Trials of Tricuspid Valve Technology in 2020: Where are we now?

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Disclosures: Gilbert Tang, MD

- Abbott: faculty trainer and consultant
- Site PI of TRILUMINATE TriClip early feasibility study
Severe TR = worse survival, more cardiac events
US TVT Registry: Impact of Tricuspid Regurgitation

Cumulative incidence of death over follow-up months, showing different severity levels (Severe, Moderate, Mild/None). The 38.5% cumulative incidence of death is highlighted for the Severe group. The 23.5% and 23.4% cumulative incidences for Moderate and Mild/None groups, respectively, are also shown with a p-value of <0.0001. These findings are from Sorajja P et al. J Am Coll Cardiol 2017;70:2315-27.
Only 0.4% of TR patients treated today

Etiology: Secondary or Functional (>75%)

1.6 M
≥3+ TR Prevalence

12,324
Surgical Procedures

Principles of Tricuspid Repair

- Ensure leaflet coaptation and mobility
- Stabilize the annulus
- Avoid conduction injury
Surgical Tricuspid Repair Techniques

- Annuloplasty
- Annular Dilatation
- De Vega Repair
- Clover Technique
- Hetzer Repair
- Kay Repair Technique
Transcatheter Tricuspid Landscape

Direct Suture Annuloplasty
- Kay
- DeVega

Direct Ring Annuloplasty
- Complete / Incomplete
- Cardioband
- Millipede

Coaptation Enhancement
- Clover
- Hetzer

Valve Replacement
- Edge-to-Edge
- TriCinch
- Forma
- Clip
- Pascal

- Navigate
- TriCare
- TricValve

Courtesy: A Latib
Challenges in Device and Trial Designs

- Heterogeneous patient population
- Quality imaging a prerequisite
- Imaging requirements and parameters vary by devices
- Anatomic criteria vary by devices
- Clinical endpoints harder to define
When may Transcatheter over Surgery preferred?

- No transcatheter devices approved in US
- High or prohibitive risk for primary or reop surgery
- Favorable tricuspid anatomy and good TEE imaging required
- RV lead not a contraindication
- Avoid severely dilated annulus / RV with poor function
Transcatheter Therapies for Treating Tricuspid Regurgitation

Josep Rodés-Cabau, MD, a Rebecca T. Hahn, MD, b Azeem Latib, MD, c Michael Laule, MD, d Alexander Lauten, MD, e Francesco Maisano, MD, f Joachim Schofer, MD, g Francisco Campelo-Parada, MD, h Rishi Puri, MBBS, PhD, i Alec Vahanian, MD j
Intraprocedural Imaging of Transcatheter Tricuspid Valve Interventions

Rebecca T. Hahn, MD, Michael Nabauer, MD, Michel Zuber, MD, Tamim M. Nazif, MD, Jörg Hausleiter, MD, Maurizio Taramasso, MD, PhD, Alberto Pozzoli, MD, Isaac George, MD, Susheel Kodali, MD, Vinayak Bapat, CTn, Francesco Maisano, MD

ABSTRACT

Interest in the transcatheter solutions for tricuspid regurgitation has gained momentum given the limited indications for and high in-hospital mortality associated with isolated surgical intervention. Advanced imaging techniques to guide the procedures are the key to technical success. The following overview of the imaging requirements of selected devices is intended to give a glimpse into the complex procedures now possible with imaging guidance. (J Am Coll Cardiol Img 2019;12:532-53) © 2019 by the American College of Cardiology Foundation.
Multimodality Imaging of the Tricuspid Valve and Right Heart Anatomy

Omar K. Khalique, MD, João L. Cavalcante, MD, Dipan Shah, MD, Andradia Guta, MD, Yang Zhan, MD, Nicolo Piazza, MD, Denisa Muraru, MD

- annulus size
- right heart size and function
- subvalvular apparatus
- trabeculations
- coronary visualization
- vena cavae and femoral veins
- procedural planning
Innovations in tricuspid valve intervention

Ahmed El-Eshmawi\textsuperscript{a}, Gilbert H.L. Tang\textsuperscript{a}, Subodh Verma\textsuperscript{b}, Bobby Yanagawa\textsuperscript{b}, Marc Ruef\textsuperscript{c}, and David H. Adams\textsuperscript{a}
First-in-Human Timeline

2010: TricValve - IVC (Month)
2011:
2012: 4Tech Tricinch (November)
2013: TricValve – IVC + SVC (Month)
2014: TriClip MitraClip (Month)
2015: Millipede (March)
2016: MIA (December)
2017: Trilign (September)

Courtesy: N. Piazza
Approaches to Transcatheter Tricuspid Interventions

Approaches:
1. Superior vena cava
2. Inferior vena cava
3. Transapical
4. Transatrial

Anatomic Targets
1. Leaflets
2. Annulus
3. IVC

Courtesy: R Hahn
Clinical Experience with Edge-to-Edge Tricuspid

- Off-label with MitraClip system
- >600 cases in Europe, >300 in US
- Outcomes vary by anatomy and pathology
Case Presentation

- 89F, ESRD on dialysis, frail
- Prior pacemaker implantation, lead at posterior-septal commissure
- Unable to screen for TriClip repair via TRILUMINATE EFS due to dialysis
Baseline TEE: Torrential TR
RV Inflow Xplane
Transgastric
4D Transgastric Multiplane
4D ICE
4D ICE Multiplane
Leaflet Grasping on 4D ICE with Multiplane
Confirm Leaflet Insertion on 4D ICE
Confirm Leaflet Insertion on 4D Transgastric Multiplane
ICE
Percutaneous Edge-to-Edge Repair for Tricuspid Regurgitation: Initial 1 Year Outcomes from the TRILUMINATE Clinical Trial

Georg Nickenig MD, Marcel Weber MD, Phillip Lurz MD PhD, Paul Sorajja MD, Jörg Hausleiter MD, Marta Sitges MD, Paolo Denti MD, Jean-Noël Trochu MD, PhD, Michael Nabauer MD, and Rebecca T. Hahn MD
Study Device

Clip

Steerable Guide Catheter

Steerable Sleeve

Clip Delivery System

~6mm*

~9 mm**

TriClip™ NT
# Study Design

<table>
<thead>
<tr>
<th><strong>OBJECTIVE</strong></th>
<th>Evaluate safety and performance of the TriClip™ in patients with symptomatic moderate or greater tricuspid regurgitation.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DESIGN</strong></td>
<td>Prospective, single arm, multi-center study, conducted at 21 sites in United States and Europe.</td>
</tr>
<tr>
<td><strong>PRIMARY ENDPOINTS</strong></td>
<td>Effectiveness: TR reduction of at least 1 grade at 30 days post-procedure. Safety: A composite of major adverse events at 6-months.</td>
</tr>
<tr>
<td><strong>ELIGIBILITY</strong></td>
<td>Inclusion: (1) Symptomatic with moderate or greater TR. (2) No indication for left-sided/pulmonary valve correction. Exclusion: (1) Severe hypertension or pulmonary artery pressure (2) LVEF ≤ 20%</td>
</tr>
</tbody>
</table>
Procedural Data

Number of Clips Implanted per Subject (n=85 subjects)

- 1 Clip (20%)
- 2 Clips (47.1%)
- 3 Clips (28.2%)
- 4 Clips (4.7%)

Clipping Location (n=185 Clips)

- 3% (5) Anterior-Posterior
- 20% (37) Septal-Posterior
- 77% (143) Anterior-Septal

Aortic Valve
### Baseline Characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>First 50 Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (years)</td>
<td>78.4 ± 8.5</td>
</tr>
<tr>
<td>Male / Female (%)</td>
<td>42% / 58%</td>
</tr>
<tr>
<td>Hypertension</td>
<td>92%</td>
</tr>
<tr>
<td>Prior MI</td>
<td>22.0%</td>
</tr>
<tr>
<td>A-fib</td>
<td>96%</td>
</tr>
<tr>
<td>Prior Aortic Intervention</td>
<td>10%</td>
</tr>
<tr>
<td>Prior Mitral Intervention</td>
<td>32%</td>
</tr>
<tr>
<td>Replacement – Surgery</td>
<td>12.5%</td>
</tr>
<tr>
<td>Replacement – Percutaneous</td>
<td>12.5%</td>
</tr>
<tr>
<td>Repair – Surgery</td>
<td>31.3%</td>
</tr>
<tr>
<td>Repair – Percutaneous</td>
<td>43.8%</td>
</tr>
<tr>
<td>Other</td>
<td>6.3%</td>
</tr>
<tr>
<td>CRT/ICD/PPM</td>
<td>14%</td>
</tr>
<tr>
<td>Diabetes</td>
<td>16%</td>
</tr>
<tr>
<td>Renal Disease</td>
<td>40%</td>
</tr>
<tr>
<td>RV End Diastolic Dimension (cm)</td>
<td>5.23 ± 0.64</td>
</tr>
<tr>
<td>NYHA FC III/IV</td>
<td>77.5%</td>
</tr>
<tr>
<td>EuroSCORE II</td>
<td>7.90 ± 10.42%</td>
</tr>
<tr>
<td>LVEF</td>
<td>59.18 ± 8.11%</td>
</tr>
<tr>
<td>TAPSE (cm)</td>
<td>1.44 ± 0.33</td>
</tr>
<tr>
<td>PA Pressure, systolic (mmHg)</td>
<td>37.6 ± 13.7</td>
</tr>
<tr>
<td>6MWT (m)</td>
<td>295.58 ± 139.63</td>
</tr>
<tr>
<td>BNP (pg/ml)</td>
<td>541.49 ± 391.68</td>
</tr>
<tr>
<td>NT-proBNP (pg/ml)</td>
<td>4687.3 ± 16959.5</td>
</tr>
</tbody>
</table>
• TR reduction (at least 1 grade) was achieved in 87% of subjects at 1 year.

• The proportion of subjects with moderate or less TR increased from 4% at baseline to 54% at 30 days and 64% at 1 year.

1-year data indicate a durable TR repair.
• Continued improvements in NYHA functional class from 30 days to 1-year.

• The proportion of subjects with NYHA functional class I/II increased from 22% at baseline to 84% at 30 days and 80% at 1 year.

1-year data indicate continued symptomatic improvements.
KCCQ Score

Δ = 16.81 ± 23.40
p < 0.0001 (paired, n=42)

Δ = 16.17 ± 15.91
p < 0.0001 (paired, n=49)

6 Minute Walk Distance

Δ = 33.09 ± 62.88
p = 0.0111 (paired, n=27)
At 1 year, the reduction of TR was associated with significantly decreased right ventricular dimensions suggesting positive remodeling, with significant improvement in right ventricular function.
<table>
<thead>
<tr>
<th>Events (within 50 Pt scope)</th>
<th>30-Day (n)</th>
<th>1-Year (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Adverse Event (MAE)</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td><strong>Cardiovascular Mortality</strong></td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Myocardial Infarction</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Stroke</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>New Onset Renal Failure</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Non-elective CV surgery, TVRS device-related AE</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
### Additional Safety Endpoints

<table>
<thead>
<tr>
<th>Events (within 50 Pt scope)</th>
<th>30-Day (n)</th>
<th>1-Year (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All-cause Mortality</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Major Bleeding *</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Pulmonary Thromboembolism</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>New Onset Liver Failure</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>New Onset Atrial Fibrillation</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Single Leaflet Device Attachment #</td>
<td>3^</td>
<td>3</td>
</tr>
<tr>
<td>Embolization</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Tricuspid Valve Mean Gradient ≥ 5mmHg</td>
<td>2^</td>
<td>2</td>
</tr>
</tbody>
</table>

* Subjects were reported drop in hemoglobin of 3-5 g/Dl (BARC Type 3a)

* Subjects TR severity did not worsen, as compared to baseline.

^ In the full 85 patient cohort, 5 SLDA cases and 4 stenosis cases occur at 30 day. Not all these subjects have 1-year follow up data available yet, thus only cases in the 50Pt scope are shown in the table.

- Deaths: 4 cases not related to device or procedure, 1 case unlikely related to device or procedure (all site reported).
- Major bleeding: 3 possibly procedure related, 1 probably procedure related, 1 possibly device related (all site reported). Two new cases at 1-year were not related to device.
- SLDA: No re-intervention required. No additional new clinical symptoms related to SLDA.
- TVPG ≥ 5: No re-intervention required. No clinical symptoms related to stenosis.

No new device related safety events beyond 30 days.
• Durable repair with TR reduction of at least 1 grade in 87% of subjects with paired data at 1 year.

• Low MAE rate at 1 year with no new device-related AEs after 30 days.

• Significant improvement in NYHA class I/II (22% to 80%), KCCQ (16.8 points) and 6MWD (33.1 meters) persisted at 1 year.

• Positive RV reverse modeling and improved RV function at 1 year.
### TRILUMINATE Pivotal Study Design

#### Trial Design
- Prospective, randomized, controlled, multi-center trial
- **450** subjects enrolled at up to 80 sites in the US, Canada, Europe
  - Primary endpoint to be assessed after 350 subjects reach 12 month follow-up
  - Adaptive design incorporated, in case study is under-powered to show a difference
- **Principal Investigator:** Dr. David Adams (Mt. Sinai), Dr. Paul Sorajja (Abbott Northwestern)
- **Core lab:** Dr. Rebecca Hahn (CRF)

#### Primary Endpoint

**Randomized Arm**
A composite of mortality or tricuspid valve surgery, heart failure hospitalizations, and quality of life improvement assessed using the KCCQ, evaluated at 12 months in a hierarchical fashion using the Finkelstein-Schoenfeld methodology

**Single Arm:**
Survival and quality of life improvement (assessed using KCCQ) at 12 months compared to baseline
General Inclusion Criteria

1. In the judgment of the investigator at the site, subject has been adequately treated per applicable standards (including medical management and addressing other valve disease) and stable for at least 30 days.
   • The EC will confirm that the subject has been adequately treated medically.

2. Subject is symptomatic with severe Tricuspid Regurgitation despite being optimally treated as described in (1). TR severity is determined by the assessment of a qualifying transthoracic echocardiogram (TTE) confirmed by the Echocardiography Core Lab (ECL).

2. Patient is at intermediate or greater estimated risk of mortality for tricuspid valve surgery.
   • Determined by site heart team.
General Exclusion Criteria

1. Systolic pulmonary artery pressure (sPAP) estimated on echocardiogram is >70 mmHg or fixed pre-capillary pulmonary hypertension as assessed by right heart catheterization

2. Severe uncontrolled hypertension
   • Systolic blood pressure ≥ 180 mmHg
   • Diastolic blood pressure ≥ 110 mmHg

3. Left ventricle ejection fraction ≤ 20%

4. Indication for mitral/pulmonary valve correction in the prior 60 days

5. Any surgical/anatomical factor that would prevent appropriate clip placement
   • Pacemaker leads, calcification in gripping area, severe coaptation defect (>2cm), leaflet defects etc.
Edwards PASCAL Transcatheter Valve Repair System

- **Optimized leaflet capture**
  - Maneuvering in three planes
  - Independent leaflet capture

- **Effective MR reduction**
  - Broad paddles maximize leaflet coaptation
  - Spacer fills regurgitant orifice area

- **Excellent safety profile**
  - Spacer and contoured paddles reduce stress on leaflets
  - Elongation promotes safe subvalvular maneuvering

Empowering

Effective

Safe
## Edwards PASCAL Transcatheter Valve Repair System

| Delivery system |
|-----------------|-----------------|------------------|
| 22 French guide sheath |
| Design allows for catheter maneuvering in three independent planes |
| Independent catheters allow predictable implant positioning |

**Diagram:**
- Guide sheath
- Steerable catheter
- Implant catheter

*CAUTION: Investigational device. Limited by Federal (or United States) law to investigational use.*
Compassionate Use Experience

Multicenter, observational, compassionate use experience in patients with severe tricuspid regurgitation deemed high surgical risk or inoperable by local heart team

Key Outcomes:

• Procedural Success, defined as implantation of at least one device with post-procedural TR grade ≤ 2+, with no mortality or conversion to surgery
• Clinical and Device Outcomes at 30 days
### Procedural Results

<table>
<thead>
<tr>
<th></th>
<th>n=28 % (n) or Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Procedural Success</td>
<td>86% (24)</td>
</tr>
<tr>
<td>Mean # of Devices Implanted</td>
<td>1.4 ± 0.6</td>
</tr>
<tr>
<td>Independent Leaflet Grasping</td>
<td>90%</td>
</tr>
<tr>
<td>Procedure Time (Skin to Skin), mins</td>
<td>134 ± 68</td>
</tr>
<tr>
<td>Mortality</td>
<td>0%</td>
</tr>
<tr>
<td>Conversion to Surgery</td>
<td>0%</td>
</tr>
</tbody>
</table>
## Clinical Outcomes at 30 Days

<table>
<thead>
<tr>
<th>Outcome</th>
<th>n</th>
<th>%</th>
<th>(n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality</td>
<td></td>
<td>7.1%</td>
<td>(2)</td>
</tr>
<tr>
<td>Stroke</td>
<td></td>
<td>0.0%</td>
<td>(0)</td>
</tr>
<tr>
<td>Myocardial Infarction</td>
<td></td>
<td>0.0%</td>
<td>(0)</td>
</tr>
<tr>
<td>Major Bleeding</td>
<td></td>
<td>0.0%</td>
<td>(0)</td>
</tr>
<tr>
<td>Tamponade</td>
<td></td>
<td>0.0%</td>
<td>(0)</td>
</tr>
<tr>
<td>Acute Kidney Injury</td>
<td></td>
<td>0.0%</td>
<td>(0)</td>
</tr>
<tr>
<td>Conversion to Surgery</td>
<td></td>
<td>0.0%</td>
<td>(0)</td>
</tr>
<tr>
<td>Reintervention</td>
<td></td>
<td>0.0%</td>
<td>(0)</td>
</tr>
<tr>
<td>Heart Failure Hospitalization</td>
<td></td>
<td>3.5%</td>
<td>(1)</td>
</tr>
<tr>
<td>SLDA</td>
<td></td>
<td>7.1%</td>
<td>(2)</td>
</tr>
</tbody>
</table>
Significant Reduction in TR Severity at 30 Days

- Significant reduction in TR severity in 85% of patients with TR ≤2+ at 30 days

N=28  N=28  N=26

*p<0.001"Wilcoxon Signed-Rank Test*
Significant Improvements in Exercise Capacity

- Significant improvement in 6MWT by 96 meters at 30 days

*Wilcoxon Signed-Rank Test
6MWT – Six Minute Walk Test
Edwards Cardioband Tricuspid

Percutaneous Annuloplasty Cardioband Repair

Heart-Team:
Francesco Maisano
Fabian Nietlispach
Michel Zuber
Maurizio Taramasso

UniversitätsSpital Zürich

M Taramasso, TCT 2016
Edwards Cardioband Tricuspid System Early Feasibility Study

Single arm, multicenter, prospective study to evaluate the safety and performance of the Cardioband Tricuspid System in the treatment of functional tricuspid regurgitation
# Study Endpoints

<table>
<thead>
<tr>
<th>Primary Endpoints</th>
<th>Secondary Endpoints</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Safety</strong></td>
<td>Discharge, 1 month, 6 month, 1 year and annually for 5 years post implant procedure</td>
</tr>
<tr>
<td>• Safety will be analyzed as a composite endpoint of Major Adverse Events* (MAEs) at 30 days</td>
<td>• TR grade, EROA and Regurgitant Volume (by echocardiography)</td>
</tr>
<tr>
<td><strong>Performance</strong></td>
<td></td>
</tr>
<tr>
<td>• Device success</td>
<td>• NYHA</td>
</tr>
<tr>
<td>• Procedural success</td>
<td>• 6MWT</td>
</tr>
<tr>
<td>• Clinical success</td>
<td>• KCCQ</td>
</tr>
</tbody>
</table>

*Cardiovascular mortality, MI, stroke, tamponade, right coronary artery perforation, arrhythmia and conduction disorders requiring permanent pacing, new need for renal replacement therapy, severe bleeding, reintervention on the previously implanted study device and major access site and vascular complications requiring intervention. NYHA – New York Heart Association; 6MWT – Six Minute Walk Test; KCCQ – Kansas City Cardiomyopathy Questionnaire
## Study Demographics

<table>
<thead>
<tr>
<th>Condition</th>
<th>N=22 % or Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>78 ± 8</td>
</tr>
<tr>
<td>Female</td>
<td>77%</td>
</tr>
<tr>
<td>NYHA Class III or IV</td>
<td>73%</td>
</tr>
<tr>
<td>LVEF (%)</td>
<td>59 ± 6</td>
</tr>
<tr>
<td>Diabetes</td>
<td>32%</td>
</tr>
<tr>
<td>Ascites</td>
<td>18%</td>
</tr>
<tr>
<td>Atrial flutter/fibrillation</td>
<td>96%</td>
</tr>
<tr>
<td>Conduction defects/heart block</td>
<td>23%</td>
</tr>
<tr>
<td>Prior valve interventions</td>
<td>32%</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>18%</td>
</tr>
<tr>
<td>PCI/stent</td>
<td>32%</td>
</tr>
<tr>
<td>Elevated Systolic Pulmonary Artery Pressure (≥30mmHg)</td>
<td>100%</td>
</tr>
<tr>
<td>Mean peak pulmonary arterial pressure (mmHg)</td>
<td>39 ± 10</td>
</tr>
<tr>
<td>Renal Disease</td>
<td>41%</td>
</tr>
<tr>
<td>Hypertension</td>
<td>56%</td>
</tr>
<tr>
<td>Prior Stroke or TIA</td>
<td>18%</td>
</tr>
<tr>
<td>Pacemaker, ICD or CRT</td>
<td>23%</td>
</tr>
</tbody>
</table>
Safety Profile at 30 Days

<table>
<thead>
<tr>
<th>CEC Adjudicated Events</th>
<th>N=22 n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular mortality</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Stroke</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Right coronary artery constriction</td>
<td>1 (4.5)&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Right coronary artery perforation</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Arrhythmia and conduction disorders requiring permanent pacing</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>New need for renal replacement therapy</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Severe bleeding&lt;sup&gt;*&lt;/sup&gt;</td>
<td>7 (31.8)&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Fatal</td>
<td>0 (0.0)&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Life-Threatening</td>
<td>2 (9.1)&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Extensive</td>
<td>1 (4.5)&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Major</td>
<td>4 (18.2)&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Major access site and vascular complications requiring intervention</td>
<td>1 (4.5)&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Re-intervention on the previously implanted study device</td>
<td>0 (0.0)</td>
</tr>
</tbody>
</table>

<sup>a</sup> Distal right coronary artery obstruction occurred during implant adjustment and was resolved by stenting. Patient was stable and discharged home on POD 05. <sup>b</sup> Severe bleeding defined per MVARC as major, extensive, life-threatening, and fatal bleeding. <sup>*</sup>Related to procedure; none related to device.

7 patients experienced 9 procedure-related events. *6/7 patients were on oral anticoagulation or dual antiplatelet therapy at baseline for atrial fibrillation. n=2<sup>*</sup> life-threatening: Cardiac tamponade with bleeding; subdural Hematoma. n=1 extensive: Hemoglobin drop without sign of active bleed possibly due to the procedure. n=4<sup>+</sup> major: Vascular complication at hemodynamic monitoring access site with bleeding; GI bleed; coagulopathy; bleeding at bilateral groin catheter insertion sites.
Technical Success

Successful access, deployment and positioning of the Cardioband device 95.5% (21/22)
Significant Annular Reduction Sustained at 30 Days\(^1\)

Paired Analysis

\(N=17\)

Mean, 95% confidence interval; \(^{a}\)T-test

\(^1\)Core lab – Cardiovascular Research Foundation
Significant TR Severity Reduction Sustained at 30 Days¹
Paired Analysis

Discharge

- P<0.0001

- 50% Torrential
- 25% Massive
- 25% Severe
- 10% Moderate
- 15% Mild

- N=20

30 Days

- P<0.0001

- 50% Torrential
- 25% Massive
- 25% Severe
- 11% Moderate
- 11% Mild

- N=18

¹Wilcoxon signed-rank test
²Core lab – Cardiovascular Research Foundation
Clinically and Quality of Life Improvements at 30 Days
Paired Analysis

NYHA

<table>
<thead>
<tr>
<th>NYHA Class</th>
<th>Baseline</th>
<th>30 Days</th>
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</thead>
<tbody>
<tr>
<td>Class I</td>
<td>71%</td>
<td></td>
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<tr>
<td>Class II</td>
<td>29%</td>
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<tr>
<td>Class III</td>
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</tbody>
</table>

KCCQ Score

Δ13 Points

<table>
<thead>
<tr>
<th>Overall Score</th>
<th>Baseline</th>
<th>30 Days</th>
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</thead>
<tbody>
<tr>
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<td>54</td>
<td>66</td>
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</table>

6MWT

Δ10 Meters

<table>
<thead>
<tr>
<th>Distance Walked (m)</th>
<th>Baseline</th>
<th>30 Days</th>
</tr>
</thead>
<tbody>
<tr>
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<td>239</td>
<td>229</td>
</tr>
</tbody>
</table>

NYHA Class - New York Heart Association Functional Classification, KCCQ - Kansas City Cardiomyopathy Questionnaire, 6MWT - 6 Minute Walk Test.

*a* Wilcoxon signed-rank test; *b* T-test.
Study Conclusions

- Patients with functional tricuspid regurgitation have a large unmet need with limited treatment options
- This initial US experience from the Edwards Cardioband Tricuspid System Early Feasibility Study shows acceptable safety and performance in patients with tricuspid regurgitation
- Significant annular reduction and TR reduction stable at 30 days
- Patients experienced clinically significant improvement in functional status and quality of life

Enrollment is ongoing (NCT03382457)
Which transcatheter TV therapy for which patients?

Phase I
Initial Right Ventricular (RV) dilatation results in Tricuspid Annulus (TA) dilatation

Phase II
Progressive RV and TA dilatation results in lack of leaflets coaptation

Phase III
Progressive RV distortion results in tethering of the leaflets, pulmonary Htn

Leaflet Device
Annular Device
Replacement

Leaflet Device
Annular Device
Replacement

Replacement
Palliative CAVI
Spacer (FORMA)

Take Home Messages

- Untreated severe TR carries a poor prognosis
- Transcatheter tricuspid repair at its infancy, but early results promising
- Imaging is key to patient selection and procedural success
- 4D ICE complements 4D TEE during procedure
Take Home Messages

- Heart team approach is key in early evaluation and management in this high risk population
- Early evaluation maximizes opportunity to offer entire spectrum of therapies (medical, surgical, transcatheter)
Thank You

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