Treatment of Heart Valve Disease: Evolution and Perspectives

Ottavio Alfieri
S.Raffaele University Hospital, Milan
Contemporary Approach to Heart Valve Disease

- Heart – team
- Guidelines
Heart Team in action at the S. Raffaele
Skill-set

Others

Interventional cardiology

Surgery

Clinical cardiology

EPS

Anesthesia
The beauty of sharing and cooperating

There is no “I” in cure
The Heart-Team concept is not new in Medicine…
Heart Team

• Complexity of the disease

• Complexity of the patient

• Expansion of the therapeutic options
Guidelines on the management of valvular heart disease (version 2012)

The Joint Task Force on the Management of Valvular Heart Disease of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS)

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# Classes of recommendations

<table>
<thead>
<tr>
<th>Classes of recommendations</th>
<th>Definition</th>
<th>Suggested wording to use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class I</td>
<td>Evidence and/or general agreement that a given treatment or procedure is beneficial, useful, effective.</td>
<td>Is recommended/is indicated.</td>
</tr>
<tr>
<td>Class II</td>
<td>Conflicting evidence and/or a divergence of opinion about the usefulness/efficacy of the given treatment or procedure.</td>
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<tr>
<td><strong>Class IIa</strong></td>
<td>Weight of evidence/opinion is in favour of usefulness/efficacy.</td>
<td>Should be considered.</td>
</tr>
<tr>
<td><strong>Class IIb</strong></td>
<td>Usefulness/efficacy is less well established by evidence/opinion.</td>
<td>May be considered.</td>
</tr>
<tr>
<td>Class III</td>
<td>Evidence or general agreement that the given treatment or procedure is not useful/effective, and in some cases may be harmful.</td>
<td>Is not recommended.</td>
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</tbody>
</table>

European Journal of Cardio-Thoracic Surgery 2012 -
## Levels of evidence

<table>
<thead>
<tr>
<th>Level of Evidence</th>
<th>Data Derived From</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of Evidence A</td>
<td>Data derived from multiple randomized clinical trials or meta-analyses.</td>
</tr>
<tr>
<td>Level of Evidence B</td>
<td>Data derived from a single randomized clinical trial or large non-randomized studies.</td>
</tr>
<tr>
<td>Level of Evidence C</td>
<td>Consensus of opinion of the experts and/or small studies, retrospective studies, registries.</td>
</tr>
</tbody>
</table>
"The Loop of Knowledge"

Contemporary Treatment of Heart Valve Disease

Availability of numerous therapeutic options

- Expansion of the treated population
- Personalized treatment
Aetiologies of Single Valvular Heart Diseases in the Euro Heart Survey

43% AS
13% AR
32% MR
12% MS

- Other
- Ischemic
- Congenital
- Inflammatory
- Endocarditis
- Rheumatic
- Degenerative

lung et al. Eur Heart J 2003;24:1244-53

Aortic Valve Implantation

Multiple Therapeutic Options

Conventional through midline sternotomy

Surgical through minimal incision

On pump, arrested heart sutureless valve replacement

Surgical apico-aortic valved conduit

Transaortic delivery

Transapical delivery

Transaxillary delivery

Transcarotid delivery

Percutaneous transfemoral

TAVI
Mini-sternotomy for aortic valve replacement reduces the length of stay in the cardiac intensive care unit: meta-analysis of randomised controlled trials

**Figure 2** Duration of ventilation in hours.

**Figure 3** Postoperative bleeding in the first 24 h measured in millilitres.
### Figure 4
Length of intensive care unit stay in days.

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>Mean (SD)</th>
<th>Total</th>
<th>Mean (SD)</th>
<th>Total</th>
<th>Weight</th>
<th>Mean difference (IV, Random, 95% CI)</th>
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<tbody>
<tr>
<td>01</td>
<td>0.28 (0.16)</td>
<td>30</td>
<td>1.15 (0.6)</td>
<td>30</td>
<td>29.1%</td>
<td>-0.87 (-1.09, -0.65)</td>
</tr>
<tr>
<td>02</td>
<td>1.2 (0.1)</td>
<td>20</td>
<td>2.1 (0.9)</td>
<td>20</td>
<td>23.8%</td>
<td>-0.90 (-1.30, -0.50)</td>
</tr>
<tr>
<td>03</td>
<td>1.1 (0.4)</td>
<td>40</td>
<td>1.4 (0.8)</td>
<td>40</td>
<td>27.6%</td>
<td>-0.30 (-0.58, -0.02)</td>
</tr>
<tr>
<td>04</td>
<td>1.83 (0.7)</td>
<td>20</td>
<td>1.94 (1)</td>
<td>20</td>
<td>19.5%</td>
<td>-0.11 (-0.64, 0.42)</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td></td>
<td>110</td>
<td></td>
<td>110</td>
<td>100.0%</td>
<td>-0.57 (-0.95, -0.20)</td>
</tr>
</tbody>
</table>

Heterogeneity: $\chi^2=0.11$, $df=3$ ($p=0.002$); $I^2=80$
Test for overall effect: $Z=2.39$ ($p=0.03$)

#### Figure 5
Length of hospital stay in days.

<table>
<thead>
<tr>
<th>Study or subgroup</th>
<th>Mean (SD)</th>
<th>Total</th>
<th>Mean (SD)</th>
<th>Total</th>
<th>Weight</th>
<th>Mean difference (IV, Random, 95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>8 (0.83)</td>
<td>30</td>
<td>17.7 (8.7)</td>
<td>30</td>
<td>17.7%</td>
<td>-9.70 (-12.83, -6.57)</td>
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<tr>
<td>02</td>
<td>9.3 (1)</td>
<td>20</td>
<td>9.4 (1.5)</td>
<td>20</td>
<td>28.3%</td>
<td>-0.10 (-0.89, 0.69)</td>
</tr>
<tr>
<td>03</td>
<td>7.2 (1.6)</td>
<td>40</td>
<td>8.2 (2.3)</td>
<td>40</td>
<td>28.1%</td>
<td>-1.00 (-1.87, -0.13)</td>
</tr>
<tr>
<td>04</td>
<td>6.3 (2.3)</td>
<td>20</td>
<td>6.3 (2.4)</td>
<td>20</td>
<td>25.8%</td>
<td>0.00 (-1.46, 1.46)</td>
</tr>
<tr>
<td>Total (95% CI)</td>
<td></td>
<td>110</td>
<td></td>
<td>110</td>
<td>100.0%</td>
<td>-2.03 (-4.12, 0.05)</td>
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</tbody>
</table>

Heterogeneity: $\chi^2=3.83$, $df=3$ ($p=0.0001$); $I^2=92$
Test for overall effect: $Z=1.91$ ($p=0.06$)

Sutureless aortic prosthesis

Sorin Perceval S

Edwards Intuity
Sutureless aortic valve replacement as an alternative treatment for patients belonging to the “gray zone” between transcatheter aortic valve implantation and conventional surgery: A propensity-matched, multicenter analysis

Augusto D’Onofrio, MD, a Antonio Messina, MD, b Roberto Lorusso, MD, c Ottavio R. Alfieri, MD, d Melissa Fusari, MD, e Paolo Rubino, MD, f Mauro Rinaldi, MD, g Roberto Di Bartolomeo, MD, h Mattia Glauber, MD, i Giovanni Troise, MD, b and Gino Gerosa, MD a

<table>
<thead>
<tr>
<th>Variable</th>
<th>TA-TAVI (n = 38)</th>
<th>SU-AVR (n = 38)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital mortality, n (%)</td>
<td>2 (5.3)</td>
<td>0 (0)</td>
<td>.49</td>
</tr>
<tr>
<td>ARF requiring CVVH, n (%)</td>
<td>1 (2.6)</td>
<td>2 (5.3)</td>
<td>1.00</td>
</tr>
<tr>
<td>AMI, n (%)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>1.00</td>
</tr>
<tr>
<td>Stroke, n (%)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>1.00</td>
</tr>
<tr>
<td>Bleeding (life-threatening/disabling, major), n (%)</td>
<td>2 (5.3)</td>
<td>1 (2.6)</td>
<td>1.00</td>
</tr>
<tr>
<td>PPM implantation, n (%)</td>
<td>2 (5.3)</td>
<td>2 (5.3)</td>
<td>1.00</td>
</tr>
<tr>
<td>Mean transaortic gradient, mm Hg</td>
<td>10.25 ± 5.03</td>
<td>10.95 ± 3.72</td>
<td>.59</td>
</tr>
<tr>
<td>AR at discharge (at least mild), n (%)</td>
<td>17 (44.7)</td>
<td>6 (15.8)</td>
<td>.001</td>
</tr>
<tr>
<td>LVEF at discharge, % (IR)</td>
<td>60 (55-60)</td>
<td>60 (54-65)</td>
<td>.75</td>
</tr>
<tr>
<td>New-onset atrial fibrillation, n (%)</td>
<td>7 (18.4)</td>
<td>16 (42.1)</td>
<td>.04</td>
</tr>
<tr>
<td>Orotracheal intubation time, hours (IR)</td>
<td>4 (0-5)</td>
<td>5.5 (4-8)</td>
<td>.21</td>
</tr>
</tbody>
</table>

Conclusions: This preliminary experience showed that, in patients at high risk for conventional surgery, SU-AVR is as safe and effective as TA-TAVI and that it is associated with a lower rate of postprocedural paravalvular leak. (J Thorac Cardiovasc Surg 2012;144:1010-8)
Aortic Valve Bypass Surgery: Midterm Clinical Outcomes in a High-Risk Aortic Stenosis Population

James S. Gammie, Leandra S. Krowsoski, James M. Brown, Patrick N. Odonkor, Cindi A. Young, Mary J. Santos, John S. Gottdiener and Bartley P. Griffith

31 high-risk pts
Operative mortality 13% (4/31 pts)

Conclusions—AVB surgery is an important therapeutic option for high-risk patients with symptomatic AS. Ventricular outflow is distributed in a predictable fashion between the conduit and the left ventricular outflow tract, and AVB surgery reliably relieves AS. Stroke and renal dysfunction were uncommon. (*Circulation*. 2008;118:1460-1466.)
Apico-aortic conduit: a revival for selected high risk patients

- 42-year-old patient with severe calcification of homograft in aortic position;
- 2° REDO operation
Apico-aortic conduit: a revival for selected high risk patients

- GUCH patient with severe subaortic obstruction
- Previous Fontan operation
# Devices for Transcatheter Aortic Valve Implantation

## 2007

<table>
<thead>
<tr>
<th>Device</th>
<th>Frame/Deployment</th>
<th>Valve</th>
<th>Soval/skirt/cuff</th>
<th>Access</th>
<th>Anti Calcification Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edwards Sapien THV</td>
<td>Stainless Steel</td>
<td>Bovine</td>
<td>None</td>
<td>TF, TA</td>
<td>None (glutaraldehyde fixation)</td>
</tr>
<tr>
<td>Edwards Sapien XT</td>
<td>Stainless Steel</td>
<td>Bovine</td>
<td>None</td>
<td>TF, TA</td>
<td>None (glutaraldehyde fixation)</td>
</tr>
<tr>
<td>Symetis Acurate TA</td>
<td>Self-expanding</td>
<td>Porcine</td>
<td>Polyethylene</td>
<td>None</td>
<td>None (glutaraldehyde fixation)</td>
</tr>
<tr>
<td>Abbott/St Jude Portico</td>
<td>Self-expanding</td>
<td>Bovine</td>
<td>Polyethylene</td>
<td>TF, Tc, Tao</td>
<td>None (glutaraldehyde fixation)</td>
</tr>
<tr>
<td>Boston Scientific Lotus</td>
<td>Self-expanding</td>
<td>Bovine</td>
<td>Polyethylene</td>
<td>TF, Tc, Tao</td>
<td>None (glutaraldehyde fixation)</td>
</tr>
</tbody>
</table>

## 2017

<table>
<thead>
<tr>
<th>Device</th>
<th>Frame/Deployment</th>
<th>Valve</th>
<th>Soval/skirt/cuff</th>
<th>Access</th>
<th>Anti Calcification Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Edwards Sapien 3</td>
<td>Self-expanding</td>
<td>Bovine</td>
<td>None</td>
<td>TF, TA</td>
<td>None (glutaraldehyde fixation)</td>
</tr>
<tr>
<td>New Valve Technology</td>
<td>Self-expanding</td>
<td>Bovine</td>
<td>None</td>
<td>TF</td>
<td>None (glutaraldehyde fixation)</td>
</tr>
<tr>
<td>Medtronic Evolut R</td>
<td>Self-expanding</td>
<td>Bovine</td>
<td>None</td>
<td>TF</td>
<td>None (glutaraldehyde fixation)</td>
</tr>
</tbody>
</table>

## Details

- **Medtronic CoreValve**: Self-expanding nitinol
- **Jena Valve**: Self-expanding nitinol
- **Symetis Acurate Neo**: Self-expanding nitinol
- **Medtronic Evolut Pro**: Self-expanding nitinol
- **Boston Scientific Lotus Edge**: Mechanically-expandable braided nitinol
Current Performance Benchmarks for TAVI *

- All-cause mortality ≤3%
- Major (disabling) strokes ≤2%
- Major vascular complications ≤5%
- New permanent pacemakers ≤10%
- Mod-severe para-valvular regurgitation ≤5%

* Through different approaches: TF, TA, Transaortic, Transaxillary, Transcarotid
TAVI is Available in More Than 65 Countries Around the World

>300,000 total implants to date
Symptomatic AS: SAVR Risk

Pipeline of TAVR Trials across the spectrum of aortic stenosis

Investigational devices
- Edwards Sapien/Sapien XT/S3
- Medtronic CoreValve/Evolut R
- Boston Lotus
- Direct Flow Medical Direct Flow
- Abbott Vascular Portico
- Symetis Acurate Neo
- Any available TAVR system

24 TAVR RCTs

Capodanno D, Leon MB. EuroIntervention 2016
The Evolution of Clinical Evidence

Risk

- **PARTNER 1B**
  - n=358

- **Corevalve ER**
  - n=489

- **PARTNER 1A**
  - n=699

- **CoreValve HR**
  - n=795

- **PARTNER 2A**
  - n=2032

- **SURTAVI**
  - n=1746

- **NOTION**
  - n=280

- **NOTION II**

- **PARTNER III**

- TAVI superior to medical Rx
- TAVI noninferior or superior to SAVR
- TAVI noninferior or superior (TF access) to SAVR
Pro TAVI

Age > 75 y ; STS score >4%
Previous cardiac surgery
Frailty / Restricted mobility
Favorable access for TF TAVI
Porcelaine aorta ( or heavy calcifications)
Functioning grafts at risk with sternotomy
Chest deformities / scoliosis
Expected pt/prosthesis mismatch
Sequelae of chest radiations
Pro AVR

Short distance between coronary ostia and valve
Bicuspid valve / calcification pattern unfavorable for TAVI
Severe tricuspid insufficiency
Aneurysm of the ascending aorta
Septal hypertrophy requiring myectomy
TAVI: Challenges & Open Questions

• Permanent pacemaker & paravalvular leak rates
• Durability & leaflet thickening
• Bicuspid valves
• Brain damage
• Late coronary obstruction
Evolution of interventions

- Surgery is the only treatment
- Surgery is the gold standard treatment
- Surgery is the preferred treatment for low and intermediate risk patients
- Transcatheter interventions are performed in intermediate risk patients
- Surgery is performed in patients with contraindication to transcatheter approach
New perspectives: transcatheter aortic valve implantation in the year 2020

In 2020 transcatheter aortic valve implantation (TAVI) will be the default treatment in patients with aortic stenosis

Performance
Safety (mortality, stroke)
Vascular complications
Perivalvular leaks
Conduction defects
Durability
Surgical AVR will be limited to contraindications to TAVI and to pts requiring combined cardiac or aortic surgery.
Estimated Global TAVI Growth

In the next 10 years, TAVI growth will increase \(X4\)!
Mitral Valve
Mitral Regurgitation is the most frequent valve disease in Europe & US

Prevalence of Moderate or Severe Mitral Valve Disease in the US = ~4.2M Patients*


* Nkomo: 1.7% prevalence (population based studies); US Census Bureau 2016: 248M adults
Types of Mitral Regurgitation

**Functional Mitral Regurgitation (FMR)**
- LV Dysfunction
  - Dilated Annulus
    - (Non-ischemic or ischemic dilated cardiomyopathy)
  - Loss of leaflet coaptation due to:
    - Annular enlargement
    - Papillary muscle displacement causing leaflet tethering/tenting

**Degenerative Mitral Regurgitation (DMR)**
- LA Dysfunction
  - Dilated Annulus
    - (Chronic atrial fibrillation, hypertension)
  - Leaflet prolapse due to:
    - Leaflet deformities or lesions
    - Ruptured/ elongated chordae
    - Papillary muscle rupture

Etiologies:
- Advanced Barlow’s Disease
- Fibroelastic deficiency

Surgical Risk vs Benefit

Limited Value

Optimum Value

Surgical Risk

Clinical Benefit

Increasing age, frailty, comorbidities, LV dysf.

Increasing age, frailty, comorbidities, LV dysf.

Increased age, frailty, comorbidities, LV dysf.

Surgical Risk vs Benefit

Poor value:
- Patient
- Purchaser
- Physician
Treating mitral regurgitation

Patient-optimized care

Transcatheter interventions
Minimally invasive surgery
Conventional Open heart procedures

Tailored approach – the best option for the patient
Surgical mitral repair techniques

**Leaflet:**
- Resection (quad, trian, butterf, other)
- Sliding
- Folding
- Augmentation
- Edge-to-edge
- Cleft closure

**Chordae:**
- Implantation
- Transfer
- Cutting

**Annulus:**
- Ring implantation (undersiz, partial)
- Plication
- Decalcification

**Papillary muscles:**
- Repositioning
- Relocation
- Approximation
- LVR
Minimally Invasive Mitral Repair

- HD Camera
- 5 mm 30° Endoscope
- Port Endoscope
- Same ICS as incision
- Left Atrial Vent
- 5 mm 30° Endoscope
- Camera Arm Holder
- LA Retractor
- Cardioplegia Line
- Chitwood Clamp
Robot Assisted
Late Outcomes of Mitral Valve Repair for Mitral Regurgitation Due to Degenerative Disease

Tirone E. David, MD; Susan Armstrong, MSc; Brian W. McCrindle MD; Cedric Manlhiot, BSc

Background—The pathological spectrum of degenerative diseases of the mitral valve (MV) that causes mitral regurgitation (MR) is broad, and there is limited information on late outcomes of MV repair in various subgroups of patients and pathologies. This study examines this issue.

Methods and Results—All 840 patients who had MV repair for MR due to degenerative diseases from 1985 to 2004 were prospectively followed with clinical and echocardiographic evaluations at biennial intervals up to 26 years, median of 10.4 years. Clinical, hemodynamic, and pathological variables were evaluated for their association with outcomes. Age, left ventricular ejection fraction, and functional class were predictors of late cardiac- and valve-related deaths by multivariable analysis. MV repair failed to restore life span to normal in patients with functional class IV. Thirty-eight patients had repeat MV surgery, and the probability of reoperation at 20 years was 5.9%. During the follow-up, recurrent severe MR developed in 37 patients, and moderate MR developed in 61. Age, isolated prolapse of the anterior leaflet, the degree of myxomatous changes in the MV, lack of mitral annuloplasty, and duration of cardiopulmonary bypass were associated with increased risk of recurrent MR. At 20 years, the freedom from recurrent severe MR was 90.7%, and the freedom from moderate or severe MR was 69.2%.

Conclusions—MV repair for degenerative MR restored life span to normal except in patients with symptoms at rest and impaired left ventricular function. Advanced age and complex mitral valve pathologies increased the risk of late recurrent MR. (Circulation. 2013;127:1485-1492.)

Key Words: degenerative disease of the mitral valve ▪ mitral regurgitation ▪ mitral valve repair
Figure 5. Freedom from recurrent severe recurrent MR (upper) and moderate and severe MR (lower). The dotted lines are the 95th confidence interval around the parameter estimates. MR indicates mitral regurgitation.
THE EVOLVING APPROACH TO MITRAL VALVE INTERVENTIONS

open heart

Sternotomy
Minimally Invasive
Robotic

→

closed heart

Transcatheter
Transcatheter MV Repair: Device Landscape 2018

Edge-to-edge
- Abbott MitraClip***
- Edwards Pascal*
- MitraFlex

MV replacement
- Edwards CardiAQ*
- Edwards Fortis*
- Neovasc Tiara*
- Abbott Tendyne*
- Medtronic Intrepid*
- HighLife*
- Caisson*
- NCSI NaviGate*
- M Valve*
- Mitraltech CardioValve*
- Cephea
- St. Jude
- Micro Interventional
- ValveXchange
- MitrAssist
- Braile Quattuor
- Direct Flow
- Sinomed Accufit
- Valcare Corona

MV replacement (cont)
- MitralHeal
- HT Consultant Saturn
- Lutter valve
- Transcatheter Technologies
- Tresillo
- Venus
- Verso
- Transmural Systems
- Saturn (InnovaHeart)
- 4C Medical TMVR

Other approaches
- NeoChord DS 1000**
- Harpoon neochords*
- Babic chords*
- Middle Peak Medical*
- St. Jude leaflet plication*
- Cardiosolutions Mitra-Spacer*
- Mitralix*
- Mitraltech Vchordal
- Coramaze Mitramaze

*In patients  *CE mark  *FDA approved
The MitraClip® System
MITRACLIP® NTR and MITRACLIP® XTR: 3RD-GENERATION SYSTEM

**MitraClip NTR**
The original MitraClip NT size, with an improved Clip Delivery System.

**MitraClip XTR**
Longer arms for easier grasping and better reach,¹ with an improved Clip Delivery System.

**MitraClip® 3rd-Generation Design Intent:**
- Increase coaptation surface area
- Expand the range of MV anatomies treatable with MitraClip
- Increase steering precision, deliverability and ease-of-use
- Reduce device time and clip rate

CE Mark and FDA approved, not approved in Japan
Global MitraClip Experience

>75000 patients treated

Implant Rate: 97%
Development of surgical MV repair + replacement vs Mitraclip
(from German Heart Report 2017)

COAPT vs. MITRA-FR: 12-Month Death or HF Hosp

**MITRA-FR**

<table>
<thead>
<tr>
<th>Months</th>
<th>No. at Risk</th>
<th>Control Group</th>
<th>Device Group</th>
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<tbody>
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<td>0</td>
<td>152</td>
<td>123</td>
<td>151</td>
</tr>
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<tr>
<td>12</td>
<td>153</td>
<td>194</td>
<td></td>
</tr>
</tbody>
</table>

**COAPT**

<table>
<thead>
<tr>
<th>Months</th>
<th>No. at Risk</th>
<th>Control Group</th>
<th>Device Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>3</td>
<td>90%</td>
<td>90%</td>
<td>90%</td>
</tr>
<tr>
<td>6</td>
<td>80%</td>
<td>80%</td>
<td>80%</td>
</tr>
<tr>
<td>9</td>
<td>70%</td>
<td>70%</td>
<td>70%</td>
</tr>
<tr>
<td>12</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
</tr>
</tbody>
</table>

**MitraClip + MT**

**MitraClip + GDMT**

- **OR [95% CI]** = 1.16 [0.73–1.84]
- **P** = 0.53

**MitraClip + GDMT**

- **HR [95% CI]** = 0.63 [0.49–0.82]
- **P** < 0.001

Obadia JF et al. NEJM. 2018 Aug 27. doi: 10.1056/NEJMoa1805374

Stone GW et al. NEJM. 2018 Sept 23.
## Why are the COAPT Results so Different from MITRA-FR?

<table>
<thead>
<tr>
<th></th>
<th>MITRA-FR (n=304)</th>
<th>COAPT (n=614)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Severe MR entry</strong></td>
<td><strong>Severe FMR by EU guidelines:</strong> EROA &gt;20 mm^2 or RV &gt;30 mL/beat 31 ± 10 mm^2</td>
<td><strong>Severe FMR by US guidelines:</strong> EROA &gt;30 mm^2 or RV &gt;45 mL/beat 41 ± 15 mm^2</td>
</tr>
<tr>
<td>criteria</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>EROA (mean ± SD)</strong></td>
<td>31 ± 10 mm^2</td>
<td>41 ± 15 mm^2</td>
</tr>
<tr>
<td><strong>LVEDV (mean ± SD)</strong></td>
<td>135 ± 35 mL/m^2</td>
<td>101 ± 34 mL/m^2</td>
</tr>
<tr>
<td><strong>GDMT at baseline and FU</strong></td>
<td>Receiving HF meds at baseline – allowed variable adjustment in each group during follow-up per “real-world” practice</td>
<td>CEC confirmed pts were failing maximally-tolerated GDMT at baseline – few major changes during follow-up</td>
</tr>
<tr>
<td><strong>Acute results:</strong> No clip / ≥3+ MR</td>
<td>9% / 9%</td>
<td>5% / 5%</td>
</tr>
<tr>
<td><strong>Procedural complications</strong></td>
<td>14.6%</td>
<td>8.5%</td>
</tr>
<tr>
<td>12-mo MitraClip ≥3+ MR</td>
<td>17%</td>
<td>5%</td>
</tr>
</tbody>
</table>
One-year outcomes and predictors of mortality after MitraClip therapy in contemporary clinical practice: results from the German transcatheter mitral valve interventions registry

Miriam Puls1*, Edith Lubos2, Peter Boekstegers3, Ralph Stephan von Bardeleben4, Taoufik Ouarrak5, Christian Butter6, Christine S. Zuern7, Raffi Bekeredjian8, Horst Sievert9, Georg Nickenig10, Holger Eggebrecht11, Jochen Senges5†, and Wolfgang Schillinger1,12†

Table 4 Predictors of 1-year mortality in the transcatheter mitral valve interventions registry cohort

<table>
<thead>
<tr>
<th>Predictor</th>
<th>Multivariable analysis (Cox regression model)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age &gt;75 years</td>
<td>1.29 (0.90–1.87)</td>
</tr>
<tr>
<td>Female gender</td>
<td>1.13 (0.78–1.64)</td>
</tr>
<tr>
<td>NYHA IV</td>
<td>1.62 (1.10–2.40)</td>
</tr>
<tr>
<td>Anaemia</td>
<td>2.44 (1.16–5.12)</td>
</tr>
<tr>
<td>Previous aortic valve intervention</td>
<td>2.12 (1.32–3.41)</td>
</tr>
<tr>
<td>Creatinine ≥1.5 mg/dL</td>
<td>1.77 (1.24–2.54)</td>
</tr>
<tr>
<td>Peripheral artery disease</td>
<td>2.12 (1.41–3.20)</td>
</tr>
<tr>
<td>LVEF &lt;30%</td>
<td>1.58 (1.10–2.31)</td>
</tr>
<tr>
<td>Severe tricuspid regurgitation</td>
<td>1.84 (1.23–2.77)</td>
</tr>
<tr>
<td>Procedural failurea</td>
<td>4.36 (2.37–8.02)</td>
</tr>
</tbody>
</table>
Direct Annuloplasty

the only approach with a proven surgical background

Mitralign
Bident
• Arterial access
• Transannular cinching

GDS
Accucinch
• Arterial access
• Subannular cinching

Valtech
Cardioband
• Venous access
• Annular fixation
The complementary role of transcatheter techniques

- Stand-alone annuloplasty: early treatment FMR / symmetric tethering
- Stand-alone Mitraclip: FMR with asymmetric tethering (IMR) DMR with little annular dilatation
- Combined Annuloplasty and MitraClip: DMR with important annular dilatation and advanced FMR
- MV Replacement: advanced organic MR and advanced FMR
Thank you