Percutaneous Mitral Valve Therapies: State of the Art in 2020 LA ACP Annual Meeting

Steven R Bailey MD

MSCAI, FACC, FAHA,FACP

Professor and Chair, Department of Medicine

Malcolm Feist Chair of Interventional Cardiology

LSU Health Shreveport

Professor Emeritus, UH Health San Antonio

Sbail8@lsuhsc.edu

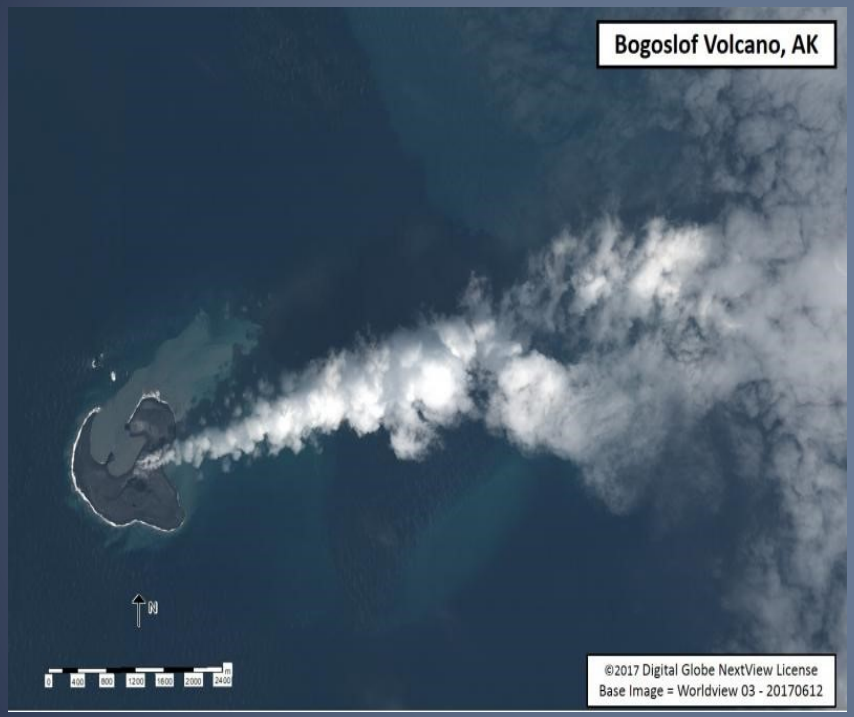
SRB March 2020

Disclosure Statement of Financial Interest

Within the past 12 months, I or my spouse/partner have had a financial interest/arrangement or affiliation with the organization(s) listed below.

Affiliation/Financial Relationship	Company
• Grant/Research Support	• None
• Consulting Fees/Honoraria	• BSCI, Abbot DSMB
• Intellectual Property Rights	• UTHSCSA
• Other Financial Benefit	• CCI Editor In Chief

The 30,000 Ft View



3 Ft View of Valvular Heart Disease in Cardiology

SRB March 2020

Mitral Stenosis

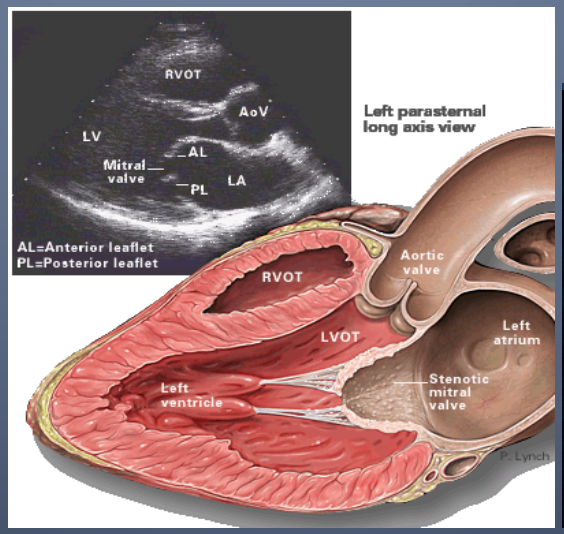
- The most common etiology of MS is rheumatic fever, with a latency of approximately 10 to 20 years after the initial streptococcal infection. Symptoms usually appear in adulthood

- Other etiologies are rare but include:
  - congenital MS
  - radiation exposure
  - atrial myxoma
  - mucopolysaccharidoses

- MS secondary to calcific annular disease is increasingly seen in elderly patients, and in patients with advanced chronic kidney disease.

Mitral Stenosis

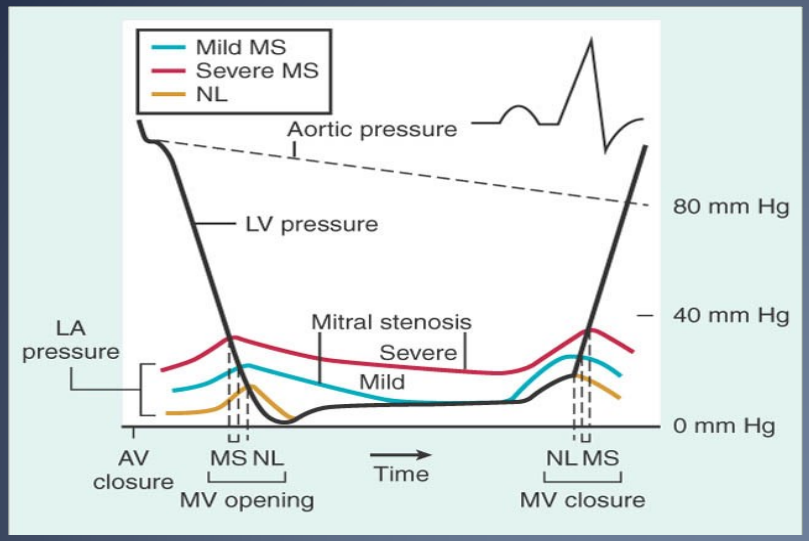
- Mitral stenosis most commonly results from rheumatic heart disease
  - fusion of the valve leaflet cusps at the commissures
  - thickening and shortening of the chordae
  - calcium deposition within the valve leaflets
- Characteristic “fish-mouth” or “hockey stick” appearance on the echocardiogram (depending on view)

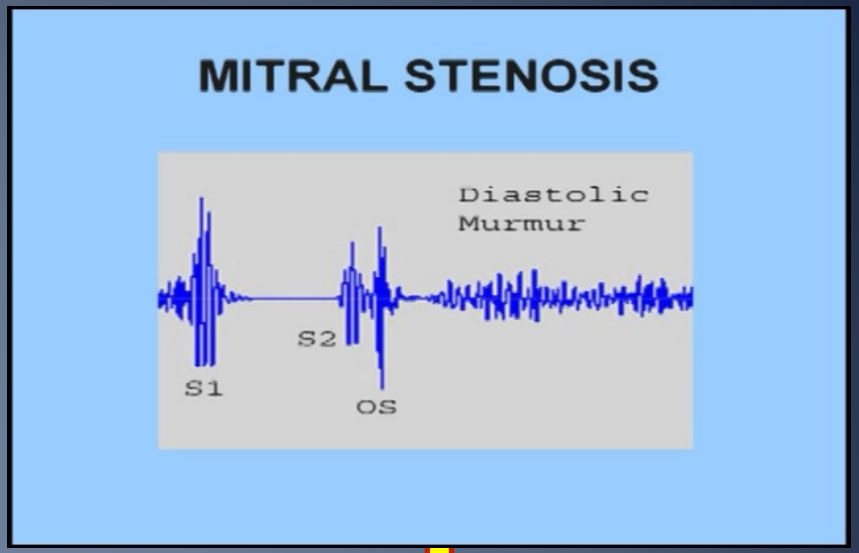


Mitral Stenosis: Natural History

- **The severity of symptoms depends primarily on the degree of stenosis.**
- **Symptoms often go unrecognized by patient and physician until significant shortness of breath, hemoptysis, or atrial fibrillation develops.**
- **Do not tolerate tachycardia or volume overloads well.**
- **At high risk for development of left atrial/appendage thrombus formation, and subsequent stroke.**
- **Symptoms can be managed medically initially.**

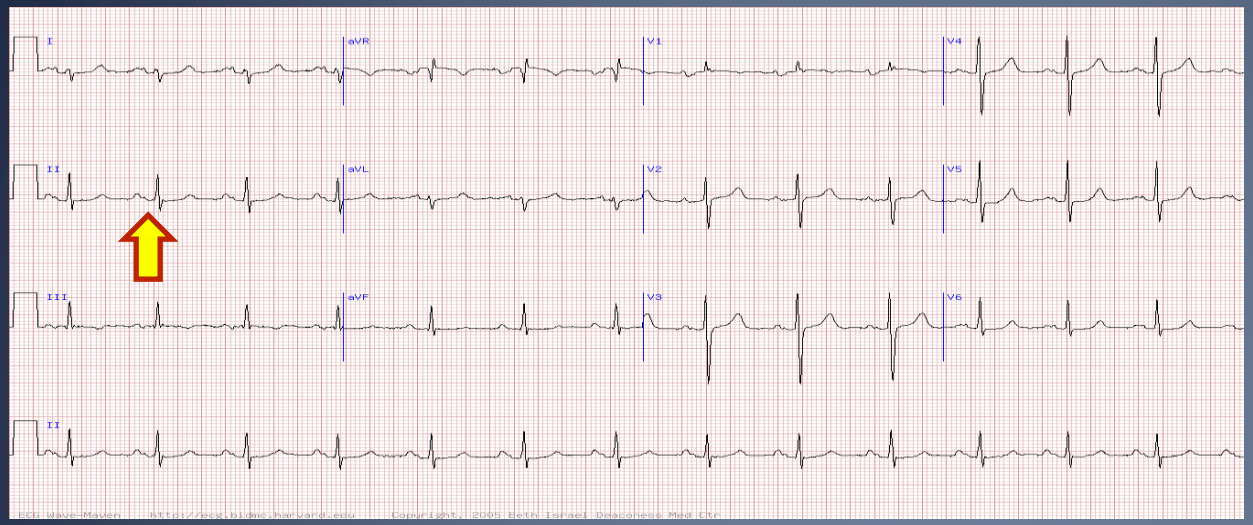
Mitral Stenosis Hemodynamics



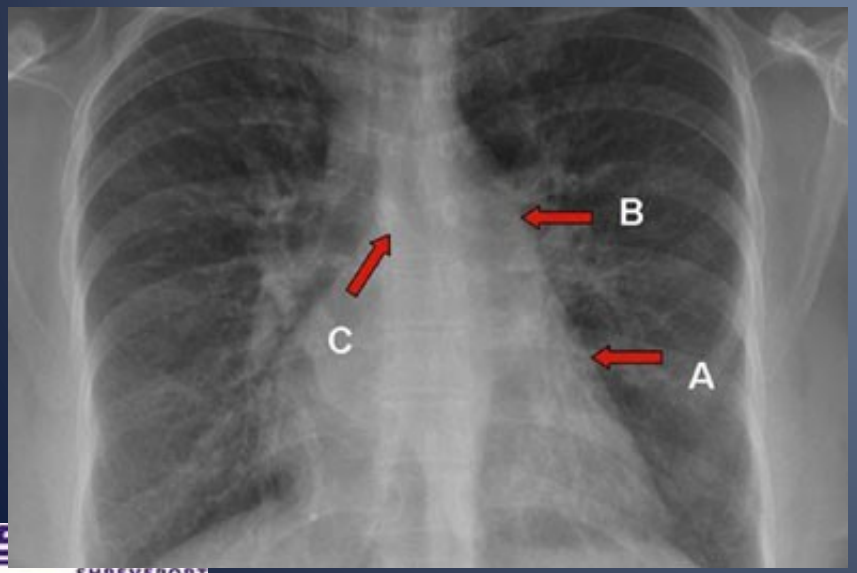


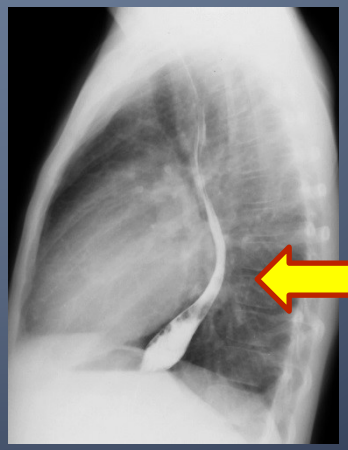
- As the mitral valve area gets progressively smaller, a higher pressure in the LA is needed to "push" blood from LA to LV.
- LA enlarges markedly. Atrial fibrillation commonly results.
- ↑ LA pressure → ↑pulmonary pressures →RV Hypertrophy
- Eventually, right heart failure will occur
- LV function is usually normal at rest, but may fail to increase normally with exercise.

Findings in Mitral Stenosis



- **EKG: LAE; RVH; Eventually atrial fibrillation**
- **CXR: LAE; straightened left heart border; straightened right mainstem bronchus**





Lateral CXR: Bulging of left atrium against esophagus

SRB March 2020

Clinical Stages of Mitral Stenosis

Stage	Definition	Valve Anatomy	Valve Hemodynamics	Hemodynamic Consequences	Symptoms
A	**At risk of MS**	• Mild valve doming during diastole	• Normal transmitral flow velocity	• None	• None
B	**Progressive MS**	• Rheumatic valve changes with commissural fusion and diastolic doming of the mitral valve leaflets • Planimetered MVA >1.5 cm^2	• Increased transmitral flow velocities • MVA >1.5 cm^2 • Diastolic pressure half-time <150 msec	• Mild-to-moderate LA enlargement • Normal pulmonary pressure at rest	• None
C	**Asymptomatic severe MS**	• Rheumatic valve changes with commissural fusion and diastolic doming of the mitral valve leaflets • Planimetered MVA ≤1.5 cm^2 • (MVA ≤1 cm^2 with very severe MS)	• MVA ≤1.5 cm^2 • (MVA ≤1 cm^2 with very severe MS) • Diastolic pressure half-time ≥150 msec • (Diastolic pressure half-time ≥220 msec with very severe MS)	• Severe LA enlargement • Elevated PASP >30 mm Hg	• None

Clinical Stages of Mitral Stenosis

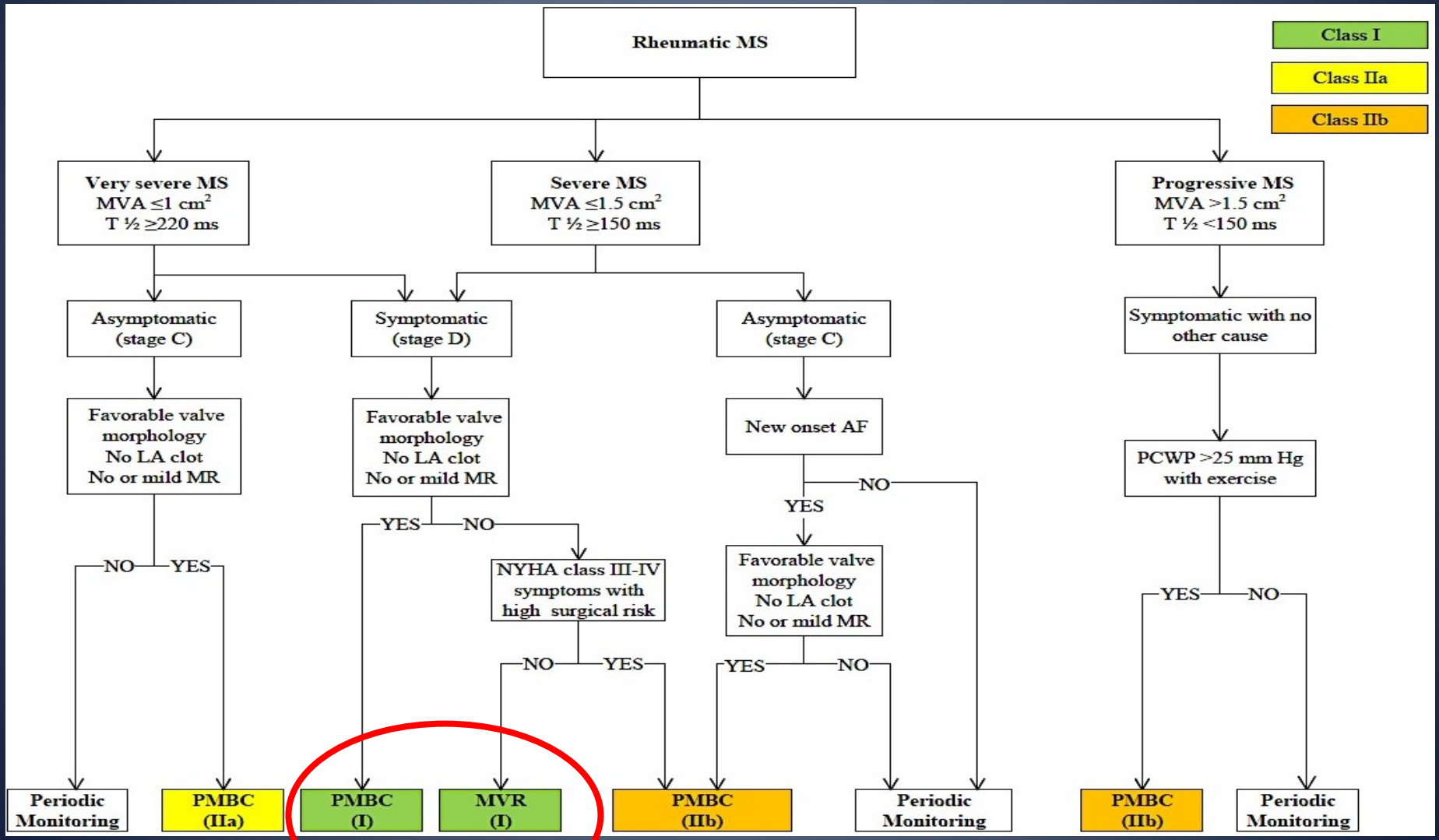
Stage	Definition	Valve Anatomy	Valve Hemodynamics	Hemodynamic Consequences	Symptoms
D	**Symptomatic severe MS**	• Rheumatic valve changes with commissural fusion and diastolic doming of the mitral valve leaflets • Planimetered MVA ≤1.5 cm^2	• MVA≤1.5 cm^2 • (MVA ≤1 cm^2 with very severe MS) • Diastolic pressure half-time ≥150 msec • (Diastolic pressure half-time ≥220 msec with very severe MS)	• Severe LA enlargement • Elevated PASP >30 mm Hg	• Decreased exercise tolerance • Exertional dyspnea

Medical Therapy of Mitral Stenosis

- **Limit/minimize left atrial (LA) pressure elevation***
  - **Diuretic**
  - **Slow heart rate (increases LA emptying time)**
  - **Maintain sinus rhythm (i.e., atrial contraction)**
- **Management of atrial fibrillation (Afib)**
  - **Prevent atrial fibrillation**
  - **Control heart rate when Afib occurs**
- **Prevent thromboembolic events**
  - **anticoagulation**

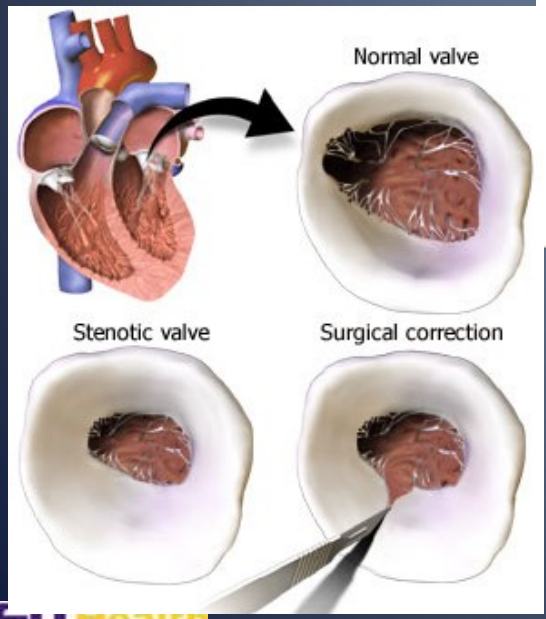
** LA pressure ↑ when there is (a) ↑intravascular volume, cardiac output or heart rate or (b) loss of atrial contraction (i.e., pregnancy, infection, hyperthyroidism, and atrial fibrillation)*

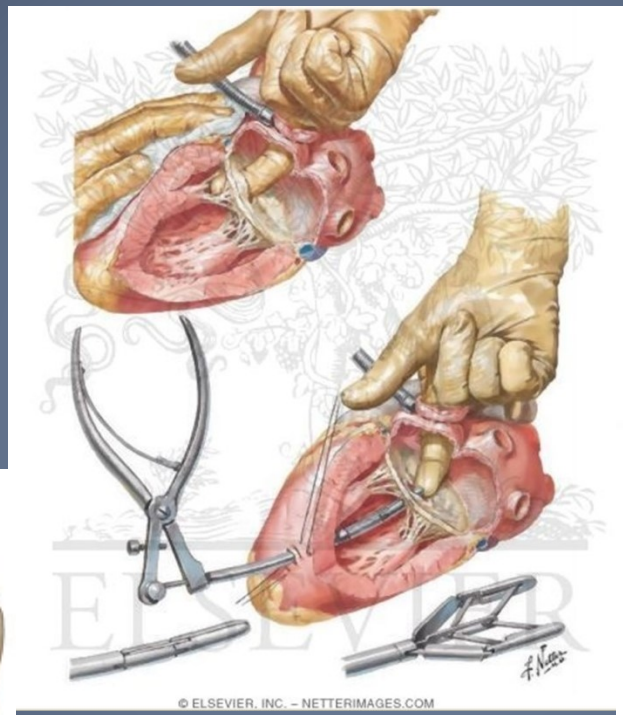
Indications for Intervention for Rheumatic Mitral Stenosis



Mitral Stenosis Surgery

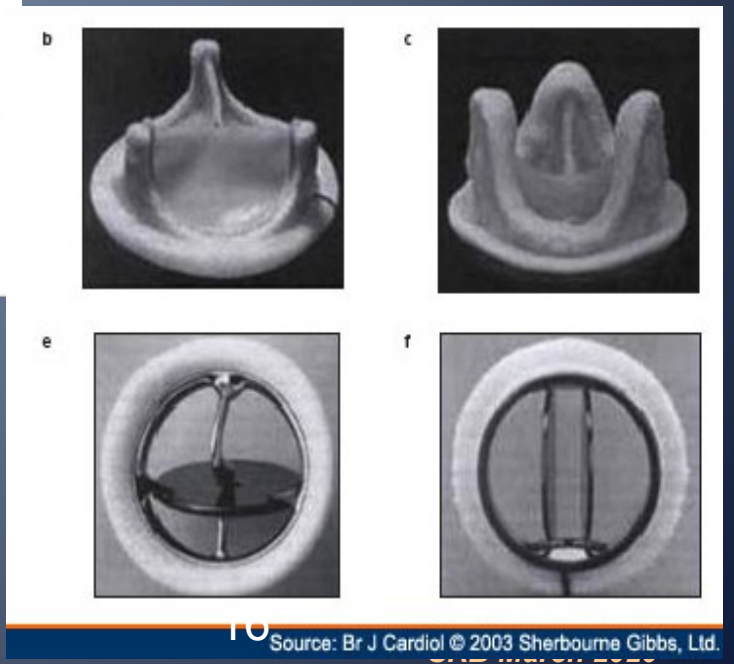
Open commissurotomy



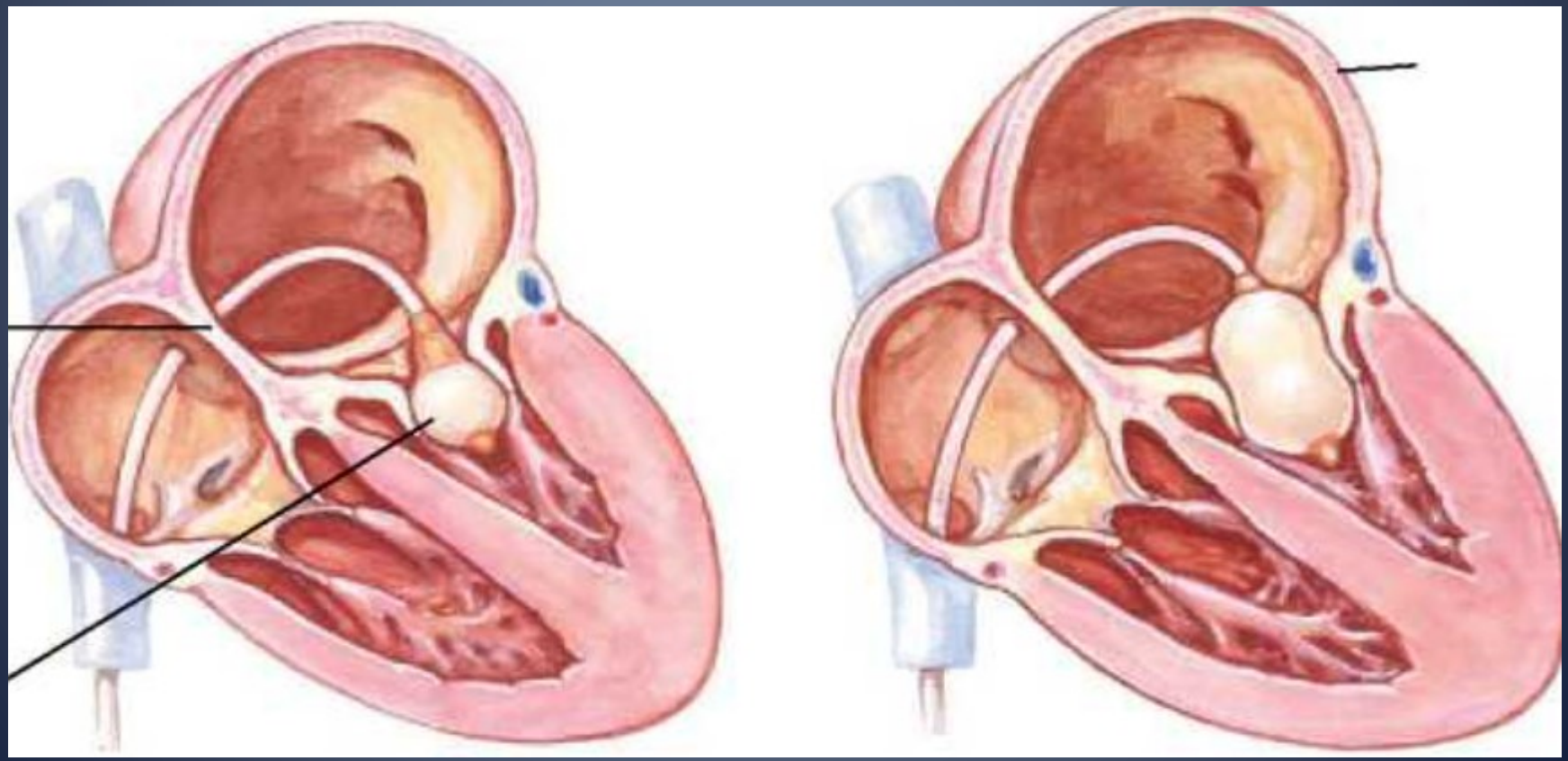


Closed commissurotomy

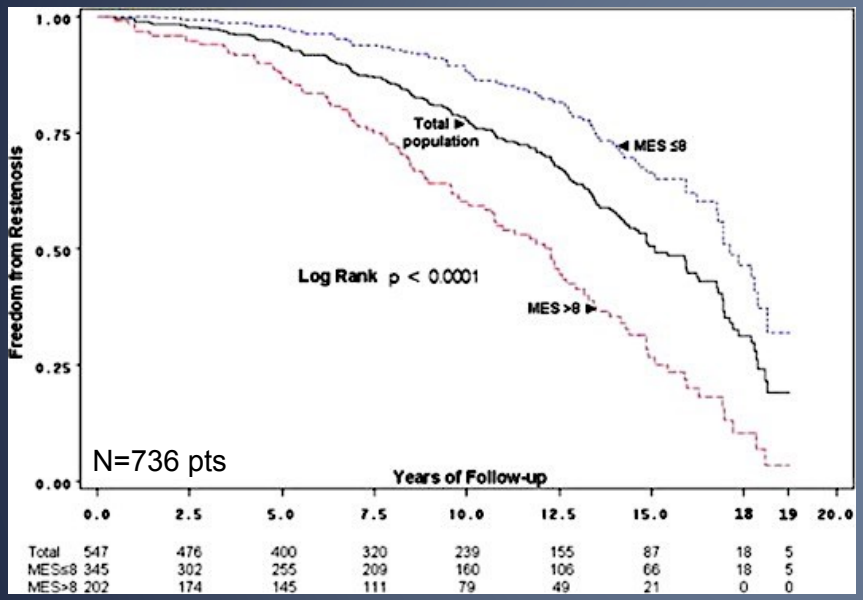
Valve replacement

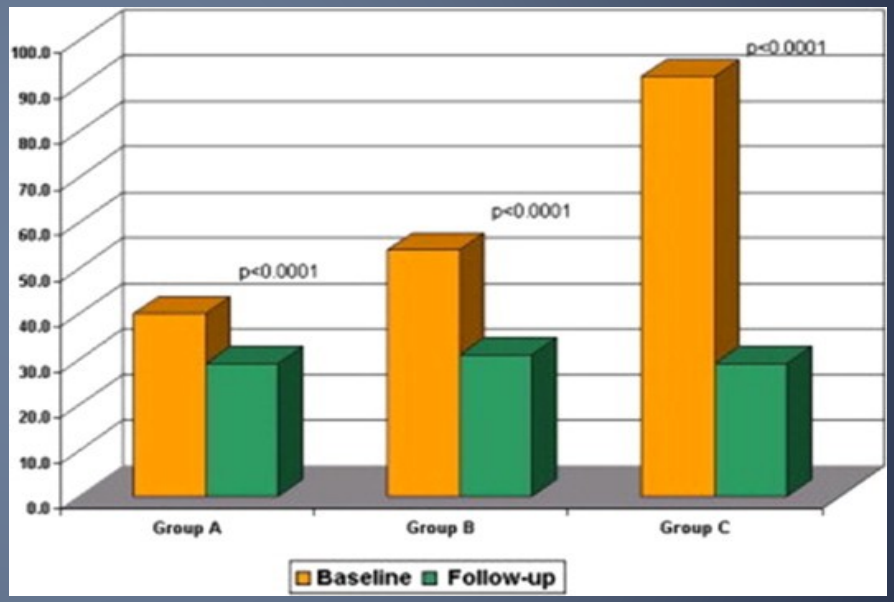


Mitral ValvuloplastyTechnique



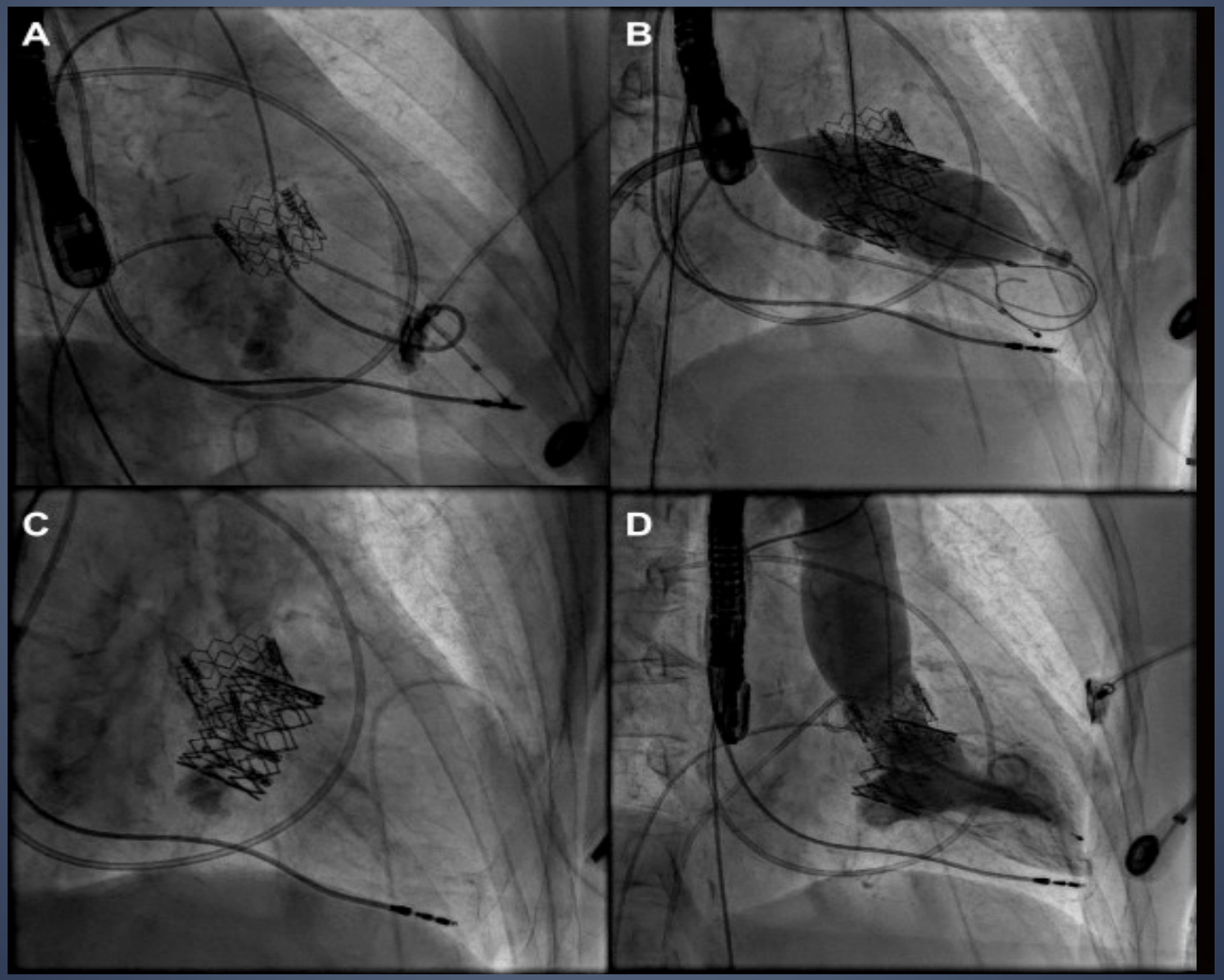
Outcomes After PBMC
19 year Followup





Fazway et al EHJ Volume 66, Issue 2, June 2014, Pages 133-138

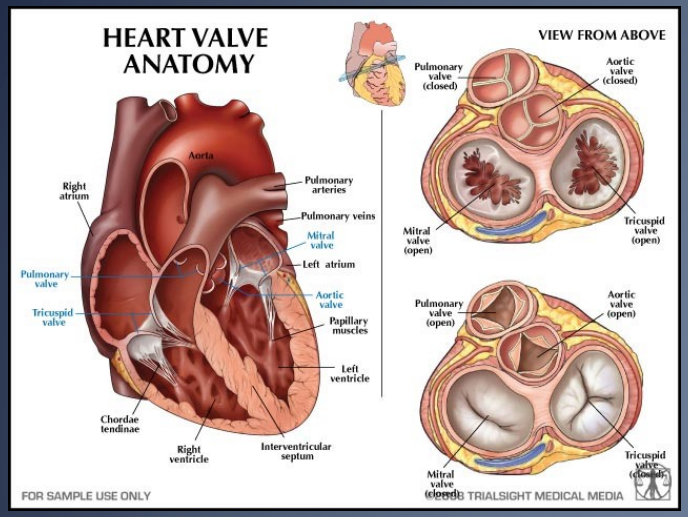
Percutaneous Mitral Valve Replacement for MAC



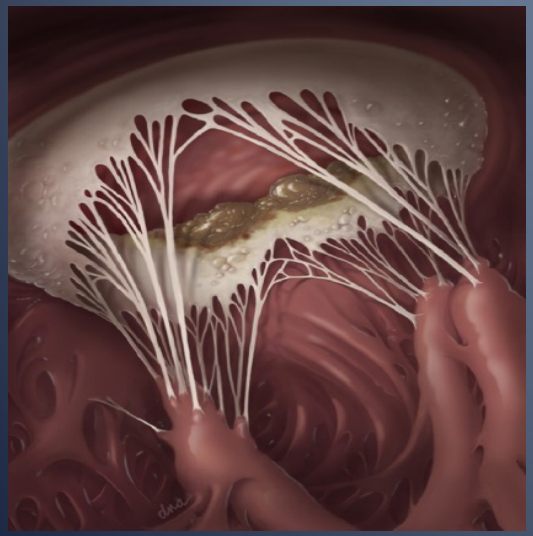
SRB March 2020

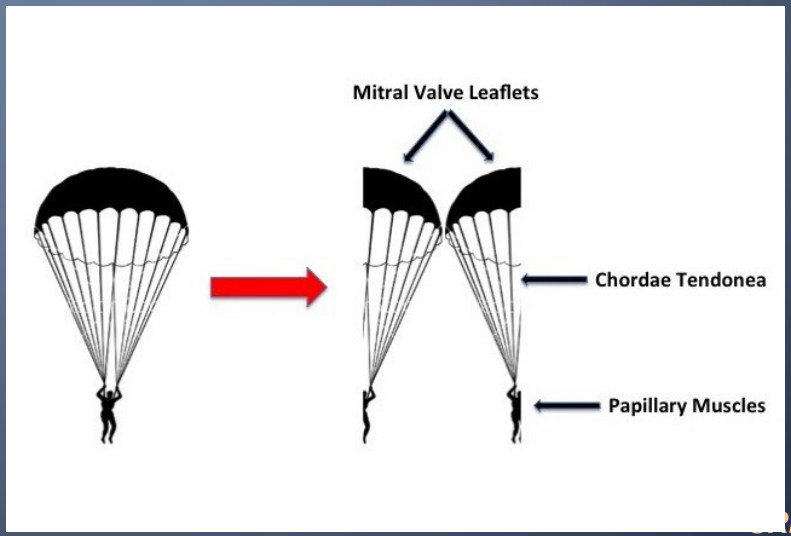
LSU Health SHREVEPORT

Anatomy of the Atrioventricular Valves



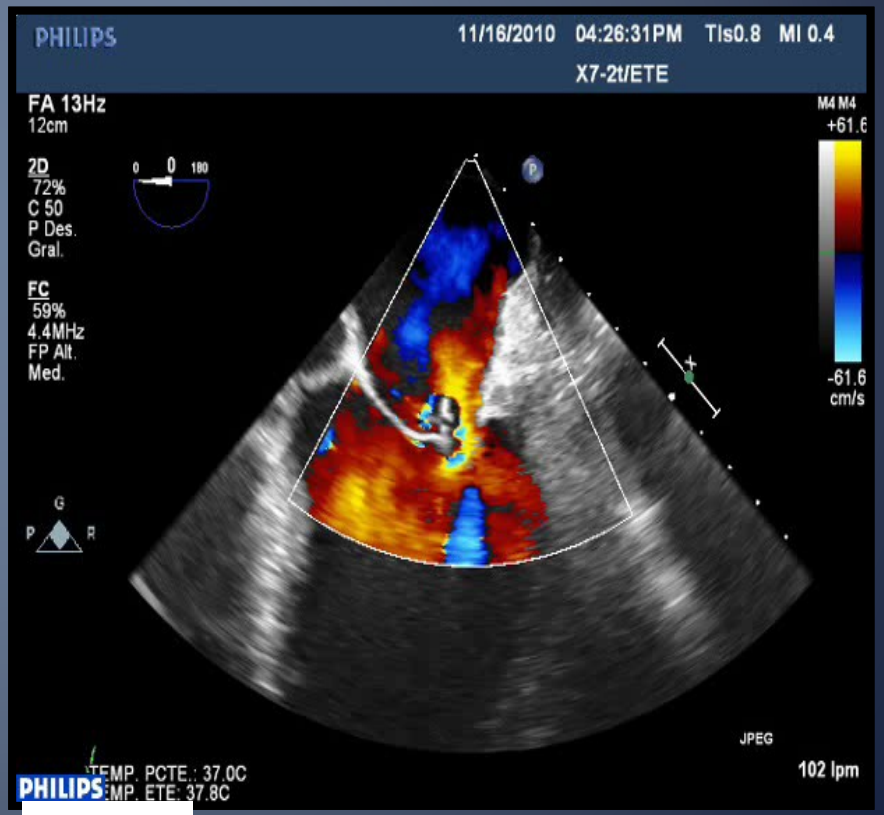
- Papillary muscles arise from the ventricular wall, and give rise to multiple fibrous chordae tendinae.
- Chordae attach to the edges of the valve leaflets, maintaining constant tension.
- Mitral valve: 2 leaflets. Tricuspid valve: 3 leaflets.
- Leaflets attach to the fibrous annulus.
- Annulus more oval/ horseshoe shaped.
- Valve opening, closure much more dynamic





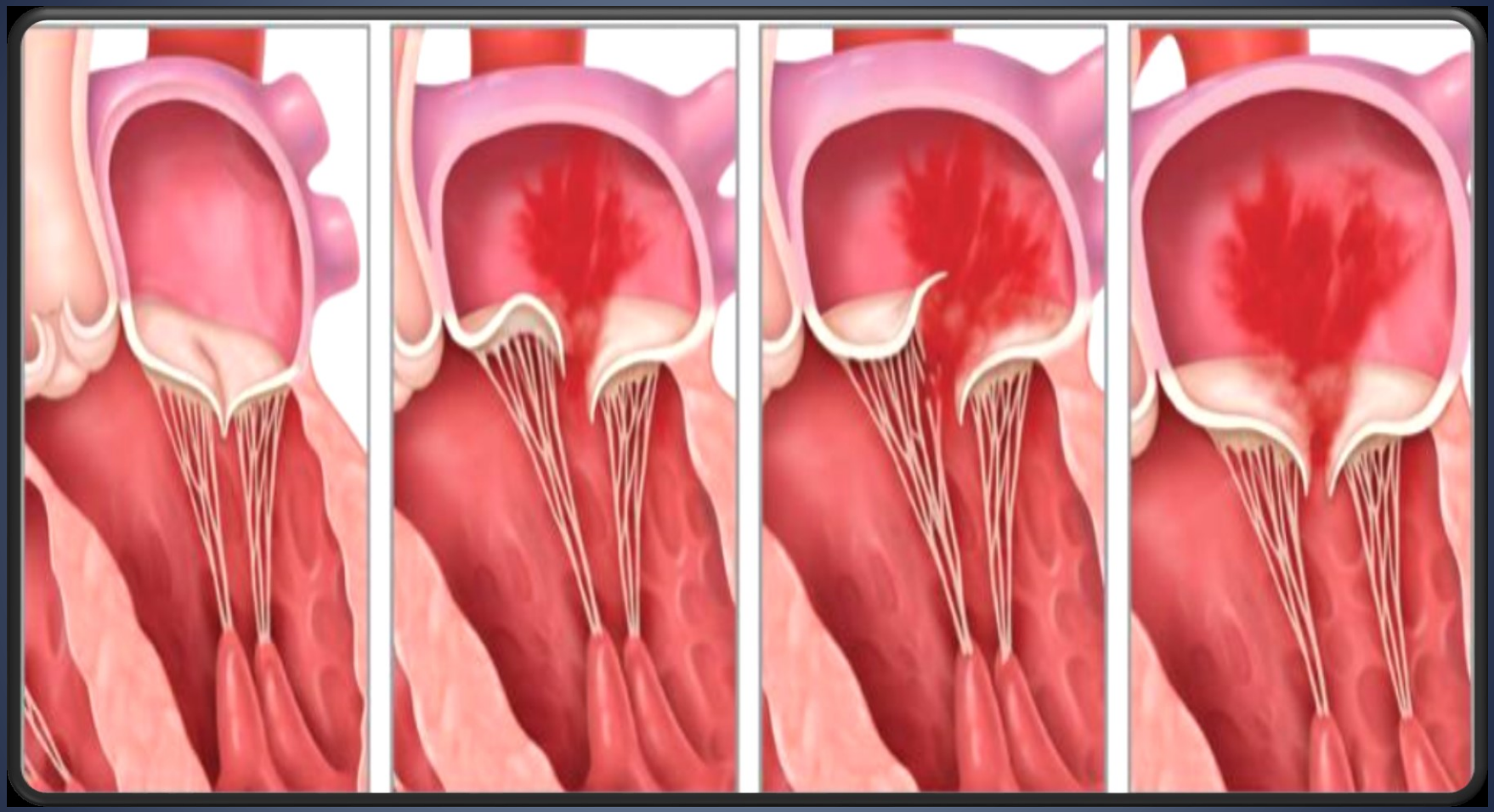
Mitral Regurgitation
Brief Case Presentation

- 62 year old male college professor with a “heart murmur when I entered the Army” who is admitted for evaluation of subacute onset of shortness of breath over the preceding 3 months. No recent illness or hospitalization
- Vital Signs BP 138/74 HR 88 Regular RR 18 WT 167 lb HT 6’1”
- Physical Exam remarkable for JVP at 8cm with lungs that were clear. Cardiac Exam shows Gr III/IV HSM that radiated to the left axilla with + S4 No S3. S1, A2 normal P2 increased.



SRB March 2020

MR Etiologies



Normal

Degenerative MR Prolapse

Degenerative MR Flail

Functional MR Ischemic vs. nonischemic

SRB March 2020

LSU Health SHREVEPORT

Objectives Mitral Regurgitation

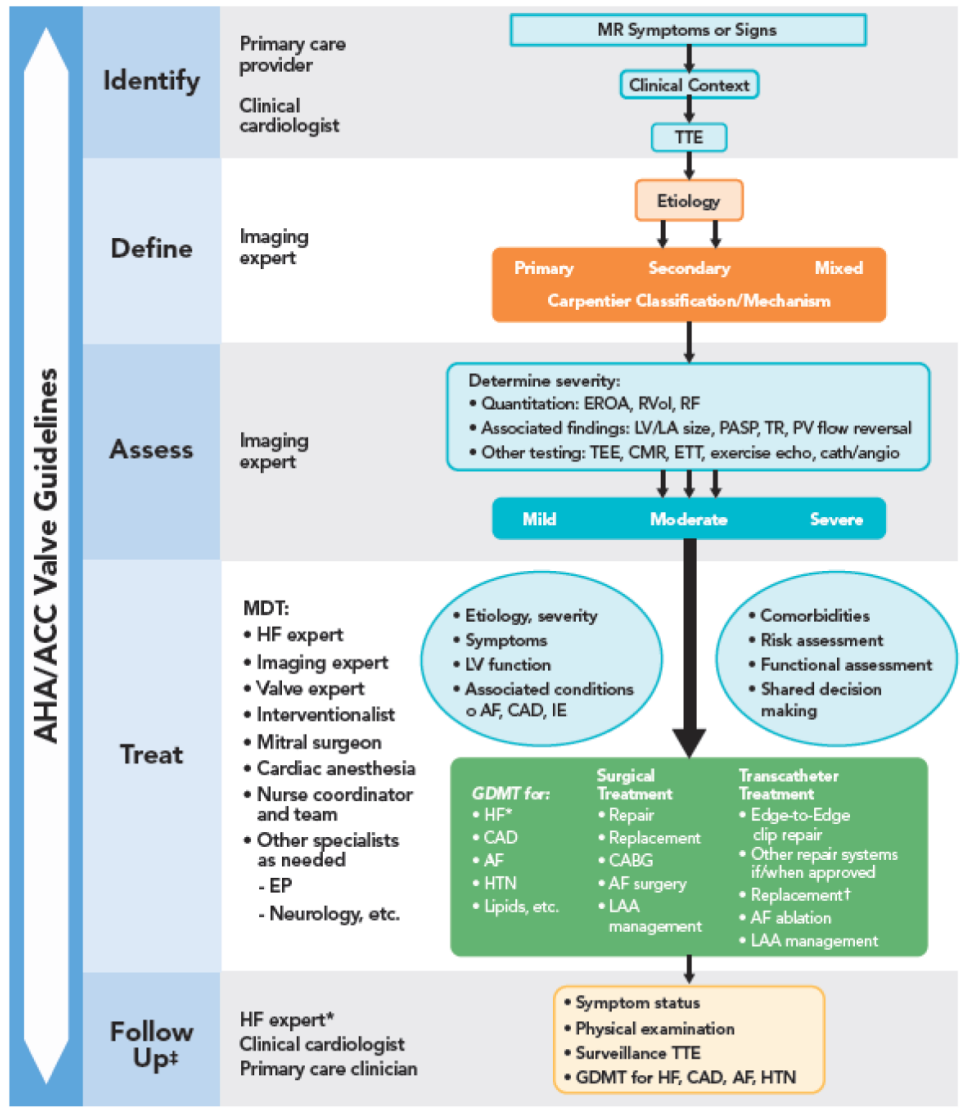
- Understand the mechanisms and classification of Mitral Regurgitation
- Review guidelines and outcomes for management strategies of mitral valve disease
- Discuss new techniques for monitoring mitral valvular heart disease
- Review percutaneous mitral valve procedures
- Discuss outcomes and opportunities for new percutaneous therapies

Identification of Mitral Regurgitation

There are a large number of patients who have MR that are unrecognized

- MR is due to multiple etiologies/mechanisms
- Patients are often minimally symptomatic
- Physical exam may be difficult
- Imaging studies require additional skill

2020 Management of MR



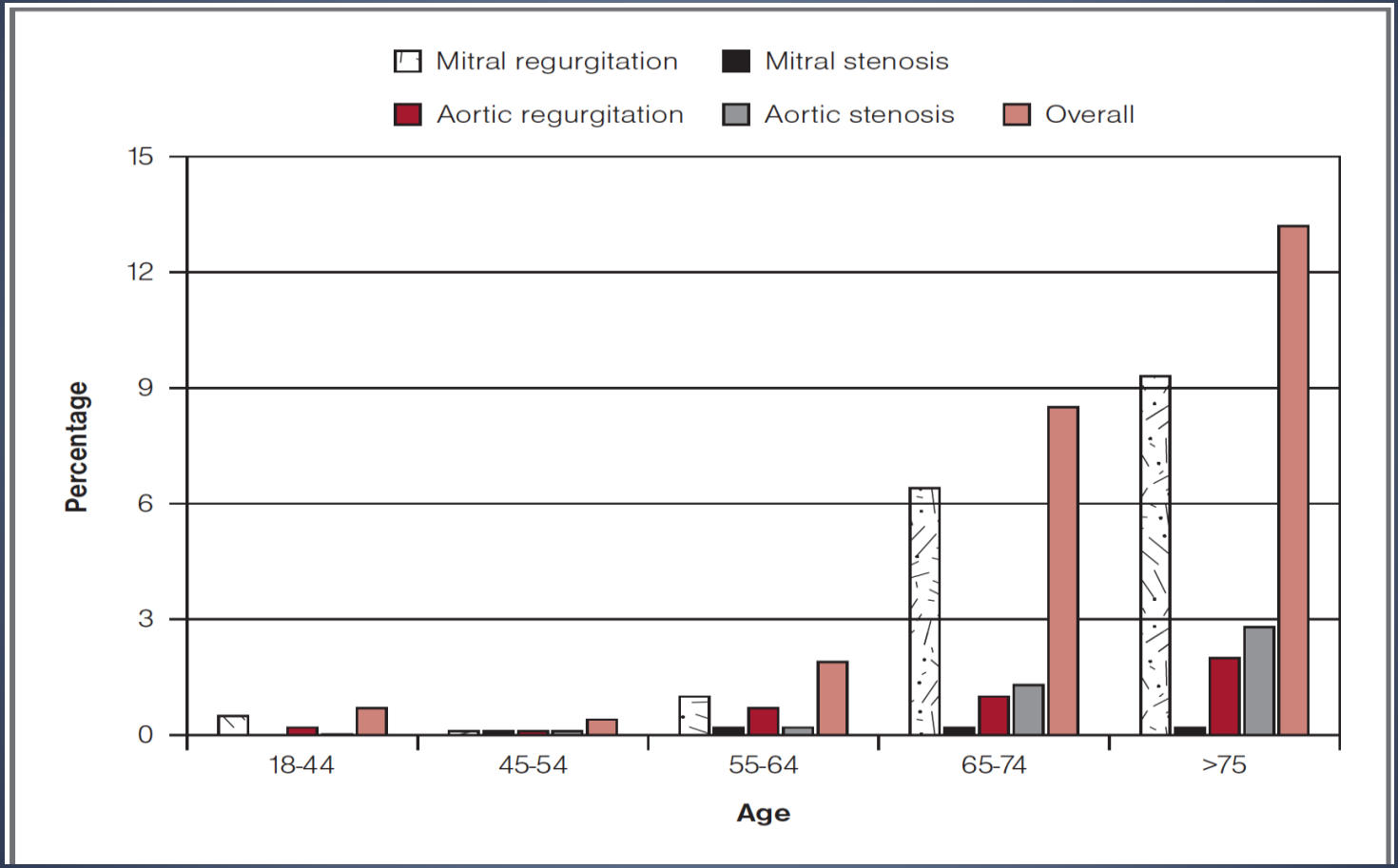
O'gara et al 2020 Focused Update of the 2017 ACC Expert Consensus Decision Pathway on the Management of Mitral Regurgitation DOI: 10.1016/j.jacc.2020.02.005

SRB March 2020

LSU Health SHREVEPORT

Prevalence of VHD in USA

2.5% of the overall population

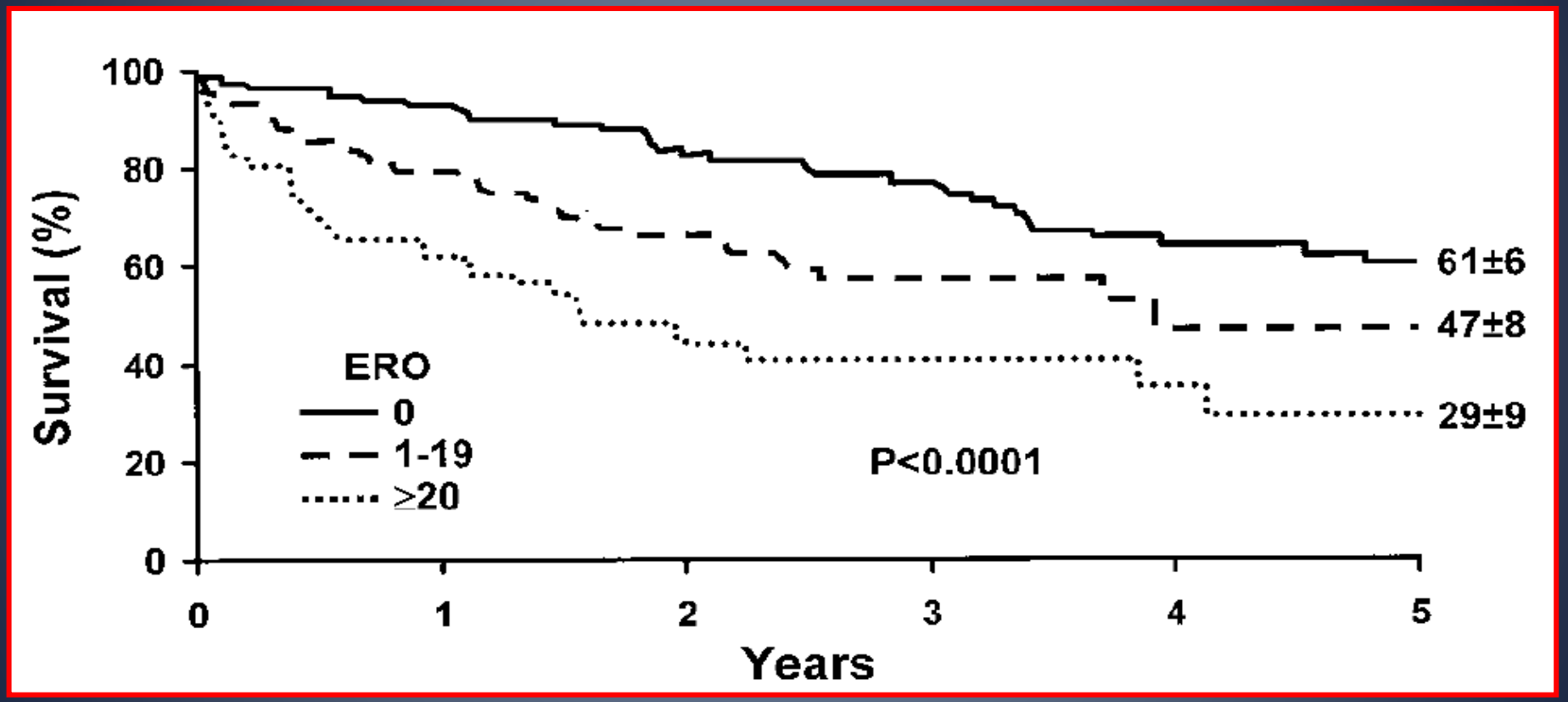


Nkomo VT et. Al. Burden of valvular heart diseases: a population-based study. Lancet. *2006;368 (9540):1005-1011.*

SRB March 2020

LSU Health SHREVEPORT

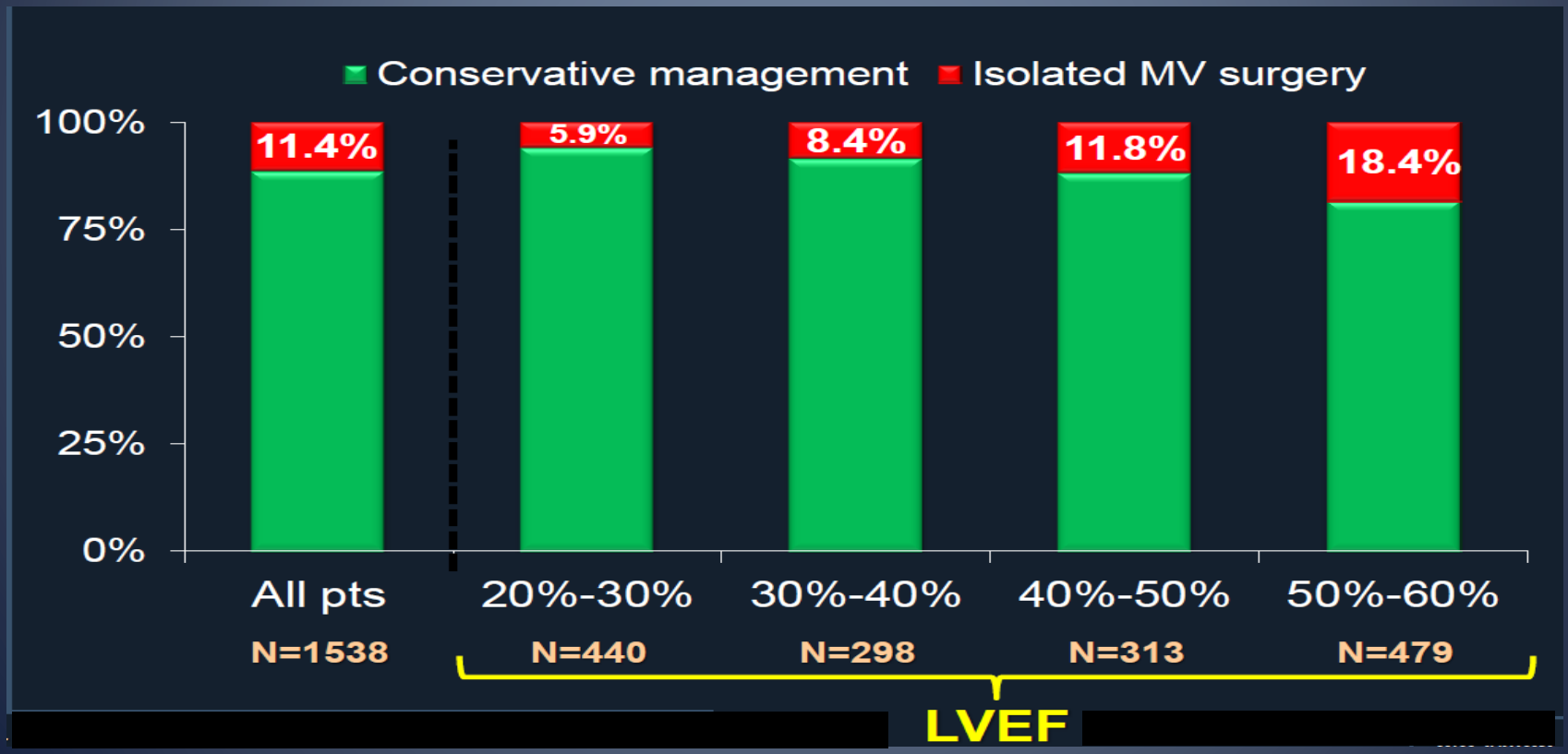
Relationship between MR Severity and Mortality in Secondary MR



(Grigioni ,Circulation 2001;103:1759-63)

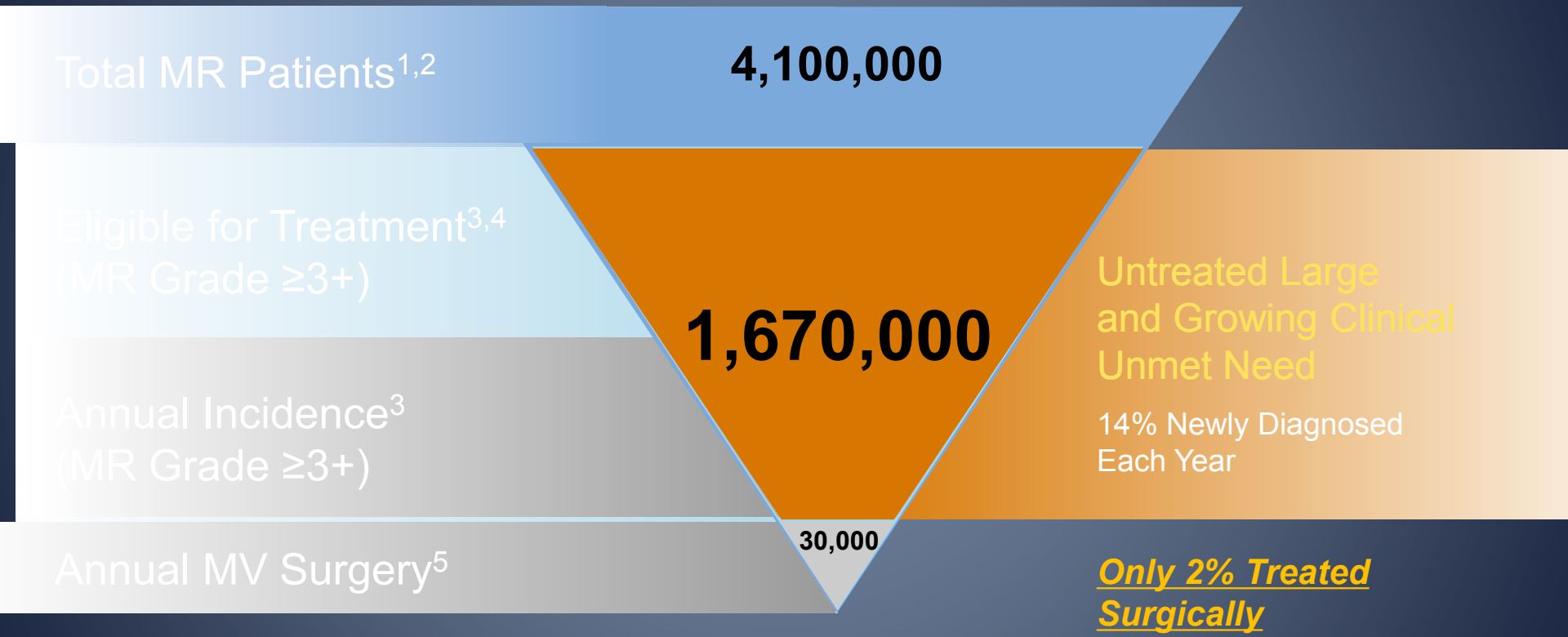
How Are Patients with Isolated FMR Treated ?

Duke Databank: 1,538 pts not undergoing CABG with echocardiographic 3+ to 4+ FMR and LVEF ≥20% between 2000 and 2010



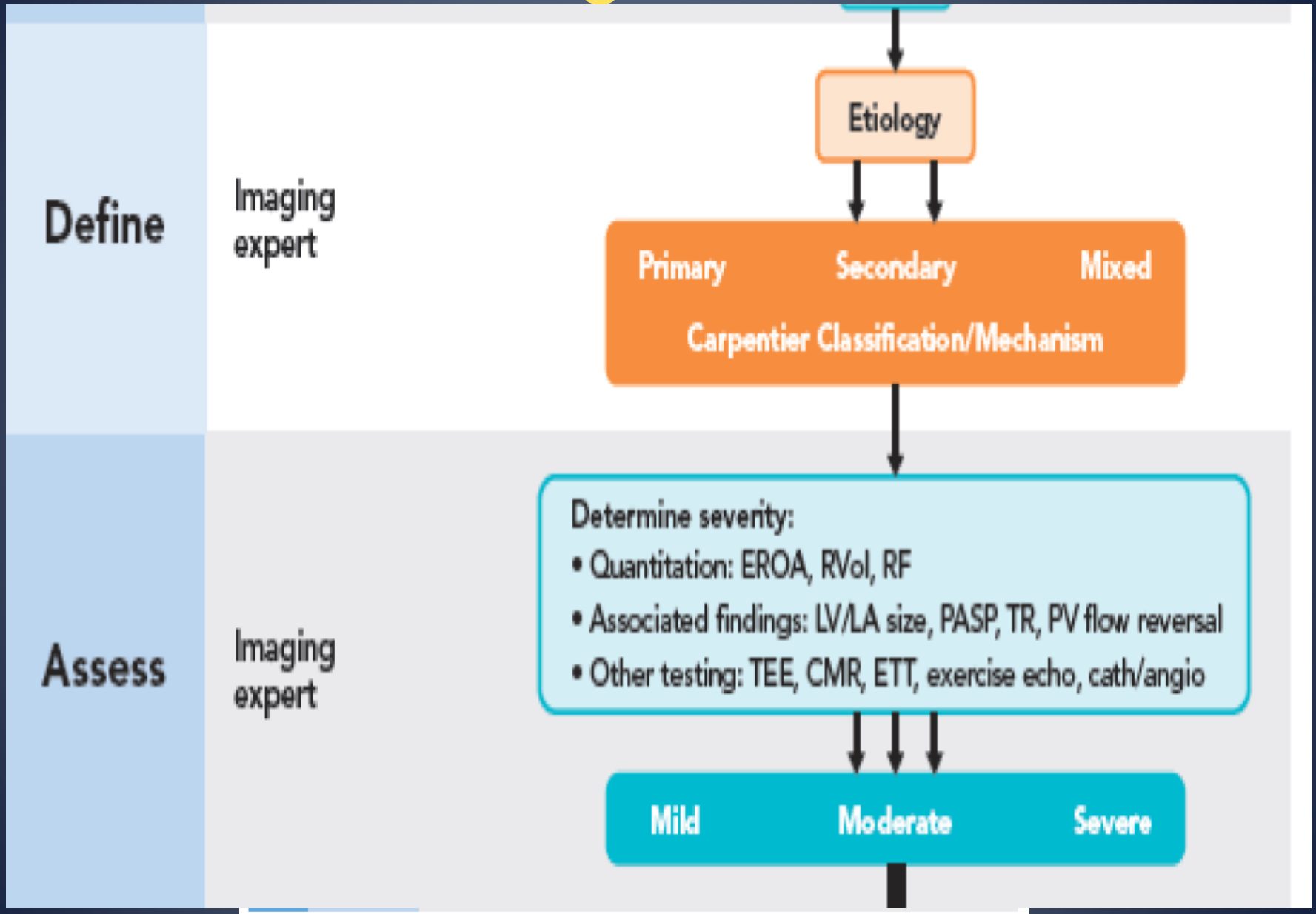
A Largely Unmeet Need in a Large Patient Population

Mitral Regurgitation 2009 U.S. Prevalence



1. US Census Bureau. Statistical Abstract of the US: 2006, Table 12.
2. Nkomo et al. Burden of Valvular Heart Diseases: A Population-based Study, Lancet, 2006; 368: 1005-11.
3. Patel et al. Mitral Regurgitation in Patients with Advanced Systolic Heart Failure, J of Cardiac Failure, 2004.
4. ACC/AHA 2008 Guidelines for the Management of Patients with Valvular Heart Disease, Circulation: 2008
5. Gammie, J et al, Trends in Mitral Valve Surgery in the United States: Results from the STS Adult Cardiac Database, Annals of Thoracic Surgery 2010.

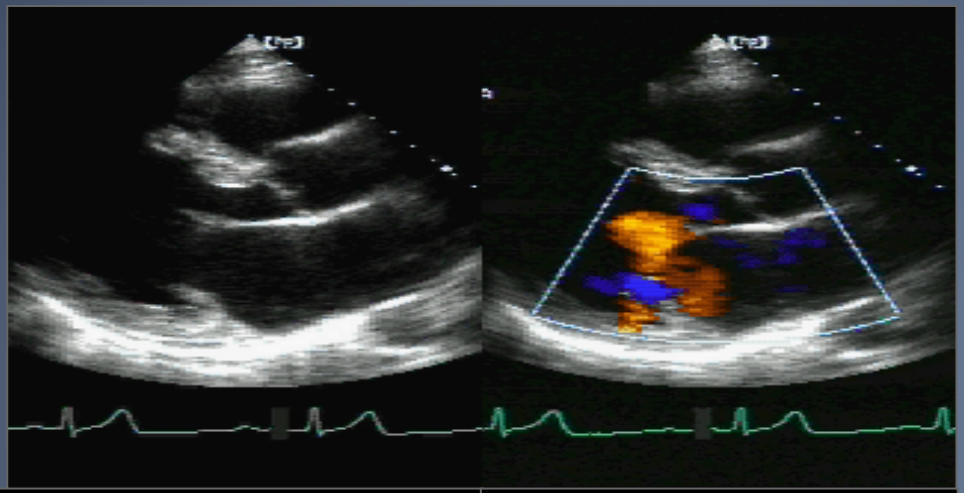
2020 Management of MR



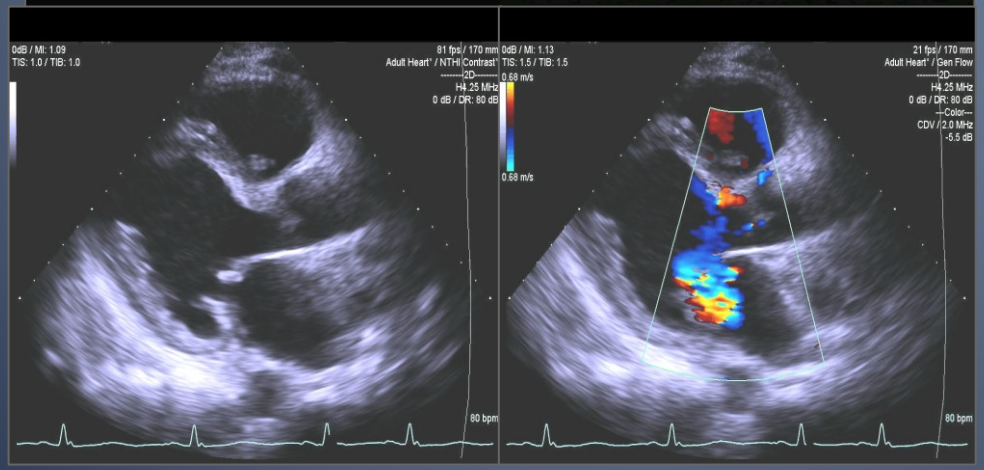
O'gara et al 2020 Focused Update of the 2017 ACC Expert Consensus Decision Pathway on the Management of Mitral Regurgitation DOI: 10.1016/j.jacc.2020.02.005

SRB March 2020

Defining the Etiology
Valve Structure & MR Jet Characteristics



Primary



Secondary

Echo Assessment of MR

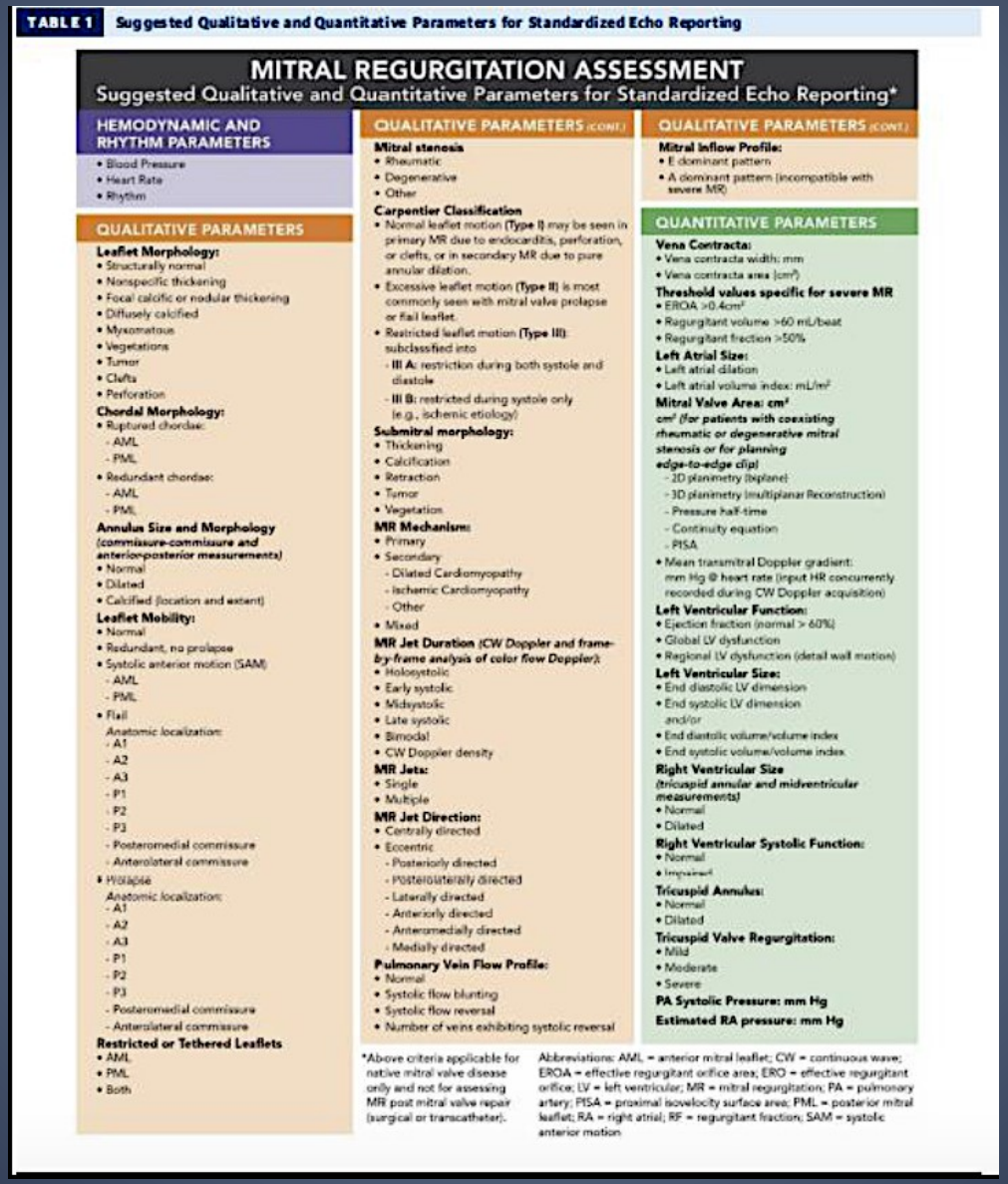


TABLE 1 Suggested Qualitative and Quantitative Parameters for Standardized Echo Reporting

MITRAL REGURGITATION ASSESSMENT
Suggested Qualitative and Quantitative Parameters for Standardized Echo Reporting*

HEMODYNAMIC AND RHYTHM PARAMETERS
- Blood Pressure
- Heart Rate
- Rhythm

QUALITATIVE PARAMETERS

Leaflet Morphology:
- Structurally normal
- Nonspecific thickening
- Focal calcific or nodular thickening
- Diffusely calcified
- Myxomatous
- Vegetations
- Tumor
- Clefts
- Perforation

Chordal Morphology:
- Ruptured chordae:
  - AML
  - PML
- Redundant chordae:
  - AML
  - PML

Annulus Size and Morphology *(commissure-commissure and anterior-posterior measurements)*
- Normal
- Dilated
- Calcified (location and extent)

Leaflet Mobility:
- Normal
- Redundant, no prolapse
- Systolic anterior motion (SAM)
  - AML
  - PML
- Flail
  - *Anatomic localization:*
  - A1
  - A2
  - A3
  - P1
  - P2
  - P3
  - Posteromedial commissure
  - Anterolateral commissure
- Prolapse
  - *Anatomic localization:*
  - A1
  - A2
  - A3
  - P1
  - P2
  - P3
  - Posteromedial commissure
  - Anterolateral commissure

Restricted or Tethered Leaflets
- AML
- PML
- Both

QUALITATIVE PARAMETERS (CONT.)

Mitral stenosis
- Rheumatic
- Degenerative
- Other

Carpentier Classification
- Normal leaflet motion **(Type I)** may be seen in primary MR due to endocarditis, perforation, or clefts, or in secondary MR due to pure annular dilation.
- Excessive leaflet motion **(Type II)** is most commonly seen with mitral valve prolapse or flail leaflet.
- Restricted leaflet motion **(Type III)**: subclassified into
  - **III A:** restriction during both systole and diastole
  - **III B:** restricted during systole only (e.g., ischemic etiology)

Submitral morphology:
- Thickening
- Calcification
- Retraction
- Tumor
- Vegetation

MR Mechanism:
- Primary
- Secondary
  - Dilated Cardiomyopathy
  - Ischemic Cardiomyopathy
  - Other
- Mixed

MR Jet Duration *(CW Doppler and frame-by-frame analysis of color flow Doppler):*
- Holosystolic
- Early systolic
- Midsystolic
- Late systolic
- Bimodal
- CW Doppler density

MR Jets:
- Single
- Multiple

MR Jet Direction:
- Centrally directed
- Eccentric
  - Posteriorly directed
  - Posterolaterally directed
  - Laterally directed
  - Anteriorly directed
  - Anteromedially directed
  - Medially directed

Pulmonary Vein Flow Profile:
- Normal
- Systolic flow blunting
- Systolic flow reversal
- Number of veins exhibiting systolic reversal

QUALITATIVE PARAMETERS (CONT.)

Mitral Inflow Profile:
- E dominant pattern
- A dominant pattern (incompatible with severe MR)

QUANTITATIVE PARAMETERS

Vena Contracta:
- Vena contracta width: mm
- Vena contracta area (cm^2)

Threshold values specific for severe MR
- EROA >0.4cm^2
- Regurgitant volume >60 mL/beat
- Regurgitant fraction >50%

Left Atrial Size:
- Left atrial dilation
- Left atrial volume index: mL/m^2

Mitral Valve Area: cm^2 ***cm^2 (for patients with coexisting rheumatic or degenerative mitral stenosis or for planning edge-to-edge clip)***
- 2D planimetry (biplane)
- 3D planimetry (multiplanar Reconstruction)
- Pressure half-time
- Continuity equation
- PISA
- Mean transmitral Doppler gradient: mm Hg @ heart rate (input HR concurrently recorded during CW Doppler acquisition)

Left Ventricular Function:
- Ejection fraction (normal > 60%)
- Global LV dysfunction
- Regional LV dysfunction (detail wall motion)

Left Ventricular Size:
- End diastolic LV dimension
- End systolic LV dimension

and/or
- End diastolic volume/volume index
- End systolic volume/volume index

Right Ventricular Size *(tricuspid annular and midventricular measurements)*
- Normal
- Dilated

Right Ventricular Systolic Function:
- Normal
- Impaired

Tricuspid Annulus:
- Normal
- Dilated

Tricuspid Valve Regurgitation:
- Mild
- Moderate
- Severe

PA Systolic Pressure: mm Hg

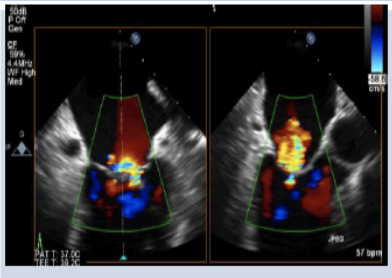
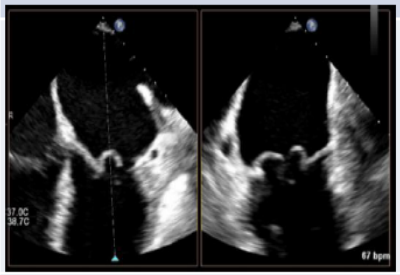
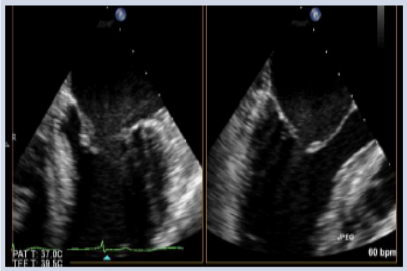
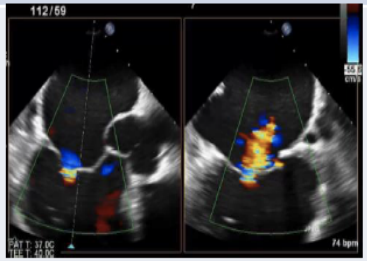
Estimated RA pressure: mm Hg

*Above criteria applicable for native mitral valve disease only and not for assessing MR post mitral valve repair (surgical or transcatheter).

Abbreviations: AML = anterior mitral leaflet; CW = continuous wave; EROA = effective regurgitant orifice area; ERO = effective regurgitant orifice; LV = left ventricular; MR = mitral regurgitation; PA = pulmonary artery; PISA = proximal isovelocity surface area; PML = posterior mitral leaflet; RA = right atrial; RF = regurgitant fraction; SAM = systolic anterior motion

LSU Health SHREVEPORT

SRB March 2020

Carpentier	Definition	Echocardiographic Examples
Type I	***normal leaflet motion*** *with isolated annular dilation, leading to poor leaflet coaptation*	
Type II	***excess motion of the margin of a leaflet*** *segment above the annular plane*	
Type IIIa	***restricted leaflet motion*** *during diastole and systole*	
Type IIIb	***restricted leaflet motion*** *predominantly during systole*	

- Endocarditis
- Dilated Annulus
  - A Fibrillation
  - Restrictive CM

- MVP
- Papillary Rupture
- Trauma

- Rheumatic
- Collagen Vascular
- Radiation
- Drugs
- MAC

- Ischemic Heart DZ
- Dilated CM

Carpentier A. J Thorac Cardiovasc Surg 1983 September;86(3):32

Case Presentation
Functional Mitral Regurgitation

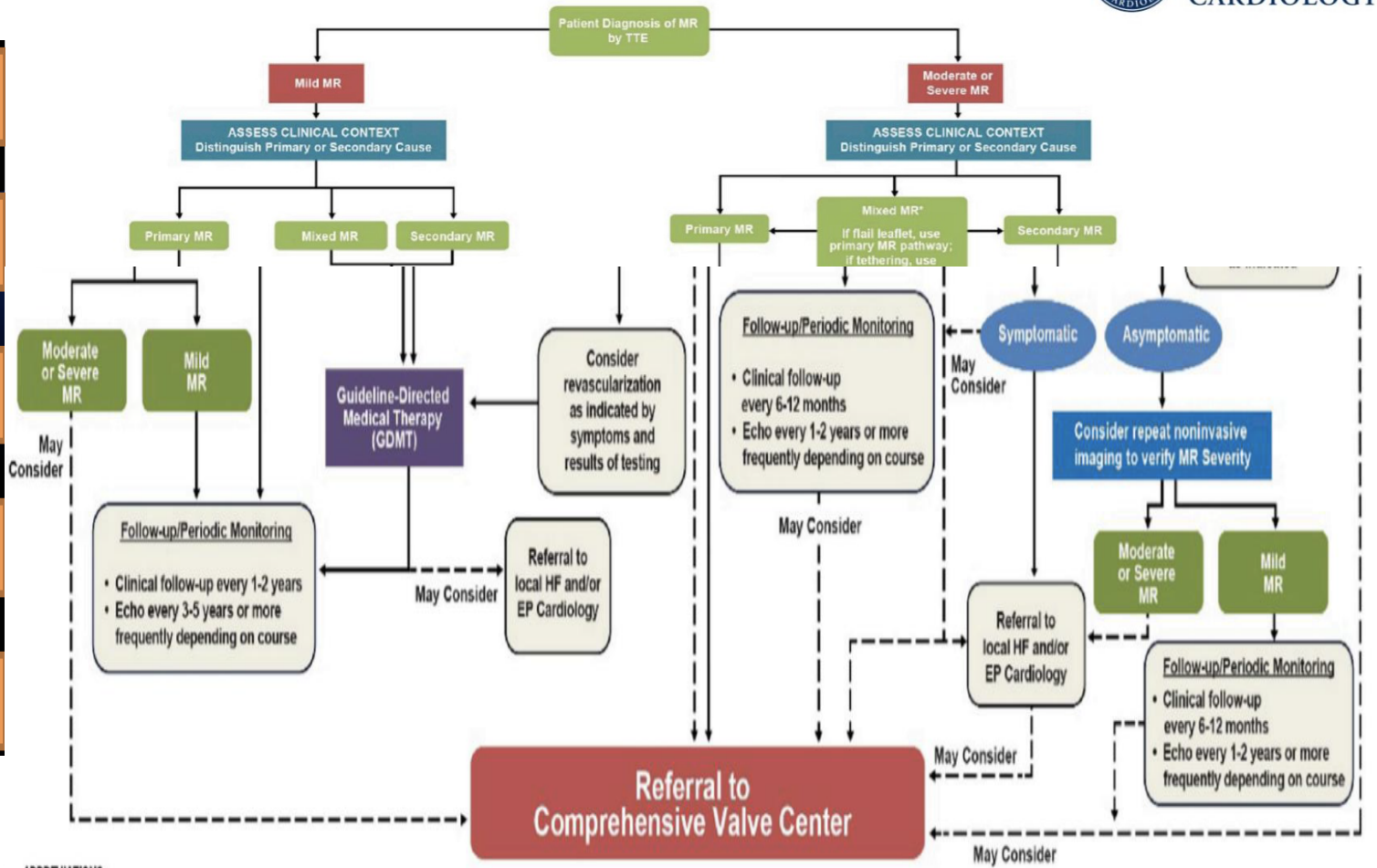
- 68 year old male with a three year history of progressive dyspnea on exertion with two hospitalizations in the last 2 months for poorly controlled congestive heart failure
- 4V CABG (SVG with LIMA) eight years ago with LVEF 40% and patent grafts by cath at OSH 3 months ago.
- On maximal tolerated doses of ACE, Carvedilol and diuretics

- Severity
- Morphology
- Symptoms
- Treatment
- Follow-up

MITRAL REGURGITATION REFERRAL TOOLKIT

AMERICAN COLLEGE of CARDIOLOGY

REFERRAL ALGORITHM



ABBREVIATIONS:
AF = atrial fibrillation; CAD = coronary artery disease; EF = ejection fraction; EP = electrophysiology; GDMT = guideline directed medical therapy; HF = heart failure; HFrEF = heart failure with preserved ejection fraction; ICD = implantable cardioverter-defibrillator; JVD = jugular vein distention; LV = left ventricular; LVESD = left ventricular end-systolic diameter; MI = myocardial infarction; MR = mitral regurgitation; MRA = magnetic resonance angiogram; NYHA = New York Heart Association; PA = pulmonary artery; PASP = pulmonary artery systolic pressure; TEE = transesophageal echocardiogram; TTE = transthoracic echocardiogram

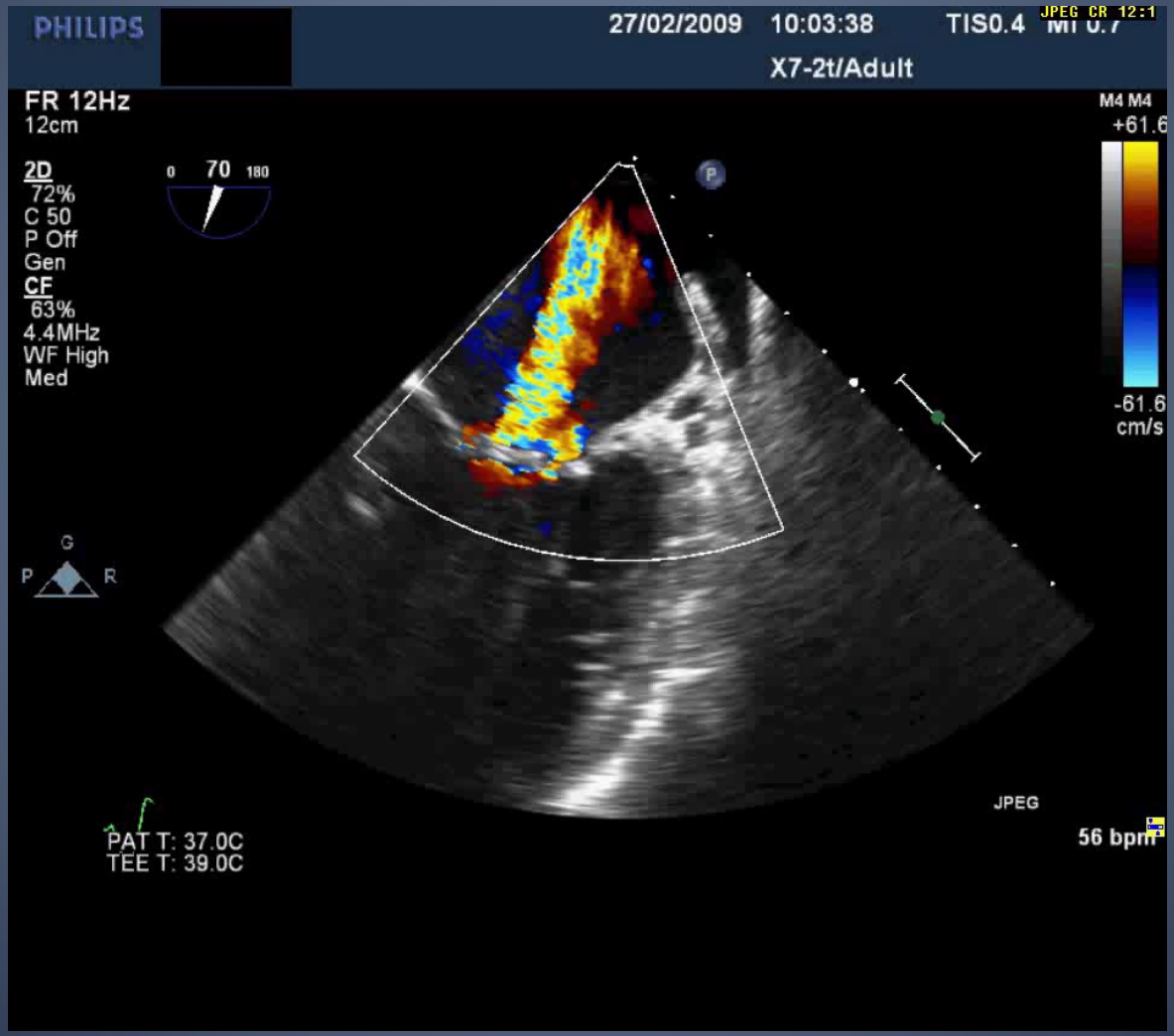
Consideration of local HF and/or EP cardiology is predicated on the potential for advanced therapies including tiered medical treatment, device intervention or arrhythmia management.

** Refer to the 2017 AHA/ACC Focused Update of the 2014 AHA/ACC Guideline for the Management of Patients With Valvular Heart Disease*

LSU Health SHREVEPORT

SRB March 2020

Mitral Regurgitation
Brief Case Presentation

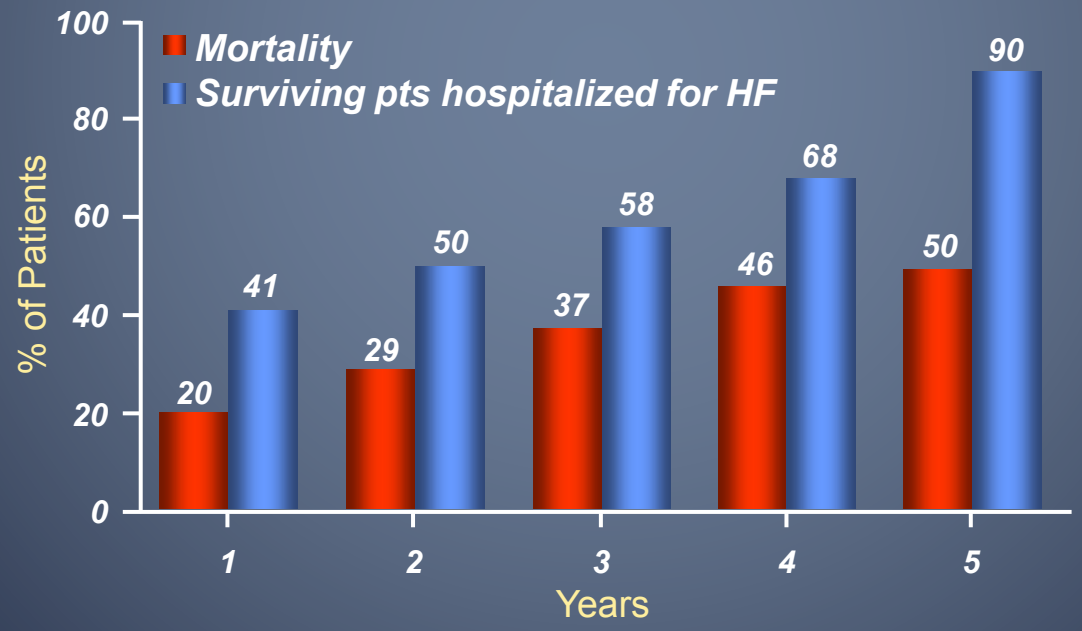


TEE of the Mitral Valve

Perk G et al. *J Am Soc Echocardiogr*. 2009;22:865

Management of Severe MR in patients with HF (CCF)

1,095 pts with 3+/4+ MR and HF between 2000 and 2008*
(74% FMR, 21% DMR)



171 of 474 (36%) un-operated pts with FMR and good echos would have been eligible for MitraClip based on published criteria

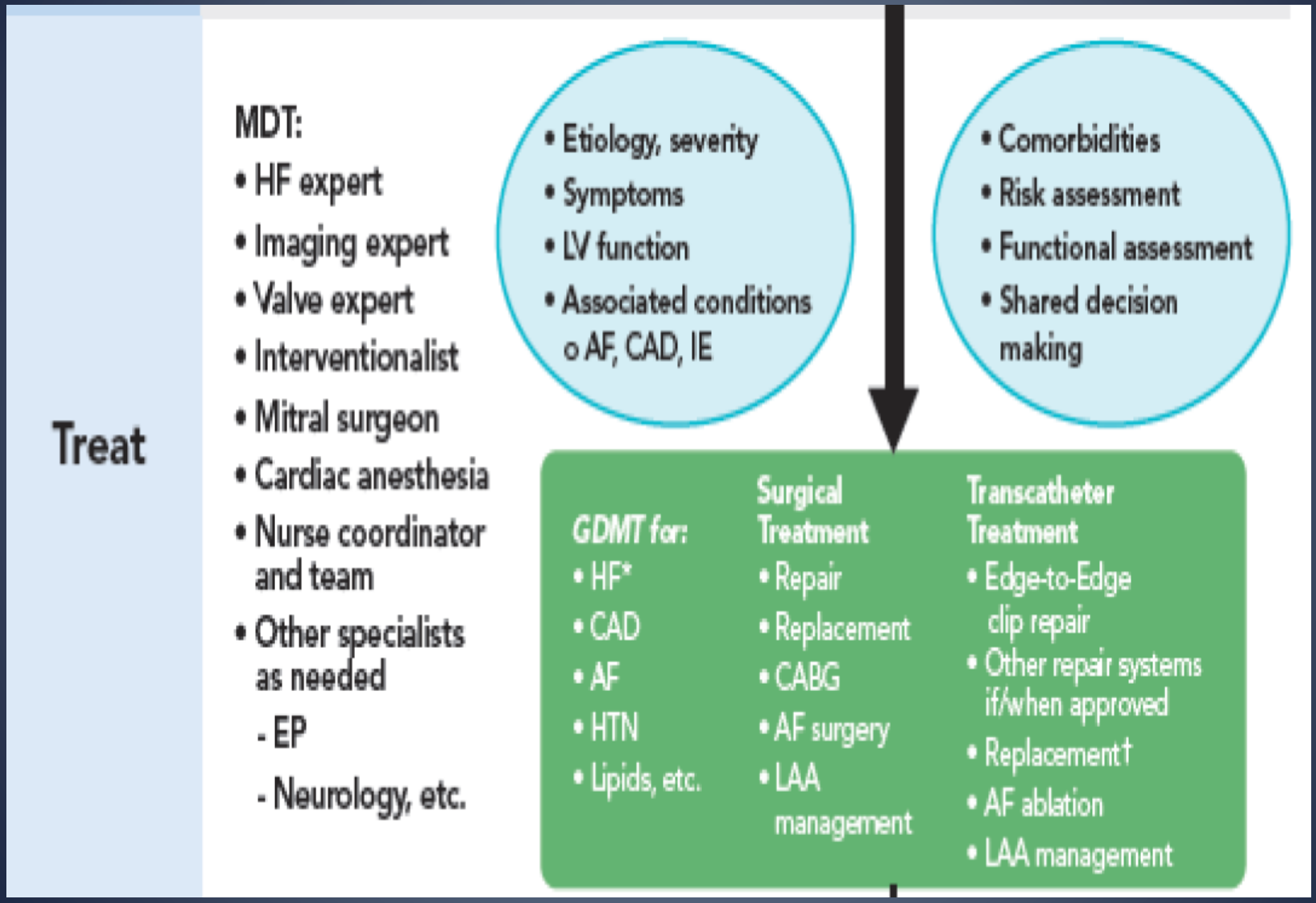
* Excluded MVA ≤2 cm^2, AR ≥2+, aortic peak velocity ≥2.5 m/s, HCM, endocarditis, concomitant AV, Ao or pericardial surgeries, LVAD or OHT.

Goel SS et al. JACC 2014;63,:185–90

SRB March 2020

LSU Health SHREVEPORT

2020 Management of MR



O'gara et al 2020 Focused Update of the 2017 ACC Expert Consensus Decision Pathway on the Management of Mitral Regurgitation DOI: 10.1016/j.jacc.2020.02.005

SRB March 2020

LSU Health SHREVEPORT

Follow Up of Chronic MR

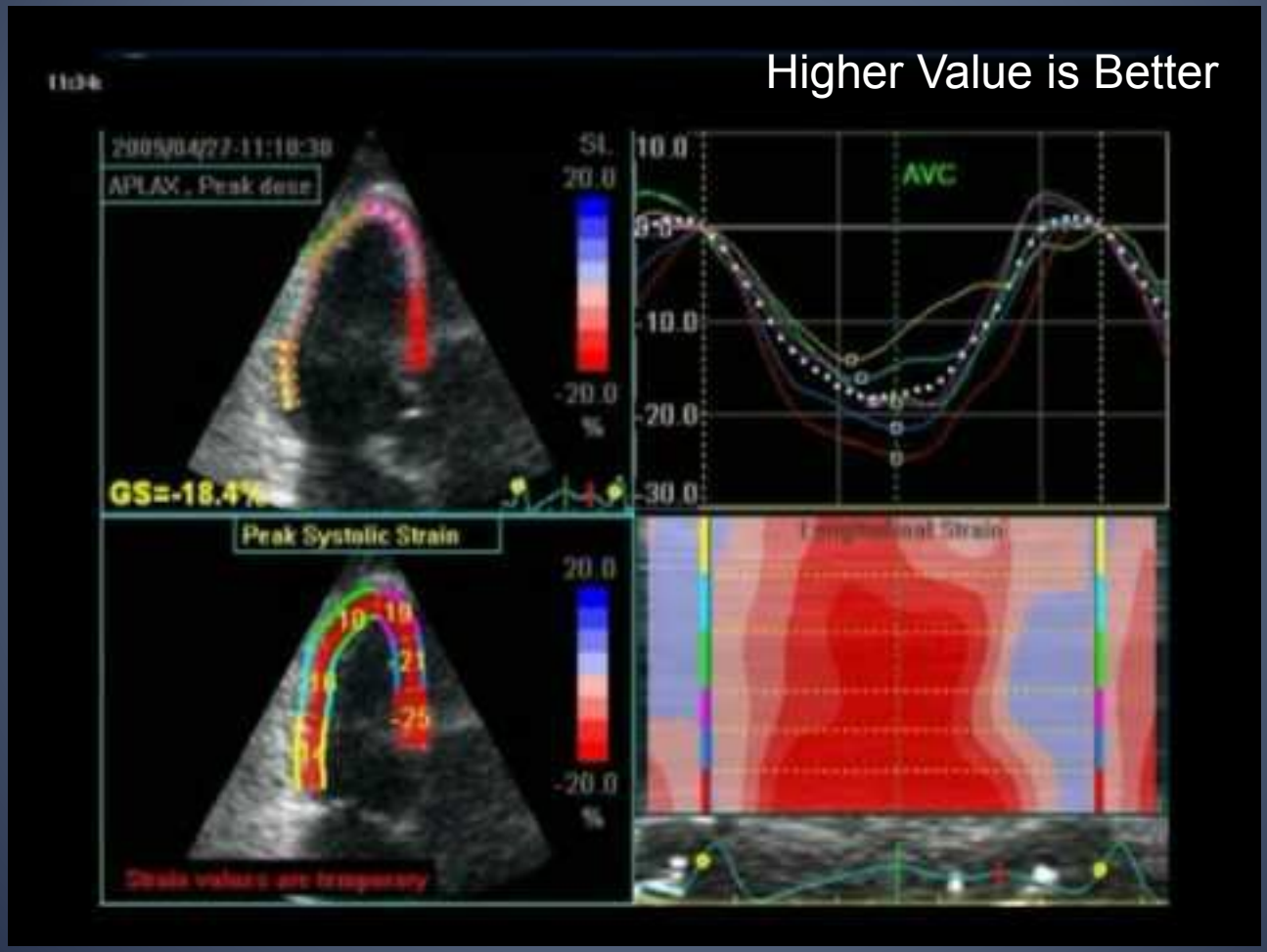
- Clinical Evaluation
  - Functional Status/ETT
- Laboratory Evaluation
  - BNP level
- Echo Follow-up
  - LV Function
  - Global Longitudinal Strain

Frequency of Echocardiograms in Asymptomatic Patients With VHD and Normal Left Ventricular Function

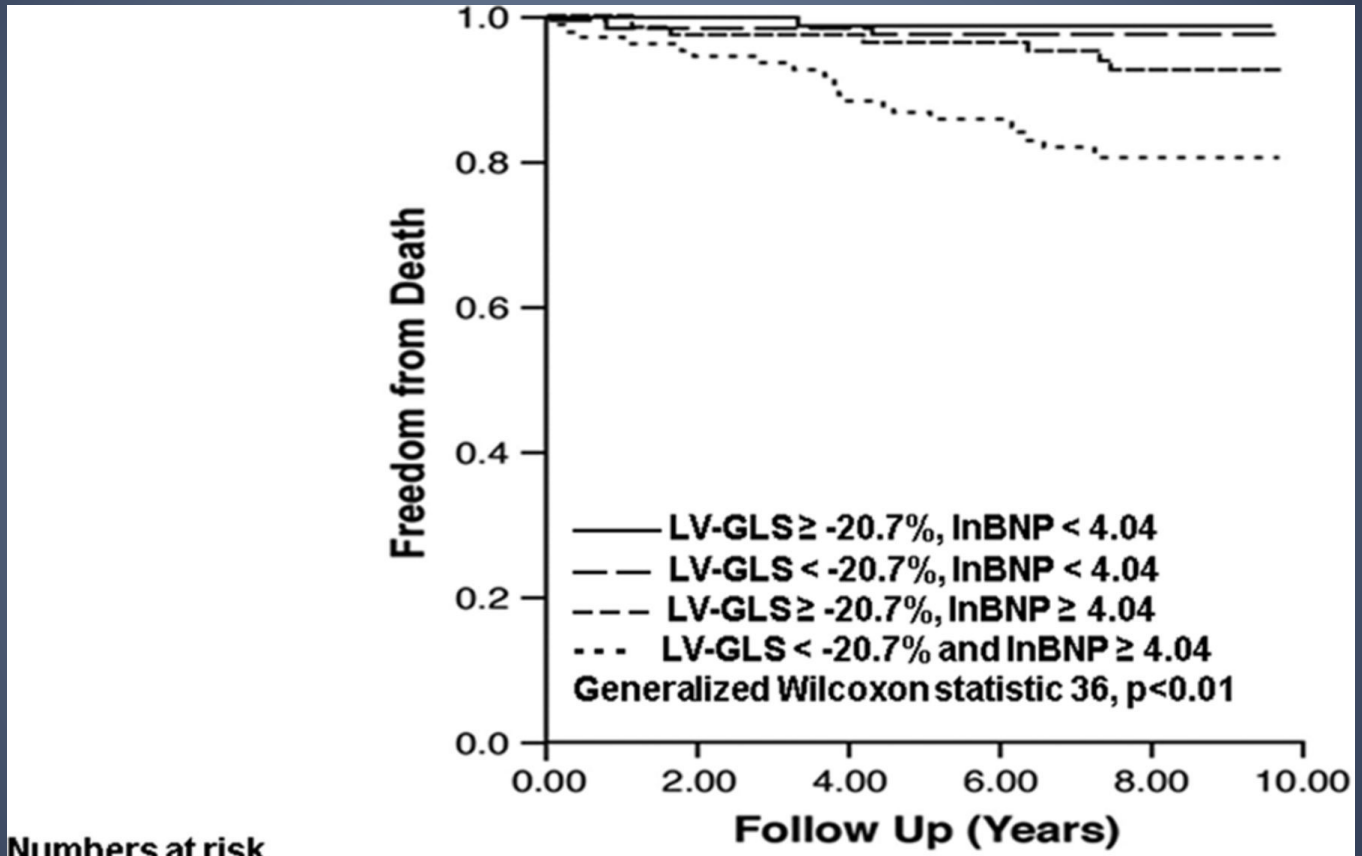
Stage	Valve Lesion			
Stage	Aortic Stenosis	Aortic Regurgitation	Mitral Stenosis	**Mitral Regurgitation**
Progressive (stage B)	Every 3–5 y (mild severity V_{max} 2.0–2.9 m/s) Every 1–2 y (moderate severity V_{max} 3.0–3.9 m/s)	Every 3-5 y (mild severity) Every 1-2 y (moderate severity)	Every 3–5 y (MVA >1.5 cm^2)	Every 3–5 y (mild severity) Every 1–2 y (moderate severity)
Severe (stage C)	Every 1 y (V_{max} ≥4 m/s)	Every 1 y Dilating LV–more frequent	Every 1–2 y (MVA 1.0–1.5 cm^2) Every 1 y (MVA <1 cm^2)	Every 6 months to 1 y Dilating LV–more frequent

Global Longitudinal Strain

Evaluation of Regional Myocardial Function



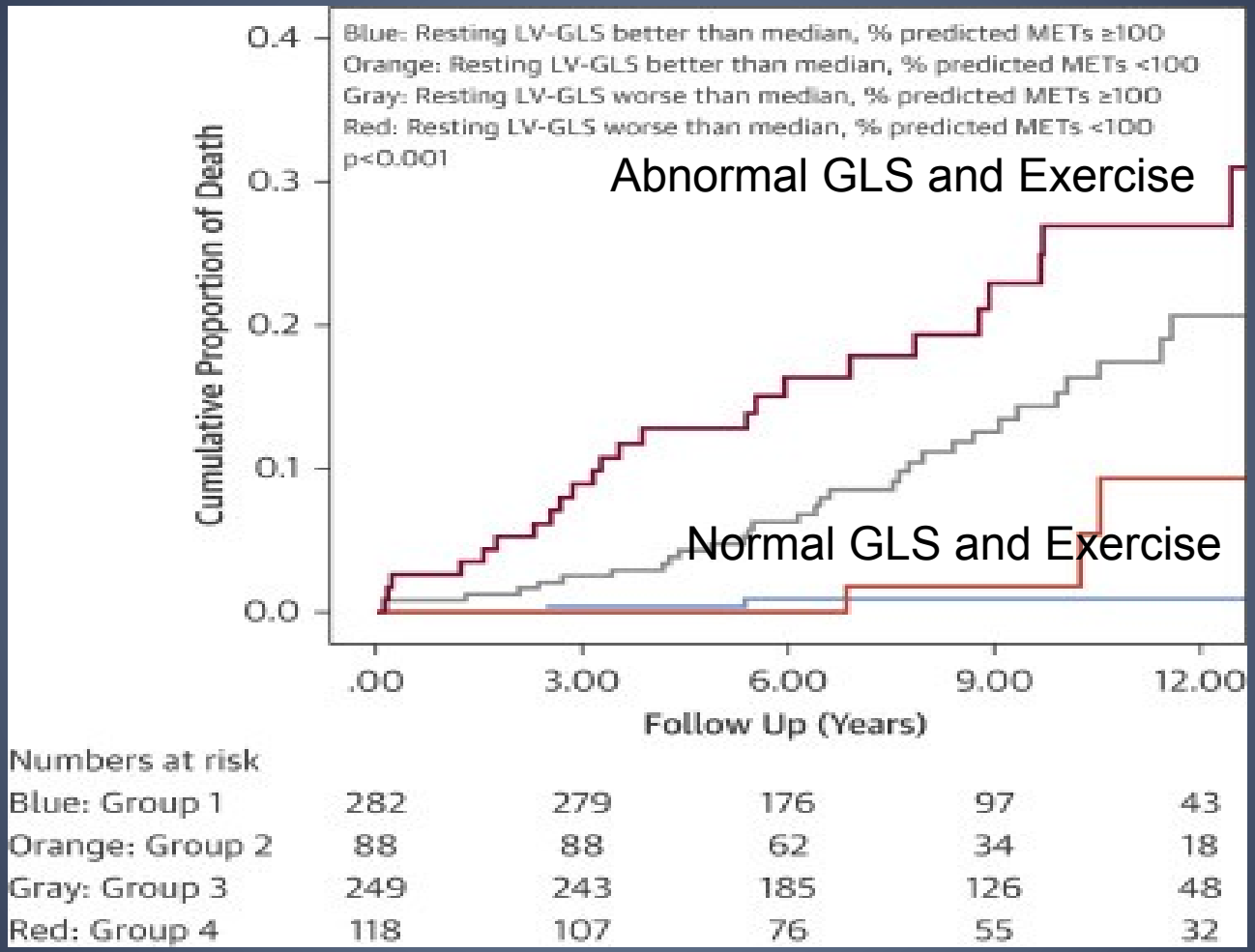
Kaplan–Meier survival curves BNP Combined with GLS in MR



Numbers at risk						
LV-GLS ≥ -20.7%, lnBNP < 4.04	128	128	127	111	72	0
LV-GLS < -20.7%, lnBNP < 4.04	106	105	105	95	56	0
LV-GLS ≥ -20.7%, lnBNP ≥ 4.04	98	96	96	86	58	0
LV-GLS < -20.7%, lnBNP ≥ 4.04	116	110	103	93	54	0

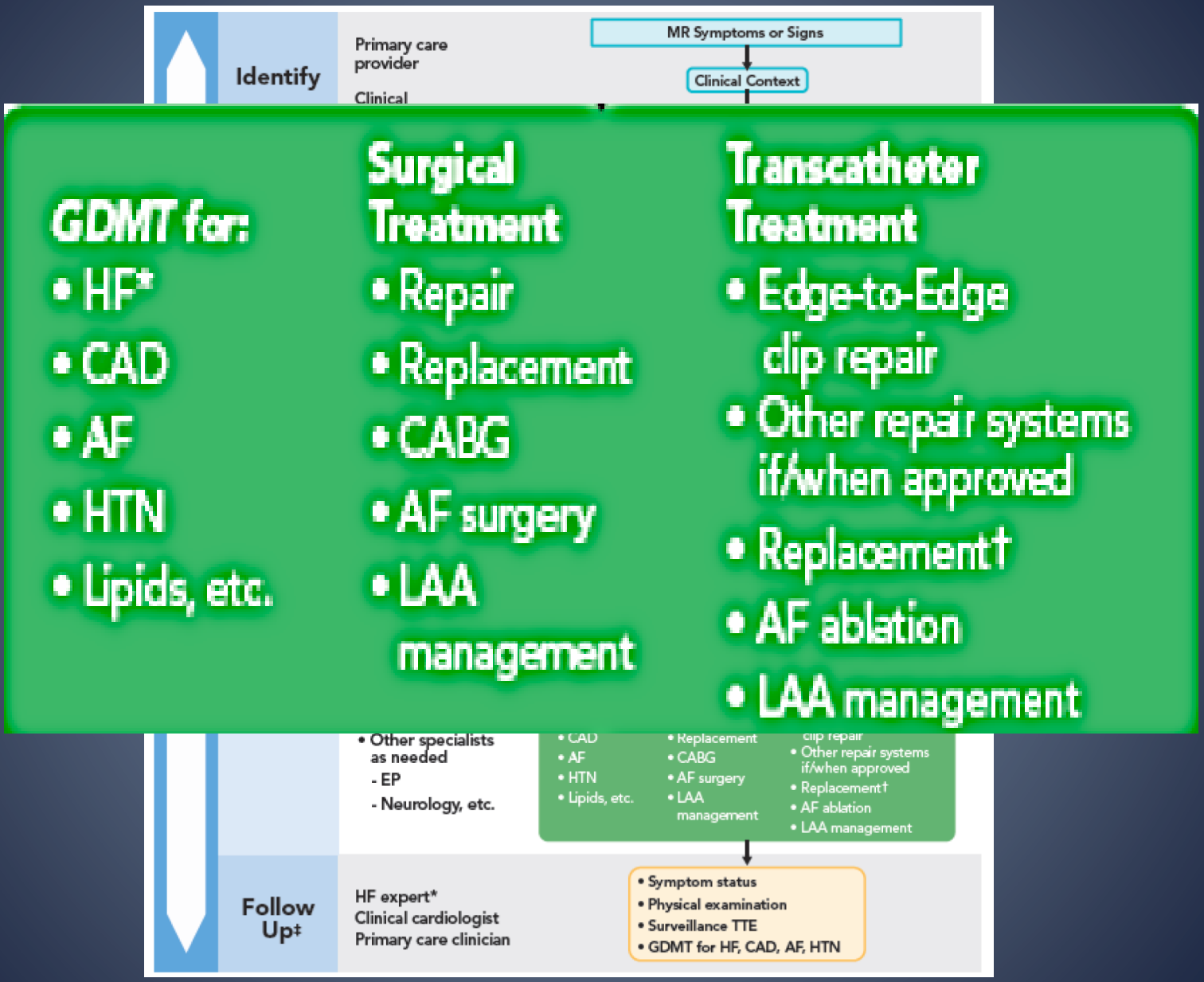
Alaa Alashi et al. Circ Cardiovasc Imaging. 2016;9:e004451

Exercise and Global Strain



Mentias et al J AM Coll Cardiol 2016:69:1974-86

2020 Management of MR

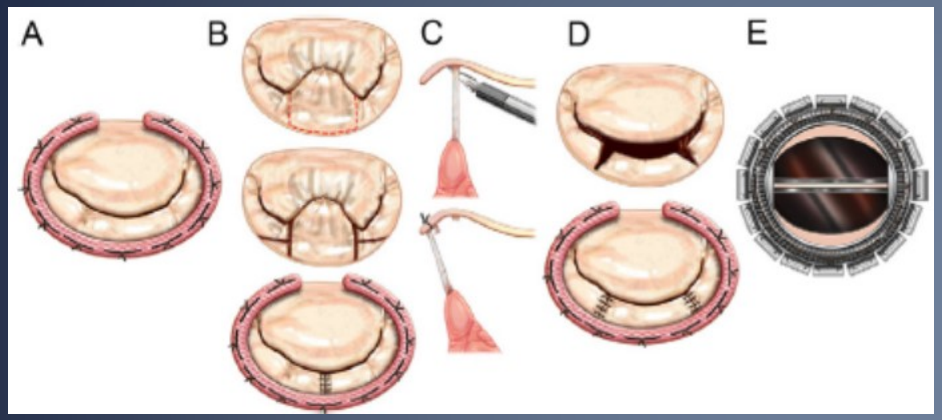


O'gara et al 2020 Focused Update of the 2017 ACC Expert Consensus Decision Pathway on the Management of Mitral Regurgitation DOI: 10.1016/j.jacc.2020.02.005

SRB March 2020

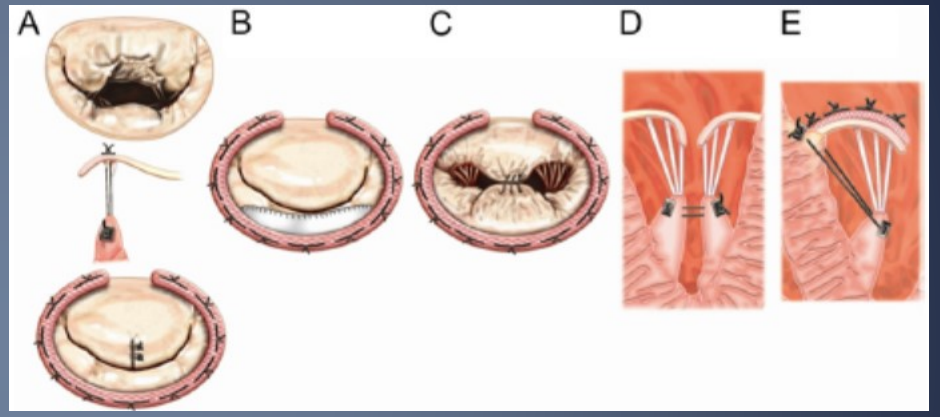
Surgical Techniques and Outcomes for DMR

Established techniques



(A) Ring annuloplasty
(B) Quadrangular resection and sliding leaflet plasty
(C) Chordal transfer
(D) Cleft closure
(E) Mitral replacement

Newer techniques



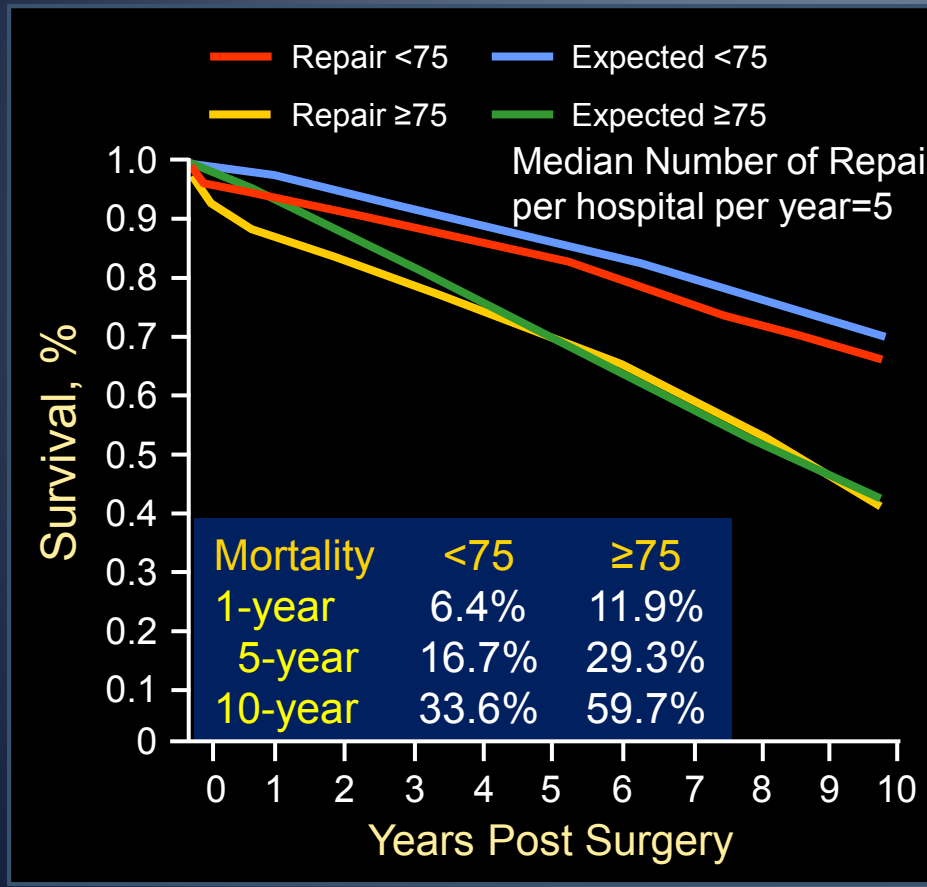
(A) Chordal replacement (PTFE)
(B) Posterior leaflet augmentation
(C) Edge-to-edge Alfieri stitch
(D) Papillary muscle approximation
(E) Posterior wall reduction

Glower DD. JACC 2012;60:1315–22

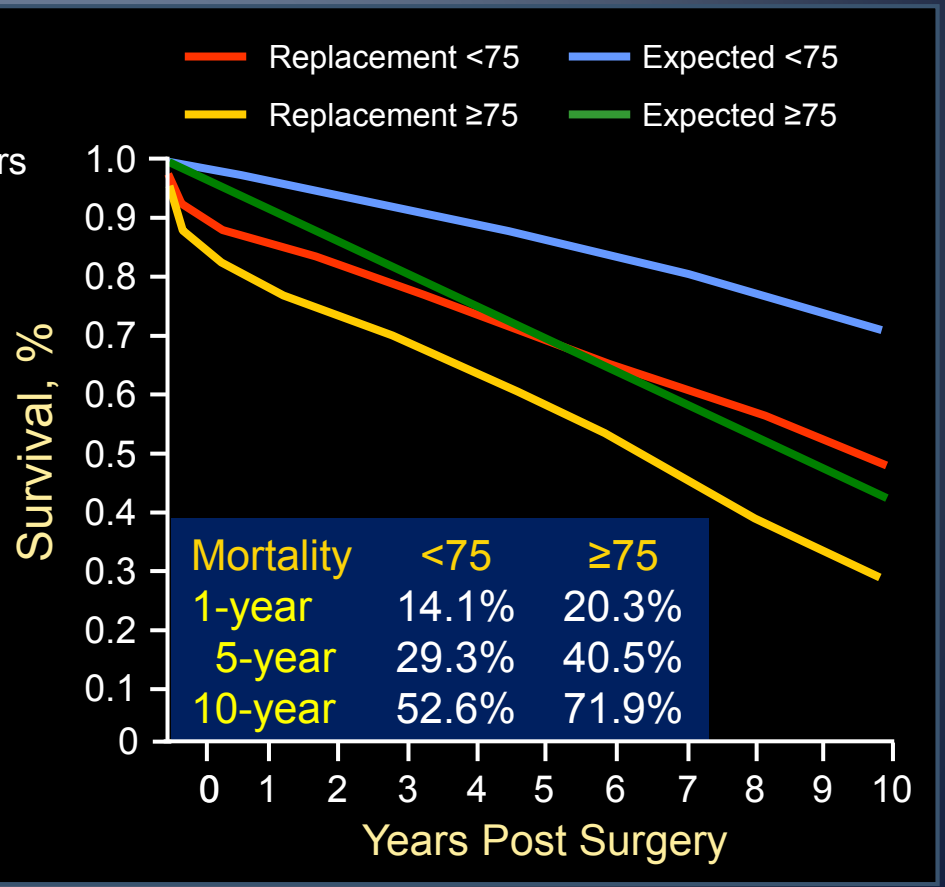
Long-term Outcomes after Isolated MV Repair vs. Replacement

Median age 75 yrs; 36.7% MV repair, 63.3% MV replacement

MV repair by age



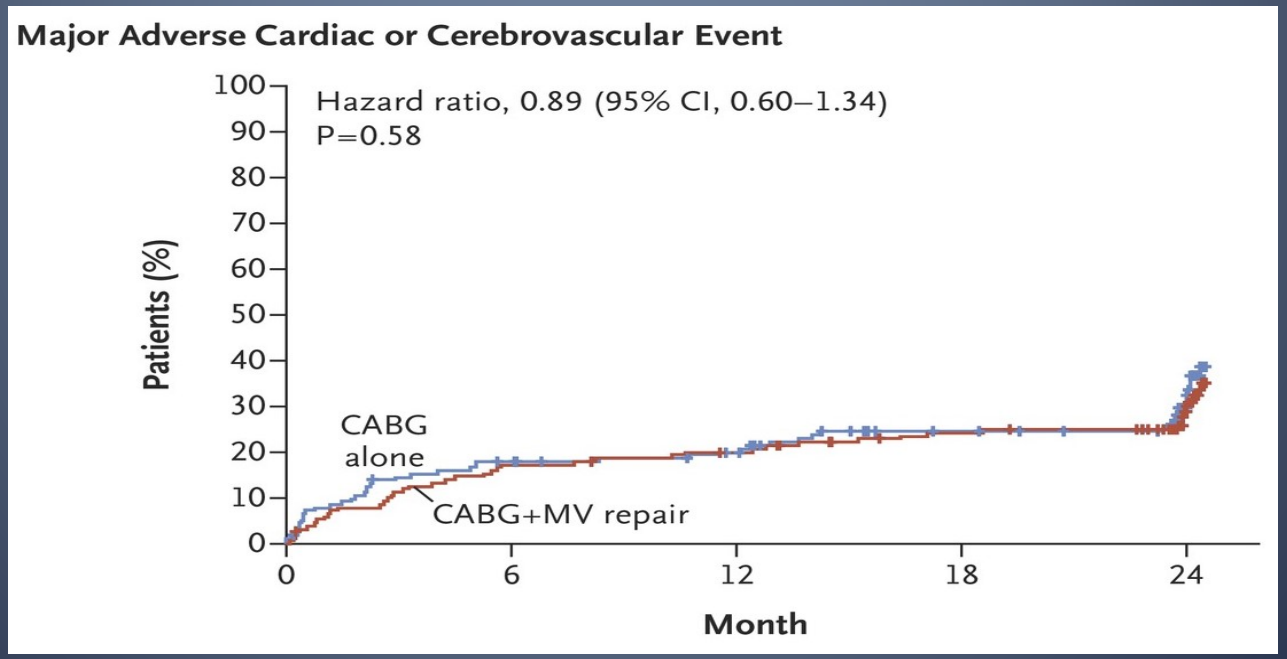
MV replacement by age



Vassileva CM et al. Circ 2013;127:1870-6

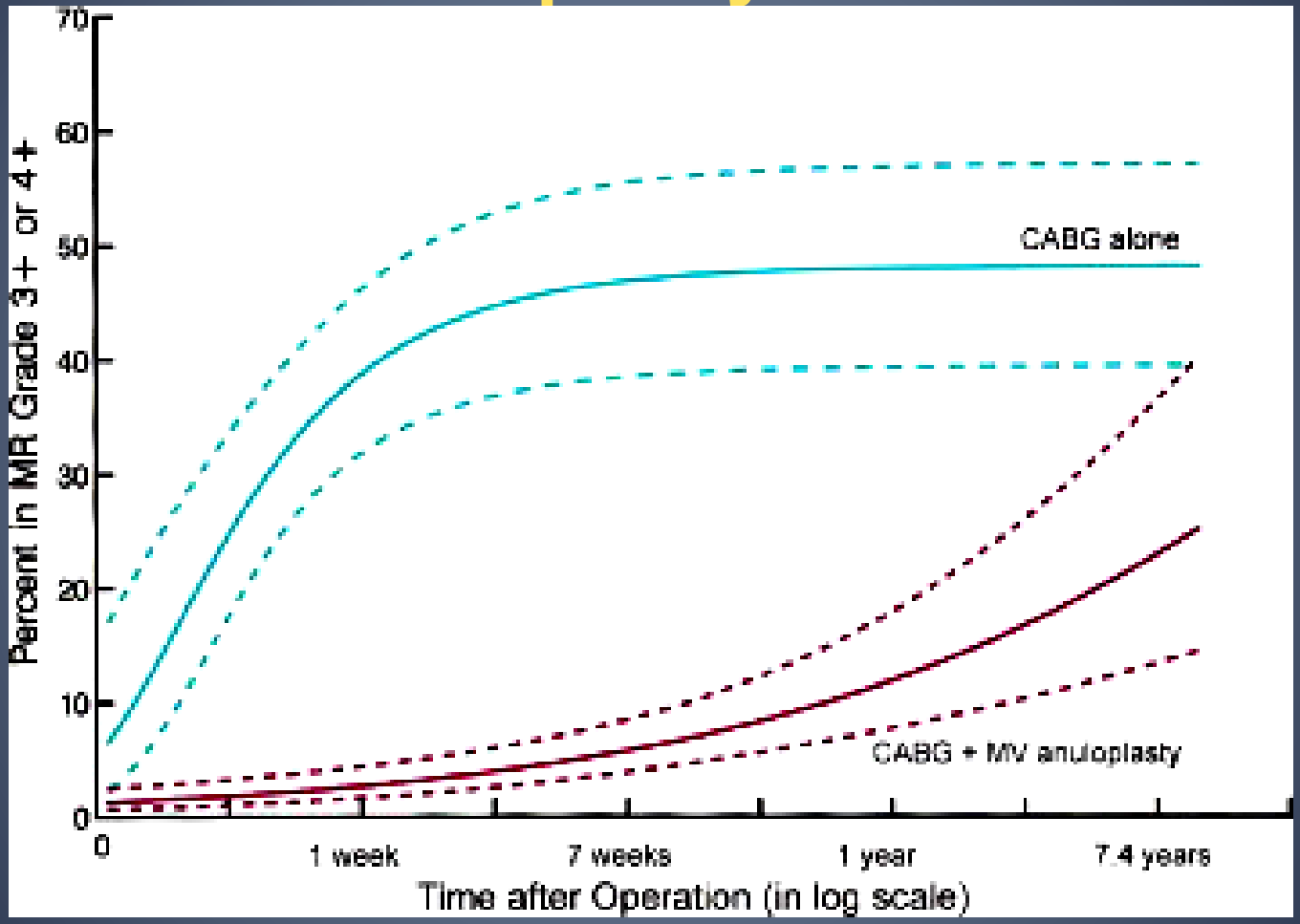
Usefulness of Valve Surgery during CABG in Secondary MR

- **301 pts with multivessel CAD and ischaemic MR (ERO 0.2 to 0.4 cm², vena contracta 3 to 7 mm)**
- **Randomized to CABG + valve repair vs. CABG**
- ***Primary End point :LVESVI at 1 yr:* 49.6 ± 31.5 ml vs.46.1 ± 22.4 ml/m² (NS)**



(Michler . N Engl J Med 2016;374:1932-41)

Recurrence of Severe MR After CABG +/-Annuloplasty in Ischemic MR



- Recurrent severe MR lower with annuloplasty, but still 20% at 5 years

Mihaljevic et al, JACC 2007;49:2191

Current Mitral Regurgitation related Devices

Leaflet/Chordal Solutions

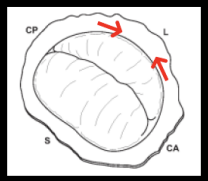
- *MitraClip, PASCAL*
- *Neochord, Harpoon*
- *Cardiosolutions, Middle Peak Medical*

Leaflet Repair

Direct Annular Shape Change

- *Millipede IRIS*
- *Edwards/Valtech Cardioband*
- *ValCare Amend*

Direct Annular Reshaping



Indirect Annuloplasty

- *Ancora Accucinch*
- *Carillon, MVRx ARTO*
- *Mitral Valve Cerclage*

Indirect/CS Annuloplasty

Mitral Valve Replacement

- *Tendyne*
- *Intrepid*
- *HighLife, Cephea, Caisson*

TMV Replacement

MitraClip anatomical patient selection considerations

Recommended criteria[1]

- Pathology in A2-P2 area
- Coaptation length > 2 mm (depending on leaflet mobility)
- Coaptation depth < 11 mm
- Flail gap < 10 mm
- Flail width < 15 mm
- Mitral valve orifice area > 4cm^2 (depending on leaflet mobility)
- Mobile leaflet length > 1 cm

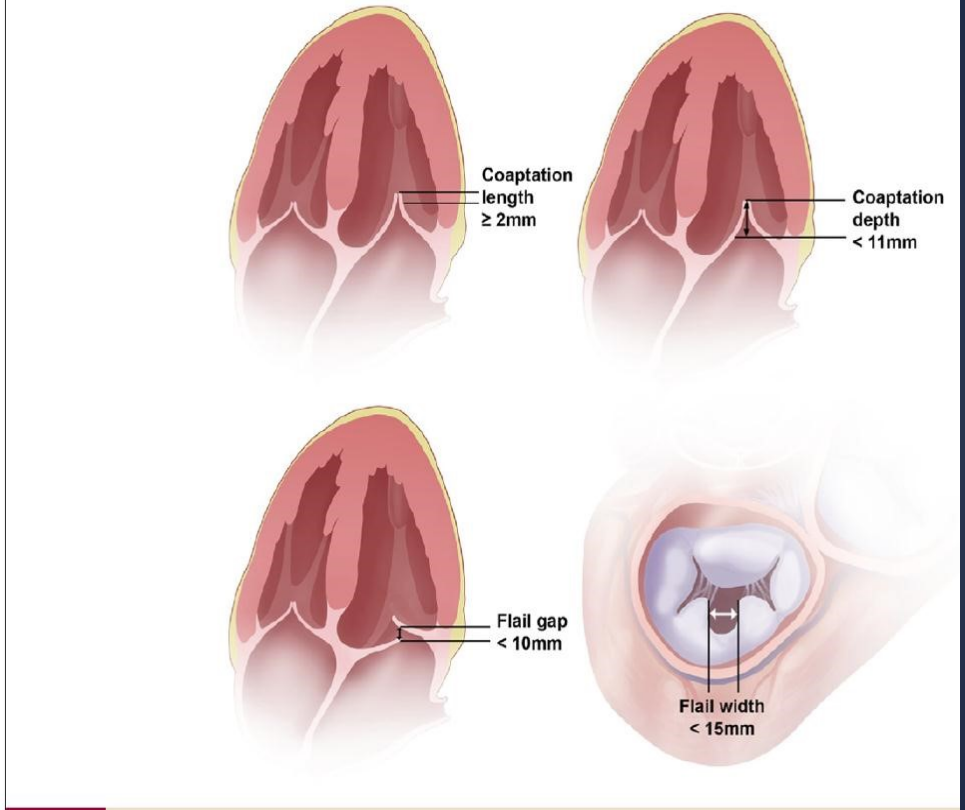
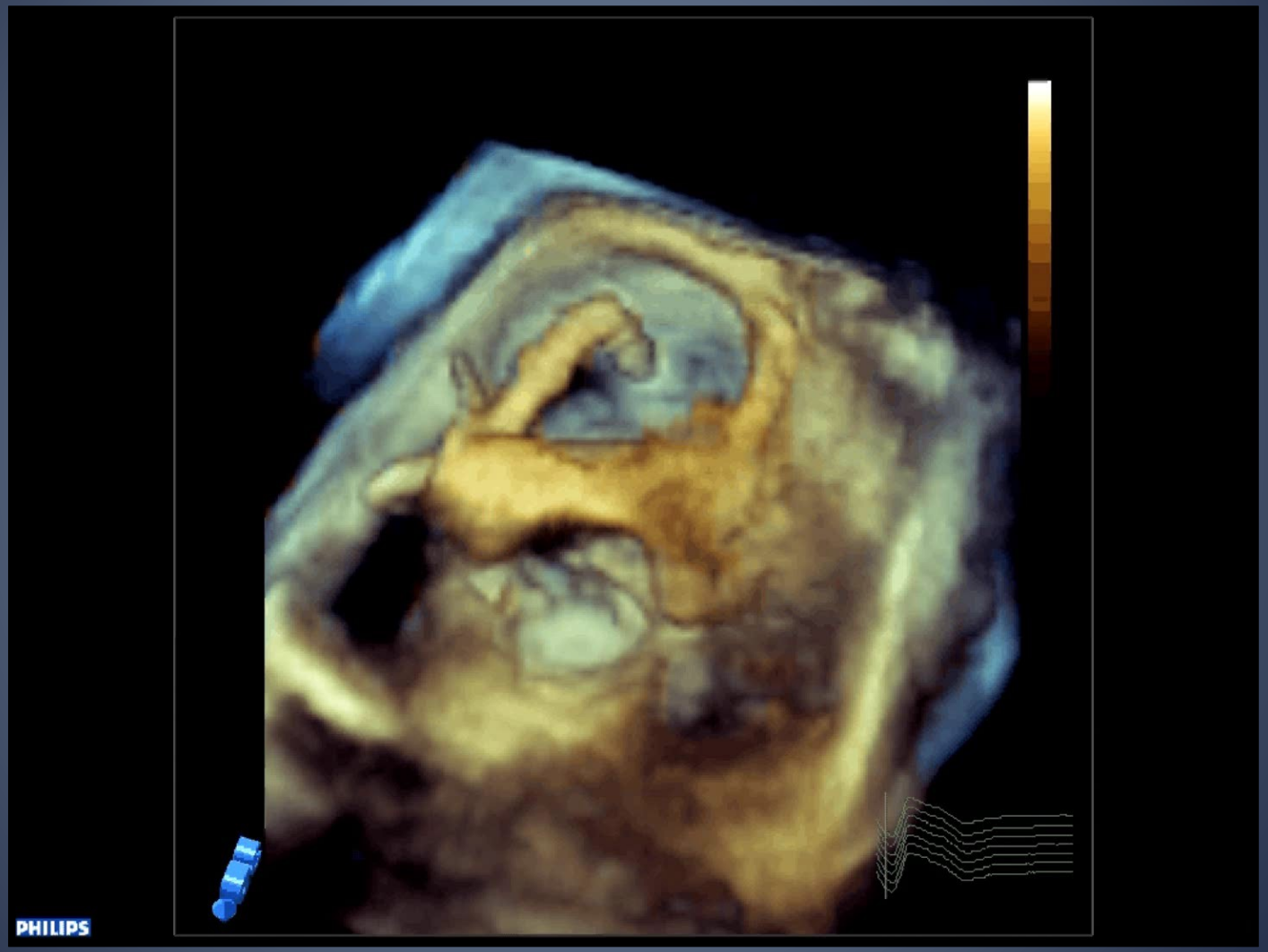


Figure 3 Key Anatomic Eligibility Criteria

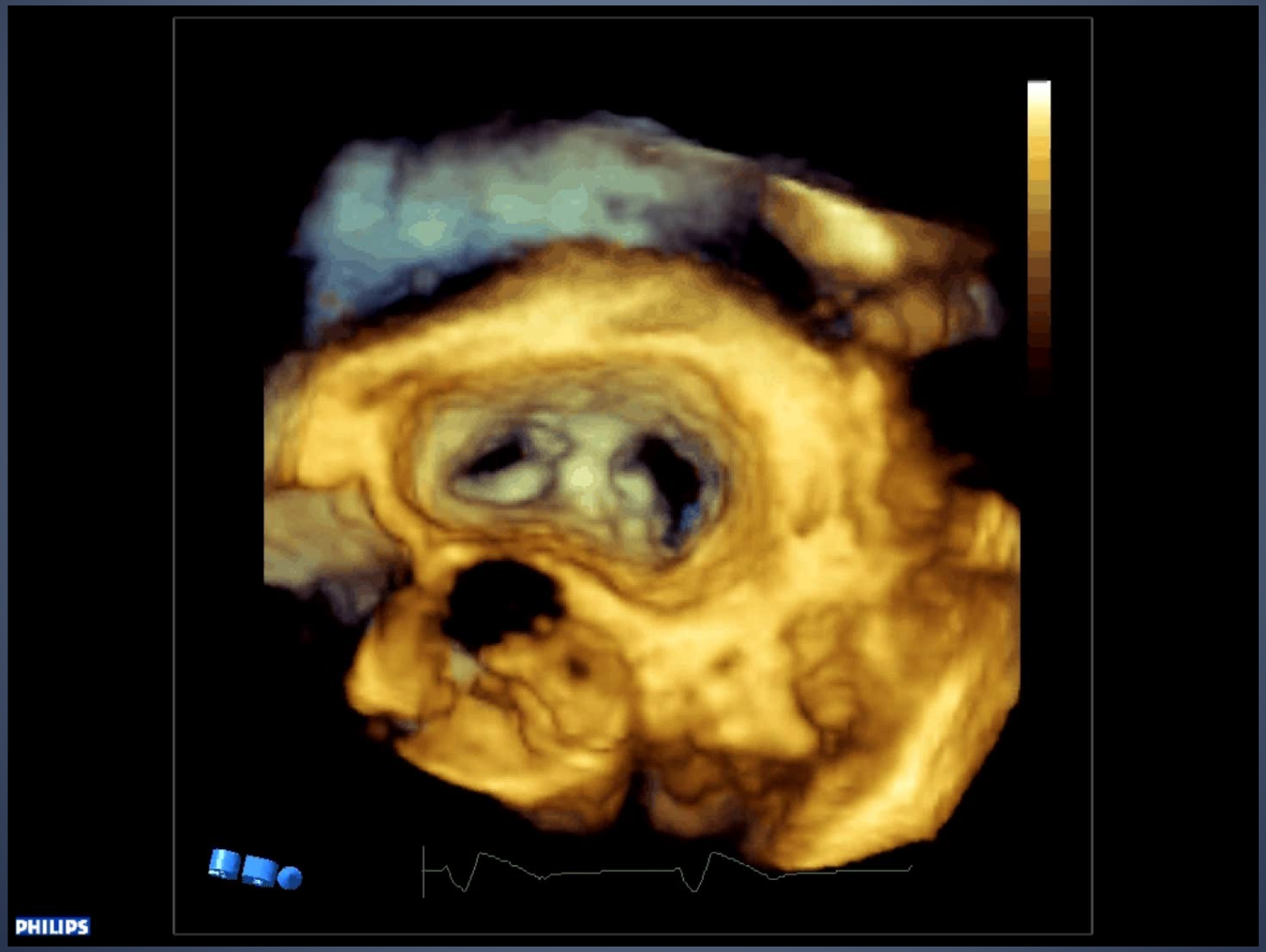
The coaptation length must be at least 2 mm. Coaptation depth must be <11 mm. If a flail leaflet exists, the flail gap must be ≤10 m
width must be ≤15 mm. These anatomic characteristics are necessary for sufficient leaflet tissue for mechanical coaptation when the

Delivery System



Swaans M et al. *Eur J Echocardiogr.* 2009;10:982

Post Clip Placement
Figure of Eight



Swaans M et al. *Eur J Echocardiogr.* 2009;10:982

The COAPT Trial

Cardiovascular Outcomes Assessment of the MitraClip Percutaneous Therapy for Heart Failure Patients with Functional Mitral Regurgitation

A parallel-controlled, open-label, multicenter trial in 614 patients with heart failure and moderate-to-severe (3+) or severe (4+) secondary MR who remained symptomatic despite maximally-tolerated GDMT

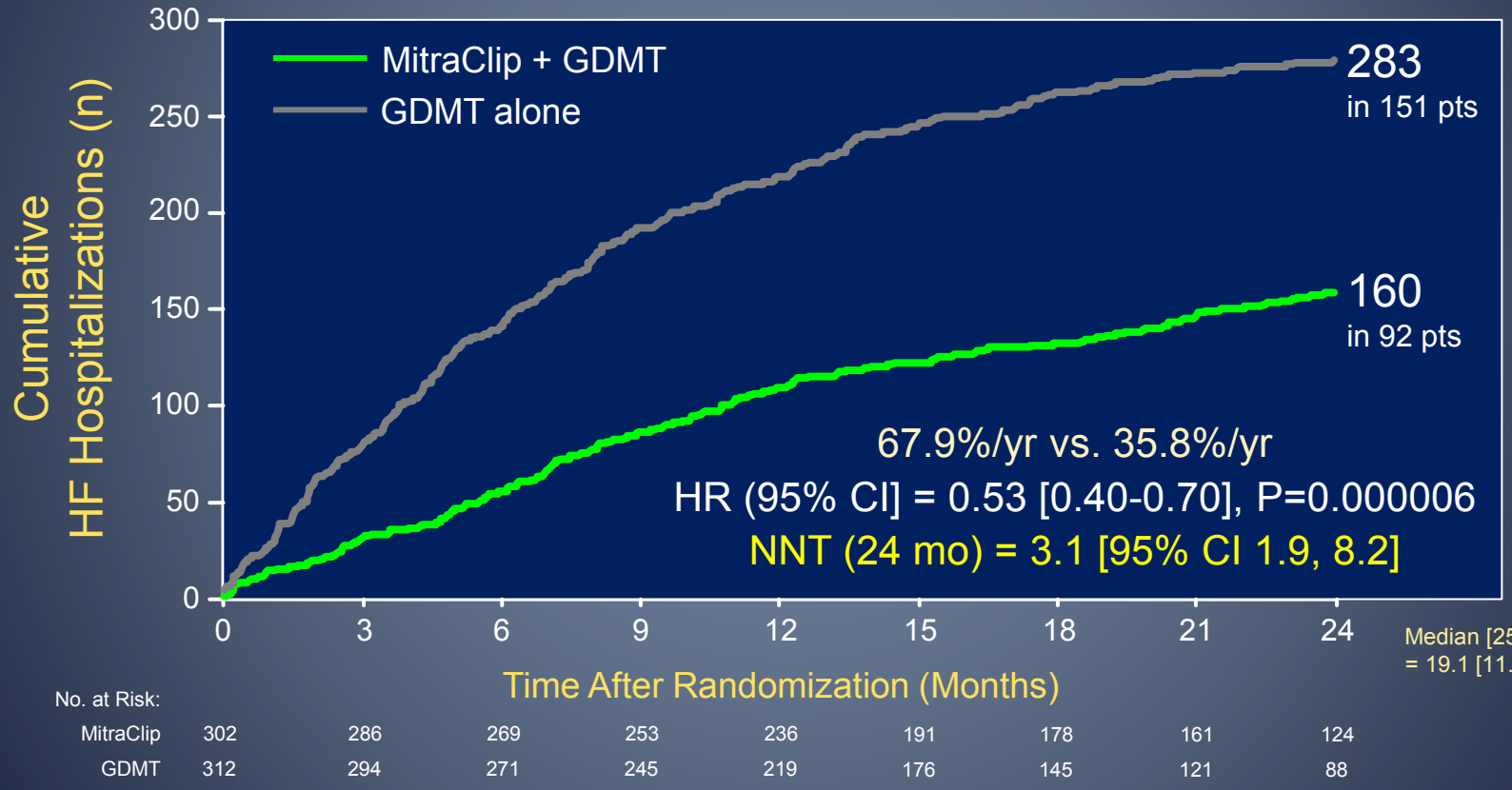
*Stratified by cardiomyopathy etiology (ischemic vs. non-ischemic) and site

Stone GW et al. N Engl J Med. 2018;379:2307-18

COAPT TRIAL

Primary Effectiveness Endpoint

All Hospitalizations for HF within 24 months



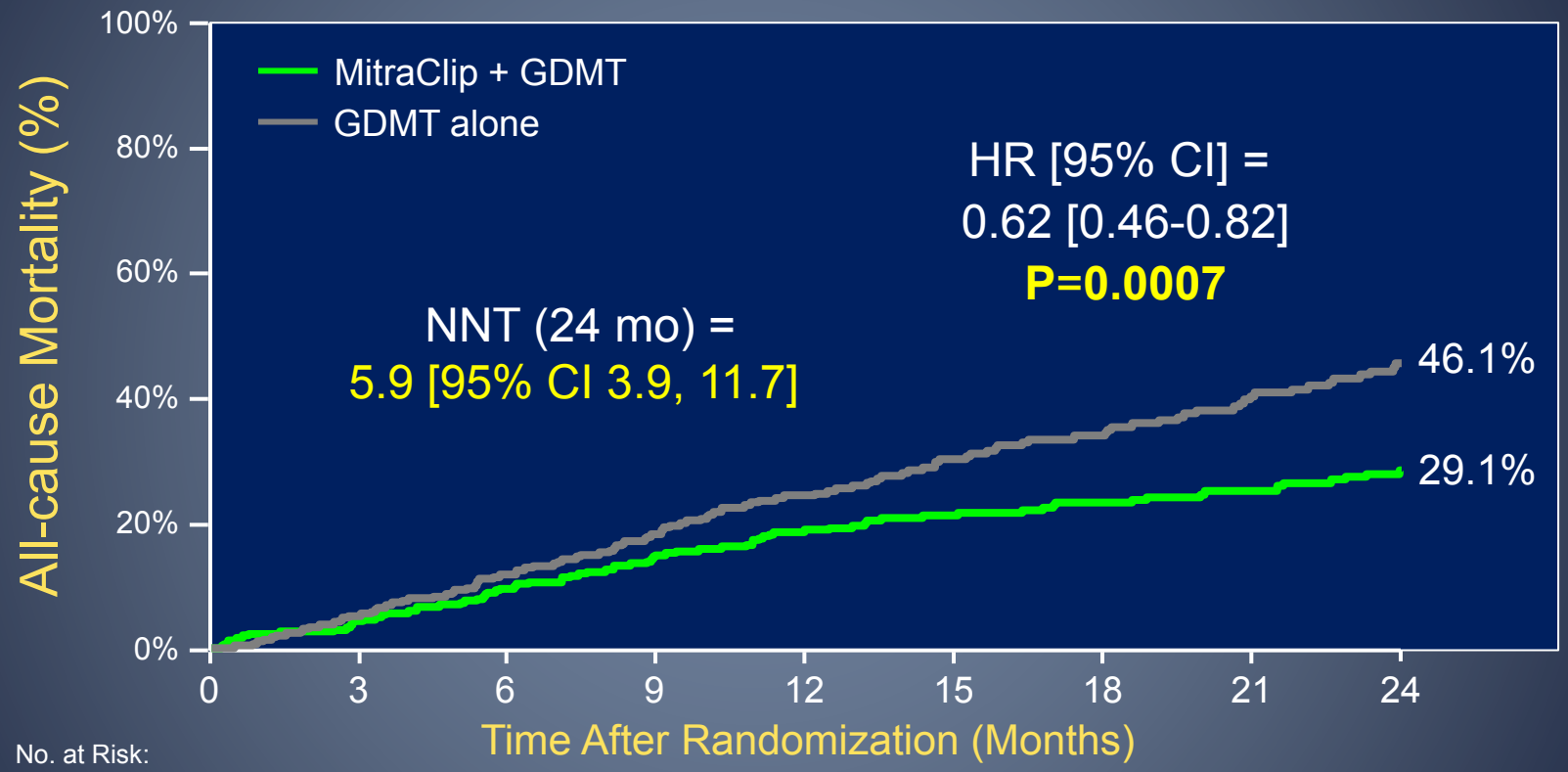
Median [25%, 75%] FU = 19.1 [11.9, 24.0] mos

No. at Risk:									
MitraClip	302	286	269	253	236	191	178	161	124
GDMT	312	294	271	245	219	176	145	121	88

LSU Health SHREVEPORT

SRB March 2020

All-Cause Mortality

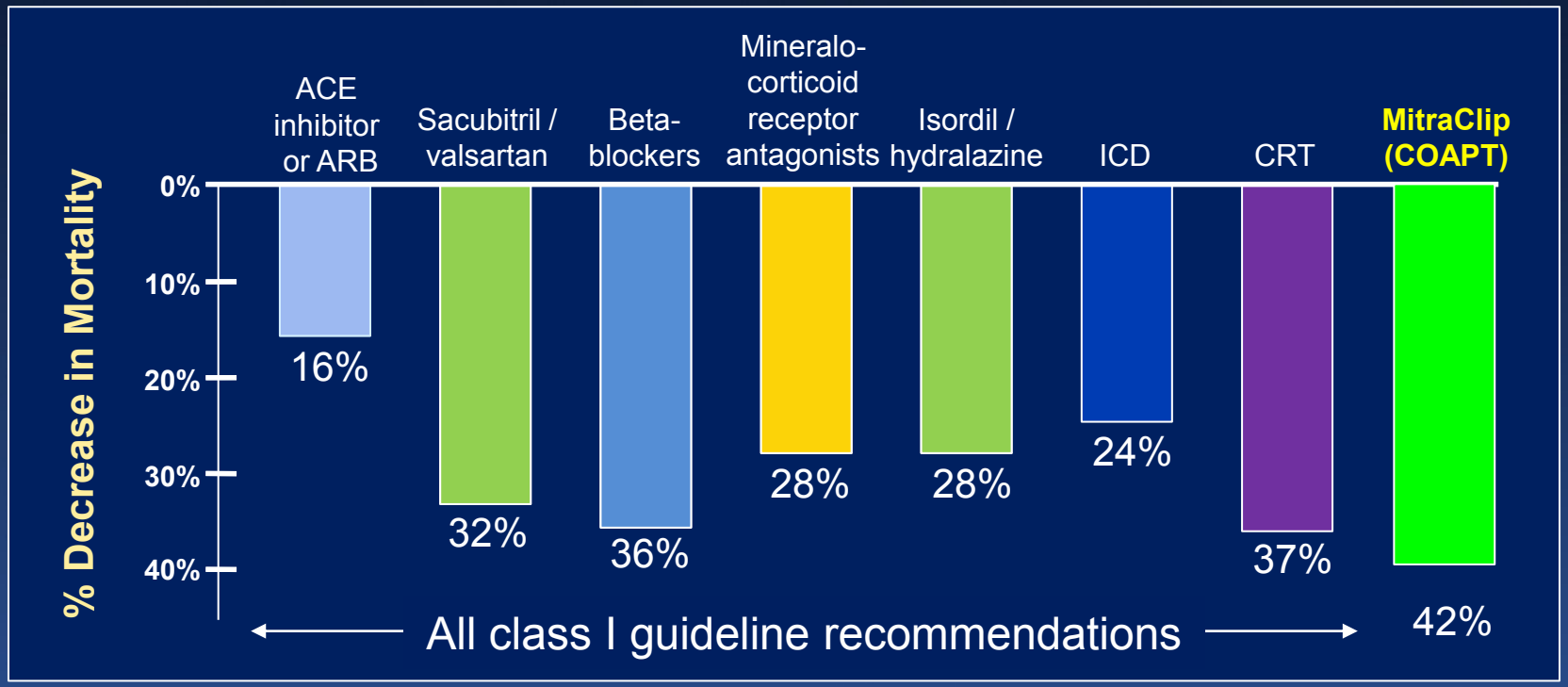


No. at Risk:									
MitraClip + GDMT	302	286	269	253	236	191	178	161	124
GDMT alone	312	294	271	245	219	176	145	121	88

Stone GW et al. N Engl J Med. 2018;379:2307-18

SRB March 2020

The Mortality Benefit of Therapies for HFrEF

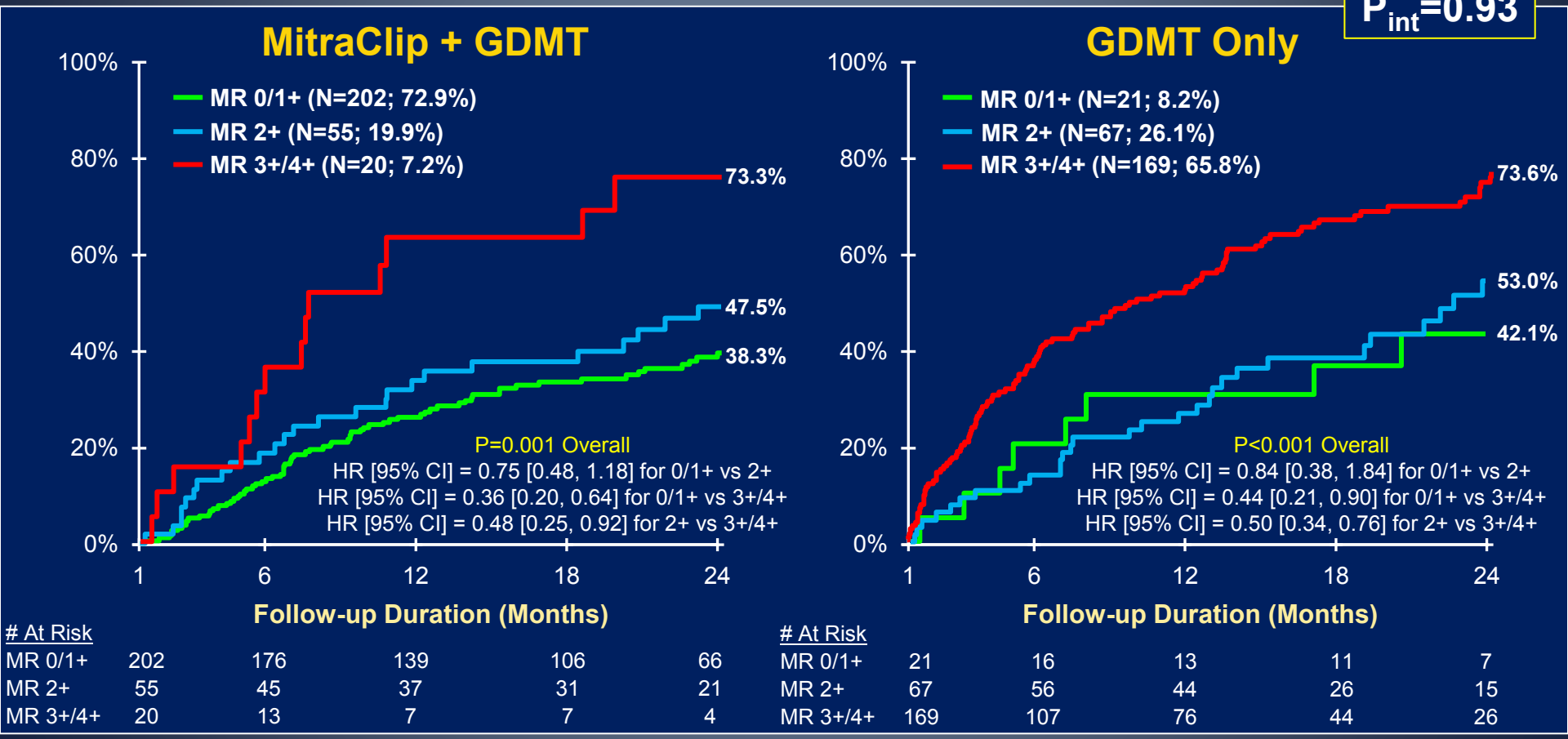


c/o J Lindenfeld

Time to Death or First HF Hosp

Randomization groups stratified by 30-day residual MR

P_{int}=0.93



# At Risk					
MR 0/1+	202	176	139	106	66
MR 2+	55	45	37	31	21
MR 3+/4+	20	13	7	7	4

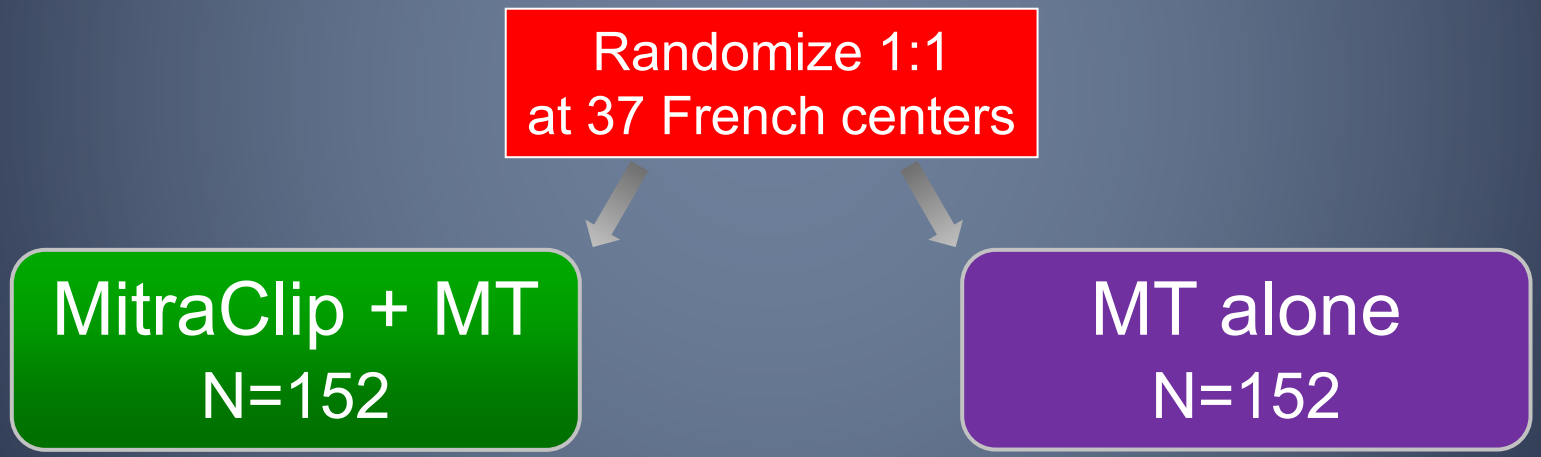
# At Risk					
MR 0/1+	21	16	13	11	7
MR 2+	67	56	44	26	15
MR 3+/4+	169	107	76	44	26

The MITRA-FR Trial

304 pts with SMR due to LV dysfunction with LVEF 15-40%, NYHA II-IVa, hospitalization for HF within the previous 12 mos, not eligible for mitral surgery

MR defined by EU "severe" criteria as EROA *>20 mm²* or RVol *>30 mL/beat*

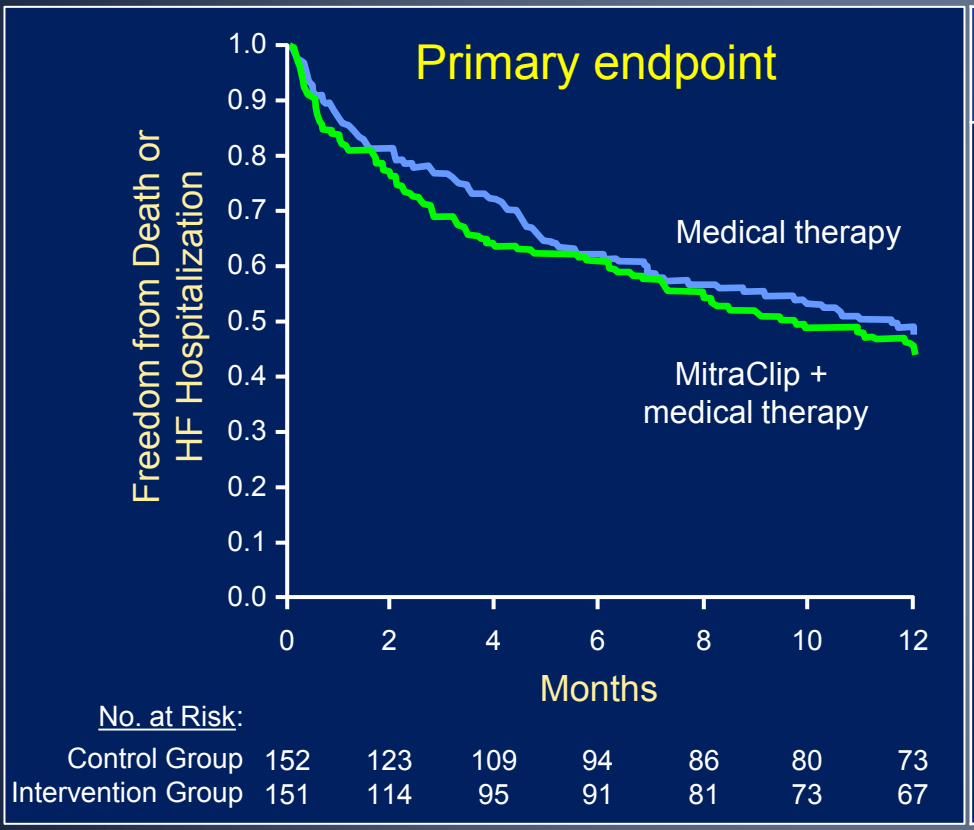
Both groups with "real-world" HF meds (not maximally-tolerated GDMT)



Primary endpoint: Freedom from death or HF hospitalizations through 12 months

Obadia JF et al. N Engl J Med. 2018;379:2297-306

MITRA-FR: 12-Month Outcomes



	MitraClip + MT	MT alone	OR [95% CI] or HR [95% CI]*	*P* value
1° EP: Death or HF hosp	54.6%	51.3%	1.16 [0.73–1.84]	0.53
Death	24.3%	22.4%	1.11 [0.69–1.77]*	0.65
CV death	21.7%	20.4%	1.09 [0.67–1.78]*	0.74
HF hosp	48.7%	47.4%	1.13 [0.81–1.56]*	0.59
MACE*	56.6%	51.3%	1.22 [0.89–1.66]*	–

Obadia JF et al. N Engl J Med. 2018;379:2297-306

* MACE = Death, MI, CVA, HF hosp

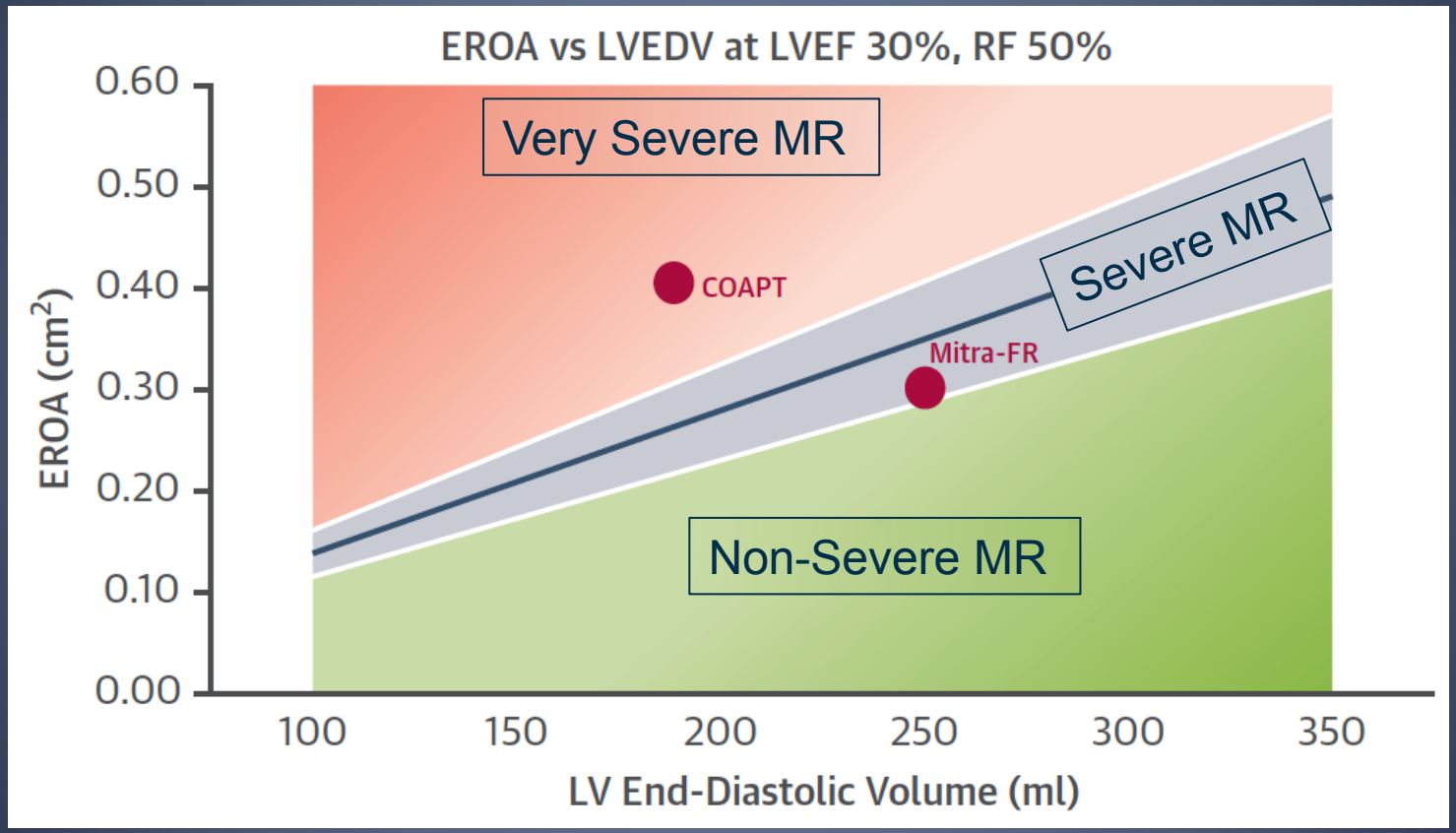
Why are the COAPT Results so Different from MITRA-FR?

Possible Reasons

	MITRA-FR (n=304)	COAPT (n=614)
Severe MR entry criteria	Severe FMR by EU guidelines: EROA >20 mm^2 or RV >30 mL/beat	Severe FMR by US guidelines: EROA >30 mm^2 or RV >45 mL/beat or PSVFR or other
EROA (mean ± SD)	31 ± 10 mm^2	41 ± 15 mm^2
LVEDV (mean ± SD)	135 ± 35 mL/m^2	101 ± 34 mL/m^2

*MITRA-FR defn: device implant failure, transf or vasc compl req surg, ASD, card shock, cardiac embolism/stroke, tamponade, urg card surg

Proportionate vs. Disproportionate MR



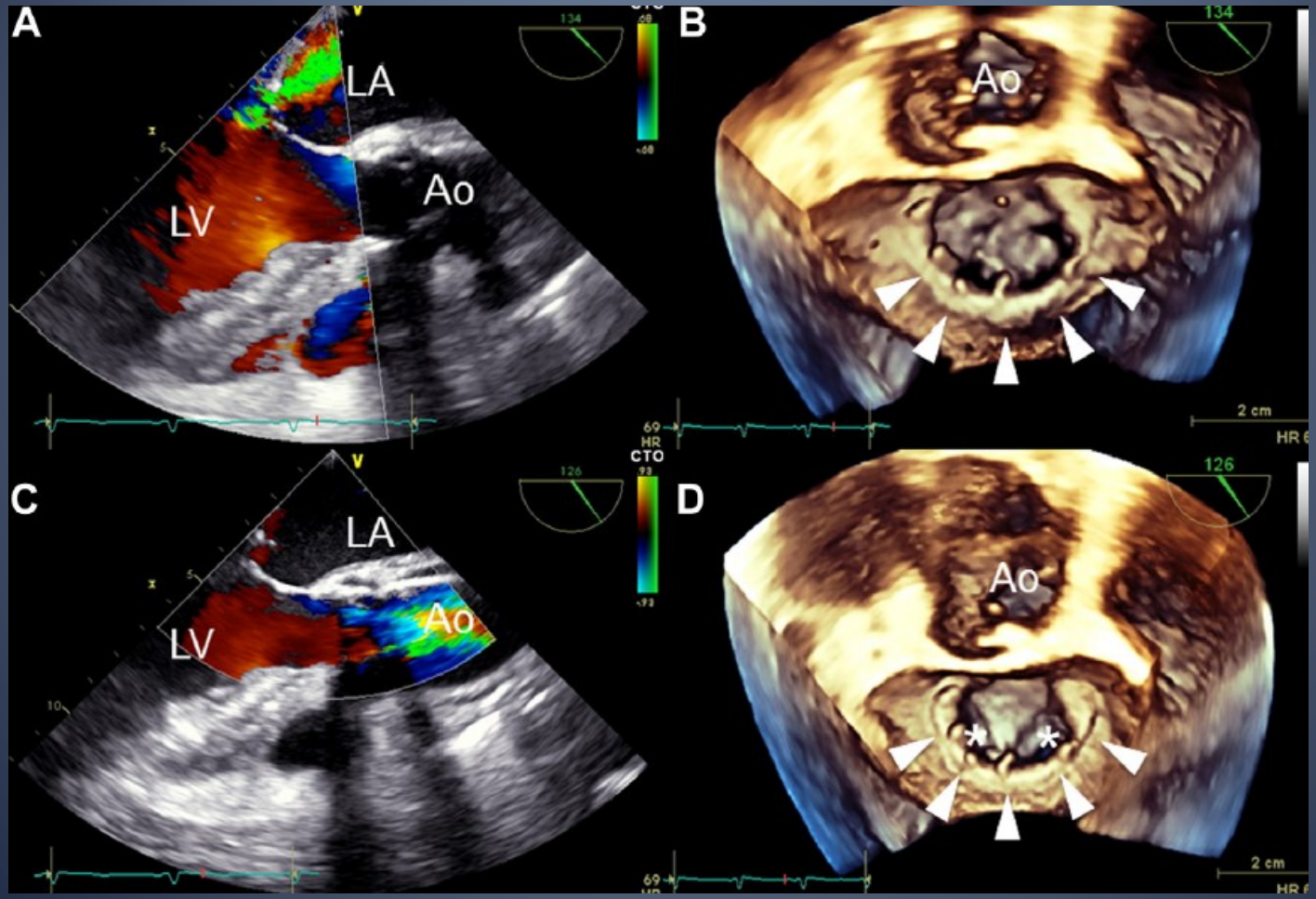
Grayburn PA et al. JACC CV Im 2019;12:353–62

MitraClip for Severe MR Recurrence after Surgical Rings

6/6 successful cases (≤2+ MR) without procedural complications

days - 12 years post surgery (1 clip in all cases due to smaller MVOA)

Pre 4+



Post trace

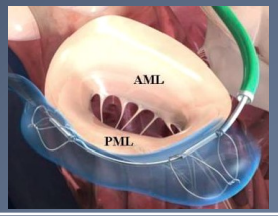
Cosgrove-Edwards ring

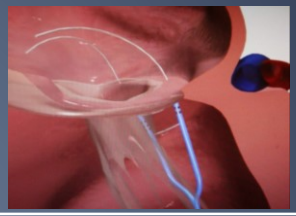
Double orifice

Grasso C et al. JACC 2014;63:834–9

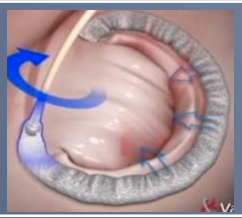
A Sampling of Mitral Annuloplasty Devices

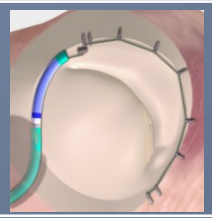
* CE mark





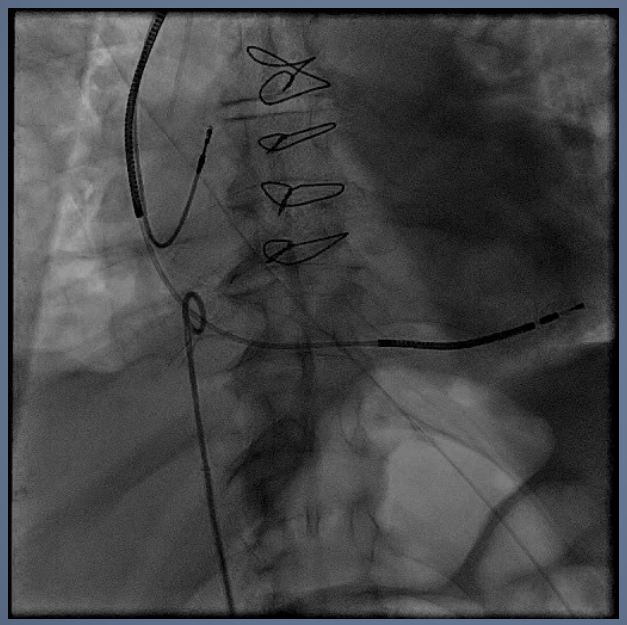
	Cardiac Dimensions Carillon *	MVRx ARTO	Mitralign TAMR *
Mechanism	Coronary sinus mediated posterior annulus cinching	A-P shortening via coronary sinus - LA band	Retrograde aortic pledget-mediated annular plication
N pts treated	~600 (113 in studies)	45	71 (51 with 2nd gen)

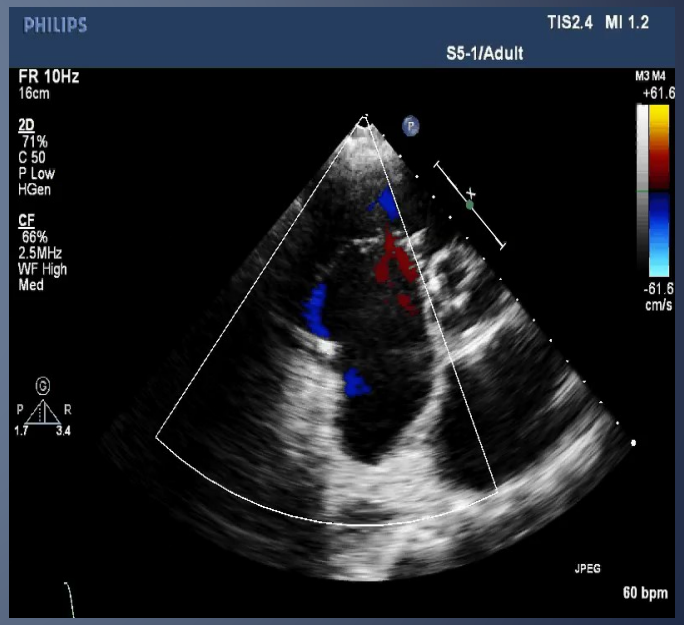




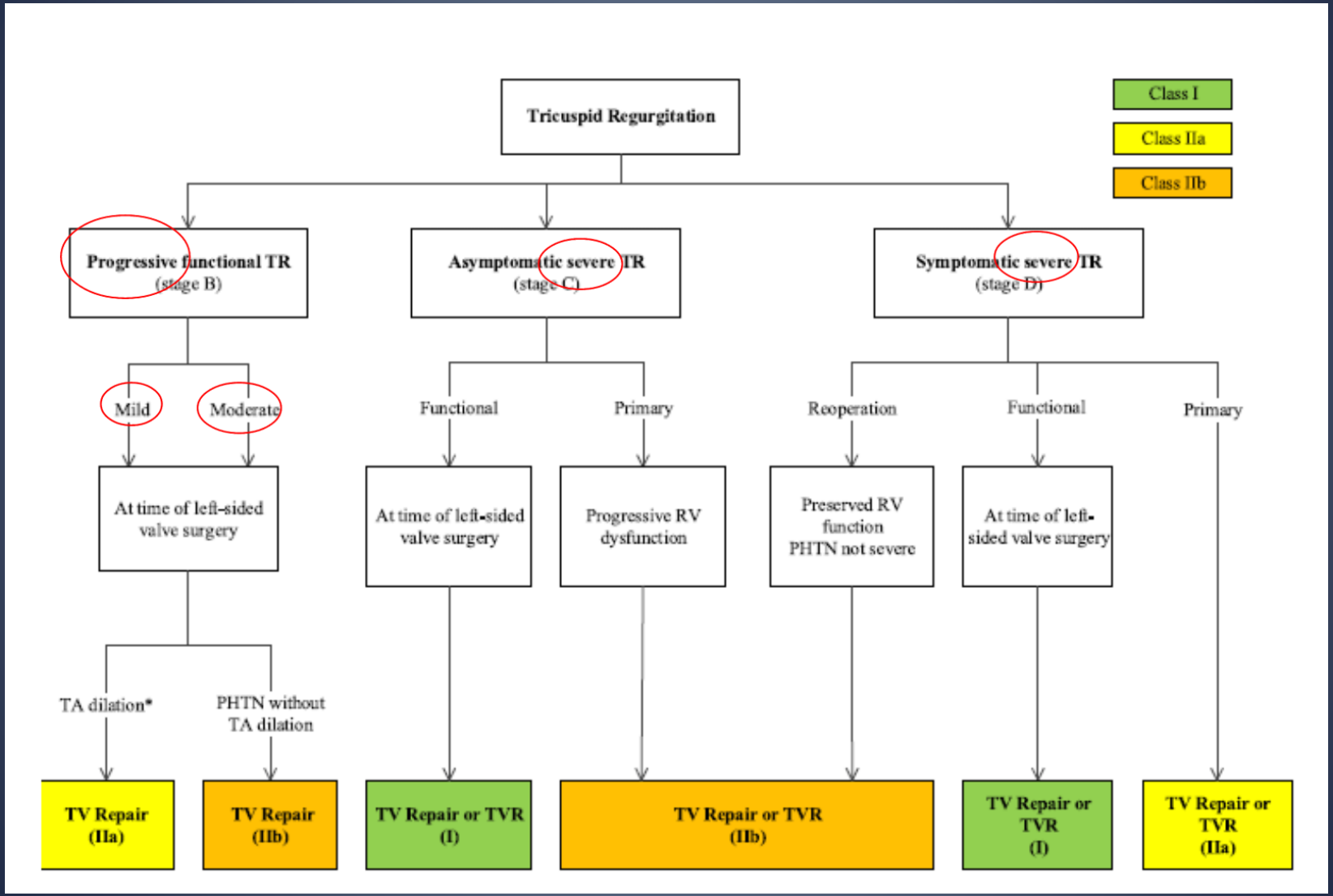
	Edwards Cardioband *	Ancora Heart Accucinch	Millipede IRIS
Mechanism	LA semi-rigid posterior partial annuloplasty band with anchor cinching	LV postero-basal annuloventriculoplasty via anchor cinching	Complete circumferential semi-rigid direct annuloplasty ring
N pts treated	~100	39 (6 versions)	11

Clinical Presentation of TR





Mild TR; Consider Repair if L-sided Surgery or Clip



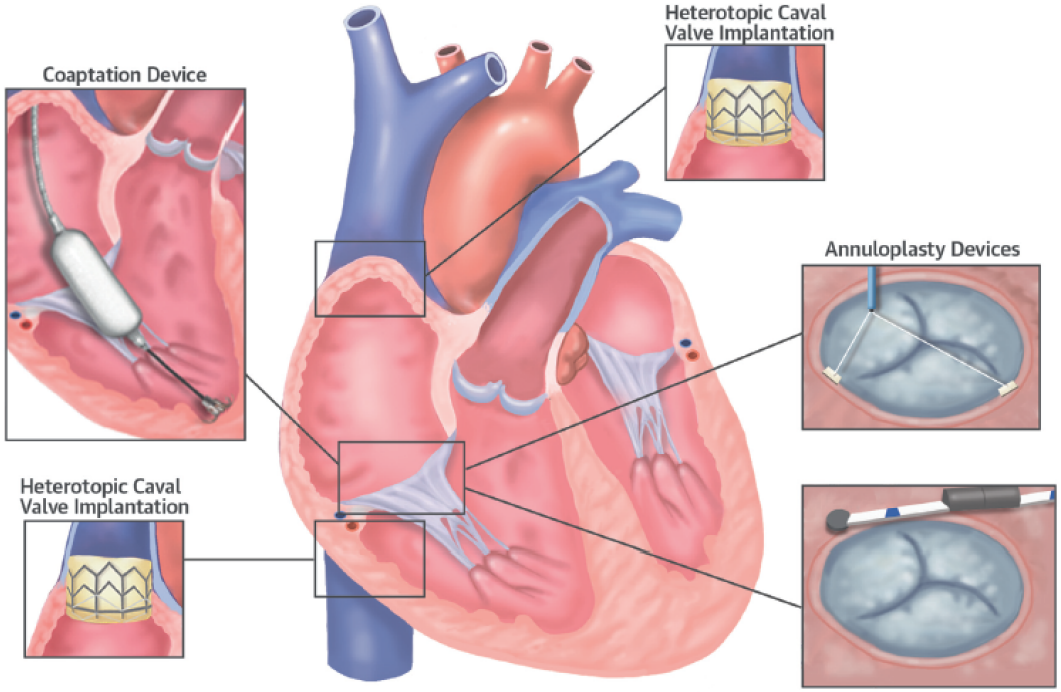
Nishimura et al. *J Am Coll Cardiol.* 2014;63:e57-185

SRB March 2020

LSU Health SHREVEPORT

CENTRAL ILLUSTRATION Transcatheter Therapies for TR

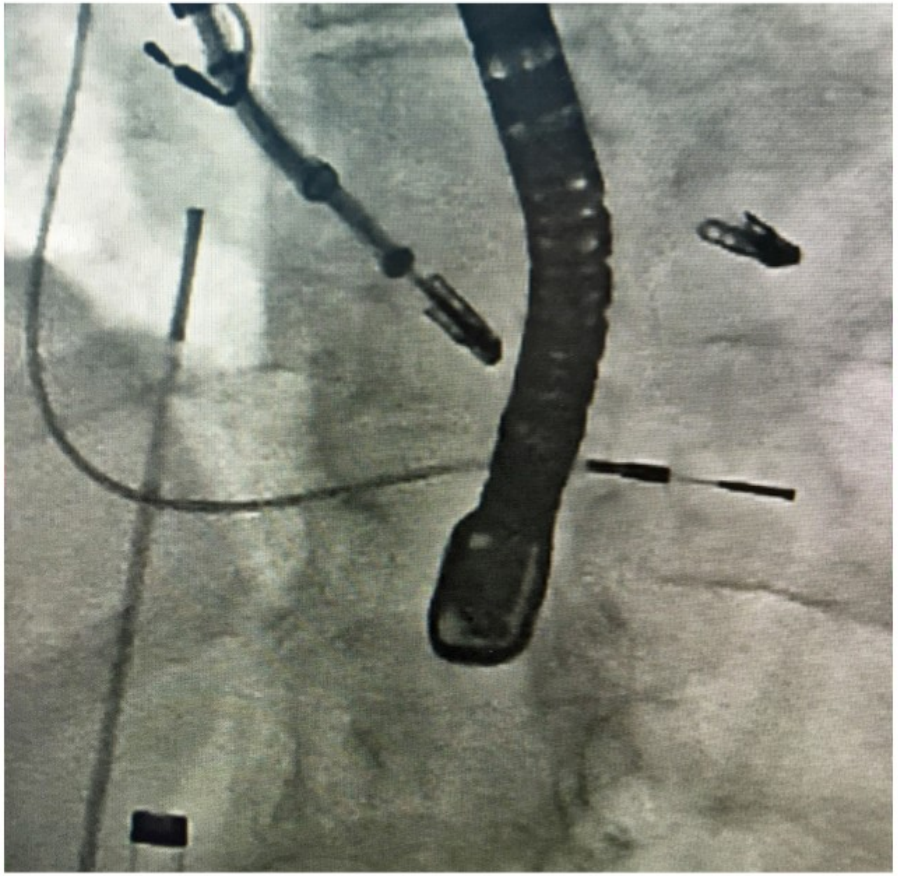
Transcatheter Therapies for Tricuspid Regurgitation



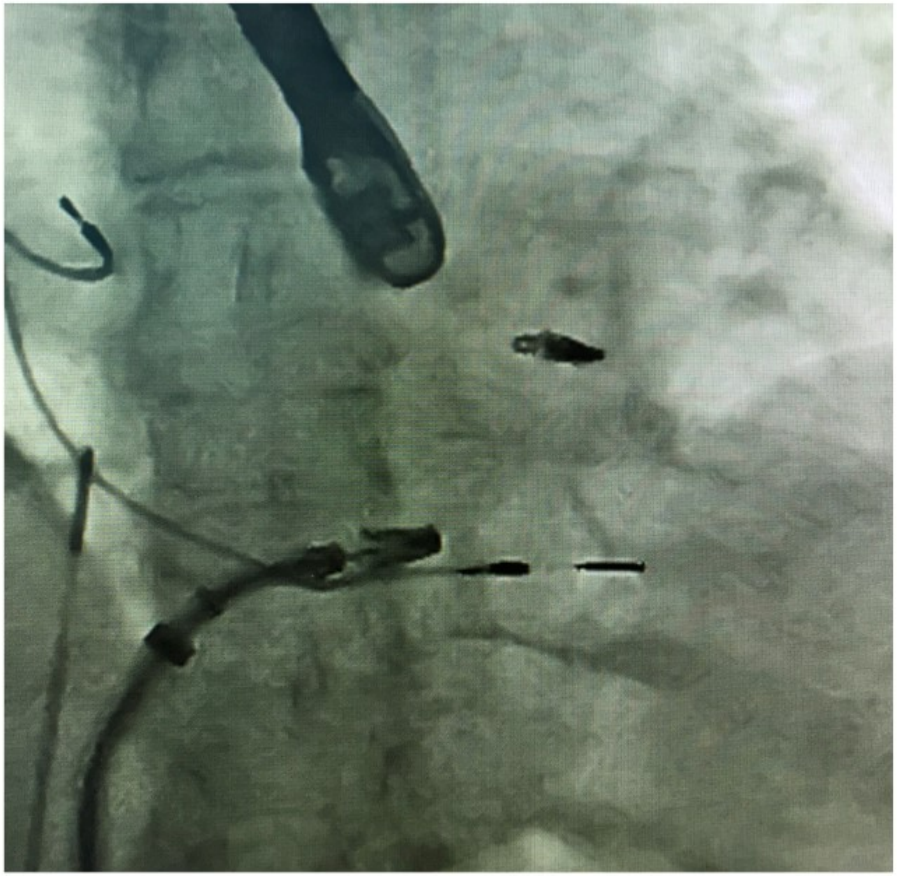
Challenges of Transcatheter Therapies for Tricuspid Regurgitation

- Large tricuspid annulus dimensions
- Nonplanar and elliptical annulus shape
- Absence of calcium
- Right ventricular morphology
- Proximity of other structures (coronary sinus, AV node and HIs bundle, vena cava, right coronary artery)

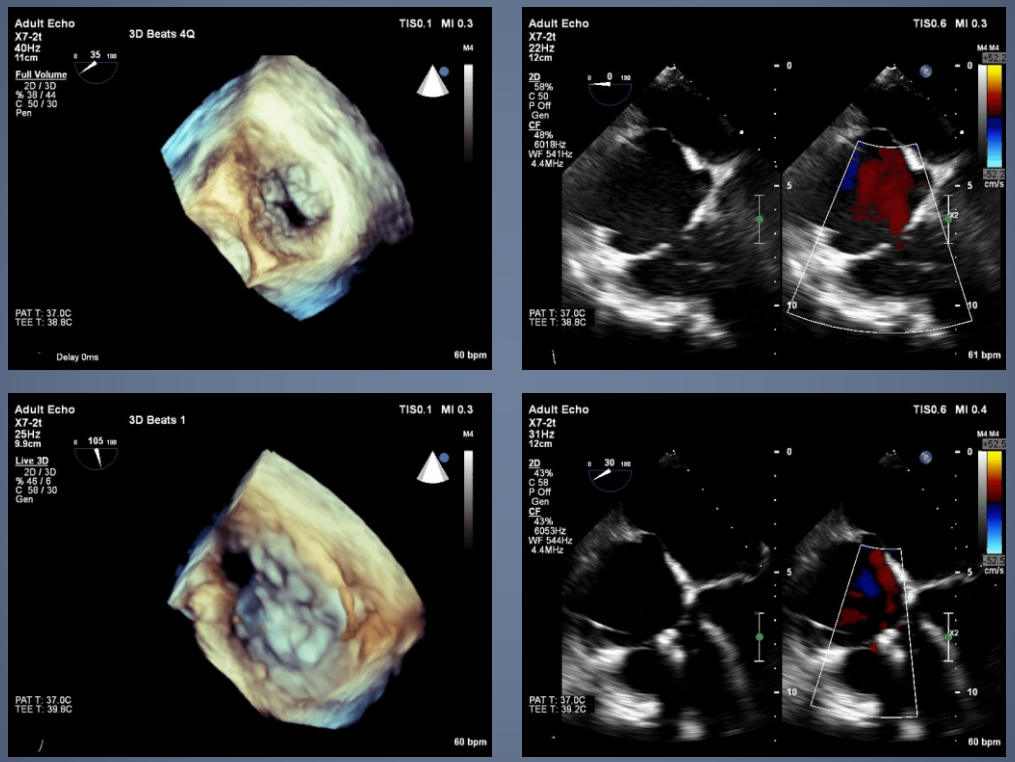
Internal Jugular Approach



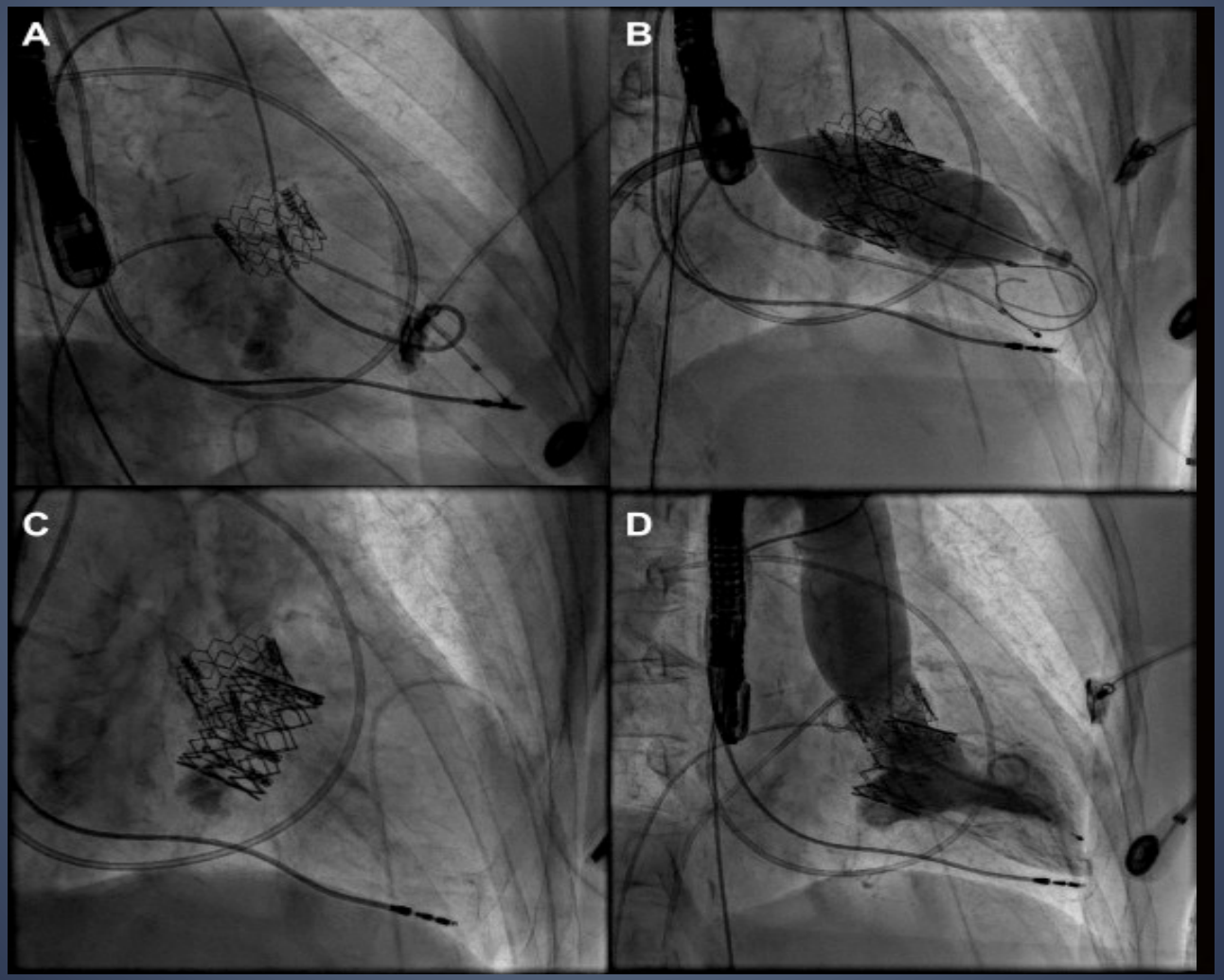
Common Femoral Approach



TEE: Pre and Post MitraClip



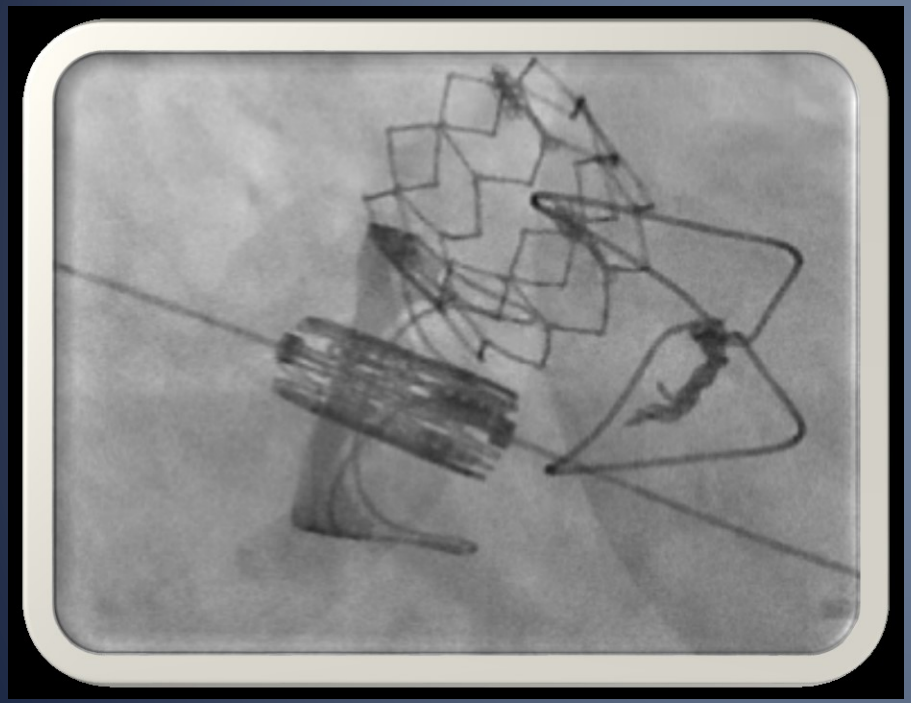
Percutaneous Mitral Valve Replacement for MAC

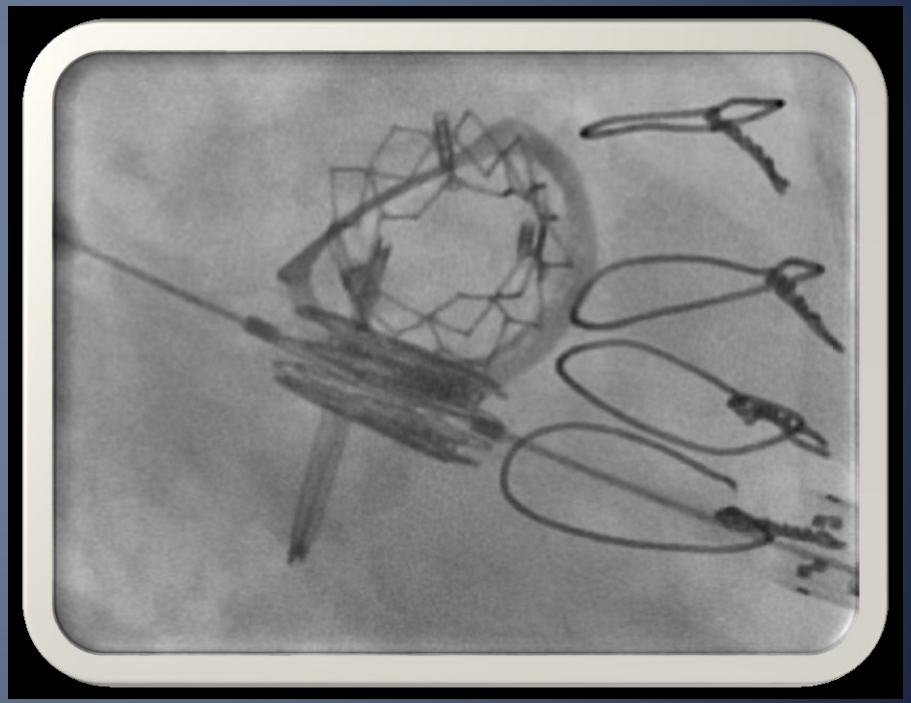


SRB March 2020

LSU Health SHREVEPORT

Mitral Valve-in-Valve / Valve-in-Ring





TMVR Landscape 2019

Braile Biomedica

Braile Biomedica

CardiAQ 1st G

CardiAQ Edwards

Cephea

Direct Flow Medical

Twelve Medtronic

M-Valve

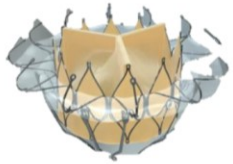
Edwards Fortis

HighLife

Navigate

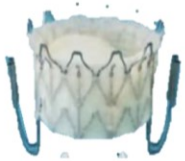
Neovasc Tiara

PermaValve MID



Sinomed

Tendyne Abbott



SATURN TMVR

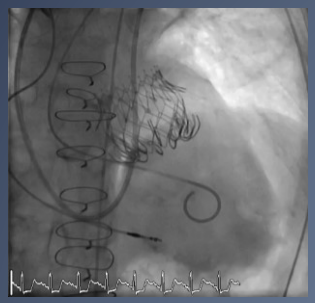
Mitraltech

Caisson

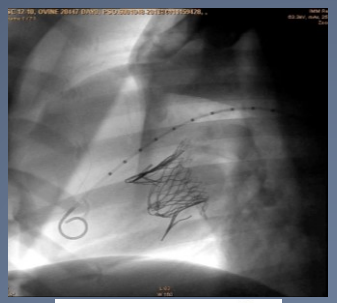
Sapien M3 Edwards

AND Many Others…

Transcatheter MVR with Human Use

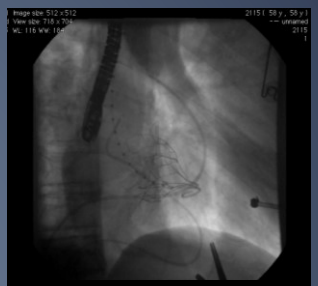



CardiAQ Edwards




Neovasc Tiara


Edwards Fortis




Abbott Tendyne

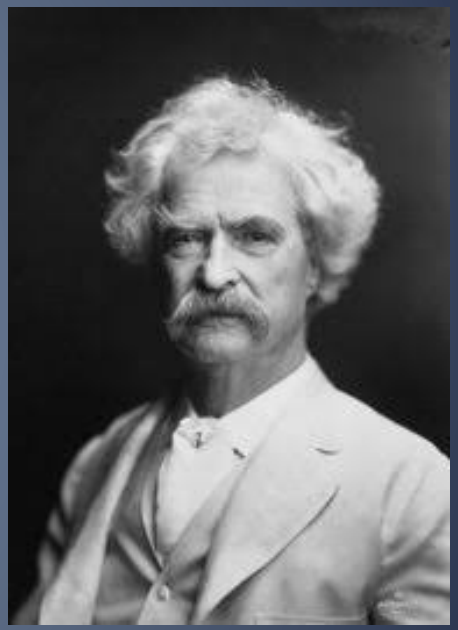

HighLife


Medtronic Intrepid


Caisson

From Greg Stone

"It's Difficult to Make Predictions, Especially About the Future"

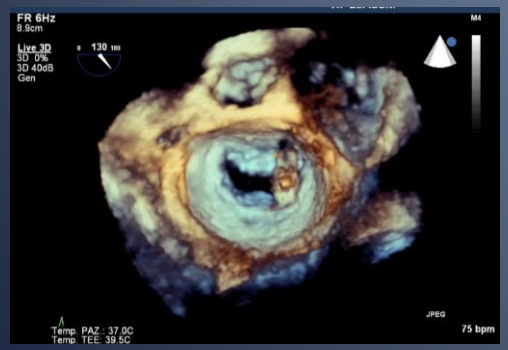


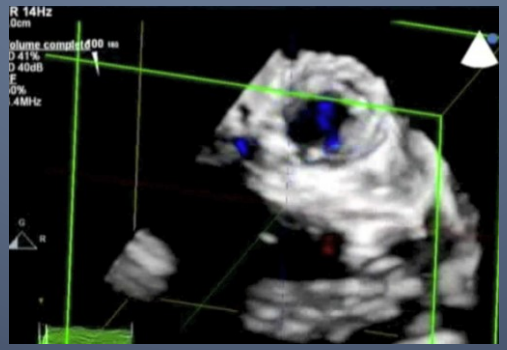
Mark Twain

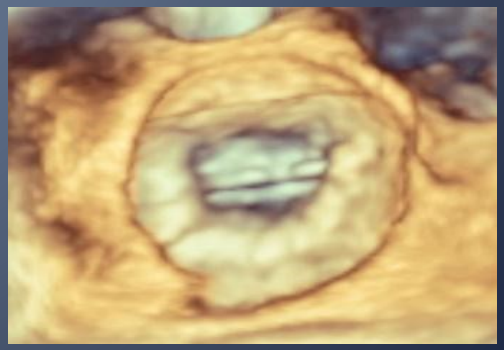
(November 30, 1835 – April 21, 1910)

MR and Percutaneous Device Therapy

- The presence of MR predicts increasing mortality and health care expenses in patients, especially those with Heart Failure
- Requires a multidisciplinary team to provide optimal care
- Less invasive treatments of MR are emerging as a viable and effective method to improve survival and contain costs
- MitraClip is the most common therapy today, but more options will become available in the next future including “surgical like” percutaneous annuloplasty and replacement







Any Questions?

sbail8@lsuhsc.edu