Κολπική μαρμαρυγή με συνοδό ανεπάρκεια των κολποκοιλιακών βαλβίδων: υπάρχει διέξοδος από το φαύλο κύκλο;

Γεωργιος Κουργιαννιδης
Afib is a turning point in the physical history of MR

The Vicious Cycle

- MR begets AFIB
- AFIB begets AFIB
- MR begets MR
- AFIB begets MR

Morbidity and mortality
Stroke
Bleeding Risk
Heart Failure
Surgical Results
In an AF patient with moderately severe MR, should we first fix the MR to achieve atrial reverse remodeling and hopefully maintain sinus rhythm, OR should we primarily address the AF (RFCA/AADs/CVs) and hope that it will prevent annular/leaflet remodeling and hence decrease mitral regurgitation?"
MR And Atrial Fibrillation


**Mv repair+Cox-Maze**

..in PRIMARY MR

MV 217pts

<table>
<thead>
<tr>
<th></th>
<th>1 years</th>
<th>5 years</th>
<th>7 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>SR</td>
<td>92</td>
<td>86</td>
<td>70</td>
</tr>
<tr>
<td>SR no AAD</td>
<td>82</td>
<td>70</td>
<td>58</td>
</tr>
</tbody>
</table>

Prevalence and Prognostic Significance of Functional Mitral and Tricuspid Regurgitation Despite Preserved Left Ventricular Ejection Fraction in Atrial Fibrillation Patients

Yukio Abe, MD; Kanako Akamatsumi, MD; Kazato Ito, MD; Yoshiki Matsumura, MD, PhD; Kenji Shimeno, MD, PhD; Takahiko Naruko, MD, PhD; Yosuke Takahashi, MD, PhD; Toshihiko Shibata, MD, PhD; M

Circ J 2018; 82: 1451 – 1458

cohort type: single center consecutive ECHO afib LV normal pts

<table>
<thead>
<tr>
<th>MR</th>
<th>TR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>8.1%</td>
</tr>
<tr>
<td>&gt;10 y</td>
<td>28%</td>
</tr>
<tr>
<td>24+/-17 FU</td>
<td>12%</td>
</tr>
</tbody>
</table>
MECHANISMS aFMR

- ANNULAR DILATATION
- LEAFLET ADAPTATION IN AF-MR: ENDOTHELIAL-MESENCHYMAL TRANSFORMATION
- ABNORMAL ANNULO PAPILLARY BALANCE DUE TO IMPAIRED LV LONG-AXIS FUNCTION
- REDUCED MA CONTRACTILITY DUE TO ABNORMAL LV CIRCUMFERENTIAL MECHANICS
- ATRIOGENIC LEAFLET TETHERING
- HAMSTRINGING OF THE PML DUE TO PARADOXICAL LV POSTERIOR WALL MOTION
ATRIOGENIC LEAFLET TETHERING
HAMSTRINGING OF THE PML DUE TO PARADOXICAL LV POSTERIOR WALL MOTION
MR And Atrial Fibrillation

- Hamstrung PML
- Bent Posterobasal Segment
- LA
MR And Atrial Fibrillation

LV

MR

LA
828 pt ablation/53 FMR

**Figure 3** MR Severity at Baseline and Follow-Up
POSITIVE EFFECT OF RADIOFREQUENCY CATHETER ABLATION ON MITRAL REGURGITATION SECONDARY TO ATRIAL FIBRILLATION

81 RFCA 6mo

76.5% kept sinus rhythm while 23.4% showed recurrent AF.

**Sinus group showed significant reduction in MR and MAnnulus size in A-P direction**

Recurrent group showed no significant changes

Kuwahara et (poster) JACC April 5, 2016 Volume 67, Issue 13
<table>
<thead>
<tr>
<th><strong>Vohra et al</strong></th>
<th>20 pts</th>
<th>mitral annuloplasty plus concomitant antiarrhythmic procedures</th>
<th>18.0 ± 12.5 months</th>
<th>AF a mean duration of 84.6 ± 92.0 months</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>European Journal of Cardio-Thoracic Surgery</em> 42 (2012) 634–637</td>
<td>In all cases, AF preceded MR</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Takahashi et al</strong></th>
<th>10 AFMR pts with HF symptoms</th>
<th>mitral annuloplasty</th>
<th>FU 10-52 mo</th>
<th>LAV improved</th>
</tr>
</thead>
</table>
Annular Dilatation in TV is more profound

31 consecutive patients with lone AF and 28 normal controls

And can be Isolated....

9.2% FTR vs 45.3% LHTR

437 patients with moderate to severe TR underwent 3-dimensional (3D) transesophageal echocardiography...

• AF predicts recurrence of TR after left valves surgery
  
  Wang et al. Am Heart Assoc. 2016;5:e004213

• Improvement in TR without performing surgical correction is not uncommon in patients with severe functional TR due to Left Valve Disease and AF (22.5%).


• Isolated TR associated with Afib may improve with conversion to Sinus Rhythm

MR and Atrial Fibrillation

Severe Tricuspid Regurgitation on Echocardiography

Symptomatic

Primary Etiology

Intracardiac Device?

Yes

Consider Lead Extraction

No

Consider Percutaneous Intervention

Secondary Etiology

Persistent Atrial Fibrillation?

Yes

Consider Rhythm Control

No

TV Repair or Replacement

Asymptomatic

Persistent Atrial Fibrillation?

Yes

Consider Rhythm Control

No

Diuretic Therapy

↑ RA Pressure?

No

Monitor for ↑ RA Pressure & Symptoms

Yes

Persistent Symptoms

Elevated Surgical Risk?

Yes

Consider Percutaneous Intervention

No

No
Early rhythm control strategy in patients in mild MR to prevent LA/MA remodeling

Routine/Serial evaluation of MA dimensions?

TR as a marker of annular dilatation and to more strict rhythm control?

- **24% still MR in Gertz Study (...All were Advanced MR)**
- **Hypertension is a confounder not addressed substantially in studies**
• Based on the above findings an early rhythm control strategy may be justified to prevent Mitral valve remodeling

• Similarly an early mitral valve repair may also be considered for MR (plus Afib surgical or catheter ablation) to avoid further atrial and valvular remodelling

• Therapies regarding TR should always imply prior rhythm control (AADs/RFCA) because of its reversibility
MR And Atrial Fibrillation

Fibrotic Atrial Cardio myopathy

Seeing.... not looking
MECHANISMS aFMR

- ANNULAR DILATATION
- LEAFLET ADAPTATION IN AF-MR: ENDOTHELIAL-MESENCHYMAL TRANSFORMATION
- ABNORMAL ANNULO PAPILLARY BALANCE DUE TO IMPAIRED LV LONG–AXIS FUNCTION
- REDUCED MA CONTRACTILITY DUE TO ABNORMAL LV CIRCUMFERENTIAL MECHANICS
- ATRIOGENIC LEAFLET TETHERING
- HAMSTRINGING OF THE PML DUE TO PARADOXICAL LV POSTERIOR WALL MOTION
ANNULAR DILATATION

Almost universal finding but controversial. Second hit

This study demonstrated that isolated MA dilation in patients with lone AF does not usually cause moderate to severe MR, even though they have MA dilation comparable to those with ICM and frequent, significant MR


Silbiger Echocardiography. 2019;36:164–169
170 pts with CT

Each 1 mm/m² increase in AP diameter of MA odds ratio of 1.8 (95% CI, 1.35–2.40) of having significant MR after correcting for age, type of AF, hypertension, LV function and dimensions, and LA dimensions.


Rosendael Am J Cardiol 2014;114:763e768
Mitral Valve Adaptation to Isolated Annular Dilation
Insights Into the Mechanism of Atrial Functional Mitral Regurgitation

Dae-Hee Kim, MD, PhD,1 Ran-Bro, MD,1 Mark D. Handschumacher, BS,2 Sahmin Lee, MD, PhD,1
Yun-Sil Choe, RN, BDCS,1 Kyo-Hi Kim, RN, BDCS,1 Yewoern Shin, RN, BDCS,1 Hong-Kyung Park, RN, BDCS,1
Joyce Bouchiff, PhD,2 Elena Altawoa, MD, PhD,2 Jong-Min Song, MD, PhD,2 Duk-Hyun Kang, MD, PhD,2
Robert A. Levine, MD,1 Joe-Kwan Song, MD, PhD1

FIGURE 2 Representative Example of 3-Dimensional Reconstructions

<table>
<thead>
<tr>
<th></th>
<th>Total MLA</th>
<th>Closure area</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total MLA</strong></td>
<td>9.5 cm²</td>
<td>5.8 cm²</td>
</tr>
<tr>
<td><strong>Closure area</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total MLA: closure area ratio</strong></td>
<td>1.63</td>
<td></td>
</tr>
<tr>
<td><strong>Posterior: anterior annulus perimeter ratio</strong></td>
<td>1.24</td>
<td></td>
</tr>
</tbody>
</table>

**Normal**

<table>
<thead>
<tr>
<th></th>
<th>Total MLA</th>
<th>Closure area</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total MLA</strong></td>
<td>14.3 cm²</td>
<td>9.2 cm²</td>
</tr>
<tr>
<td><strong>Closure area</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total MLA: closure area ratio</strong></td>
<td>1.55</td>
<td></td>
</tr>
<tr>
<td><strong>Posterior: anterior annulus perimeter ratio</strong></td>
<td>1.40</td>
<td></td>
</tr>
</tbody>
</table>

**AF, MR-**

<table>
<thead>
<tr>
<th></th>
<th>Total MLA</th>
<th>Closure area</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total MLA</strong></td>
<td>20.3 cm²</td>
<td>16.5 cm²</td>
</tr>
<tr>
<td><strong>Closure area</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total MLA: closure area ratio</strong></td>
<td>1.26</td>
<td></td>
</tr>
<tr>
<td><strong>Posterior: anterior annulus perimeter ratio</strong></td>
<td>1.53</td>
<td></td>
</tr>
</tbody>
</table>

**AF, MR+**
ABNORMAL ANNULO PAPILLARY BALANCE DUE TO IMPAIRED LV LONG–AXIS FUNCTION

FIGURE 5 Annulo-papillary balance. In the normal LV, annular descent toward the apex (A) is offset by PM contraction (B), such that annulo-papillary distance remains constant during systole (C = D). See text. Reproduced with permission from Silbiger JJ. J Am Soc Echocardiogr 2013;26:1107-17

Silbiger Echocardiography. 2019;36:164–169
REDUCED MITRAL ANNULAR CONTRACTILITY DUE TO ABNORMAL LV CIRCUMFERENTIAL MECHANICS

- Normal sinus rhythm coupled presystolic and systolic annular dynamics
- AF absent presystolic but preserved systolic annular dynamics, albeit with a delayed timing
- AFMR is associated with diminished presystolic and additionally systolic annular dynamics
- Such abnormal dynamics are associated with impaired LV GLS.

Tang et al J Am Soc Echocardiogr 2018
ATRIOGENIC LEAFLET TETHERING
HAMSTRINGING OF THE PML DUE TO PARADOXICAL LV POSTERIOR WALL MOTION

FIGURE 1  A. Note that the LA and posterior mitral annulus rest within the mouth of the LV inlet. The posterior annulus is related to the LA internally and to the crest of the LV inlet externally. The mitral leaflets normally rest in the plane of the mitral annulus. B. With atriogenic leaflet tethering, the posterior pole of the mitral annulus (P) becomes displaced by mounting the crest of the LV inlet. As a result, the ventricular surface of the PML becomes pressed against crest of the LV inlet and is no longer able to coapt effectively with the AML. At the same time, the plane of the mitral annulus (dashed line) becomes displaced superiorly (small arrows). This increases annulo-papillary distance such that the mitral leaflets become tethered into the LV cavity. A—anterior pole of the mitral annulus.

Figure 3. Histologic section through the posterior mitral annulus. Note that the LA is internal to the posterior annulus and that the crest of the LV inlet is external to the posterior annulus. The curved arrow depicts displacement of the annulus onto the crest of the LV inlet. Adapted with permission from Wilcox BR, Cook AC, Anderson RH. Surgical anatomy of the heart. Cambridge, UK: Cambridge University Press; 2004:55. LV = left ventricular; LA = left atrial.
**FIGURE 3** Posterior mitral leaflet (PML) hamstringing. The rise in LV pressure during systole causes the posterior LV base to move paradoxically, that is, away from the LV cavity (curved arrow), hamstringing (restricting) the PML such that it is unable to effectively participate in coaptation. See text. P = posterior mitral annulus; PM = papillary muscle.
MR confers to poorer results of RFCA

95 pts with significant MR 1 year

Gertz et al. Europace (2011) 13, 1127–1132
216 RFCA pts

Table 3  The relation between the aetiology of VR and the ablation outcome

<table>
<thead>
<tr>
<th>Factors</th>
<th>OR (95% CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>AF duration</td>
<td>1.01 (1.00, 1.02)</td>
<td>0.008</td>
</tr>
<tr>
<td>LA size</td>
<td>1.14 (1.04, 1.25)</td>
<td>0.006</td>
</tr>
<tr>
<td>LVDd</td>
<td>0.99 (0.93, 1.05)</td>
<td>0.731</td>
</tr>
<tr>
<td>MR- mild</td>
<td>3.22 (1.18, 8.73)</td>
<td>0.022</td>
</tr>
<tr>
<td>MR- ≥moderate</td>
<td>4.61 (1.45, 14.63)</td>
<td>0.010</td>
</tr>
<tr>
<td>TR- mild</td>
<td>0.72 (0.27, 1.92)</td>
<td>0.513</td>
</tr>
<tr>
<td>TR- ≥moderate</td>
<td>0.72 (0.27, 1.89)</td>
<td>0.504</td>
</tr>
<tr>
<td>AR- mild</td>
<td>1.54 (0.63, 3.79)</td>
<td>0.349</td>
</tr>
<tr>
<td>AR- ≥moderate</td>
<td>1.46 (0.21, 9.89)</td>
<td>0.701</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Factors</th>
<th>OR (95% CI)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ATa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P value</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MR-organic</td>
<td>42 (36.2%)</td>
<td>0.002</td>
</tr>
<tr>
<td>-functional</td>
<td>74 (63.8%)</td>
<td></td>
</tr>
<tr>
<td>TR-organic</td>
<td>2 (2.1%)</td>
<td>0.409</td>
</tr>
<tr>
<td>-functional</td>
<td>94 (97.9%)</td>
<td></td>
</tr>
<tr>
<td>AR-organic</td>
<td>24 (53.3%)</td>
<td>0.526</td>
</tr>
<tr>
<td>-functional</td>
<td>21 (46.7%)</td>
<td></td>
</tr>
</tbody>
</table>

VR, valvular regurgitation; SR, sinus rhythm; ATa, atrial tachyarrhythmia; MR, mitral regurgitation; TR, tricuspid regurgitation; and AR, aortic regurgitation.

Figure 2  Predictors of ATa recurrence. AF, atrial fibrillation; LA, left atrium; LVDd, left ventricular end-diastolic diameter; MR, mitral regurgitation; TR, tricuspid regurgitation; and AR, aortic regurgitation.
Aggressive rhythm control on top of optimal medical treatment is obligatory to access the need for tricuspid correction if MV surgery is indicated.

TR can serve as a marker of annular dilatation and lead to more stringent rhythm control.

Can atrial fibrosis as assessed by electroanatomical mapping or CMR be a stratifier for ORGANIC MVR?
### Prevalence of aFUNCTIONAL MR in Evolving Physiology vs Longstanding AFib vs Paroxysmal AF

<table>
<thead>
<tr>
<th>Study</th>
<th>Population Description</th>
<th>Prevalence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sharma et al</td>
<td>57 consecutive patients with lone AF/TEE</td>
<td>66%</td>
</tr>
<tr>
<td>Saito et al.</td>
<td>189 hospitalized HF patients with AF</td>
<td>15.9%</td>
</tr>
<tr>
<td>Gertz et al</td>
<td>828 pt for ablation</td>
<td>6% (12%)</td>
</tr>
</tbody>
</table>
260 patients

21.5 vs. 8.1 per 100 patient-years for Pacemaker in ablation

260 patients

Figure 1. Freedom from Atrial Fibrillation.
Freedom from atrial fibrillation was defined as the absence of the condition at both 6 months and 12 months, as assessed by means of 3-day Holter monitoring. MVS denotes mitral-valve surgery, and PVI pulmonary- vein isolation.

55.6% underwent mitral-valve repair