Catheter-based LAA occlusion: promising experiences

Ulf Landmesser, MD
Cardiology, Cardiovascular Center,
University Hospital Zürich, Switzerland
Persistent use of anticoagulation in clinical practice?

21,077 stroke survivors: the persistent use of anticoagulation with warfarin declined to 45% after 2 years.

Glader EL et al.; Stroke 2010; 41: 397-401
Ischemic stroke in patients with AFib has mostly a cardiac thromboembolic genesis, the main origin of these thrombi is the LAA.
### Location of thrombus in left atrium in non-valvular atrial fibrillation

<table>
<thead>
<tr>
<th>Setting</th>
<th>N</th>
<th>Appendage</th>
<th>Percent</th>
<th>LA Body</th>
<th>Percent</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>TEE</td>
<td>317</td>
<td>66</td>
<td>21</td>
<td>1</td>
<td>0.3</td>
<td>Stoddard; JACC, 1995</td>
</tr>
<tr>
<td>TEE</td>
<td>233</td>
<td>34</td>
<td>15</td>
<td>1</td>
<td>0.4</td>
<td>Manning; Circ, 1994</td>
</tr>
<tr>
<td>Autopsy</td>
<td>506</td>
<td>35</td>
<td>7</td>
<td>12</td>
<td>2.4</td>
<td>Aberg; Acta Med Scan, 1969</td>
</tr>
<tr>
<td>TEE</td>
<td>52</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>3.8</td>
<td>Tsai; JFMA, 1990</td>
</tr>
<tr>
<td>TEE</td>
<td>48</td>
<td>12</td>
<td>25</td>
<td>1</td>
<td>2.1</td>
<td>Klein; Int J Card Image, 1993</td>
</tr>
<tr>
<td>TEE &amp; Operation</td>
<td>171</td>
<td>8</td>
<td>5</td>
<td>3</td>
<td>1.8</td>
<td>Manning; Circ, 1994</td>
</tr>
<tr>
<td>SPAF III TEE</td>
<td>359</td>
<td>19</td>
<td>5</td>
<td>1</td>
<td>0.3</td>
<td>Klein; Circ, 1994</td>
</tr>
<tr>
<td>TEE</td>
<td>272</td>
<td>19</td>
<td>7</td>
<td>0</td>
<td>0.0</td>
<td>Leung; JACC, 1994</td>
</tr>
<tr>
<td>TEE</td>
<td>60</td>
<td>6</td>
<td>10</td>
<td>0</td>
<td>0.0</td>
<td>Hart; Stroke, 1994</td>
</tr>
<tr>
<td>Total Thrombus</td>
<td>201</td>
<td></td>
<td></td>
<td>21</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

91% (201/222) of Left Atrial Thrombus Localized to the LAA

Left atrial appendage: *the most lethal human attachment*?

Sinus rhythm  Atrial fibrillation

Does the Left Atrial Appendage Morphology Correlate With the Risk of Stroke in Patients With Atrial Fibrillation?

Results From a Multicenter Study

Luigi Di Biase, MD, PhD,*†‡ Pasquale Santangeli, MD,*‡ Matteo Anselmino, MD, PhD,§
Prasant Mohanty, MBBS, MPH,* Ilaria Salvetti, MD,§ Sebastiano Gili, MD,§ Rodney Horton, MD,*
Javier E. Sanchez, MD,* Rong Bai, MD,* Sanghamitra Mohanty, MD,* Agnes Pump, MD,*
Mauricio Cereceda Brantes, MD,* G. Joseph Gallinghouse, MD,* J. David Burkhardt, MD,*
Federico Cesarani, MD,|| Marco Scaglione, MD,¶ Andrea Natale, MD,*† Fiorenzo Gaita, MD§
Left Atrial Appendage Morphology

Analysis of CT and MRI from 932 patients with atrial fibrillation

CT and MRI Scans of a **Chicken Wing** LAA Morphology (48%)

CT and MRI Scans of a **Cactus** LAA Morphology (30%)

CT and MRI Scans of a **Windsock** LAA Morphology (19%)

CT and MRI Scans of a **Cauliflower** LAA Morphology (3%)

Di Biase L et al. JACC 2012; 60(6):531–8
Does LAA morphology relate to risk of stroke?
Prevalence of Prior Stroke/TIA According to Different LAA Morphologies

A

<table>
<thead>
<tr>
<th>Morphology</th>
<th>Stroke Rate (%)</th>
<th>OR</th>
<th>CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicken Wing</td>
<td>5%</td>
<td>0.2</td>
<td>0.4-0.8</td>
</tr>
<tr>
<td>Windsock</td>
<td>15%</td>
<td>1.1</td>
<td>0.4-3.2</td>
</tr>
<tr>
<td>Cactus</td>
<td>20%</td>
<td>2.5</td>
<td>1.0-6.1</td>
</tr>
<tr>
<td>Cauliflower</td>
<td>20%</td>
<td>2.0</td>
<td>0.2-7.2</td>
</tr>
</tbody>
</table>

B

<table>
<thead>
<tr>
<th></th>
<th>Stroke Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chicken Wing</td>
<td>4%</td>
</tr>
<tr>
<td>Non-Chicken Wing</td>
<td>12%</td>
</tr>
</tbody>
</table>

OR 10.1 (95% CI 1.25 to 79.7), p=0.019

Chicken Wing Versus Non–Chicken Wing Morphologies

Di Biase L et al. JACC 2012; 60(6):531–8
Left atrial appendage function in sinus rhythm:

*LAA in systole and diastole by TEE (left) and cardiac MRI (right)*

Pollick C et al.; Circulation 1991

Holmes D et al.; Circulation 2009
LAA – prothrombotic milieu in atrial fibrillation

Increased von Willebrand Factor in the Endocardium as a Local Predisposing Factor for Thrombogenesis in Overloaded Human Atrial Appendage

Mitsumasa Fukuchi, MD,* Jun Watanabe, MD,* Koji Kumagai, MD,* Yukio Katori, MD,† Shigeo Baba, MD,* Koji Fukuda, MD,* Takuya Yagi, MD,* Atsushi Iuchi, MD,‡ Hitoshi Yokoyama, MD,‡ Masahito Miura, MD,* Yutaka Kagaya, MD,* Shigekazu Sato, MD,§ Koichi Tabayashi, MD,‡ Kunio Shirato, MD*

Sendai, Japan

vWF expression

SR

A.fib.
Feasability of percutaneous left atrial appendage closure

Conclusions—Thus, transcatheter closure of the LAA is feasible in humans. This novel implant technology may be appropriate for patients with AF who are not suitable candidates for anticoagulation therapy. Further trials are needed to show the long-term safety and its efficacy in reducing stroke. (Circulation. 2002;105:1887-1889.)
Currently available data on LAA closure with PLAATO device and stroke rate

<table>
<thead>
<tr>
<th>Author (yr)</th>
<th># Pat.</th>
<th>FU</th>
<th>Estimated annual stroke rate</th>
<th>Actual annual stroke rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block [2009]</td>
<td>64</td>
<td>5 years</td>
<td>6.6%</td>
<td>3.8%</td>
</tr>
<tr>
<td>Park [2009]</td>
<td>73</td>
<td>2 years</td>
<td>5.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Ussia [2009]</td>
<td>20</td>
<td>40±10 month</td>
<td>6.4%</td>
<td>0.0%</td>
</tr>
<tr>
<td>De Meester [2008]</td>
<td>10</td>
<td>3±47 month</td>
<td>7.1%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Ostermeyer [2005]</td>
<td>111</td>
<td>9.8 month</td>
<td>6.3%</td>
<td>2.2%</td>
</tr>
</tbody>
</table>
Devices for percutaneous left atrial appendage closure

PLAATO

WATCHMAN

One body (anchoring and sealing)
WATCHMAN LAA Closure Device in situ

Percutaneous closure of the left atrial appendage versus warfarin therapy for prevention of stroke in patients with atrial fibrillation: a randomised non-inferiority trial

David R Holmes, Vivek Y Reddy, Zoltan G Turi, Shephal K Doshi, Horst Sievert, Maurice Buchbinder, Christopher M Mullin, Peter Sick, for the PROTECT AF Investigators

Lancet 2009; 374: 534–42
PROTECT AF - Patient Study Timeline

Day 0

Preimplant interval

Device subject takes warfarin

Device subject gets implant

Randomize

Day 2-14

Day 45 postimplant

Device subject has ceased warfarin

Ongoing to 5 years

Control subject takes warfarin

Ongoing to 5 years

PROTECT AF Study - Key Inclusion/Exclusion Criteria

• Key Inclusion Criteria
  • Age 18 years or older
  • Documented non-valvular AF
  • Eligible for long-term warfarin therapy, and no other conditions that would require long-term warfarin therapy
  • Calculated CHADS2 score ≥ 1

• Key Exclusion Criteria
  • NYHA Class IV Congestive Heart Failure
  • ASD and/or atrial septal repair or closure device
  • Planned ablation procedure within 30 days of potential WATCHMAN Device implant
  • Symptomatic carotid disease
  • LVEF < 30%
  • TEE Criteria: Suspected or known intracardiac thrombus
PROTECT AF Study - Primary Endpoint

Primary efficacy endpoint (combined)
- ischemic stroke
- hemorrhagic stroke
- cardiovascular/unexplained death
- systemic embolism

Primary safety endpoint
- excessive bleeding
- procedure related complications
  (serious pericardial effusion, device embolization, procedure related related stroke)
PROTECT AF - Primary Endpoint

**Primary efficacy**

**Primary safety**

**All stroke**

**All cause mortality**
PROTECT AF - All Stroke

<table>
<thead>
<tr>
<th>Device</th>
<th>Control</th>
<th>Posterior probabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cohort</strong></td>
<td><strong>Events (no.)</strong></td>
<td><strong>Total pt-yr</strong></td>
</tr>
<tr>
<td>900 pt-yr</td>
<td>15</td>
<td>582.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Event-free probability**

- **Device**
- **Control**

**ITT cohort:** patients analyzed based on their randomly assigned group (regardless of treatment received)

PROTECT AF - Ischemic Stroke

<table>
<thead>
<tr>
<th>Cohort</th>
<th>Device</th>
<th></th>
<th>Control</th>
<th></th>
<th>Posterior probabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Events (no.)</td>
<td>Total pt-yr</td>
<td>Rate (95% CI)</td>
<td>Events (no.)</td>
<td>Total pt-yr</td>
</tr>
<tr>
<td>900 pt-yr</td>
<td>14</td>
<td>582.9</td>
<td>2.4 (1.3, 3.9)</td>
<td>5</td>
<td>318.9</td>
</tr>
</tbody>
</table>

**ITT cohort:**
patients analyzed based on their randomly assigned group (regardless of treatment received)

900 patient-year analysis

Event-free probability

Days: 0, 365, 730, 1095

Events: 244, 148, 52, 12

Events: 463, 270, 92, 22

## PROTECT AF - Hemorrhagic Stroke

### ITT cohort:
patients analyzed based on their randomly assigned group (regardless of treatment received)

<table>
<thead>
<tr>
<th>Cohort</th>
<th>Device</th>
<th>Control</th>
<th>Posterior probabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Events (no.)</td>
<td>Total pt-yr</td>
<td>Rate (95% CI)</td>
</tr>
<tr>
<td>900 pt-yr</td>
<td>1</td>
<td>593.6</td>
<td>0.2 (0.0, 0.6)</td>
</tr>
</tbody>
</table>

![Event-free probability graph](image)

Pericardial Effusions by Experience

- Pericardial effusions – most common safety issue
- Throughout PROTECT AF Trial, procedural modifications and training enhancements were implemented

<table>
<thead>
<tr>
<th>Site implant group</th>
<th>Any</th>
<th>Serious</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>Early patients (1-3)</td>
<td>13/154</td>
<td>8.4</td>
</tr>
<tr>
<td>Late patients (≥4)</td>
<td>27/388</td>
<td>7.0</td>
</tr>
<tr>
<td>Total</td>
<td>40/542</td>
<td>7.2</td>
</tr>
</tbody>
</table>

- Continued ACCESS Registry
Improved safety with experience: Continued Access Registry

Safety of Percutaneous Left Atrial Appendage Closure
Results From the Watchman Left Atrial Appendage System for Embolic Protection in Patients With AF (PROTECT AF) Clinical Trial and the Continued Access Registry

Vivek Y. Reddy, MD; David Holmes, MD; Shephal K. Doshi, MD; Petr Neuzil, MD, PhD; Saibal Kar, MD

Table 3. Safety Event Rates at Sites Participating in Both PROTECT AF and CAP

<table>
<thead>
<tr>
<th>Event</th>
<th>PROTECT AF</th>
<th>CAP</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procedure time, mean±SD, min</td>
<td>56±27</td>
<td>50±21</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Implant success, n/total (%)</td>
<td>335/367 (91.3)</td>
<td>437/460 (95.0)</td>
<td>0.033</td>
</tr>
<tr>
<td>Procedure/device-related safety adverse event within 7 d, n/total (%)</td>
<td>24/367 (6.5)</td>
<td>17/460 (3.7)</td>
<td>0.061</td>
</tr>
<tr>
<td>Serious pericardial effusion within 7 d, n/total (%)</td>
<td>15/367 (4.1)</td>
<td>10/460 (2.2)</td>
<td>0.110</td>
</tr>
<tr>
<td>Procedure-related stroke, n/total (%)</td>
<td>2/367 (0.5)</td>
<td>0/460 (0.0)</td>
<td>0.113</td>
</tr>
</tbody>
</table>

PREVAIL Trial to be reported soon

Circulation 2011;123(4):417-24
The Clinical Impact of Incomplete Left Atrial Appendage Closure With the Watchman Device in Patients With Atrial Fibrillation

A PROTECT AF (Percutaneous Closure of the Left Atrial Appendage Versus Warfarin Therapy for Prevention of Stroke in Patients With Atrial Fibrillation) Substudy

Juan F. Viles-Gonzalez, MD,* Saibal Kar, MD,† Pamela Douglas, MD,‡ Srinivas Dukkipati, MD,* Ted Feldman, MD,§ Rodney Horton, MD,‖ David Holmes, MD,¶ Vivek Y. Reddy, MD*
Primary Efficacy Endpoint Rates by Leak Severity

Viles-Gonzalez et al. JACC 2012;59(10):923–9

LAA Ostium by 3-Dimensional TEE and Watchman Device

Peri-Device Leak by TEE Imaging
Functional Impact of Clinical Events: Significant Disability or Death
Devices for percutaneous left atrial appendage closure

PLAATO

WATCHMAN

Amplatzer Cardiac Plug (ACP)

One body (anchoring and sealing)

Two bodies (anchoring and disc for sealing)
Atrial Appendix Closure Device
Amplatzer Cardiac Plug (ACP)

Lobe landing zone
Angiography of LAA and implantation of the LAA occluder *(ACP Device)*
LAA occlusion with the ACP device
3D Echo of LAA before and after the occlusion (using ACP)

ACP trial
- recruiting patients: estimated 3000 patients
- Aim: non-inferiority for efficacy and superiority for safety
2012 focused update of the ESC Guidelines for the management of atrial fibrillation

An update of the 2010 ESC Guidelines for the management of atrial fibrillation

Developed with the special contribution of the European Heart Rhythm Association
Summary and Conclusions

1. In addition to novel anticoagulants, *non-pharmacological approaches* are being developed for prevention of strokes in patients with A.fibrillation

2. The PROTECT-AF study has supported the concept that LAA closure can prevent strokes in patients with A.fib. - the safety of this approach is improving. PREVAIL and ACP trials are ongoing.

3. In particular, in patients with A.fib. and contra-indications for anticoagulation and a relevant cerebro-ischemic risk, LAA closure represent a possible treatment option.
Thank you
LAA – anatomical considerations
Assessment of Left Atrial Appendage Function by Biplane Transesophageal Echocardiography in Patients With Nonrheumatic Atrial Fibrillation: Identification of a Subgroup of Patients at Increased Embolic Risk

ANDREAS MÜGGE, MD, FACC, HENNING KÜHN, MD, PETER NIKUTTA, MD, JOCHEN GROTE, MD, J. ANTONIO G. LOPEZ, MD, FACC, WERNER G. DANIEL, MD, FACC

Hannover, Germany

Figure 2. Demonstration of the left atrial appendage (LAA) by transesophageal echocardiography (vertical view) in a patient with sinus rhythm. Top, The maximal (left panel, 3.10 cm) and minimal (right panel, 1.44 cm) areas of the left atrial appendage cavity during one cardiac cycle (34% area change). Bottom, Pulsed Doppler signal measured at the outlet of the appendage. Note the biphasic flow patterns with filling and emptying velocities >50 cm/s. LA = left atrium.

Figure 5. Pulsed Doppler spectrum measured at the outlet of the left atrial appendage in a patient with chronic nonrheumatic atrial fibrillation. Note that there is near negligible flow measurable in this patient.
Vorhofflimmern - Antikoagulation

ESC Guidelines

CHADS₂ score ≥ 2₃

Consider other risk factors* No Yes

Age ≥ 75 years No Yes

≥ 2 other risk factors* No Yes

1 other risk factor* No Yes

OAC (or aspirin) Nothing (or aspirin)

*Congestive heart failure, Hypertension, Age > 75 years, Diabetes, Stroke/TIA/thrombo-embolism (doubled)

*Other clinically relevant non-major risk factors: age 65–74, female sex, vascular disease

OAC
Stroke risk in patients with nonvalvular atrial fibrillation

<table>
<thead>
<tr>
<th>CHADS2 risk criteria</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prior stroke or TIA</td>
<td>2</td>
</tr>
<tr>
<td>Age .75 y</td>
<td>1</td>
</tr>
<tr>
<td>Hypertension</td>
<td>1</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>1</td>
</tr>
<tr>
<td>Heart failure</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Patients (N = 1733)</th>
<th>Adjusted stroke rate (%/y) (95% CI)</th>
<th>CHADS2-score</th>
</tr>
</thead>
<tbody>
<tr>
<td>120</td>
<td>1.9 (1.2 to 3.0)</td>
<td>0</td>
</tr>
<tr>
<td>463</td>
<td>2.8 (2.0 to 3.8)</td>
<td>1</td>
</tr>
<tr>
<td>523</td>
<td>4.0 (3.1 to 5.1)</td>
<td>2</td>
</tr>
<tr>
<td>337</td>
<td>5.9 (4.6 to 7.3)</td>
<td>3</td>
</tr>
<tr>
<td>220</td>
<td>8.5 (6.3 to 11.1)</td>
<td>4</td>
</tr>
<tr>
<td>65</td>
<td>12.5 (8.2 to 17.5)</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>18.2 (10.5 to 27.4)</td>
<td>6</td>
</tr>
</tbody>
</table>
### Table 10: Clinical characteristics comprising the HAS-BLED bleeding risk score

<table>
<thead>
<tr>
<th>Letter</th>
<th>Clinical characteristic</th>
<th>Points awarded</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>Hypertension</td>
<td>1</td>
</tr>
<tr>
<td>A</td>
<td>Abnormal renal and liver function (1 point each)</td>
<td>1 or 2</td>
</tr>
<tr>
<td>S</td>
<td>Stroke</td>
<td>1</td>
</tr>
<tr>
<td>B</td>
<td>Bleeding</td>
<td>1</td>
</tr>
<tr>
<td>L</td>
<td>Labile INRs</td>
<td>1</td>
</tr>
<tr>
<td>E</td>
<td>Elderly (e.g. age &gt; 65 years)</td>
<td>1</td>
</tr>
<tr>
<td>D</td>
<td>Drugs or alcohol (1 point each)</td>
<td>1 or 2</td>
</tr>
</tbody>
</table>

*Maximum 9 points*

---

*Hypertension* is defined as systolic blood pressure > 160 mmHg. *Abnormal kidney function* is defined as the presence of chronic dialysis or renal transplantation or serum creatinine ≥ 200 μmol/L. *Abnormal liver function* is defined as chronic hepatic disease (e.g. cirrhosis) or biochemical evidence of significant hepatic derangement (e.g. bilirubin > 2 x upper limit of normal, in association with aspartate aminotransferase/alanine aminotransferase/alkaline phosphatase > 3 x upper limit normal, etc.). *Bleeding* refers to previous bleeding history and/or predisposition to bleeding, e.g. bleeding diathesis, anaemia, etc. *Labile INRs* refers to unstable/high INRs or poor time in therapeutic range (e.g. < 60%). *Drugs/alcohol use* refers to concomitant use of drugs, such as antiplatelet agents, non-steroidal anti-inflammatory drugs, or alcohol abuse, etc. INR = international normalized ratio. Adapted from Pisters et al. 60
Amplatzer atrial septal occluder to occlude LAA

Left atrial appendage flow velocity and spontaneous echo contrast/thrombus

Figure 2. Mean left atrial appendage (LAA) Doppler velocity in control patients and in subgroups of patients with increasing grades of severity of left atrial spontaneous echo contrast (SEC) and left atrial thrombus.
Correct sizing depends only on accurate measurement of lobe landing zone.
ACP
Amplatz Cardiac Plug
Virtual endoscopic view of the left superior (LS) and left inferior (LI) PVs and LAA

## PROTECT AF

<table>
<thead>
<tr>
<th>Event</th>
<th>Intervention (n=463)</th>
<th>Control (n=244)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serious pericardial effusion*</td>
<td>22 (4.8%)</td>
<td>0</td>
</tr>
<tr>
<td>Major bleeding†</td>
<td>16 (3.5%)</td>
<td>10 (4.1%)</td>
</tr>
<tr>
<td>Procedure-related ischaemic stroke</td>
<td>5 (1.1%)</td>
<td>0</td>
</tr>
<tr>
<td>Device embolisation</td>
<td>3 (0.6%)</td>
<td>0</td>
</tr>
<tr>
<td>Haemorrhagic stroke‡</td>
<td>1 (0.2%)</td>
<td>6 (2.5%)</td>
</tr>
<tr>
<td>Other§</td>
<td>2 (0.4%)</td>
<td>0</td>
</tr>
</tbody>
</table>

*Defined as the need for percutaneous or surgical drainage. †Major bleeding is defined as a bleeding event that required at least 2 units of packed red blood cells or surgery to correct. ‡Of the seven haemorrhagic strokes, six resulted in death (intervention group, n=1; control group, n=5). §An oesophageal tear and a procedure-related arrhythmia.

**Table 3: Adverse events**
Percutaneous closure of the left atrial appendage versus warfarin therapy for prevention of stroke in patients with atrial fibrillation: a randomised non-inferiority trial

David R Holmes, Vivek Y Reddy, Zoltan G Turi, Shephal K Doshi, Horst Sievert, Maurice Buchbinder, Christopher M Mullin, Peter Sick, for the PROTECT AF Investigators®

Lancet 2009; 374: 534–42

<table>
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<th>Device</th>
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<tbody>
<tr>
<td>Cohort</td>
<td>Events (no.)</td>
</tr>
<tr>
<td>900 pt-yr</td>
<td>20</td>
</tr>
</tbody>
</table>

Atrial Appendix Closure

ITT Cohort: Non-inferiority criteria met
Differences between PLAATO/WATCHMAN and ACP in terms of function

- PLAATO/WATCHMAN have one body which is responsible for anchoring as well as for sealing.
- ACP has two bodies, the puck for anchoring and the disc for sealing.
WATCHMAN
### Baseline Risk Factors

<table>
<thead>
<tr>
<th></th>
<th><strong>WATCHMAN</strong></th>
<th><strong>Control</strong></th>
<th><strong>P-value</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>N= 463</strong></td>
<td><strong>N= 244</strong></td>
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<tr>
<td><strong>CHADS Score</strong></td>
<td></td>
<td></td>
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<tr>
<td>1</td>
<td>158/463 (34.1)</td>
<td>66/244 (27.0)</td>
<td>0.3662</td>
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<tr>
<td>2</td>
<td>157/463 (33.9)</td>
<td>88/244 (36.1)</td>
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<tr>
<td>3</td>
<td>88/463 (19.0)</td>
<td>51/244 (20.9)</td>
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<tr>
<td>4</td>
<td>37/463 (8.0)</td>
<td>24/244 (9.8)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>19/463 (4.1)</td>
<td>10/244 (4.1)</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>4/463 (0.9)</td>
<td>5/244 (2.0)</td>
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<tr>
<td><strong>AF Pattern</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Paroxysmal</td>
<td>200/463 (43.2)</td>
<td>99/244 (40.6)</td>
<td>0.7623</td>
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<tr>
<td>Persistent</td>
<td>97/463 (21.0)</td>
<td>50/244 (20.5)</td>
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<tr>
<td>Permanent</td>
<td>160/463 (34.6)</td>
<td>93/244 (38.1)</td>
<td></td>
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<tr>
<td>Unknown</td>
<td>6/463 (1.3)</td>
<td>2/244 (0.8)</td>
<td></td>
</tr>
<tr>
<td><strong>LVEF %</strong></td>
<td>57.3 ± 9.7</td>
<td>56.7 ± 10.1</td>
<td>0.4246</td>
</tr>
<tr>
<td></td>
<td>460 (30.0, 82.0)</td>
<td>239 (30.0, 86.0)</td>
<td></td>
</tr>
</tbody>
</table>
Reading the lobe landing zone

- parallel landing runway of 10mm length desired

- for secure ACP lobe enchoring the distal part of the landing zone should be trabeculated (contrast trap)
ACP Implant Sizing

1. Read the desired lobe landing zone.
2. Measure the landing zone at this position.
3. Estimate the space behind the landing zone.

Small space: Landing zone + 3 mm
- Lobe deployment at the landing zone

Big space: Landing zone + 5 mm
- Sandwich technique
Recommendations for transcatheter LAA-occlusion

- Extended LAA imaging (TEE, CT, MRI) prior implantation (LAA morphology, thrombus detection)
- Avoiding high transseptal puncture
- All 3 implants appropriate for long, cylindric LAA body
- Tapered LAA-body with big entrance cross-section diameter and short LAA-body length bares an increased risk of device embolization and LAA-perforation. This is true in particular for ocluders of PLAATO- and WATCHMAN-type.
Recommended requirements to start transcatheter LAA-occlusion

- Experience in the transseptal puncture technique
- Experienced, hand-in-hand assistance
- Experienced TEE-guidance
- Experience in the pericardial puncture technique
- Simulator training
- At least three proctor guided implantations
Warfarin Discontinuation

87% of implanted subjects were able to cease warfarin at 45 days and the rate further increased at later time points.

<table>
<thead>
<tr>
<th>Visit</th>
<th>Watchman N/Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>45 day</td>
<td>349/401 (87.0)</td>
</tr>
<tr>
<td>6 month</td>
<td>347/375 (92.5)</td>
</tr>
<tr>
<td>12 month</td>
<td>261/280 (93.2)</td>
</tr>
<tr>
<td>24 month</td>
<td>95/101 (94.1)</td>
</tr>
</tbody>
</table>

Reasons for remaining on warfarin therapy after 45-days:
- Observation of flow in the LAA (n = 30)
- Physician Order (n = 13)
- Other (n = 9)
Abklärung und mögliche Indikationen

Abklärung: TEE (Ausschluss von Thromben)

Indikation:

- Patienten mit CHADS Score (≥2) und erhöhtem Blutungsrisiko unter oraler Antikoagulation
Orifice size of left atrial appendage (LAA) as a function of age for A, male subjects, and B, female subjects.
Age Dependent Prevalence of Atrial Fibrillation

0.4% - 1% in the general population
8% in individuals of 80 yrs and older

Risk Reduction by ASS / Warfarin

Adapted odds ratios for ischemic stroke and intracranial bleeding in dependence of anticoagulation intensity


2x intracranial hemorrhage rate when INR > 3.0!

70% increase in stroke rate when INR < 2.0!

Transseptal puncture

- Ablation for AFib
- Mitral valve intervention

- LAA occlusion
LAA Anatomy

1. wall often thin
2. multiple lobes often
3. entrance mostly not trabeculated
4. neck mostly angulated
5. entrance always ovale

Su P et al.
Heart 2008;94:1166-70

Park J-W et al.
Asklepios Hospital Hamburg Harburg, Germany
Patienten-Aufklärung

Einverständniserklärung zum Katheterverschluß des linken Vorhofohrs bei Vorhofflimmern

Ich wurde über den bei mir vorgesehenen Eingriff informiert und bin damit einverstanden.


Ich bin orientiert worden, dass in wenigen Fällen das Vorhofohr nicht vollständig verschlossen werden kann, was unter Umständen eine zweite Behandlung nötig macht.

Ich wurde auch auf die allgemeinen Risiken einer Herzkatheteruntersuchung aufmerksam gemacht. Ich weiss, dass Blutungen z. B. an der Einstichstelle und Störungen des Herzrhythmus auftreten können und behandelt werden müssen. Andere ernste Komplikationen (schwere Allergie auf die verwendeten Medikamente, Durchblutungsstörungen der Arterien und Geninselbildung in den Arterien, Blutung in den Herzbeutel, Nierenfunktionsstörungen, Schlaganfälle usw.) treten bei weniger als 1% der Patienten auf.

Da ein kleines Risiko einer bakteriellen Infektion besteht, werde ich ein Antibiotikum erhalten und während einiger Monate bei Zahn- oder sonstigen Eingriffen oder fiebrigen Erkrankungen Antibiotika zur Vorbeugung einnehmen müssen.

Ich habe die mir gegebenen Informationen verstanden. Meine Fragen wurden alle befriedigend beantwortet.

- Perikarderguss (1-2 %)
- Device-Embolisation (< 1 %)
**Percutaneous Left Atrial Appendage Suture Ligation Using the LARIAT Device in Patients With Atrial Fibrillation**

**Initial Clinical Experience**

Krzyżtof Bartus, MD, Ph.D,* Frederick T. Han, MD,† Jacek Bednarek, MD, Ph.D,*
Jacek Myc, MD, Ph.D,* Bogusław Kapelak, MD, Ph.D,* Jerzy Sadkowski, MD, Ph.D,*
Jacek Lełakowski, MD, Ph.D,* Stanisław Bartus, MD, Ph.D,* Steven J. Yakubov, MD,§
Randall J. Lee, MD, Ph.D††

Krakow, Poland; San Francisco, California, and Columbus, Ohio

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**Components for the Percutaneous LAA Ligation Procedure**

**Fluoroscopic Guidance to Assist in the Closure of the LAA**
Percutaneous Left Atrial Appendage Closure for Stroke Prophylaxis in Patients with Atrial Fibrillation: 2.3 Year Follow-Up of the PROTECT AF Trial
Vivek Y. Reddy, Shephal K. Doshi, Horst Siever, Maurice Buchbinder, Petr Neuzil, Kenneth Huber, Jonathan L. Halperin and David Holmes

Circulation. published online January 16, 2013;
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Print ISSN: 0009-7322, Online ISSN: 1524-4539

Trial Patient Profile.
Catheter-Based Left Atrial Appendage (LAA) Ligation for the Prevention of Embolic Events Arising From the LAA
Initial Experience in a Canine Model

Randall J. Lee, MD, PhD; Krzysztof Bartus, MD; Steven J. Yakubov, MD
## PROTECT AF - Patient Demographics

### Baseline Demographics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>WATCHMAN N= 463</th>
<th>Control N= 244</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (years)</strong></td>
<td>71.7 ± 8.8</td>
<td>72.7 ± 9.2</td>
<td>0.1800</td>
</tr>
<tr>
<td></td>
<td>463 (46.0, 95.0)</td>
<td>244 (41.0, 95.0)</td>
<td></td>
</tr>
<tr>
<td><strong>Height (inches)</strong></td>
<td>68.2 ± 4.2</td>
<td>68.4 ± 4.2</td>
<td>0.6067</td>
</tr>
<tr>
<td></td>
<td>462 (54.0, 82.0)</td>
<td>244 (59.0, 78.0)</td>
<td></td>
</tr>
<tr>
<td><strong>Weight (lbs)</strong></td>
<td>195.3 ± 44.4</td>
<td>194.6 ± 43.1</td>
<td>0.8339</td>
</tr>
<tr>
<td></td>
<td>463 (85.0, 376.0)</td>
<td>244 (105.0, 312.0)</td>
<td></td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>137/463 (29.6)</td>
<td>73/244 (29.9)</td>
<td>0.9276</td>
</tr>
<tr>
<td>Male</td>
<td>326/463 (70.4)</td>
<td>171/244 (70.1)</td>
<td></td>
</tr>
</tbody>
</table>
WATCHMAN LAA Closure Device in situ

PREVAIL Trial is recruiting
Hemodynamics in AFib

AFib is associated with a decreased blood flow velocity in the left atrium. In particular in the LAA, blood flow velocity frequently decreases to stasis, increasing the probability of thrombus formation in the LAA.
PROTECT AF - Clinical Trial Design

• Prospective, randomized study of WATCHMAN LAA Device vs. Long-term Warfarin Therapy in patients with non-valvular atrial fibrillation
• 2:1 allocation ratio device to control
• 707 eligible Patients enrolled
  ▪ Device Group (463)
  ▪ Control Group (244)
• 59 Enrolling Centers (U.S. & Europe)