Echocardiography in the Operating Room

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TEE Guidance, PLEASE

Guidelines

2010 ASA/SCA:

Recommends perioperative TEE should be used on all valvular procedures.

2011 AHA:

Recommends perioperative TEE for any patients undergoing valvular surgery as Class I indication.

TEE Indications

General indication	Specific examples
1. Evaluation of cardiac and aortic structure and function in situations where the findings will alter management and TTE is non-diagnostic or TTE is deferred because there is a high probability that it will be non-diagnostic.	a. Detailed evaluation of the abnormalities in structures that are typically in the far field such as the aorta and the left atrial appendage. b. Evaluation of prosthetic heart valves. c. Evaluation of paravalvular abscesses (both native and prosthetic valves). d. Patients on ventilators. e. Patients with chest wall injuries. f. Patients with body habitus preventing adequate TTE imaging. g. Patients unable to move into left lateral decubitis position.
2. Intraoperative TEE.	a. All open heart (i.e., valvular) and thoracic aortic surgical procedures. b. Use in some coronary artery bypass graft surgeries. c. Noncardiac surgery when patients have known or suspected cardiovascular pathology which may impact outcomes.
3. Guidance of transcatheter procedures	a. Guiding management of catheter-based intracardiac procedures (including septal defect closure or atrial appendage obliteration, and transcatheter valve procedures).
4. Critically ill patients	a. Patients in whom diagnostic information is not obtainable by TTE and this information is expected to alter management.

J Am Soc Echocardiogr 2013;26:921-64.

Practical TEE Guidelines-CHI

TEE Use In Cardiovascular Cases(Assuming no Contraindications)	
All valves All aortic surgery All VADs / heart transplants All congenital heart surgery All patients with an EF < 30% All patients with suspected intra-cardiac clot or PEs All Lariat procedures All laser pacemaker lead extractions Any CABG procedure with ongoing ischemia	Required
CABG with normal ventricular function	Strongly Recommended
**TEE capabilities must be immediately available for all cardiovascular surgical procedures. Non-use of TEE during any procedure should be a clinical decision and not from lack of equipment.	Required

Catholic Health Initiative

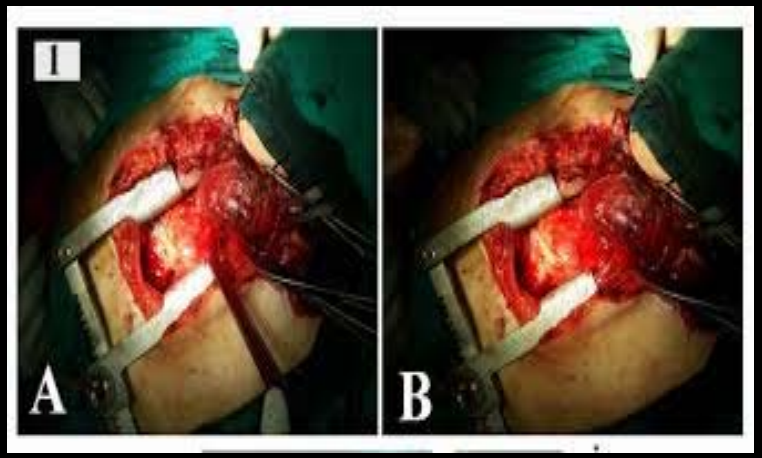
TEE Contraindications

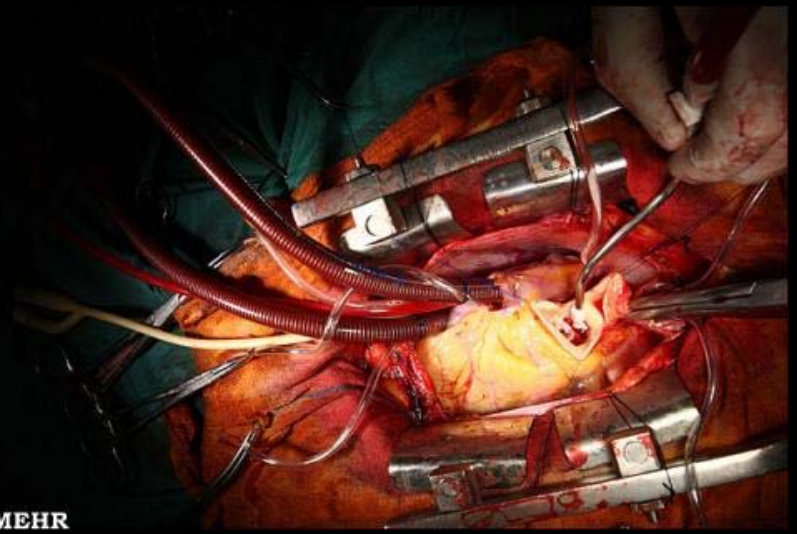
Absolute contraindications	Relative contraindications
• Perforated viscus • Esophageal stricture • Esophageal tumor • Esophageal perforation, laceration • Esophageal diverticulum • Active upper GI bleed	• History of radiation to neck and mediastinum • History of GI surgery • Recent upper GI bleed • Barrett's esophagus • History of dysphagia • Restriction of neck mobility (severe cervical arthritis, atlantoaxial joint disease) • Symptomatic hiatal hernia • Esophageal varices • Coagulopathy, thrombocytopenia • Active esophagitis • Active peptic ulcer disease

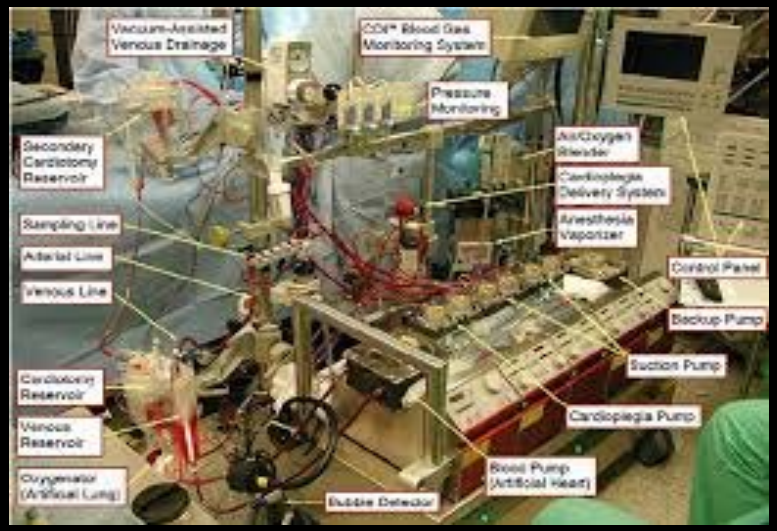
J Am Soc Echocardiogr 2013;26:921-64

Good News
Patient is Anesthetized, Paralyzed, Mechanically Ventilated

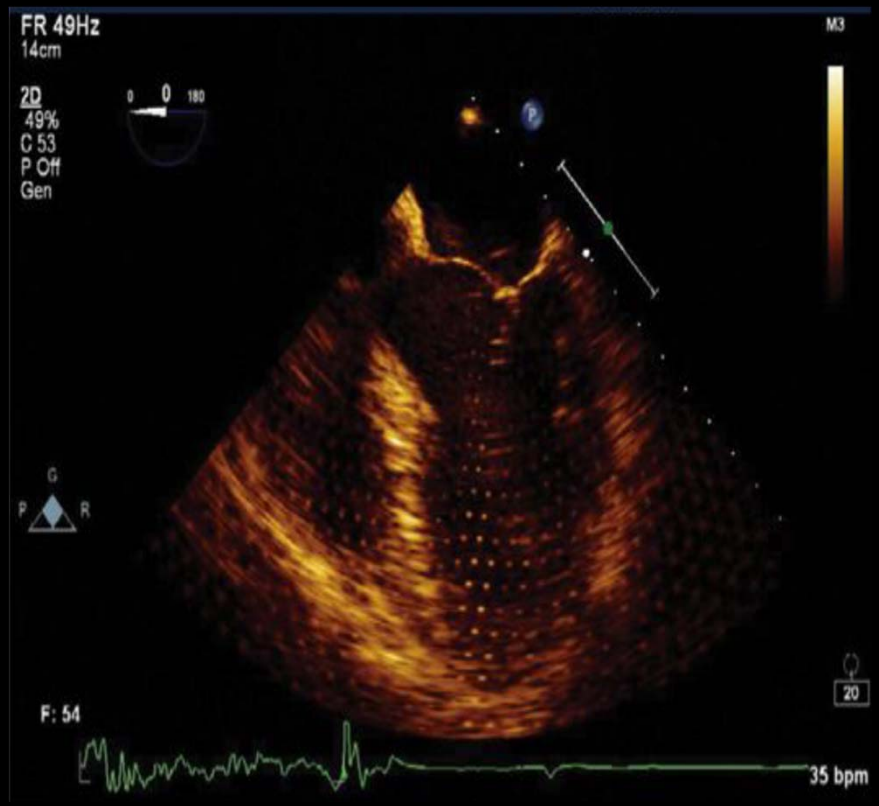
Bad News-Time Pressure
Only 15-20 minuets for TEE Exam

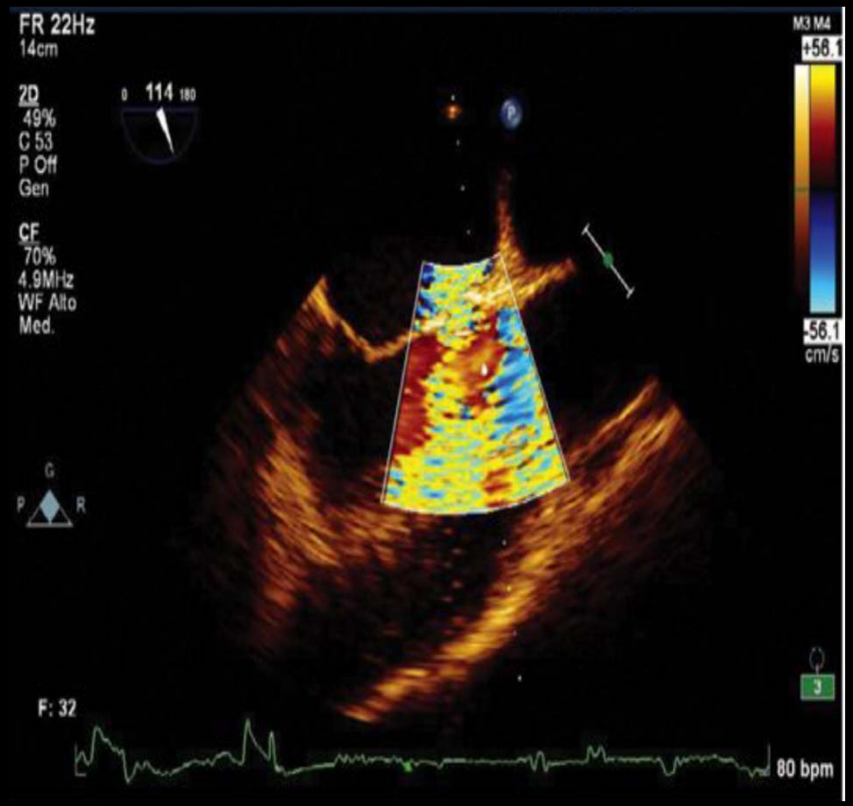






More Bad News-Electrocautery Inteference



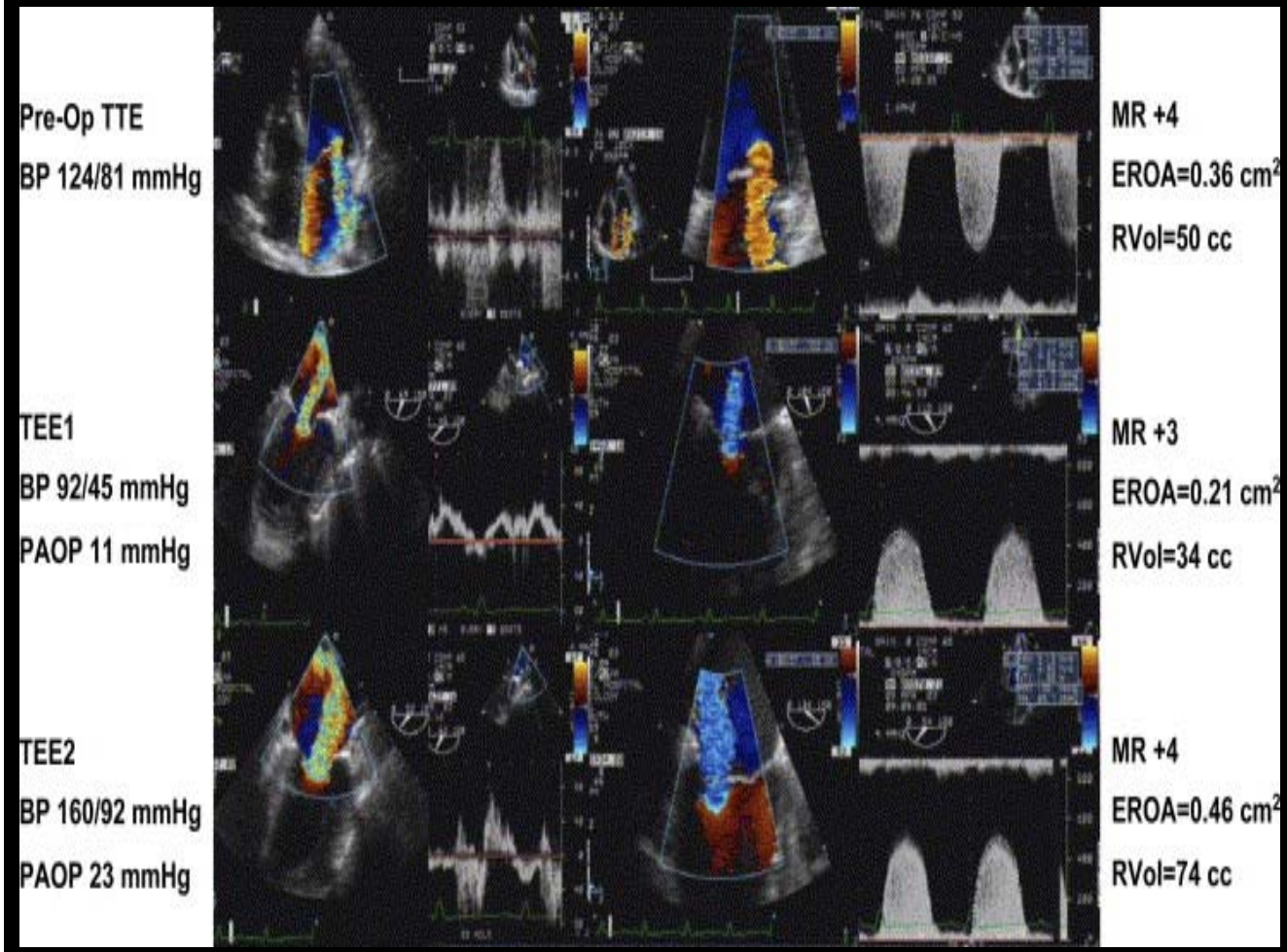


What do we really want to know?-Pre CPB

- Confirm valvular dysfunction severity and refine mechanisms and approaches for effective communication to the surgeon
- Assess right and left ventricular systolic function
- Assess severity of AR for cardioplegia planning
- Search for unsuspected conditions i.e., thrombus, papilloma
- Exclude ascending aorta atheroma that may affect cannulation
- Rule out interatrial communication

PROGRESS IN CARDIOVASCULAR DISEASES. 57(2014)74–90

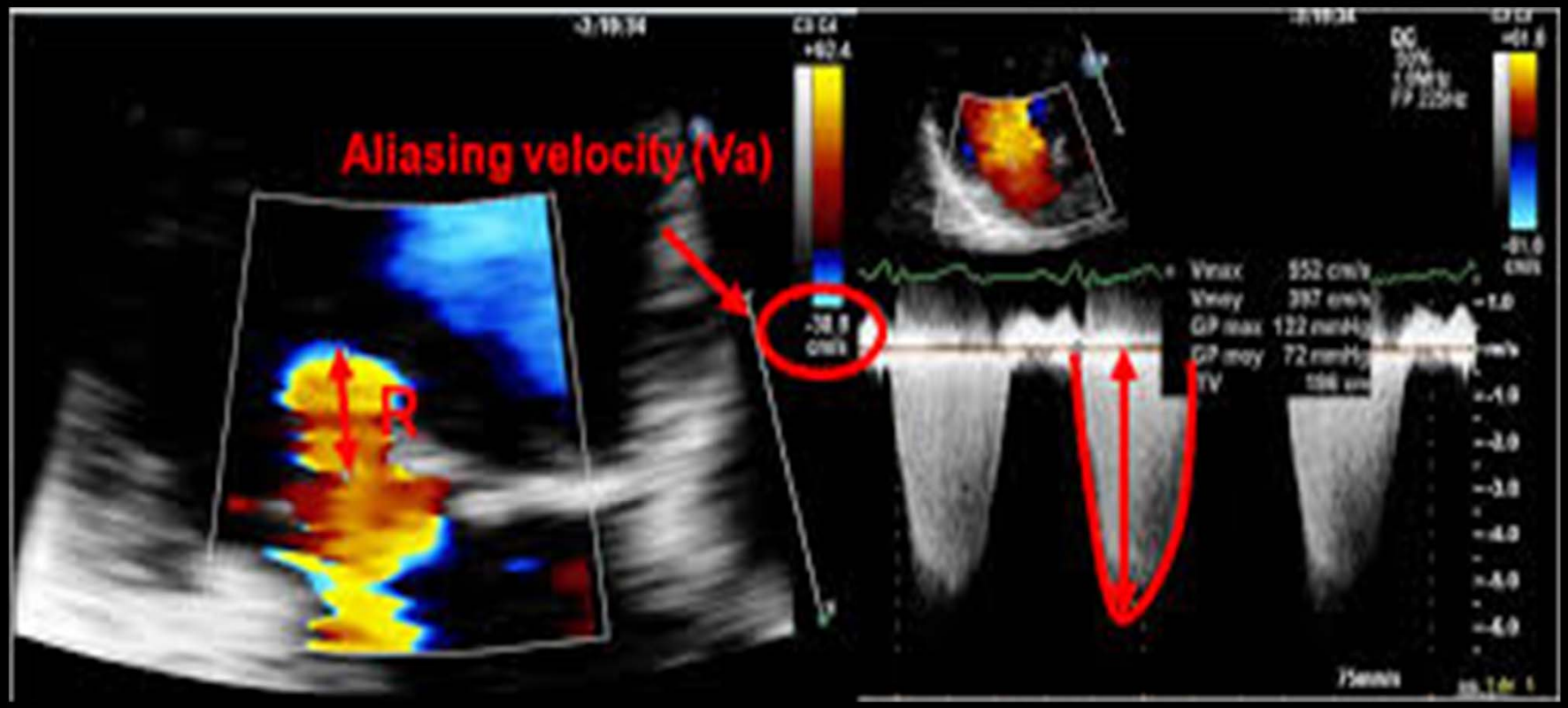
Why is the MR getting better under Anesthesia?



1. Reduction of afterload
2. Reduction of contractility
3. Reduction of SAM
4. Medical management

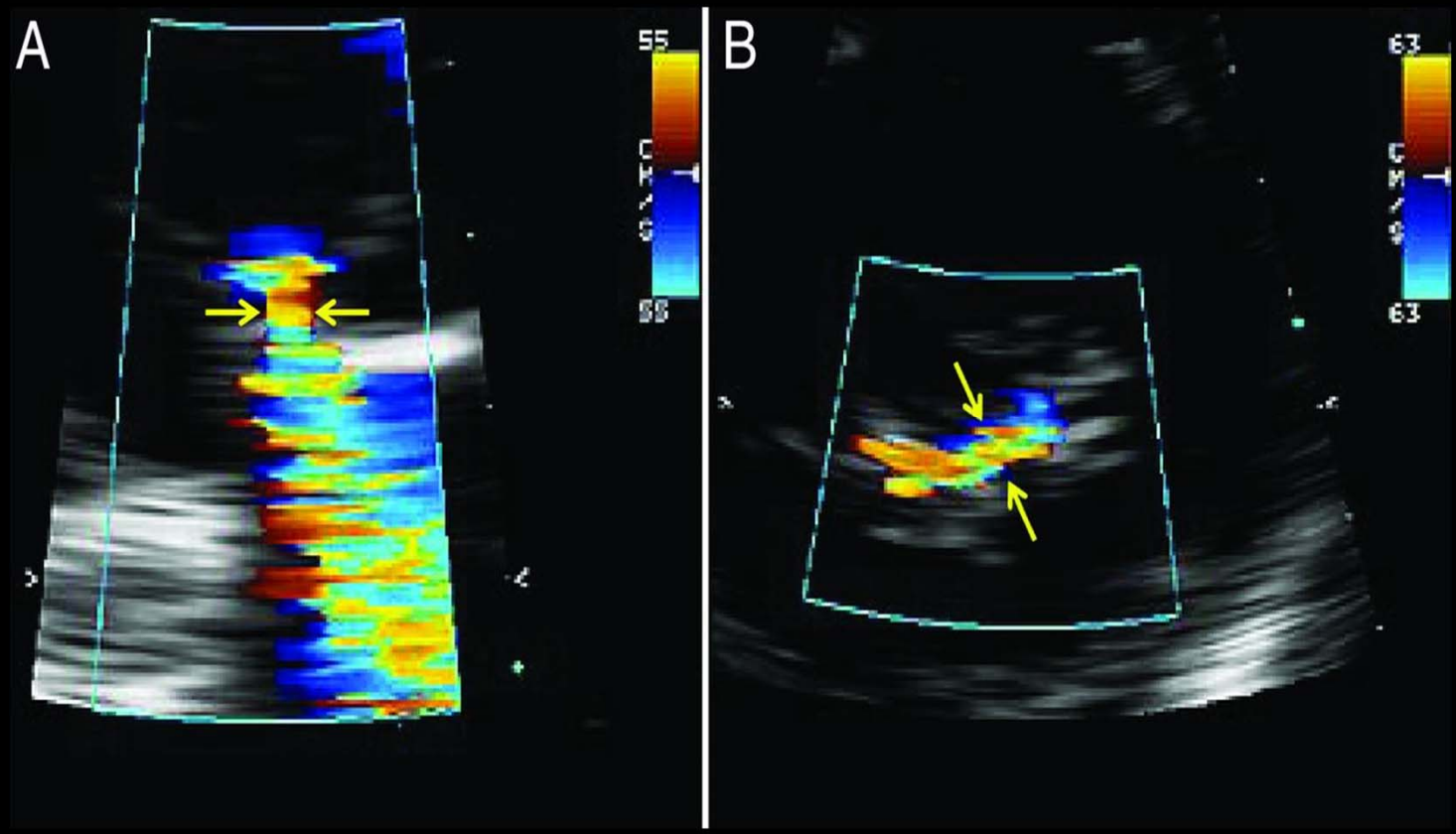
Shiran A et al JASE 2007;20:690-697

PISA （Proximal Isovelocity Surface Area））



www.escardio.org

Vena Contracta



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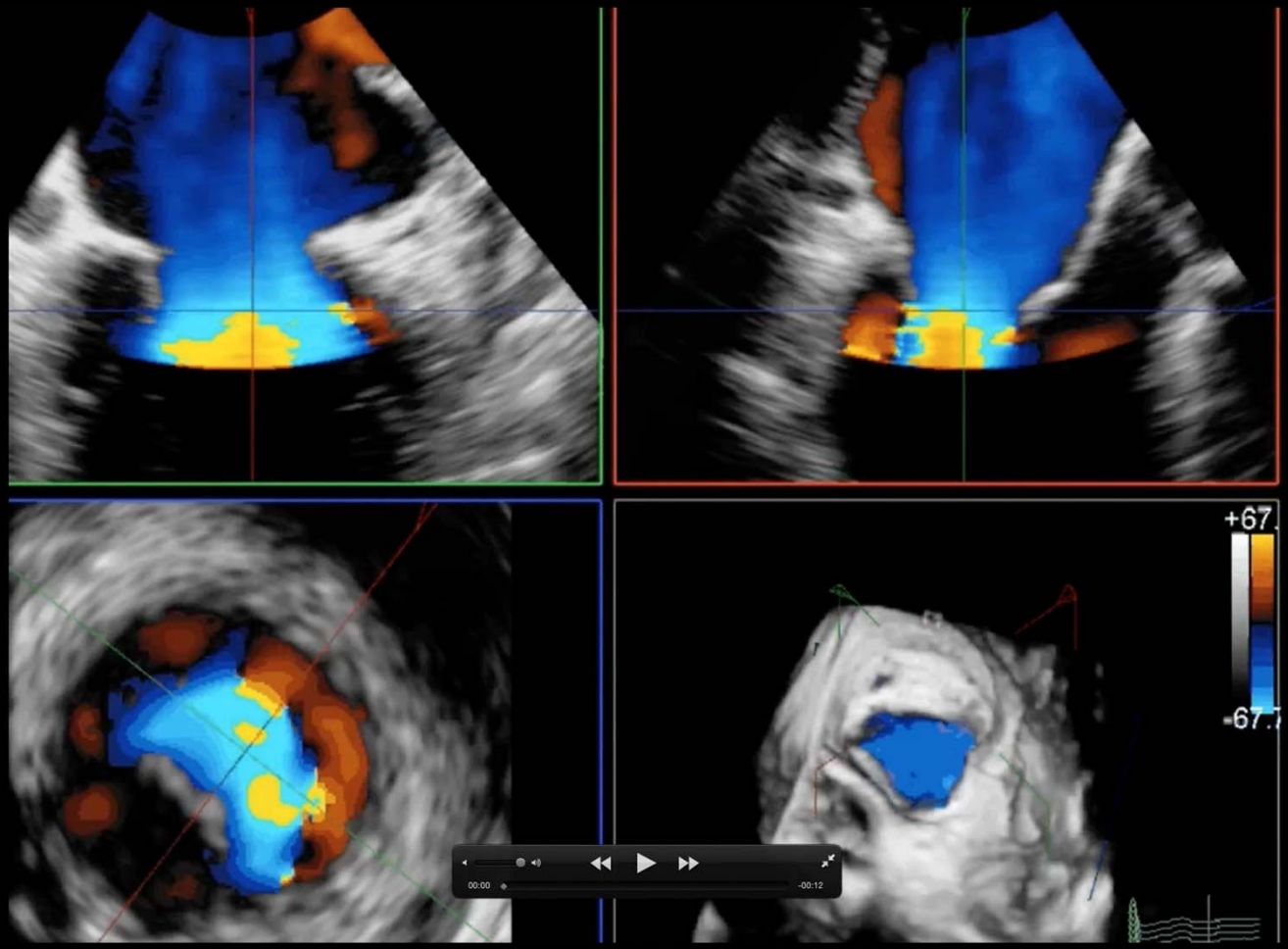
3D Mitral Regurgitation Quantification



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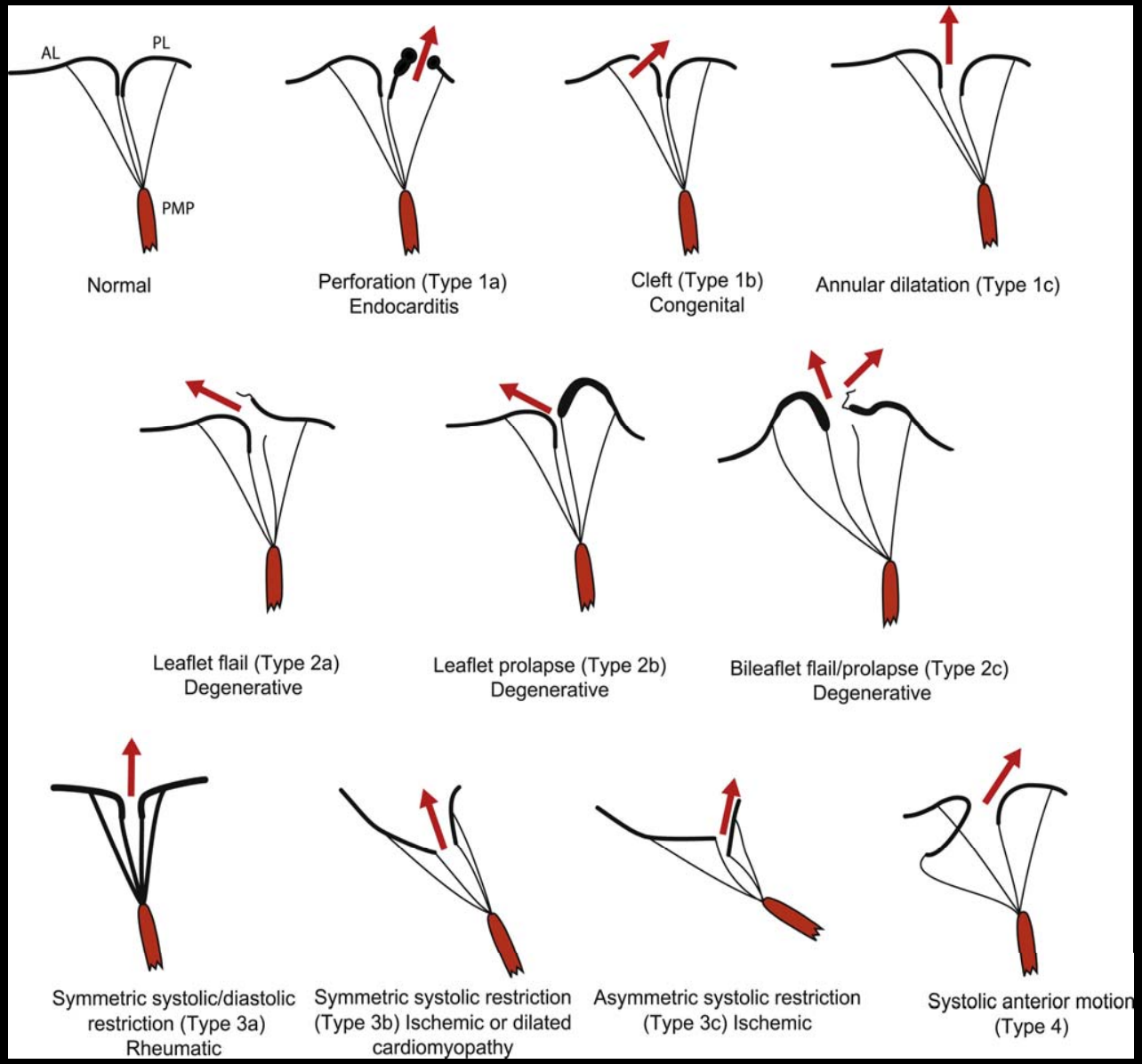
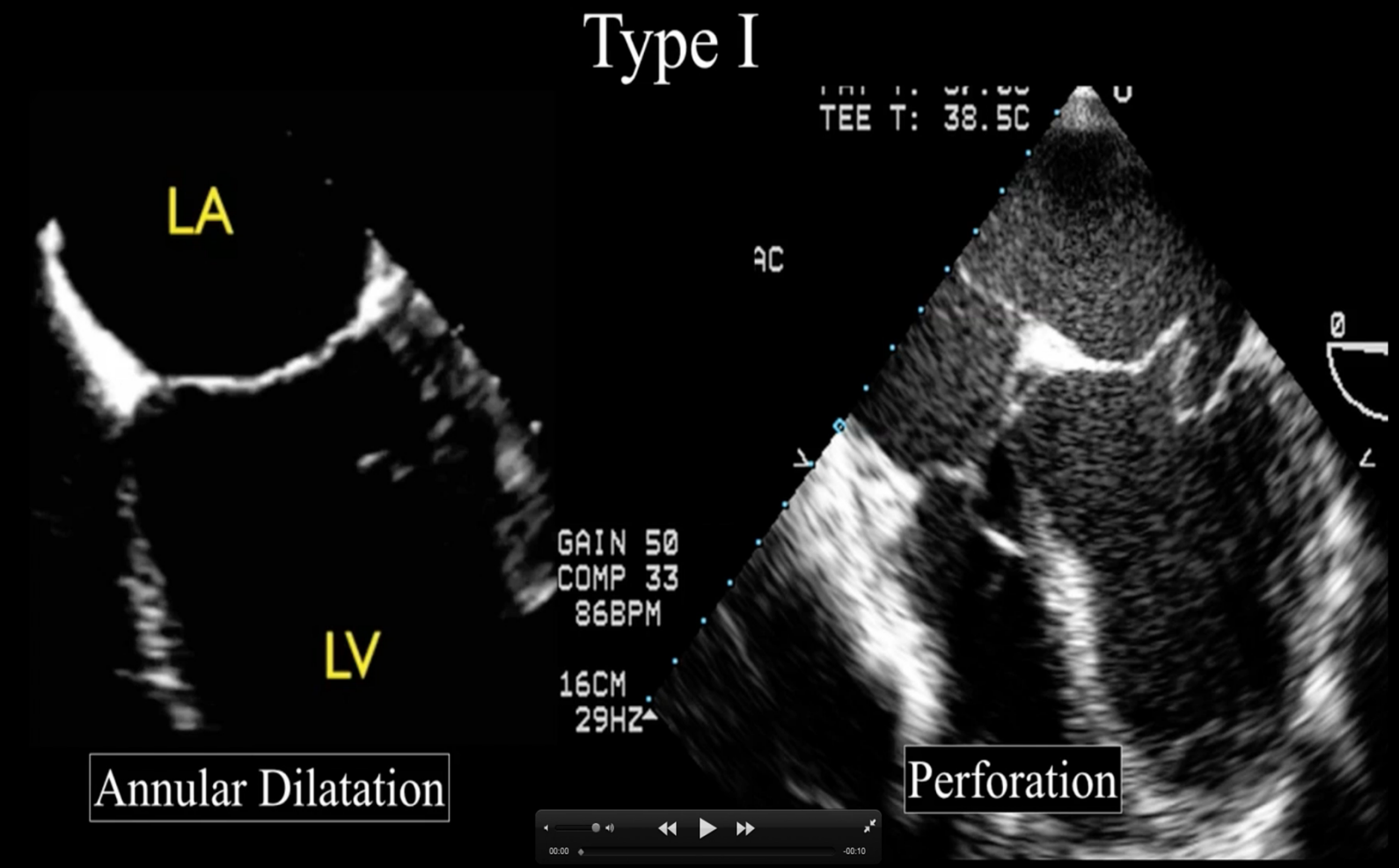
MR Mechanisms



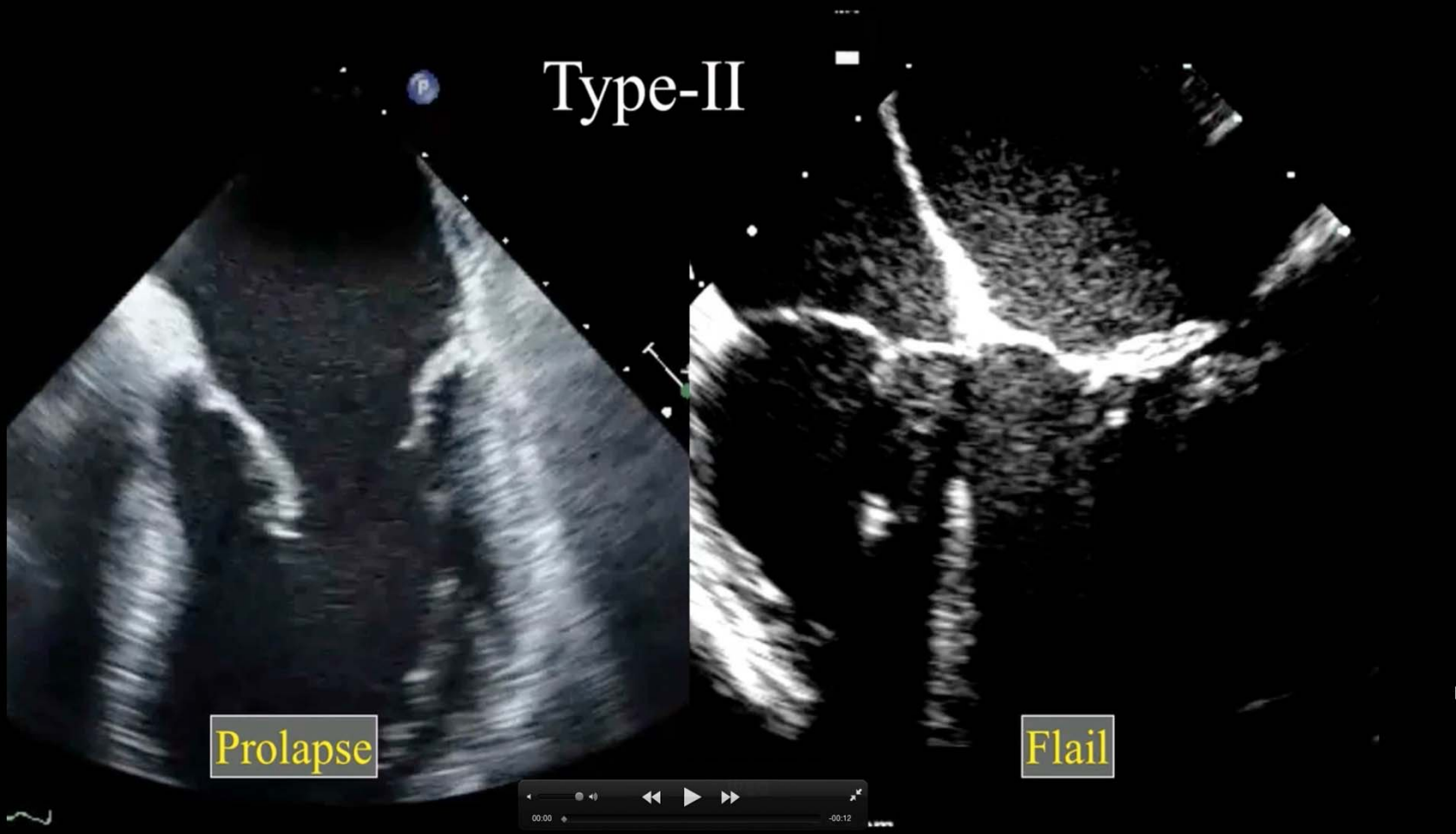
J Am Soc Echocardiogr 2014;27:345-66.

MR Type I



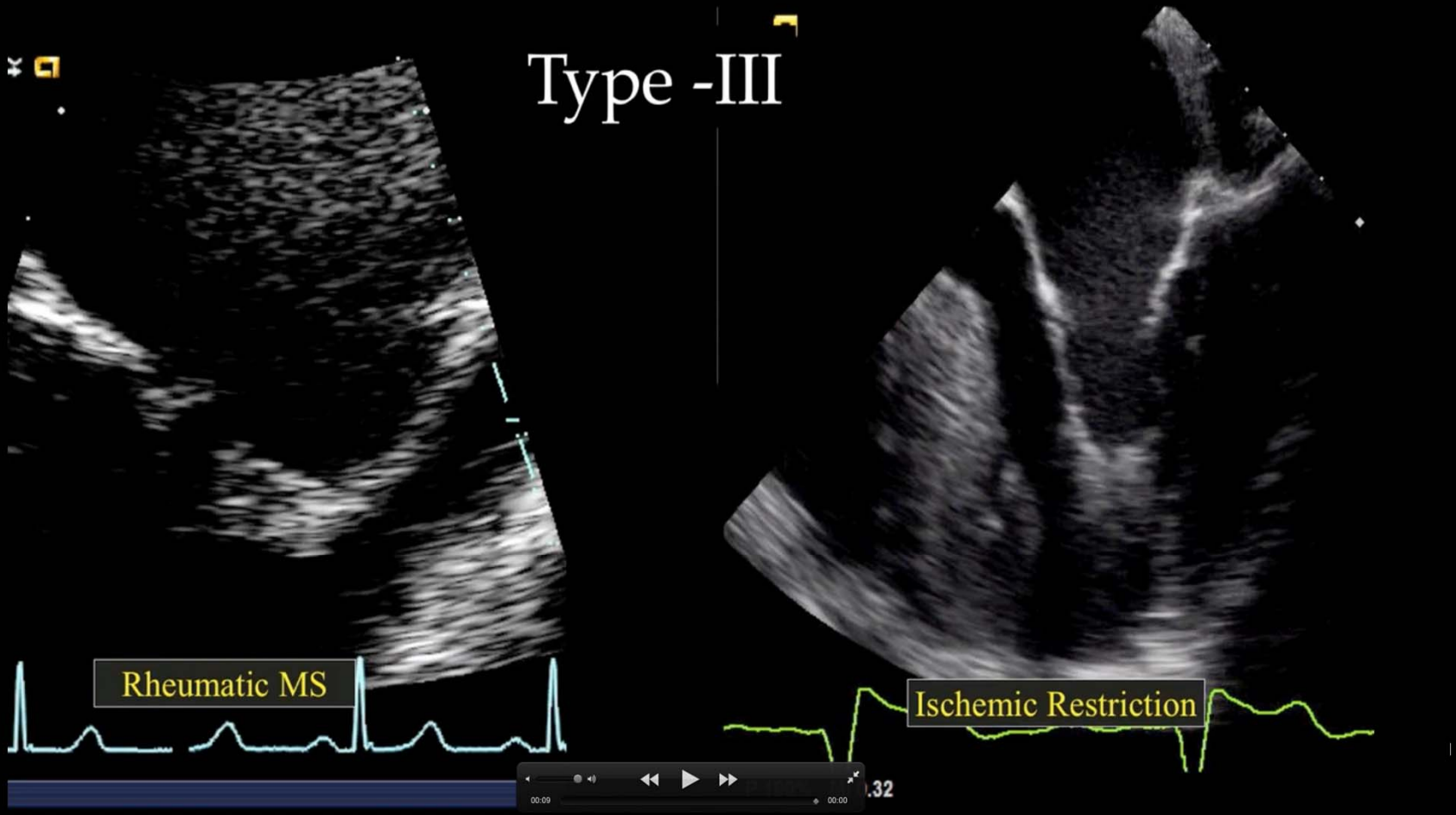
Anesth Analg 2015;121:34–58

MR Type II



Anesth Analg 2015;121:34–58

MR Type III



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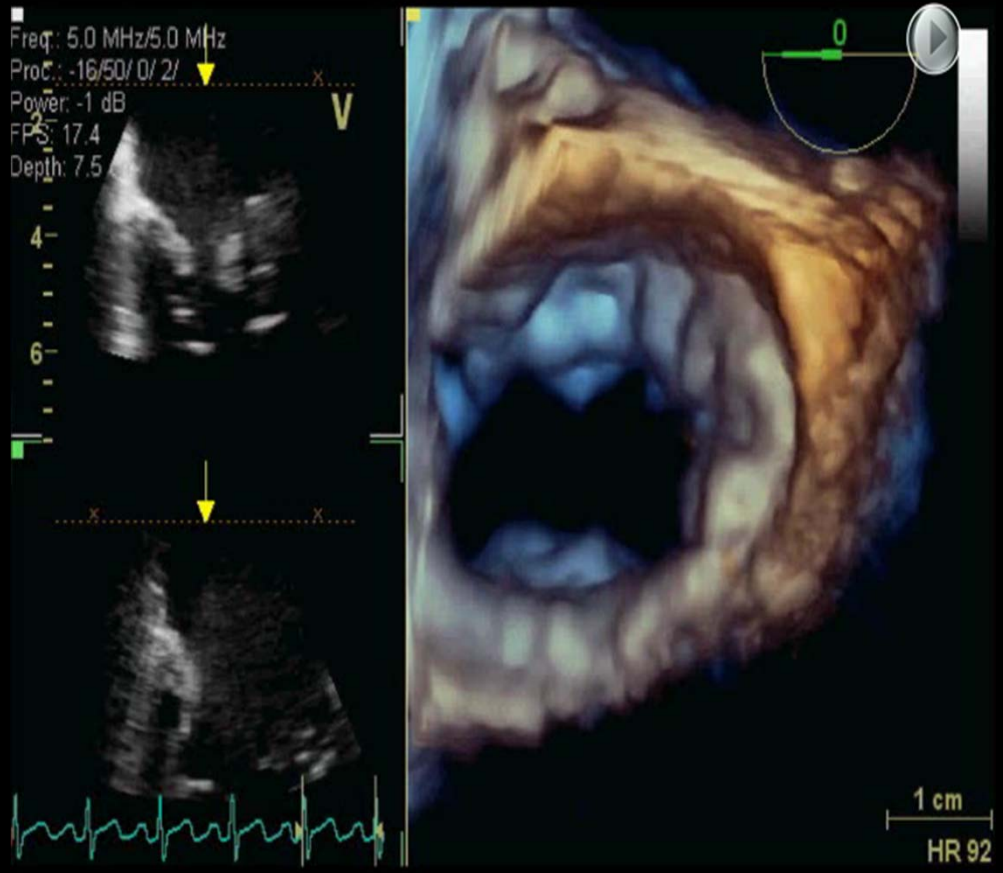
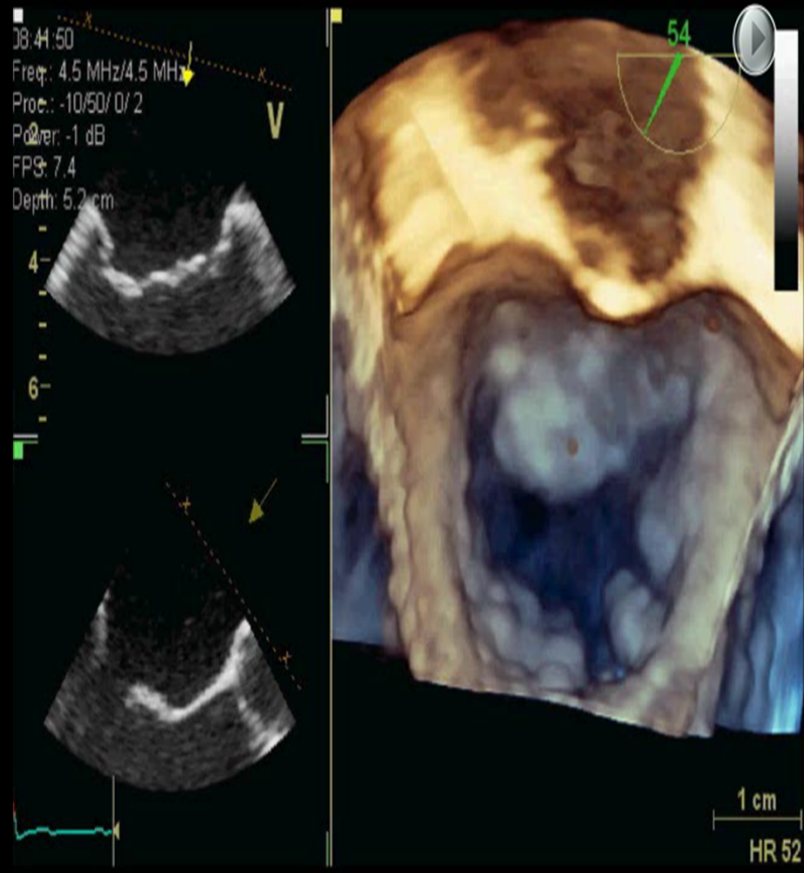
3D to Evaluate MR





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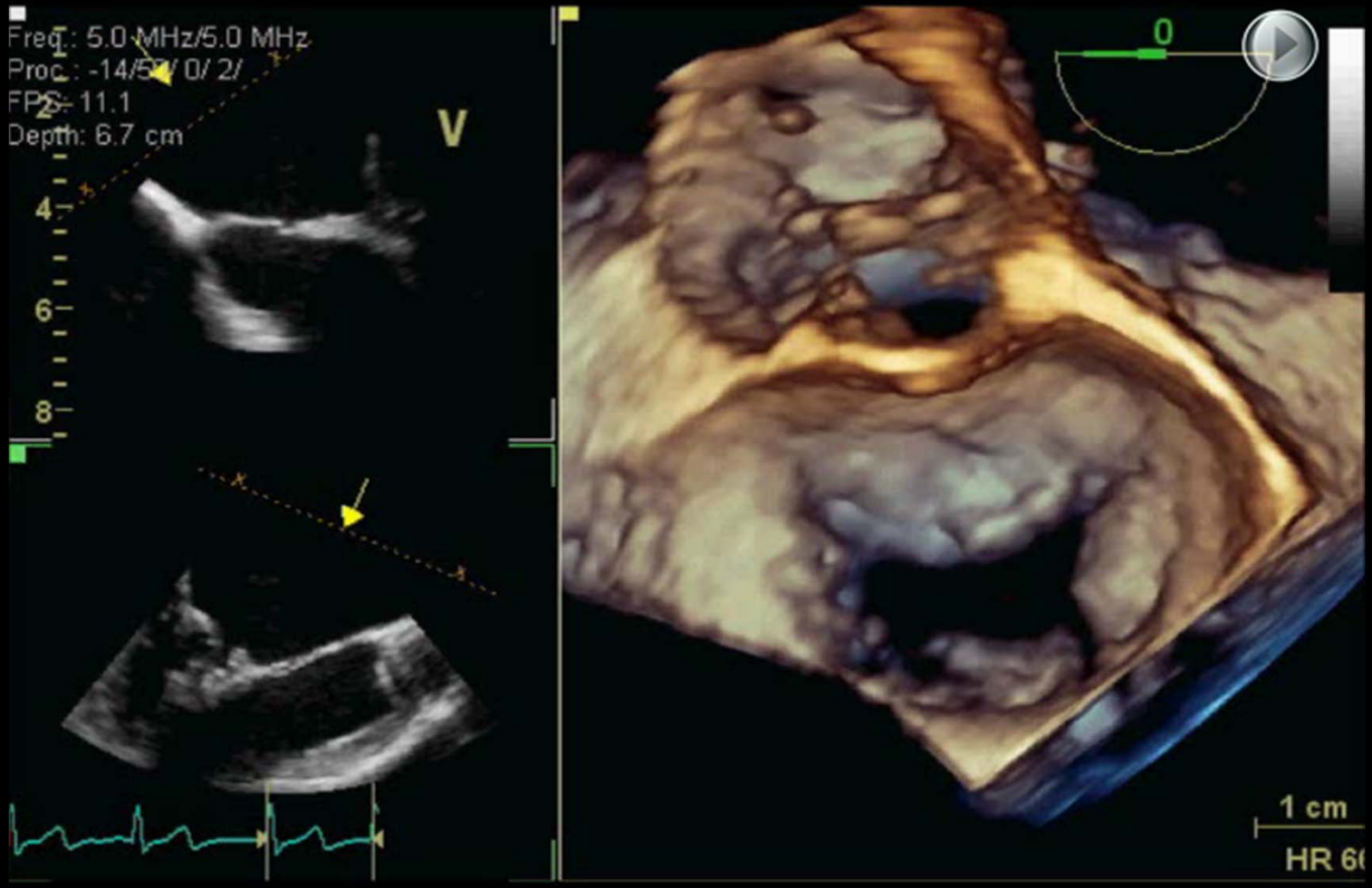
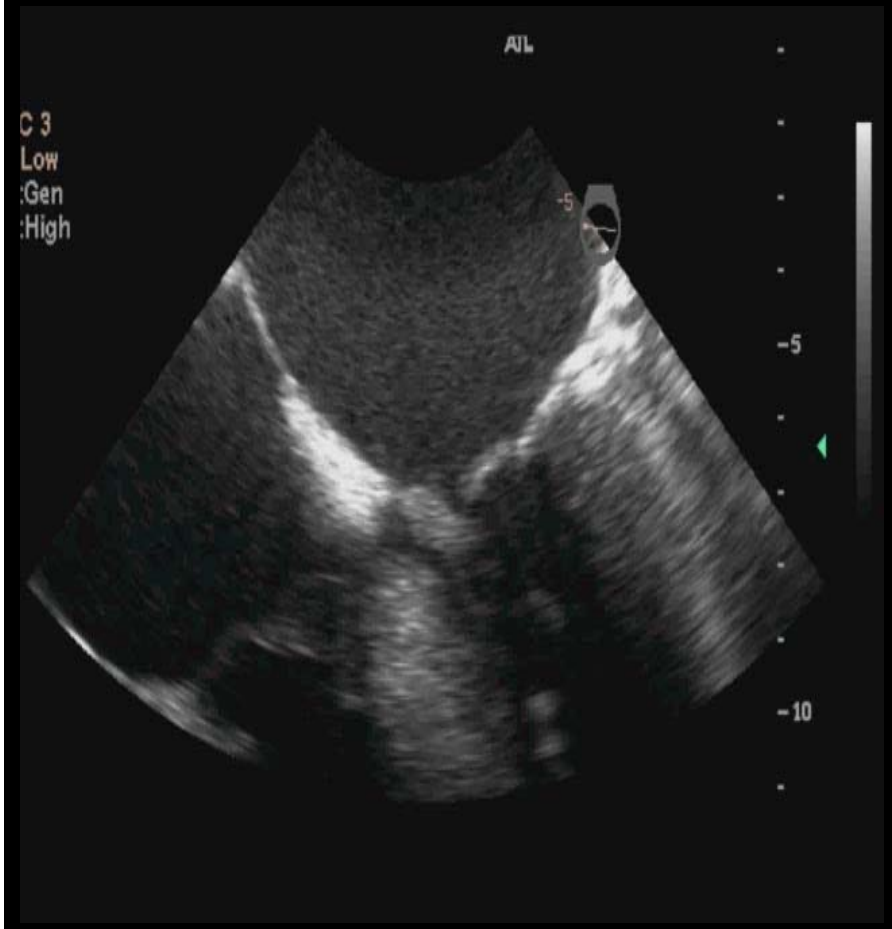
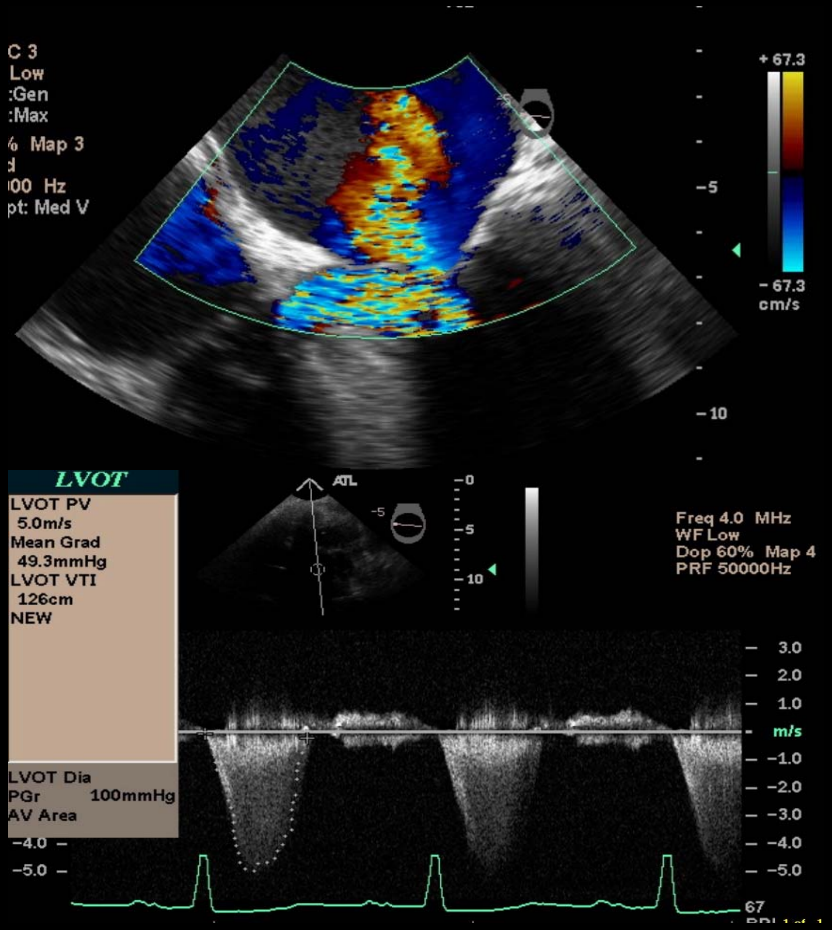
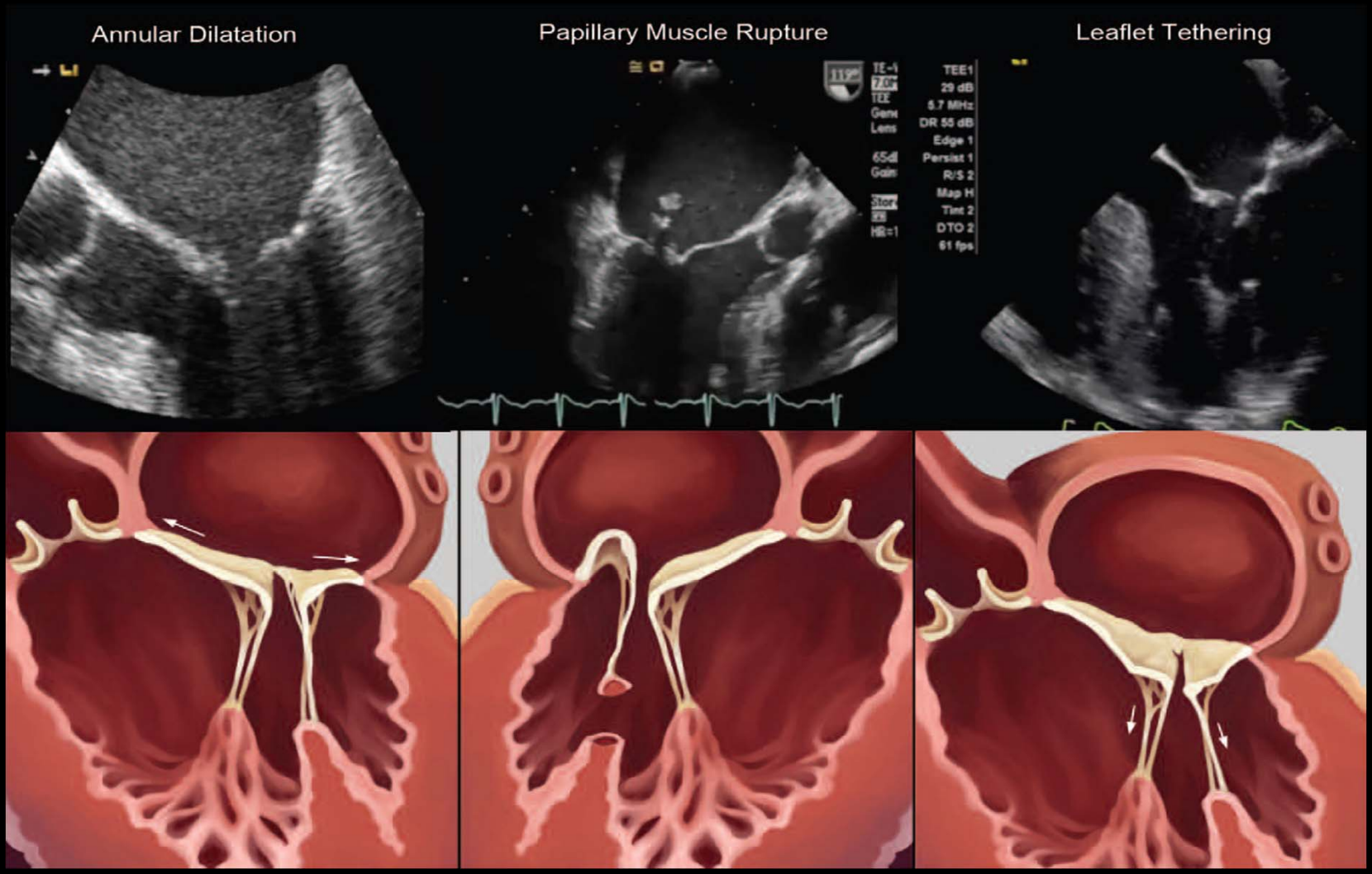


Systolic Anterior Motion (SAM)



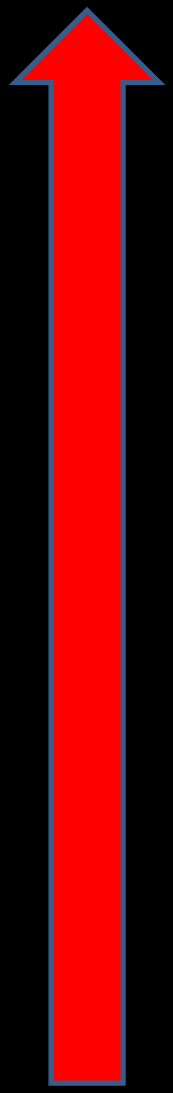


Ischemic MR


Annular Dilatation
Papillary Muscle Rupture
Leaflet Tethering

Mechanism	Surgical Procedures
Type I: Normal Leaflet Motion	
-Leaflet Perforation	Patch Repair
-Anuular Dilatation	Annuloplasty
Type II: Excessive Leaflet Motion	
-Chordal Rupture/Elongation	Quadrangular Resection
-Papillary Muscle Rupture/Elongation	Chordal Shortening
-Myxomatous Leaflet Degeneration	Chordal Transfer
-Fibroelastic Deficiency	Alfieri
Type III: Restricted Leaflet Motion	
-Leaflet Chordal Fusion	Commissurotomy
-Primary Myocardial Disease	Debridement
-Myocardial Infarction	Annuloplasty
-Rheumatic Heart Disease	Replacement

Operation Difficulty



Rheumatic

Mitral Annular Calcification

Ischemic MR

Anterior Leaflet Pathology

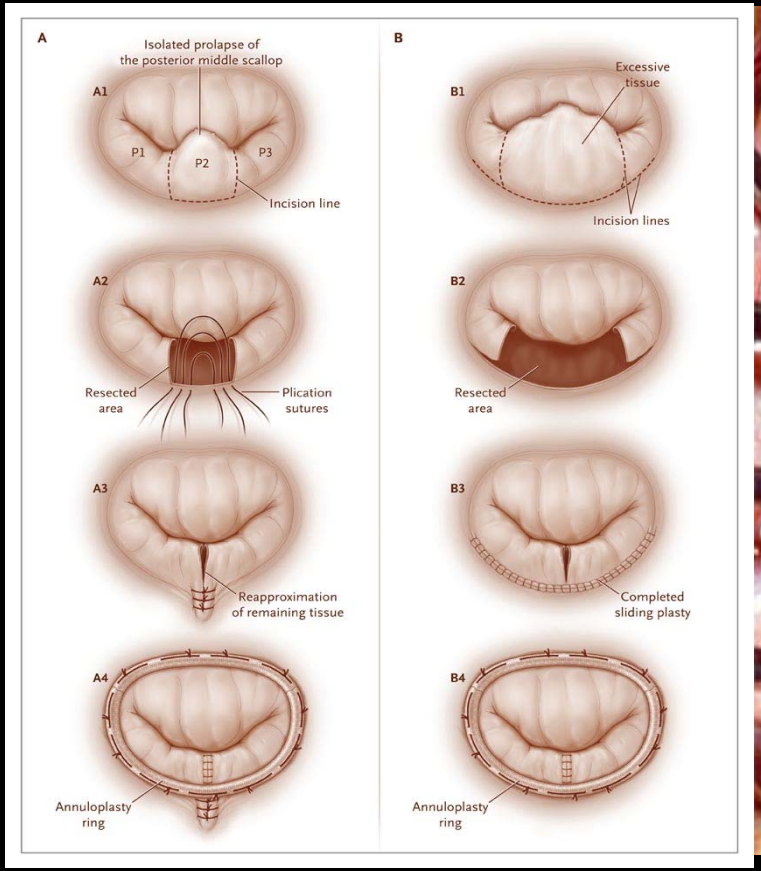
Bileaflet Disease

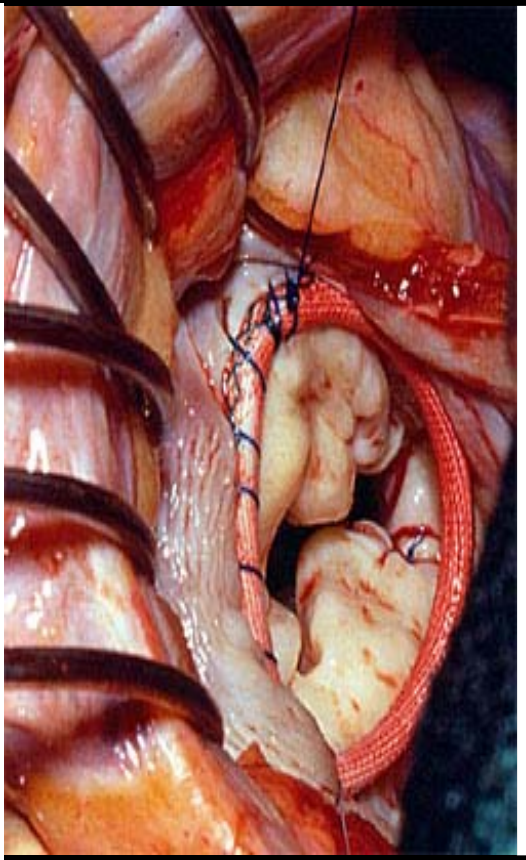
Commissural Flail

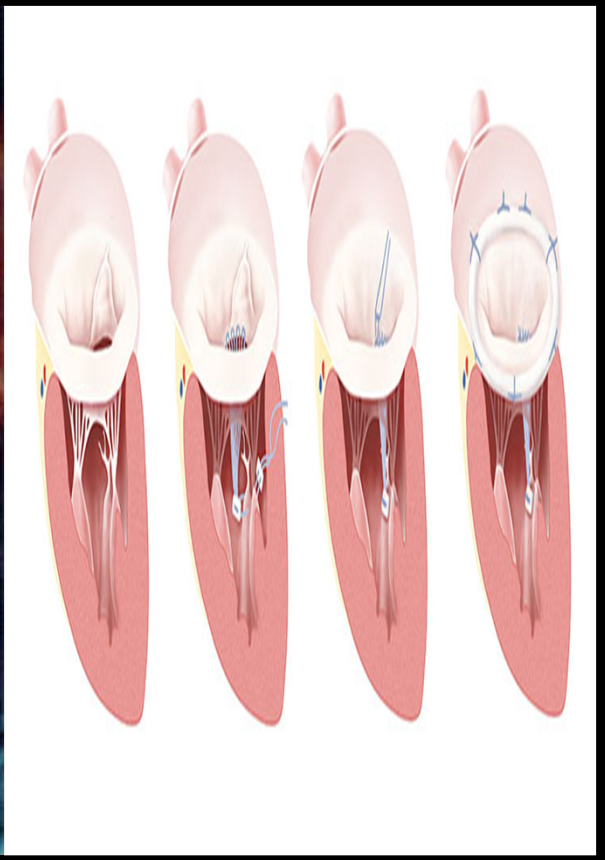
LV Enlargement

Posterior Leaflet Flail

Surgical Techniques







www.smw.ch

Mitral Valve Rings

The security of a proven design based on forty years of experience in mitral valve repair
Based on over 100,000 implants of the Carpentier-Edwards
Physio ring
Integrates new learning about mitral valve anatomy and physiology

The most frequently used mitral valve repair ring
The most clinically proven mitral valve repair ring

Reinforcement band that can be used for either mitral or tricuspid repair

Treat mitral regurgitation caused by the enlargement of the left ventricle

Incorporates an asymmetrical design for the restoration of mitral valve competency
Patients who are undergoing a CABG (coronary artery bypass grafting) procedure may benefit from a concomitant mitral valve repair if pre-operative tests show the presence of mitral regurgitation

Shaped to provide the same diameter of a normal mitral

TEE to Predict MV Repair Success

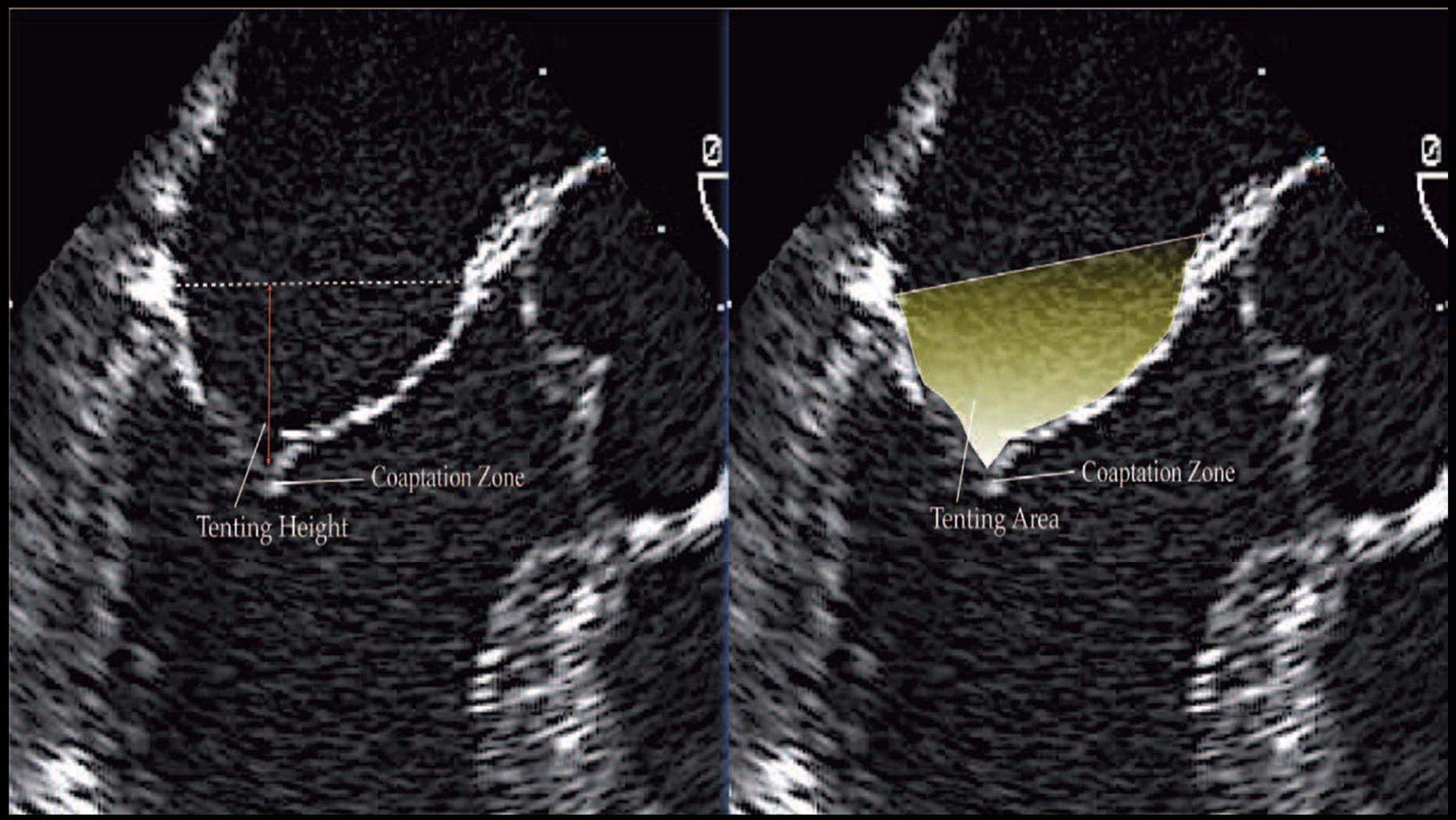
Failure

- Severe annular dilation
- Severe MAC
- Bileaflet Involvement
- Multi-segment disease

Success

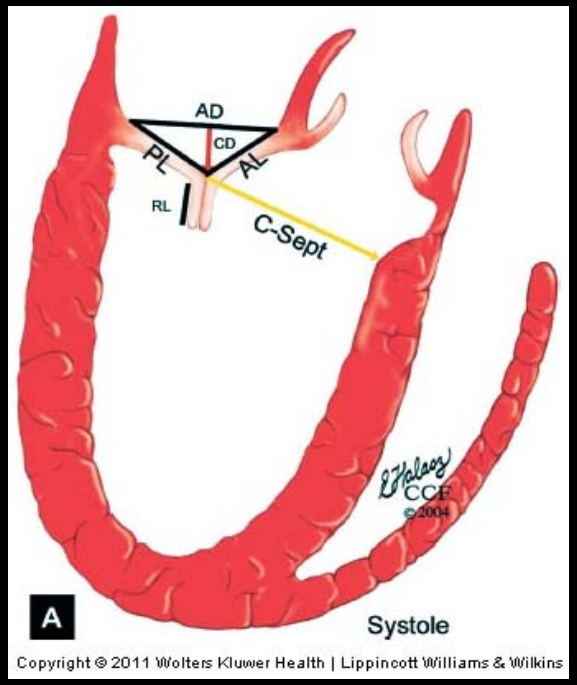
- Young Pt
- Long posterior leaflet
- Long chordae

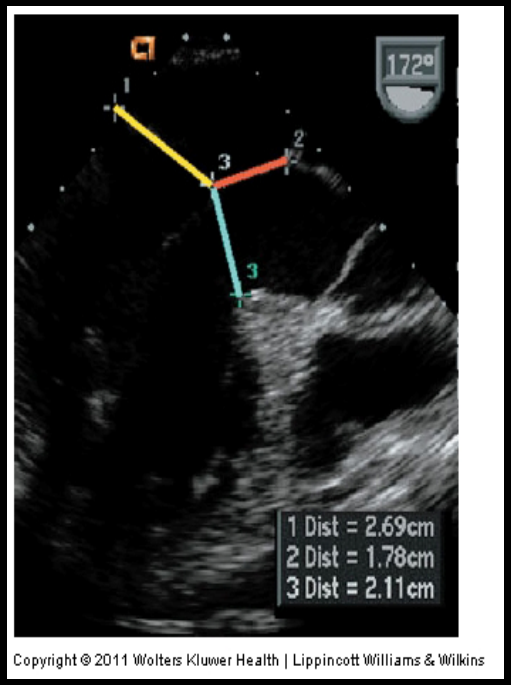
Ischemic MR Repair Prediction

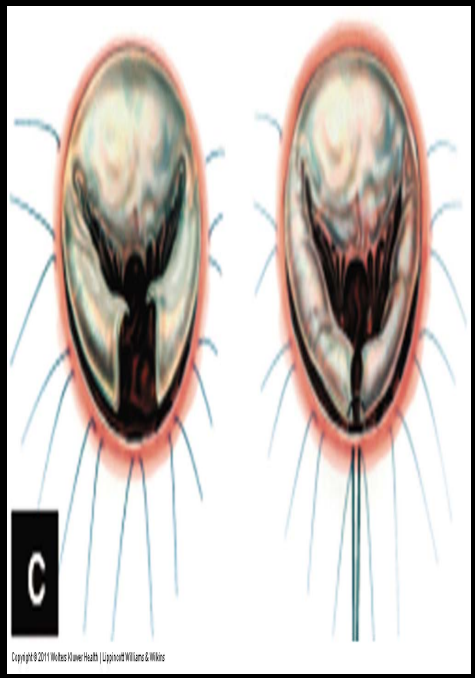


Systolic Anterior Motion Risk Factors

AL/PL ≤ 1.3
C-Sept ≤ 2.5 cm
A long, redundant anterior leaflet





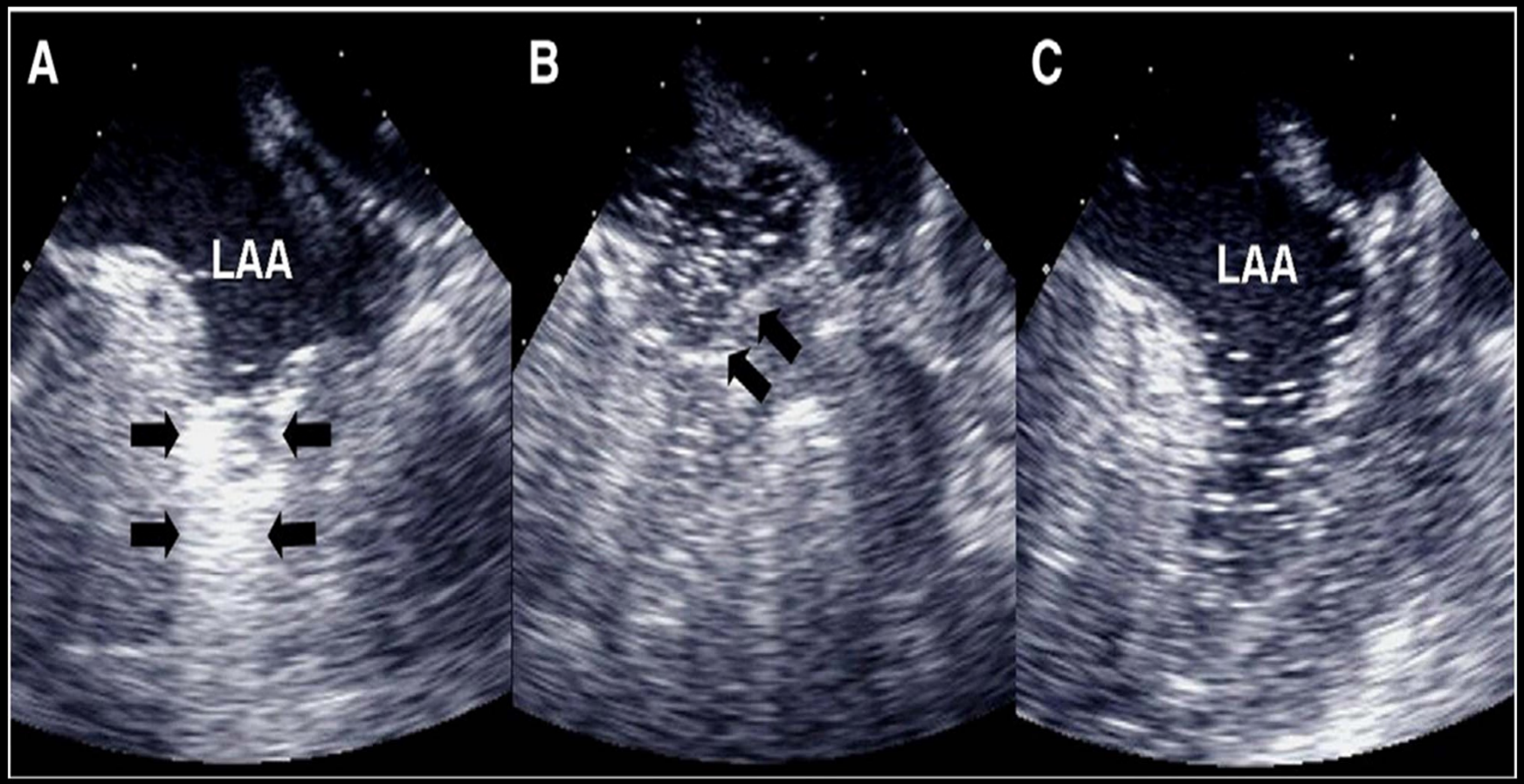


Savage R Comprehensive Textbook of Perioperative TEE 2011

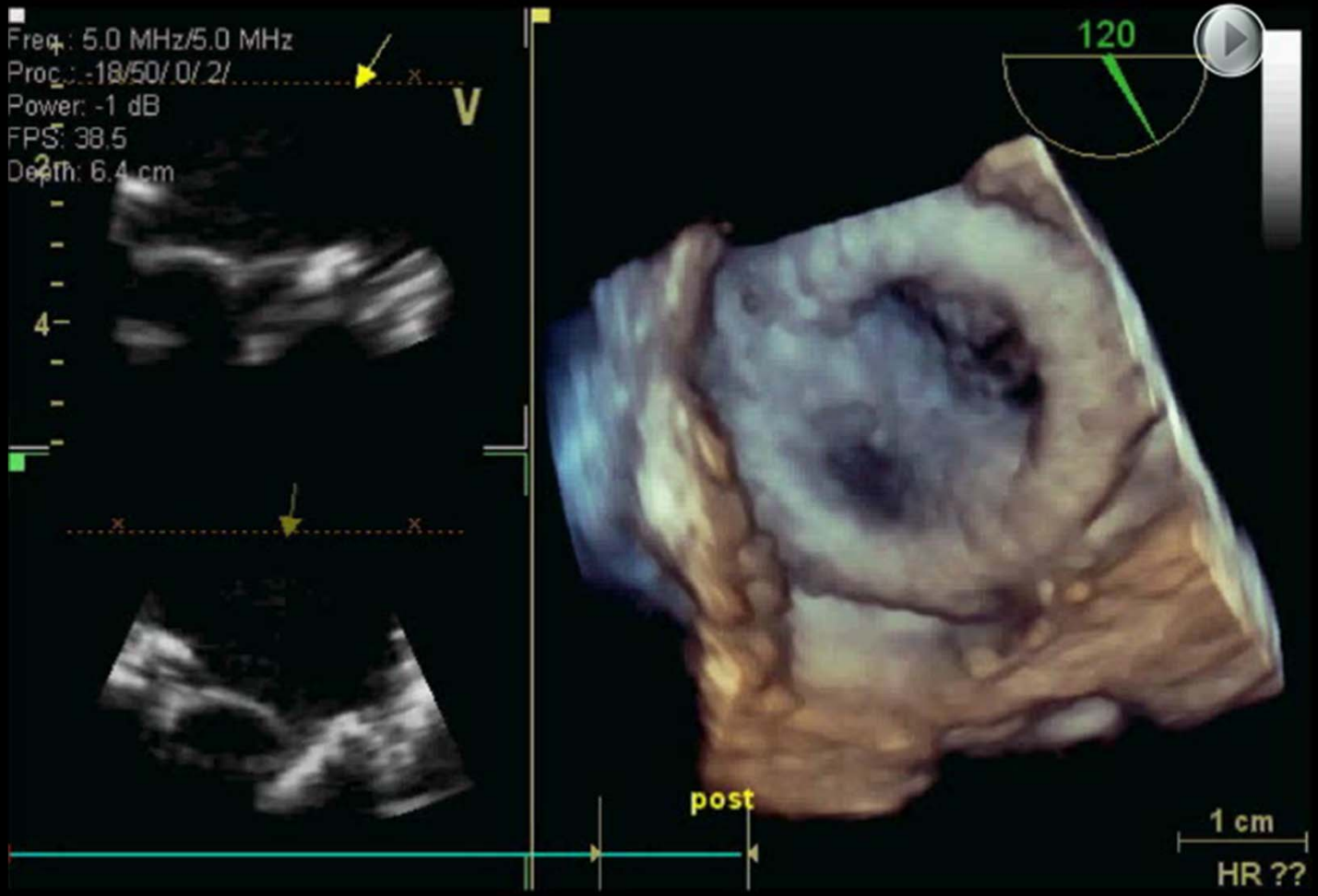
Post CPB TEE

- Timely presence of echocardiographer in operating room
- Assist surgeon in de-airing procedures
- Reassess left and right ventricular systolic function
- Anatomic and hemodynamic evaluation of valvular procedure result under appropriate hemodynamic conditions of heart rate, blood pressure and intra-cardiac volume
- Effective communication of residual severity of valvular dysfunction, anatomy and mechanism of dysfunction
- Rule out ascending aorta hematoma or dissection

De-Air



Perivalvular Leak



Post MVR Stenosis

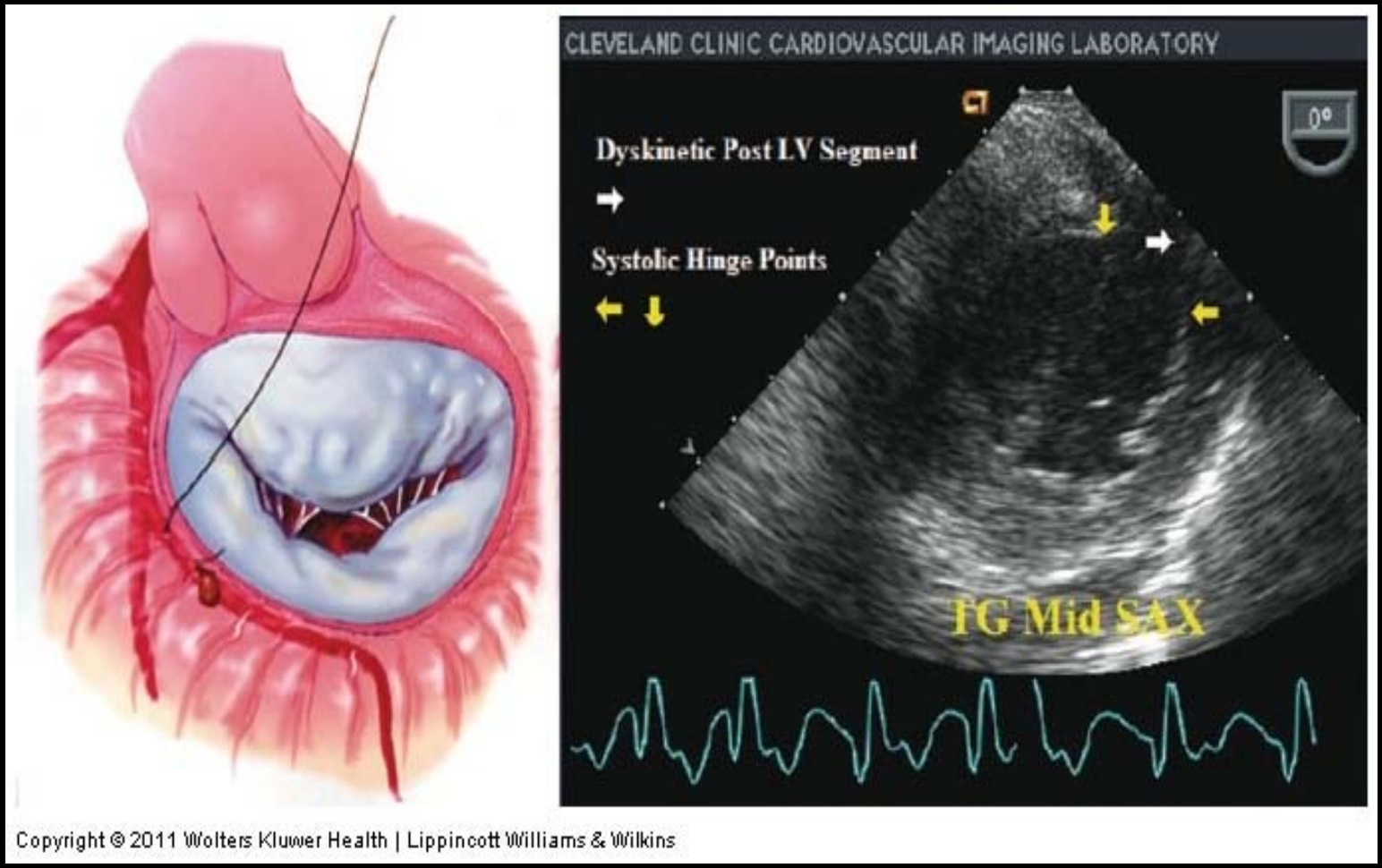
Mild: MVA >1.5cm^2
Mean Gr: <5mmHg

Moderate: MVA 1-1.5cm^2
Mean Gr: 5-10mmHg

Severe: MVA <1cm^2
Mean Gr: >10mmHg

Savage R Comprehensive Textbook of Perioperative TEE 2011

LCX Occlusion



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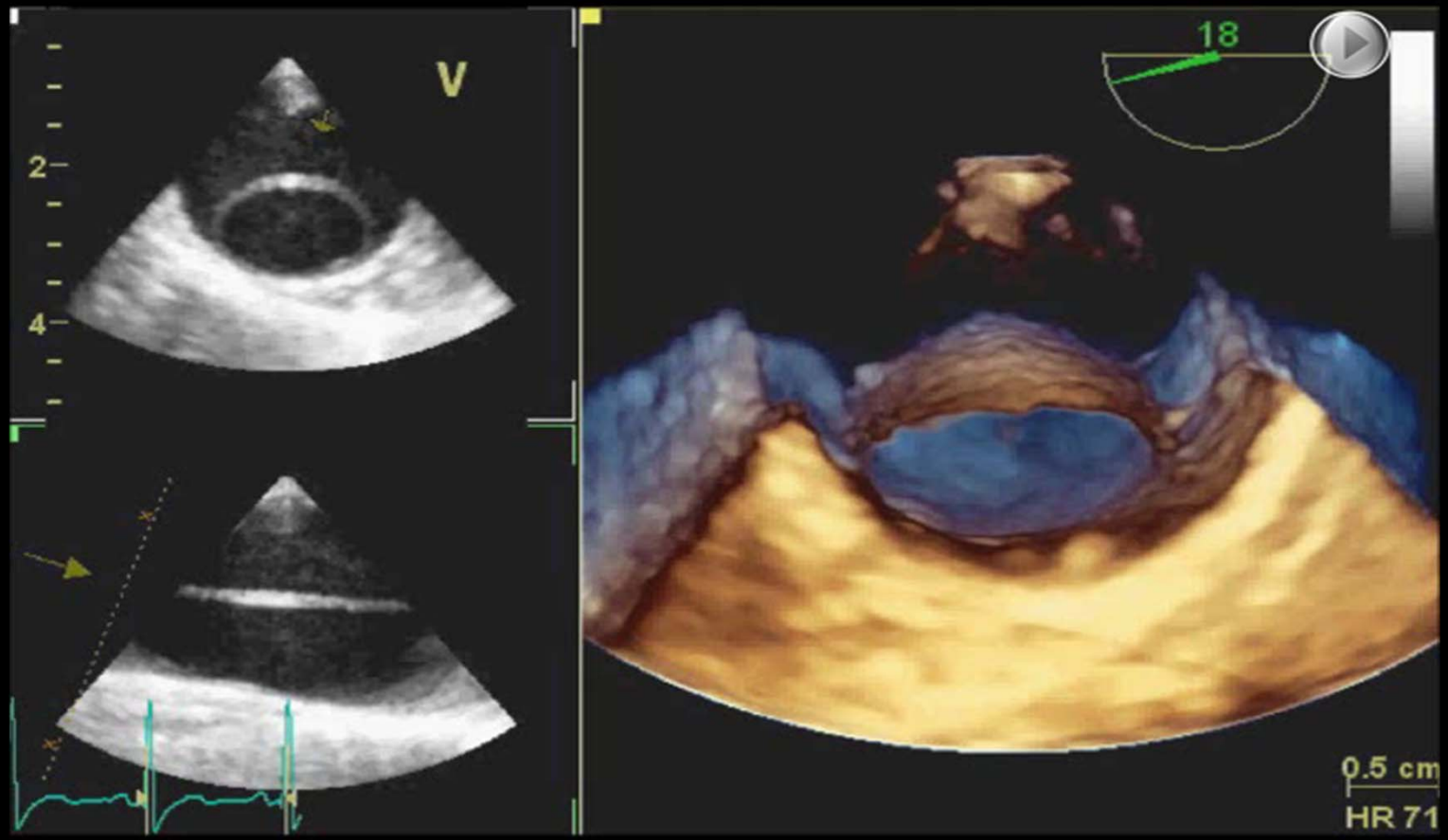
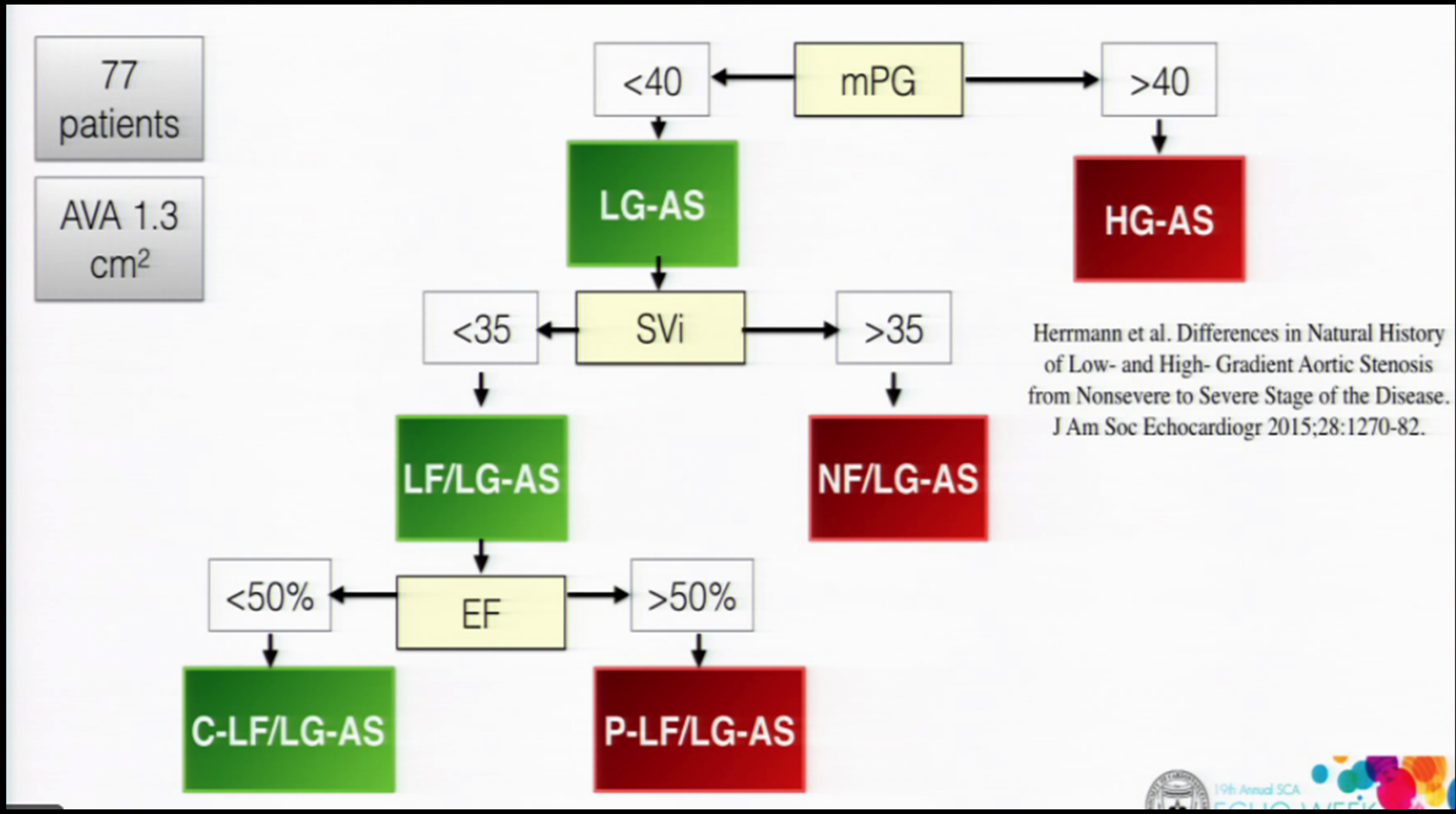
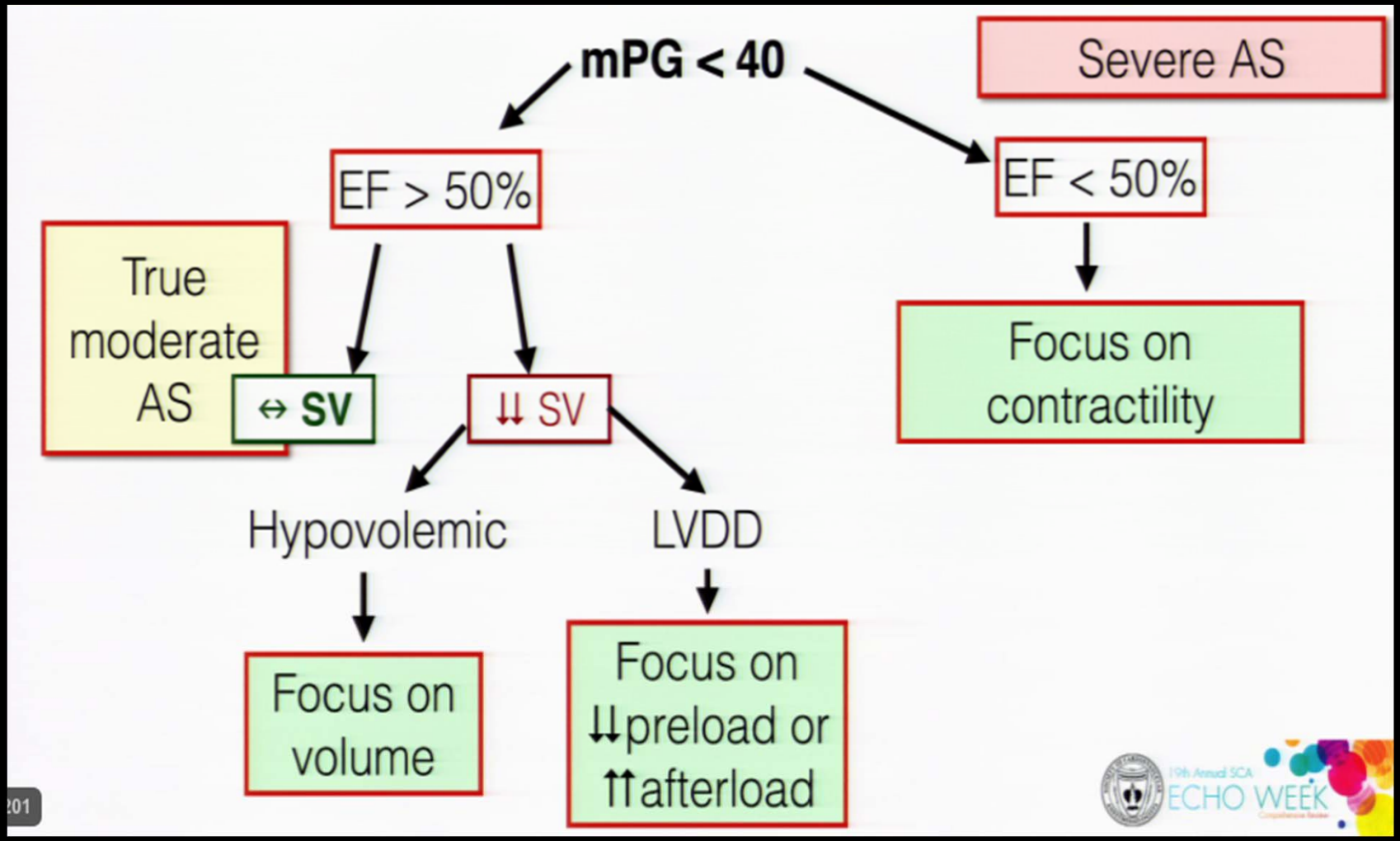
Aortic Dissection Post CPB



Aortic Valve-Low Gradient Aortic Stenosis

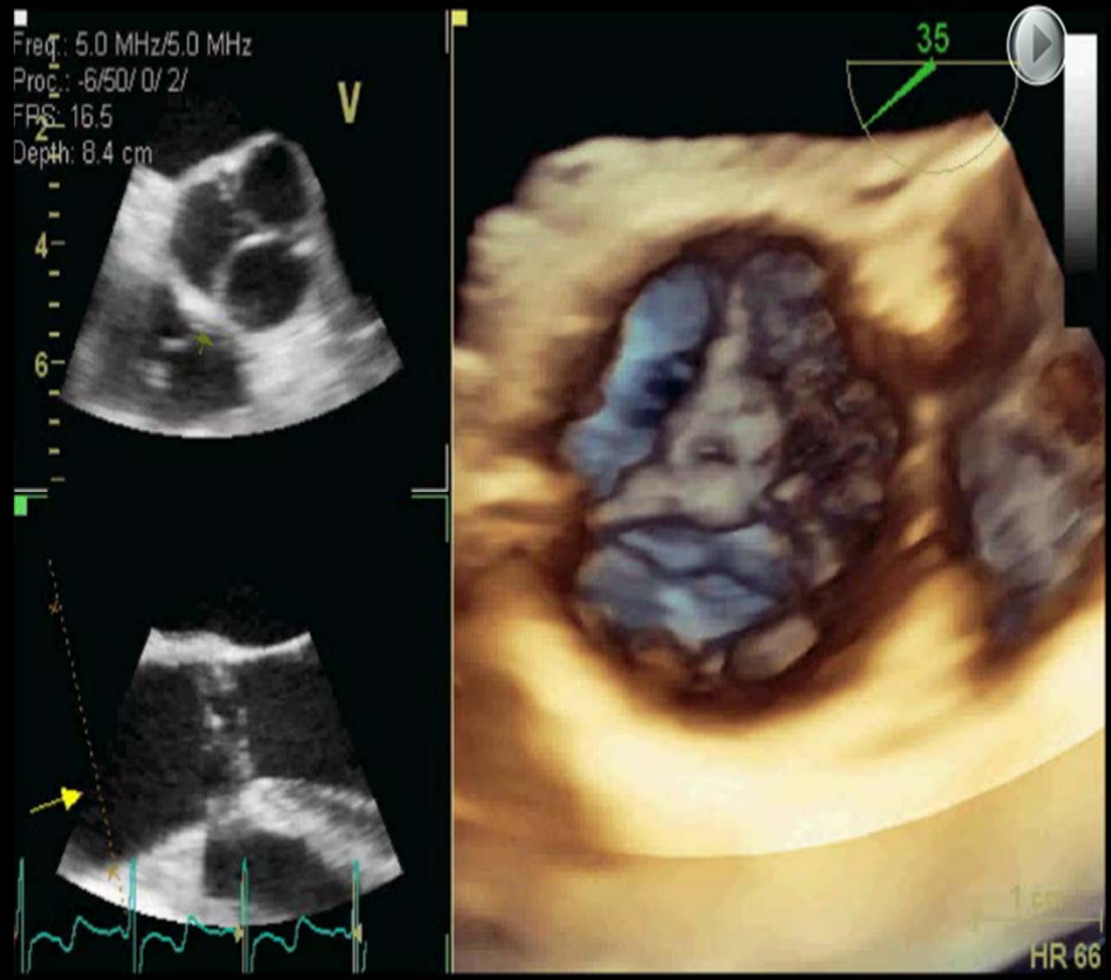


Aortic Valve in the OR-AS Low Gradient

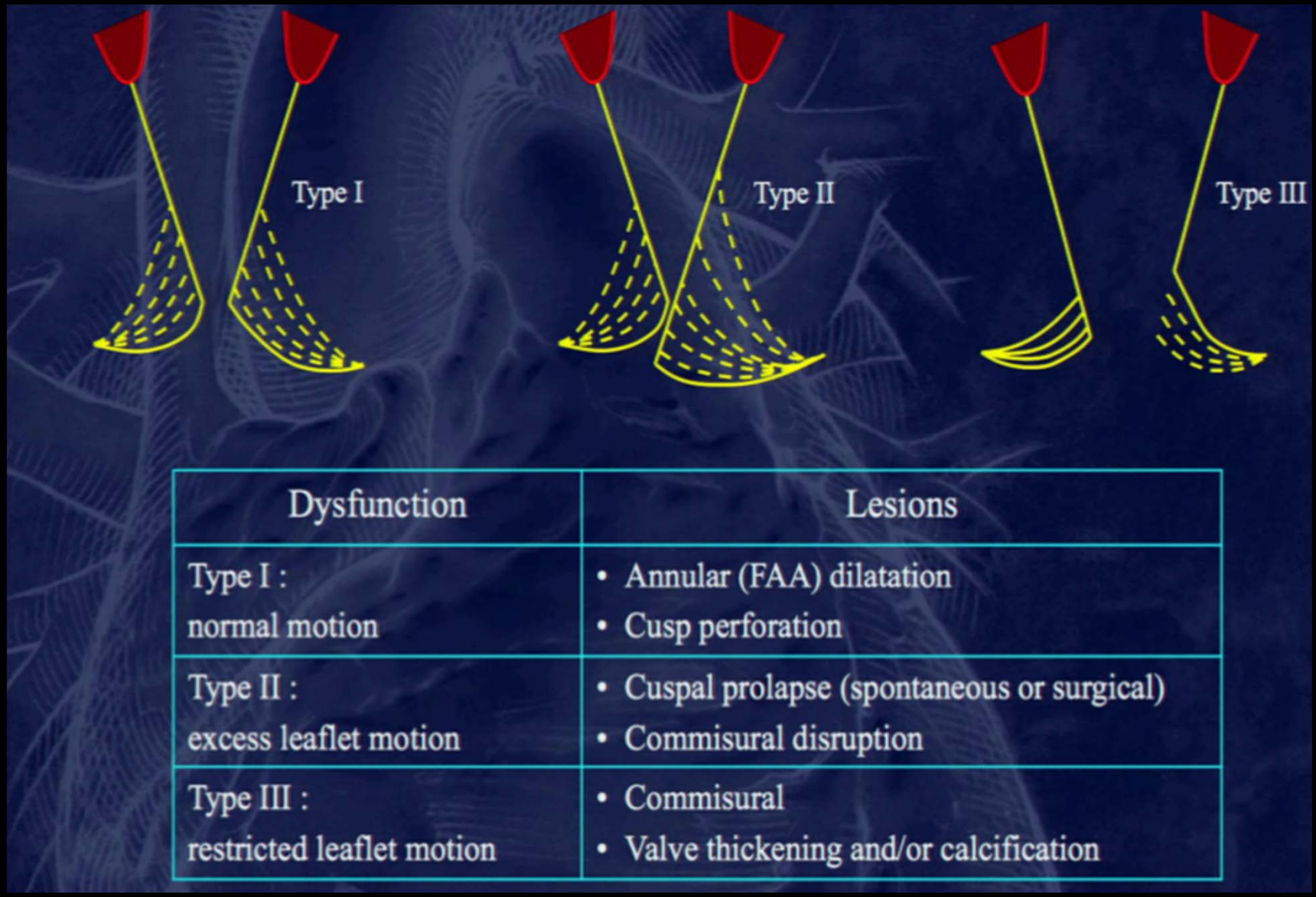


Aortic Valve Regurgitation

1. Trileaflet
2. Dilated SOV
3. LCC Prolapse
4. CDF to identify origin of AR

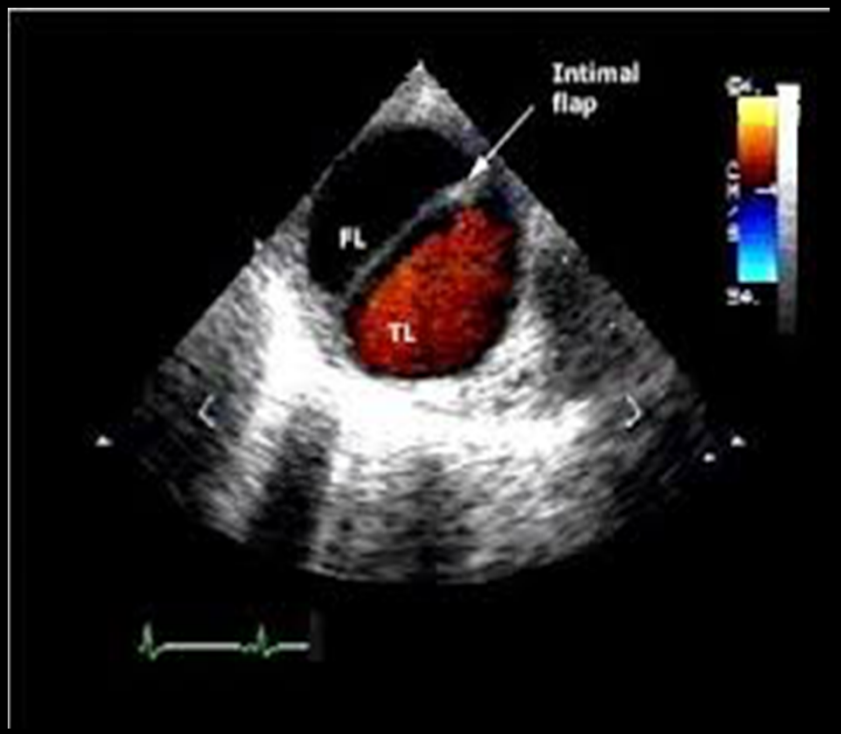


Aortic Regurgitation Mechanisms



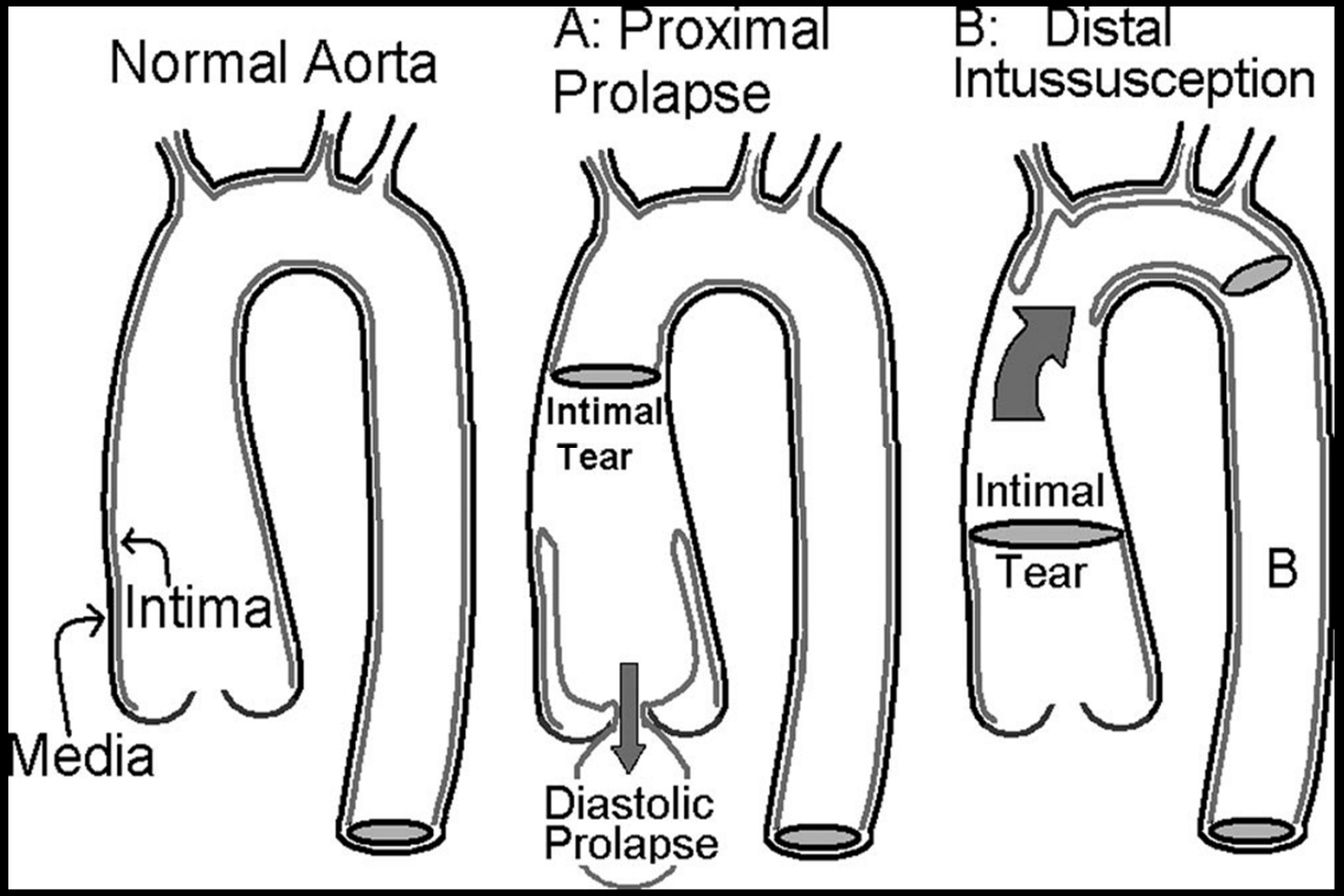
Dysfunction	Lesions
Type I : normal motion	• Annular (FAA) dilatation • Cusp perforation
Type II : excess leaflet motion	• Cuspal prolapse (spontaneous or surgical) • Commisural disruption
Type III : restricted leaflet motion	• Commisural • Valve thickening and/or calcification

Aortic Dissection True/False Lumen Entry Point



www.cursoenarm.net

Aortic Regurgitation Caused by Dissection



Coronary Involvement

J Am Soc Echocardiogr 2015;28:119-82.

Summary

- Hemodynamic changes under anesthesia will affect TEE results
- Intraoperative TEE to focus on mechanism and implications for surgical techniques
- Identify complications from surgery