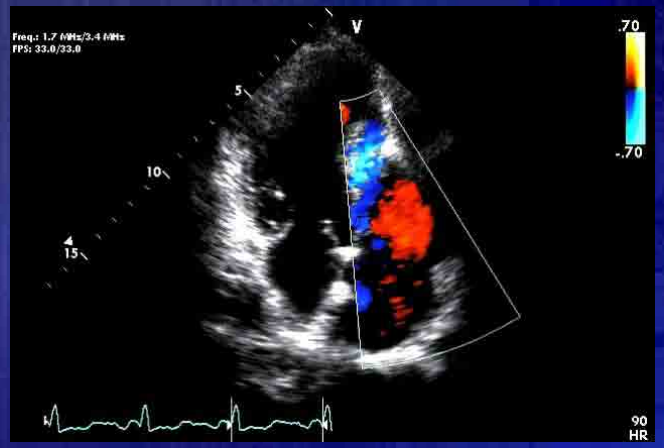
Mechanical Complications after AMI Echo Evaluation

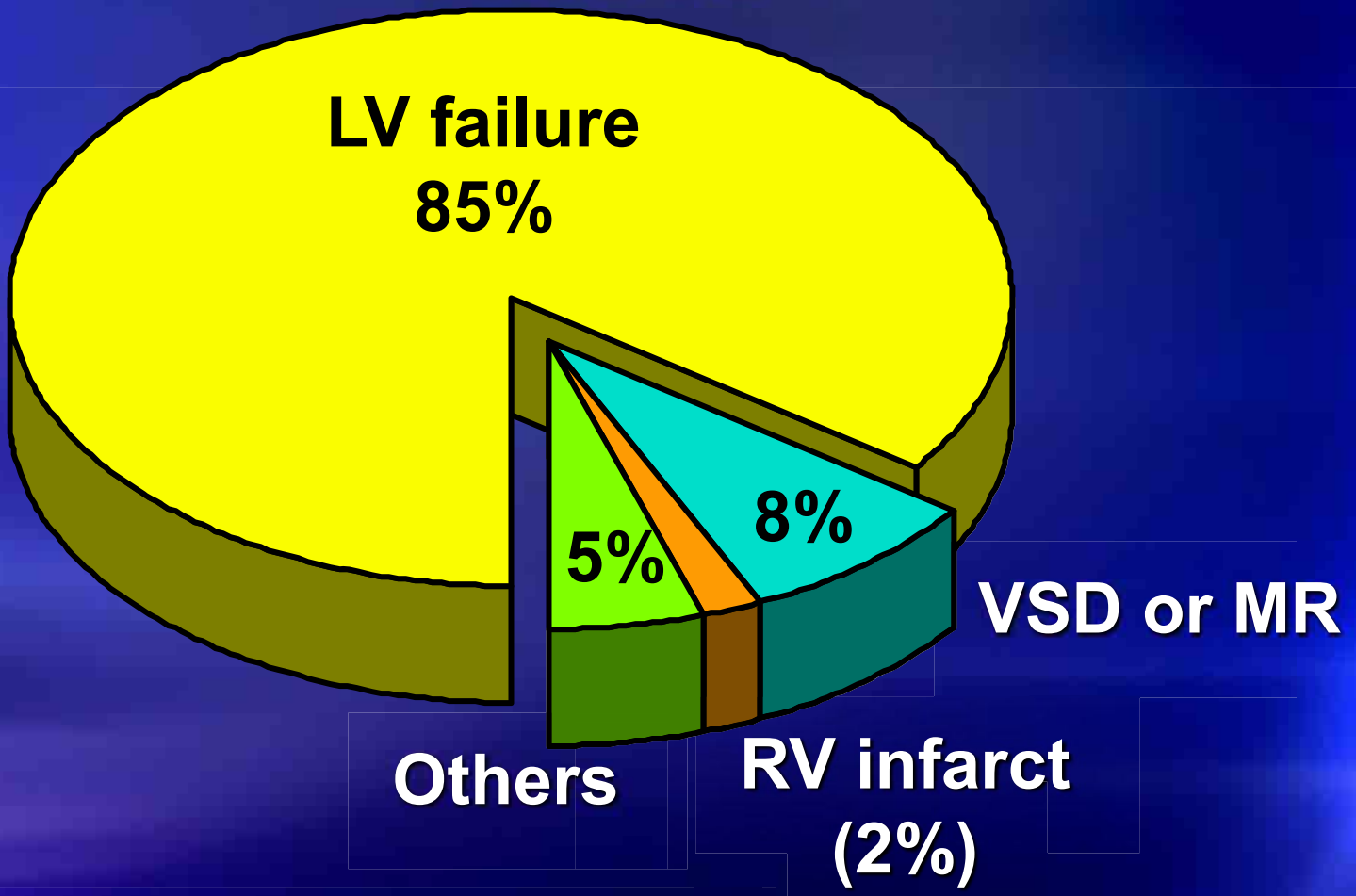


Torino, Italy
October 21, 2011

Jae K. Oh, MD

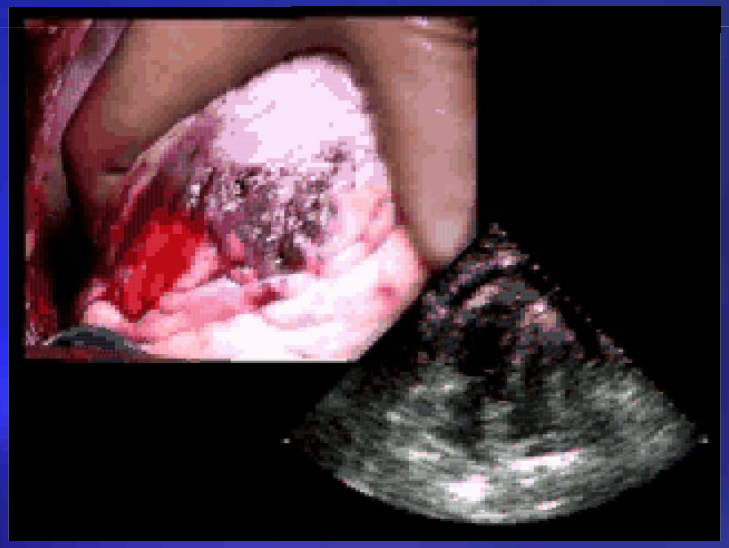
CP1204347-6

Cardiogenic Shock After AMI
Causes

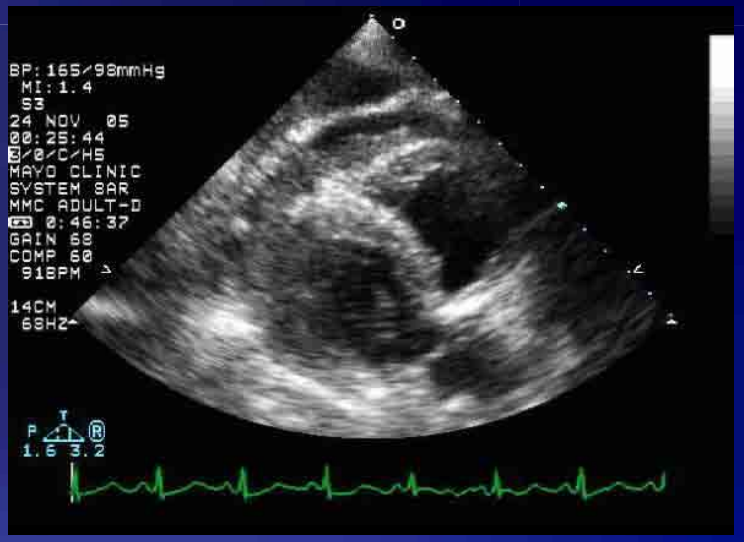


Hochman et al: Circ, 1995 for Shock Trial

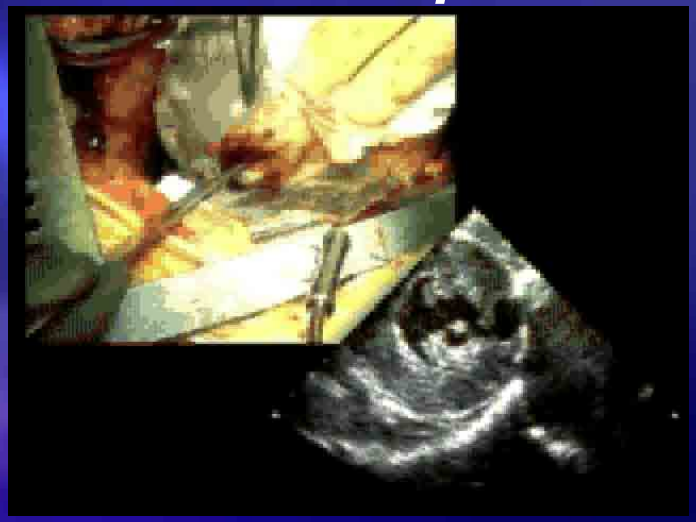
Ruptures after AMI



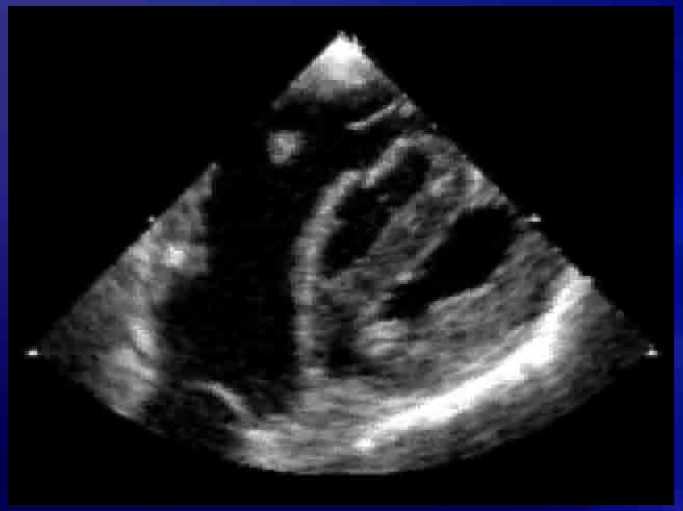
Free Wall Rupture



Hemopericardium

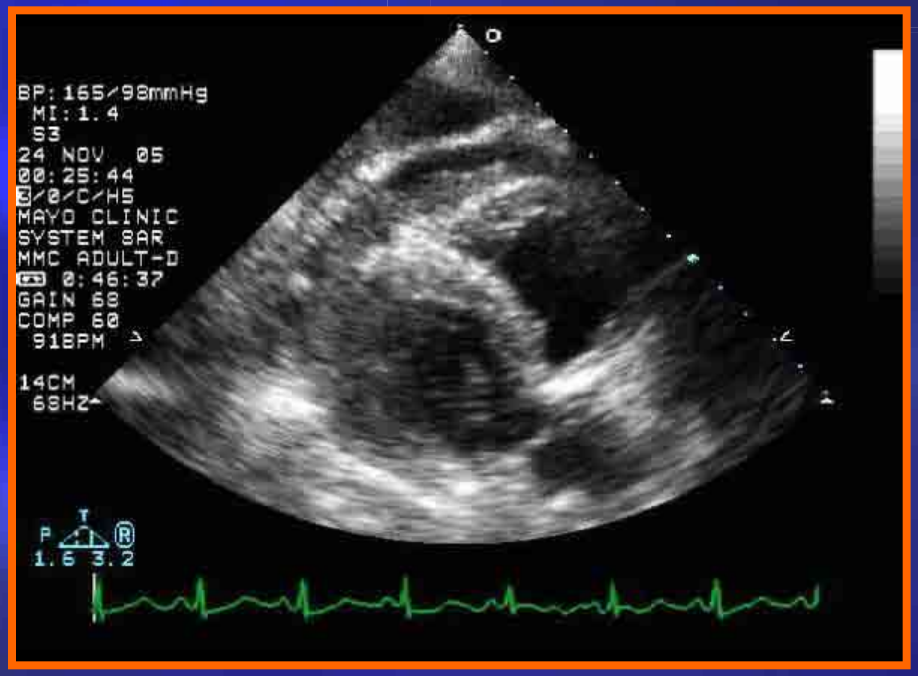


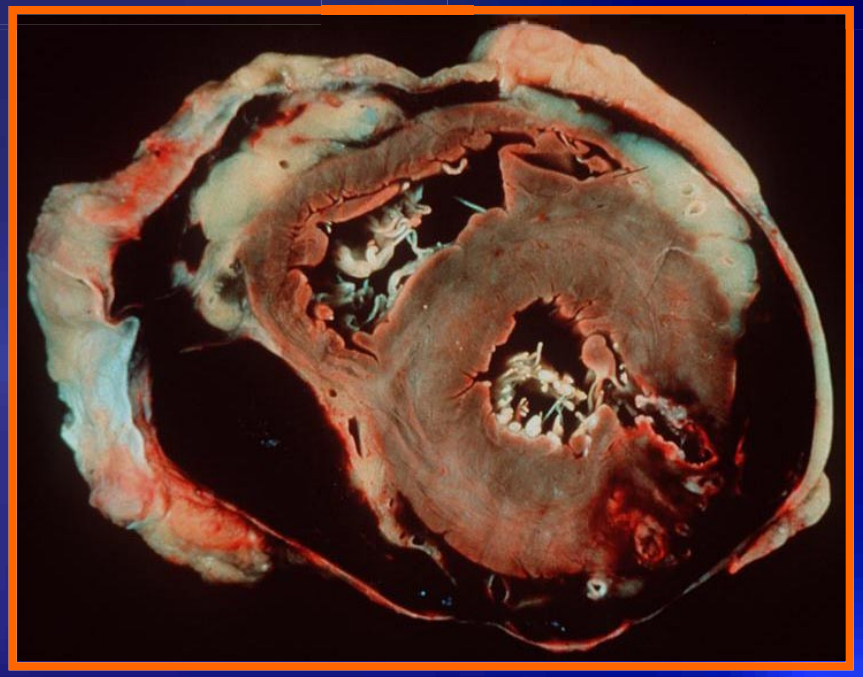
Subepicardial Aneurysm



Ventricular Septal Rupture

Hemopericardium
Free Wall Rupture

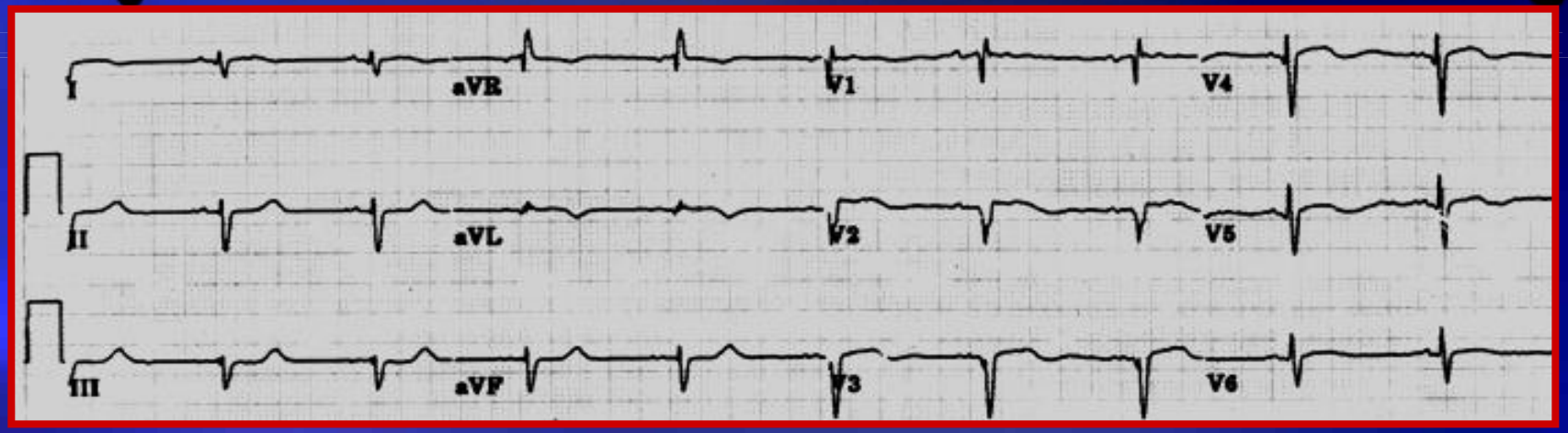


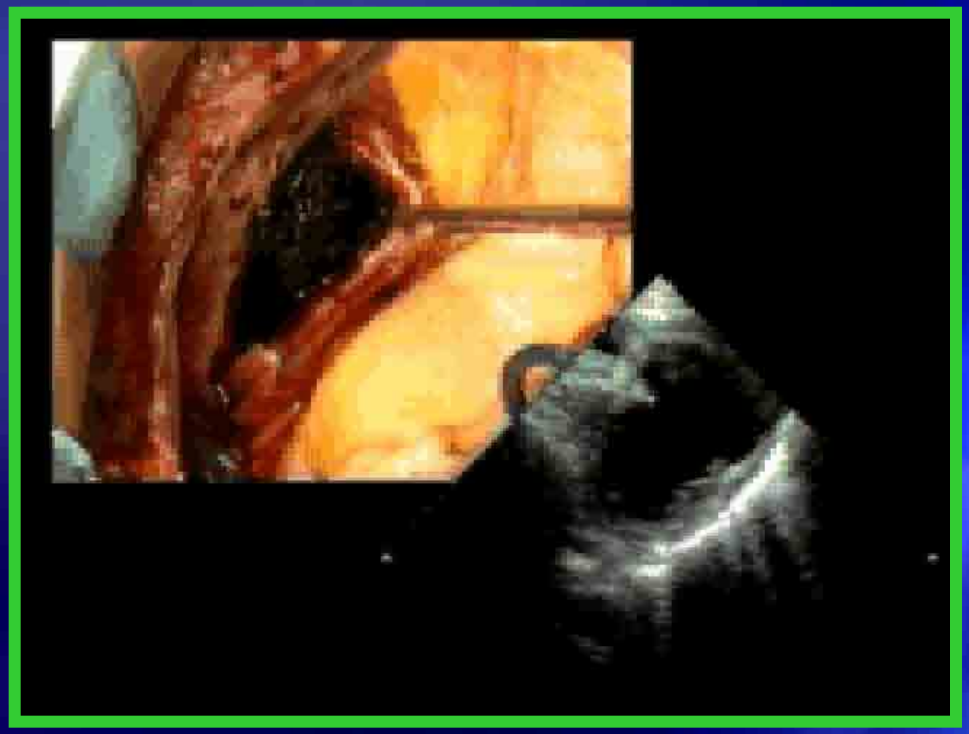


Most common in the lateral wall
Usually first infarct in elderly woman

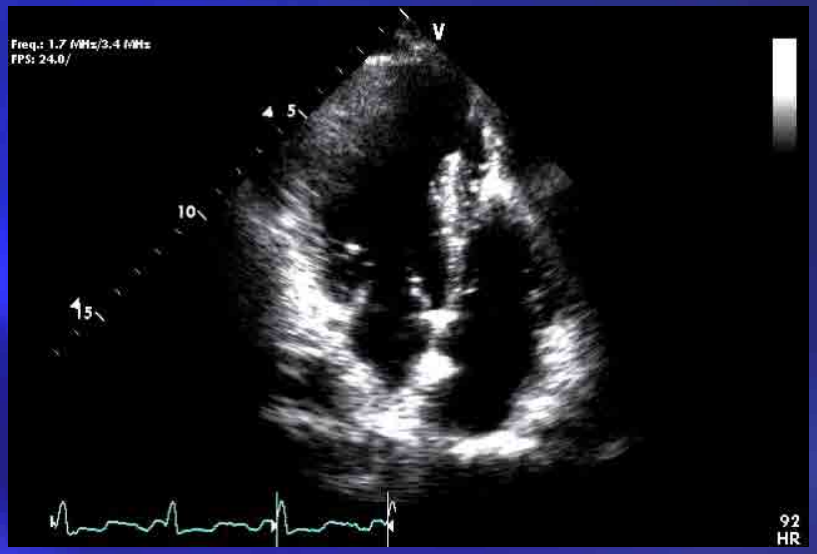
Subepicardial Aneurysm

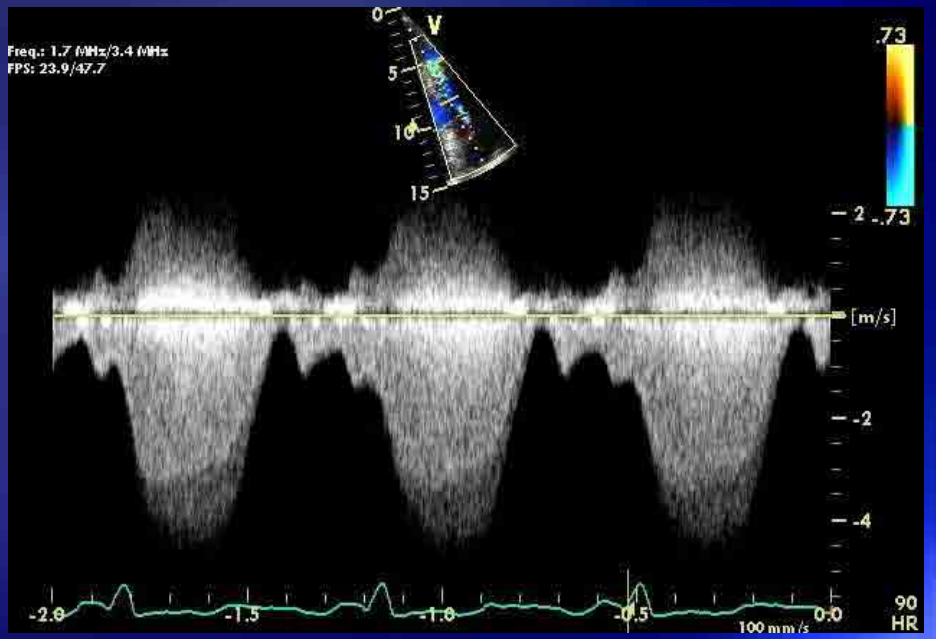
57 yo Man with Anterolateral MI 6 months ago

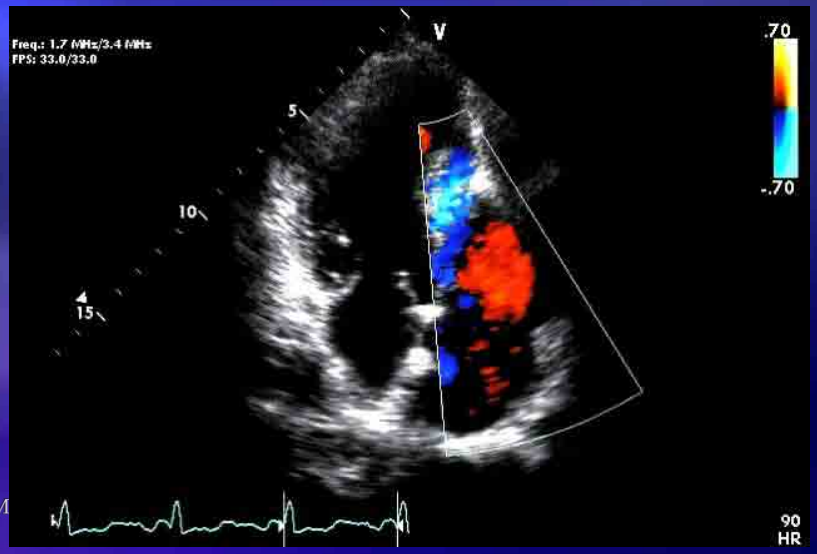




Ventricular Septal Rupture
62 year old man with anterior MI







Post Infarction Ventricular Septal Defect Can We Do Better?

Marek A. Deja, Jacek Szostek, Kazimierz Widenka, Bartlomiej Szafron, Tomasz J. Spyt, Mark St.J. Hickey, Andrzej W. Sosnowski

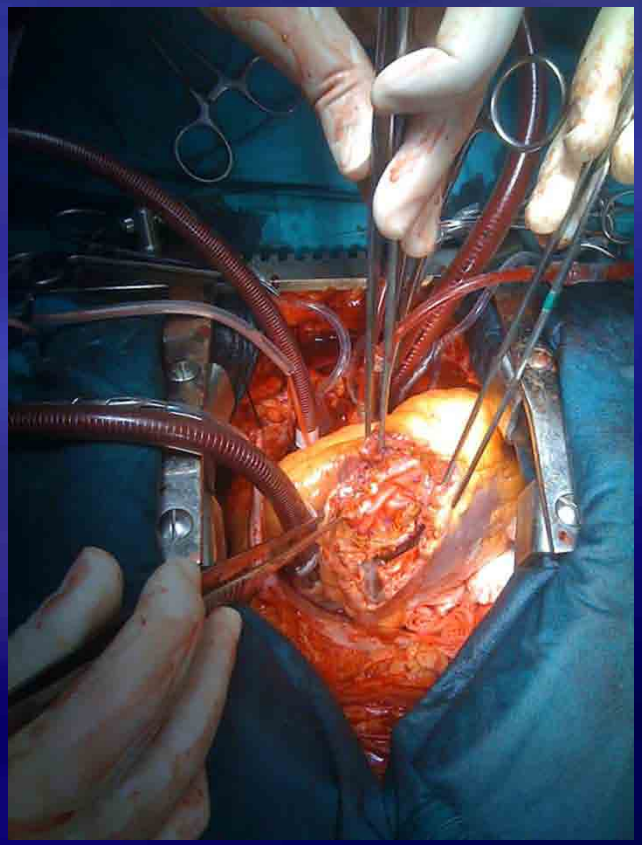
International CT Surgery 18; 2000

Conclusions – Preoperative cardiogenic shock and early postinfarction septal rupture carry a grave prognosis ***(47/117; 37% death in 30 days).*** Achieving haemodynamic stability prior to surgery may be beneficial but prolonged attempts to improve patients' cardiovascular state are hazardous.

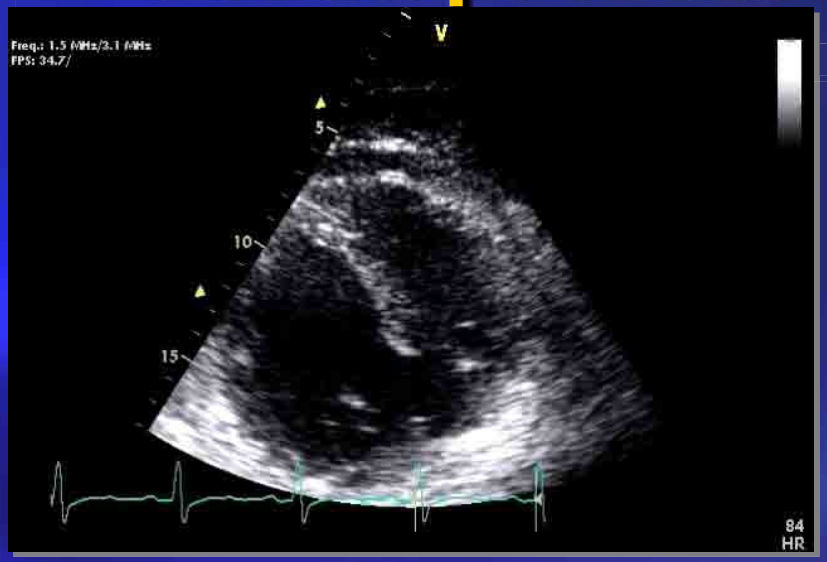
The use of Impella Recover in the treatment of post-infarction ventricular septal defect: A new case report

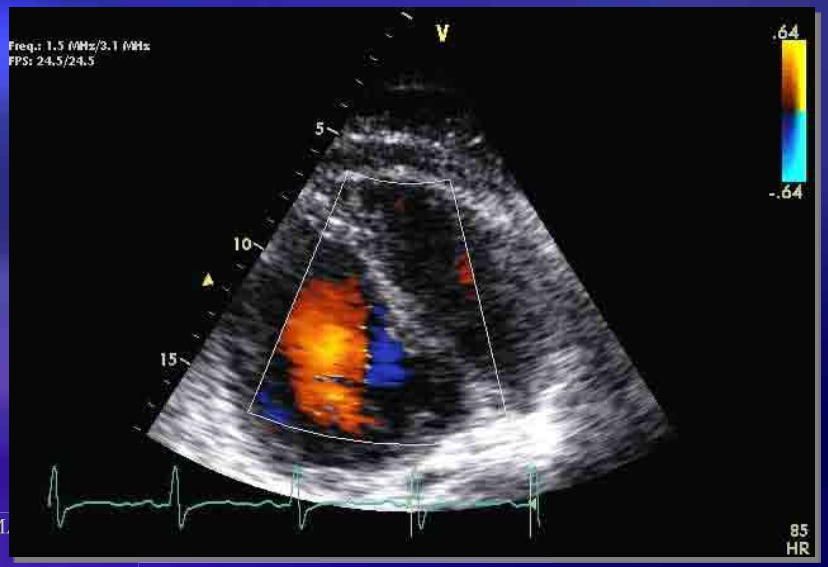
Francesco Patanè [a,*], Rosario Grassi [b], Maria Chiara Zucchetti [c], Fabrizio Ceresa [a], Angelo Davide Amata [a], Edoardo Zingarelli [d], Fabrizio Sansone [d], Filippo Marte [e], Salvatore Patanè [e]

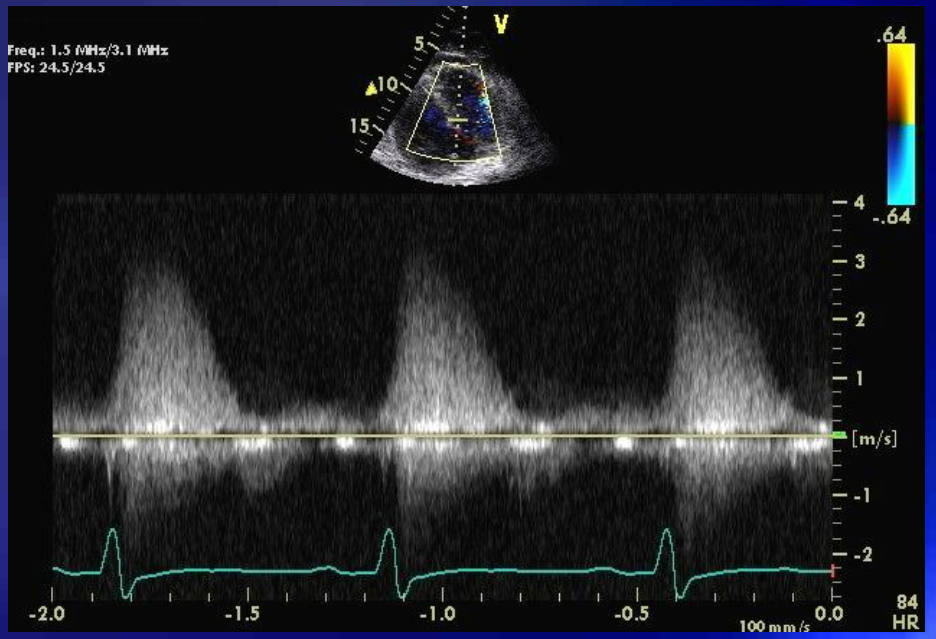
[a] *Cardiac Surgery Division, Papardo Hospital, Messina, Italy*
[b] *Cardiological Division, Papardo Hospital, Messina, Italy*
[c] *Cardiac Surgical Intensive Care, Papardo Hospital, Messina, Italy*
[d] *Cardiac Surgery Division, Mauriziano Hospital, Turin, Italy*
[*] *Cardiologia Nuovo Presidio Ospedaliero Cutroni Zodda–Barcellona P.d.G(Me) AUSL5, Messina, Italy*



58 year old man with inferior MI
Blood pressure 116/80 mmHg

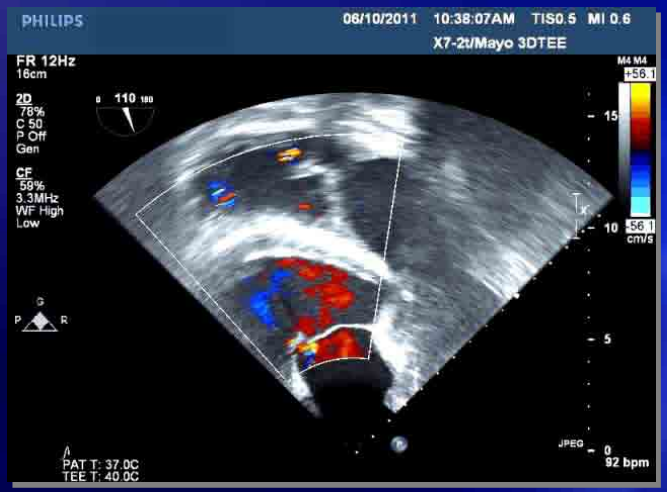




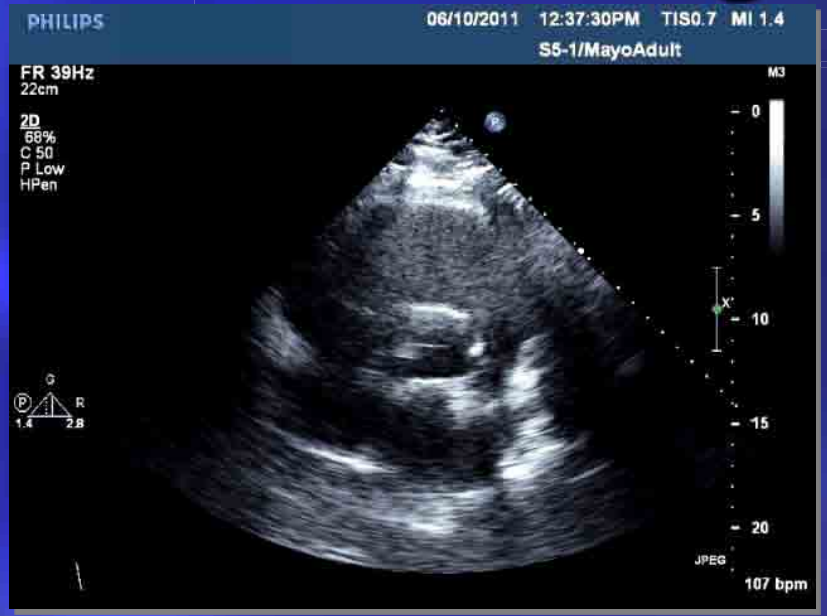


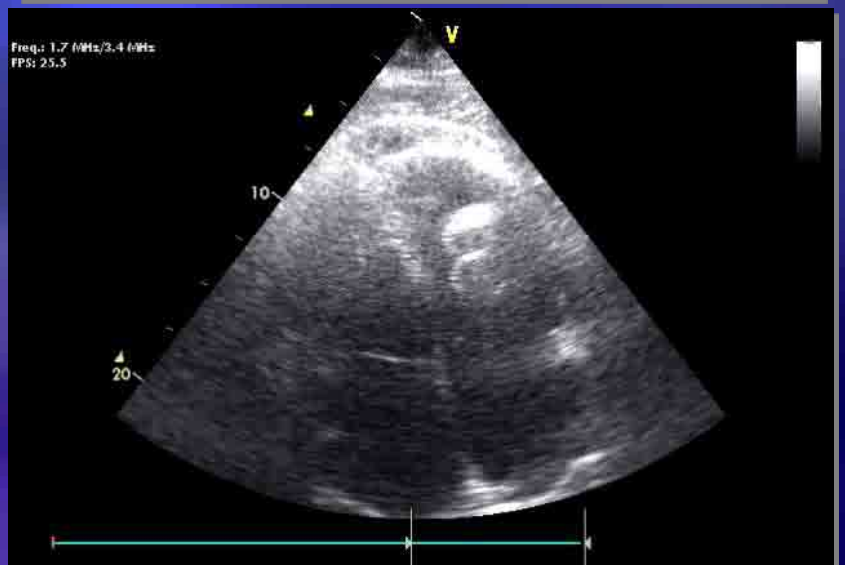
RV Systolic Pressure 80 mmHg

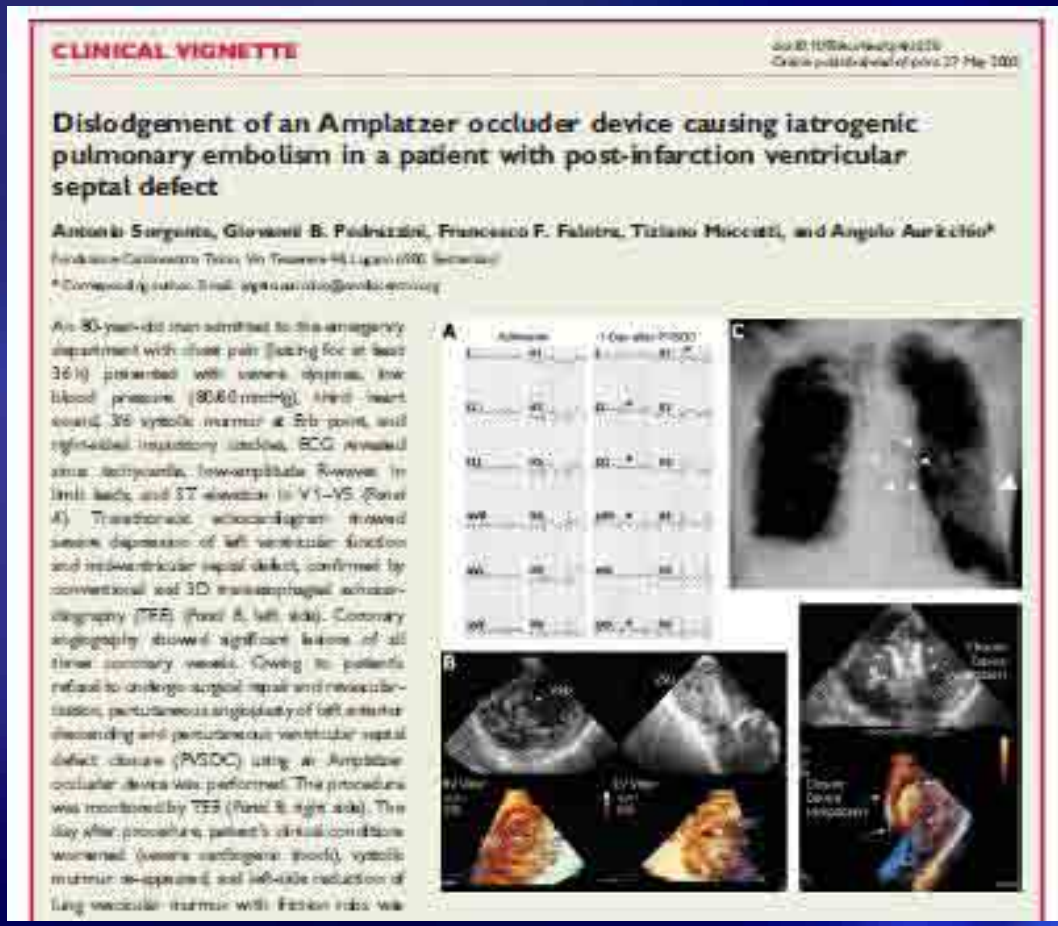
58 year old man with inferior MI and VSD Closure with 30 mm Amplatzer Devise



Soon after Devise Closure of VSD Devise migration to RVOT/ PA





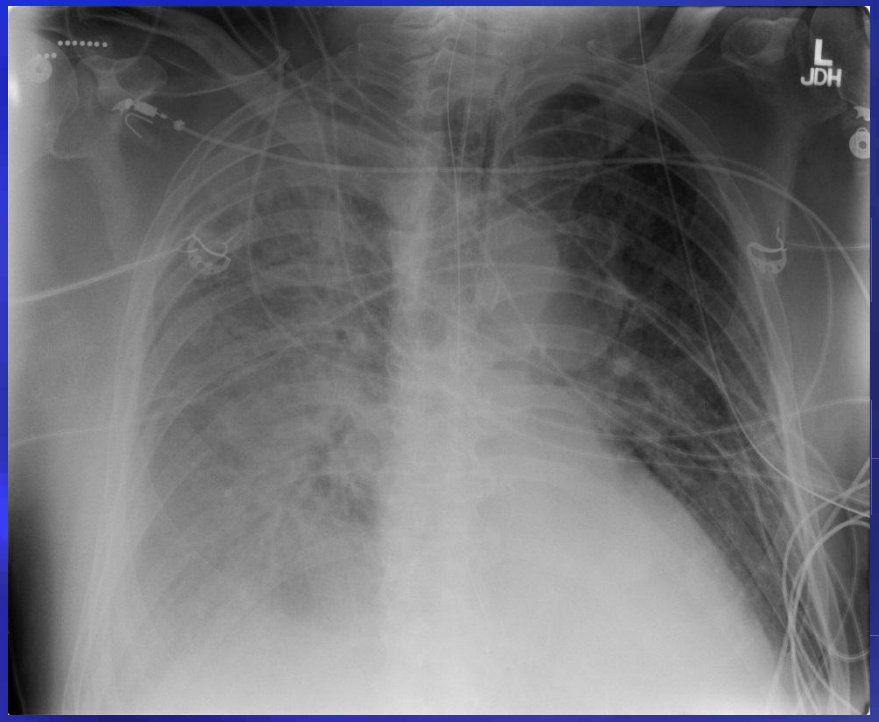


CLINICAL VIGNETTE

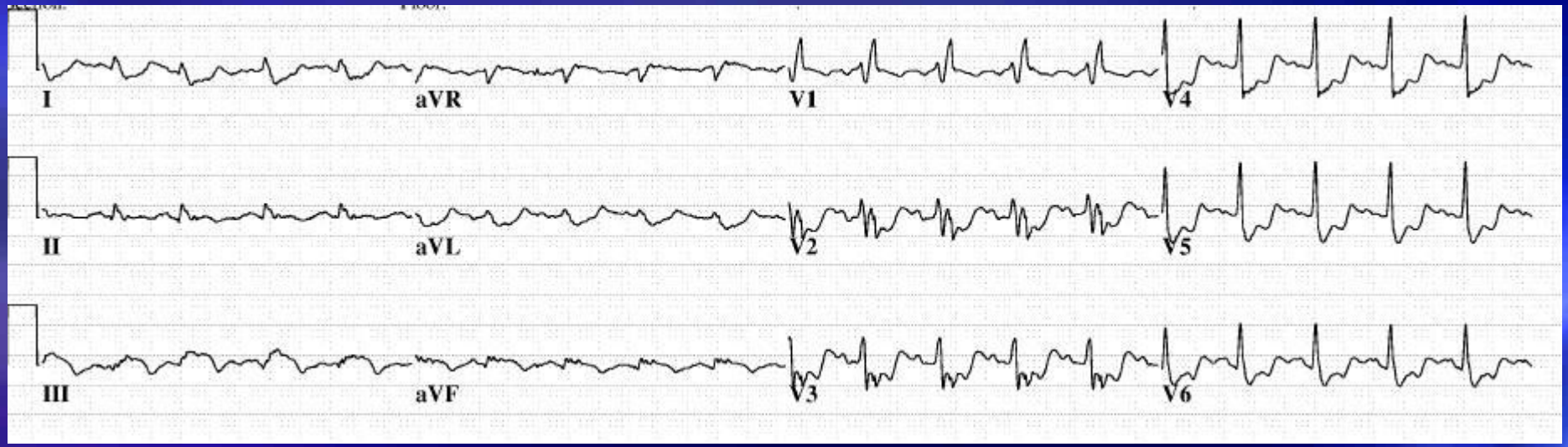
Dislodgement of an Amplatzer occluder device causing iatrogenic pulmonary embolism in a patient with post-infarction ventricular septal defect

Antonio Sorgente, Giovanni B. Pedrazzini, Francesco F. Faletra, Tiziano Moccetti, and Angelo Auricchio*

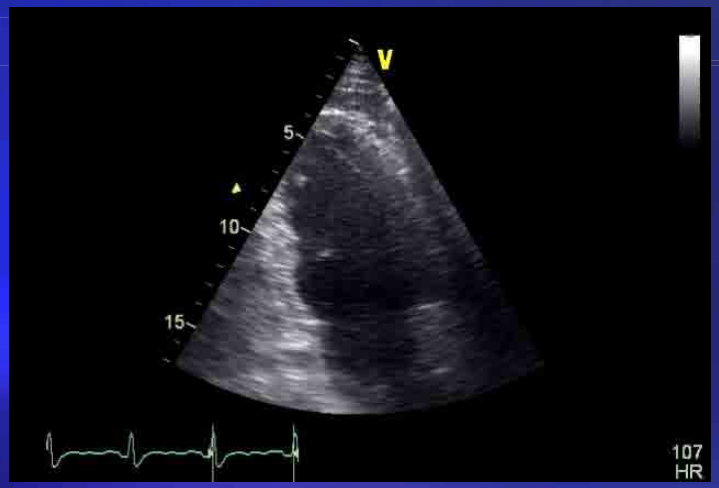
Sorgente , Auricchio et al EHJ May 2008



84 yo man
One week hx of SOB
Treated initially for pneumonia



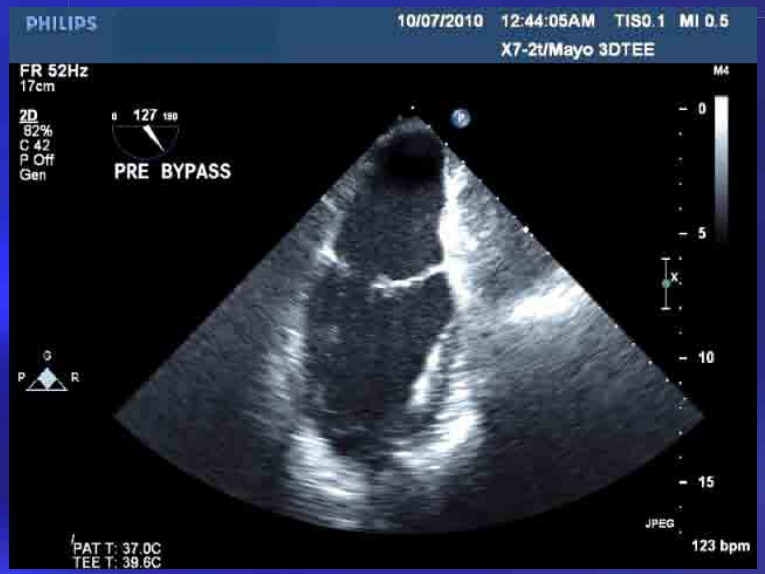
84 yo man with dyspnea and hypotension
No murmur

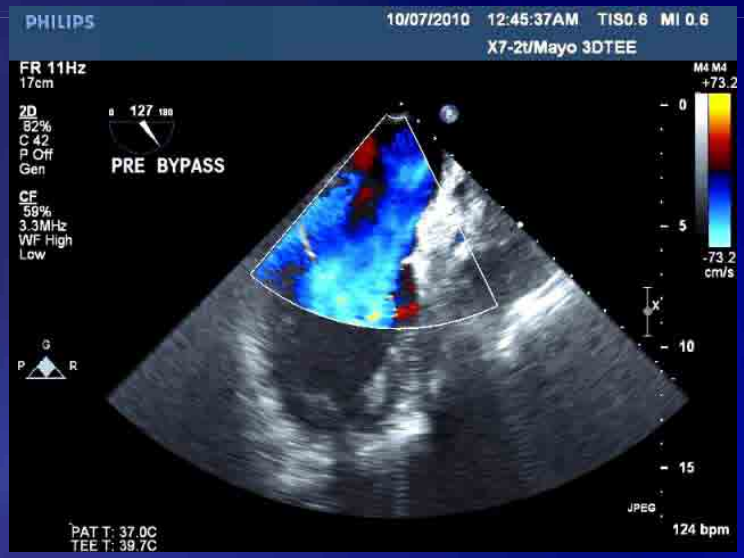


1= Flail Mitral Valve 2= Ruptured PM

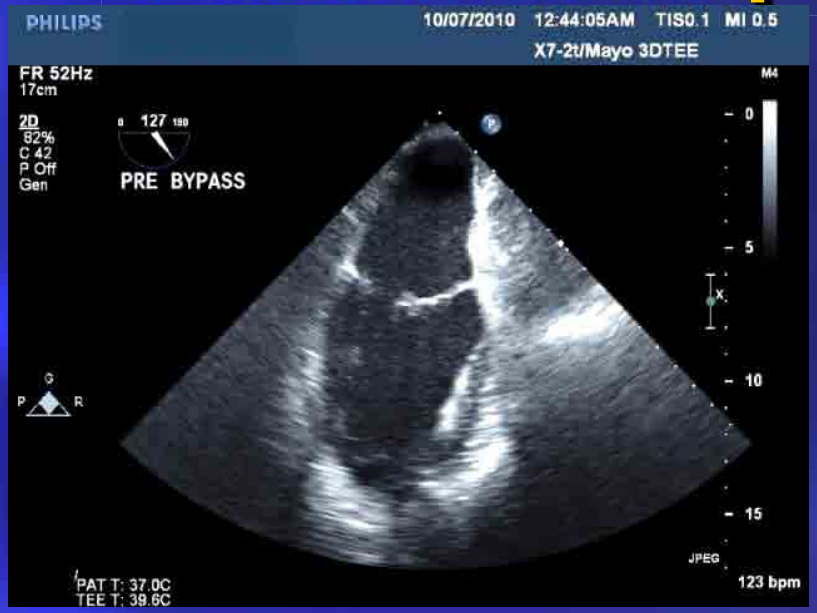
3=Ventricular Septal Rupture 4= LV Dysfunction

TEE in 84 year old man with dyspnea
Partial PM Rupture and Severe MR





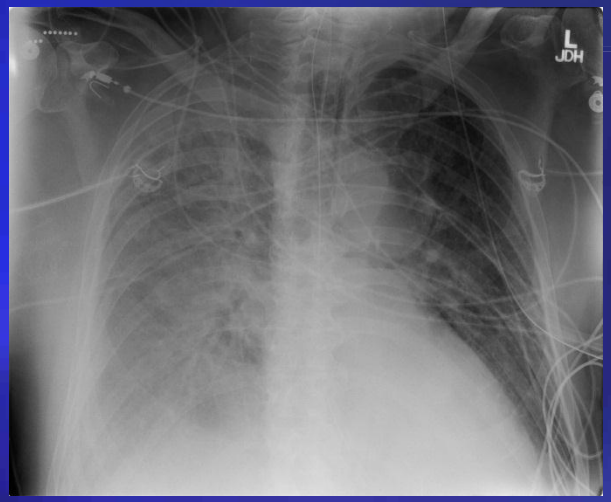
84 year old man with dyspnea
Partial PM Rupture and Severe MR

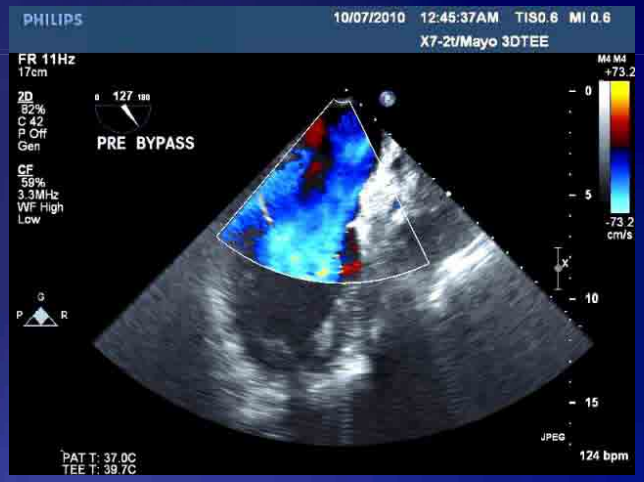


MVR, CABG to RCA, and RVAD

Complete Rupture

84 yo man with PM rupture
Unilateral Pulmonary Edema





Valvular Heart Disease

Circ 2010

Prevalence, Characteristics, and Outcomes of Patients Presenting With Cardiogenic Unilateral Pulmonary Edema

David Attias, MD; Nicolas Mansencal, MD, PhD; Bertran Auvert, MD, PhD; Antoine Vieillard-Baron, MD, PhD; Aurélie Delos, MD; Pascal Lacombe, MD; Roland N'Guetta, MD; François Jardin, MD; Olivier Dubourg, MD

2% of cardiac pulmonary edema and associated with MR in 100%

Clinical Outcome After Surgical Correction of Mitral Regurgitation Due to Papillary Muscle Rupture

Antonio Russo, MD; Rakesh M. Suri, MD; Francesco Grigioni, MD; Véronique L. Roger, MD, MPH; Jae K. Oh, MD; Douglas W. Mahoney, MD; Hartzell V. Schaff, MD; Maurice Enriquez-Sarano, MD

Circulation 118: 1528 October 2008

Conclusions – Surgery for post-MI PMR involves a notable operative mortality, but there are recent trends for lower operative risk, particularly with associated coronary artery bypass graft. Long term after surgery, outcome is restored to that of similar MI without PMR. These encouraging observations emphasize the importance of prompt diagnosis and aggressive therapeutic approach for patients incurring PMR after MI.

Late Survival in Operative Survivors of Surgery for Post-MI PMR vs Patients with MI Without PMR

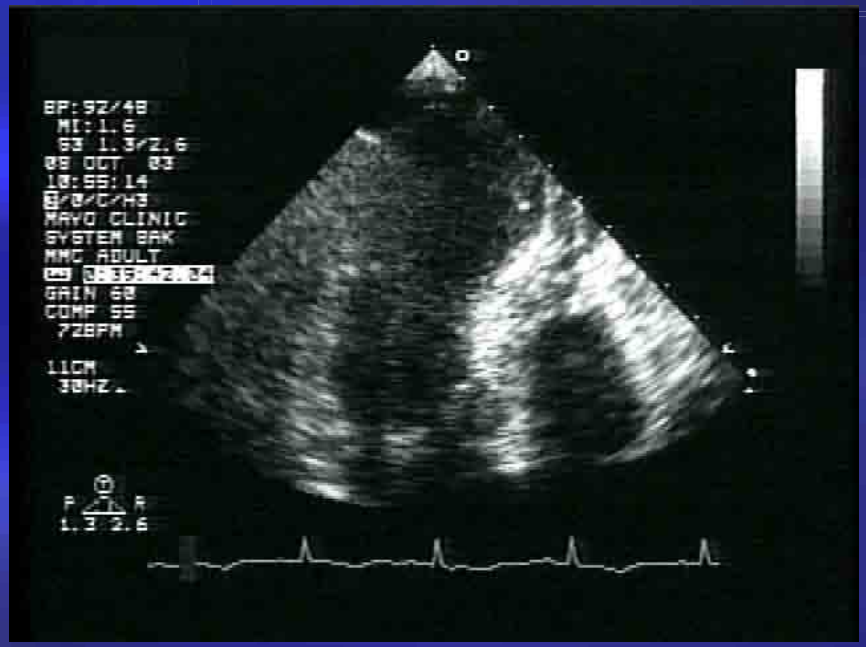
Russo et al: Circ 118:1528, 2008

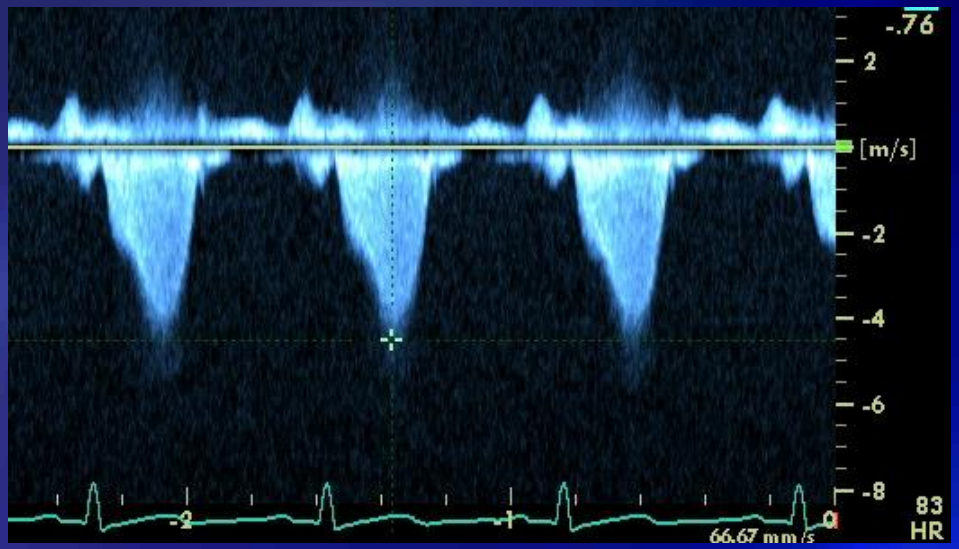
Acute Myocardial Infarction
New Murmur

- Ventricular septal defect (VSD)
  - Both anterior and inferior wall MI
  - Low output syndrome
  - Surgical emergency (60% mortality)
- Papillary muscle rupture (PMR)
  - Mostly inferior or lateral wall MI
  - Pulmonary edema
  - Surgical emergency (25% mortality)
- Acute LVOT dynamic obstruction
  - Previously hypertensive women
  - Medical treatment

Shock and murmur after AMI

LV outflow track obstruction

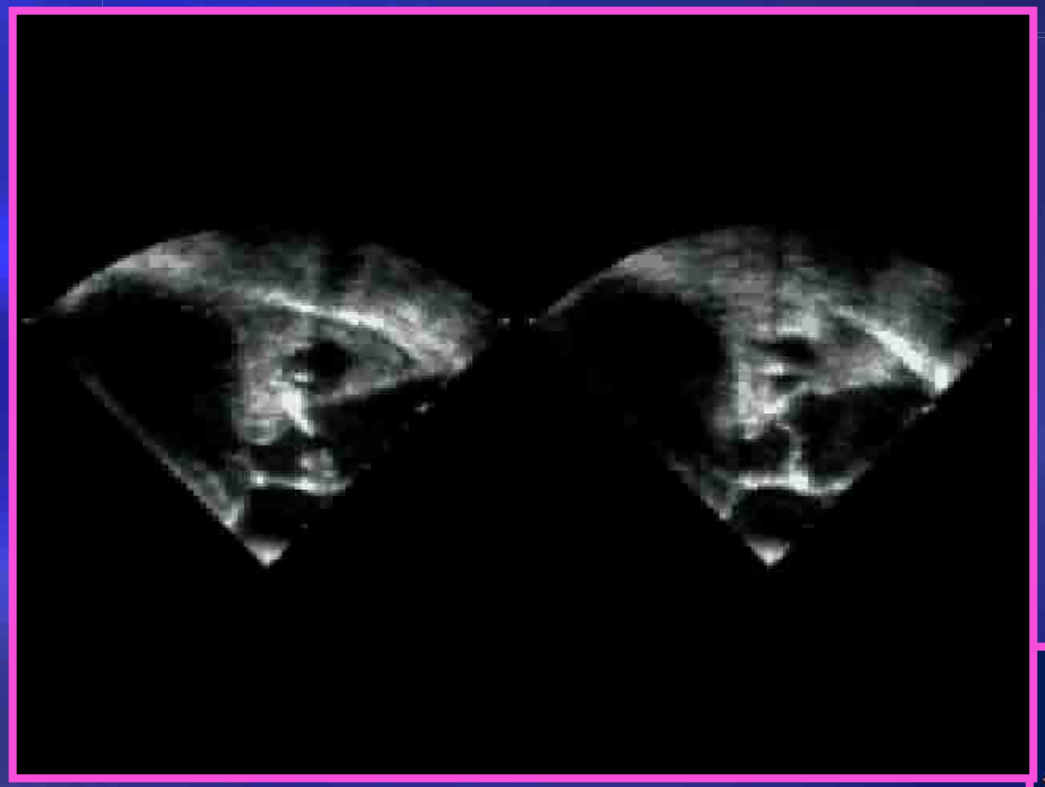




Due to hyperdynamic basal segments in hypertensive elderly woman with anterior MI or apical ballooning

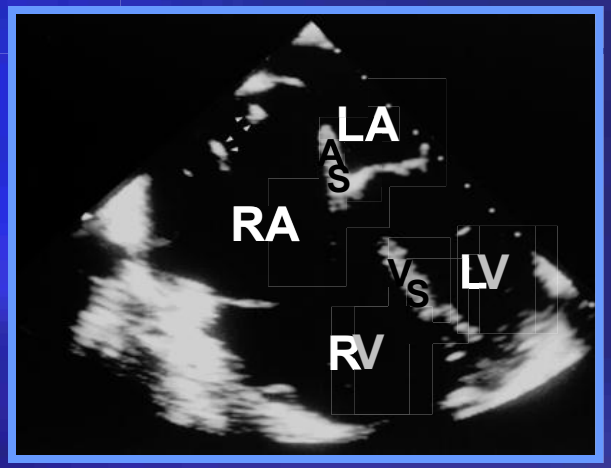
Rx: Fluid, Beta-blocker, ά - agonist

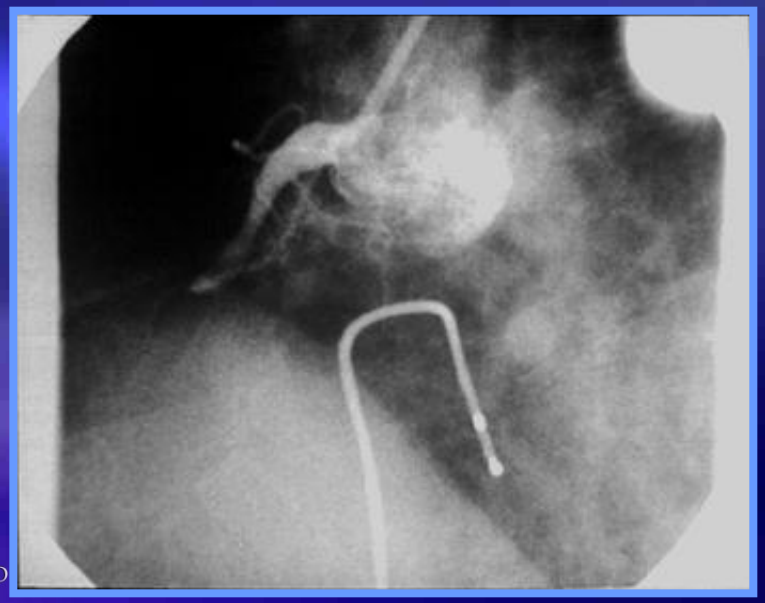
Cardiogenic shock with new murmur
Acute LVOT obstruction

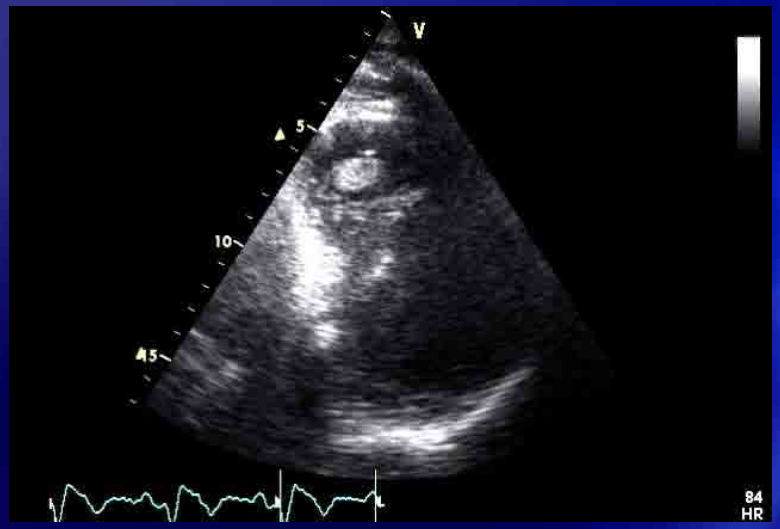


Fluid
Beta-blocker
Less inotrope
Alpha agonist

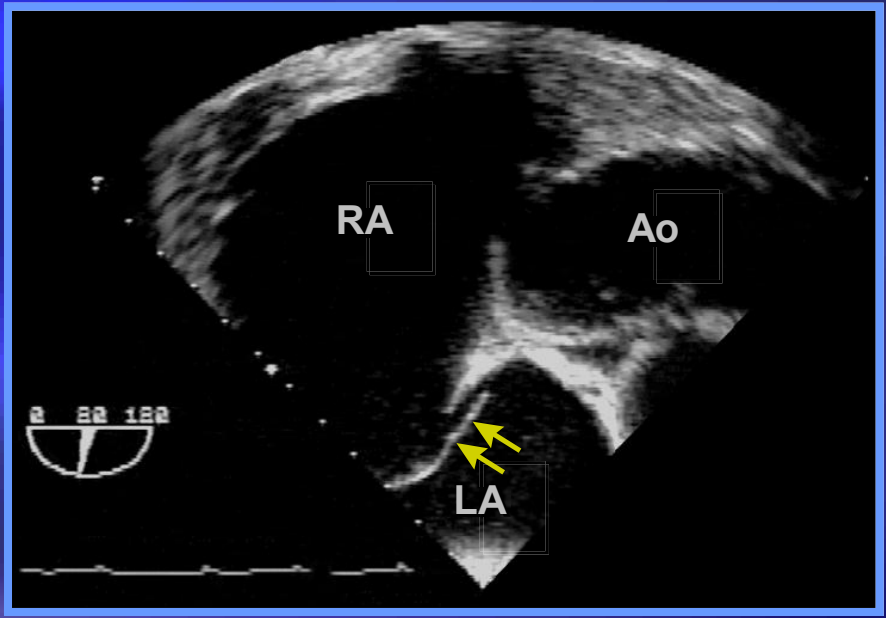
Always think about RV Infarct in patients with Inferior MI





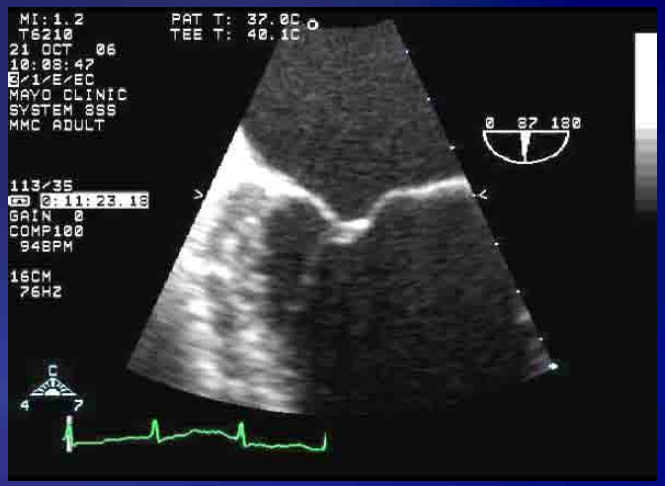


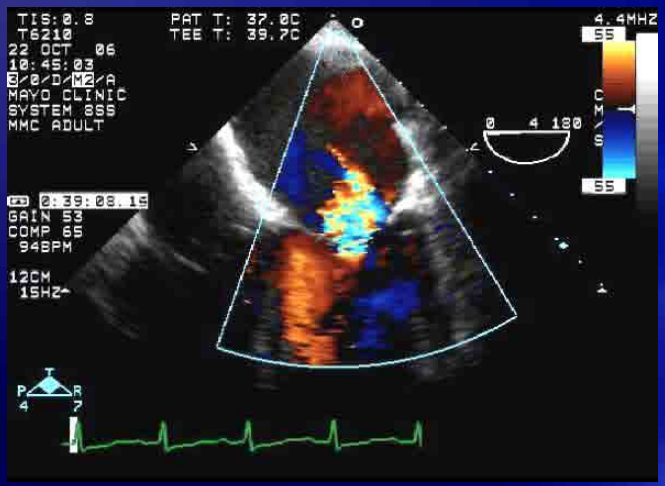
80-Year-Old Inferior MI
Hypoxemia



Right to left shunt via PFO

Ischemic Mitral Regurgitation





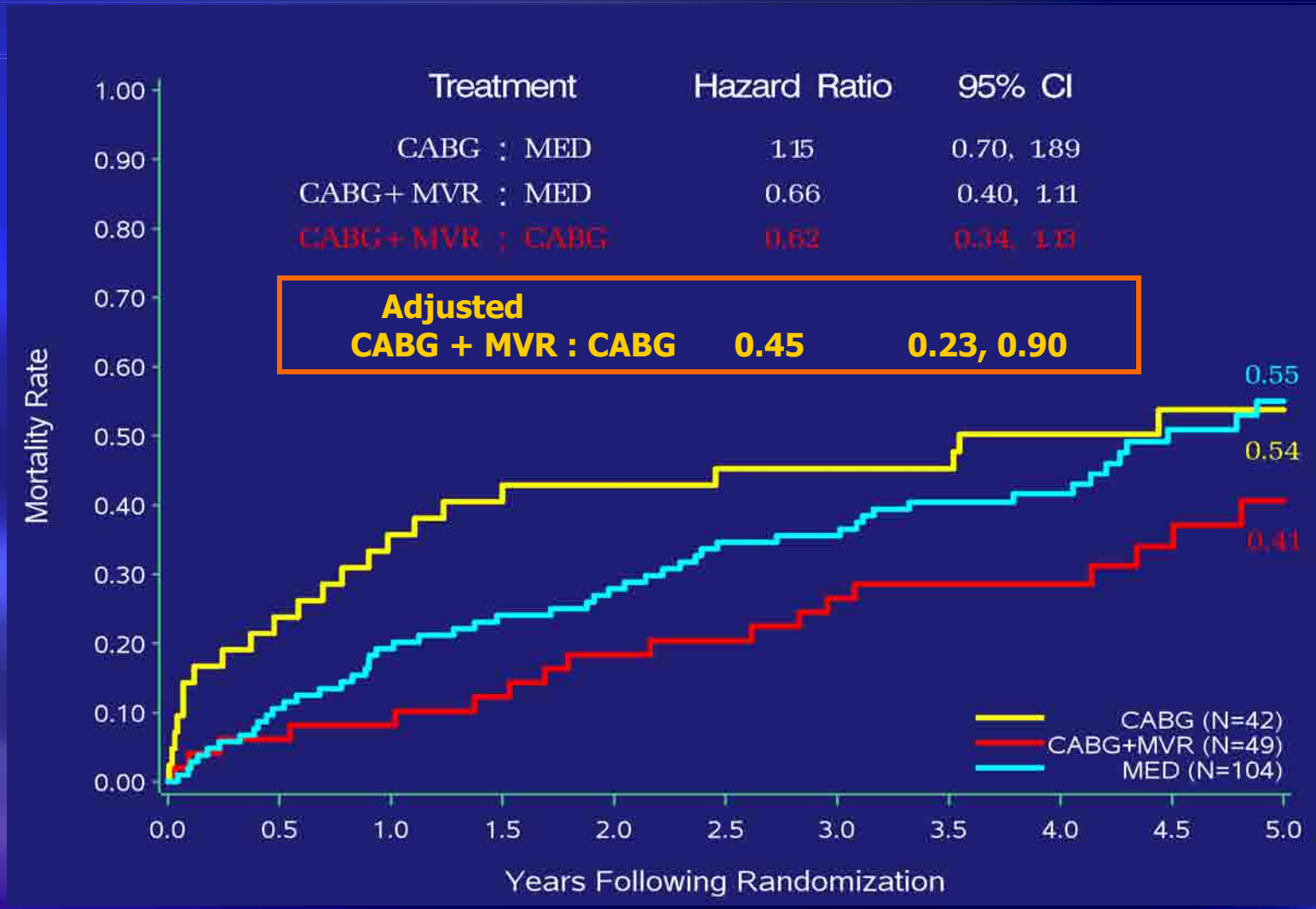
Influence of Mitral Regurgitation on Survival in the Surgical Treatment for IsChemic Heart Failure Trial

Marek A Deja
on behalf of the STICH Investigators

MAYO CLINIC

Late Breaking Clinical Trial ESC 2011

All-Cause Mortality Estimates for 195 Patients with Moderate/Severe MR



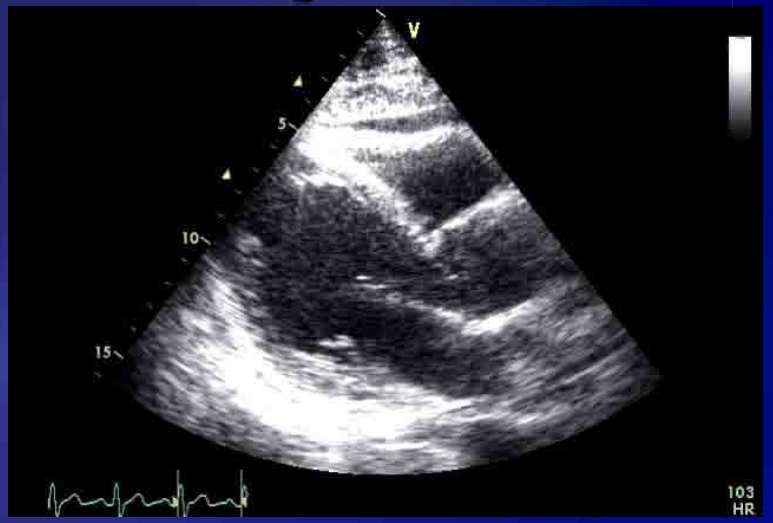
What's New in AMI Complications?

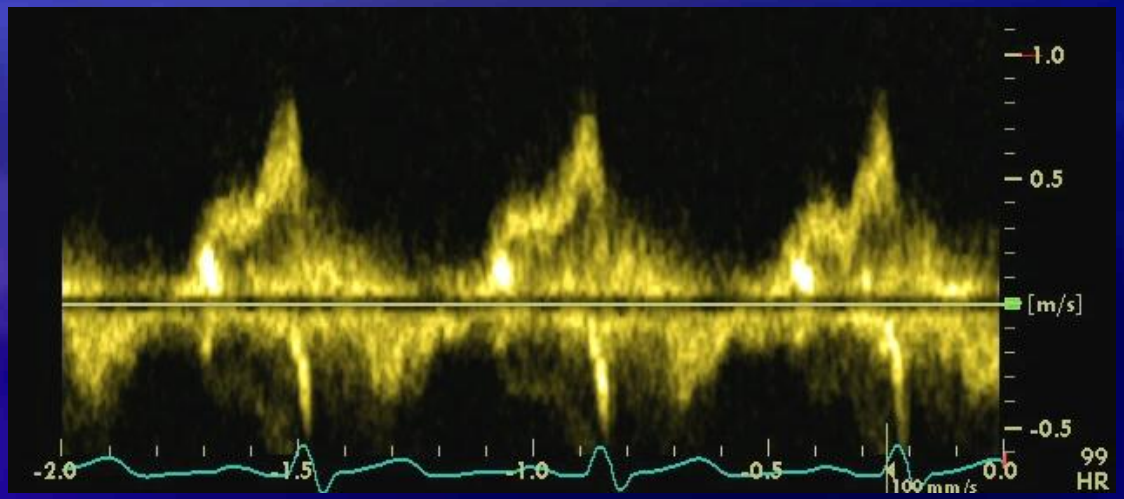
- Echocardiography is the main modality for a rapid and reliable Dx.
- Incidence and survival are lower and better with new innovative Rx.
- Impella and device closure to stabilize the patients with unstable hemodynamics due to VSD or PMR
- Acute LVOT obstruction
- CABG and MVR are beneficial in patients with ischemic functional MR ?

57 year old male with STEMI

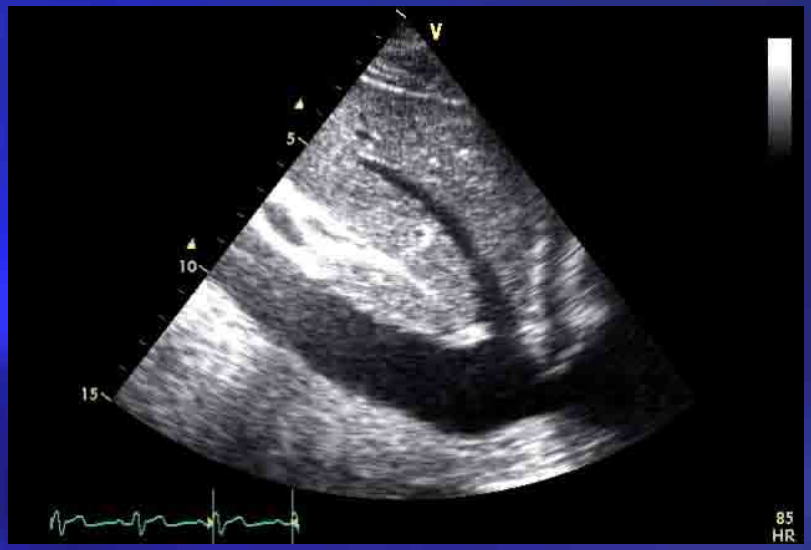
Thrombolysis and Stent

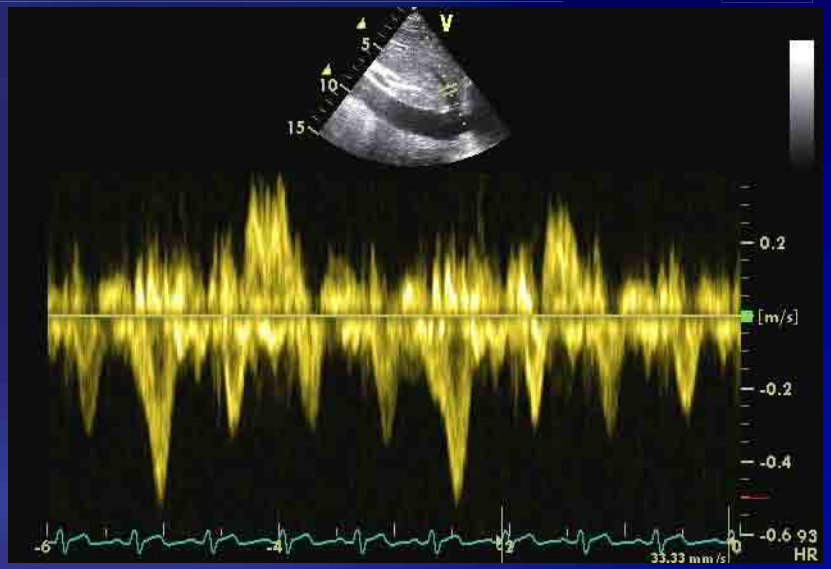
Hypotensive and tachycardic

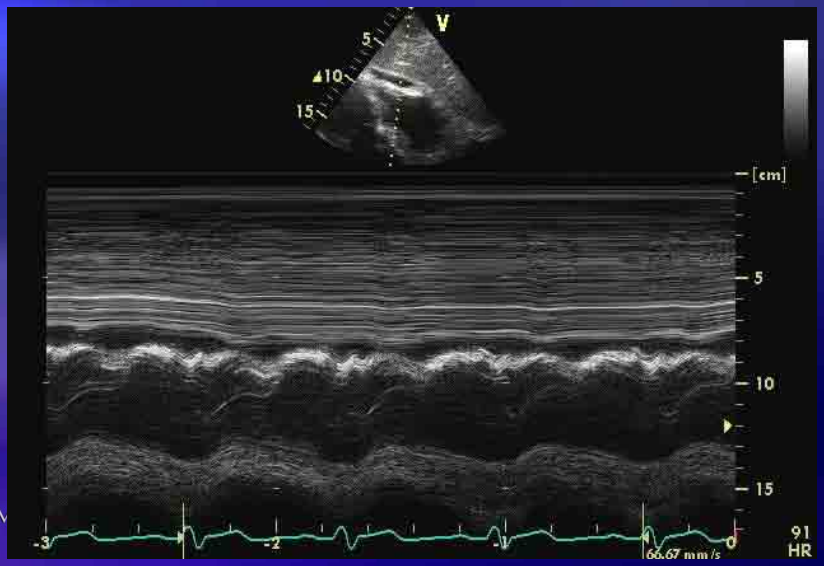


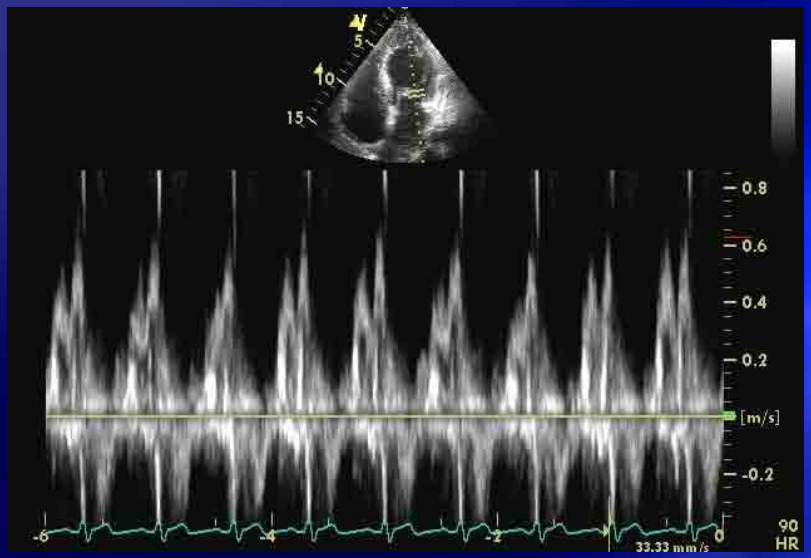


57 year old man with STEMI





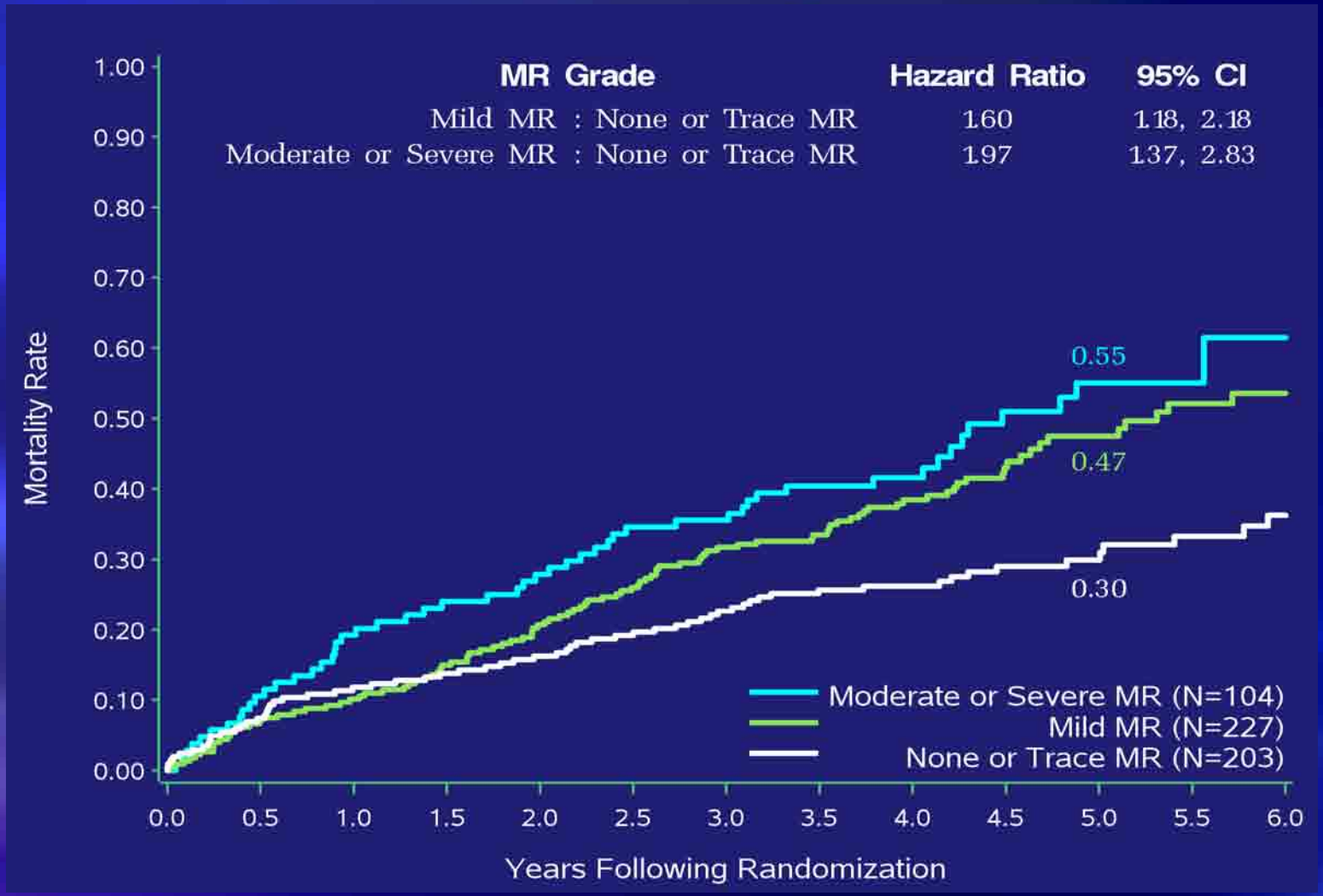





MAYO CLINIC

Closure Device for VSR

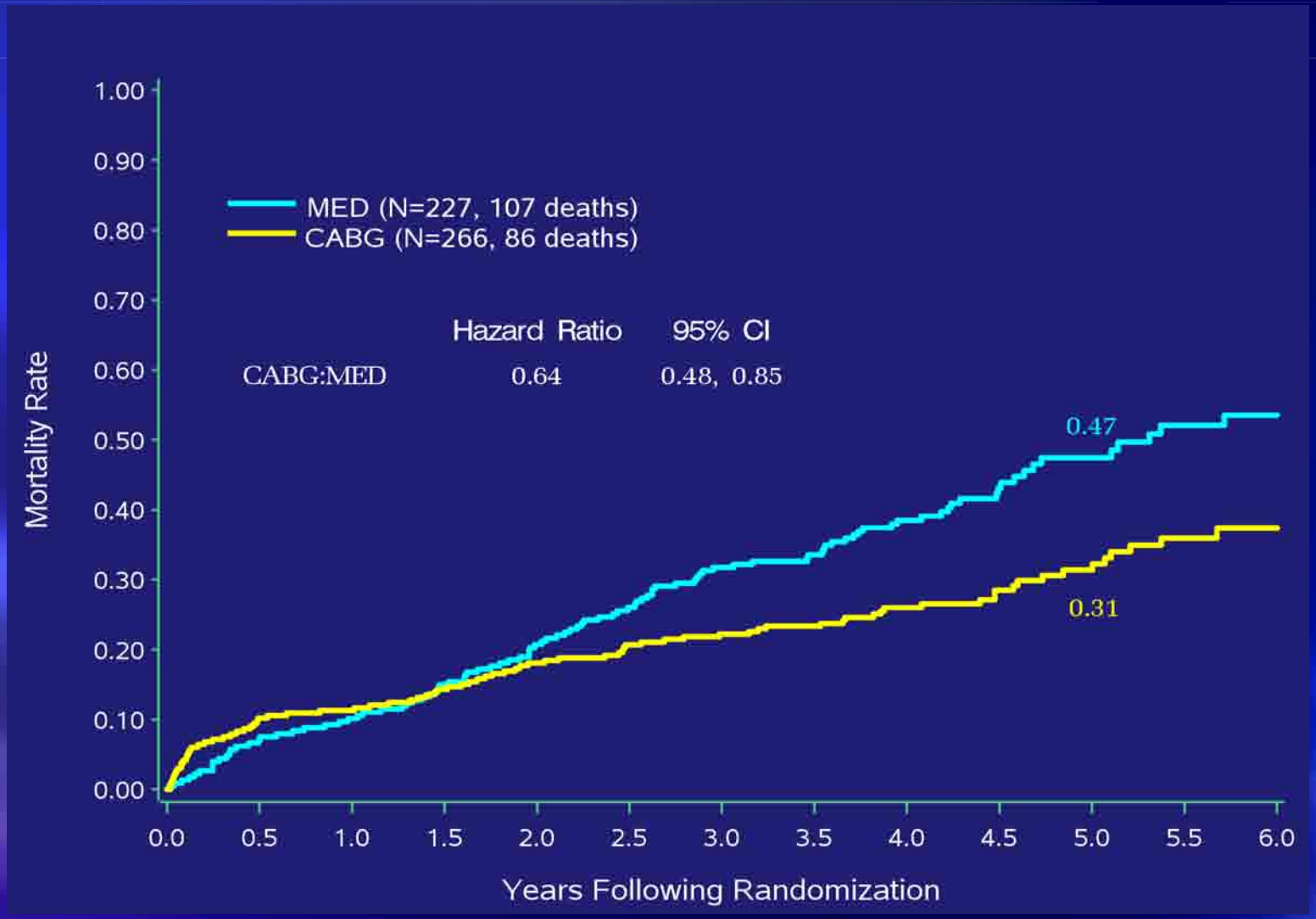
All-Cause Mortality Estimates for 534 MED Patients by MR Severity



MAYO CLINIC

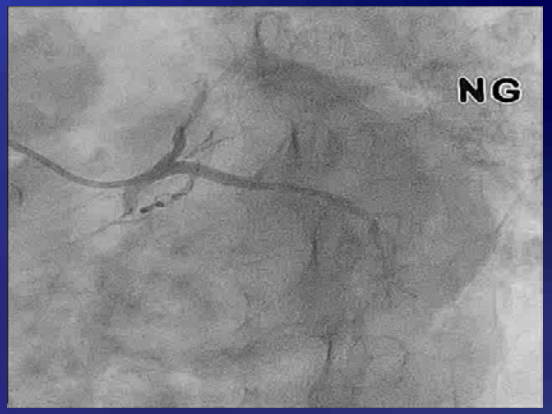
ESC LBCT 2011

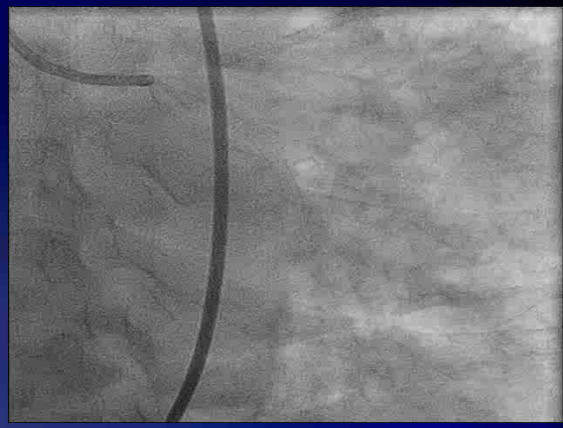
All-Cause Mortality Estimates for 493 Patients with Mild MR

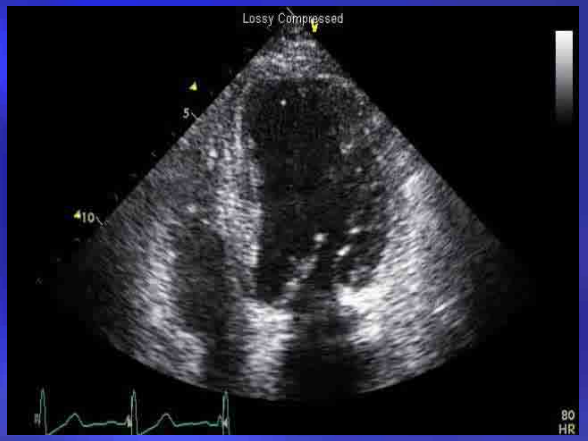


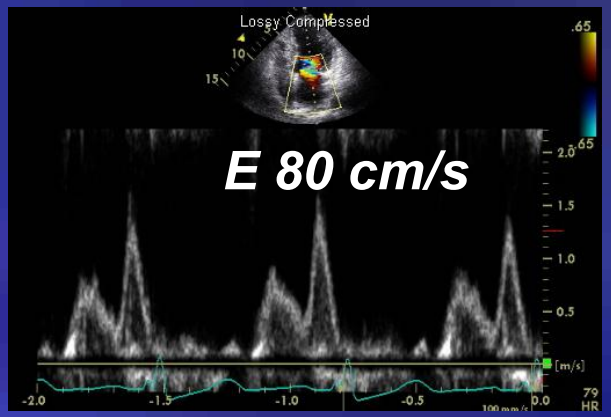
Acute MI

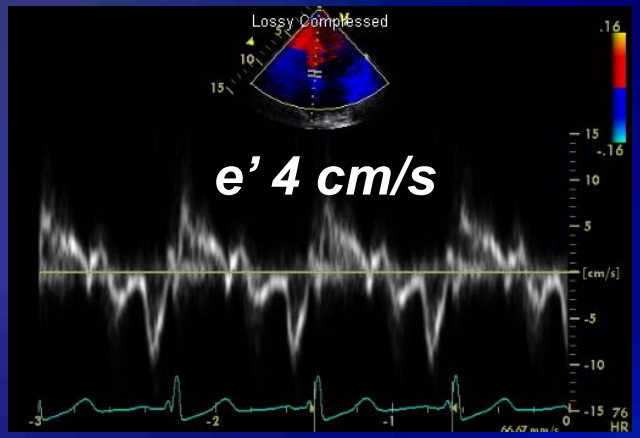
Systole and Diastole

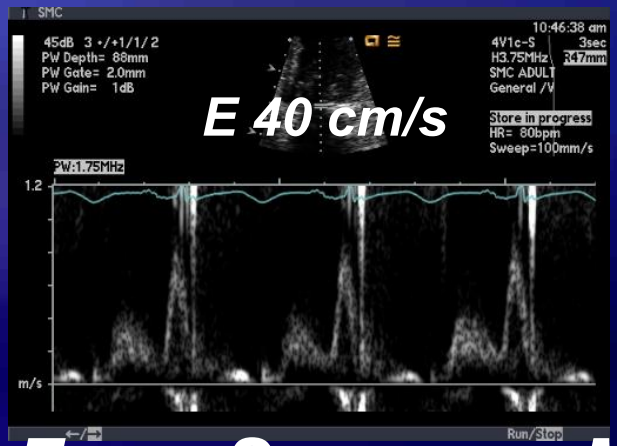












MAYO CLINIC

From Samsung Medical Center

Thank You !

Characteristics of LV Apical Ballooning

- Postmenopausal women
- Acute emotional or physiologic stress
- Usually ST elevation
- Troponin peaks early
- Overall prognosis good
- Recurrence uncommon

Proposed Pathophysiologic Mechanisms

- Multivessel epicardial coronary spasm
- Microvascular coronary spasm or dysfunction
- Catecholamine-mediated myocardial stunning

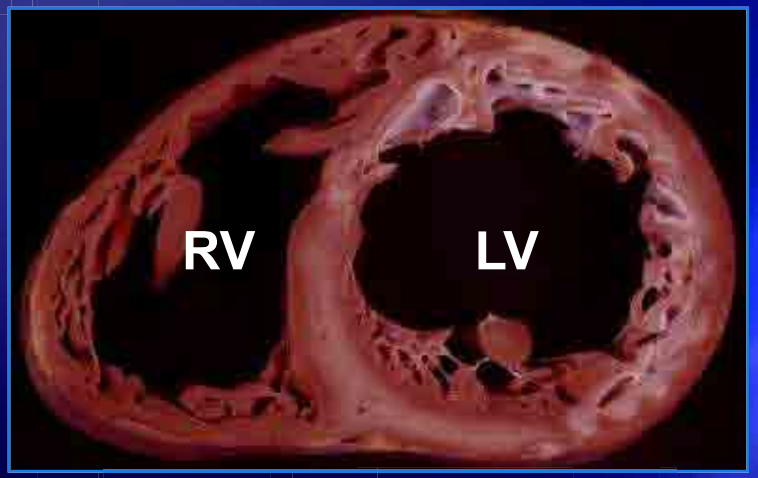
Complications of MI
Electrical and Pump Failure

Electrical failure

- Post-MI arrhythmias
- Nonlethal (common)
- Lethal (resuscitated)
- Lethal (sudden death)

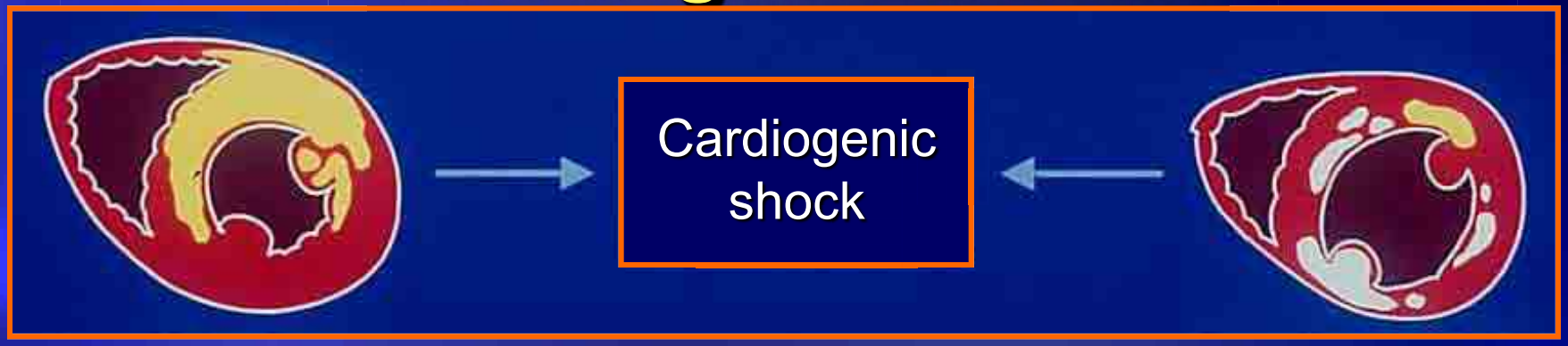
Pump failure

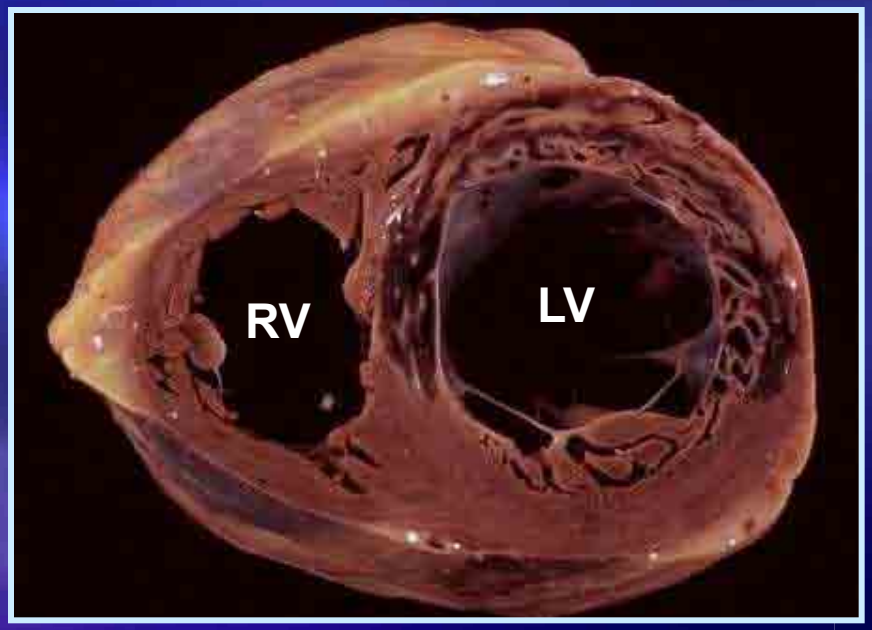
- Acute heart failure
- Cardiogenic shock (>40% loss of LV)
- Chronic heart failure (ischemic CM)



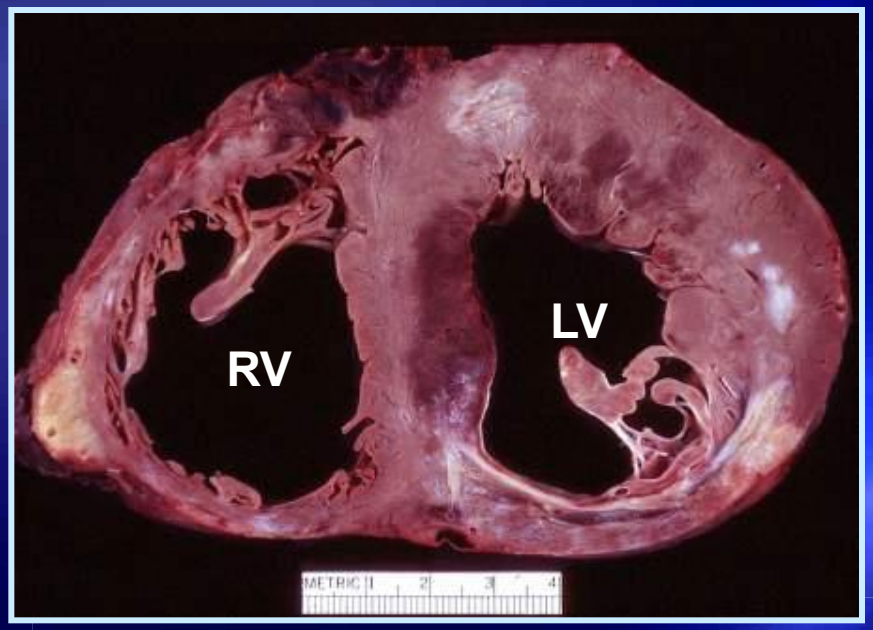
Short-axis view

Complications of MI
Cardiogenic Shock





Massive acute MI



Acute and Old MIs

Dynamic LV Outflow Tract Obstruction

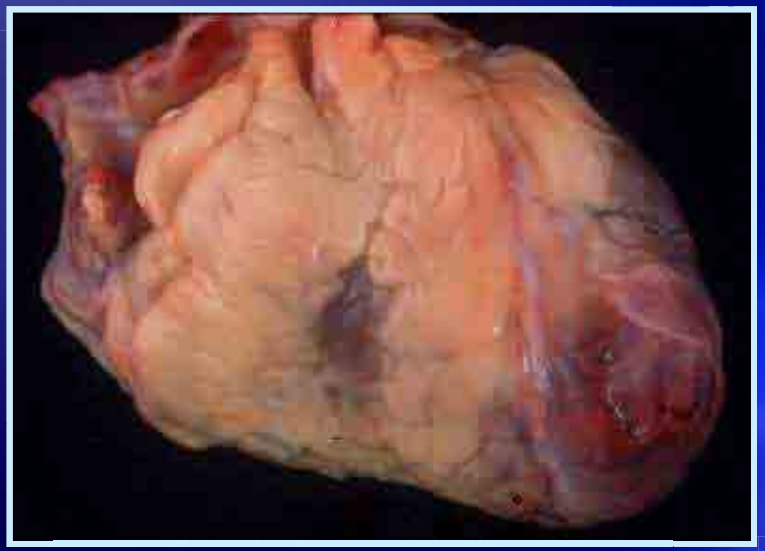
- LAD infarction sparing the basal septum
- Hyperdynamic compensatory basal function causes systolic anterior motion of the mitral valve and outflow tract obstruction
- Aggravated by hypovolemia, afterload reduction and inotropes
- Treat with fluid, afterload, and avoiding positive inotropes (use negative inotropes with caution)

Complications of MI
Rupture of LV Free Wall

Frequency
- 1% of all MIs; 7% of all MI deaths

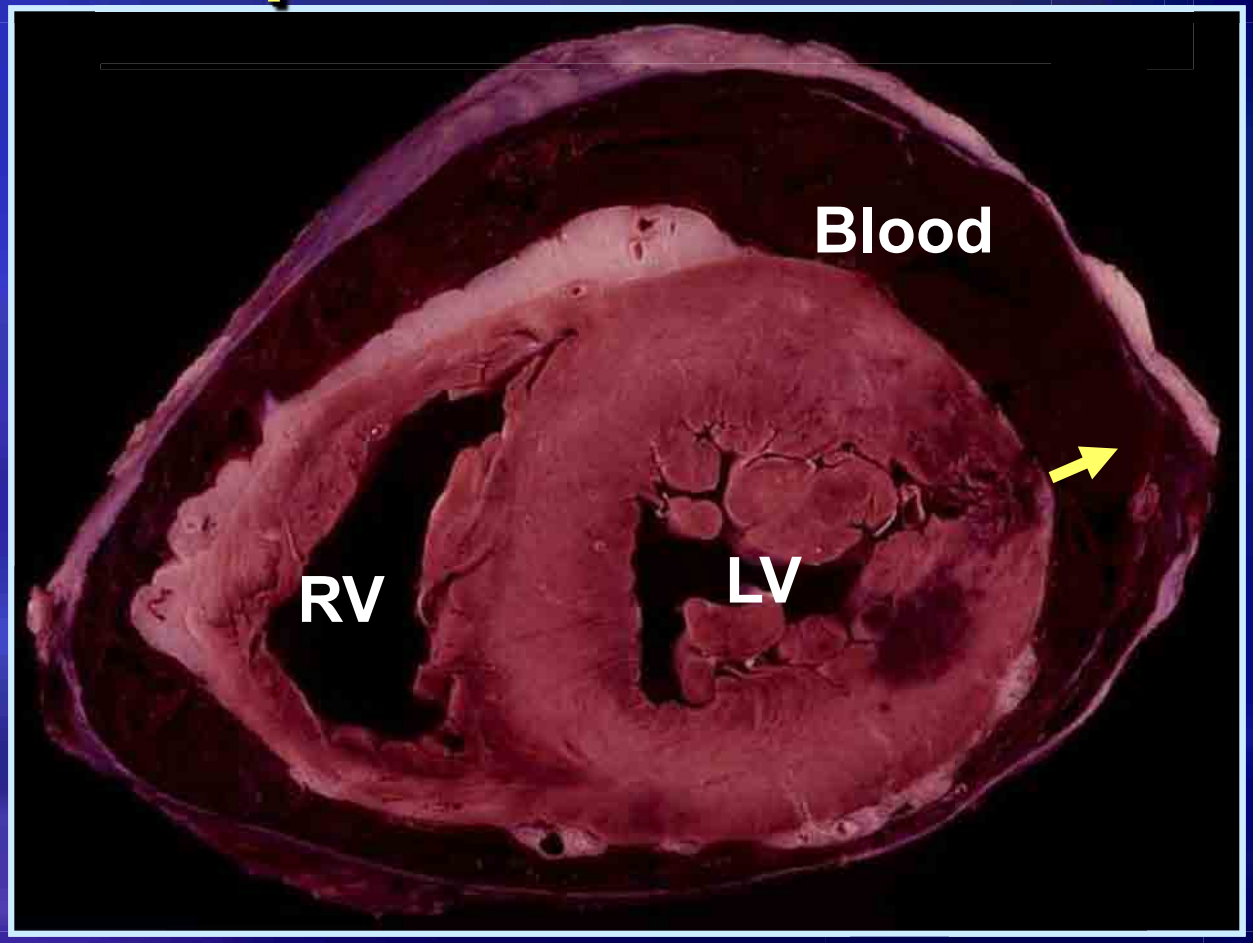
Location
- Lateral wall > anterior wall or inferior wall

Risk factors
- >60 years old
- F:M = 4:1
- Hypertension
- No LV hypertrophy
- First MI (no scars)



Heart (anterior view)

Complications of MI
Rupture of LV Free Wall



Hemopericardium (short-axis view)

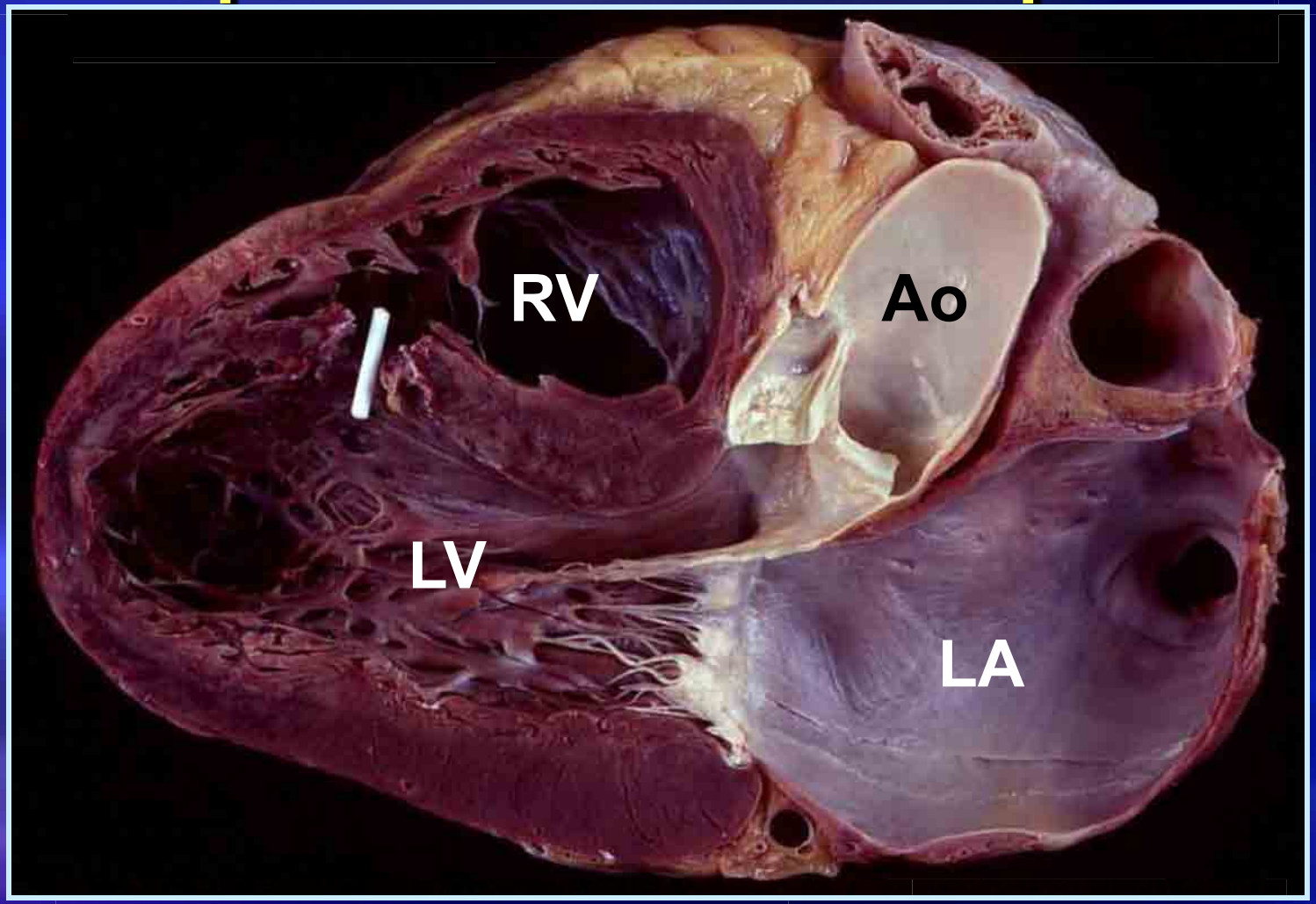
LV Free Wall Rupture

- Most have no clinical warning and result in precipitous death
- If PEA, have a high index of suspicion
- 30-40% may have subacute free wall rupture presaged by repetitive emesis, agitation, positional/pleuritic chest pain, hypotension, bradyarrhythmias, syncope, ECG changes

Echo Findings of LV Free Wall Rupture

- Can be difficult to see
- Imaging may be during “combat” conditions
- Often at site of focal infarct along lateral wall
- Mobile coagulum/hematoma within focal effusion

Complications of MI
Rupture of Ventricular Septum



Simple rupture (long-axis view)

Complications of MI
Rupture of Ventricular Septum

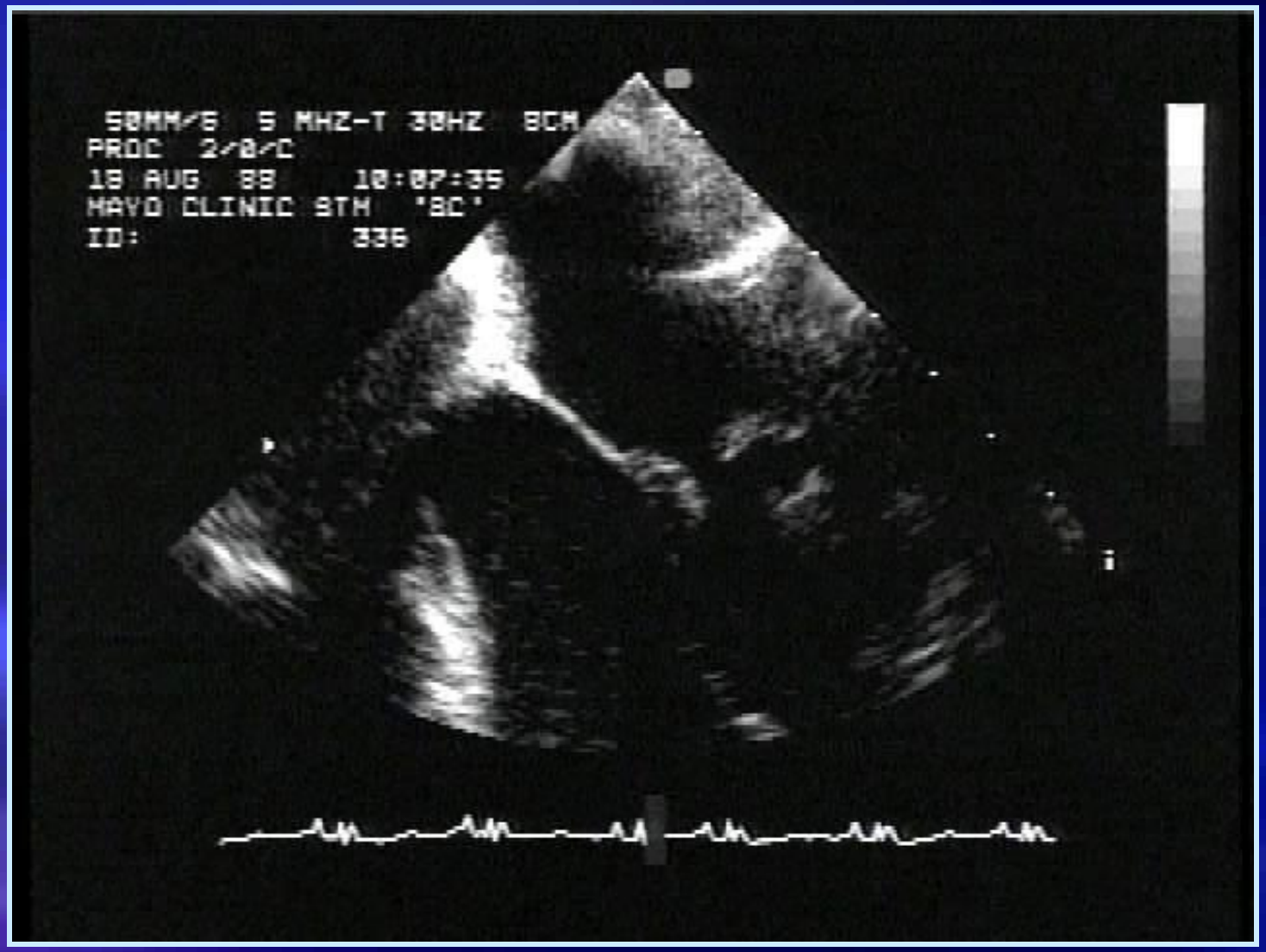
Frequency
- <1% of acute MIs (< free wall)

Location
- Mid-ventricular & apical (LAD territory)
- Simple rupture: Through-and-through
- Basal (dominant coronary distribution)
- Complex rupture: Serpiginous path

Consequences
- Acute left-to-right shunt (acquired VSD)
- Operative repair of VSD (high mortality)

Role of TEE in Acute MI

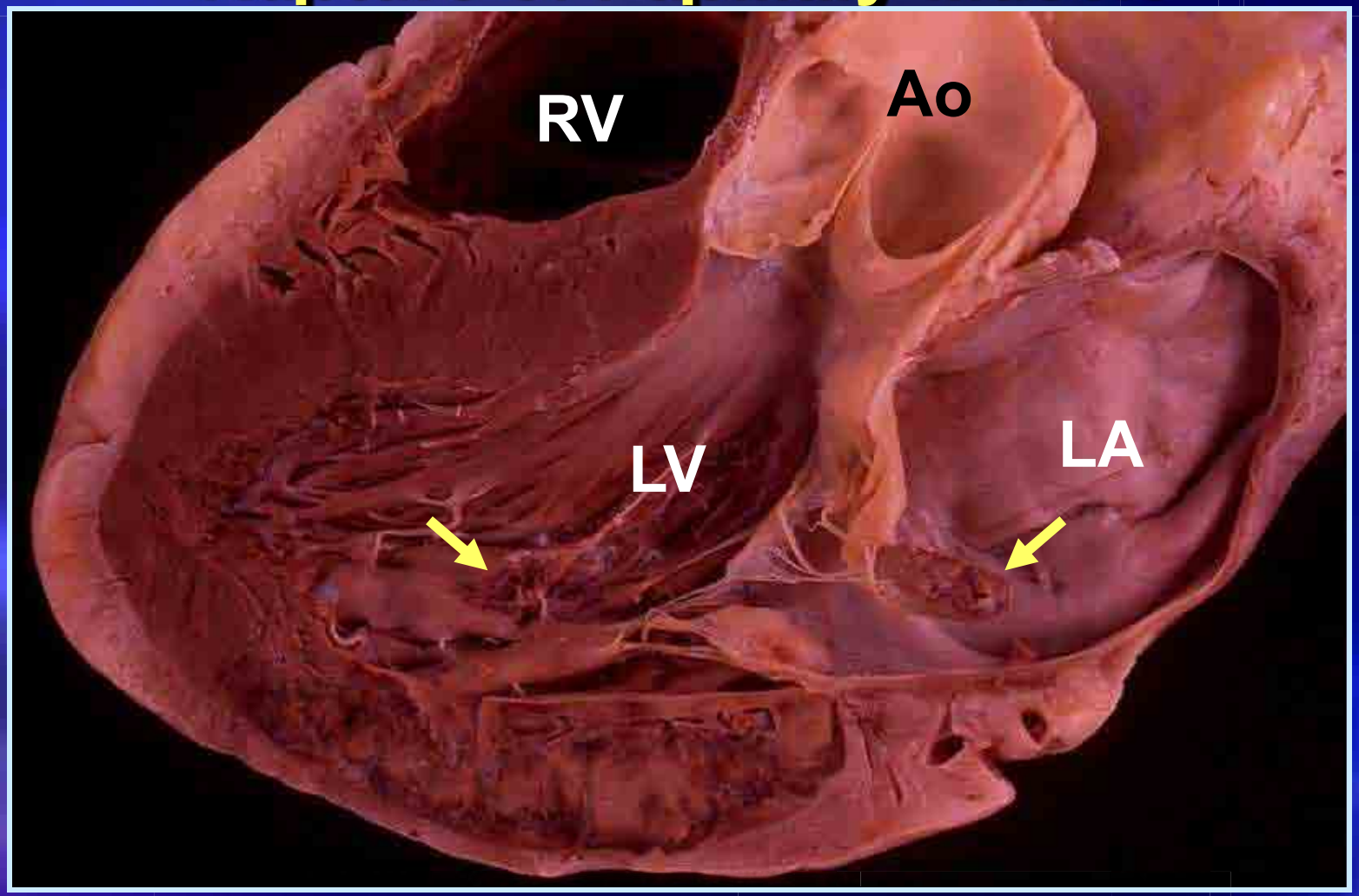
- Technically inadequate TTE
- Especially helpful in
  - Some VSDs
  - Papillary muscle rupture
  - R→L shunting across atrial septum
  - Subepicardial aneurysm


50MM/S 5 MHZ-T 30HZ 8CM
PROC 2/0/C
19 AUG 88 10:07:35
MAYO CLINIC 8TH 'BC'
ID: 336


50MM/S 5 MHZ-T 15HZ 8CM
PROC 2/0/C/A/D
19 AUG 88 10:07:52
MAYO CLINIC STH 'BC'
ID: 336
55.CM/S
55.CM/S

Complications of MI

Rupture of Papillary Muscle

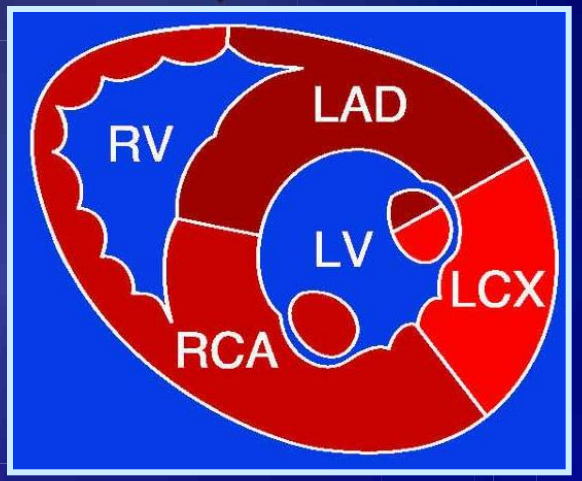


Flail leaflet (long-axis view)

Complications of MI
Rupture of Papillary Muscle

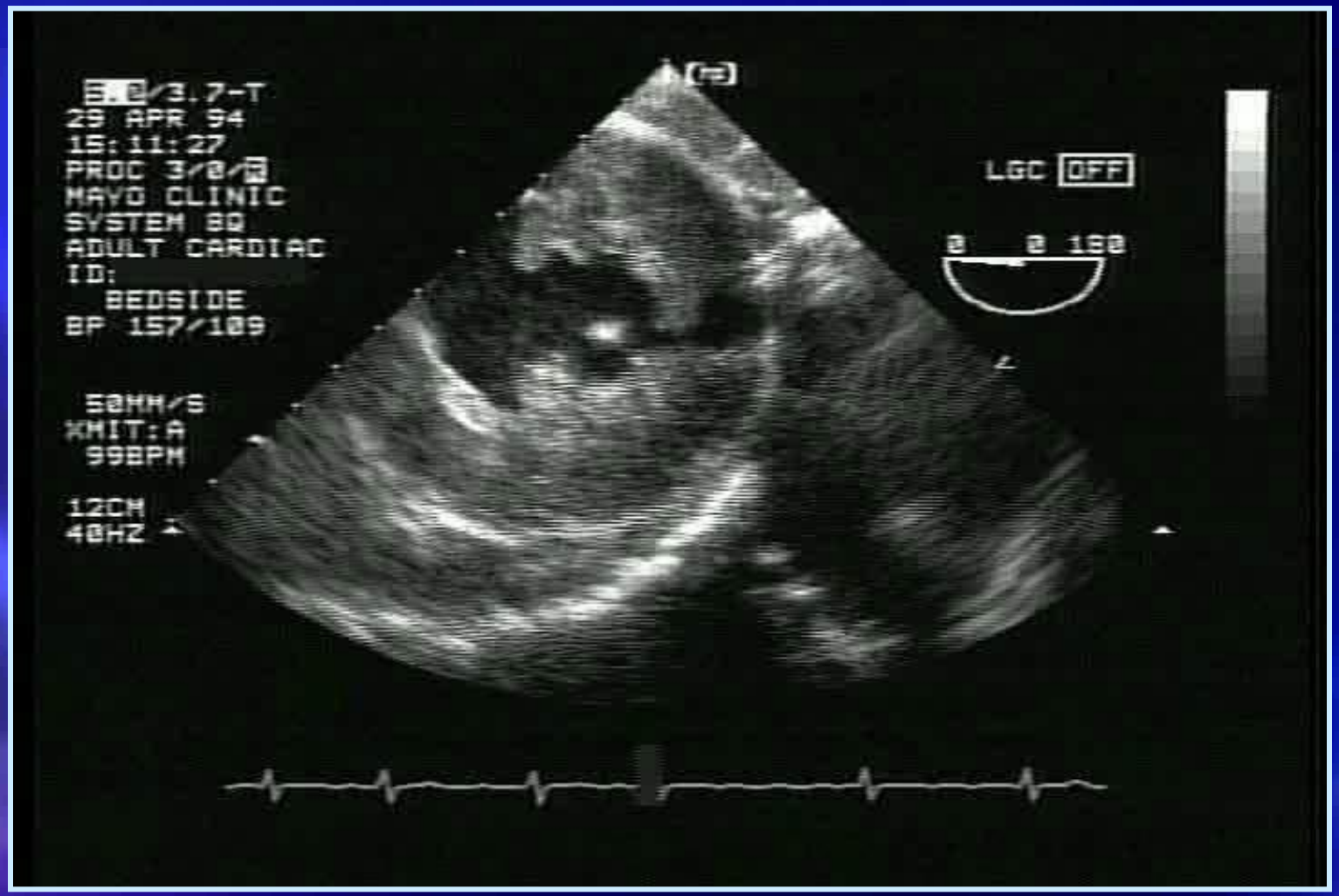
Frequency
- <1% of acute MIs (< LV free wall)

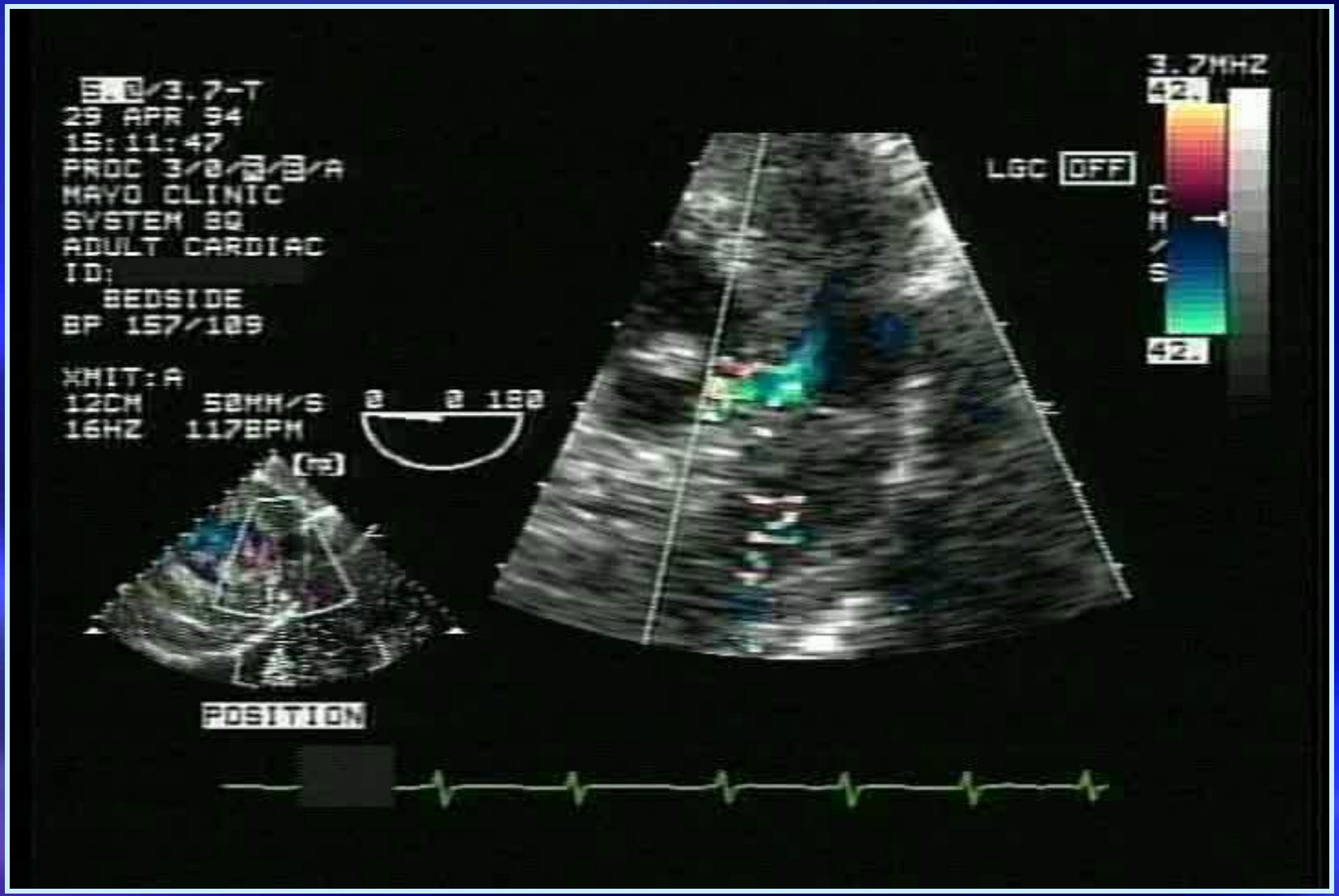
Location
- Mitral, post-med 85%
- Mitral, ant-lat 15%
- Tricuspid, ant <1%



Consequence
- Depends on extent of ruptured muscle
- Acute regurgitation, of variable severity
- Operative repair (low mortality)

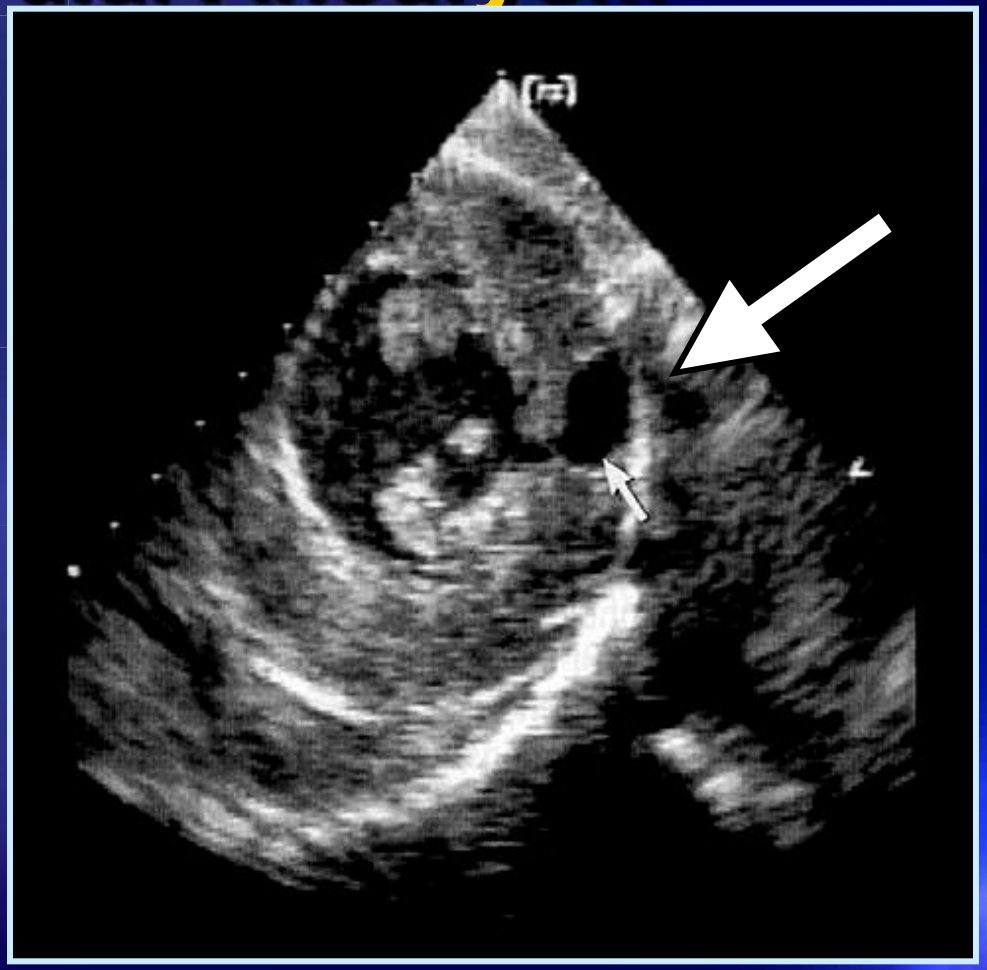
68-yr-old female, acute MI, hypotension




3.7MHZ
42.
CM/S
42.
LGC OFF
3.7-T
29 APR 94
15:11:47
MAYO CLINIC
SYSTEM 80
ADULT CARDIAC
ID:
BEDSIDE
BP 157/109
XMIT:A
12CM 50MM/S
16HZ 117BPM
POSITION

Subepicardial Aneurysm

- Incomplete rupture
- TEE >TTE
- Often triangular appearance, expands with systole
- Considered unstable



80-yr-old male, admitted for Rx of AF, Hx CHF


PHILIPS
04/06/2005 07:51:00
TIS2.4 MI 1.2
S5-1/Adult
FR 18Hz
16cm
2D
60%
C 50
P Low
HGen
CF
67%
2.5MHz
WF High
Med
BP: 118/64mmHg
M3 M1
+19.3
-19.3
cm/s
JPEG
68 bpm


PHILIPS
04/06/2005 07:54:12 TIS2.4 MI 1.4
S5-1/Adult
FR 15Hz
18cm
2D
49%
C 50
P Low
HGen
CF
76%
2.5MHz
WF High
Med
BP:118/64mmHg
M3 M1
+50.1
-50.1
cm/s
JPEG
63 bpm

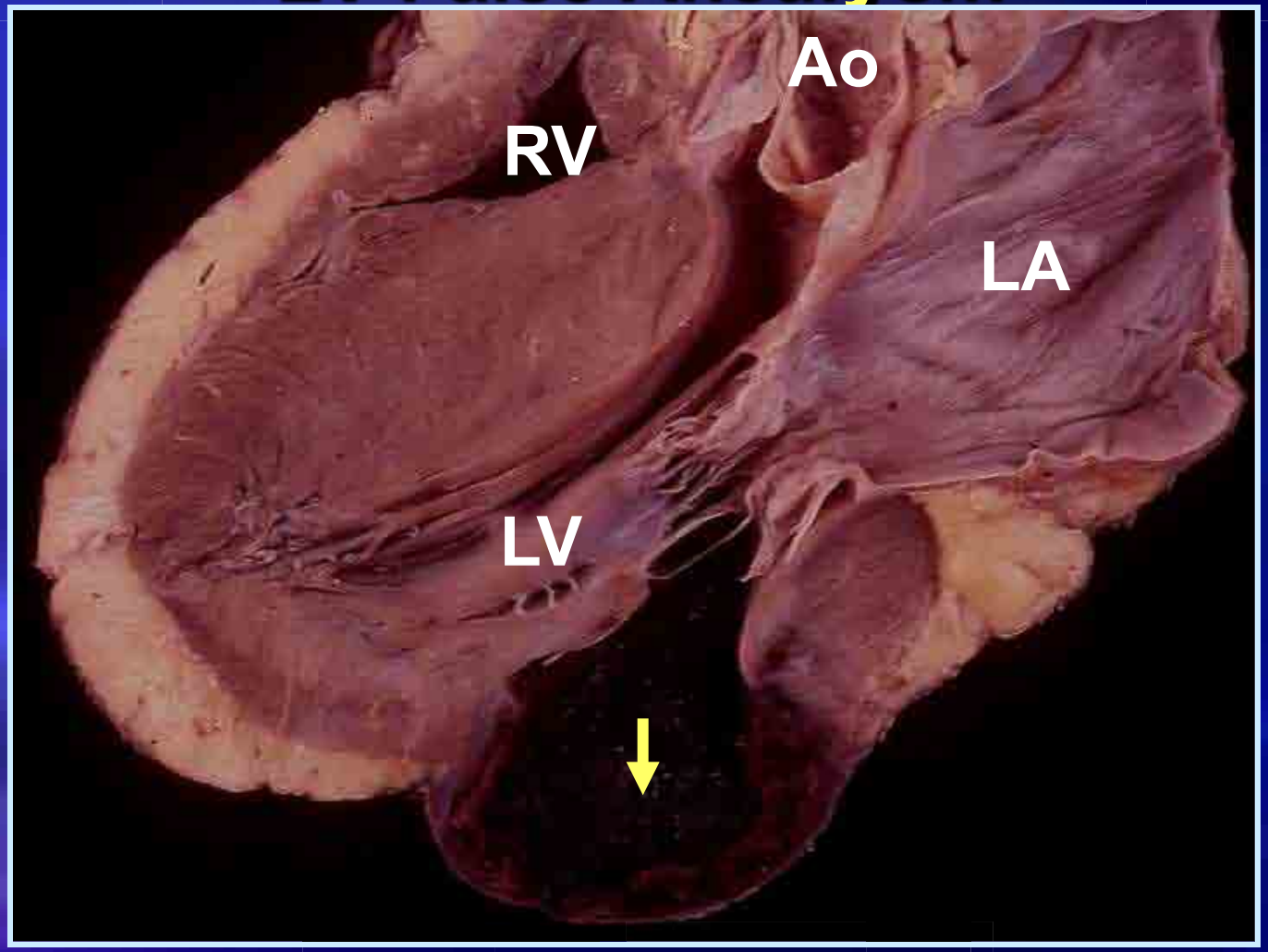

PHILIPS
04/06/2005 07:58:50 TIS0.7 MI 1.4
S5-1/Adult
FR 45Hz
18cm
2D
55%
C 50
P Low
HGen
M3
BP:118/64mmHg
JPEG
62 bpm


PHILIPS
04/06/2005 07:58:58 TIS0.7 MI 1.4
S5-1/Adult
FR 45Hz
18cm
2D
55%
C 50
P Low
HGen
M3
BP: 118/64mmHg
JPEG
71 bpm

LV false aneurysm diagnosed 8 yr previously

Complications of MI

LV False Aneurysm



Long-axis view

Complications of MI
LV False Aneurysm

Definition

- Contained rupture (by epicardium or by adherent parietal pericardium)
- No myocardium in wall of aneurysm

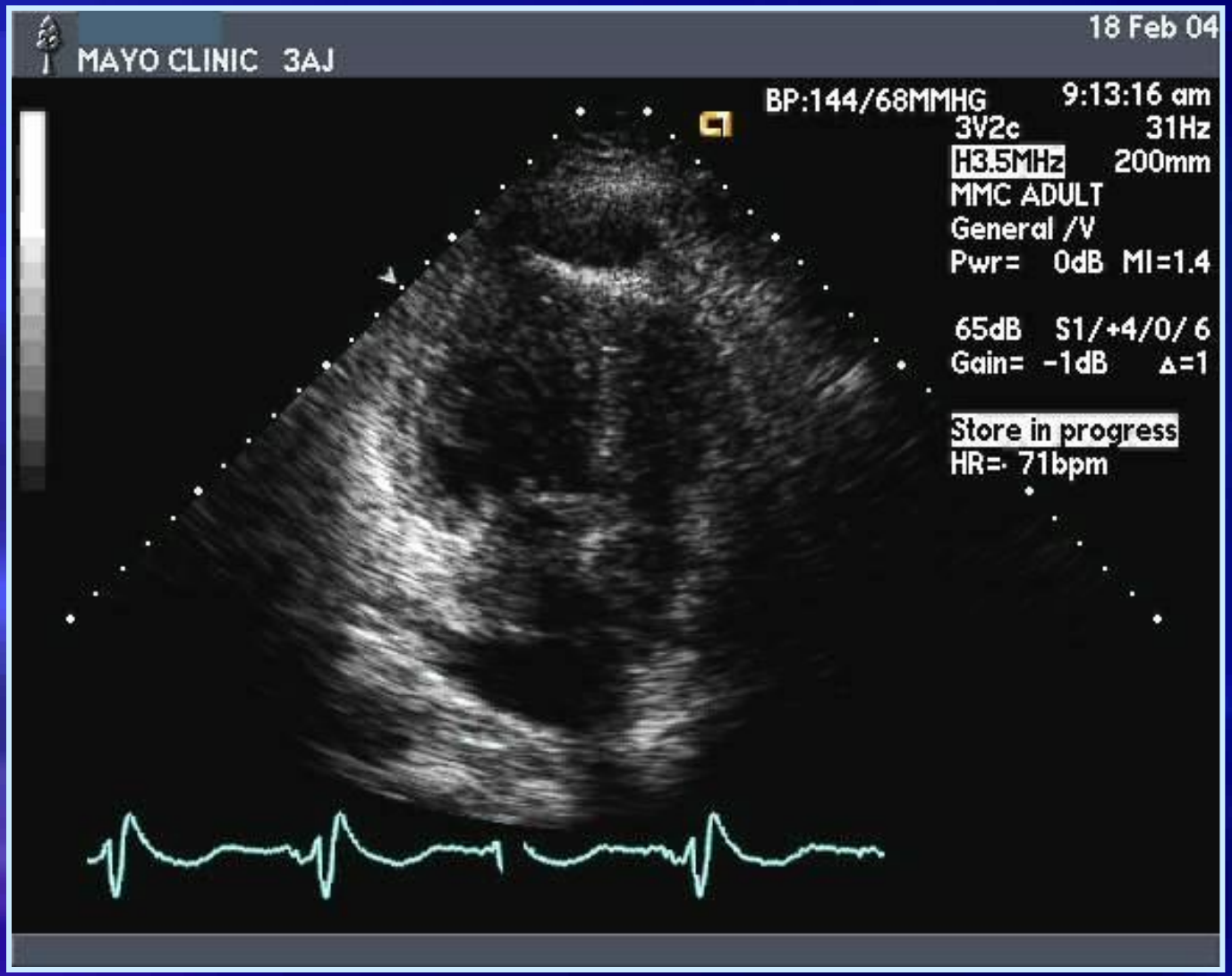
Appearance

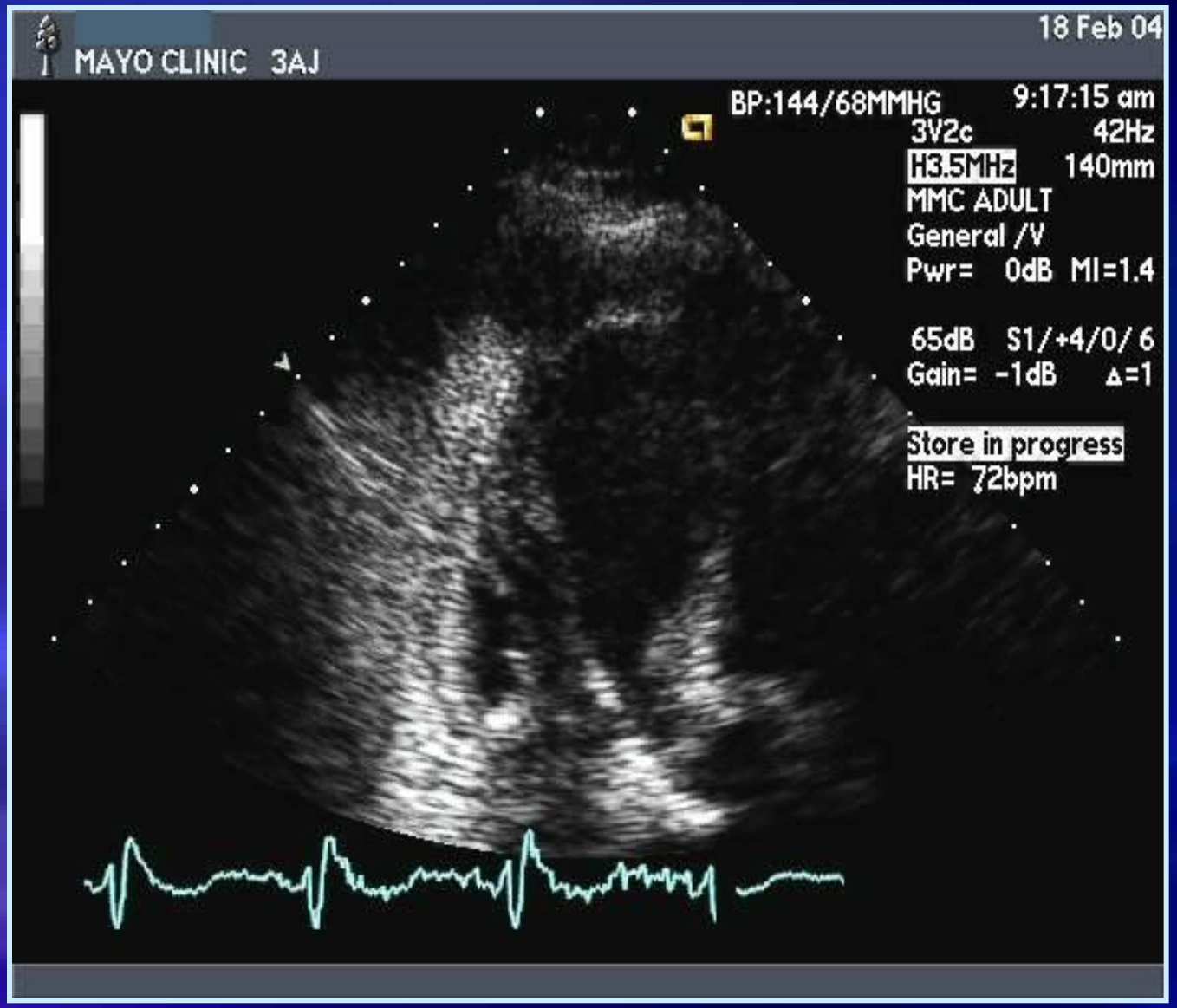
- Saccular shape with narrow neck
- Thin walled with mural thrombus

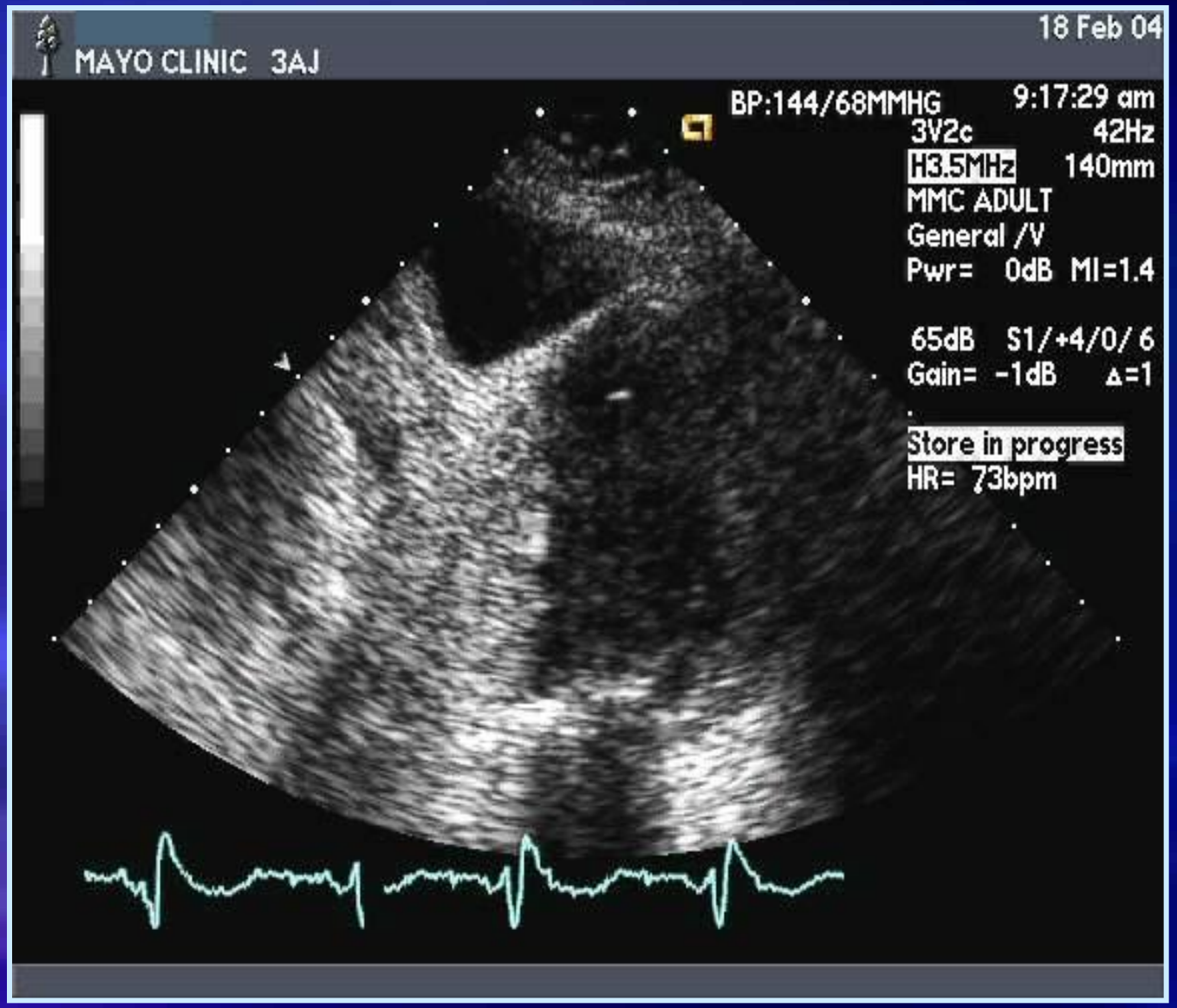
Consequences

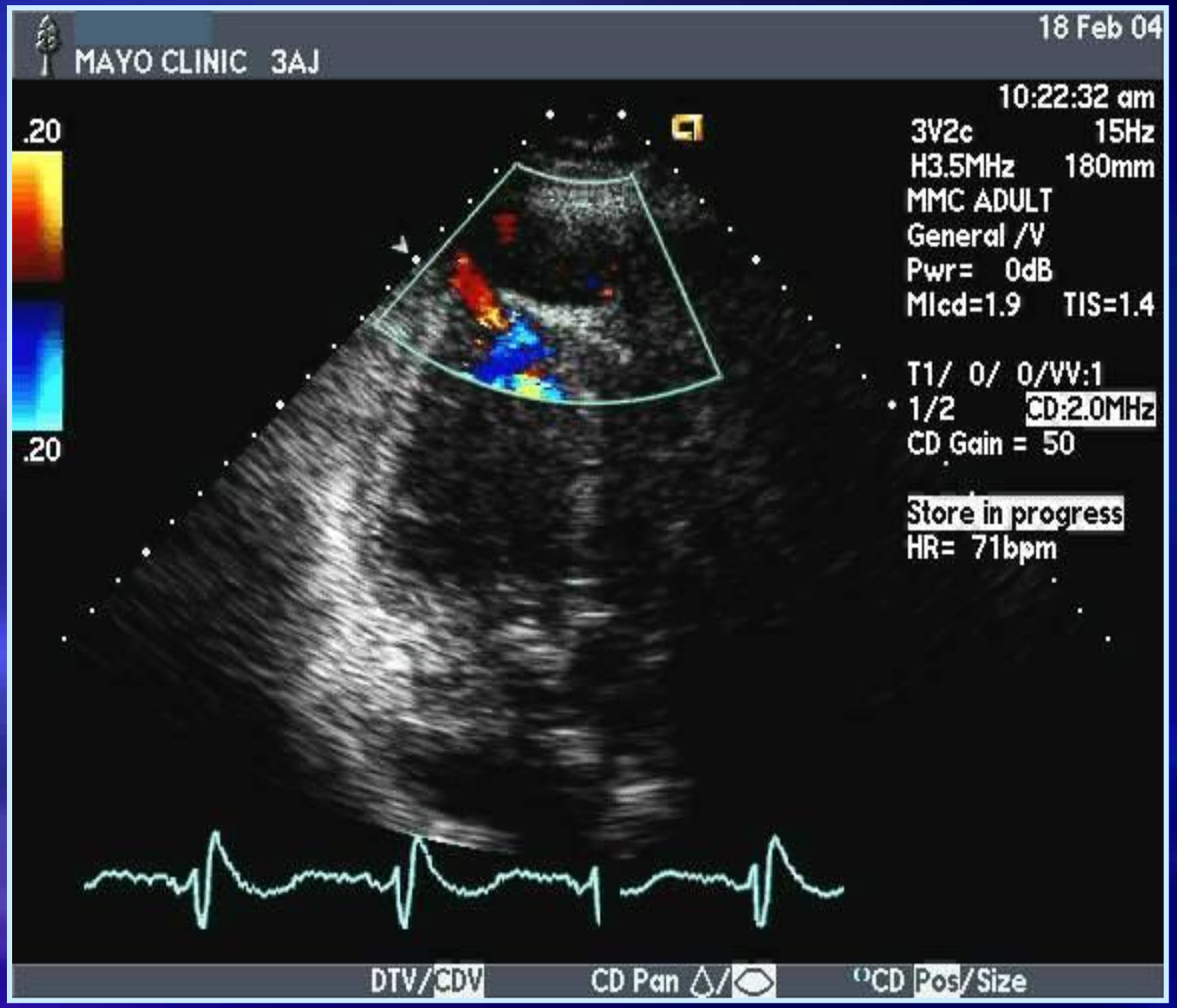
- Rupture, within 1 month — common
- Rupture, after 1 year — uncommon

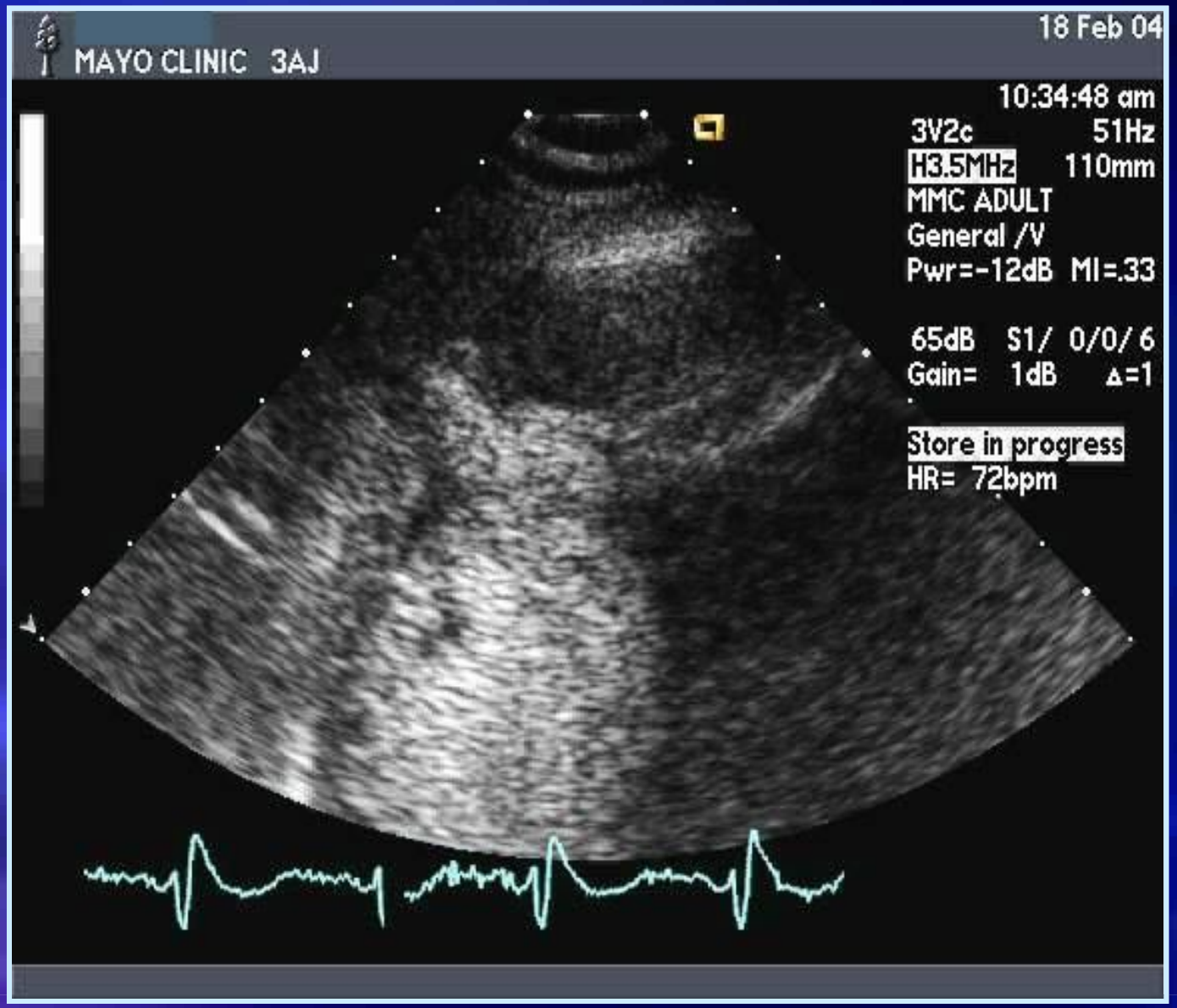
70-yr-old male, hypotension, DM, histoplasmosis
MI 7 mo ago, prior AVR, CABG




MAYO CLINIC 3AJ
18 Feb 04
BP:144/68MMHG
9:17:15 am
3V2c
42Hz
H3.5MHz
140mm
MMC ADULT
General /V
Pwr= 0dB MI=1.4
65dB S1/+4/0/6
Gain= -1dB Δ=1
Store in progress
HR= 72bpm

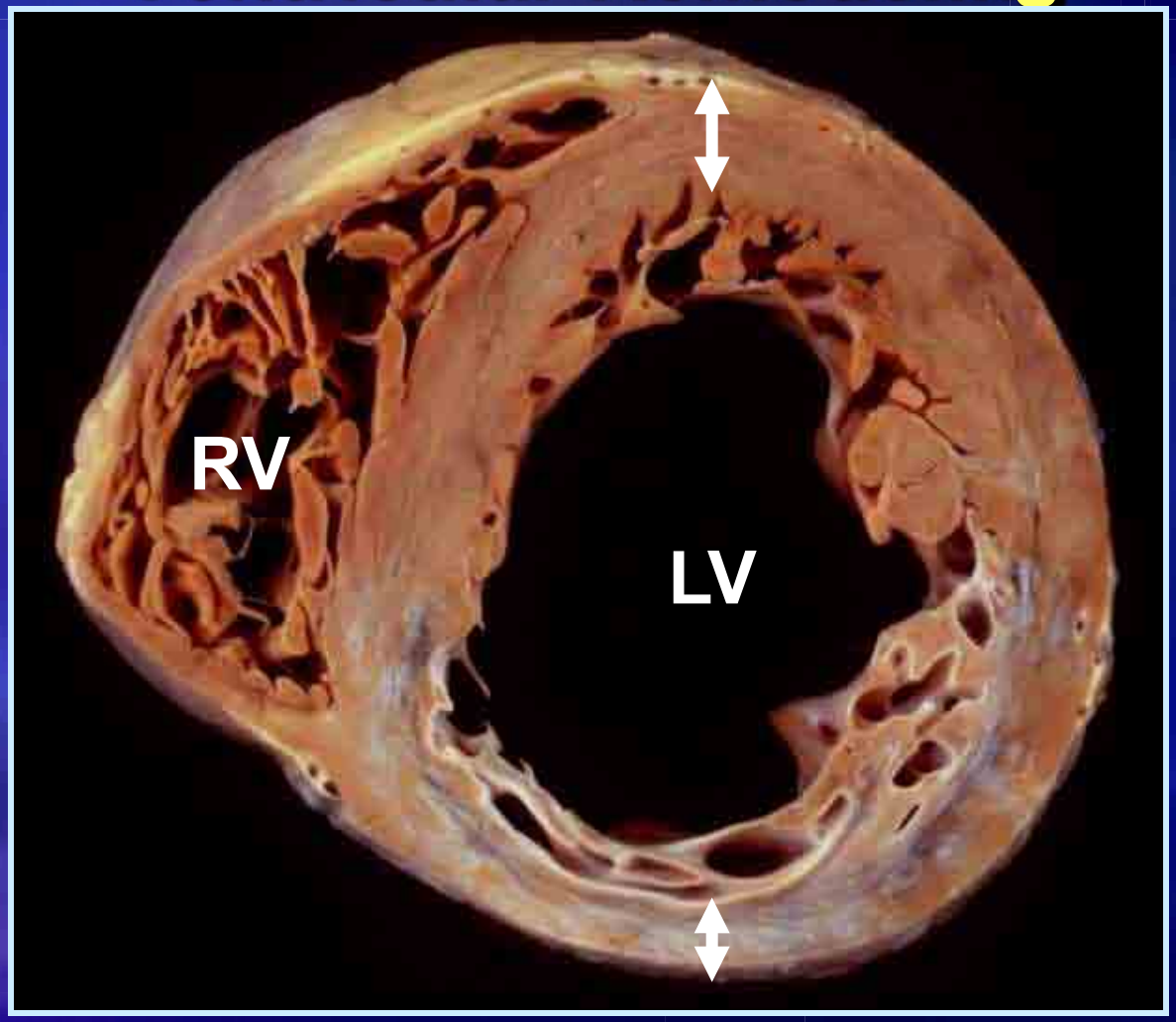

MAYO CLINIC 3AJ
18 Feb 04
BP:144/68MMHG
9:17:29 am
3V2c
42Hz
H3.5MHz
140mm
MMC ADULT
General /V
Pwr= 0dB MI=1.4
65dB S1/+4/0/6
Gain= -1dB Δ=1
Store in progress
HR= 73bpm


MAYO CLINIC 3AJ
18 Feb 04
10:22:32 am
.20
.20
3V2c 15Hz
H3.5MHz 180mm
MMC ADULT
General /V
Pwr= 0dB
MIcd=1.9 TIS=1.4
T1/ 0/ 0/VV:1
1/2 CD:2.0MHz
CD Gain = 50
Store in progress
HR= 71bpm
DTV/CDV
CD Pan
CD Pos/Size



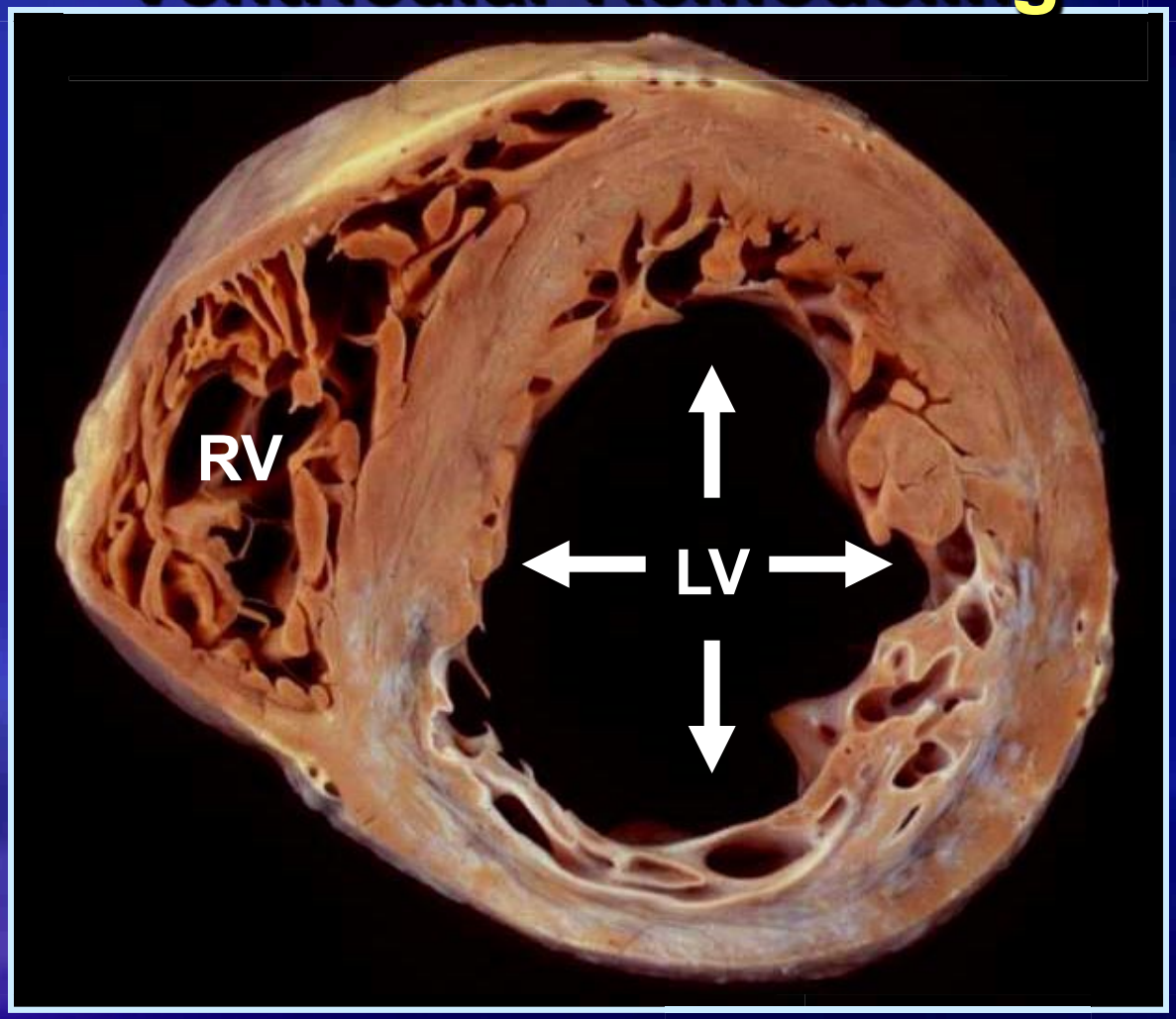
Rx conservatively, pt died 11 days later

Complications of MI
Ventricular Remodeling



Old infarct (short-axis view)

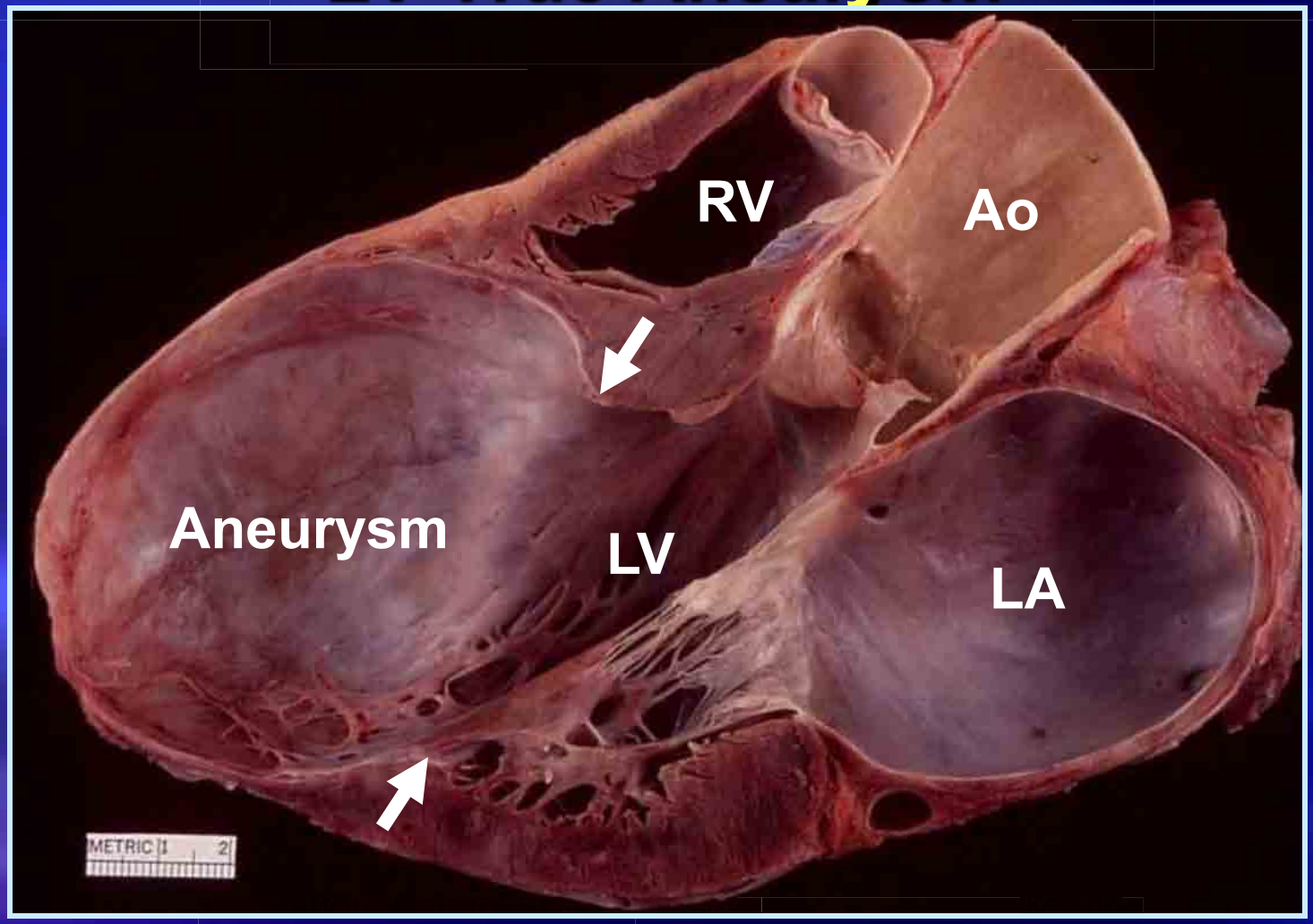
Complications of MI
Ventricular Remodeling



Old infarct (short-axis view)

LV Apical Aneurysm

Complications of MI
LV True Aneurysm



Apical (long-axis view)

Complications of MI
LV True Aneurysm

Definition

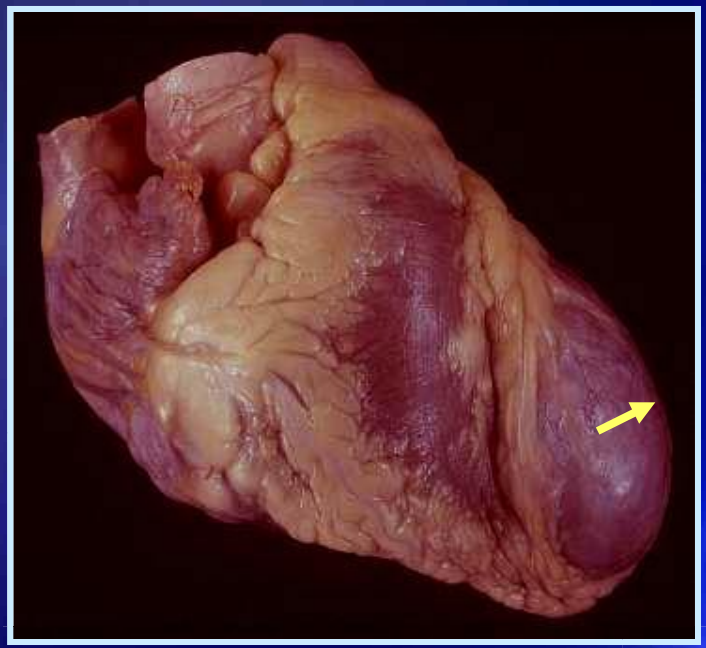
- Localized dilatation in chamber, beyond normal contour, containing myocardium

Appearance

- Saccular, wide neck

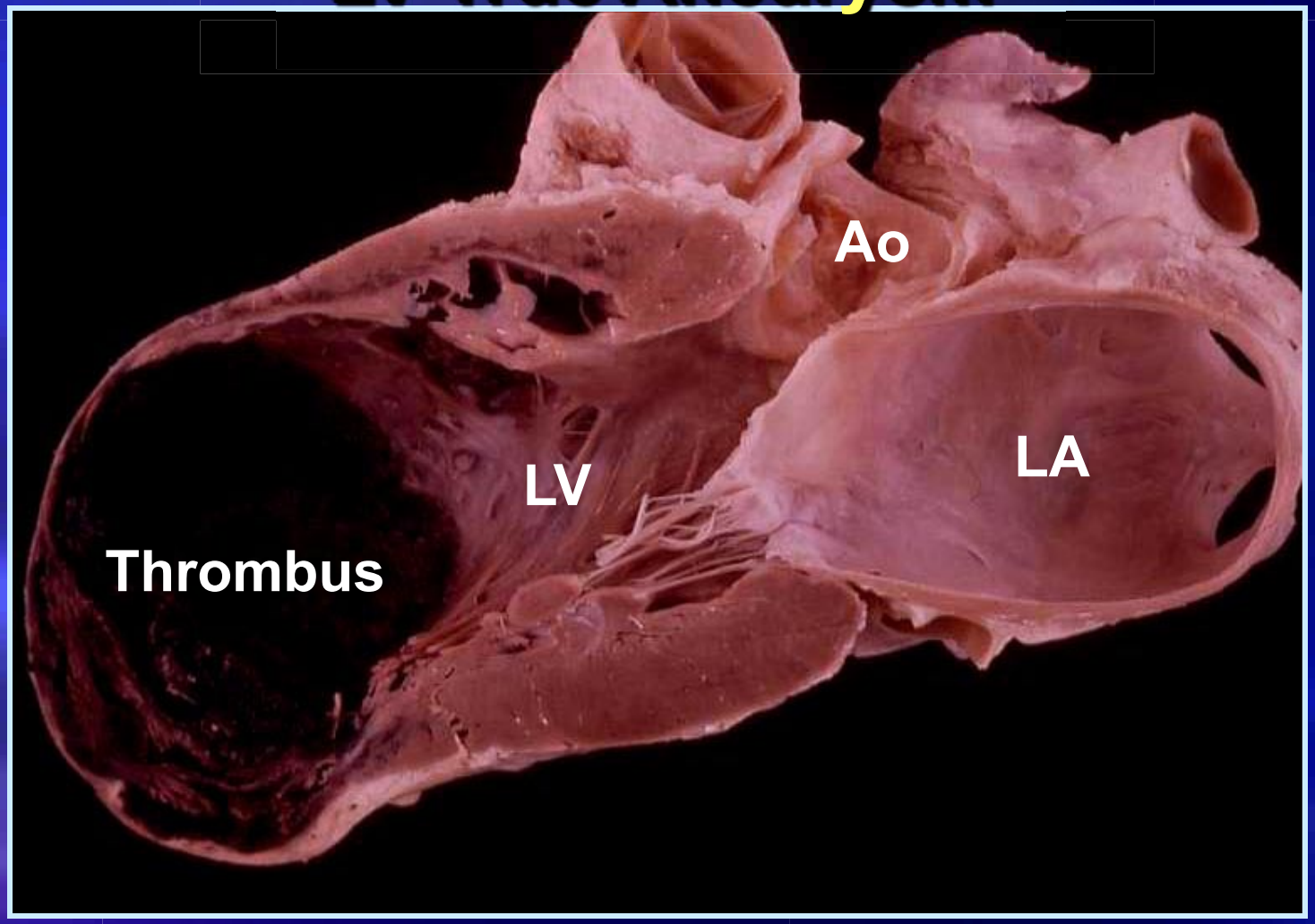
Consequences

- Arrhythmias (VT)
- Thrombus (emboli)
- Chronic CHF (large)
- No rupture (>1 mo)



Heart (anterior view)

Complications of MI
LV True Aneurysm



Mural thrombus (long-axis view)

Left Ventricular Thrombus

- Static flow in region of akinesis or dyskinesis plus endocardial inflammation
- Usually apex
  - RV, posterior aneurysms
- Embolic potential variable


PT:
355
07-MAR-89
08:36:49AM
s3194 29HZ
DEPTH= 160
MAYO/A-1
PWR = 0dB
45dB 1/B/D
GAIN= 9dB
HR= 89bpm
WHITE/BLACK
L/R INVERT
APEX INVERT

Echo and LV Thrombus

- False-positive: Trabeculae, chordae, artifact, papillary muscle
- False-negative: Endocardium, near-focus artifact
- At least 2 planes
- Specify if mobile or protruding

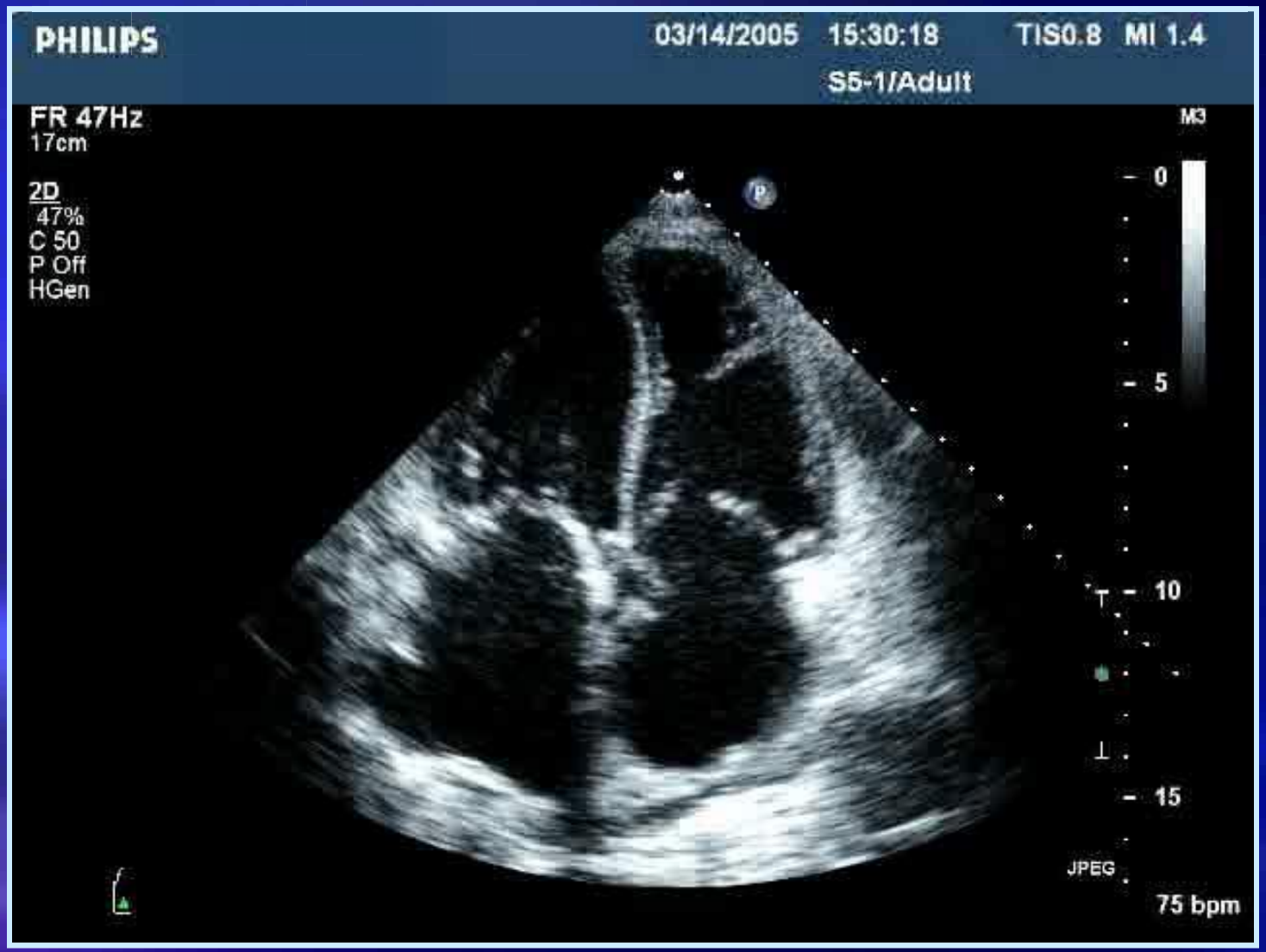
93-yr-old woman with CHF


PHILIPS
03/14/2005 15:26:45
TIS0.9 MI 1.3
S5-1/Adult
FR 53Hz
14cm
2D
47%
C 50
P Off
HGen
M3
0
5
10
JPEG
76 bpm


PHILIPS
03/14/2005 15:26:59 TIS0.9 MI 1.3
S5-1/Adult
FR 53Hz
14cm
2D
47%
C 50
P Off
HGen
M3
0
5
10
JPEG
191 bpm

LV

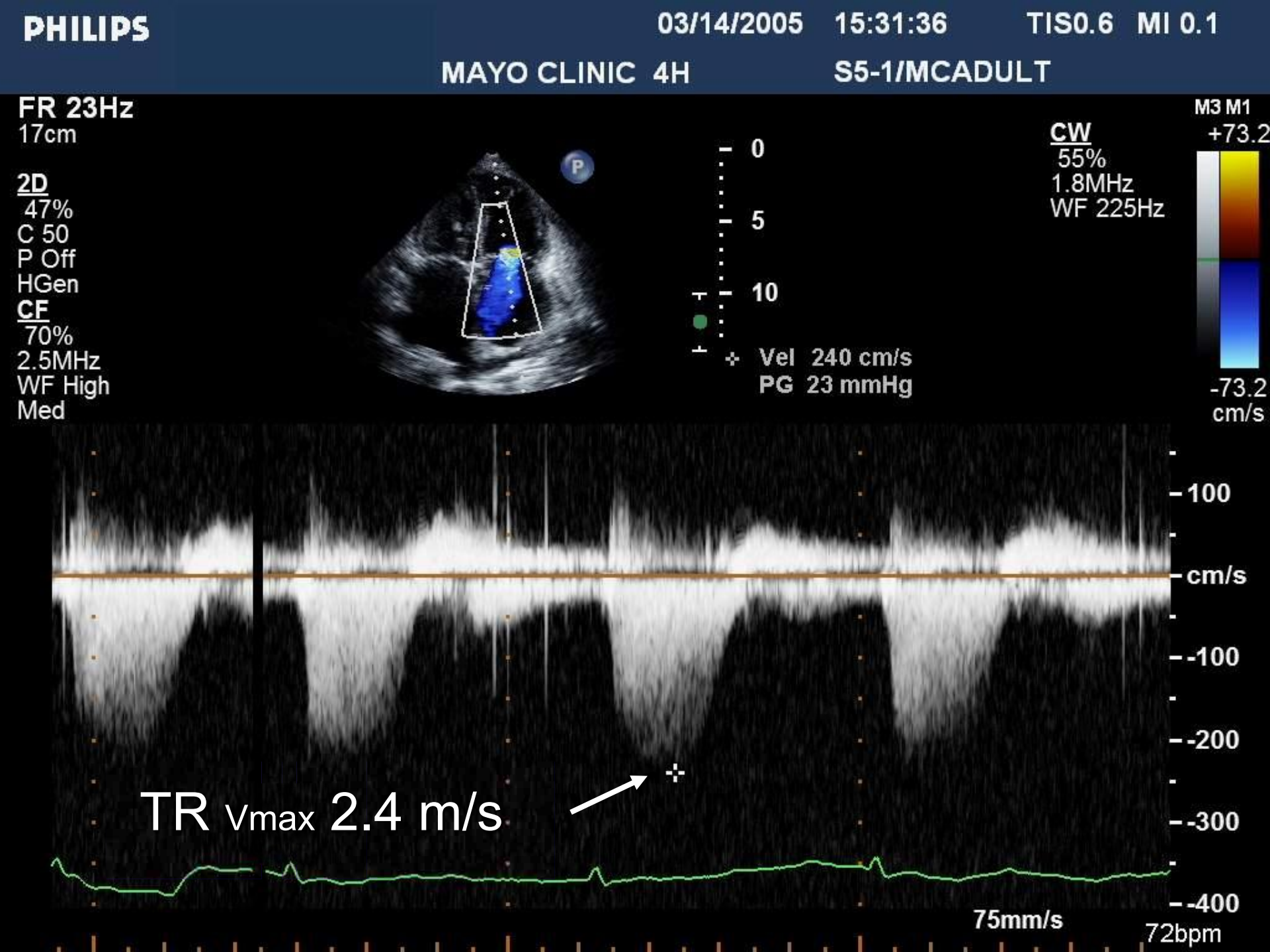
RV


PHILIPS
03/14/2005 15:30:18
TIS0.8 MI 1.4
S5-1/Adult
FR 47Hz
17cm
2D
47%
C 50
P Off
HGen
M3
0
5
10
15
JPEG
75 bpm

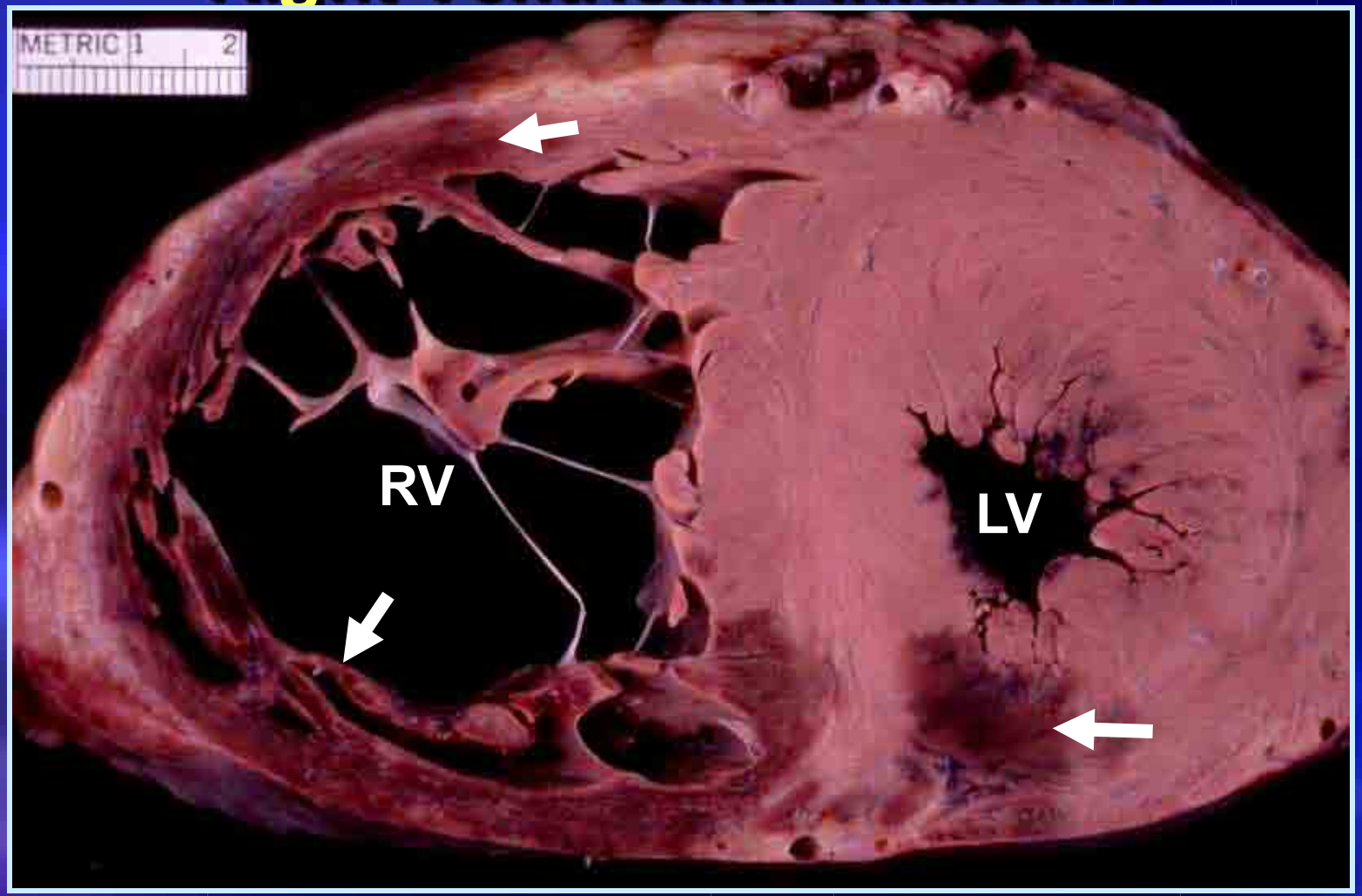
LV

RV


PHILIPS
03/14/2005 15:30:39 TIS1.5 MI 1.1
S5-1/Adult
FR 23Hz
17cm
2D
49%
C 50
P Off
HGen
CF
70%
2.5MHz
WF High
Med
M3 M1
+73.2
0
5
10
15
-73.2
cm/s
JPEG
*** bpm


PHILIPS
03/14/2005 15:31:36 TIS0.6 MI 0.1
MAYO CLINIC 4H S5-1/MCADULT
FR 23Hz
17cm
2D
47%
C 50
P Off
HGen
CF
70%
2.5MHz
WF High
Med
0
5
10
Vel 240 cm/s
PG 23 mmHg
CW
55%
1.8MHz
WF 225Hz
M3 M1
+73.2
-73.2
cm/s
100
cm/s
-100
-200
-300
-400
TR Vmax 2.4 m/s
75mm/s
72bpm

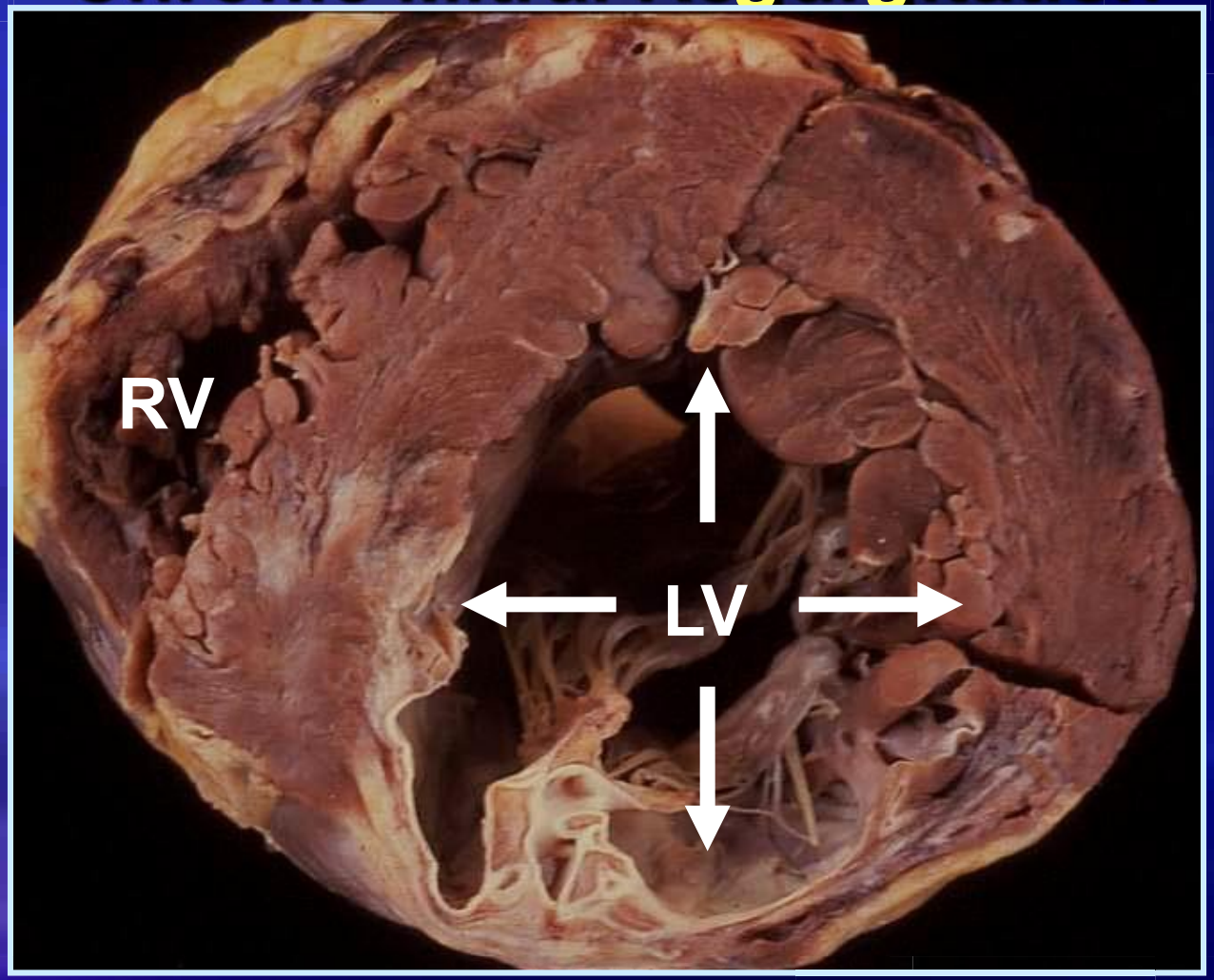
Complications of MI
Right Ventricular Infarction



Acute MI (short-axis view)

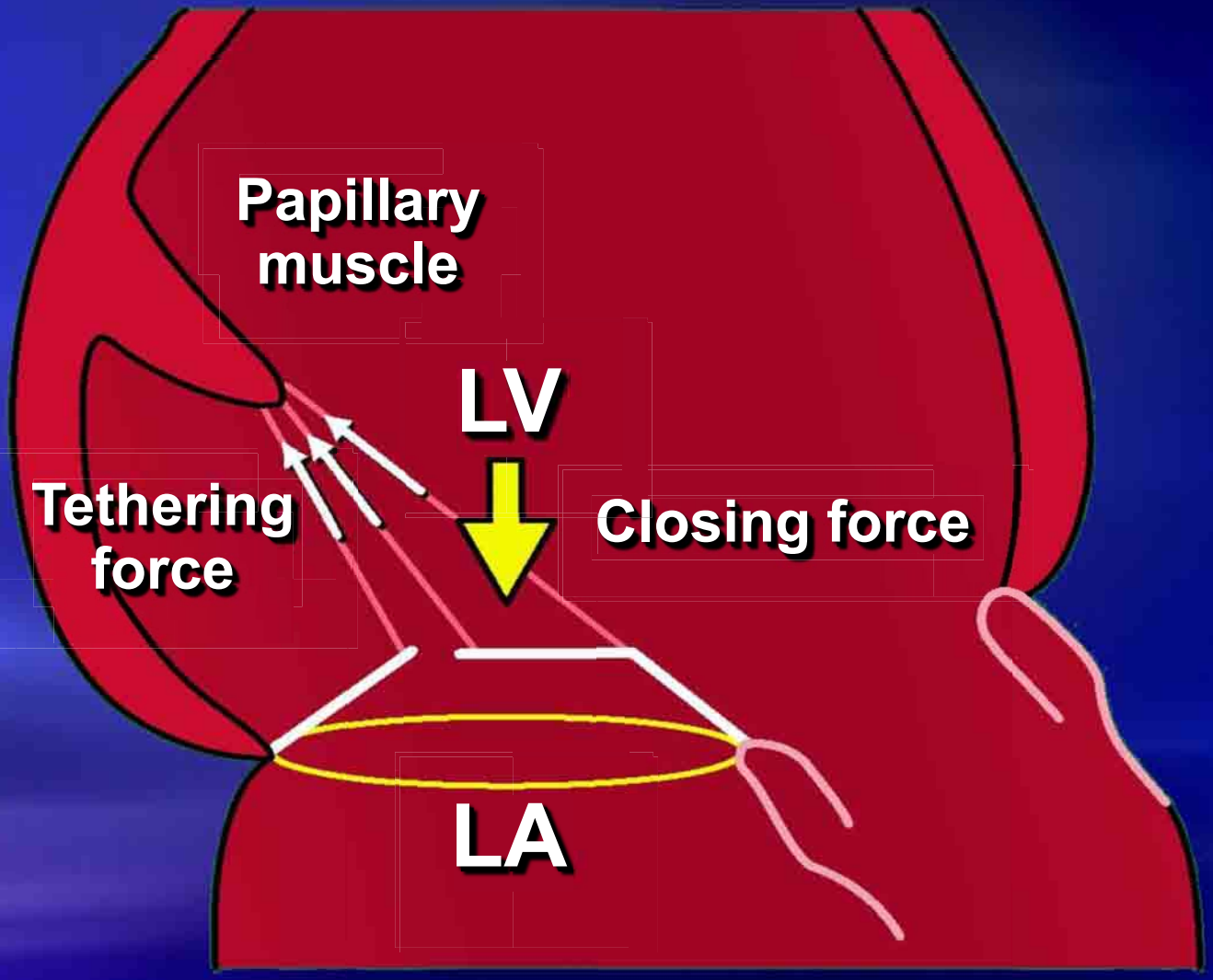
Complications of MI

Chronic Mitral Regurgitation



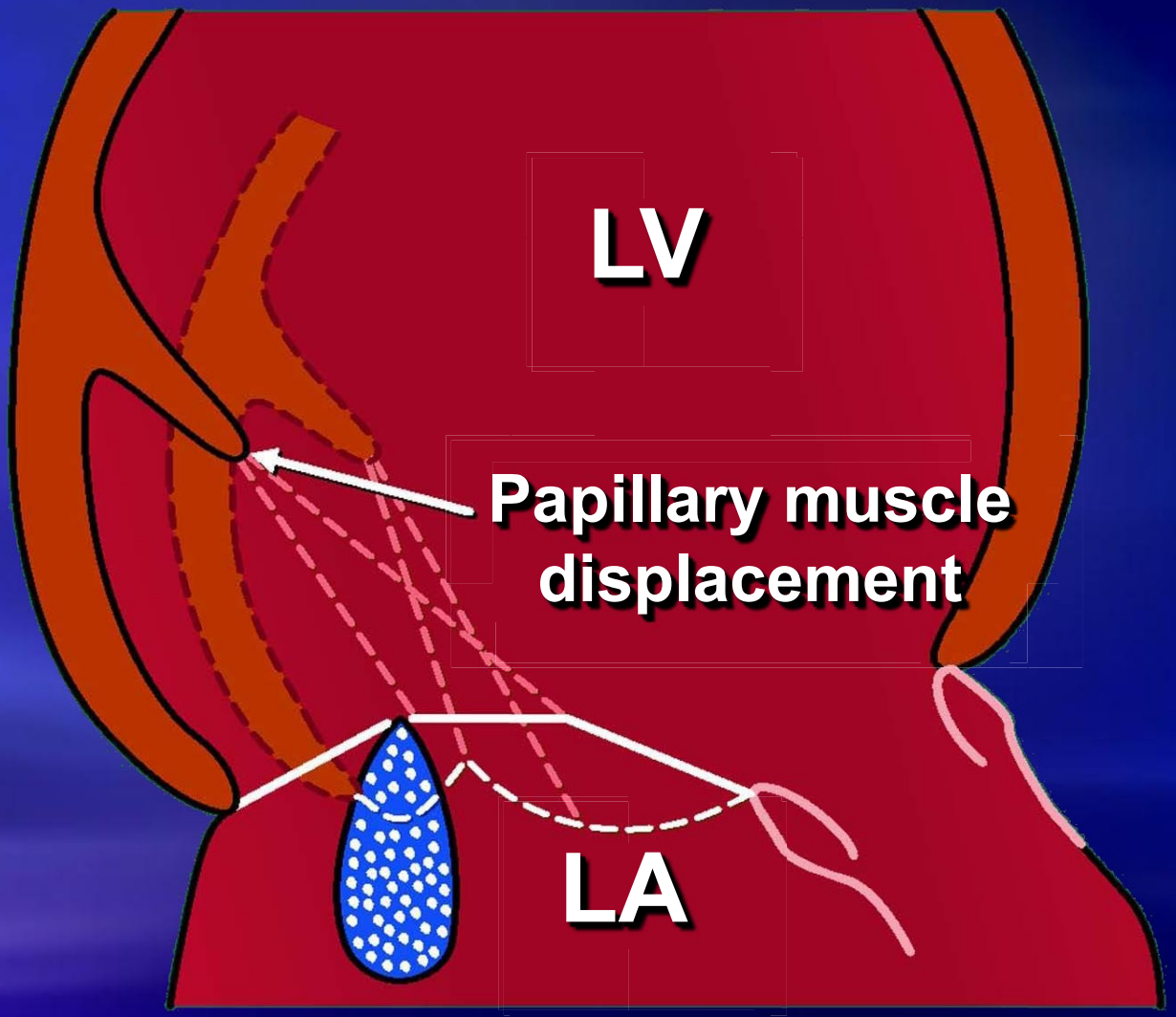
Old transmural MI (short-axis view)

Balance of Forces on the Mitral Valve



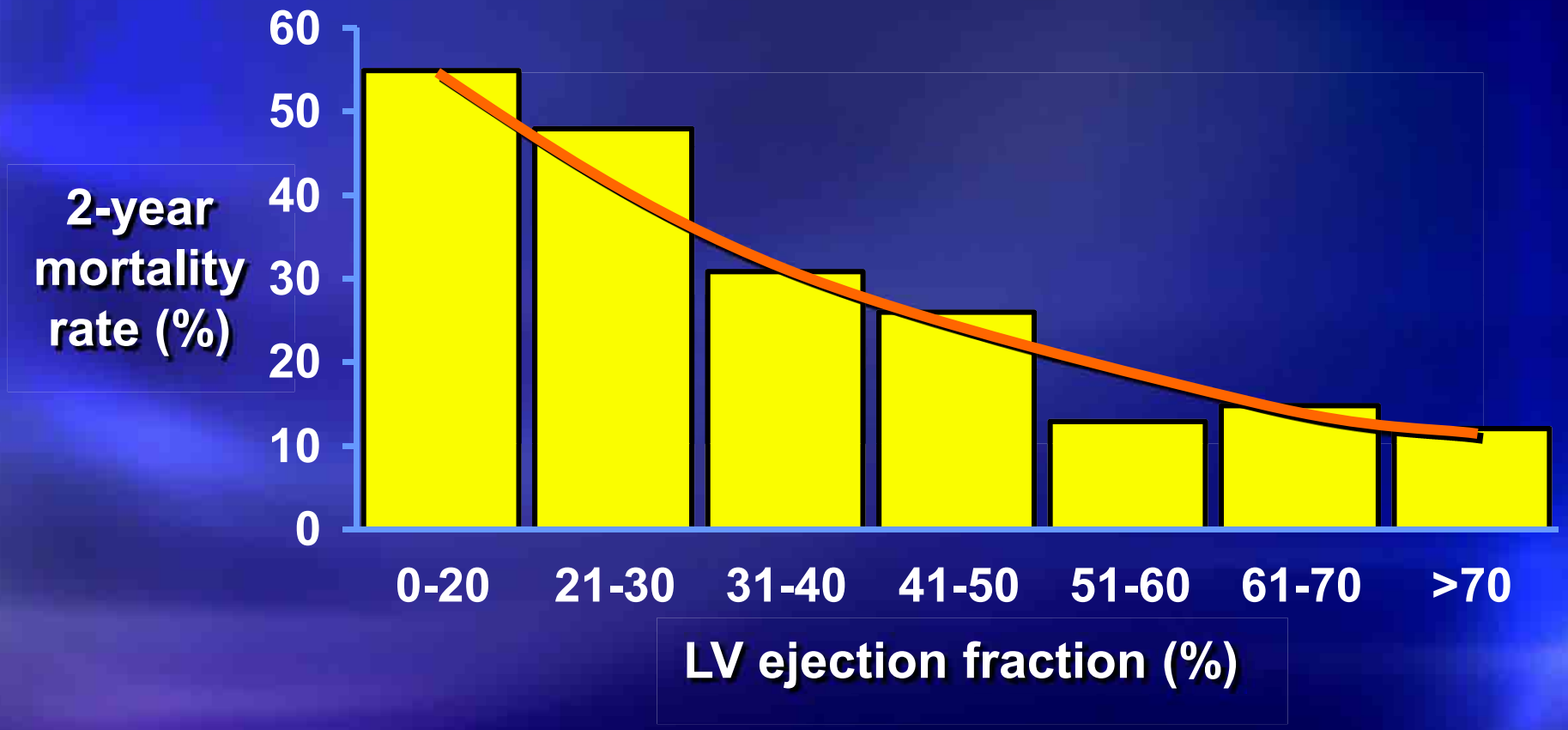
Otsuji et al: Circulation, 1997

Balance of Forces on the Mitral Valve



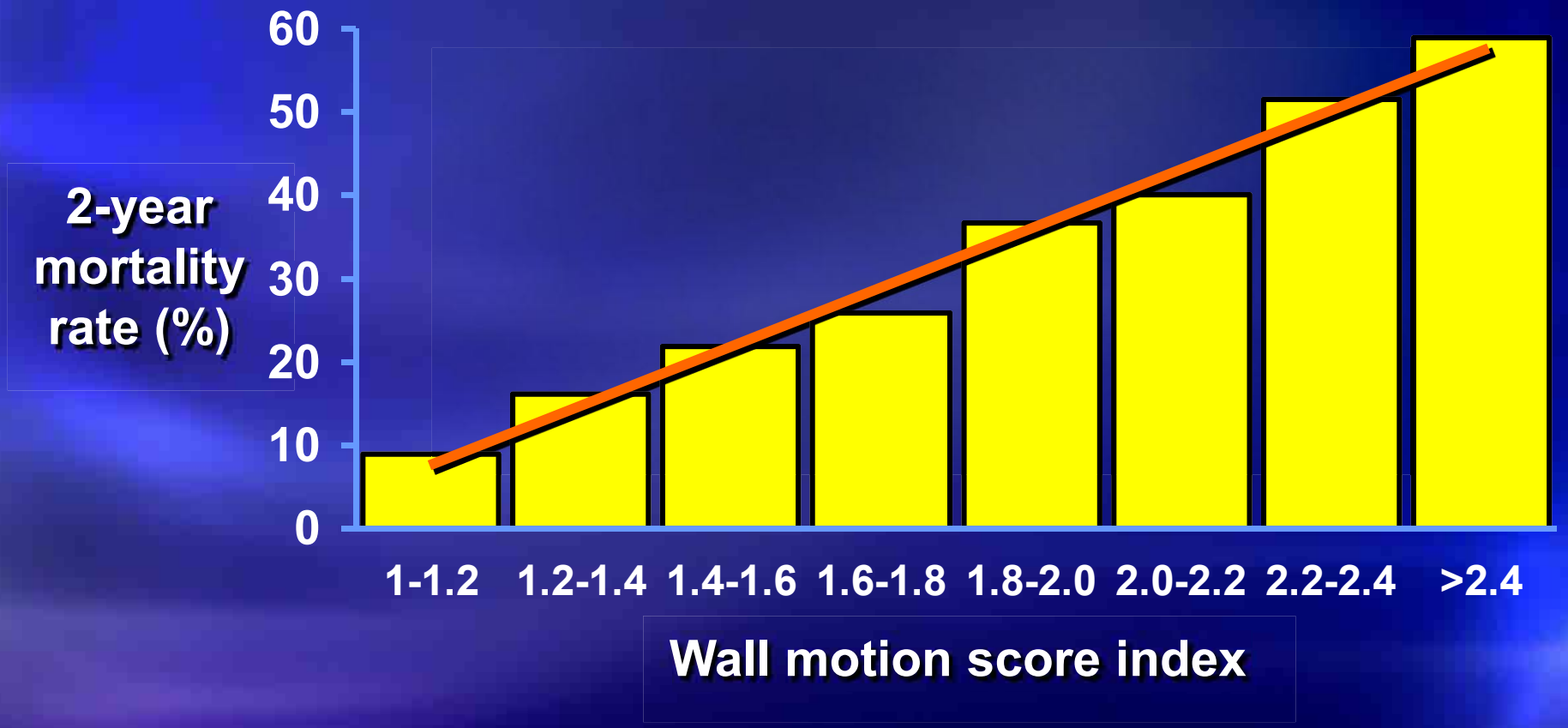
Otsuji et al: Circulation, 1997

Acute Myocardial Infarction
LV Ejection Fraction and Mortality



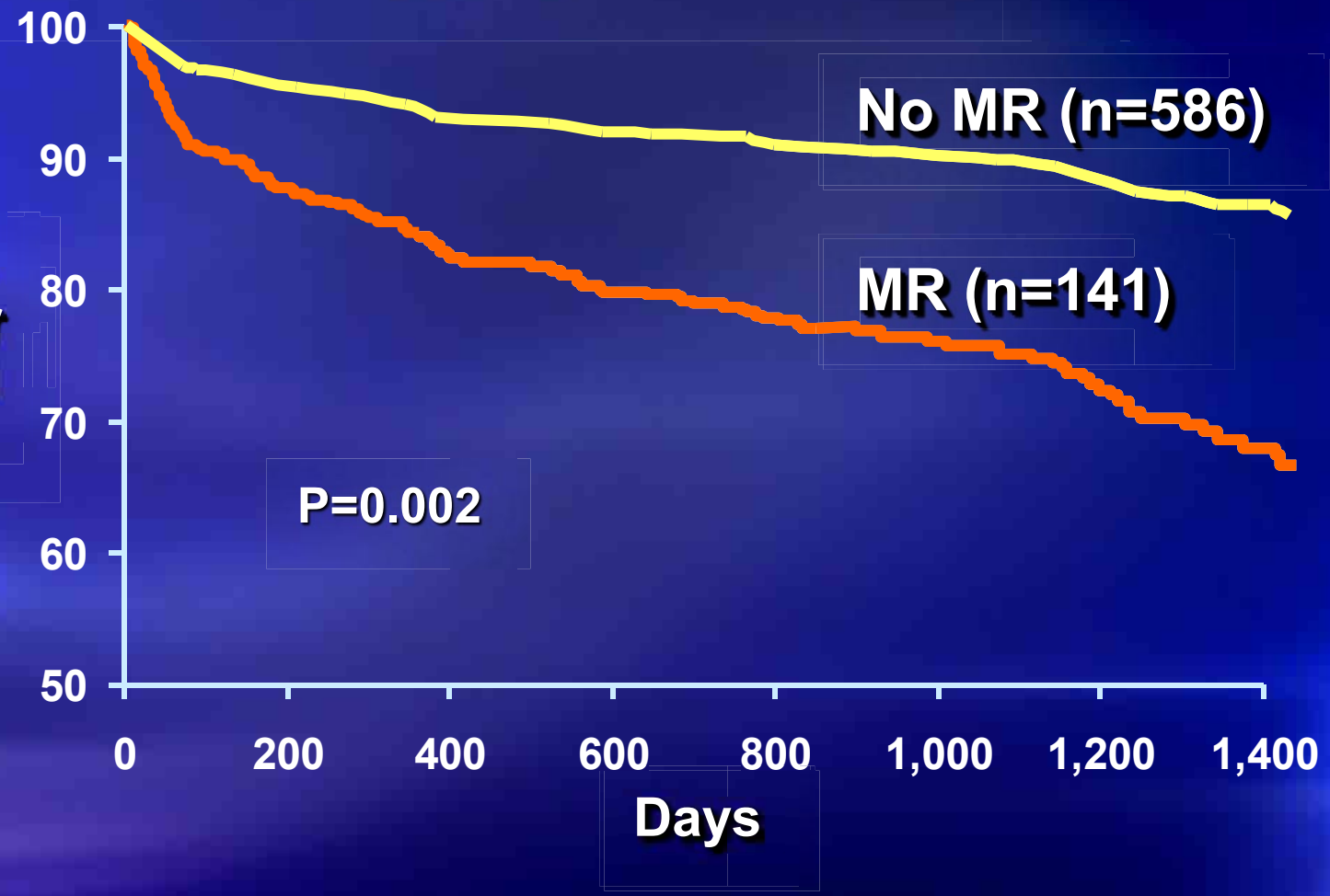
Møller et al: Am Heart J, 2006

Acute Myocardial Infarction
Wall Motion Score Index and Mortality



Møller et al: Am Heart J, 2006

Mitral Regurgitation Post-MI



Lamas et al: Circulation, 1997 (SAVE substudy)

Thanks for Listening !

58 year old man with inferior MI
Blood pressure 116/80 mmHg

and VSD Closure with 30 mm Amplatzer Devise