Percutaneous Left Atrial Appendage Occlusion in Patients With Non-valvular Atrial Fibrillation – Are Indications Expanding?

Paul A. Friedman, MD
Mayo Clinic
Rochester, MN, USA
Disclosures

Sponsored Research
• SJM

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• Preventice

Consultant
• Leadexx
• Medtronic
• Boston Scientific

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Age Distribution of People with AF

Mean Age AF Ablation: 55
Range: 41-67

Arch Int Med 155:471, 1995

Meta-analysis AF trials, Calkins, Circ Arrhythm 2009
Including >6900 patients
## CHA₂DS₂-VASc Score and Stroke Rate

### Risk factor Score

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Congestive heart failure/LV dysfunction</td>
<td>1</td>
</tr>
<tr>
<td>Hypertension</td>
<td>1</td>
</tr>
<tr>
<td>Age ≥75</td>
<td>2</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>1</td>
</tr>
<tr>
<td>Stroke/TIA/thrombo-embolism</td>
<td>2</td>
</tr>
<tr>
<td>Vascular disease</td>
<td>1</td>
</tr>
<tr>
<td>Age 65-74</td>
<td>1</td>
</tr>
<tr>
<td>Sex category (ie, female sex)</td>
<td>1</td>
</tr>
<tr>
<td><strong>Maximum score</strong></td>
<td><strong>9</strong></td>
</tr>
</tbody>
</table>

### Adjusted Stroke Rate According to CHA2DS2-VASc score

<table>
<thead>
<tr>
<th>CHA2DS2VASc score</th>
<th>Pt (n=7,329)</th>
<th>Adjusted stroke rate (%/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>422</td>
<td>1.3</td>
</tr>
<tr>
<td>2</td>
<td>1,230</td>
<td>2.2</td>
</tr>
<tr>
<td>3</td>
<td>1,730</td>
<td>3.2</td>
</tr>
<tr>
<td>4</td>
<td>1,718</td>
<td>4.0</td>
</tr>
<tr>
<td>5</td>
<td>1,159</td>
<td>6.7</td>
</tr>
<tr>
<td>6</td>
<td>679</td>
<td>9.8</td>
</tr>
<tr>
<td>7</td>
<td>294</td>
<td>9.6</td>
</tr>
<tr>
<td>8</td>
<td>82</td>
<td>6.7</td>
</tr>
<tr>
<td>9</td>
<td>14</td>
<td>15.2</td>
</tr>
</tbody>
</table>
Anticoagulants – Tested in Trials With >60,000 Patients for Stroke Prevention

Bleeding rates
• Major 2-3%
• Any 15-25%

Discontinuation rates
• 20-25% in major studies

Concept: Avoid “systemic” complications by using “local” approach: & 100% adherence

Possibly control AF?
Types of Percutaneous Appendage Closure

- Endocardial Plug
  - Watchman
  - WaveCrest
  - Amplatzer Cardiac Plug

- Hybrid Endo/Epi Loop
  - Lariat

- Epicardial Loop
  - Aegis
EHRA/EAPCI CONSENSUS STATEMENT

EHRA/EAPCI expert consensus statement on catheter-based left atrial appendage occlusion

Bernhard Meier (EAPCI Chairperson) (Switzerland)\(^1\), Yuri Blaauw (The Netherlands)\(^2\), Ahmed A. Khattab (Switzerland)\(^1\), Torsten Lewalter (Germany)\(^3\), Horst Sievert (Germany)\(^4\), Claudio Tondo (Italy)\(^5\), Michael Glikson (EHRA Chairperson) (Israel)\(^6\*\)

Document Reviewers: Gregory Y. H. Lip (UK), Jose Lopez-Minguez (Spain), Marco Roffi (Switzerland), Carsten Israel (Germany), Dariusz Dudek (Poland), Irene Savelieva (on behalf of EP-Europace, UK)

\(^1\)Cardiology, Bern University Hospital, 3010 Bern, Switzerland; \(^2\)Department of Cardiology, Maastricht University Medical Center, 6281 Maastricht, The Netherlands; \(^3\)Isar Medical Centre, 80331 Munich, Germany; \(^4\)Cardiovascular Center Frankfurt, 60389 Frankfurt, Germany; \(^5\)Cardiac Arrhythmia Research Center, Centro Cardiologico Monzino, IRCCS, 20138 Milan, Italy; and \(^6\)Davidki Arrhythmia Center, Sheba Medical Center, 52621 Tel Hashomer, Israel

Published online August 29, 2014
Atrial fibrillation patient with indication for PAC for stroke/embolism prevention (CHA$_2$DS$_2$-VASc ≥ 2)

- **Suitable for OAC**
  - Increased risk for bleeding
    - 1. HAS-BLED score ≥3
    - 2. Need for a prolonged triple anticoagulation therapy (e.g. recent coronary stents)
    - 3. Increased bleeding risk not reflected by the HAS-BLED score (e.g. thrombopenia, cancer, or risk of tumor associated bleeding in case of systemic OAC)
    - 4. Renal failure (severe) as contraindication to NOAC

  Individual risk/benefit evaluation for (N)OAC vs. alternative methods
  - YES
    - OAC, preferable NOAC
    - Mention LAA occlusion
  - NO
    - Acceptable risk for systemic (N)OAC?
    - YES
      - Acceptable risk for systemic (N)OAC
      - LAA occlusion (includes the need for antiplatelet therapy)
    - NO
      - No treatment vs. LAA occlusion

- **Patient refusal of OAC despite adequate information**
  - 1. Contraindication for systemic (N)OAC
  - 2. Refusing systemic (N)OAC after adequate information and physicians advice

  Advise NOAC
Atrial fibrillation patient with indication for PAC for stroke/embolism prevention (CHA$_2$DS$_2$-VASc >1)

- Suitable for OAC
- Increased risk for bleeding
- Patient refusal of OAC despite adequate information
- 1. Contraindication for systemic (N)OAC

“Although this population constitutes a small minority of LAA occlusion recipients today, this is the only indication that is currently based on randomized controlled data…”

OAC, preferable NOAC
Mention LAA occlusion

- YES
- Acceptable risk for systemic (N)OAC?
  - No
  - No treatment vs. LAA occlusion
  - LAA occlusion (includes the need for antiplatelet therapy)
- NOAC
Studies of Watchman LAA Closure For Stroke Prevention Patient-Level Meta-analysis

PROTECT AF and CAP: Largest Data Sets to Evaluate Totality of Data

<table>
<thead>
<tr>
<th></th>
<th>PROTECT AF</th>
<th>PREVAIL</th>
<th>CAP</th>
<th>CAP2</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enrolled</td>
<td>800</td>
<td>761</td>
<td>566</td>
<td>579</td>
<td>2,406</td>
</tr>
<tr>
<td>Randomized</td>
<td>707</td>
<td>407</td>
<td>–</td>
<td>–</td>
<td>1,114</td>
</tr>
<tr>
<td>Watchman: warfarin</td>
<td>463:244</td>
<td>269:138</td>
<td>566</td>
<td>579</td>
<td>1,877:382</td>
</tr>
<tr>
<td>(2:1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean follow-up (yr)</td>
<td>4.0</td>
<td>2.2</td>
<td>3.7</td>
<td>0.58</td>
<td>N/A</td>
</tr>
<tr>
<td>Patient-years</td>
<td>2,717</td>
<td>860</td>
<td>2,022</td>
<td>332</td>
<td>5,931</td>
</tr>
</tbody>
</table>

Warfarin 45 days; ASA + plavix to day 180; ASA

Holmes et al JACC 65(24)2614, 2015
### Patient Demographics Across Trials

<table>
<thead>
<tr>
<th></th>
<th>PROTECT AF (n=707)</th>
<th>PREVAIL (n=407)</th>
<th>CAP (n=566)</th>
<th>CAP2 (n=579)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (yr)</strong></td>
<td>72.0±8.9</td>
<td>74.3±7.4</td>
<td>74.0±8.3</td>
<td>75.3±8.0</td>
</tr>
<tr>
<td><strong>Male</strong></td>
<td>70.3</td>
<td>70.0</td>
<td>65.5</td>
<td>61.0</td>
</tr>
<tr>
<td><strong>Ethnicity/race</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>0.7</td>
<td>0.5</td>
<td>1.6</td>
<td>0.7</td>
</tr>
<tr>
<td>Black/African American</td>
<td>1.6</td>
<td>1.7</td>
<td>1.9</td>
<td>1.2</td>
</tr>
<tr>
<td>White/Caucasian</td>
<td>91.5</td>
<td>94.4</td>
<td>91.9</td>
<td>94.1</td>
</tr>
<tr>
<td>Hispanic/Latino</td>
<td>5.7</td>
<td>2.7</td>
<td>3.5</td>
<td>2.1</td>
</tr>
<tr>
<td>Other</td>
<td>0.6</td>
<td>0.7</td>
<td>1.1</td>
<td>1.0</td>
</tr>
<tr>
<td><strong>CHADS2 score</strong></td>
<td>2.2±1.2</td>
<td>2.6±1.0</td>
<td>2.4±1.2</td>
<td>2.7±1.1</td>
</tr>
<tr>
<td><strong>CHADS2 risk factors</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHF</td>
<td>26.9</td>
<td>19.1</td>
<td>23.3</td>
<td>27.1</td>
</tr>
<tr>
<td>Hypertension</td>
<td>89.8</td>
<td>88.8</td>
<td>91.4</td>
<td>92.5</td>
</tr>
<tr>
<td>≥75 yrs of age</td>
<td>43.1</td>
<td>51.8</td>
<td>53.6</td>
<td>59.7</td>
</tr>
<tr>
<td>Diabetes</td>
<td>26.2</td>
<td>24.9</td>
<td>32.4</td>
<td>33.9</td>
</tr>
<tr>
<td>Stroke/transient ischemic attack</td>
<td>18.5</td>
<td>30.4</td>
<td>27.8</td>
<td>29.0</td>
</tr>
<tr>
<td><strong>CHA2DS2-VASc</strong></td>
<td>3.5±1.6</td>
<td>4.0±1.2</td>
<td>3.9±1.5</td>
<td>4.5±1.3</td>
</tr>
<tr>
<td>HAS-BLED = 0 (low risk)</td>
<td>6.4</td>
<td>1.7</td>
<td>2.8</td>
<td>2.8</td>
</tr>
<tr>
<td>HAS-BLED = 1.2 (moderate risk)</td>
<td>73.7</td>
<td>68.6</td>
<td>61.0</td>
<td>69.9</td>
</tr>
<tr>
<td>HAS-BLED = 3+ (high risk)</td>
<td>19.9</td>
<td>29.7</td>
<td>36.2</td>
<td>28.3</td>
</tr>
</tbody>
</table>
LAA Closure: Patient-Level Meta-Analysis
Stroke Prevention in Nonvalvular Atrial Fibrillation With LAA Closure

![Device placed in LAA](image)

<table>
<thead>
<tr>
<th>Event Type</th>
<th>HR</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficacy</td>
<td>0.79</td>
<td>0.22</td>
</tr>
<tr>
<td>All stroke or SE</td>
<td>1.02</td>
<td>0.94</td>
</tr>
<tr>
<td>Ischemic stroke or SE</td>
<td>1.95</td>
<td>0.05</td>
</tr>
<tr>
<td>Hemorrhagic stroke</td>
<td>0.22</td>
<td>0.004</td>
</tr>
<tr>
<td>CV/unexplained death</td>
<td>0.48</td>
<td>0.006</td>
</tr>
<tr>
<td>All-cause death</td>
<td>0.73</td>
<td>0.07</td>
</tr>
</tbody>
</table>

Hazard ratio (95% CI)

Favors Watchman ← → Favors warfarin

All Cause Mortality: 4 Year Follow-Up

HR (95% CI), 0.66 (0.45-0.98)
P=0.04

US FDA Approved Indication

- This device is indicated to reduce the risk of thromboembolism from the left atrial appendage (LAA) in patients with non-valvular atrial fibrillation who:
  - Are at increased risk for stroke and systemic embolism based on CHADS2 or CHA2DS2 VASc scores and are recommended for anticoagulation;
  - Are deemed by their physicians to be suitable for warfarin; and
  - Have an appropriate rationale to seek a non-pharmacologic alternative to warfarin, taking into account the safety and effectiveness of the device compared to warfarin.

Cumulative Device Experience

Procedural complications reduced since PROTECT AF, and similar to registry experience

<table>
<thead>
<tr>
<th></th>
<th>PROTECT AF device group n/attempted (%)</th>
<th>CAP registry n/attempted (%)</th>
<th>PREVAIL device group n/attempted (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implant success</td>
<td>408/449 (90.9)</td>
<td>534/566 (94.3)</td>
<td>252/265 (95.1)</td>
</tr>
<tr>
<td>Procedure related death</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Procedure related ischemic stroke</td>
<td>5/449 (1.1)</td>
<td>0/566 (0.0)</td>
<td>1/265 (0.4)</td>
</tr>
<tr>
<td>Cardiac perforation (surgical repair)</td>
<td>7/449 (1.6)</td>
<td>1/566 (0.2)</td>
<td>1/265 (0.4)</td>
</tr>
<tr>
<td>Pericardial effusions with tamponade (pericardiocentesis)</td>
<td>13/449 (2.9)</td>
<td>7/566 (1.2)</td>
<td>4/265 (1.5)</td>
</tr>
<tr>
<td>Device embolization</td>
<td>3/449 (0.7)</td>
<td>1/566 (0.2)</td>
<td>2/265 (0.8)</td>
</tr>
</tbody>
</table>
CMS Approved Indication

• This device is indicated to reduce the risk of thromboembolism from the left atrial appendage (LAA) in patients with non-valvular atrial fibrillation who
  • A CHADS$_2$ score $\geq 2$ or CHA$_2$DS$_2$-VASc score $\geq 3$
  • A formal shared decision making interaction with an independent non-interventional physician using an evidence-based decision tool on oral anticoagulation in patients with NVAF prior to LAAC.
  • A suitability for short-term warfarin but deemed unable to take long term oral anticoagulation following the conclusion of shared decision making, as LAAC is only covered as a second line therapy to oral anticoagulants

Decision memo: CAG-00445N (March 13, 2015)
CMS Approved Indication

- This device is indicated to reduce the risk of thromboembolism from the left atrial appendage (LAA) in patients with non-valvular atrial fibrillation who
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  - A suitability for short-term warfarin but deemed unable to take long term oral anticoagulation following the conclusion of shared decision making, as LAAC is only covered as a second line therapy to oral anticoagulants

Decision memo: CAG-00445N (March 13, 2015)
Atrial fibrillation patient with indication for PAC for stroke/embolism prevention (CHA₂DS₂-VASc >1)

Suitable for OAC

Increased risk for bleeding

Patient refusal of OAC despite adequate information

1. Contraindication for systemic (N)OAC

2. Refusing systemic (N)OAC after adequate information and physician advice

Advise NOAC

NOAC

OAC, preferable NOAC
Mention LAA occlusion

YES

Acceptable risk for systemic (N)OAC?

No

No treatment vs. LAA occlusion

LAA occlusion (includes the need for antiplatelet therapy)

“Patients with a high thrombo-embolic risk (CHA₂DS₂-VASc score > 2) but contraindication to oral and systemic anticoagulation (e.g., history of a significant bleeding event such as intracranial or life threatening bleeding, the source of which cannot be eliminated) represent the most accepted clinical indication for LAA occlusion…”
Atrial fibrillation patient with indication for PAC for stroke/embolism prevention (CHA₂DS₂-VASc >1)

1. Contraindication for systemic (N)OAC
2. Refusing systemic (N)OAC after adequate information and physicians advice

Advise NOAC

Individual risk/benefit evaluation for (N)OAC vs. alternative methods

OAC, preferable NOAC
Mention LAA occlusion

Acceptable risk for systemic (N)OAC?

NOAC

LAA occlusion (includes the need for antiplatelet therapy)

No treatment vs. LAA occlusion

What about adherence to NOACs?

YES

HAS-BLED score ≥3
Need for a prolonged triple anticoagulation therapy (e.g. recent coronary stents)
Increased bleeding risk not reflected by the HAS-BLED score (e.g. thrombopenia, cancer, or risk of tumor associated bleeding in case of systemic OAC)
Renal failure (severe) as contraindication to NOAC

What about adherence to NOACs?
NOACS vs Warfarin
Stroke or Systemic Embolism

<table>
<thead>
<tr>
<th></th>
<th>NOAC (events)</th>
<th>Warfarin (events)</th>
<th>RR (95% CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>RE-LY</td>
<td>134/6,076</td>
<td>199/6,022</td>
<td>0.66</td>
<td>0.0001</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.53-0.82)</td>
<td></td>
</tr>
<tr>
<td>ROCKET AF</td>
<td>269/7,081</td>
<td>306/7,090</td>
<td>0.88</td>
<td>0.12</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.75-1.03)</td>
<td></td>
</tr>
<tr>
<td>ARISTOTLE</td>
<td>212/9,120</td>
<td>265/9,081</td>
<td>0.80</td>
<td>0.012</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.67-0.95)</td>
<td></td>
</tr>
<tr>
<td>ENGAGE-TIMI 48</td>
<td>296/7,035</td>
<td>337/7,036</td>
<td>0.88</td>
<td>0.10</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.75-1.02)</td>
<td></td>
</tr>
<tr>
<td>Combined (random)</td>
<td>911/29,312</td>
<td>1,107/29,229</td>
<td>0.81</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.73-0.91)</td>
<td></td>
</tr>
</tbody>
</table>

**Stroke or systemic embolism was significantly reduced in the trials of apixaban (ARISTOTLE) and dabigatran (RE-LY)**

Ruff et al: Lancet, Dec 2013
### NOACS vs Warfarin

**Risk of Major Bleeding**

<table>
<thead>
<tr>
<th>Trial</th>
<th>NOAC (events)</th>
<th>Warfarin (events)</th>
<th>RR (95% CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>RE-LY</td>
<td>375/6,076</td>
<td>397/6,022</td>
<td>0.94 (0.82-1.07)</td>
<td>0.34</td>
</tr>
<tr>
<td>ROCKET AF</td>
<td>395/7,111</td>
<td>386/7,125</td>
<td>1.03 (0.90-1.18)</td>
<td>0.72</td>
</tr>
<tr>
<td>ARISTOTLE</td>
<td>327/9,088</td>
<td>462/9,052</td>
<td>0.71 (0.61-0.81)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>ENGAGE-TIMI 48</td>
<td>444/7,012</td>
<td>557/7,012</td>
<td>0.80 (0.71-0.90)</td>
<td>0.0002</td>
</tr>
<tr>
<td>Combined (random)</td>
<td>1,541/29,287</td>
<td>1,802/29,211</td>
<td>0.86 (0.73-1.00)</td>
<td>0.06</td>
</tr>
</tbody>
</table>

Risk of major bleeding was lower in trials of apixaban (ARISTOTLE) and edoxoban (ENGAGE AF)

Ruff et al: Lancet, Dec 2013
How adherent are patients to NOACs?

- Retrospective analysis of administrative claims data (privately insured and Medicare Advantage enrollees)

- Patients (n=64,661) with atrial fibrillation who initiated treatment with warfarin, dabigatran, rivaroxaban, or apixaban between November 1, 2010 and December 31, 2014 were identified

- **Endpoint: adherence ≥80%**

<table>
<thead>
<tr>
<th></th>
<th>Apixaban (n=3900) (%)</th>
<th>Dabigatran (n=10,235) (%)</th>
<th>Rivaroxaban (n=12,336) (%)</th>
<th>All NOACs (n=26,471) (%)</th>
<th>Warfarin (n=38,190) (%)</th>
<th>P value (All NOACs Pooled vs Warfarin)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unadjusted adherence</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>All</strong></td>
<td>61.9</td>
<td>38.5</td>
<td>50.5</td>
<td>47.5</td>
<td>40.2</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>CHA_2DS_2-VASc score 0 or 1</strong></td>
<td>50.1</td>
<td>24.6</td>
<td>36.5</td>
<td>32.6</td>
<td>27.1</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>CHA_2DS_2-VASc score 2 or 3</strong></td>
<td>62.0</td>
<td>40.3</td>
<td>52.8</td>
<td>49.1</td>
<td>38.1</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td><strong>CHA_2DS_2-VASc score ≥4</strong></td>
<td>64.0</td>
<td>42.4</td>
<td>53.2</td>
<td>51.1</td>
<td>42.3</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Yao X et al: J Am Heart Assoc, 2016
Stroke of Systemic Embolism

Adherence: Warfarin 40.2%, NOAC 47.5% at 1.1 years

Yao X et al: J Am Heart Assoc, 2016
Atrial fibrillation patient with indication for PAC for stroke/embolism prevention (CHA\textsubscript{2}DS\textsubscript{2}-VASc >1)

- Suitable for OAC
- Increased risk for bleeding
  1. HAS-BLED score ≥3
  2. Need for a prolonged triple anticoagulation therapy (e.g. recent coronary stents)
  3. Increased bleeding risk not reflected by the HAS-BLED score (e.g. thrombopenia, cancer, or risk of tumor associated bleeding in case of systemic OAC)
  4. Renal failure (severe) as contraindication to NOAC
- Patient refusal of OAC despite adequate information
  1. Contraindication for systemic (N)OAC
  2. Refusing systemic (N)OAC after adequate information and physicians advice
- NOAC
  - OAC, preferable NOAC
  - Mention LAA occlusion (includes the need for antiplatelet therapy)
- Individual risk/benefit evaluation for (N)OAC vs. alternative methods
  - No treatment vs. LAA occlusion
  - Acceptable risk for systemic (N)OAC?
    1. HAS-BLED score ≥3
    2. Need for a prolonged triple anticoagulation therapy (e.g. recent coronary stents)
    3. Increased bleeding risk not reflected by the HAS-BLED score (e.g. thrombopenia, cancer, or risk of tumor associated bleeding in case of systemic OAC)
    4. Renal failure (severe) as contraindication to NOAC
HAS-BLED Score

- H: hypertension
- A: abnormal renal/liver function
- S: stroke
- B: bleeding history
- L: labile INR
- E: elderly
- D: drug consumption/alcohol abuse

1-year bleeding rate on VKA
- 0-1: 2.66% (95% CI: 2.40-2.94)
- 2: 5.54% (95% CI: 5.15-5.96)
- ≥3: 8.11% (95% CI: 7.61-8.64)

Danish cohort of 118,584 patients with non-valvular AF

Normal Heart
External Topography

Superior View
Lateral View – Percutaneous epicardial access
Hybrid:  
No foreign body  
Ostial shape less important  
Post op A/C may not be needed  
May control Atrial Fibrillation
Potential New Indication: AF Control

LAALA-AF Registry: Ablation and Ligation

- Prospective observation study
- Persistent AF
- LAA ligation (LARIAT) before AF ablation (n=69)
- Controls: only ablated (n=69)

“In patients with persistent AF, addition of LAA ligation with the LARIAT device to conventional ablation appears to improve the success rate of AF ablation” → AMAZE trial prospectively studying

AF Burden Reduction with LAA Ligation

- 50 patients with AF and CIED
- Burden assess baseline, 3 months, 12 months


![Graph showing AF burden reduction with LAA ligation](image_url)
LARIAT vs Watchman Closure Rates

- LARIAT left atrial appendage closure is associated with a lower rate of leaks at long-term follow up as compared to Watchman.
- LARIAT is the only LAA closure device where a leak may be corrected.

LARIAT leak rate data only includes papers that followed >90% of subjects at 1yr
*Watchman leak rate data only includes papers that measured actual leak rates versus Watchman closure success criteria of <5mm leaks
LARIAT vs Watchman Thrombus Rates

- **LARIAT**
  - n=259
  - OAC: 0-45d (31%)
  - APT: 6mo (30%)
  - >6mo: Operator discretion
  - 1.3%

- **Watchman**
  - n=219
  - Warfarin: 45d (100%)
  - APT: 6mo (100%)
  - >6mo: Operator discretion
  - 3.6%

LARIAT: Acute Procedural Complications
Importance of Micropuncture Needle


- LB (Large bore Pajunk needle), n=288
- MP (Micropuncture needle), n=424

<table>
<thead>
<tr>
<th>Procedural variable</th>
<th>LB</th>
<th>MP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procedure-related mortality</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Pts needing open heart surgery</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Cardiac perforations without the need for cardiac surgery</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Pts needing transfusion</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Stroke in the periprocedural period</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Injury to superior epigastric, coronary, or internal mammary artery</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>5</td>
<td>2</td>
</tr>
</tbody>
</table>
Pericarditis requiring prolonged treatment (>2 wk) with nonsteroidal anti-inflammatory drugs/colchicine

LARIAT: Impact of Use of Periprocedural Colchicine on Delayed Complications

Procedural variable

- Pericarditis requiring prolonged treatment (>2 wk) with nonsteroidal anti-inflammatory drugs/colchicine
- Late pericardial effusion
- Late pleural effusion
- Total

No colchicine, n=332
Colchicine, n=380

Heparin and bleeding in LAA closure

Heparin may augment:

- Bleeding due to sheath contact with epicardial fat
- Small tears of LAA or other structures (4.8% effusion in Protect AF)
- Disruption of “bridging veins” in pericardial space
- Post op pain *due to blood in pericardium & inflammation*
Epicardial only:
Eliminate transeptal puncture
Eliminate heparin
Eliminate metal frame around suture
Electrogram navigation/confirmation
Friedman et al: JCE, 2009; Bruce et al: JCE, 2010
Atrial Remodeling

Syed...Friedman Translational Research; 165:365, 2015
### Aegis Epicardial Human Early Feasibility

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>CHADS$_2$ Score</th>
<th>Procedure Time (min)</th>
<th>Fluoro Time (min)</th>
<th>Technical Success</th>
<th>Ligating Devices Delivered</th>
<th>Adverse Event</th>
<th>Acute Closure*</th>
<th>1 Month Closure*</th>
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<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>97</td>
<td>57.8</td>
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<td>Yes</td>
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<td>3</td>
<td>2</td>
<td>20</td>
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<td>4</td>
<td>2</td>
<td>33</td>
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<td>5</td>
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<td>15</td>
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<td>6</td>
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<td>32</td>
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<td>7</td>
<td>2</td>
<td>28</td>
<td>17.3</td>
<td>Yes</td>
<td>2</td>
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<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Average procedure time <35 minutes**
**First procedure 97 min, subsequent 15-33 minutes.**
**Fluoro time average 20.8 minutes (range 6.6 to 57.8)**
Conclusions

• N/OAC is well established for stroke reduction in AF

• For patients who cannot or prefer not to take N/OAC, LAA closure is an increasingly attractive option
  • It is at least equivalent to warfarin
  • Benefit accrues over time due to reduction in bleeding complications

• Patient selection critical: CHADSVASC3 in US

• External ligation may have particular role for rhythm control and some anatomies