
# MitraClip:
# Why, How, and For Whom?

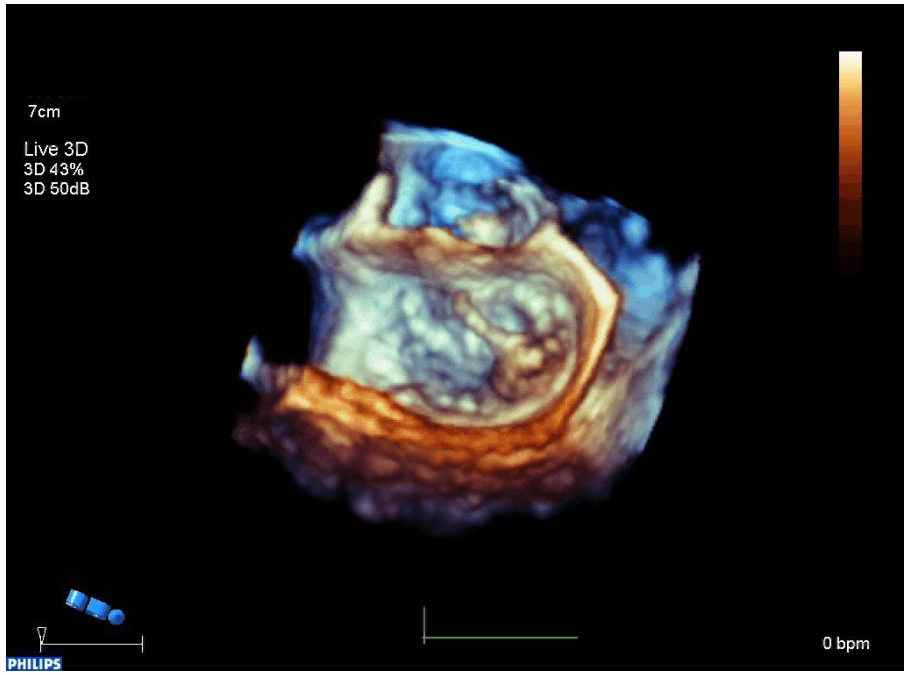
**Robert O. Bonow, MD, MS**

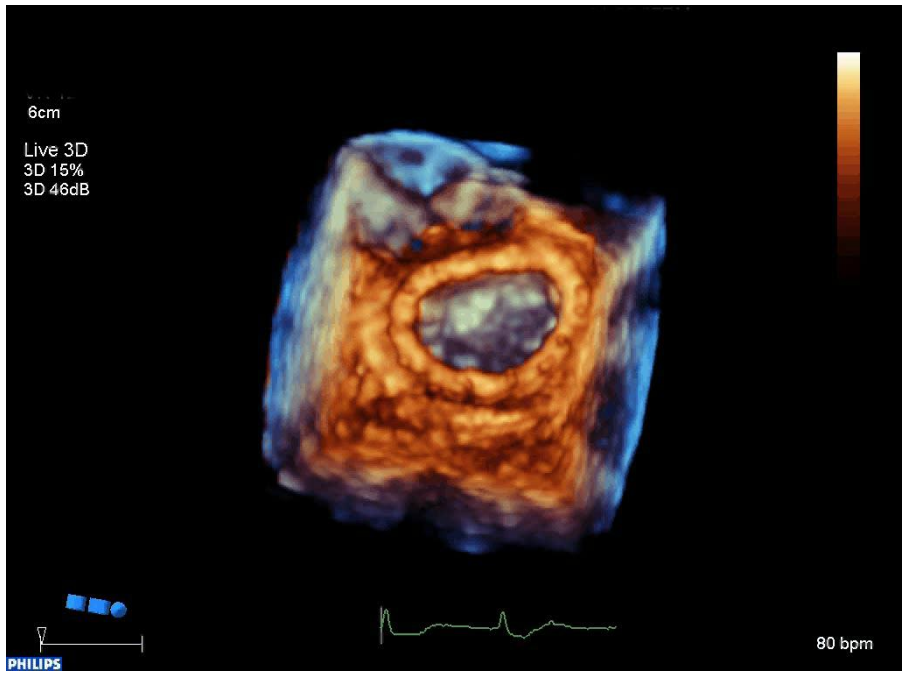
Northwestern University Feinberg School of Medicine
Bluhm Cardiovascular Institute
Northwestern Memorial Hospital

Editor-in-Chief, JAMA Cardiology

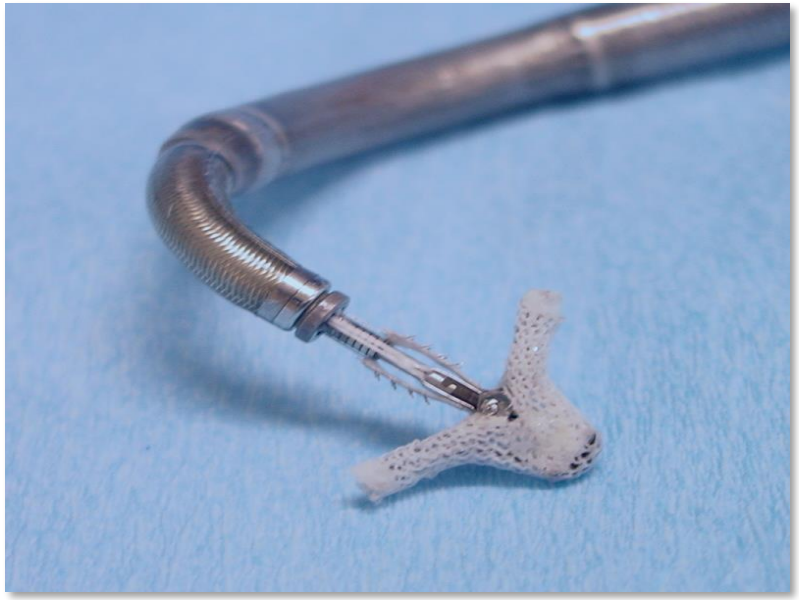
No Relationships to Disclose

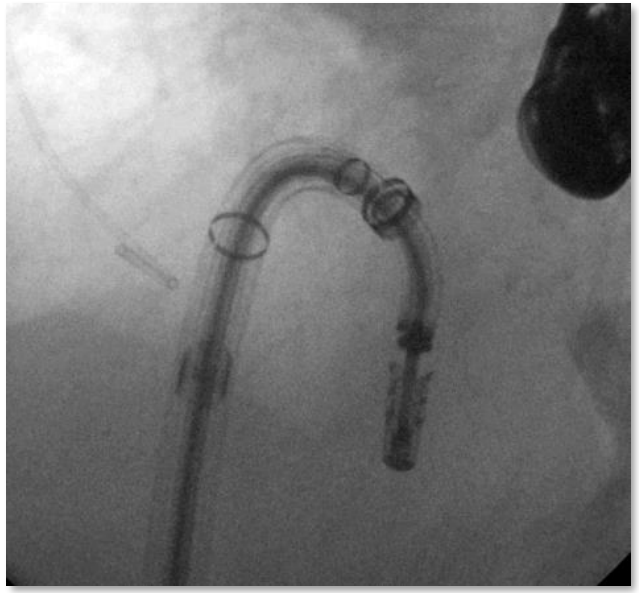
# 3DTEE in Intraoperative Echo

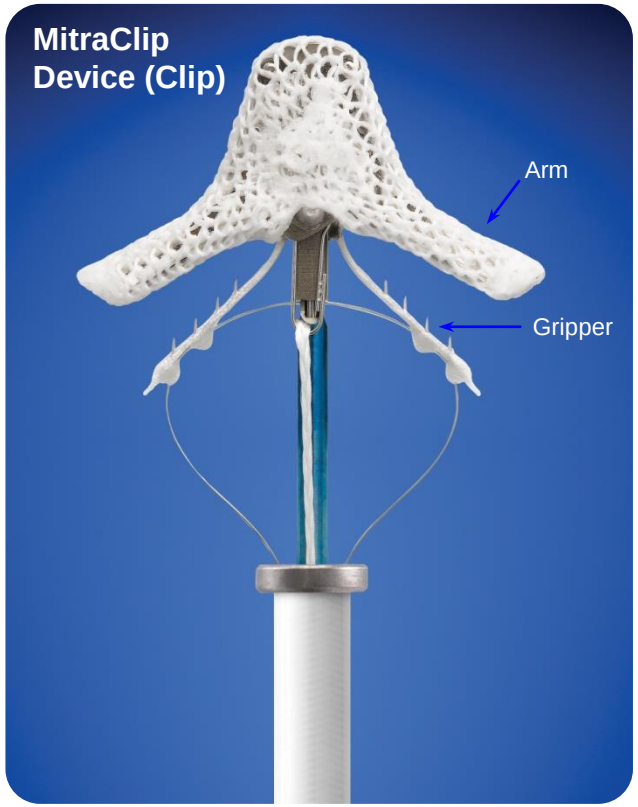


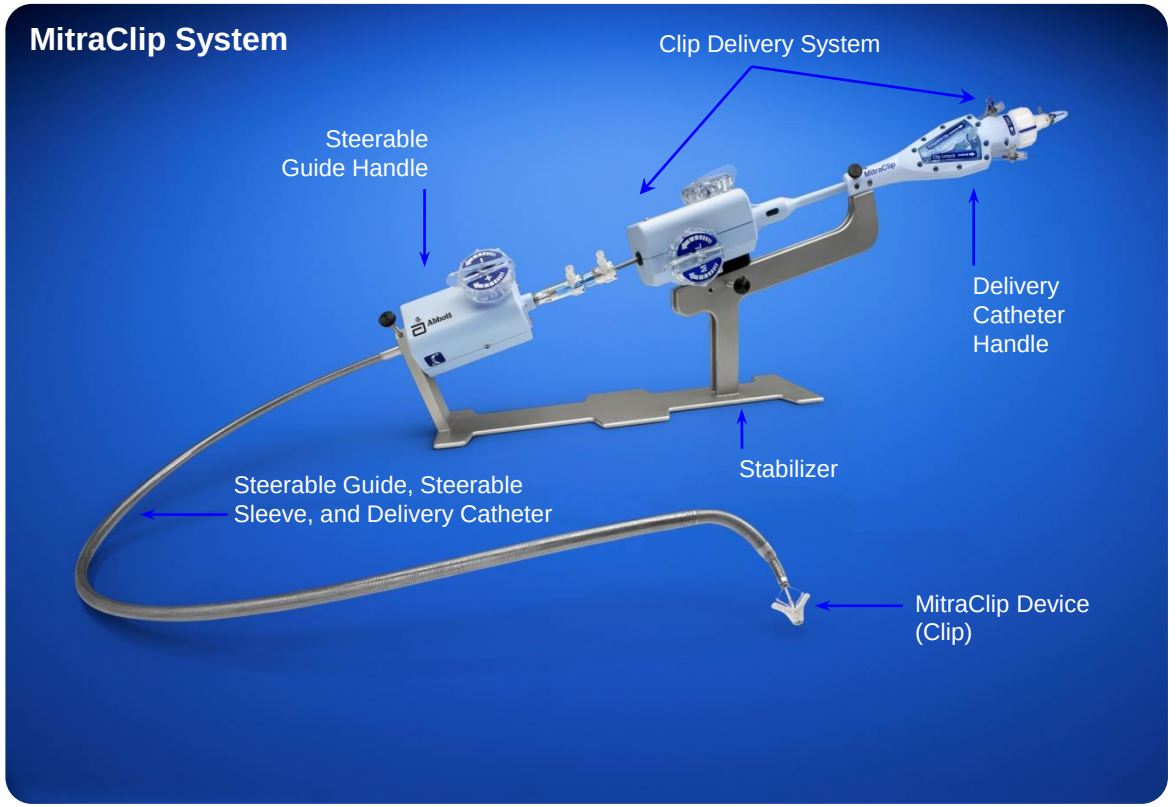




LIBERTY






MitraClip
Device (Clip)
Arm
Gripper

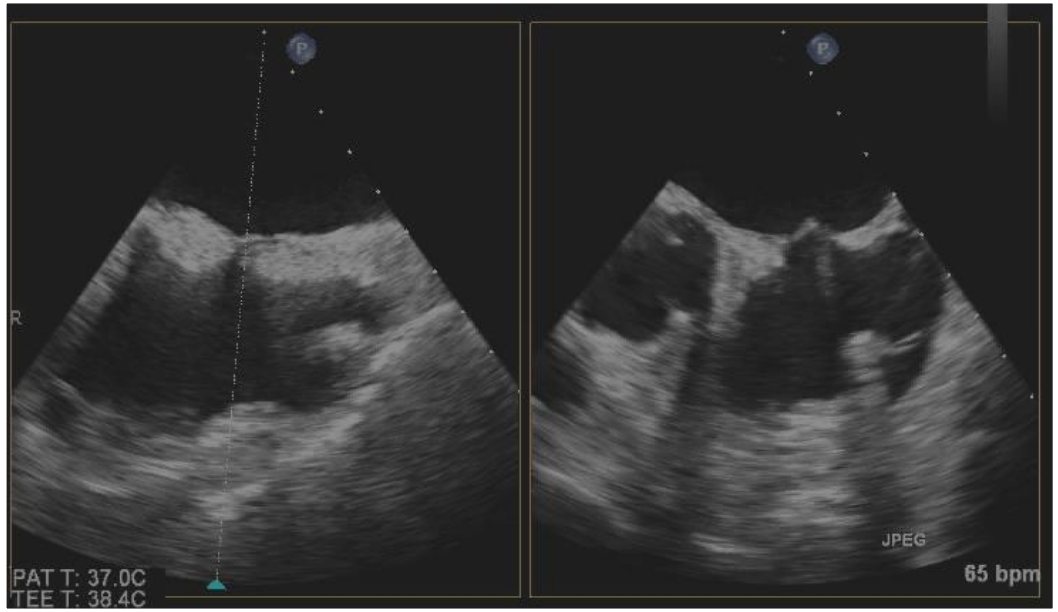

MitraClip System
Clip Delivery System
Steerable
Guide Handle
Delivery
Catheter
Handle
Stabilizer
Steerable Guide, Steerable
Sleeve, and Delivery Catheter
MitraClip Device
(Clip)

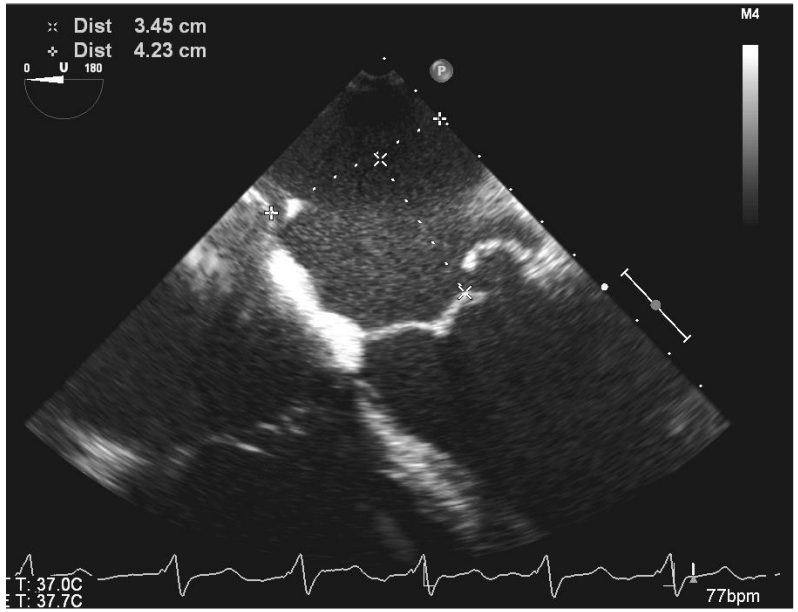
| Optimal | Limited suitable | inappropriate |
|---|---|---|
| Pathology in segment 2 | Pathology in segment 1 or 3 | Leaflet perforation or cleft |
| No calcification | - Slight calcification outside the grasping area<br>- Ring calcification<br>- Anuloplasty with ring | Severe calcification |
| Valve area >4cm$^2$ | Valve area >3 cm$^2$ & good leaflet mobility | Mitral stenosis (< 3cm$^2$, gradient >5mmHg) |
| Length of the posterior leaflet > 10mm | Length of the posterior leaflet 7-10mm | Length of the posterior leaflet < 7mm |
| Coaptation depth < 11mm | Coaptation depth >11mm | |
| Normal thickness and mobility of the leaflets | Restriction (Carpentier IIIB) | Rheumatic thickening and restriction (Carpentier IIIA) |
| MR with prolaps<br>Flail size < 15mm<br>Flail gap < 10mm | Flail size > 15mm only with large mitral aulus and option for more than 1 clip | Barlows desease |

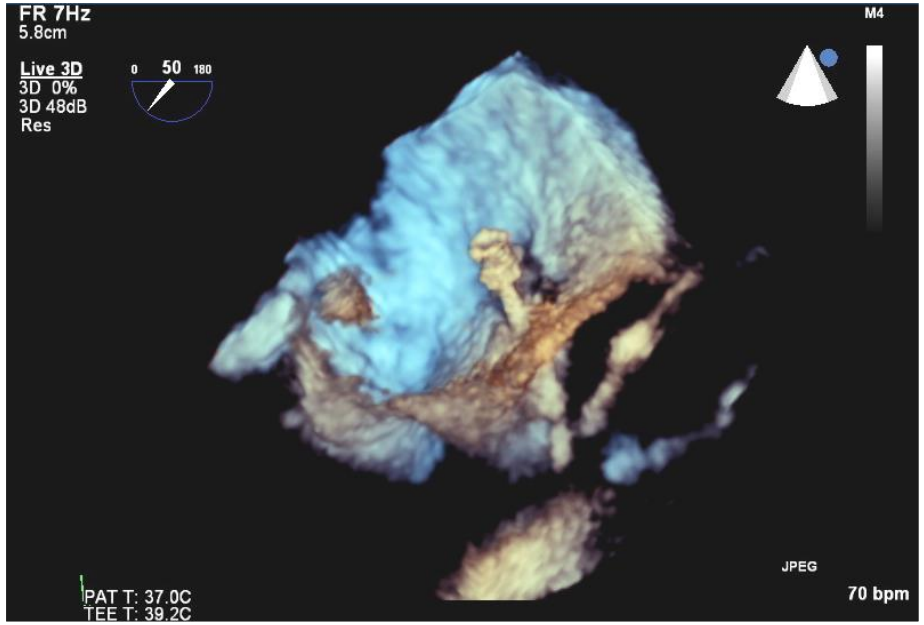
Easy

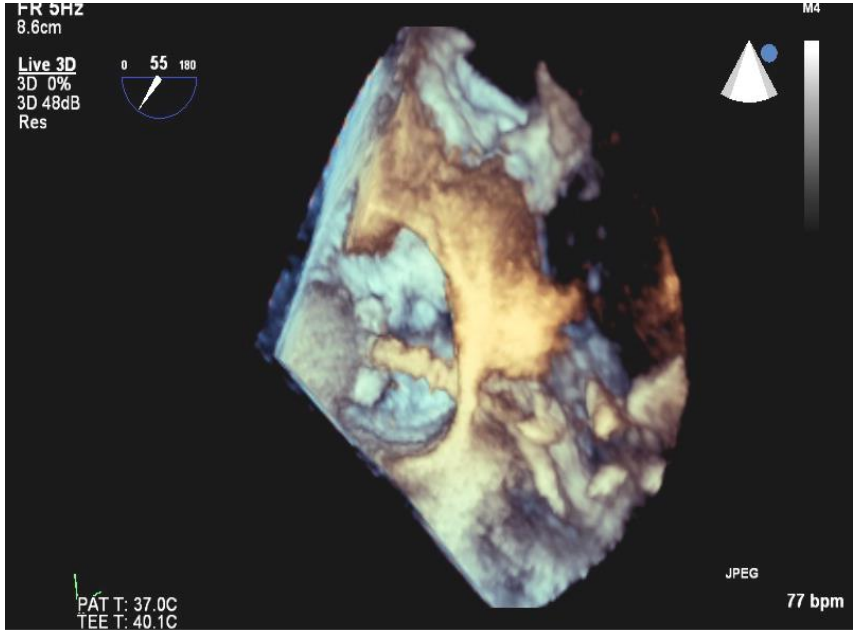
Hard

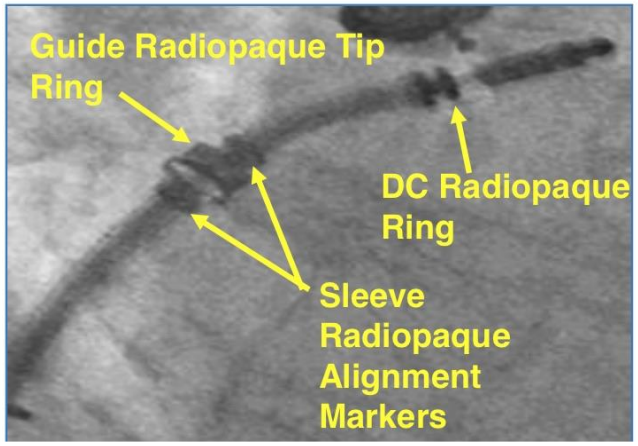
Boekstegers et al. *Clin Res Cardiol* 2013

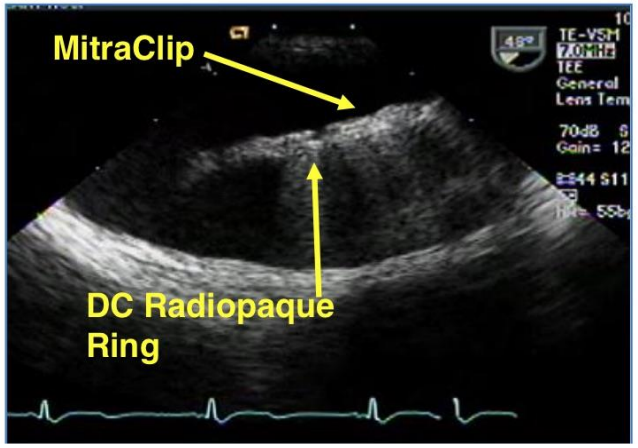

R
PAT T: 37.0C
TEE T: 38.4C
JPEG
65 bpm

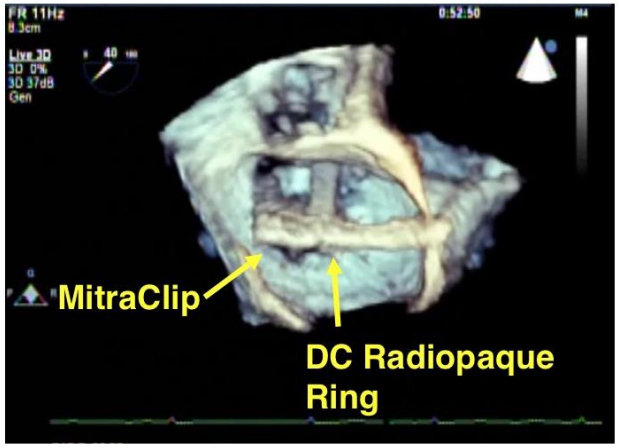

Dist 3.45 cm
Dist 4.23 cm
M4
T: 37.0C
T: 37.7C
77bpm

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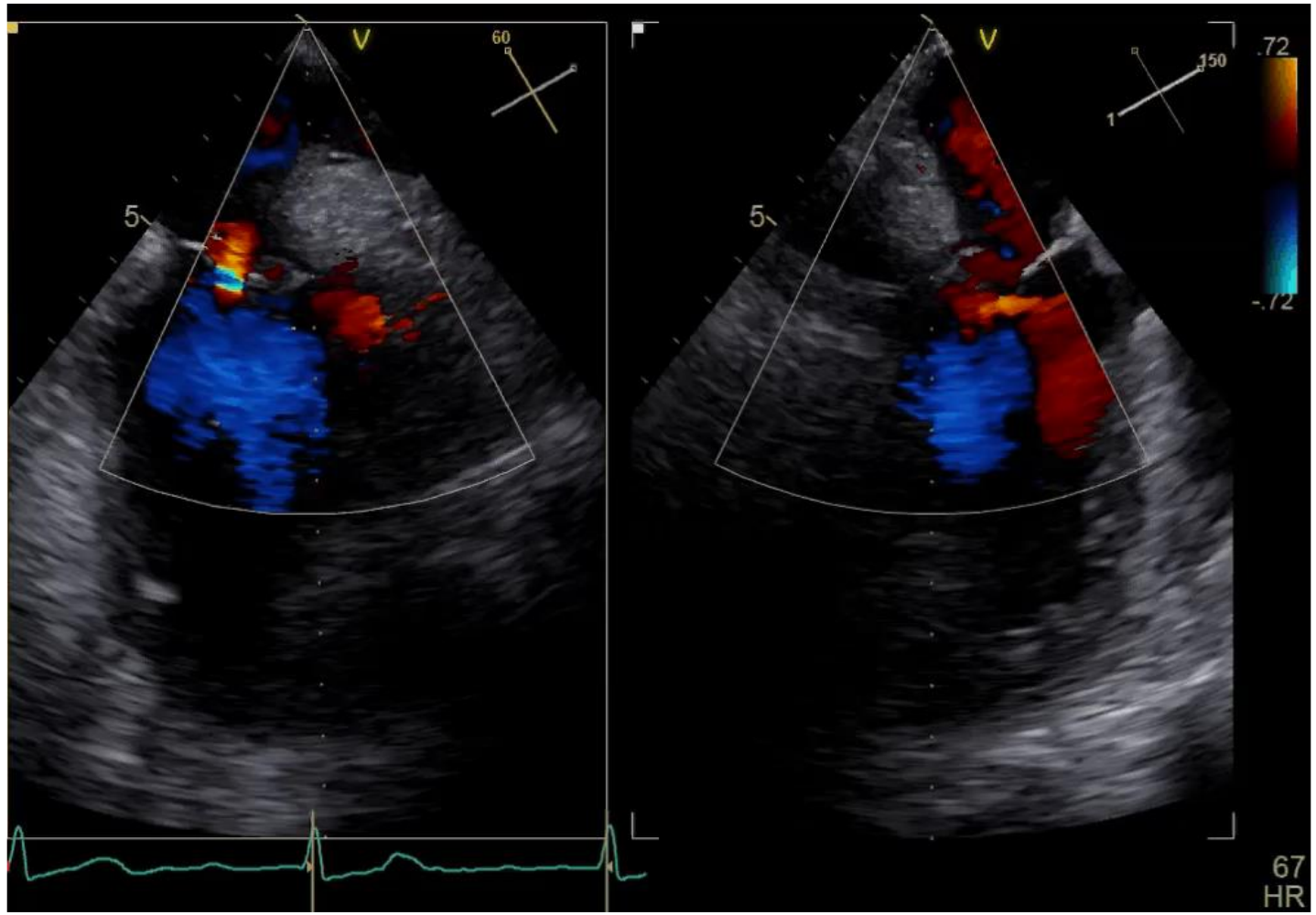
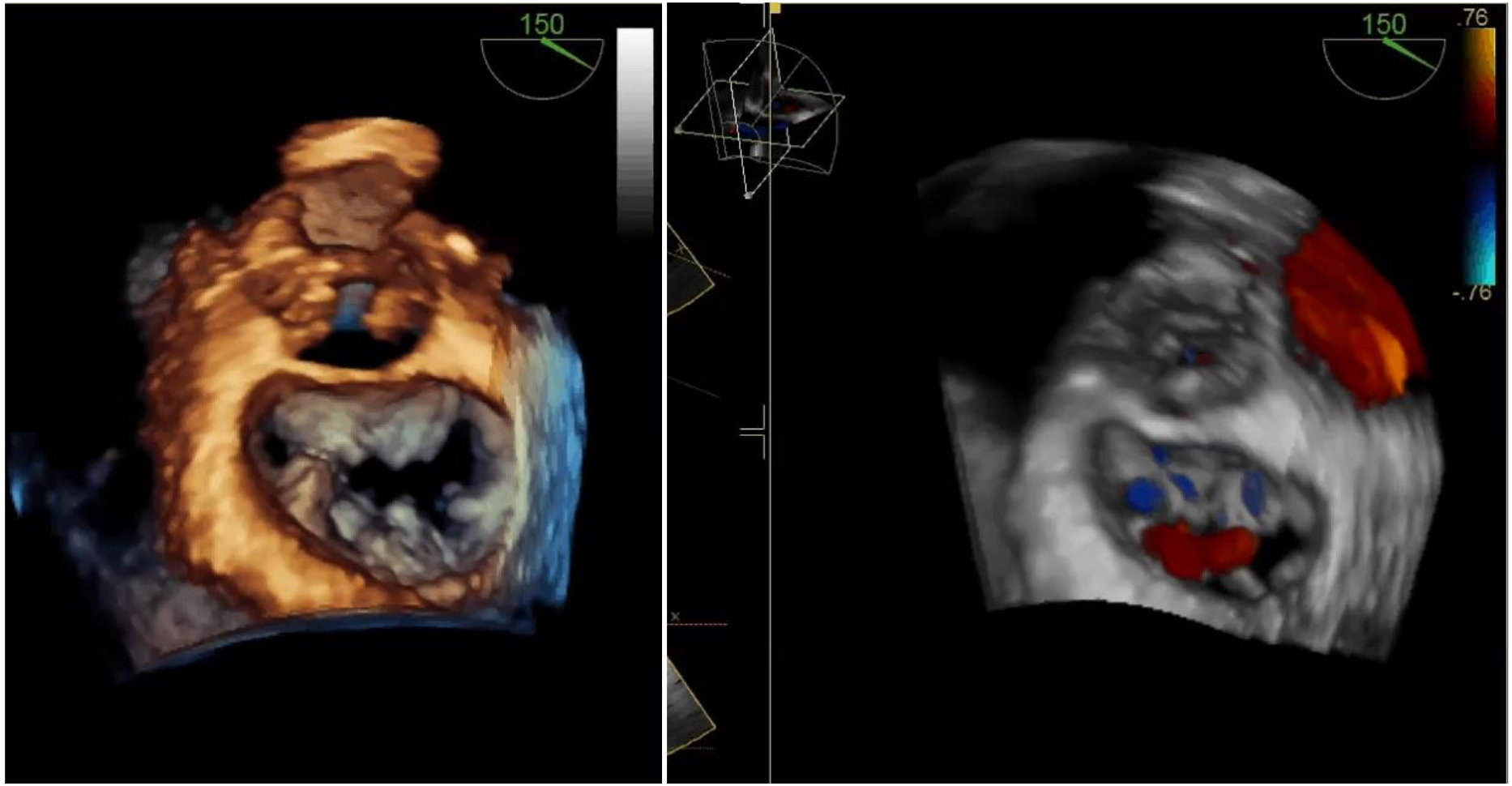
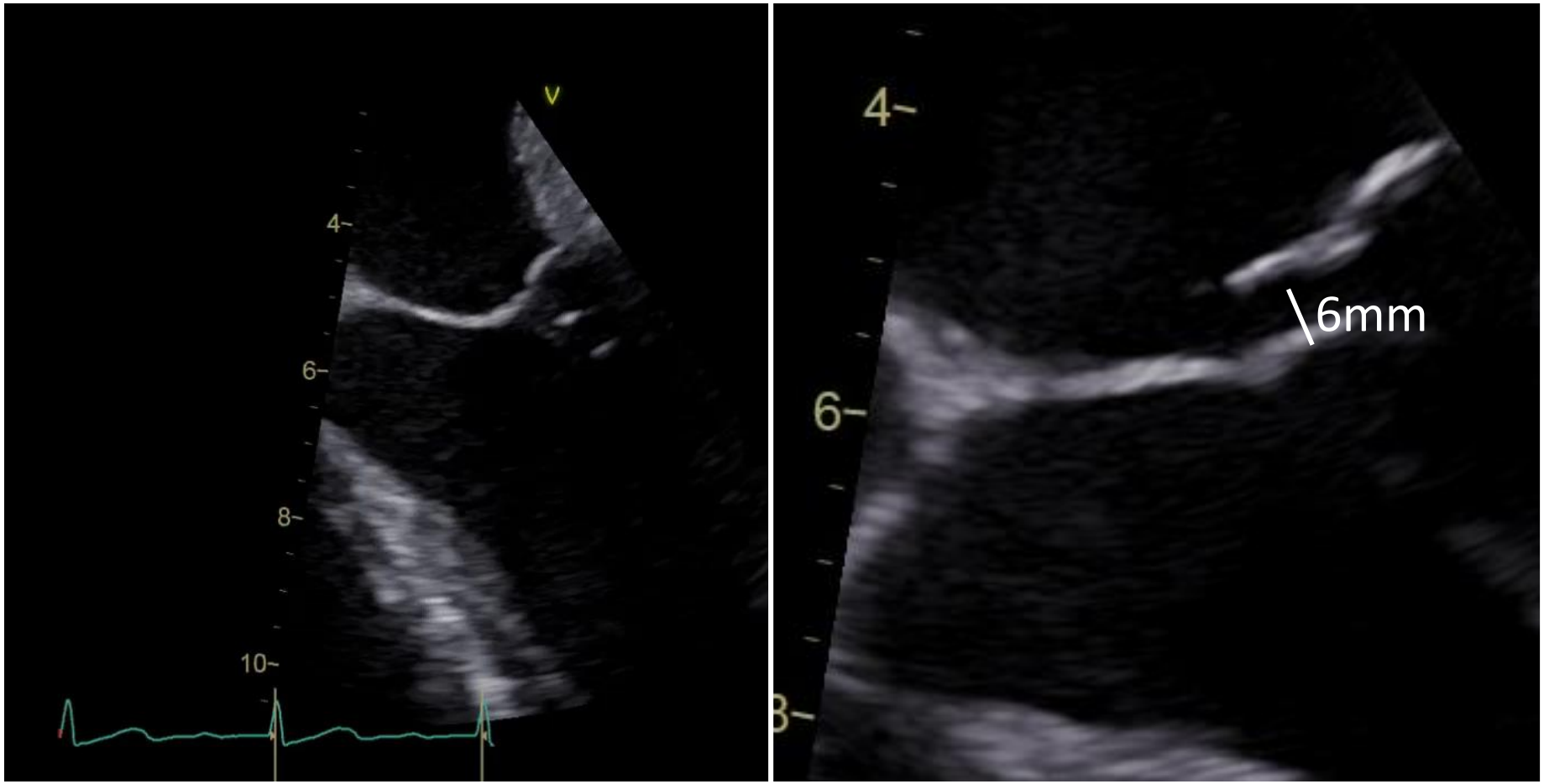
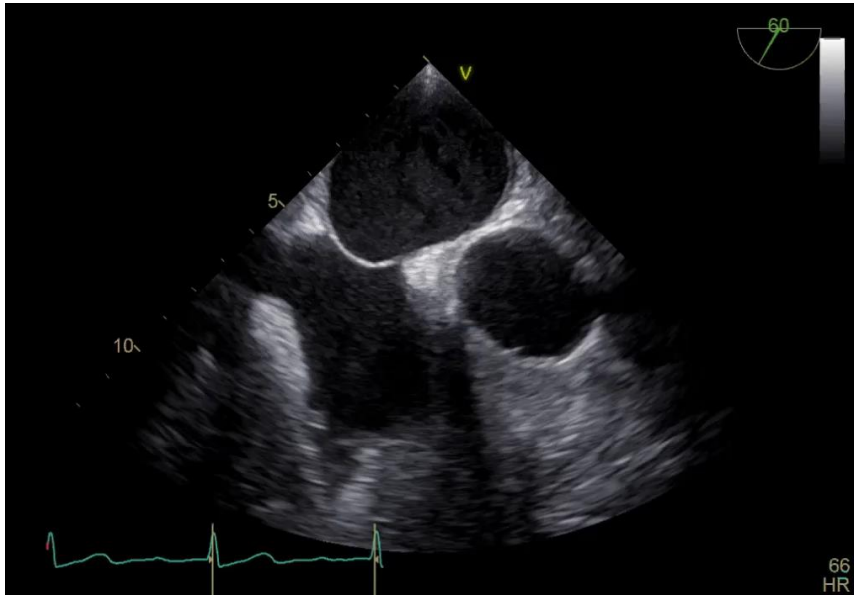
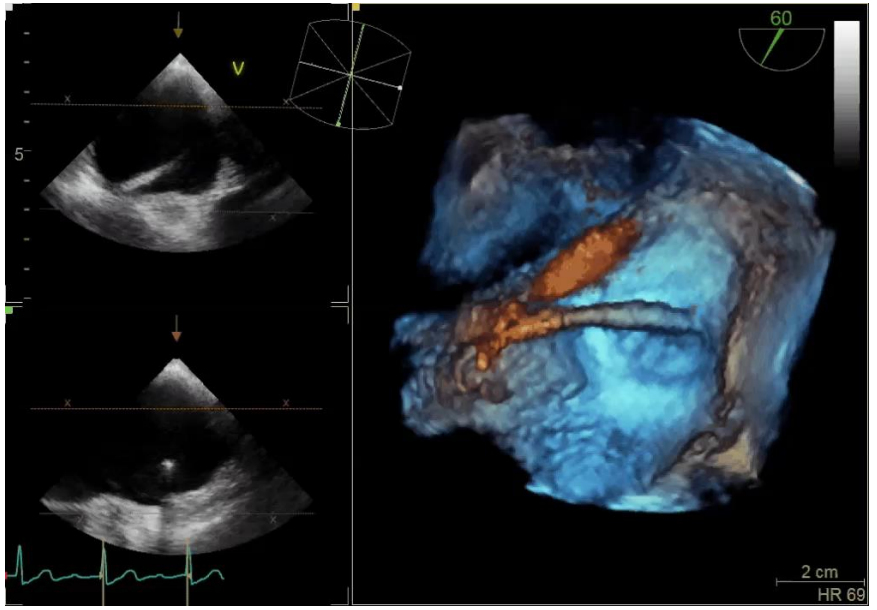
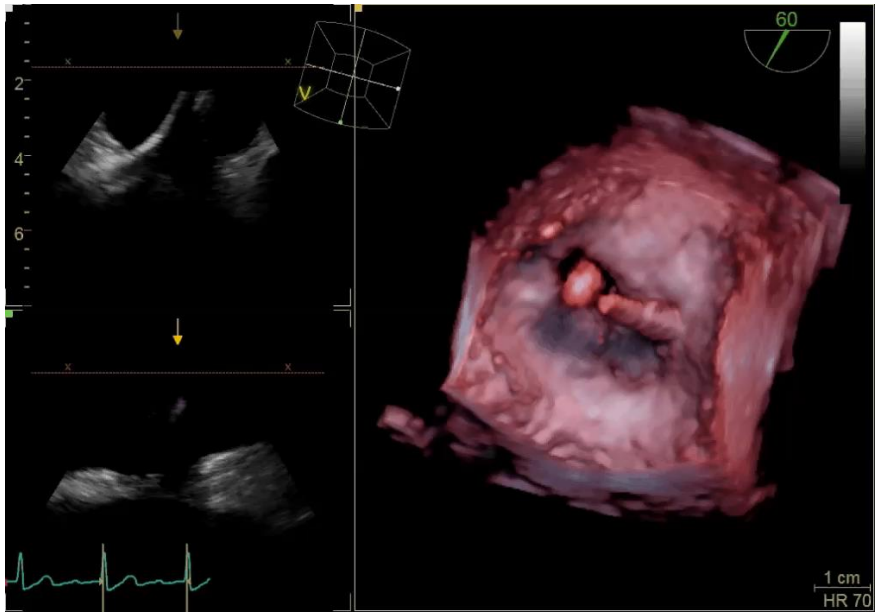

V
60
5
V
150
1
.72
-.72
5
67
HR

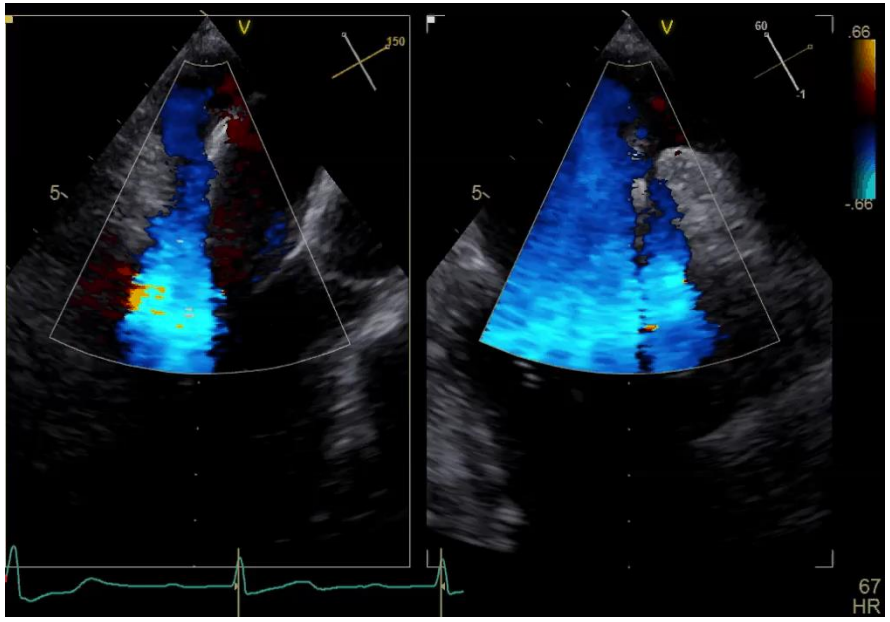

150
150
.76
-.76

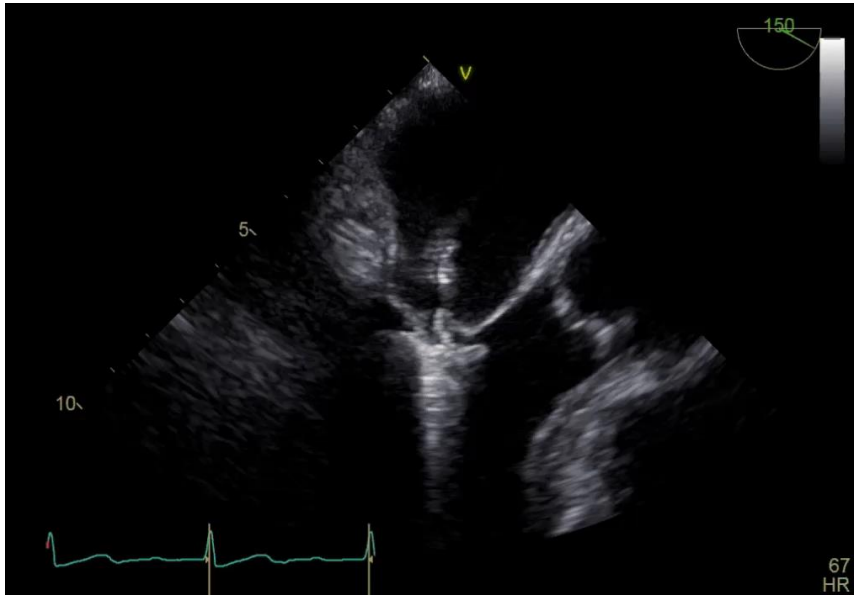

V
4
6
8
10
4
6
8
\6mm

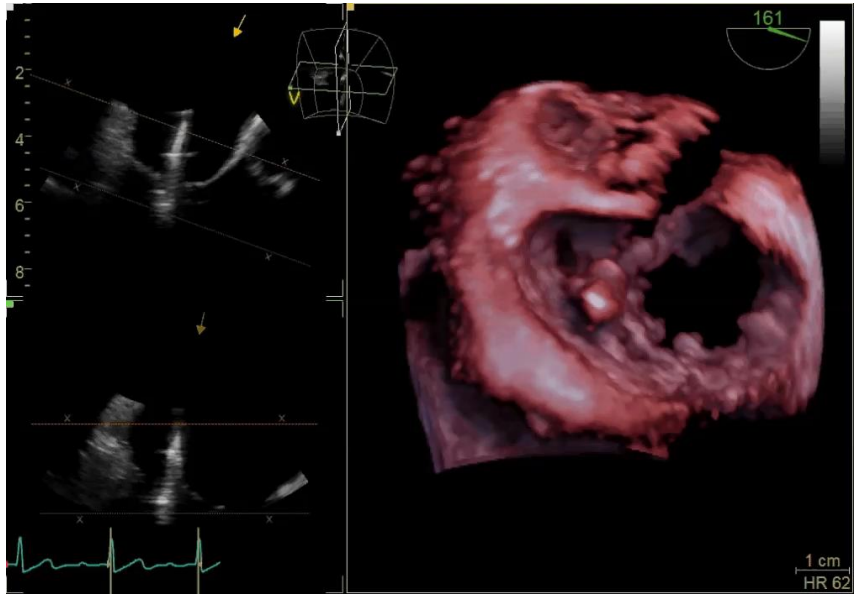

60
5
10
66
HR

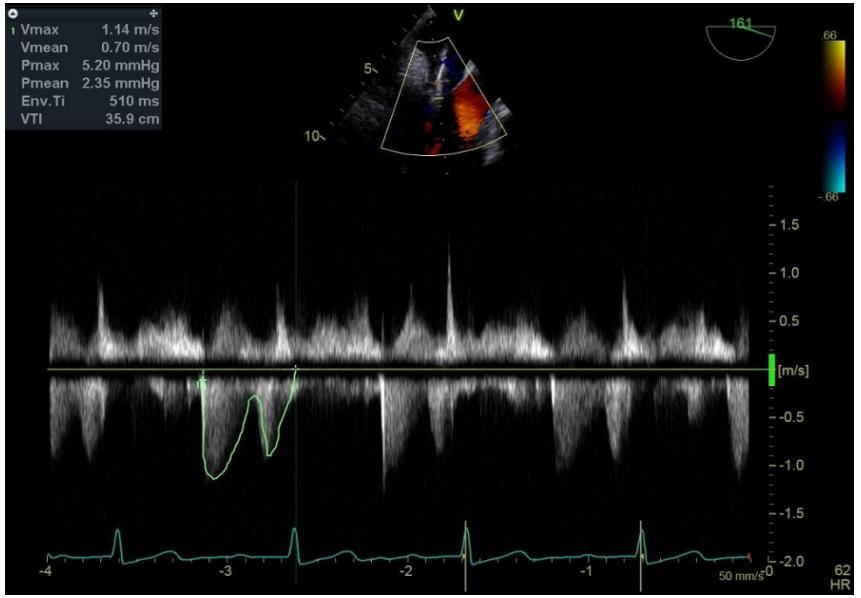

60
5
2 cm
HR 69


60
2
4
6
1 cm
HR 70


150
5
.66
-.66
67
HR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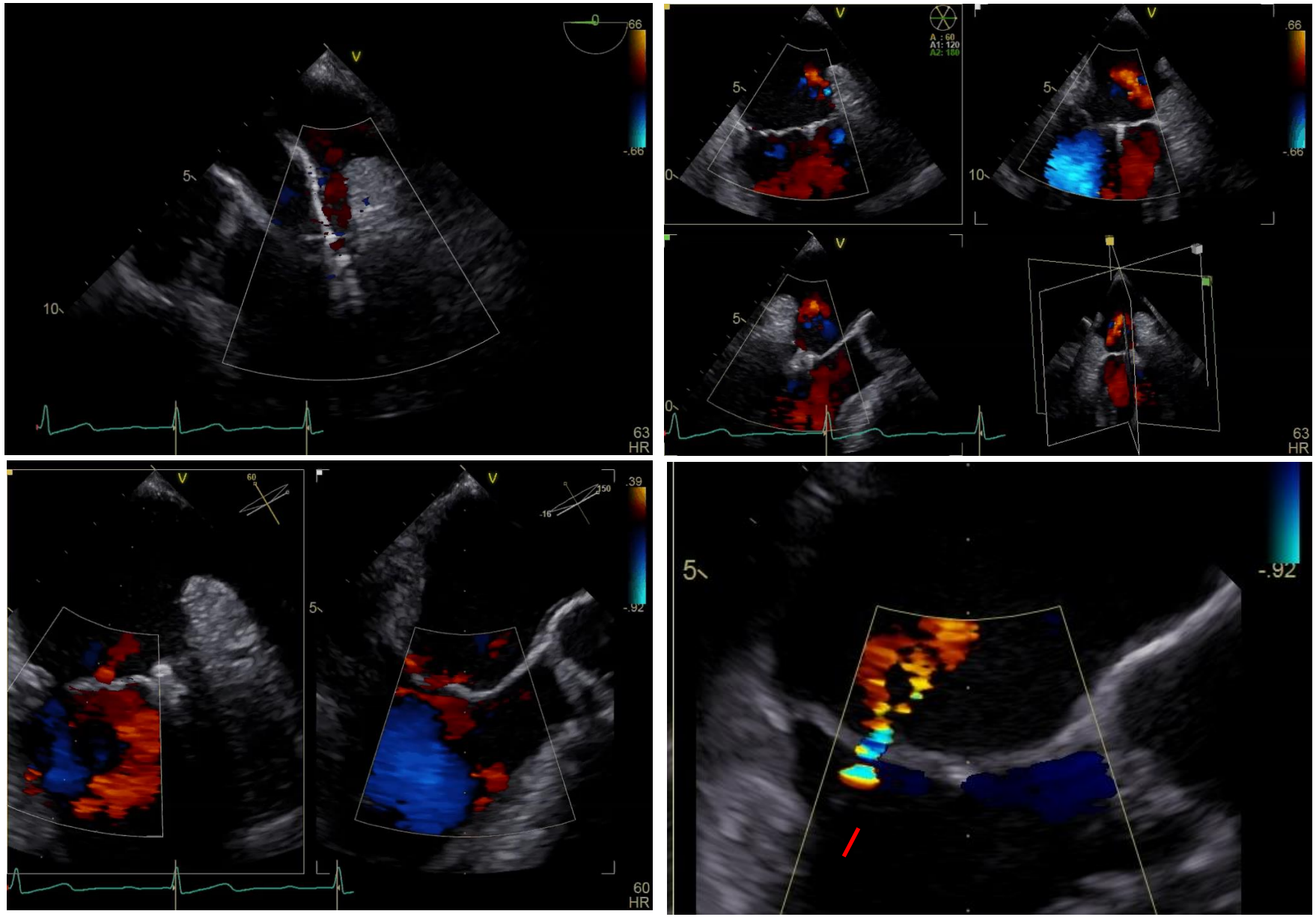
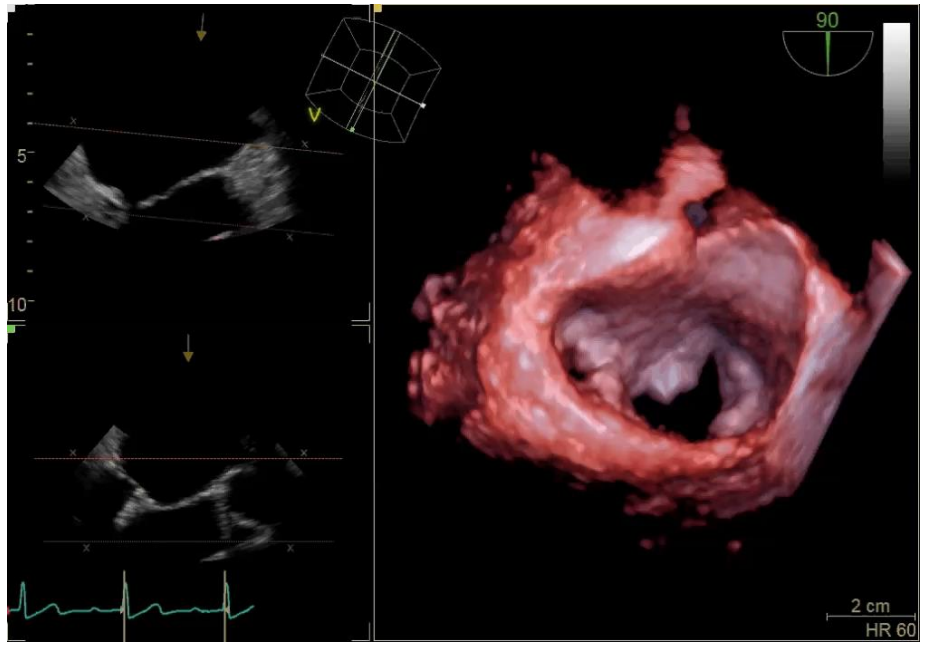
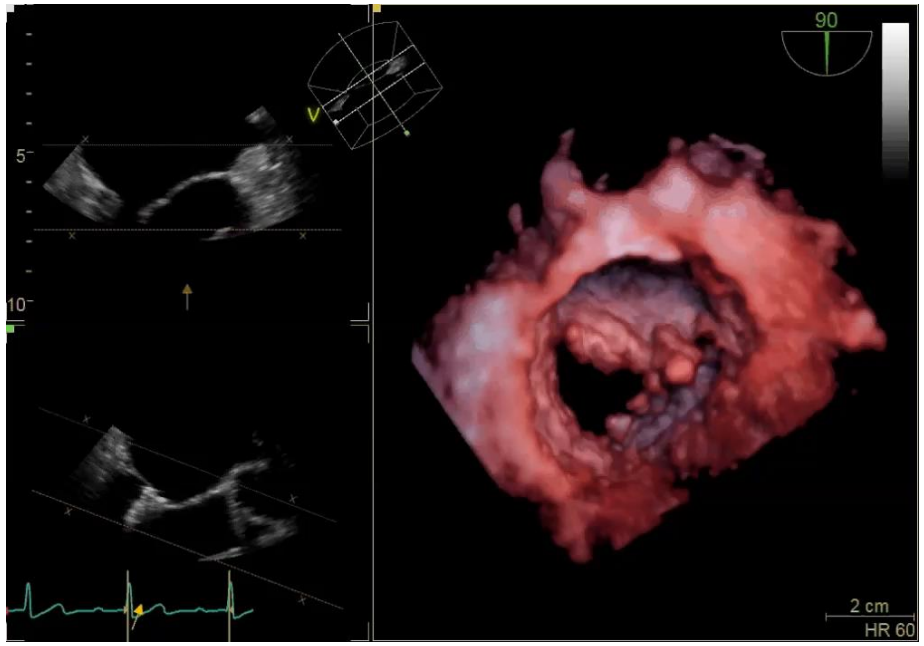

.66
-.66
63
HR
.66
-.66
63
HR
.39
-.92
60
HR
-.92




LA view




LV view

CLINICAL RESEARCH Interventional Cardiology

# Percutaneous Mitral Valve Interventions in the Real World

## Early and 1-Year Results From the ACCESS-EU, A Prospective, Multicenter, Nonrandomized Post-Approval Study of the MitraClip Therapy in Europe

Francesco Maisano, MD,* Olaf Franzen, MD,† Stephan Baldus, MD,‡ Ulrich Schäfer, MD,§ Jörg Hausleiter, MD,‖ Christian Butter, MD,¶ Gian Paolo Ussia, MD,#** Horst Sievert, MD,†† Gert Richardt, MD,‡‡ Julian D. Widder, MD,§§ Tiziano Moccetti, MD,‖‖ Wolfgang Schillinger, MD¶¶

*Milan, Italy; Copenhagen, Denmark; Hamburg, Munich, Berlin, Frankfurt, Bad Segeberg, Hannover, and Göttingen, Germany; Catania, Italy; and Lugano, Switzerland*

J Am Coll Cardiol 2013;62:1052–61

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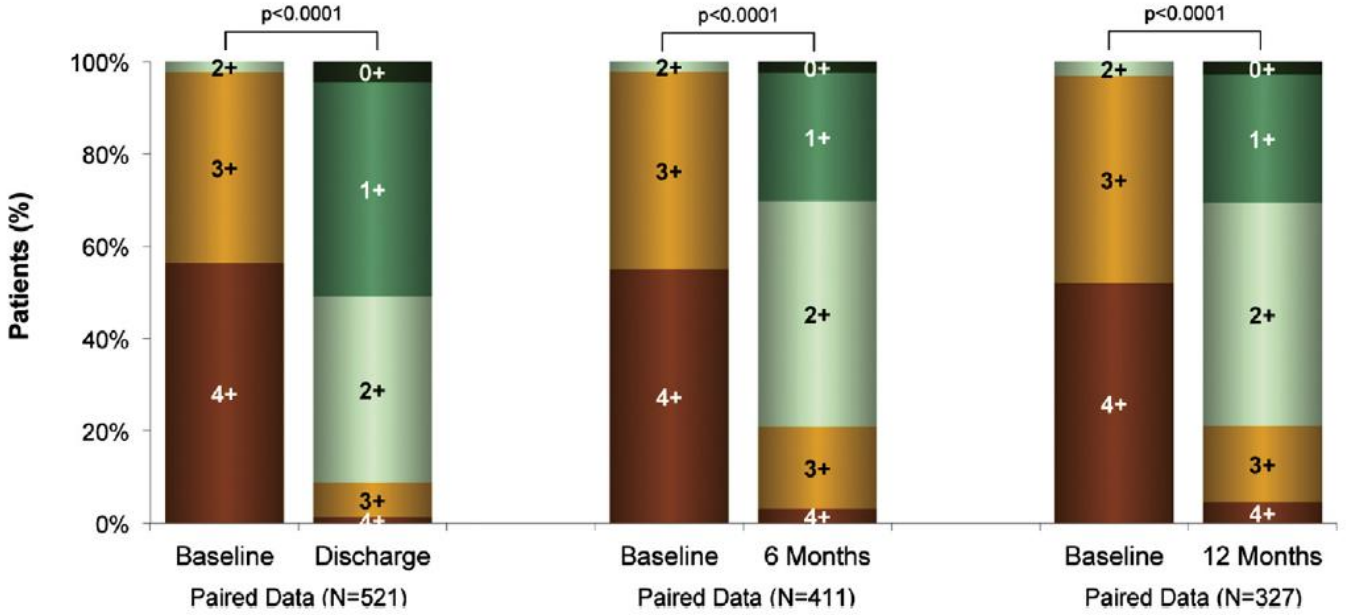
*Milan, Italy; Cope*
*Göttingen, Germa*




Maisano et al, *J Am Coll Cardiol* 2013;62:1052-1061

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## *Mitral regurgitation*

**Degenerative MR: primary valve disease**

**Functional MR: primary myocardial disease**

## *Mitral regurgitation*

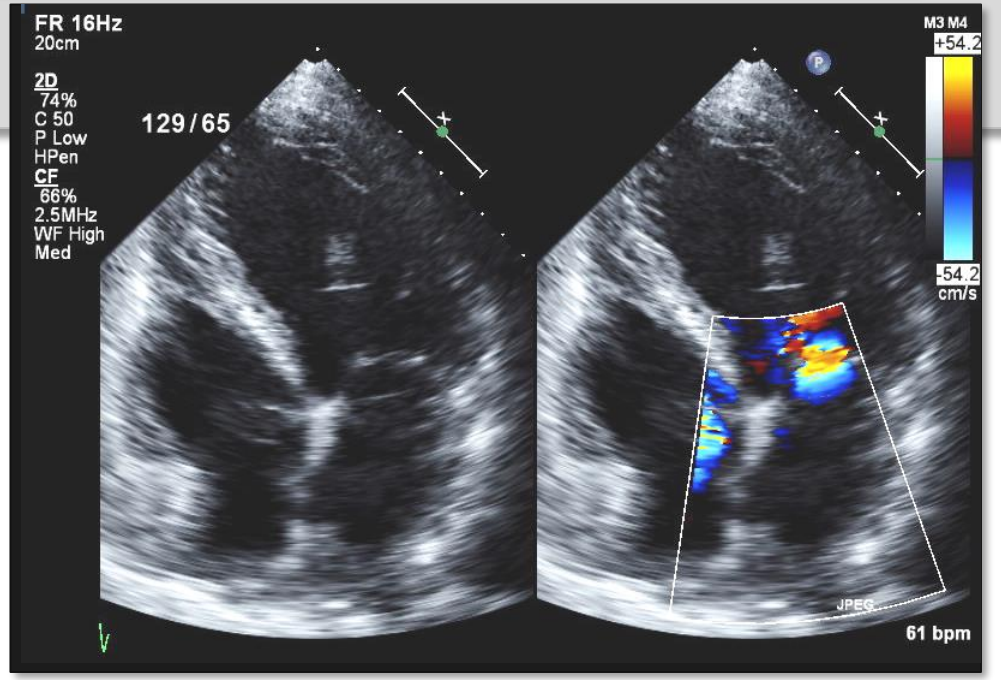
**Primary mitral regurgitation**

**Secondary mitral regurgitation**

# *Mitral regurgitation*

Primary mitral regurgitation

**Secondary mitral regurgitation**

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# *Secondary mitral regurgitation*





**Guideline-directed medical therapy for heart failure, including CRT** — **class I**

**Indications for mitral valve surgery:**

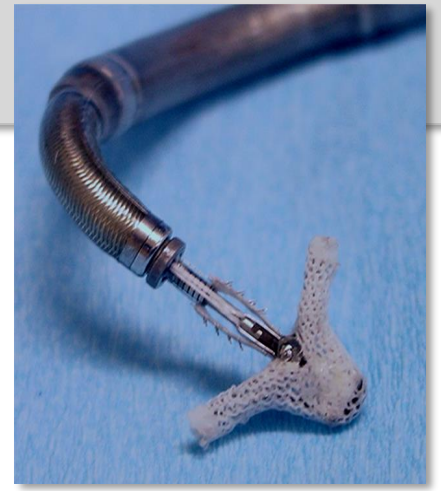
- **Patients with severe MR undergoing CABG or AVR** — **class IIa**
- **Severe MR, persistent symptoms despite optimal medical therapy, including CRT** — **class IIb**
- **Patients with moderate MR undergoing CABG or AVR** — **class IIb**

# *Mitral regurgitation*

## Indications for transcatheter MV repair for severe secondary MR:

- Severe secondary MR
- Severely symptomatic
- Prohibited or high surgical risk
- Reasonable life expectancy

**class IIb**



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# Prevalence of MR in Patients with LV Dysfunction

| | | N | Prevalence MR |
|---|---|---|---|
| Yiu et al | *Circulation* 2000 | 128 | 63% |
| Grigioni et al | *Circulation* 2001 | 303 | 64% |
| Koelling et al | *Am Heart J* 2002 | 1436 | 49% * |
| Trichon et al | *Am J Cardiol* 2003 | 2057 | 56% |
| Robbins et al | *Am J Cardiol* 2003 | 221 | 59% |
| Cleland et al | *N Engl J Med* 2004 | 605 | 50% * |
| Grayburn et al | *J Am Coll Cardiol* 2005 | 336 | 77% |
| Bursi et al | *Circulation* 2005 | 303 | 50% |
| Acker et al | *J Thorac CV Surg* 2006 | 300 | 66% |
| Di Mauro et al | *Ann Thorac Surg* 2006 | 239 | 75% |
| Rossi et al | *Heart* 2011 | 1300 | 74% |
| Deja et al | *Circulation* 2012 | 599 | 63% |
| Onishi et al | *Circ Heart Fail* 2013 | 277 | 48% * |

*Patients with moderate to severe MR

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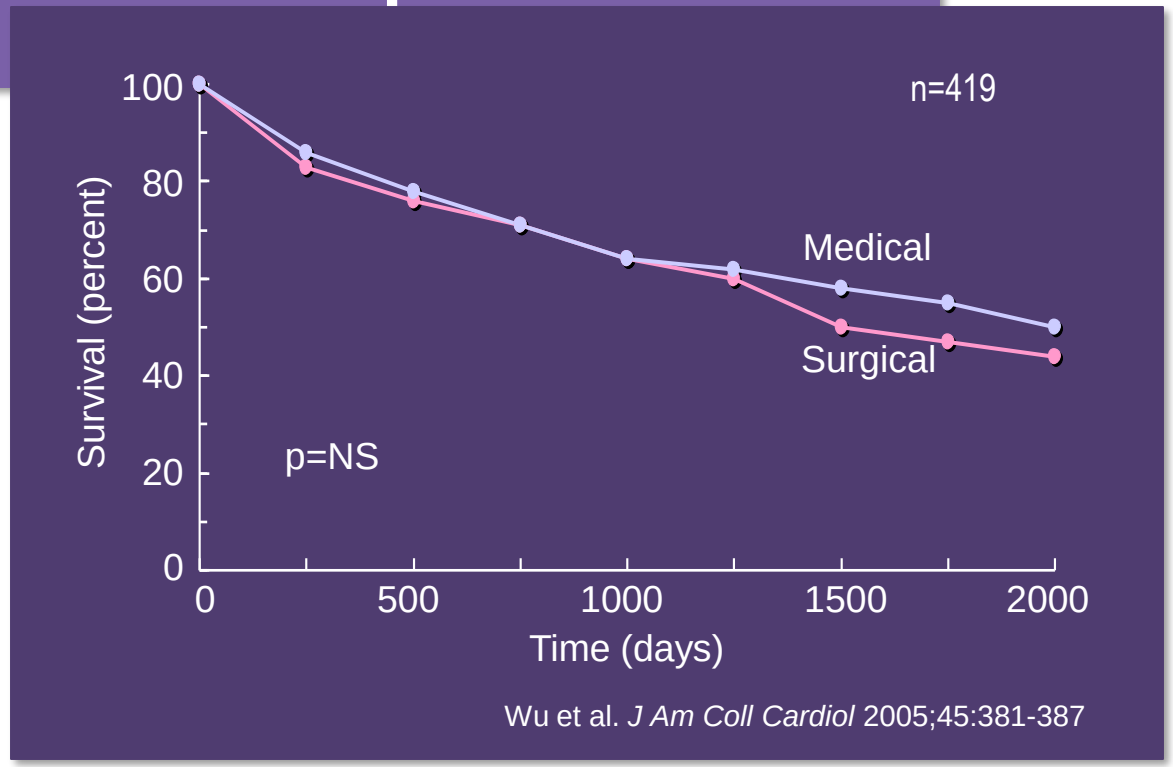
**Secondary mitral regurgitation can be repaired.**

**But should it be repaired?**




Wu et al. *J Am Coll Cardiol* 2005;45:381-387

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FOCUS ISSUE: STRUCTURAL HEART DISEASE

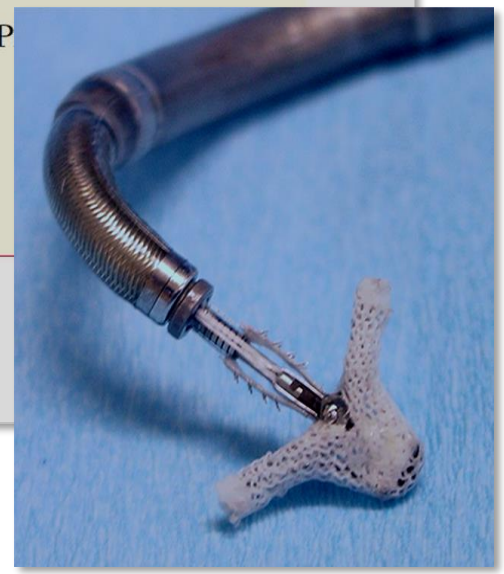
Clinical Research

# Correction of Mitral Regurgitation in Nonresponders to Cardiac Resynchronization Therapy by MitraClip Improves Symptoms and Promotes Reverse Remodeling

Angelo Auricchio, MD, PHD,* Wolfgang Schillinger, MD,† Sven Meyer, MD,‡ Francesco Maisano, MD,§ Rainer Hoffmann, MD,‖ Gian Paolo Ussia, MD,¶ Giovanni B. Pedrazzini, MD,* Jan van der Heyden, MD,# Simona Fratini, MD, P Catherine Klersy, MD, MSC,†† Jan Komtebedde, DVM,* Olaf Franzen, MD,‡ on behalf of the PERMIT-CARE Investigators

*Lugano, Switzerland; Göttingen, Hamburg, and Aachen, Germany; Milan, Catania, L'Aquila, and Pavia, Italy; and Nieuwegein, the Netherlands*

J Am Coll Cardiol 2011;58:2183–9



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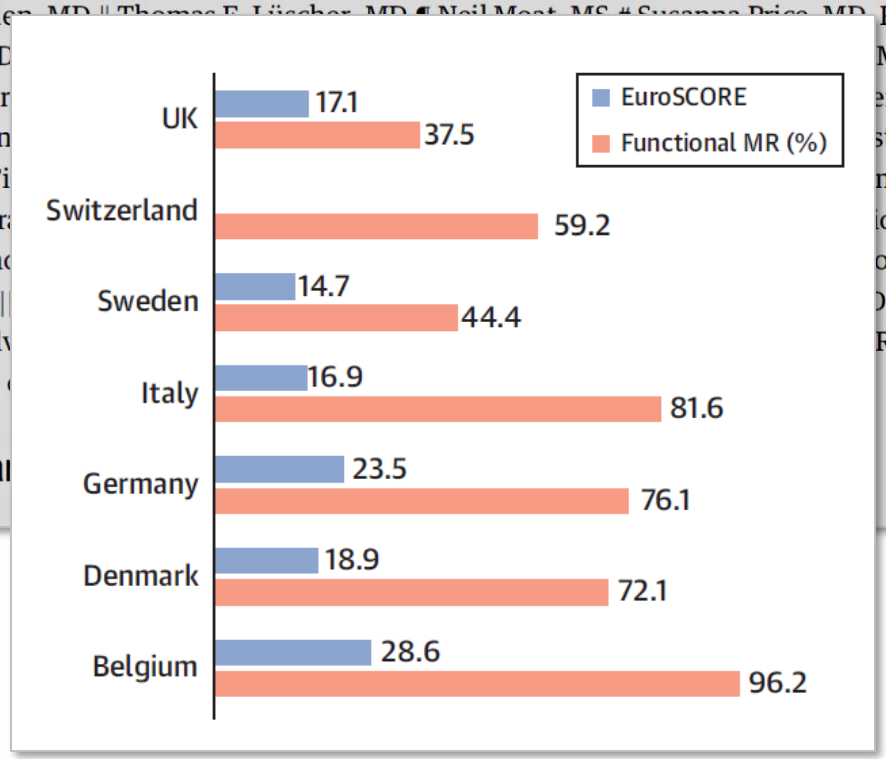
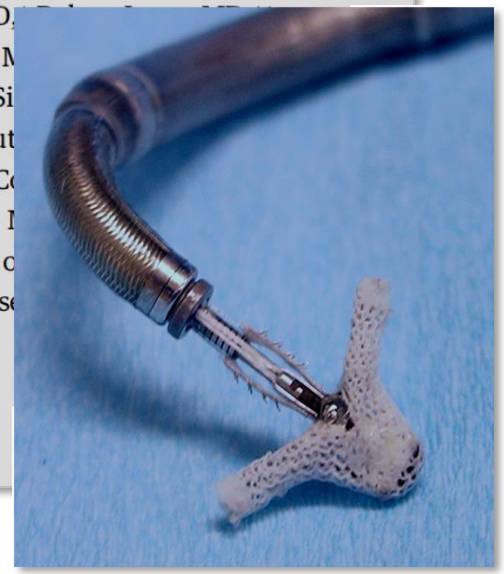
# Percutaneous Mitral Valve Edge-to-Edge Repair

## In-Hospital Results and 1-Year Follow-Up of 628 Patients of the 2011–2012 Pilot European Sentinel Registry

Georg Nickenig, MD, PhD,* Rodrigo Estevez-Loureiro, MD, PhD,† Olaf Franzen, MD,‡ Corrado Tamburino, MD, PhD,§
Marc Vanderheyden, MD,‖ Thomas F. Lüscher, MD,¶ Neil Moat, MS,# Susanna Price, MD, PhD,** Gianni Dall'Ara, MD,†
Reidar Winter, MD
Stefan Blankenber
Anna Sonia Petron
Maria Giovanna Fi
Salvatore Scandura
Francesco Maisano
Björn Plicht, MD,‖
Transcatheter Valv
European Society

J Am Coll Car



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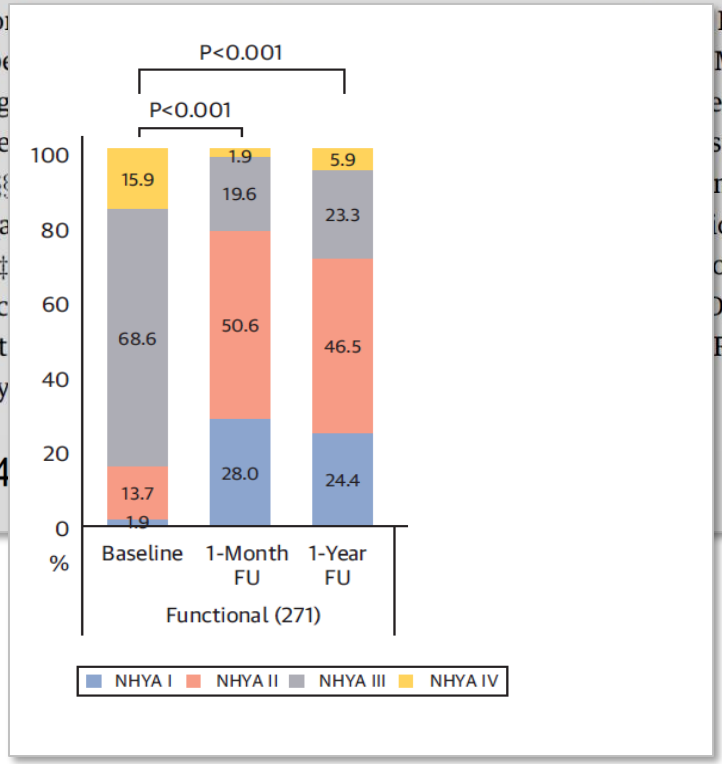
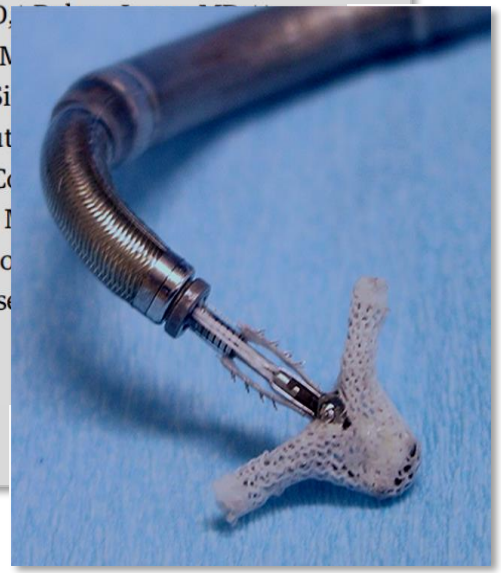
Reidar Winter, MD, PHD,†† Robe MD,
Stefan Blankenberg, MD,§§ Mag er, M
Anna Sonia Petronio, MD,## He st Si
Maria Giovanna Fiorino, MD,§§§ mut
Salvatore Scandura, MD,§ Farqa io C
Francesco Maisano, MD, PHD,‡‡ os, I
Björn Plicht, MD,‖‖‖‖‖‖ Robert Sc D,† c
Transcatheter Valve Treatment Rese
European Society of Cardiology

J Am Coll Cardiol 2014



Northwestern Medicine

***Mitral regurgitation***

**Primary mitral regurgitation**

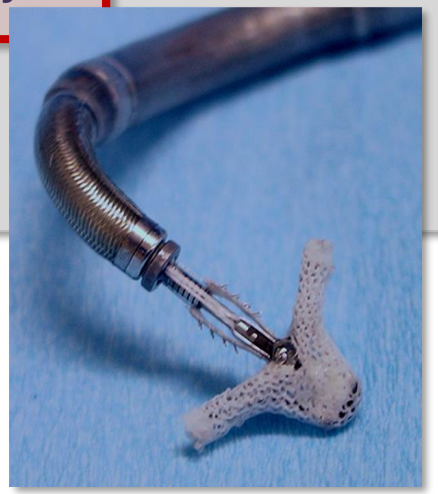
**Secondary mitral regurgitation**

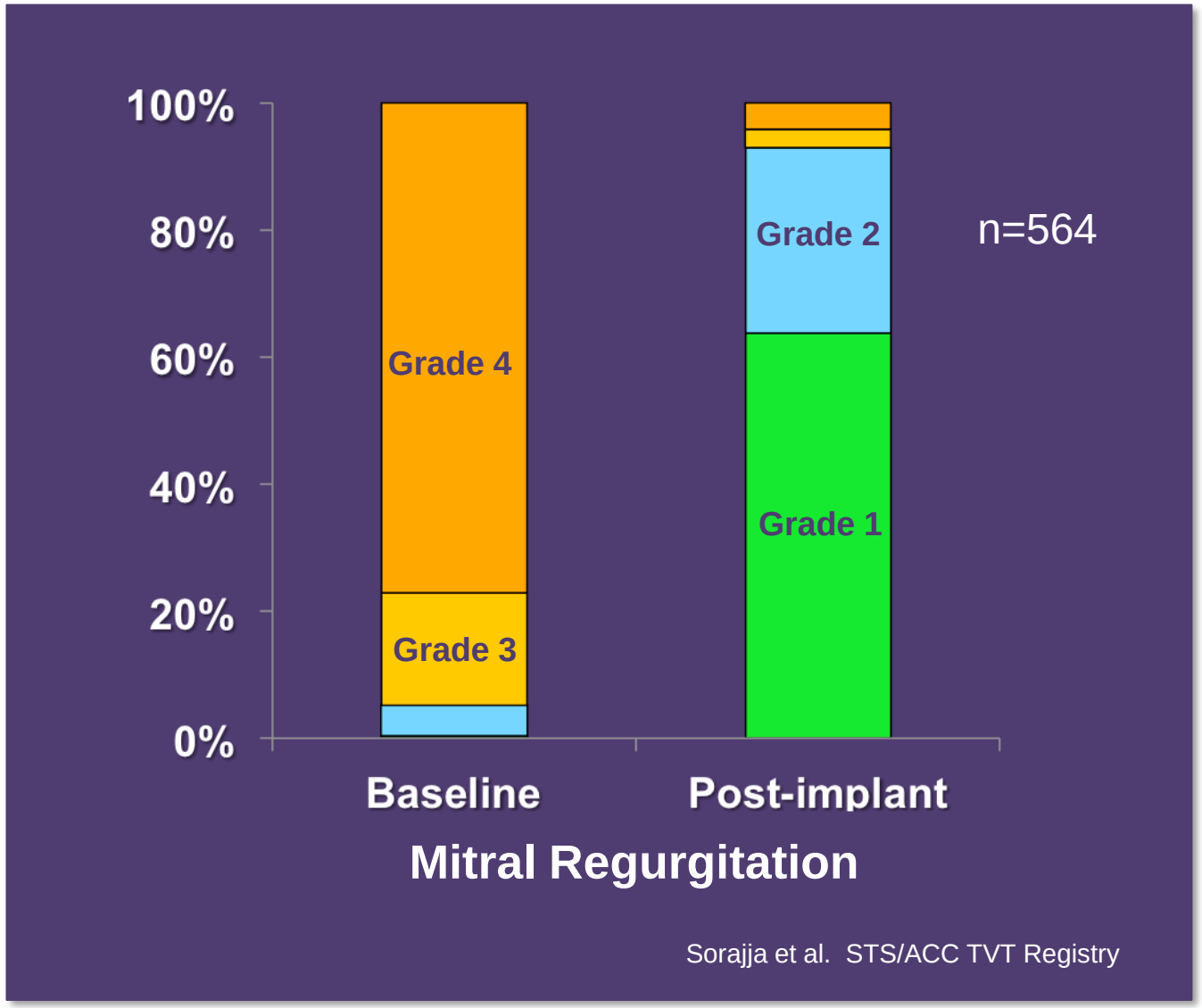
# Mitral regurgitation

## Indications for transcatheter MV repair for severe primary MR:

- Chronic severe MR
- Severely symptomatic
- Prohibited surgical risk
- Reasonable life expectancy

**class IIb**




100%
80%
60%
40%
20%
0%
Grade 4
Grade 3
Grade 2
Grade 1
n=564
Baseline
Post-implant
Mitral Regurgitation
Sorajja et al. STS/ACC TVT Registry

# *Mitral regurgitation*

## Indications for MV surgery for severe primary MR:

AMERICAN COLLEGE of CARDIOLOGY

American Heart Association.

- Repair better than mitral valve replacement

**class I**

EUROPEAN SOCIETY OF CARDIOLOGY®

EACTS

- Repair is preferred treatment when durable

**class I**

# Mitral regurgitation

## Indications for MV surgery for severe primary MR:


| | |
|---|---|
| • Repair better than mitral valve replacement | **class I** |
| • Patients should be referred to centers experienced in repair | **class I** |
| • Repair is preferred treatment when durable | **class I** |

INTERVENTIONAL CARDIOLOGY AND SURGERY

# Mitral repair best practice: proposed standards

B Bridgewater, T Hooper, C Munsch, S Hunter, U von Oppell, S Livesty, B Keogh, F Wells, M Patrick, J Kneeshaw, J Chambers, N Masani, S Ray

*Heart* 2006;92:939-944

***19 criteria for best practice:***

- Surgical training
- Intraoperative echocardiograph
- Volume thresholds
- Audit
- Cardiology and imaging

**Rigorous criteria**

**Surgeon: >25/yr**
**Hospital: >50/yr**

**Operative mortality <1%**
**5 year reoperation <5%**

Northwestern Medicine

ADULT CARDIAC

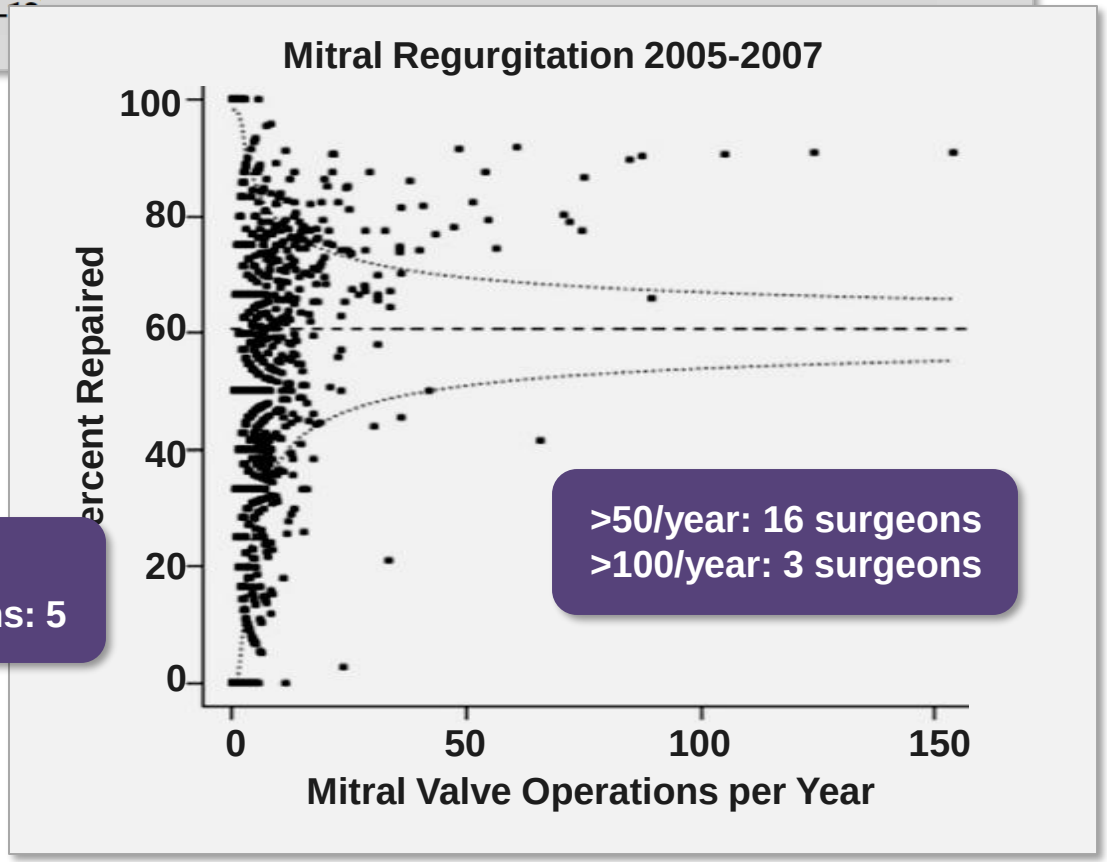
# Predictors of Mitral Valve Repair: Clinical and Surgeon Factors

Steven F. Bolling, MD, Shuang Li, MS, Sean M. O'Brien, PhD, J. Matthew Brennan, MD, Richard L. Prager, MD, and James S. Gammie, MD

Section of Cardiac Surgery, University of Michigan, Ann Arbor, Michigan; Duke Clinical Research Institute, Durham, North Carolina; and Division of Cardiac Surgery, University of Maryland, Baltimore, Maryland

Ann Thorac Surg 2010;90:1904–

28,507 patients
1,088 surgeons
639 hospitals




**Mean rate of repair: 41%**
**Median number of MV operations: 5**

**>50/year: 16 surgeons**
**>100/year: 3 surgeons**

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ADULT CARDIAC

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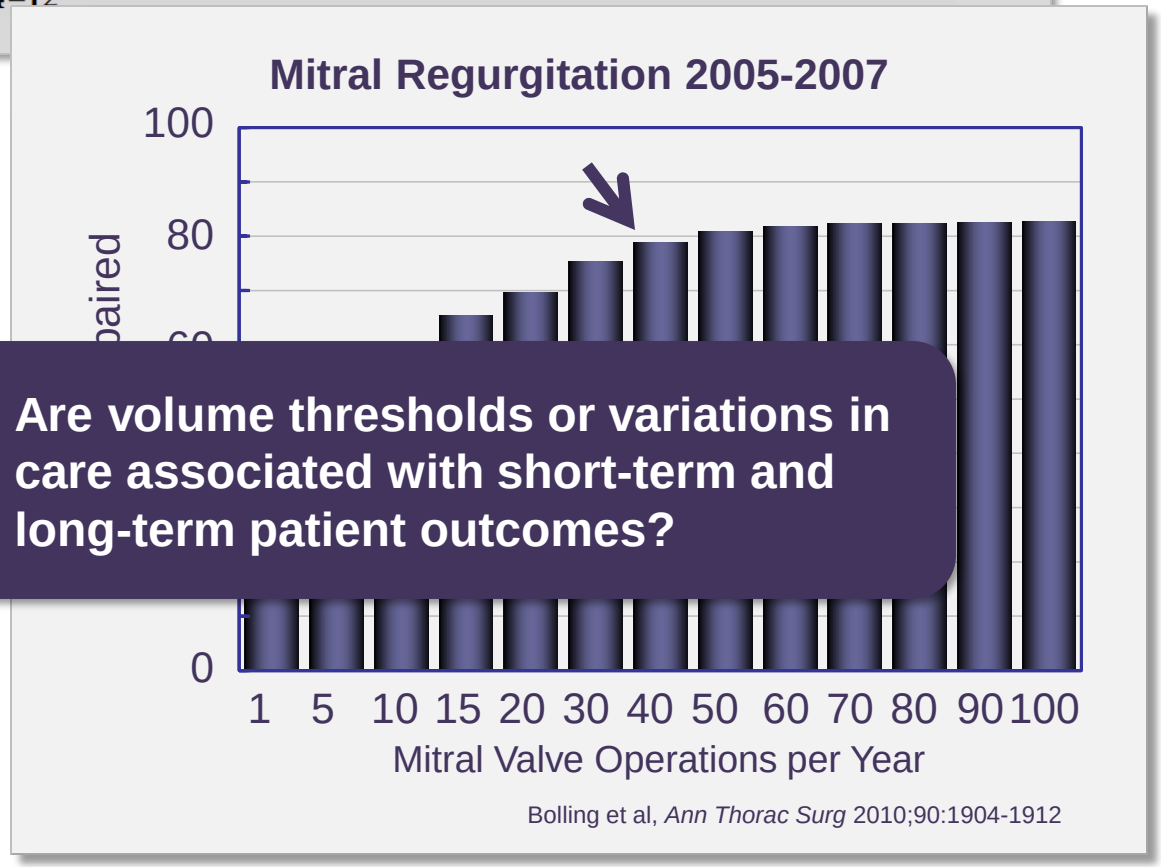


**Are volume thresholds or variations in care associated with short-term and long-term patient outcomes?**

Bolling et al, *Ann Thorac Surg* 2010;90:1904-1912

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# Mitral valve repair rates correlate with surgeon and institutional experience

Damien J. LaPar, MD, MSc,[a] Gorav Ailawadi, MD,[a] James M. Isbell, MD, MSCI,[a] Ivan K. Crosby, MD,[a] John A. Kern, MD,[a] Jeffrey B. Rich, MD,[b] Alan M. Speir, MD,[c] and Irving L. Kron, MD,[a] Investigators for the Virginia Cardiac Surgery Quality Initiative

J Thorac Cardiovasc Surg 2014;148:995-1004

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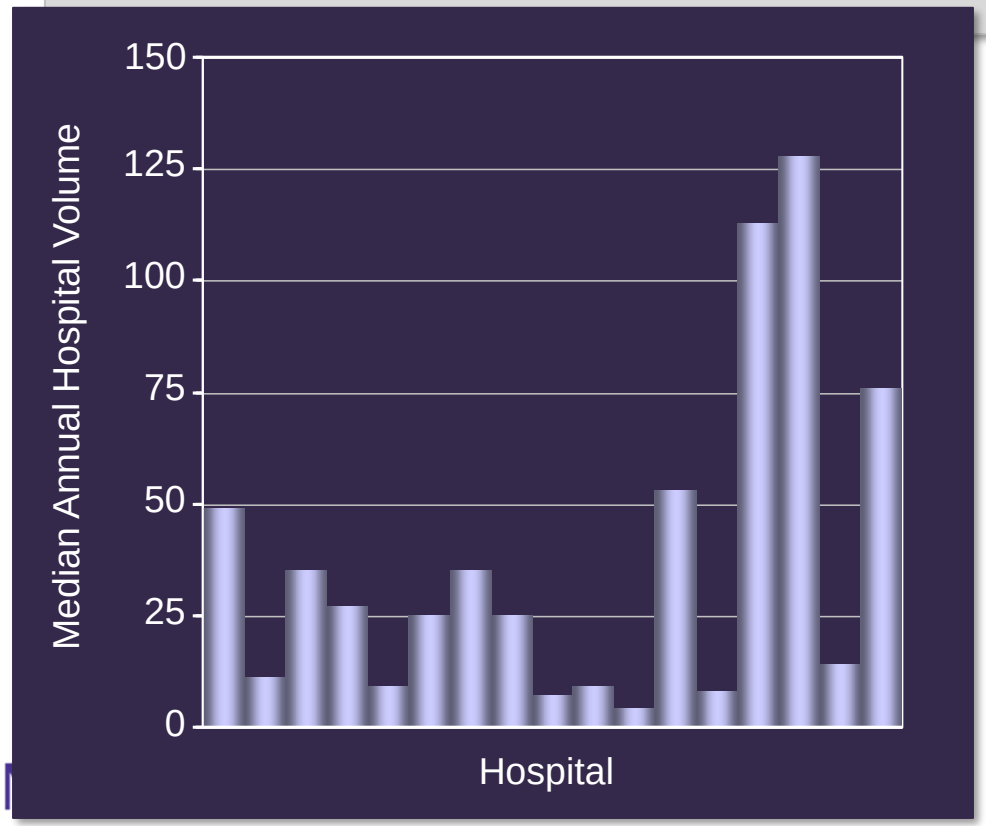

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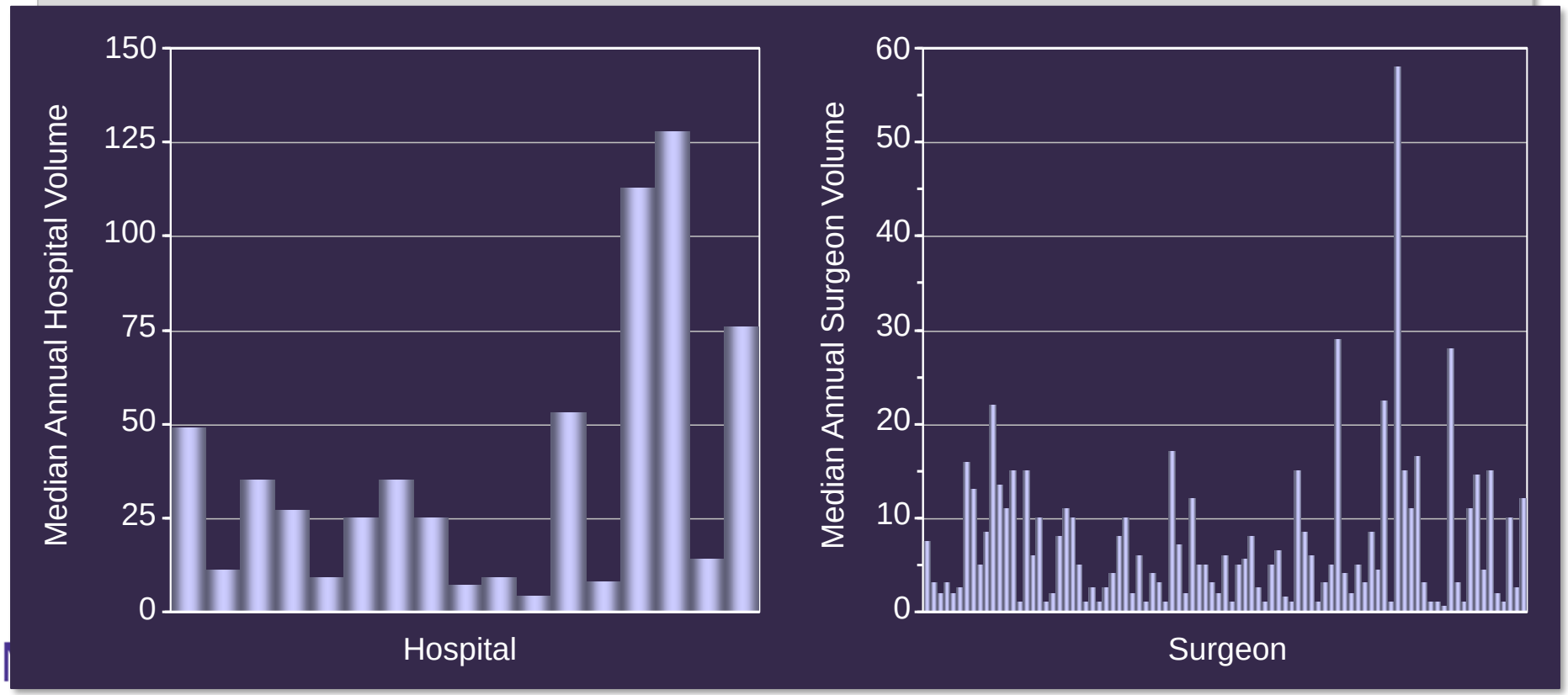

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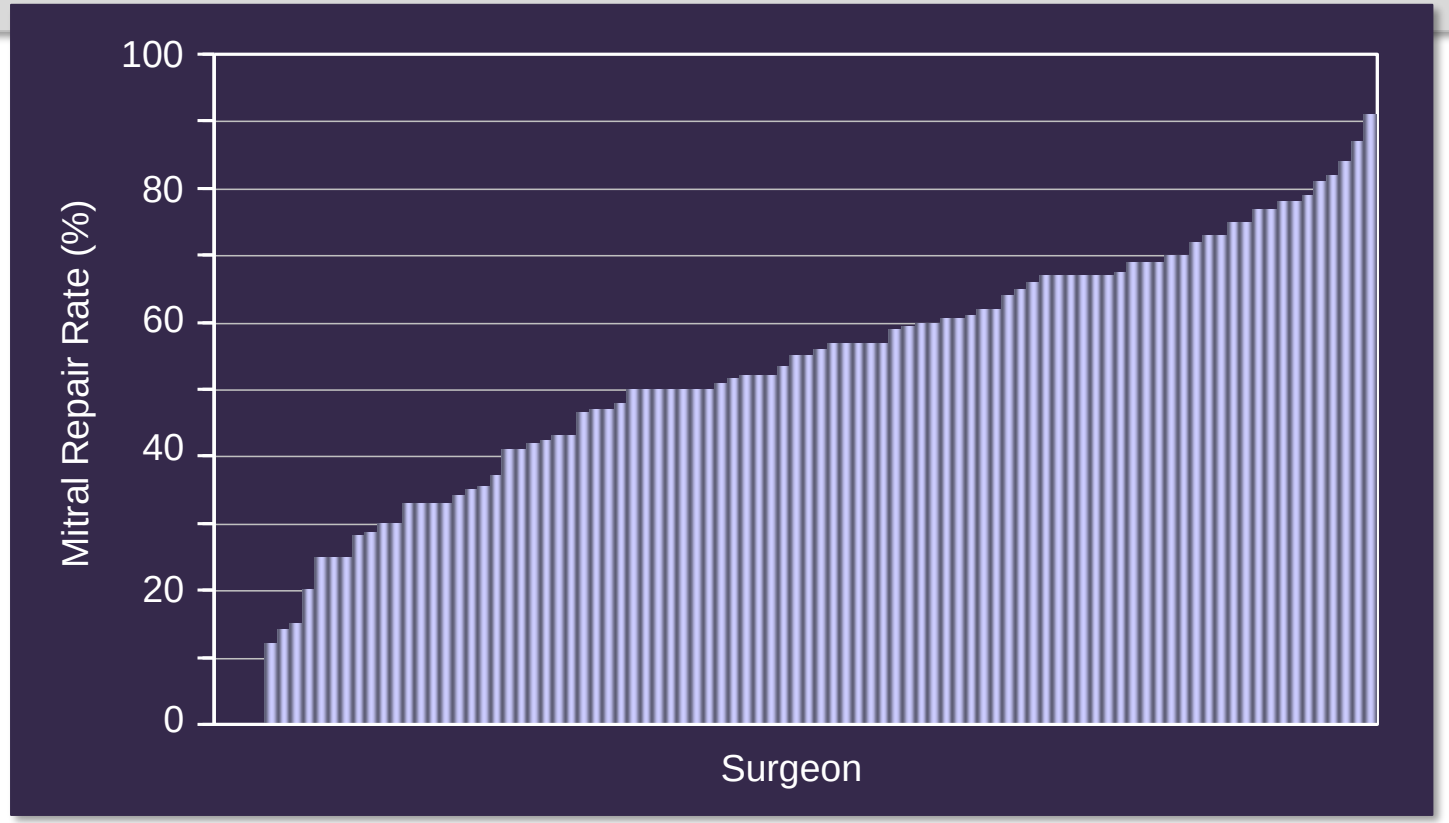


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# Hospital volume, mitral repair rates, and mortality in mitral valve surgery in the elderly: An analysis of US hospitals treating Medicare fee-for-service patients

Christina M. Vassileva, MD,[a] Christian McNeely, BS,[a] John Spertus, MD,[b] Stephen Markwell, MA,[a] and Stephen Hazelrigg, MD[a]

J Thorac Cardiovasc Surg 2015;149:762-8

**Medicare data 2000-2009**
**1239 hospitals performing MV surgery**

Number of MV operations/year:

- 91% performed ≤40
- 51% performed ≤10
- 29% performed ≤5

Number of MV repairs/year:

- 94% performed ≤20
- 65% performed ≤5
- 23% performed ≤1

# Mitral Regurgitation

## Percutaneous Edge-to-Edge Repair

- Incomplete percutaneous repair with residual MR probably ***inferior*** to complete successful surgical repair
- Incomplete percutaneous repair probably ***equivalent*** to incomplete surgical repair with residual MR
- Incomplete percutaneous repair probably ***superior*** to mitral valve replacement

EDITORIAL COMMENT

# The Time Has Come to Define Centers of Excellence in Mitral Valve Repair

Robert O. Bonow, MD, MS, David H. Adams, MD

J Am Coll Cardiol 2016;67:499-501

**Centers of Excellence in Mitral Valve Repair**

***Criteria:***

- **MV surgery volume requirement (center and surgeon)**
- **Expert periprocedural imaging capabilities**
- **Access to transcatheter technology**
- **Transparency regarding outcomes including: repair rates, mortality rates, stroke rates, repair durability**

ACC Latin America Conference 2016