MitraClip and CRT in mitral regurgitation: a good marriage?

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I disclose the following financial relationships:

Paid speaker for Abbott Vascular
CRT and MitraClip

• Prevalence of severe MR in HF patients candidates to CRT?

• Which patients improve after CRT?

• Impact of MR reduction on outcome?

• What comes first: CRT or MitraClip?
Mod-severe MR in HF patients

N = 1762, 66 year old, 68% men, LVEF 36%

- No-ICVD 53%
- IVCD 9%
- RBBB 8%
- LBBB 30%

Mod-severe MR 27%

...CRT 14%

Cinca et al. Eur J Heart Fail 2013
MR in HF and MV repair/replacement

1095 patients with severe MR and HF 2000-2008

557 left unoperated 90% FMR and 6% DMR

Goel et al. J Am Coll Cardiol 2013 in press
Outcomes of PMVR vs. surgery vs. MT

MitraClip:
77% FMR, LogEuroSCORE 24%

Surgery:
58% FMR, LogEuroSCORE 14%

Medical treatment:
87% FMR, LogEuroSCORE 19%

Swaans et al. JACC Intervent 2014
CRT and FMR: outcomes

N = 98

HR: 0.35 (95% CI 0.13-0.94); p = 0.043

van Bommel et al. Circ 2011
ESC Guidelines for treatment of MR

Primary (Degenerative)

Percutaneous edge-to-edge procedure may be considered in patients with symptomatic severe primary MR who fulfil the echo criteria of eligibility, are judged inoperable or at high surgical risk by a ‘heart team’, and have a life expectancy greater than 1 year (class IIbC).

Secondary (Functional)

MitraClip procedure may be considered in patients with symptomatic severe secondary MR despite optimal medical therapy (including CRT if indicated), who fulfil the echo criteria of eligibility, are judged inoperable or at high surgical risk by a team of cardiologists and cardiac surgeons, and who have a life expectancy greater than 1 year (class IIbC).

Vahanian et al. Eur Heart J 2012
MR improvement after CRT

Tethering ≠ Closing forces
Changes in LV and mitral geometry

↑Closing forces
Restoring LV and mitral geometry (reverse remodeling)
MR improvement after CRT

N = 34 HF patients
66±12 years
47% ischemic
LVEF 19±6%
Yu-index 36±13 ms

Closing pressure ratio

Solís et al. Circ cardiovasc Imag 2009
MR improvement after CRT

Changes in mitral valve geometry and closing forces at 6 months after CRT

Solís et al. Circ cardiovasc Imag 2009
MR improvement after CRT

<table>
<thead>
<tr>
<th></th>
<th>MR improvement (n=18)</th>
<th>No MR improvement (n=16)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre-CRT</td>
<td>Post-CRT</td>
</tr>
<tr>
<td>LVEDV, mL</td>
<td>265±88</td>
<td>228±77*</td>
</tr>
<tr>
<td></td>
<td>239±134</td>
<td>215±134*</td>
</tr>
<tr>
<td>LVESV, mL</td>
<td>216±78</td>
<td>167±81*</td>
</tr>
<tr>
<td></td>
<td>195±118</td>
<td>168±113*</td>
</tr>
<tr>
<td>LVEF, %</td>
<td>19±5</td>
<td>28±10*</td>
</tr>
<tr>
<td></td>
<td>20±7</td>
<td>24±12*</td>
</tr>
<tr>
<td>MAA, cm²</td>
<td>12.4±3.2</td>
<td>11±3.4*</td>
</tr>
<tr>
<td></td>
<td>10.8±3.9</td>
<td>10±2.8</td>
</tr>
<tr>
<td>Leaflet closing area, cm²</td>
<td>16.9±3.8</td>
<td>14.5±4.1*</td>
</tr>
<tr>
<td></td>
<td>14.2±4</td>
<td>13.1±3.6</td>
</tr>
<tr>
<td>Closing pressure ratio</td>
<td>0.77±0.04</td>
<td>0.85±0.1*</td>
</tr>
<tr>
<td></td>
<td>0.78±0.1</td>
<td>0.81±0.1</td>
</tr>
</tbody>
</table>

*=p<0.05

Solís et al. Circ cardiovasc Imag 2009
MR improvement after CRT

Kanzaki et al. J Am Coll Cardiol 2004
MR improvement after CRT

N = 25 HF patients
68±10 years, 64% ischemic
80% LBBB
LVEF 23±8%
Dyssynchrony between PMs: 169±69 ms

Ypenburg et al. J Am Coll Cardiol 2007
MR improvement after CRT

<table>
<thead>
<tr>
<th></th>
<th>Pre-CRT</th>
<th>Post-CRT</th>
<th>6 months</th>
<th>OFF</th>
</tr>
</thead>
<tbody>
<tr>
<td>MR grade</td>
<td>0/0/16/9</td>
<td>0/10/15/0</td>
<td>3/8/13/0</td>
<td>2/2/17/3</td>
</tr>
<tr>
<td>None/mild/mod/severe</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LVEDV, mL</td>
<td>251±85</td>
<td>249±87</td>
<td>205±97</td>
<td>210±101</td>
</tr>
<tr>
<td>LVESV, mL</td>
<td>196±85</td>
<td>183±85</td>
<td>145±89</td>
<td>163±88</td>
</tr>
<tr>
<td>LVEF, %</td>
<td>23±8</td>
<td>28±9</td>
<td>33±10</td>
<td>29±10</td>
</tr>
<tr>
<td>MV tenting area, cm²</td>
<td>7.8±1.0</td>
<td>7.2±1.0</td>
<td>6.7±1.2</td>
<td>6.9±1.3</td>
</tr>
<tr>
<td>Dyssynchrony, ms</td>
<td>169±69</td>
<td>25±26</td>
<td>26±28</td>
<td>134±51</td>
</tr>
</tbody>
</table>
LV dysysnchnony?

CRT Response

Location and extent of scar tissue?

Suitable cardiac vein?
N = 277 HF patients treated with CRT
N = 114 (48%) severe MR
At 6 months follow-up ⬤ 42% improved

<table>
<thead>
<tr>
<th>Associates of MR improvement after CRT</th>
<th>OR (95% CI), p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>LV radial dyssynchrony &gt;200 ms</td>
<td>2.65 (1.1-6.3), p=0.03</td>
</tr>
<tr>
<td>LV end-systolic diameter index &lt;29mm/m²</td>
<td>2.53 (1.0-6.2), p=0.04</td>
</tr>
<tr>
<td>Papillary muscle site WMSI≤2.5</td>
<td>2.59 (1.0-6.3), p=0.04</td>
</tr>
</tbody>
</table>
MR improvement after CRT and prognosis

Onishi et al. Circulation Heart Failure 2013
What comes first: MitraClip or CRT?

Surgery may be considered in patients with severe MR, LVEF >30%, who remain symptomatic despite optimal medical management (including CRT if indicated) and have low comorbidity, when revascularization is not indicated.

<table>
<thead>
<tr>
<th>Indications for CRT in patients in sinus rhythm</th>
<th>Class</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) LBBB with QRS duration &gt;150 ms. CRT is recommended in chronic HF patients and LVEF ≤35% who remain in NYHA functional class II, III and ambulatory IV despite adequate medical treatment (*)</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>2) LBBB with QRS duration 120-150 ms. CRT is recommended in chronic HF patients and LVEF ≤35% who remain in NYHA functional class II, III and ambulatory IV despite adequate medical treatment (*)</td>
<td>I</td>
<td>B</td>
</tr>
</tbody>
</table>

Percutaneous treatment of MR as bail-out therapy for non-responders to CRT

PERMIT-CARE

N = 51

Auricchio et al. J Am Coll Cardiol 2011
Percutaneous treatment of MR as bail-out therapy for non-responders to CRT

Auricchio et al. J Am Coll Cardiol 2011

<table>
<thead>
<tr>
<th>Complication</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute heart failure</td>
<td>7 (14)</td>
</tr>
<tr>
<td>Cardiac tamponade</td>
<td>1 (2)</td>
</tr>
<tr>
<td>Acute bleeding requiring transfusion</td>
<td>5 (10)</td>
</tr>
<tr>
<td>Urgent surgical valve repair/replacement</td>
<td>1 (2)</td>
</tr>
<tr>
<td>Death</td>
<td>1 (2)</td>
</tr>
</tbody>
</table>

Total procedure time (min) 172.1 ± 82.9
Total device time (min) 102.8 ± 62.9
Fluoroscopy time (min) 31.6 ± 18.1
Deployment of >1 clip 25 (49)
Use of inotropic drugs 35 (67)

Left Ventricular Volume (ml)

EDV
ESV

Left Ventricular Ejection Fraction (%)

Pre-CRT 23
Pre-MC 25
Discharge 27
3 month 28
6 month 30
12 month 33
Percutaneous treatment of MR as bail-out therapy for non-responders to CRT

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ACCESS-EU

What comes first: mitraclip vs. CRT?
SL delay 67 ms

PPM-APM 200 ms
Conclusions

• MR is frequent among patients candidates for CRT

• Response to CRT ↔ Improvement in MR
  – Improvement in closing forces
  – LV reverse remodeling
  – Restoration of MV geometry

• Percutaneous mitral valve repair feasible after CRT