Is Concomitant LAA Exclusion Necessary During Cardiac Surgery?

Jae-Seung Jung, MD, PhD
Depart of Thoracic and Cardiovascular Surgery
Director of ECMO team
Anam-Hospital, Korea University Medical Center
Left Atrial Appendage (1)

• LAA is the main source of **atrial natriuretic peptide**, which plays a role in salt and water homeostasis effects body volume status

• LAA critical role in a healthy physiological function that may be eliminated with occlusion procedures → may eventually lead to long-term adverse results, but no studies to date have shown any adverse effects post-LAA exclusion

J Physiol. 1972;225 (3):705-19
Left Atrial Appendage (2)

- LAA is a more distensible chamber than LA
- An important role as a decompression chamber for acute rise in pressure
- Exclusion of the LAA in Animal study
  - Impair hemodynamic response to volume or pressure overload
  - Increase of the LA diastolic pressure
- After LAA closure → abrupt increases in LA volume and reduced LA compliance → a larger increase in LA pressure and pulmonary vein stretch and endothelial dysfunction → promoting the development of early POAF and thrombogenesis

*Am J Physiol.* 1990;259
Evidence that LAA clot in AF causes embolic stroke

• About 70% of all strokes in patients with AF are cardio-embolic from LA
• 91% of these arise from the LAA in data from TEE and autopsy
• Prophylactic exclusion of the LAA during cardiac surgery → reducing the risk of future thromboembolic events in patients with AF?
• not yet been proven conclusively

_Circulation_ 1991;84:527–539
LAA exclusion during Cardiac Surgery

• LAA removal is safe and has to be considered

• 2017 STS guideline (Class I) for A-fib
  → Surgical ablation for AF can be performed safely on MVR, isolated CABG, isolated AVR and CABG + AVR

• LAA decreasing flow and increased LAA volume
  → Increased thrombus formation and POAF
  → Surgical LAA exclusion was needed

Surgical LAA exclusion
Methods of Surgical LAA exclusion

- **Suture Closure**
  - Endocardial internal obliteration
  - Excision and suture
  - Epicardial ligation

- **Stapler**
  - Stay close to base
  - Be careful !!

- **New Devices**
  - Safer and better
  - More Expensive
Endocardial internal obliteration
Surgical LAA closure

Exclusion

Chatterjee S, ATS 2011;92:2283-92
- Easy to do
- High incidence of residual LAA flow
  - Shallow bites to avoid LCx
  - Nearby mitral ring or prosthesis limiting complete closure
Residual leak

Suture – Failure in 55%
Stapler - Failure in 28%

> 1 cm residual appendage
Excision
Surgical LAA closure

Excision (removal and oversew)

- Most effective
- More bleeding chance

Chatterjee S, *ATS* 2011;92:2283-92
Epicardial ligation
Concomitant ligation in permanent AF
Endoloop in 12 concomitant cases
TEE and pre-discharge CT
→ No communication

At 3month FU → 75% perfused on CT
Surgical LAA Ligation

M/69 Mitral Annuloplasty + Surgical ligation; stroke at 2 weeks

137 of 2546 pts underwent surgical LAA closure from 1993 to 2004 and had TEE after surgery

- Excision (32%) vs Exclusion (68%)
- Results: Success = No patent LAA or flow into remnant or excluded LAA

<table>
<thead>
<tr>
<th>Technique</th>
<th>Successful Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excision</td>
<td>73%</td>
</tr>
<tr>
<td>Exclusion (Suture)</td>
<td>23%</td>
</tr>
<tr>
<td>Exclusion (Staple)</td>
<td>0%</td>
</tr>
</tbody>
</table>

Unsuccessful LAA closure by 3 techniques

- Trend towards decreased incidence of stroke/TIA with successful LAA closure

JACC 2008
New
Surgical Devices
Surgical Devices for LAA occlusion

Open Chest concomitant

Minimally Invasive stand-alone

Tiger-Paw (Maquet)

Stapler (Covidien)

Atriclip (Atricure)

BOA pro (Atricure)
TigerPaw (MAQUET)

Tiger-Paw (Maquet)

7 or 9 pin Size (35 & 45mm)
Prospective Clinical Study of a Novel Left Atrial Appendage Occlusion Device

A. David Slater, MD, Antone J. Tatooles, MD, Arthur Coffey, MD, Patroklos S. Pappas, MD, Michael Bresticker, MD, Kevin Greason, MD, and Mark S. Slaughter, MD

- 60 patient prospective trial
- 1 LAA tears (Suture repair)
- 1 Device malfunction
- 90% Success
  - 90 day f/u
  - Definition of Failure = Residual cavity (6mm)

Slater AD, et al. ATS, 2012
AtriClip (AtriCure)
Exclusion of the left atrial appendage with a novel device: Early results of a multicenter trial

Gorav Ailawadi, MD, Marc W. Gerdisch, MD, Richard L. Harvey, MD, Robert L. Hooker, MD, Ralph J. Damiano, Jr, MD, Thomas Salamon, MD, and Michael J. Mack, MD

- 71 patient prospective trial
- No LAA tears
- 95% Success
- 3 month f/u
- Definition of Failure = Residual cavity

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 Puippe, Stephan Baumüller, Hatem Alkadhi, Ulf Landmesser, Andre Plass, Dominique Bettex, Jacques Scherman, Jürg Grünenfelder, Michele Genoni, Volkmar Falk and Sacha P. Salzberg

• 40 patient prospective trial
• Concomitant use AtriClip with Cardiac surgery
• 3 years f/u


Table 1: Mortality and major complications

<table>
<thead>
<tr>
<th>Condition</th>
<th>Number of patients (n = 36)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall mortality</td>
<td>4 (10.8%)</td>
</tr>
<tr>
<td>Device-related mortality</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Stroke</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Transient ischaemic attack</td>
<td>1 (2.7%)</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>1 (2.7%)</td>
</tr>
<tr>
<td>Heart failure</td>
<td>1 (2.7%)</td>
</tr>
<tr>
<td>Arrhythmia</td>
<td>1 (2.7%)</td>
</tr>
<tr>
<td>Endocarditis</td>
<td>1 (2.7%)</td>
</tr>
<tr>
<td>Renal failure</td>
<td>1 (2.7%)</td>
</tr>
<tr>
<td>Pulmonary failure</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Liver failure</td>
<td>1 (2.7%)</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>2 (5.2%)</td>
</tr>
<tr>
<td>Malignancy</td>
<td>1 (2.7%)</td>
</tr>
</tbody>
</table>
LAA as origin for “stubborn” AF/AT


Benussi et al. Circulation 2011
AtriClip and LAA surgical resection can the electrical isolation of LAA

Epicardial left atrial appendage clip occlusion also provides the electrical isolation of the left atrial appendage

Christoph T. Starck, Jan Steffel, Maximilian Y. Emmert, Andre Plass, Srijoy Mahapatra, Volkmar Falk and Sacha P. Salzberg

Research Highlight

Heart team approach for left atrial appendage therapies: in addition to stroke prevention—is electrical isolation important?

Sacha P. Salzberg, David Hürlimann, Roberto Corti, Jürg Grünenfelder

Heart Clinic Zurich, Klinik Hirslanden, Zurich, Switzerland
Recent Studies
Best evidence topic - Cardiac general

Should patients undergoing cardiac surgery with atrial fibrillation have left atrial appendage exclusion?

Alan G. Dawsona,*, Sanjay Asopab, Joel Dunningb

• 310 papers → 12 best evidence to answer

• 5 clinical trial (1 RCT)

• Do not clearly show a benefit for appendage occlusion

• Due to low success rate of LAA occlusion on TEE

• Highest success rate : 93%, just 55~66% success rate of LAA occlusion in these studies

Cardiovascular Outcomes With Surgical Left Atrial Appendage Exclusion in Patients With Atrial Fibrillation Who Underwent Valvular Heart Surgery (from the National Inpatient Sample Database)

- 1998~2013, ICD-9
- Case controlled matching based on CHA₂DS₂-VASc score
- A lot of limitations, however
Impact of Left Atrial Appendage Exclusion on Cardiovascular Outcomes in Patients With Atrial Fibrillation Undergoing Coronary Artery Bypass Grafting (From the National Inpatient Sample Database)

- 2004~2013, ICD-9
- Case controlled matching based on CHA$_2$DS$_2$VASc score
- A lot of limitations, however

<table>
<thead>
<tr>
<th></th>
<th>LAA group (n = 2519)</th>
<th>Control group (n = 12,595)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tamponade</td>
<td>16 (0.6%)</td>
<td>19 (0.2%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Pericardial Effusion</td>
<td>68 (2.7%)</td>
<td>151 (1.2%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hemorrhage</td>
<td>917 (36.4%)</td>
<td>2687 (21.3%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>In hospital death</td>
<td>40 (1.6%)</td>
<td>35 (0.3%)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Acute cerebrovascular events</td>
<td>50 (2%)</td>
<td>396 (3.1%)</td>
<td>0.002</td>
</tr>
<tr>
<td>Post-operative shock state</td>
<td>29 (1.2%)</td>
<td>46 (0.4%)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Am J Cardiol 2017
CONCLUSIONS: After adjustment for treatment allocation bias, LAA closure during routine cardiac surgery was significantly associated with an increased risk of early POAF, but it did not influence the risk of stroke or mortality. It remains uncertain whether prophylactic exclusion of the LAA is warranted for stroke prevention during non-atrial fibrillation-related cardiac surgery. ($P<0.001$).

**Table 3.** Backward Multivariable Logistic Regression Model for Predicting Postoperative Atrial Fibrillation After LAA Closure

<table>
<thead>
<tr>
<th>Covariates</th>
<th>Unmatched Cohort</th>
<th>Propensity-Matched Cohort</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR (95% CI)</td>
<td>$P$ Value</td>
</tr>
<tr>
<td>LAA closure</td>
<td>3.73 (3.00–4.64)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Summary

- LAA exclusion may be mandatory in AF related Cardiac surgery.
- LAA exclusion may induced POAF due to increase LA pressure, endothelial dysfunction and pul. vein stretching in non-AF related cardiac surgery.
- Successful LAA exclusion is important for gain a benefit (Excision or specific device).
- Do not clearly show a benefit for LAA exclusion on non-AF related cardiac surgery.
Ongoing Trial

Left Atrial Appendage Occlusion Study
(LAAOS) III
LAAOS III

- a prospective randomized double-blind
- International multicenter trial
- Concomitant surgical LAA occlusion Vs. No occlusion
- Patients with AF/flutter who are undergoing routine cardiac surgery
- Target recruitment is 4700 (as of August 2017, over 3,500)
- The primary hypothesis
  → LAA occlusion will reduce stroke or systemic embolic events (mean four years), OAC use on both arm
LAAOS III

• Is Concomitant LAA Exclusion Necessary During Cardiac Surgery?

→ A results of LAAOS III will show the answer
Thank you for your attention