Ο ΡΟΛΟΣ ΤΗΣ ΥΠΕΡΗΧΟΓΡΑΦΙΑΣ ΣΤΟ ΑΙΜΟΔΥΝΑΜΙΚΟ ΕΡΓΑΣΤΗΡΙΟ
ΣΤΙΣ ΒΑΛΒΙΔΟΠΑΘΕΙΕΣ

Κ. ΑΓΓΕΛΗ
ΑΝ. ΚΑΘΗΓ. ΚΑΡΔΙΟΛΟΓΙΑΣ
Α. ΠΑΝΕΠ. ΚΑΡΔΙΟΛΟΓΙΚΗ ΚΛΙΝΙΚΗ, ΙΠΠΟΚΡΑΤΕΙΟ ΝΟΣΟΚΟΜΕΙΟ
The First Echocardiogram
- Mitral Valve 29th May 1953

Inge Edler
3D TOE as a communication tool
• .....Interventional TEE is used to guide and assess the progress and outcome of interventions in a real-time, continuous, and stepwise fashion.

• In this context the interventional echocardiographer becomes a co-proceduralist, providing clear, time-efficient, step-by-step guidance for interventional cardiologists navigating the complexities of cardiac anatomy with catheters, balloons, and devices. It is critical that during intra-procedural imaging, the interventionalist and echocardiographer maintain constant communication regarding anatomic structure and function as well as the actual progress of the procedure. .....
Transcatheter interventions

*Transthoracic or transesophageal echo*

- Pericardiocentesis
- Mitral valvuloplasty in valve stenosis
- ASD or patent foramen ovale/VSD
- Aortic valve implantation (TAVI)
- Left atrial appendage closure for atrial fibrillation
- Devices for Paravalvular leak(s)
- Intracardiac mass biopsy
- PDA/aneurysm/intervention for HOCM
- Mitral clip implantation in valve regurgitation
- New valves...in mitral valve regurgitation
THE PIVOTAL ROLE OF ECHOCARDIOGRAPHY

- Accurate assessment of nature of defect
- Patient selection
- Planning of procedure
- Precision and complication avoidance
  - Guidance, monitoring, verification of success, early identification of complications
- Patient follow up
Goals of echocardiography during transseptal catheterisation:

- Visualisation of the fossa ovalis
- Identification of the tenting of the septum
- Identification of crossing of the needle
- Confirmation of the position of the needle in left atrium
- Detection of complications
Different transseptal puncture for different procedures: Optimization of left atrial catheterization guided by transesophageal echocardiography

Andrea Radinovic¹, Patrizio Mazzone¹, Giovanni Landoni²³, Eustachio Agricola¹, Damiano Regazzoli¹, Paolo Della Bella¹

Site of transseptal puncture.
LAA: Left atrial appendage,
PVI: Pulmonary vein isolation
A Proposed Maneuver to Guide Transseptal Puncture Using Real-Time Three-Dimensional Transesophageal Echocardiography: Pilot Study

Cardiology Research and Practice
Tenting
ATRIAL FIBRILLATION

How to perform a transseptal puncture

Mark J Earley

Complications of transseptal puncture

- Pericardial effusion or tamponade
- Aortic root needle puncture
- Right or left atrial wall needle puncture
- Pleuritic chest pain
- Stroke/transient ischaemic attack
- Transient ST elevation of inferior leads
- Persistence of atrial septal defect
- Death
Mitral stenosis pre and post valvuloplasty
Transcatheter aortic valve implantation (TAVI) was introduced 8 years ago for the treatment of aortic stenosis and has since spread worldwide, with over 30,000 cases performed. Current evidence suggests that TAVI is the best option for inoperable patients and represents a reasonable alternative in high-risk patients for whom a heart team chooses TAVI over surgery (1,2). Balloon aortic valvuloplasty (BAV), which previously had limited indications because of its limited efficacy in improving the natural history of the disease, has experienced a revival with the development of TAVI as part of the procedure.
Comparison of Aortic Root Dimensions and Geometries Before and After Transcatheter Aortic Valve Implantation by 2- and 3-Dimensional Transesophageal Echocardiography and Multislice Computed Tomography

Arnold C.T. Ng, MBBS; Victoria Delgado, MD; Frank van der Kley, MD; Miriam Shanks, MD; Nico R.L. van de Veire, MD, PhD; Matteo Bertini, MD; Gaetano Nuñofora, MD; Rutger J. van Bommel, MD; Laurens F. Tops, MD; Arend de Weger, MD; Giuseppe Tavilla, MD, PhD; Albert de Roos, MD, PhD; Lucia J. Kroft, MD, PhD; Dominic Y. Leung, MBBS, PhD; Joanne Schuijf, PhD; Martin J. Schalij, MD, PhD; Jeroen J. Bax, MD, PhD
Right annular-ostial distance  Edwards-Sapiens
Closure of paravalvular MV defect-regurgitation
Interventional Echocardiography in Mitral Procedures

- Patient suitability selection.
  Mitral Valve morphology and hemodynamic assessment
- Procedural access and transseptal puncture
- Device choice
- Procedural guidance.
- Evaluation of possible complications
- Evaluation of Interventional Success
# Outcome after percutaneous edge-to-edge mitral repair for functional and degenerative mitral regurgitation: a systematic review and meta-analysis

Mauro Chiarito, Matteo Pagnesi, Enrico Antonio Martino, Michele Pighi, Andrea Scotti, Giuseppe Biondi-Zoccai, Azeem Latib, Giovanni Landoni, Carlo Di Mario, Alberto Maronato, Francesco Maisano, Ted Feldman, Ottavio Alfieri, Antonio Colombo, Cosmo Godino

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## Table 1: Main features of the studies included in the meta-analysis

<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>Study population</th>
<th>Multicentric</th>
<th>Independent echocardiographic core laboratory</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACCESS-EU</td>
<td>Prospective</td>
<td>Overall 510, FMR 393, DMR 117</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Braun et al. 2014</td>
<td>Prospective</td>
<td>Overall 119, FMR 47, DMR 72</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Chan et al. 2012</td>
<td>Prospective</td>
<td>Overall 27, FMR 12, DMR 15</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>EVEREST II RCT</td>
<td>RCT</td>
<td>Overall 178, FMR 48, DMR 130</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>EVEREST II HRS</td>
<td>Prospective</td>
<td>Overall 211, FMR 149, DMR 62</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>EVEREST II REALISM</td>
<td>Prospective</td>
<td>Overall 628, FMR 439, DMR 189</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>GRASP</td>
<td>Prospective</td>
<td>Overall 117, FMR 89, DMR 28</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Pilot European sentinel registry</td>
<td>Prospective</td>
<td>Overall 595, FMR 452, DMR 143</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Rudolph et al. 2013</td>
<td>Prospective</td>
<td>Overall 230, FMR 153, DMR 77</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Pooled population</td>
<td></td>
<td>Overall 2615, FMR 1782, DMR 833</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

DMR, degenerative mitral regurgitation; EVEREST II, Endovascular Valve Edge-to-Edge Repair Study II; FMR, functional mitral regurgitation; RCT, randomised controlled trial.

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Interventional TEE Echocardiography is key in MitraClip Procedural Steps

- Transseptal puncture
- Introduction of transseptal Sheath and clip delivery system (CDS) in the LA
- Navigation to the Mitral Valve and positioning of the MitraClip
- Rotation to achieve perpendicularity
- Grasping of the leaflets
- Assessment of leaflet insertion
- Assessment of result and MitraClip release
- Final result and evaluation of need for additional clips
- Detection of complications
Live 3D “surgical view”
MitraClip in MV Reg
The Cardioband Procedural Steps

1. Transseptal Puncture
2. System Insertion
3. Implant Deployment
4. Implant Size Adjustment

Baseline (pre-device)  Device Pre-Cinching  Device After Cinching

NEOCHORD IMPLANTATION... TECHNIQUE
PROCEDURAL IMAGING

VIDEO 5

Sapien XT deployed

3D enface MV view

Color Doppler 2

Diastolic Area 2.3 cm²

CW Doppler 2

Mean Gradient 3 mmHg
Percutaneous Transcatheter Mitral Valve Replacement
An Overview of Devices in Preclinical and Early Clinical Evaluation

Ole De Backer, MD, PhD; Nicolo Piazza, MD, PhD; Shmuel Banai, MD; Georg Lutter, MD, PhD; Francesco Maisano, MD; Howard C. Herrmann, MD; Olaf W. Franzen, MD; Lars Søndergaard, MD, DMSc
TIARA VALVE  Tendyne valve
PMV implantation
# Transcatheter Tricuspid Valve Repair

## New Valve, New Opportunities, New Challenges

Azeem Latib, MD, a,b Antonio Mangieri, MD a

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## Transcatheter Therapies for Treating Tricuspid Valve Regurgitation

<table>
<thead>
<tr>
<th>Device</th>
<th>TriCinch</th>
<th>TriCinch</th>
<th>Cardioband</th>
<th>FORMA</th>
<th>TRiClip</th>
<th>Mitrope</th>
<th>TRAPPA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanism</td>
<td>Annuloplasty</td>
<td>Annuloplasty</td>
<td>Annuloplasty</td>
<td>Coaptation device</td>
<td>Leaflet plasty</td>
<td>Annuloplasty</td>
<td>Annuloplasty</td>
</tr>
<tr>
<td>Patients treated</td>
<td>±50</td>
<td>±27</td>
<td>±18</td>
<td>±18</td>
<td>±50</td>
<td>2 (surgical)</td>
<td>-</td>
</tr>
<tr>
<td>Ongoing Study</td>
<td>SICT II</td>
<td>PREVENT</td>
<td>TR-REPAIR</td>
<td>SPACER</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Clinical endpoints</td>
<td>30-day Overall Mortality</td>
<td>30-day Safety Endpoint</td>
<td>30-day Safety Endpoint and Serious Adverse Events</td>
<td>30-day Cardiac Mortality</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Echo endpoints</td>
<td>TV Diameter</td>
<td>TV area</td>
<td>TV mobility</td>
<td>RV number</td>
<td>TV grade</td>
<td>TR grade</td>
<td>-</td>
</tr>
</tbody>
</table>

**Echo endpoints**

- **RCA damage**: 
  - **Device detachment**: 
  - **Cardiac perforation**: 
  - **Technical difficulty**: 
  - **Surgical predicate**:

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![Diagram](image)
Use of Echocardiography for Guiding Percutaneous Tricuspid Valve Procedures

Eustachio Agricola, MD, Francesco Ancona, MD, Stefano Stella, MD, Isabella Rosa, MD, Claudia Marini, MD, Marco Spartera, MD, Paolo Denti, MD, Alberto Margonato, MD, Rebecca T. Hahn, MD, Ottavio Alfieri, MD, Antonio Colombo, MD, Azeem Latib, MD
Percutaneous pulmonary and tricuspid valve implantations: An update

Robert Wagner, Ingo Daehnert, Philipp Lurz

Table 1 Devices and delivery systems for percutaneous pulmonary valve implantation

<table>
<thead>
<tr>
<th>The MELODY™ transcatheter pulmonary valve</th>
<th>The SAPIEN™ pulmonic transcatheter heart valve</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturer</td>
<td>Edwards Lifesciences LLC, Irvine, CA, United States</td>
</tr>
<tr>
<td>Regulatory approval</td>
<td>CE 5/2010</td>
</tr>
<tr>
<td>FDA approval</td>
<td>FDA 10/2012</td>
</tr>
<tr>
<td>Tissue characteristics</td>
<td>Tissue-att bovine pericardial valve hand-sewn inside a stent</td>
</tr>
<tr>
<td></td>
<td>Stainless-steel stent</td>
</tr>
<tr>
<td>Stent type</td>
<td>Length of 14 or 16 mm</td>
</tr>
<tr>
<td></td>
<td>Expandable up to 22 mm</td>
</tr>
<tr>
<td>Available sizes</td>
<td>25, 26, 28 mm (depending on the favored Ensemble™ delivery system)</td>
</tr>
<tr>
<td>Delivery system</td>
<td>Ensemble™ (Medtronic, MN) with balloon in balloon (BiB) deployment design</td>
</tr>
<tr>
<td>Sheaths for implantation</td>
<td>One-piece 22 Fr Teflon sheath</td>
</tr>
<tr>
<td></td>
<td>Edwards Biotop™ 25 containing a balloon catheter and a deflectable guiding catheter (18 Fr) 22 Fr for 23 mm valves (19 Fr) 24 Fr for 26 mm valves (16 Fr) 34 Fr for 29 mm XT valves</td>
</tr>
</tbody>
</table>
Four-Dimensional Transesophageal Echocardiography-Guided AngioVac Debulking of a Tricuspid Valve Vegetation

Adam A. Dalia, MD, MBA*, Daniel Bamira, MD†, Mazen Albaghdadi, MD‡, Michael Essandoh, MD§, Kenneth Rosenfield, MD†, David Dudzinski, MD†
A novel intervention for obstructive hypertrophic cardiomyopathy: The Liwen procedure

Obstructive hypertrophic cardiomyopathy presenting with refractory symptoms or drug resistance can be managed by means of surgical myectomy or alcohol septal ablation. In this EEP, look at the novel approach called percutaneous transapex intraseptal radiofrequency ablation (PTAISRA).
Innovation steps
Hi-Def Photo Realistic 3D TOE Rendering – Mitral Valve Perforation
Photo-realistic Rendering of 3D TOE
Near Future: Photo realistic 3D image rendering

Visualization of Medical devices during SHD interventional procedures
Echo guided interventions

Fusion of live echo and x-ray images

- Transseptal Puncture
- MitraClip
- LAA Occluder

Images courtesy of Dr. Costa, Zurich
EchoNavigator to Interrogate Final Device-Anatomy Relationship

Using EchoNavigator to Interrogate Final Device-Anatomy Relationship

MitraClip Catheter and soft tissue interaction?

Using EchoNavigator to Interrogate Final Device-Anatomy Relationship

Mitrval Valve residual regurgitant jet
Online hemodynamic color Doppler interaction?
HEART MODEL
EchoNav Anatomic Intelligence:
Simulation of transcatheter based structural heart interventions
EchoNavigator AI Heart Model 3.0
realtime beating heart SHD overlay
3D PRINTING FROM 3D TEE
The future of ECHO in interventions……

• **3D Fusion echo** will rapidly evolve in 2018-2020 as an innovative virtual surgical eye in interventions.

• **The photo realistic imaging** is another innovation step to improve native structural heart disease diagnoses and procedural control.

• **3D printing** should be involved in structural heart interventions