AF Ablation During (Off-Pump) CABG

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AATS STARS Inaugural Meeting
Miami, FL
November 17-18, 2017
2017 HRS/EHRA/ECAS/APHRS/SOLAECE expert consensus statement on catheter and surgical ablation of atrial fibrillation

Hugh Calkins, MD (Chair), 1 Gerhard Hindricks, MD (Vice-Chair), 2,* Riccardo Cappato, MD (Vice-Chair), 3,* Young-Hoon Kim, MD, PhD (Vice-Chair), 4,* Eduardo B. Saad, MD, PhD (Vice-Chair), 5,* Luis Aguinaga, MD, PhD, 6,*

**D. Indications for concomitant closed (such as CABG and AVR) surgical ablation of atrial fibrillation**

| Symptomatic AF | Paroxysmal: Surgical ablation is recommended. | I | B-NR |
| Symptomatic AF prior to initiation of antiarrhythmic therapy with a Class I or III antiarrhythmic medication | Paroxysmal: Surgical ablation is reasonable. | IIa | B-NR |
| | Persistent: Surgical ablation is reasonable. | IIa | B-NR |
| | Long-standing persistent: Surgical ablation is reasonable. | IIa | B-NR |
Indications for Concomitant Closed (Such as CABG or AVR) Surgical Ablation of AF

- Symptomatic AF
  - Paroxysmal AF
    - IIa
      - AA Drugs
      - Surgical Ablation
  - Persistent AF
    - IIa
      - AA Drugs
      - Surgical Ablation
  - Long-standing Persistent AF
    - IIa
      - AA Drugs
      - Surgical Ablation
6.5. Surgery Maze Procedures: Recommendations

Class IIa
1. An AF surgical ablation procedure is reasonable for selected patients with AF undergoing cardiac surgery for other indications. *(Level of Evidence: C)*
**2016 ESC Guidelines for the management of atrial fibrillation developed in collaboration with EACTS**

The Task Force for the management of atrial fibrillation of the European Society of Cardiology (ESC)

Developed with the special contribution of the European Heart Rhythm Association (EHRA) of the ESC

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Class</th>
<th>Level</th>
<th>Ref</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maze surgery, preferably biatrial, should be considered in patients undergoing cardiac surgery to improve symptoms attributable to AF, balancing the added risk of the procedure and the benefit of rhythm control therapy.</td>
<td>IIa</td>
<td>A</td>
<td>461, 466, 790, 791, 796, 797</td>
</tr>
<tr>
<td>Concomitant biatrial maze or pulmonary vein isolation may be considered in asymptomatic AF patients undergoing cardiac surgery.</td>
<td>IIb</td>
<td>C</td>
<td>796, 797, 833</td>
</tr>
</tbody>
</table>
AF patient undergoing open heart surgery (e.g. CABG, valve surgery)

Rhythm control therapy desirable to improve AF-related symptoms

Yes
Patient choice informed by AF Heart Team

AF surgery (IIaA)\(^a\)

No AF surgery

No

Consider to add surgical LAA exclusion in selected patients (IIbC)\(^b\)

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AF = atrial fibrillation; CABG = coronary artery bypass graft; LAA = left atrial appendage; PVI = pulmonary vein isolation.

\(^a\)AF surgery may be PVI in paroxysmal AF and biatrial maze in persistent or long-standing persistent AF.

\(^b\)Oral anticoagulation should be continued in patients at risk of stroke irrespective of AF surgery or LAA exclusion.

**Figure 19** Surgical rhythm control in patients with atrial fibrillation undergoing cardiac surgery.
The Society of Thoracic Surgeons 2017 Clinical Practice Guidelines for the Surgical Treatment of Atrial Fibrillation

Vinay Badhwar, MD, J. Scott Rankin, MD, Ralph J. Damiano, Jr, MD, A. Marc Gillinov, MD, Faisal G. Bakaean, MD, James R. Edgerton, MD, Jonathan M. Philpott, MD, Patrick M. McCarthy, MD, Steven F. Bolling, MD, Harold G. Roberts, MD, Vinod H. Thourani, MD, Rakesh M. Suri, MD, DPhil, Richard J. Shemin, MD, Scott Firestone, MS, Niv Ad, MD

Executive Summary

Surgical ablation for atrial fibrillation (AF) can be performed without additional risk of operative mortality or major morbidity, and is recommended at the time of concomitant mitral operations to restore sinus rhythm. (Class I, Level A)

Surgical ablation for AF can be performed without additional operative risk of mortality or major morbidity, and is recommended at the time of concomitant isolated aortic valve replacement, isolated coronary artery bypass graft surgery, and aortic valve replacement plus coronary artery bypass graft operations to restore sinus rhythm. (Class I, Level B nonrandomized)

Surgical ablation for symptomatic AF in the absence of structural heart disease that is refractory to class I/III antiarrhythmic drugs or catheter-based therapy or both is reasonable as a primary stand-alone procedure, to restore sinus rhythm. (Class IIA, Level B randomized)

Surgical ablation for symptomatic persistent or longstanding persistent AF in the absence of structural heart disease is reasonable, as a stand-alone procedure using the Cox-Maze III/IV lesion set compared with pulmonary vein isolation alone. (Class IIA, Level B nonrandomized)

Surgical ablation for symptomatic AF in the setting of left atrial enlargement (≥4.5 cm) or more than moderate mitral regurgitation by pulmonary vein isolation alone is not recommended. (Class III no benefit, Level C expert opinion)

It is reasonable to perform left atrial appendage excision or exclusion in conjunction with surgical ablation for AF for longitudinal thromboembolic morbidity prevention. (Class IIA, Level C limited data)

At the time of concomitant cardiac operations in patients with AF, it is reasonable to surgically manage the left atrial appendage for longitudinal thromboembolic morbidity prevention. (Class IIA, Level C expert opinion)

In the treatment of AF, multidisciplinary heart team assessment, treatment planning, and long-term follow-up can be useful and beneficial to optimize patient outcomes. (Class I, Level C expert opinion)

Technique for AF Ablation During OPCAB

• Sternotomy, limited skin incision and retraction
• Wide diaphragmatic pericardiotomy towards phrenic nerves bilaterally, traction sutures; open pleurae
• Cardiac displacement: Starfish/Urchin + deep traction suture
• Same techniques that facilitate reliable OPCAB also allow AF ablation off-pump while maintaining stable hemodynamics
The Heart May Be Rotated But Not Compressed

- Divide diaphragmatic muscle which inserts on right xiphoid to elevate right sternal border
- Open both pleural spaces widely for BITA, large hearts, low EF, multiple lateral wall grafts, AF ablation
- Bilateral, transverse, diaphragmatic pericardiotomies towards phrenic nerves
- Elevate right sternal border with rolled towels under retractor limb
- Deep pericardial traction suture(s); catheter over deep stitch
- Left PVI: let base of heart descend; rotate apex under right sternal border
- Right PVI: do not elevate apex toward the ceiling; instead, use Starfish/Urchin on RV to rotate heart to the left, revealing right PVs
- Remember to “drop the lungs” temporarily when this will be helpful
- Consider internal DC cardioversion to improve hemodynamics and facilitate OPCAB after AF ablation
Manipulate the Heart:

Slowly
Gently
Incrementally
Persistently
Deep Pericardial Traction Suture
Surgical Technique - PVI
Surgical Technique – PVI During OPCAB

- PVI (and connecting lesions/LAA clip) precede OPCAB unless critical ischemia mandates the reverse to maintain hemodynamic stability
- Use judicious low-power cautery to incise/remove epicardial fat around PVs
- Pass red rubber catheter around PVs with a “C-clamp” or large right-angle clamp
- Use the red rubber catheter to guide the jaws of the RF ablation clamp around the PVs
- Fire the RF clamp twice, then move clamp 2 mm and fire twice more, move clamp a second time and fire twice more
- Clean clamp before moving to the other side
Connecting Lesions with Cool Rail

Fig 1. Schematic representation of epicardial (bold) and endocardial (dashed) ablation lines for Sequential procedure.
Surgical Connecting Lesions

(2-0 ethibond purse-string in posterior LA)
Surgical technique – LAA clip
PVI

Combined Off-Pump Coronary Artery Bypass Grafting Surgery and Ablative Therapy for Atrial Fibrillation: Early and Mid-Term Results

Belhhan Akpınar, MD, Ilhan Sanisoglu, MD, Mustafa Guden, MD, Ertan Sagbas, MD, Baris Caynak, MD, and Zehra Bayramoglu, MD

Department of Cardiac Surgery, Florence Nightingale Hospital, Istanbul, Turkey

Table 2. Rhythm Status of Patients During Follow-Up

<table>
<thead>
<tr>
<th>Variable</th>
<th>Rhythm</th>
<th>Permanent AF</th>
<th>Paroxysmal AF</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td>Postoperative</td>
<td>AF</td>
<td>3 14.3</td>
<td>2 16.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sinus</td>
<td>18 85.7</td>
<td>10 83.3</td>
<td>0.62</td>
</tr>
<tr>
<td>Discharge</td>
<td>AF</td>
<td>10 47.6</td>
<td>5 41.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sinus</td>
<td>11 52.4</td>
<td>7 58.3</td>
<td>0.514</td>
</tr>
<tr>
<td>6 months</td>
<td>AF</td>
<td>9 41.9</td>
<td>2 16.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sinus</td>
<td>12 58.1</td>
<td>10 83.3</td>
<td>0.249</td>
</tr>
<tr>
<td>12 months</td>
<td>AF</td>
<td>8 40.9</td>
<td>2 16.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sinus</td>
<td>13 59.1</td>
<td>10 83.3</td>
<td>0.249</td>
</tr>
</tbody>
</table>

AF = atrial fibrillation.

- PVI is safe in OPCAB
- PVI was effective in restoring early NSR in most patients
- PVI was more effective/durable in paroxysmal AF
# Persistent Atrial Fibrillation Ablation Concomitant to Coronary Surgery

**Authors**

<table>
<thead>
<tr>
<th>Authors</th>
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<tbody>
<tr>
<td>S. Geidel¹, M. Lass¹, K. Krause², C. Schneider², S. Boczor², K.-H. Kuck², J. Ostermeyer¹, M. Schmoeckel¹</td>
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</tbody>
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**Affiliations**

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<tr>
<td>¹ Department of Cardiac Surgery, Asklepios Klinik St. Georg, Hamburg, Germany</td>
</tr>
<tr>
<td>² Department of Cardiology, Asklepios Klinik St. Georg, Hamburg, Germany</td>
</tr>
</tbody>
</table>

Geidel S et al. Persistent Atrial Fibrillation... Thorac Cardiov Surg 2011; 59: 207–212
• Achieved 76% NSR at 3 year follow up
• Duration of AF > 5Y and LA size > 5cm were risk factors for recurrence
Assessment of results of surgical treatment for persistent atrial fibrillation during coronary artery bypass grafting using implantable loop recorders

Alexander Cherniavsky\textsuperscript{a}, Yulia Kareva\textsuperscript{a,}\textsuperscript{*,} Inessa Pak\textsuperscript{a}, Sardor Rakhmonov\textsuperscript{a}, Evgeny Pokushalov\textsuperscript{b}, Alexander Romanov\textsuperscript{b} and Alexander Karaskov\textsuperscript{c}

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\textsuperscript{c} Novosibirsk Research Institute of Circulation Pathology, Novosibirsk, Russia

\textsuperscript{*} Corresponding author. Stroiteley Street 9, 46, Novosibirsk, Russia. Tel: +7-906-9952839; fax: +7-383-3322655; e-mail: julia11108@mail.ru (Y. Kareva).

Received 10 October 2013; received in revised form 17 November 2013; accepted 25 November 2013
• PVI and a “mini maze” procedure were both more effective than CABG alone in eliminating persistent AF
LAA closure

Left Atrial Appendage Occlusion Study (LAAOS): Results of a randomized controlled pilot study of left atrial appendage occlusion during coronary bypass surgery in patients at risk for stroke

Jeff S. Healey, MD, Eugene Crystal, MD, Andre Lamy, MD, Kevin Teoh, MD, Lloyd Semelhago, MD, Stefan H. Hohnloser, MD, Irene Cybulsky, MD, Labib Abouzahr, MD, Corey Sawchuck, MD, Sandra Carroll, BSc, Carlos Morillo, MD, Peter Kleine, MD, Victor Chu, MD, Eva Lonn, MD, and Stuart J. Connolly, MD Toronto and Hamilton, Ontario, Canada, and Frankfurt, Germany

American Heart Journal
August 2005
- Pilot study
- LAA occlusion is safe
- 90% effective in experienced hands
Exclusion of the left atrial appendage with a novel device: Early results of a multicenter trial

Gorav Ailawadi, MD, a Marc W. Gerdisch, MD, b Richard L. Harvey, MD, c Robert L. Hooker, MD, d Ralph J. Damiano, Jr, MD, e Thomas Salamon, MD, f and Michael J. Mack, MD g

(J Thorac Cardiovasc Surg 2011;142:1002-9)
TABLE 3. Efficacy results as determined by visual assessment and transesophageal echocardiography intraoperatively and by computed tomography angiography or transesophageal echocardiography imaging at 3 months

<table>
<thead>
<tr>
<th>Efficacy end points</th>
<th>% (n/N)</th>
<th>95% 1-sided Bayesian credible interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procedural success</td>
<td>95.7 (67/70)</td>
<td></td>
</tr>
<tr>
<td>by visual assessment</td>
<td>97.1 (68/70)</td>
<td></td>
</tr>
<tr>
<td>by TEE</td>
<td>95.7 (67/70)</td>
<td></td>
</tr>
<tr>
<td>3-mo success (CT or TEE)</td>
<td>98.4 (60/61)</td>
<td>95–100</td>
</tr>
<tr>
<td>By method of assessment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CT evaluation by core laboratory</td>
<td>98.2 (55/56)</td>
<td></td>
</tr>
<tr>
<td>TEE evaluation by site</td>
<td>100 (5/5)</td>
<td></td>
</tr>
<tr>
<td>Composite end point success</td>
<td>95.1 (58/61)</td>
<td>90–100</td>
</tr>
<tr>
<td>(primary end point)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*TEE, Transesophageal echocardiography; CT, computed tomography.*

- Pilot study for AtriClip
- LAA occlusion was safe
- 98% successful by CT scan
Safe, effective and durable epicardial left atrial appendage clip occlusion in patients with atrial fibrillation undergoing cardiac surgery: first long-term results from a prospective device trial

Maximilian Y. Emmert, Gilbert Puipe, Stephan Baumüller, Hatem Alkadhi, Ulf Landmesser, Andre Plass, Dominique Bettex, Jacques Scherman, Jürg Grünenfelder, Michele Genoni, Volkmar Falk and Sacha P. Salzberg, *
### Table 2: Computed tomography findings at twelve-, twenty-four, and thirty-six month follow-up after LAA clip surgery

<table>
<thead>
<tr>
<th>Follow</th>
<th>Postoperative</th>
<th>3 months</th>
<th>1 year</th>
<th>2 years</th>
<th>3 years</th>
<th>P-value&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time interval&lt;sup&gt;b&lt;/sup&gt; (days)</td>
<td>SD ± mean</td>
<td>7 ± 5</td>
<td>116 ± 35</td>
<td>383 ± 46</td>
<td>749 ± 39</td>
<td>1101 ± 17</td>
</tr>
<tr>
<td>Residual LAA perfusion</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>none</td>
</tr>
<tr>
<td>First distance to CX (mm)</td>
<td>SD ± mean</td>
<td>18 ± 5</td>
<td>17 ± 4</td>
<td>16 ± 5</td>
<td>16 ± 5</td>
<td>16 ± 5</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>9–29</td>
<td>12–29</td>
<td>8–27</td>
<td>8–25</td>
<td>9–25</td>
</tr>
<tr>
<td>Second distance to CX (mm)</td>
<td>SD ± mean</td>
<td>32 ± 8</td>
<td>34 ± 8</td>
<td>32 ± 8</td>
<td>33 ± 7</td>
<td>33 ± 7</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>20–49</td>
<td>12–29</td>
<td>23–46</td>
<td>21–45</td>
<td>21–43</td>
</tr>
<tr>
<td>Angle (degree)</td>
<td>SD ± mean</td>
<td>39 ± 22</td>
<td>41 ± 16</td>
<td>37 ± 17</td>
<td>39 ± 19</td>
<td>40 ± 21</td>
</tr>
<tr>
<td></td>
<td>Range</td>
<td>11–96</td>
<td>12–70</td>
<td>9–66</td>
<td>9–80</td>
<td>11–81</td>
</tr>
<tr>
<td>LAA stump &gt; 1cm</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>none</td>
<td>none</td>
</tr>
</tbody>
</table>

<sup>a</sup>Friedman’s 2-way paired ANOVA. The level of significance is 0.05.

<sup>b</sup>Time interval displayed as time between surgery and follow up.

LAA: left atrial appendage; CX: circumflex artery.

- Durable closure of the LAA up to 3 years of follow up with AtriClip device
- No CVA reported, patients taken off anticoagulation
AtriClip® Left **Atrial** Appendage Exclusion Concomitant to Structural Heart Procedures (ATLAS)

- Patients **without** a documented history of AF but who present with a CHA$_2$DS$_2$-VASc of $\geq$ 2 and HASBLED of $\geq$ 2 and will undergo a valve or CABG procedure with direct visual access to the LAA will be randomized 2:1 (2 with AtriClip to 1 without AtriClip)
AtriClip® Left Atrial Appendage Exclusion Concomitant to Structural Heart Procedures (ATLAS)

- Subjects who do not develop Post-operative Atrial Fibrillation (POAF) will be followed for 30 days for safety.
- Subjects who develop POAF will be followed for 365 days post index procedure.
AtriClip® Left Atrial Appendage Exclusion Concomitant to Structural Heart Procedures (ATLAS)

**Primary Outcome** - Number of subjects with perioperative complications associated with AtriClip placement

[Defined as: stroke, major bleeding that requires re-operation and/or transfusion of > 2 U packed red blood cells (PRBC) within any 24 hour period during the first 2 days post-index procedure, myocardial infarction (MI), or death]
AtriClip® Left Atrial Appendage Exclusion Concomitant to Structural Heart Procedures (ATLAS)

• Secondary Outcomes –
  – Number of subjects with intraoperative successful exclusion of LAA
  – Number of subjects who develop new POAF and suffer an adverse event
  – Events to be evaluated include: Thromboembolic & Hemorrhagic Events such as cerebrovascular accident (CVA), transient ischemic attack (TIA), peripheral ischemia, hemorrhagic stroke, neurologic bleed, gastrointestinal (GI) bleeds, or other major bleeding event
STS Database: Missed Opportunity To Benefit Patients With AF Undergoing CABG

• Approximately 6% of patients presenting for CABG have preoperative AF

• Concomitant ablation is performed in only approx 26% of patients with AF undergoing CABG

• Isolated CABG cases: approx 160k annually
• Missed opportunity: >7000 cases annually in the US