Ηχωκαρδιογραφία στην επεμβατική Καρδιολογία

Παθήσεις του μεσοκολπικού διαφράγματος – σύγκλειση αριστερού ωτίου

Μαρία Δρακοπούλου
Α’ Καρδιολογική Κλινική
Ιπποκράτειο Νοσοκομείο
Outline

• IAS

• LAA
Development and anatomy of the atrial septum

# 2018 AHA/ACC Guideline for the Management of ACHD

<table>
<thead>
<tr>
<th>CHD Anatomy*</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>I: Simple</td>
<td></td>
</tr>
</tbody>
</table>

### Native disease
- Isolated small ASD
- Isolated small VSD
- Mild isolated pulmonic stenosis

### Repaired conditions
- Previously ligated or occluded ductus arteriosus
- Repaired secundum ASD or sinus venosus defect without significant residual shunt or chamber enlargement
- Repaired VSD without significant residual shunt or chamber enlargement

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*AMERICAN COLLEGE of CARDIOLOGY

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*American Heart Association®

life is why™
ASD types

ASD closure

2018 AHA/ACC Guideline for the Management of ACHD

Secundum ASD

Shunt direction

Left-to-right

Hemodynamic assessment

Pulmonary vascular resistance <1/3 systemic vascular resistance, PASP <50% systemic, right heart enlargement, AND shunt large enough to cause physiologic sequelae (e.g., Qp:Qs ≥ 1:5:1)

Functional impairment

Yes
   Surgical or device closure (Class I)

No
   No closure (Class III: Harm)

Right-to-left (e.g., Eisenmenger syndrome)

Confirm PAH diagnosis (often requiring invasive hemodynamic assessment) (Class I)

Consultation with ACHD and PH experts

Surgical or device closure (Class IIb)

Bosentan (Class I)

PDE-5 inhibitors (Class IIa)

Combination therapy* (Class IIa)

No closure (Class III: Harm)
ASD closure

ASD rims

TEE

Common nomenclature of the atrial septal defect rims.

<table>
<thead>
<tr>
<th>Probe Orientation</th>
<th>Anatomic</th>
<th>Spatial</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 degree</td>
<td>RUPV</td>
<td>-</td>
</tr>
<tr>
<td>Upper-esophageal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 degree</td>
<td></td>
<td>Posterior</td>
</tr>
<tr>
<td>Mid-esophageal</td>
<td>AV or mitral</td>
<td>Antero-inferior</td>
</tr>
<tr>
<td>0 degree</td>
<td></td>
<td>Inferior</td>
</tr>
<tr>
<td>Low-esophageal</td>
<td>Coronary sinus</td>
<td></td>
</tr>
<tr>
<td>45 degrees</td>
<td>Aortic</td>
<td>Antero-superior</td>
</tr>
<tr>
<td>Mid-esophageal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>90 degrees</td>
<td>SVC</td>
<td>Postero-superior</td>
</tr>
<tr>
<td>Mid-esophageal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>90 degrees</td>
<td>IVC</td>
<td>Postero-inferior</td>
</tr>
<tr>
<td>Mid-esophageal</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Vaidyanathan B. et al, J Am Coll Cardiol Img 2009; 2:1238-1242
**ASD closure**

**Added value of 3D for different congenital heart lesions**

The use of 3DE techniques has increased as technology has improved, but there is wide institutional variability in the adoption of the technique.

**Recommendations**

*Added Value of 3DE for Different Congenital Heart Lesions.* 3DE is recommended for the assessment of valvar lesions, septal defects, and complex abnormalities of the cardiac connections. 3DE should be regarded as a technique that complements rather than replaces 2DE for assessment of CHD.

*Use of 3DE to Guide Catheter-based Interventions.* 3DE is recommended to assist interventional closure of selected ASDs and VSDs, particularly multiple, irregularly shaped, or residual defects.
ASD closure

Horizontal axis
4 Chamber view at 0°

Posterior rim

Anterior-inferior rim
ASD closure

Horizontal axis at 45°
ASD closure

Long axis
Bicaval view at 95°.
ASD closure

TEE
3D imaging
ASD closure

TEE
3D imaging
ASD closure

TEE

3D sizing
Closure devices

Amplatzer  
Cardioseal StarFlex  
Helex  
Biostar
**ASD closure**

**Closure devices**

**Amplatzer® Septal Occluder**

Device size \(Waist = A\)

RA disc \(B\)

LA disc \(C\)

Length of waist \(Waist = D\)

**Επιλογή Συσκευής:**

Devices ≤ 38mm

Rims ≥ 5mm

Waist 2-4mm ≥ more than defect measurements
Most important characteristics of the Cocoon septal occluder:

**Device**
- Nanoplatinum coating. Provides: 1. Superior bio-compatible properties compared to Nitinol preventing nickel leaking into the blood stream in the heart. 2. Very smooth surface minimizing the risk of adjacent cardiac structures.
- Softest currently available ASD occluder confirms to the anatomy of the atria.
- Metal to septal ratio less to other currently available devices.
- MRI compatible
- Ability to recapture and reposition
- Self-centering
- Filled with polypropylene woven fabric which is better to polyester with respect to thrombogenicity
- CE approved

**Delivery system**
- Radiopaque: Obviates the need for placement of metal rings for opacification of its distal end.

**Bubble removing system**
- Back-up valve: avoids bleeding through the delivery sheath during the delivery process.

**ASD** = atrial septal defect; **MRI** = magnetic resonance imaging.
ASD closure

Cath Procedure

Case 1
Cath Procedure

ASD closure
ASD closure

Cath Procedure

Case 1
ASD closure
ASD closure
ASD closure
Transjugular percutaneous ASD closure
Transjugular percutaneous ASD closure

Case 2
Transjugular percutaneous ASD closure  Case 2
PFO closure

Discovery of a PFO in an individual patient with an otherwise occult etiology is not synonymous with diagnosing paradoxical embolism.
### The Risk of Paradoxical Embolism (RoPE) Study

**RoPE Score Calculator**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Points</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>No history of hypertension</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>No history of diabetes</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>No history of stroke or TIA</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Non smoker</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Cortical infarct on imaging</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

**Age (y)**

<table>
<thead>
<tr>
<th>Age (y)</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>18–29</td>
<td>5</td>
</tr>
<tr>
<td>30–39</td>
<td>4</td>
</tr>
<tr>
<td>40–49</td>
<td>3</td>
</tr>
<tr>
<td>50–59</td>
<td>2</td>
</tr>
<tr>
<td>60–69</td>
<td>1</td>
</tr>
<tr>
<td>≥ 70</td>
<td>0</td>
</tr>
</tbody>
</table>

**Total score (sum of individual points)**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum score (a patient &lt; 30 y without vascular risk factors, no history of stroke or TIA, and cortical infarct)</td>
<td>10</td>
</tr>
<tr>
<td>Minimum score (a patient ≥ 70 y with vascular risk factors, prior stroke, and no cortical infarct)</td>
<td>0</td>
</tr>
</tbody>
</table>


**PFO closure**

Can a CHADS-like risk score help to predict who will benefit from PFO-specific therapy in the cryptogenic stroke population?
DURABLE NITINOL WIRE MESH WITH POLYESTER FABRIC THREAD
Excellent visibility under fluoroscopy

ASYMMETRIC DOUBLE DISC DESIGN
Minimizes material in the left atrium

INTAGLIO™ WIRE TREATMENT
Designed to reduce nickel leaching
PFO closure

First Department of Cardiology
Small PFO with left to right shunt
Outline

• IAS

• LAA
Anatomic Variants of LAA Morphology

Sample images taken from explanted hearts

Beigel et al, J Am Coll Cardiol Img 2014;7:1251–65
Anatomic Variants of LAA Morphology

Morphologies and Modalities

Beigel et al, J Am Coll Cardiol Img 2014;7:1251–65
LAA shape/morphology & size vary widely

Di Biase, D, et al. JACC 2012;60:531-8
LAA Morphology and Risk of Stroke in AF

Di Biase et al, J Am Coll Cardiol 2012;60:531–8
The orifice of the appendage is usually oval, whereas round, triangular, and water-drop shapes are observed less frequently. The left lateral ridge separates the orifices of the left pulmonary veins from the LAA orifice.

The smooth muscular wall of the LA vestibule separates the orifice from the mitral annulus.

*John P. Veinot et al. Circulation. 1997;96:3112-3115*
# Echo Guidance of LAA Closure

## Pre-Procedural Imaging

| Pre-Procedural Imaging | • Baseline cardiac chamber size and function  
|                       | • Presence of thrombus (sludge, SEC), pericardial effusion  
|                       | • Atrial septum: thickness, ASD, PFO, atrial septal aneurysm  
|                       | • LAA size and anatomy, guide device selection |

## Procedural Imaging

| Procedural Imaging | • Guiding transseptal puncture  
|                   | • Guide placement of catheters  
|                   | • Adequate device placement & release criteria |

## Post-procedural Imaging (TTE 1d, TEE 1.5-6m)

| Post-procedural Imaging (TTE 1d, TEE 1.5-6m) | • Residual leak, pericardial effusion, device embolization, device thrombus, residual interatrial shunt |
# Echo Guidance of LAA Closure Devices

<table>
<thead>
<tr>
<th></th>
<th>Amplatzer Amulet</th>
<th>Watchman</th>
<th>LAmbre</th>
<th>Ultraceal</th>
<th>Coherex WaveCrest</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Design</strong></td>
<td>Distal lobe and proportional disc</td>
<td>Parachute-shaped device</td>
<td>Umbrella and a cover connected with a short central waist</td>
<td>Proximal disc and a distal lobe</td>
<td>Umbrella shape and distal anchoring</td>
</tr>
<tr>
<td><strong>Sizes lobe</strong></td>
<td>8 sizes (16, 18, 20, 22, 25, 28, 31, and 34 mm)</td>
<td>5 sizes (21, 24, 27, 30, and 33 mm)</td>
<td>11 sizes (16, 18, 20, 22, 24, 26, 28, 30, 32, 34, and 36 mm)</td>
<td>9 sizes (16, 18, 20, 22, 24, 26, 28, 30, and 32 mm)</td>
<td>3 sizes (22, 27, and 32 mm)</td>
</tr>
<tr>
<td><strong>Sheaths</strong></td>
<td>12–14F</td>
<td>14F</td>
<td>8–10F</td>
<td>10–12F</td>
<td>12F</td>
</tr>
<tr>
<td><strong>Device selection</strong></td>
<td>3–6 mm longer than LAA neck diameter</td>
<td>10%–20% longer than LAA neck diameter</td>
<td>3–8 mm longer than the measured LAA orifice</td>
<td>Bulb diameter at least 25% to 33% greater than the largest diameter of the landing zone</td>
<td>The smaller device size is chosen so that the longest measured diameter does not exceed the nominal device size and the average of the longest and shortest diameters is at least 3 mm below the nominal device size</td>
</tr>
</tbody>
</table>
Echo Guidance of LAA Closure Devices

**Watchman Device**
- Barbs Engage LAA Wall
- 160 µ PET fabric

**Amplatzer™ Cardiac Plug**
Assess LAA According to Chosen Device

- Assess shape, lobes, trabeculations, pectinate muscles/ridges, angulation
- Measure for WATCHMAN: Oa diameter, usable depth (d)
- Measure for ACP/Amulet: Oe diameter landing zone diameter (a) (10mm ACP, 15mm Amulet), depth (b)
Assess LAA Anatomy

- Assess LAA shape
- Usable depth of LAA & diameter
- Protruding pectinate ridge/muscle
- Presence of trabeculations, lobes and bifurcations
- Angulation at landing zone

Unsuitable width for device closure:
- Watchman: orifice >31mm or <17mm
- ACP: landing zone <28.5mm or <12.6mm
- Amulet: landing zone >31mm or <11mm

Depth Requirement
- ACP: 10mm
- Amulet: 15mm
- Watchman: as deep as width of device
TEE

0 degrees

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First Department of Cardiology, University of Athens
TEE

90 degrees

First Department of Cardiology, University of Athens
First Department of Cardiology, University of Athens
A Watchman 24mm was selected
First Department of Cardiology, University of Athens
# Echo Guidance of LAA Closure

| Pre-Procedural Imaging | • Baseline cardiac chamber size and function  
• Presence of thrombus and pericardial effusion  
• Atrial septum: thickness, ASD, PFO, atrial septal aneurysm  
• LAA size and anatomy, guide device selection |
|------------------------|--------------------------------------------------------------------------------------------------|
| **Procedural Imaging** | • Guiding transseptal puncture  
• Guide placement of catheters  
• Adequate device placement & release criteria |
| **TEE or ICE**         |                                                                                                 |
| **Post-procedural Imaging** | • Residual leak, pericardial effusion, device embolization, device thrombus, residual interatrial shunt |
Transseptal Puncture
Pigtail in LUPV
Catheter in LAA
3D Imaging

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Device Deployment - Measurements

- Device compression 8-20%
- Peri-device leak <3 ± 2mm

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Fluoroscopic Closure Assessment

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Ultrasound Closure Assessment

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3D Imaging of Watchman Device

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3D Imaging of Watchman Device

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TEE assessment
ACP Device
TEE assessment
ACP Device
Summary

• Pre-procedural, procedural and post-procedural TEE is the gold standard imaging modality for closure of the ASD and LAA

• Knowledge of TEE views to scrutinize the anatomy, accurate measurements and familiarity with steps of procedure are crucial for successful interventional procedures