  \rightarrow  AF/AFL (n=6)  \rightarrow  AF/AFL (n=8)

SR (n=44)  \rightarrow  AF/AFL \leftrightarrow SR (n=23)  \leftrightarrow  SR (n=24)  \leftrightarrow  SR (n=24)

EPS/RFCA
Follow up

Discharge

Follow up
Every 3 months
- EKG

24 hours holter
- 6 months
- 12 months

Echocardiography
- 12 months

2 weeks event
after 12 months

Based on evaluation
- Stop anticoagulation
- Stop antiarrhythmic drugs
Another option for management of long persistent AF – Hybrid procedure

일시: 2014년 1월 10일(금) 08:30-15:00
장소: 삼성서울병원 병관 지하4층 Minimal Invasive Surgery Center (MIS)

일시: 2014년 1월 11일(토) 09:00-16:00
장소: 삼성서울병원 본관 지하1층 대강당

평가: 대한의사협회 5평점

2014. 1. 10(FRI)

08:30-15:00 Animal Lab

2014. 1. 11(SAT)

09:00-10:20 Session I. HOW TO DO HYBRID PROCEDURE

09:00-09:20 Current status of catheter ablation for AF
09:20-09:40 Current status of antiarrhythmic surgery for AF
09:40-10:00 Totally thorascopic ablation
10:00-10:20 Hybrid procedure

10:20-10:40 Coffee break

10:40-12:20 Session II. LIVE CASE

10:40-11:00 Postprocedural confirmation after TTA
**SMC experiences for 3 years**

<table>
<thead>
<tr>
<th>Variables</th>
<th>N = 84</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td>55 years</td>
</tr>
<tr>
<td>Gender, male</td>
<td>78 (93%)</td>
</tr>
<tr>
<td>Persistent AF (long standing)</td>
<td>70 (83%)</td>
</tr>
<tr>
<td>Previous RFCA</td>
<td>11 (13%)</td>
</tr>
<tr>
<td>AF duration (documented), months</td>
<td>40 months</td>
</tr>
<tr>
<td>Congestive HF</td>
<td>6 (7%)</td>
</tr>
<tr>
<td>Stroke history</td>
<td>9 (11%)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>11 (13%)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>29 (35%)</td>
</tr>
<tr>
<td>CHAD &gt; 1</td>
<td>17 (20%)</td>
</tr>
</tbody>
</table>
Results

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>NSR</th>
<th>NSR with event</th>
<th>NSR without event</th>
<th>Af</th>
</tr>
</thead>
<tbody>
<tr>
<td>계열1</td>
<td>100</td>
<td>92.68292683</td>
<td>10.97560976</td>
<td>79.26829268</td>
<td>7.317073171</td>
</tr>
</tbody>
</table>

The table shows the distribution of certain parameters across different categories. The chart illustrates the proportion of each category visually.
RFCA versus Hybrid ablation -persistent AF-

Freedom from recurrence of AF (%)

Follow up duration (months)

P=0.016

AF, atrial fibrillation.
Who are the Super-responders?

<table>
<thead>
<tr>
<th></th>
<th>Super responder</th>
<th>Responder</th>
<th>Poor responder</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rhythm</strong></td>
<td>Sinus</td>
<td>Sinus</td>
<td>ATA or AF</td>
</tr>
<tr>
<td>AAD</td>
<td>X</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Warfarin</td>
<td>X</td>
<td>O or others</td>
<td>O</td>
</tr>
<tr>
<td><strong>Left atrium</strong></td>
<td>Reverse remodeling</td>
<td>Reverse remodeling</td>
<td>No change</td>
</tr>
<tr>
<td>Atrial activity</td>
<td>O</td>
<td>O or X</td>
<td>X</td>
</tr>
<tr>
<td>Recurred</td>
<td>X</td>
<td>O or X</td>
<td>O</td>
</tr>
<tr>
<td><strong>No. of patients</strong></td>
<td>16</td>
<td>62</td>
<td>6</td>
</tr>
</tbody>
</table>
Glance at the future

- Mitral isthmus ablation
- True transmural lesion confirmation
- LA auricle exclusion
  - Endocardial versus epicardial
- Late recurrence management
- Atrial tachyarrhythmias
- Cost
Stand alone maze?

- Persistent atrial fibrillation
- Risk-benefit (esp. stroke)
- Super-responders
- Atrial reverse remodeling
- Restoration of atrial activity
- Consideration for later cardiac events
  - CABG, valve, aorta surgery.....
Thank you for your attention!!