Tricuspid Regurgitation

Prevalence-Treatment

Eurovalve-2017

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Prevalence of Valve Diseases
VHD Olmsted County, MN

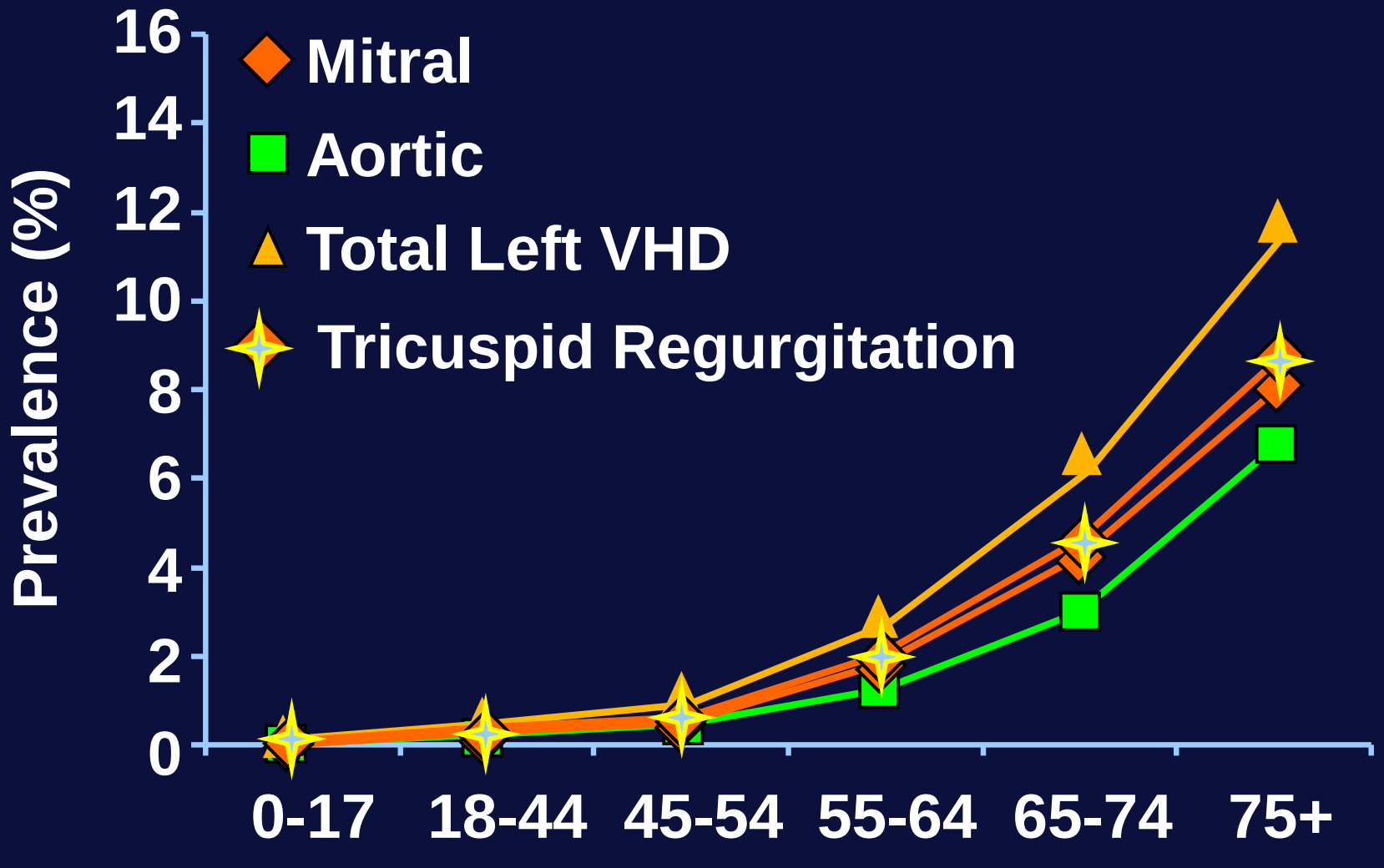
	Prevalence per 100 adult residents
Total Left VHD	1.8%
Tricuspid Regurgitation	1.3%

In the USA adults affected by moderate or severe TR are >3 M

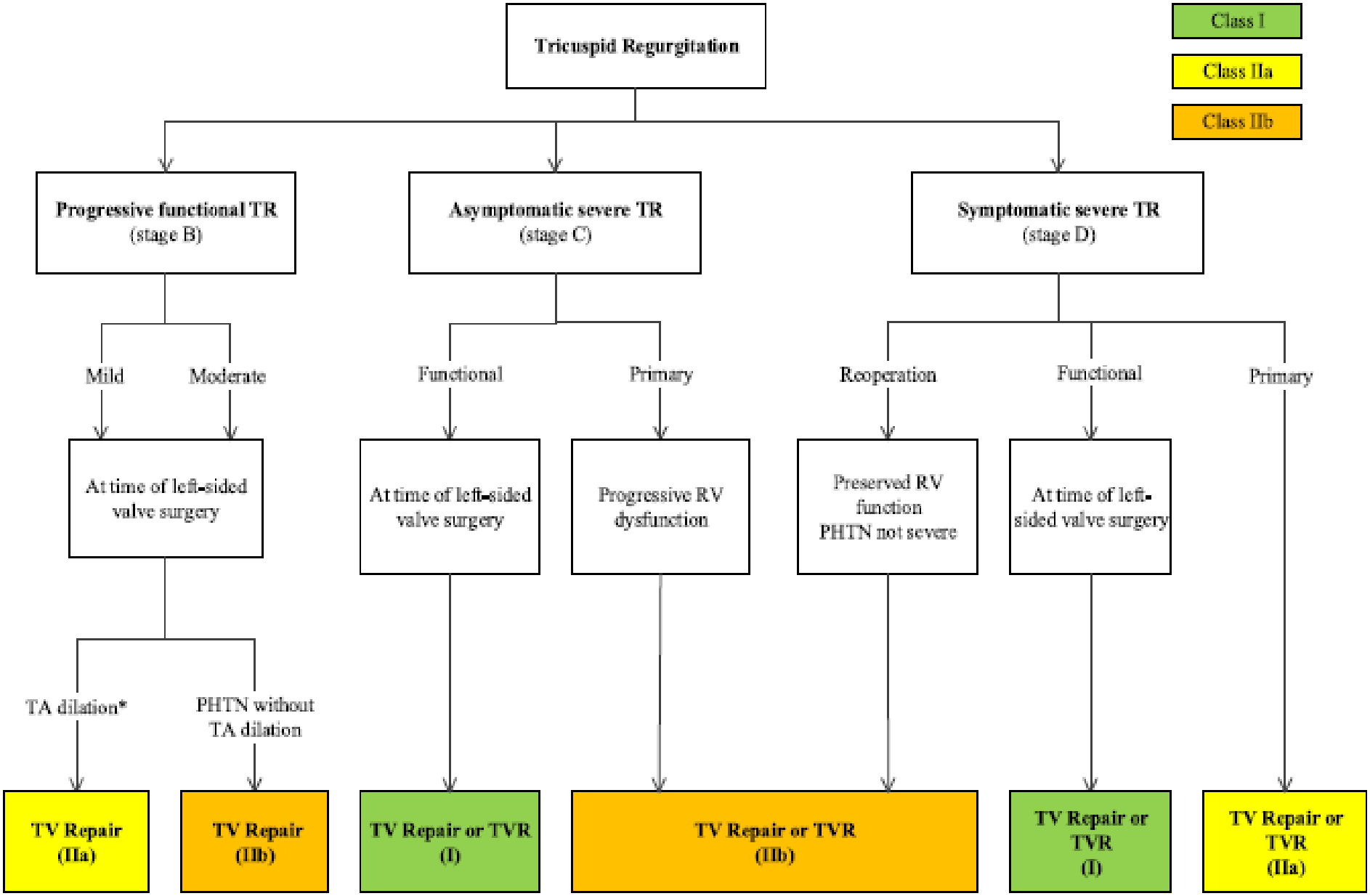
CR98:19-28

Prevalence of Valve Diseases

Olmsted County



Guidelines


Tricuspid Regurgitation
Class I
Class IIa
Class IIb
Progressive functional TR
(stage B)
Asymptomatic severe TR
(stage C)
Symptomatic severe TR
(stage D)
Mild
Moderate
Functional
Primary
Reoperation
Functional
Primary
At time of left-sided valve surgery
At time of left-sided valve surgery
Progressive RV dysfunction
Preserved RV function
PHTN not severe
At time of left-sided valve surgery
TA dilation*
PHTN without TA dilation
TV Repair (IIa)
TV Repair (IIb)
TV Repair or TVR (I)
TV Repair or TVR (IIb)
TV Repair or TVR (I)
TV Repair or TVR (IIa)

Tricuspid Regurgitation

Why is TR management so vague and poorly defined ?

Reason #1:

Heterogeneity

A smorgasbord of strange etiologies

Tricuspid Regurgitation

"Causal Disease"

1162 Quantified cases

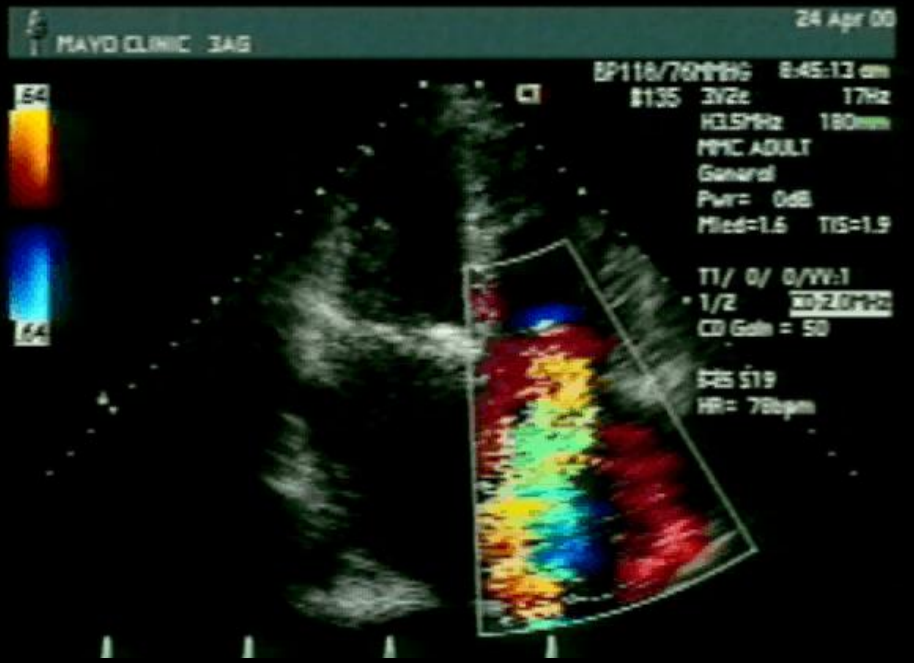
- Congenital Disease 8.9%
- Organic T Valve diseases or pacemaker wire 11.9%
- Left valve disease 25.9%
- LV Dysfunction 12.2%
- Pulmonary HTN 28.9%
- Idiopathic 12.2%

Tricuspid Regurgitation

Rheumatic Valve Disease

Surgical Specimen


MAYO CLINIC 3AG
MAYO CLINIC ADULT
General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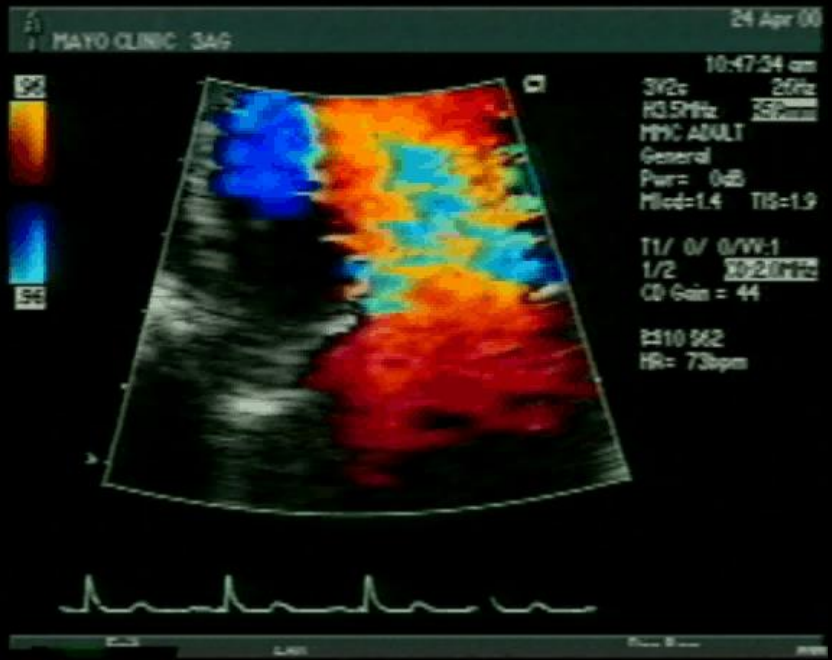
24 Apr 00
MAYO CLINIC ADULT
General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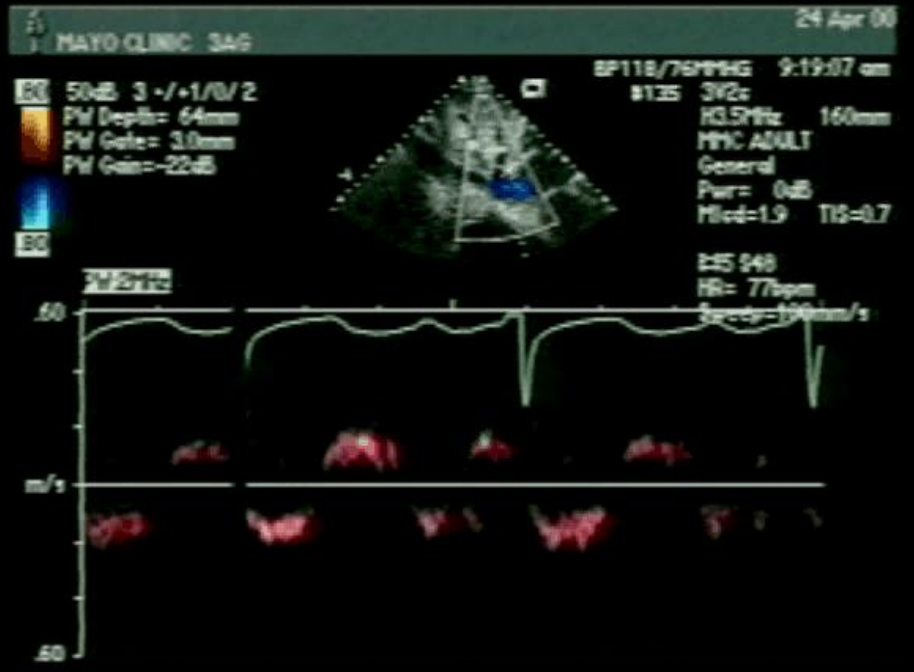
MAYO CLINIC ADULT
General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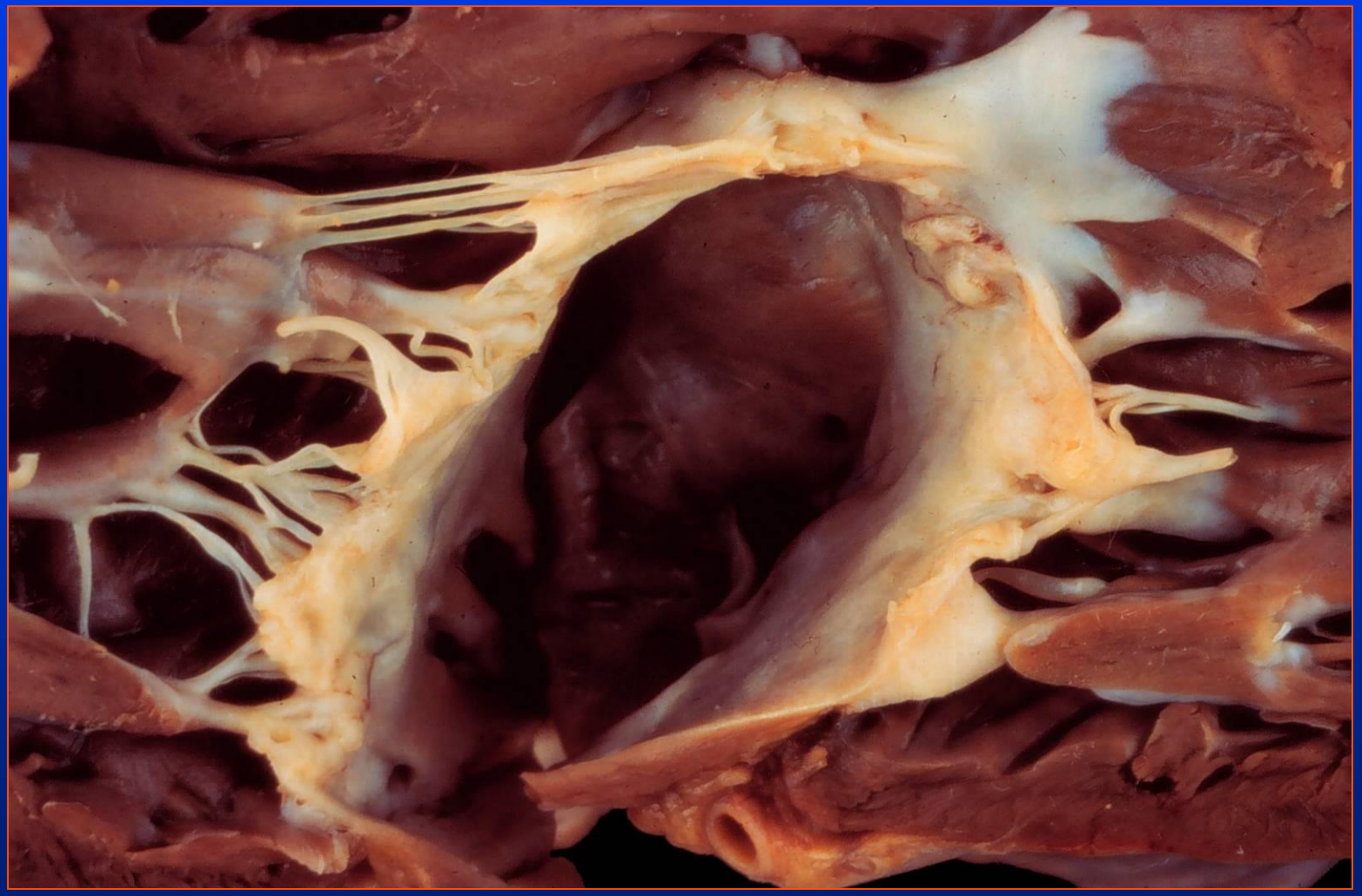
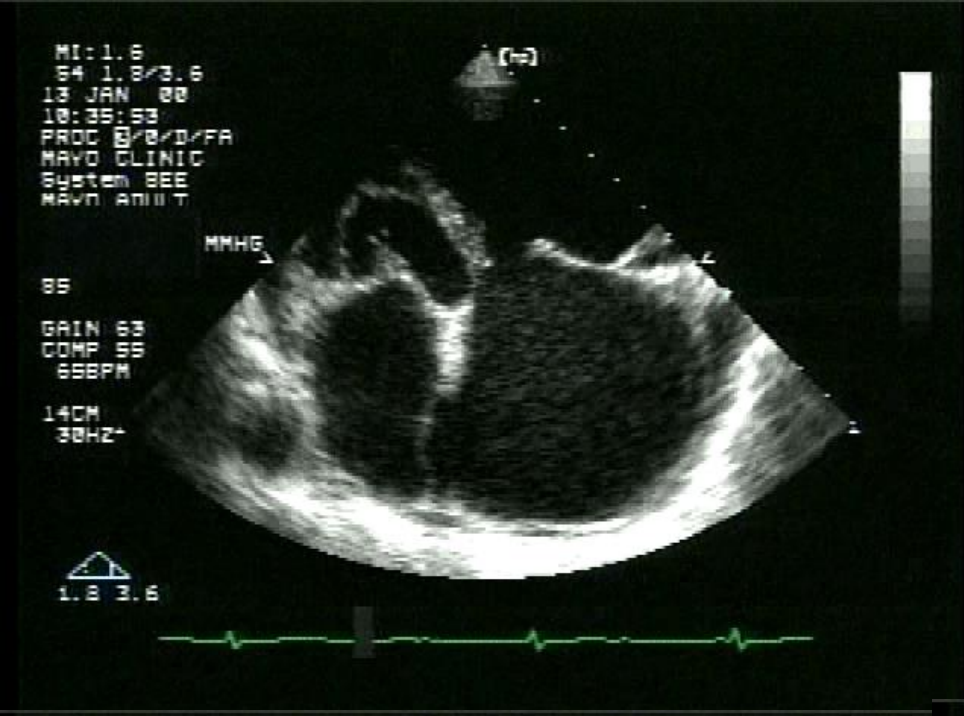
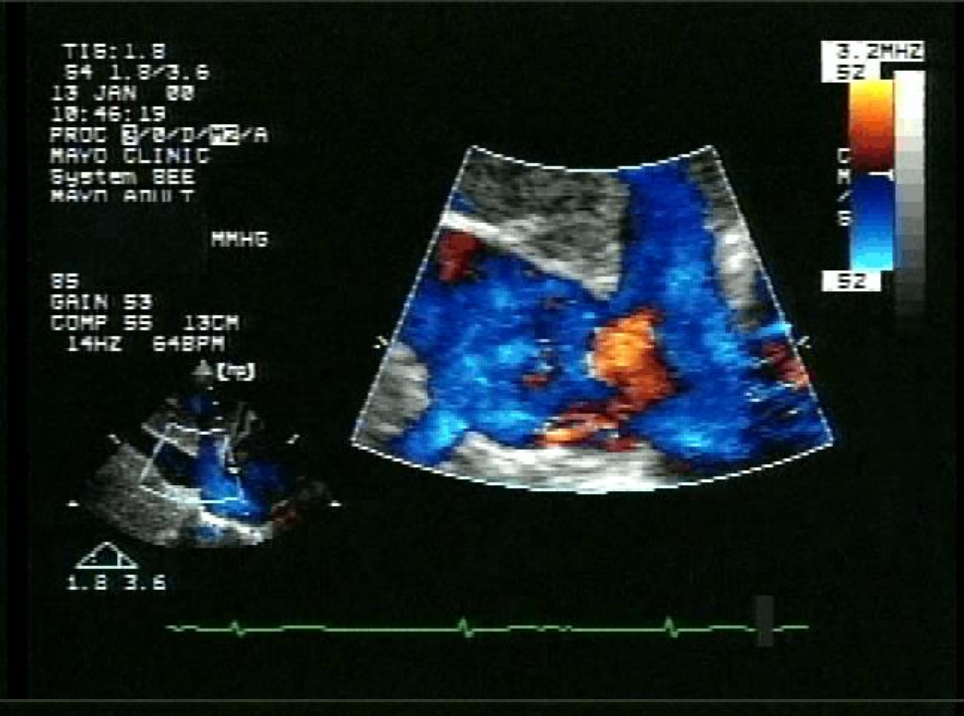
24 Apr 00
MAYO CLINIC ADULT
General
m/s

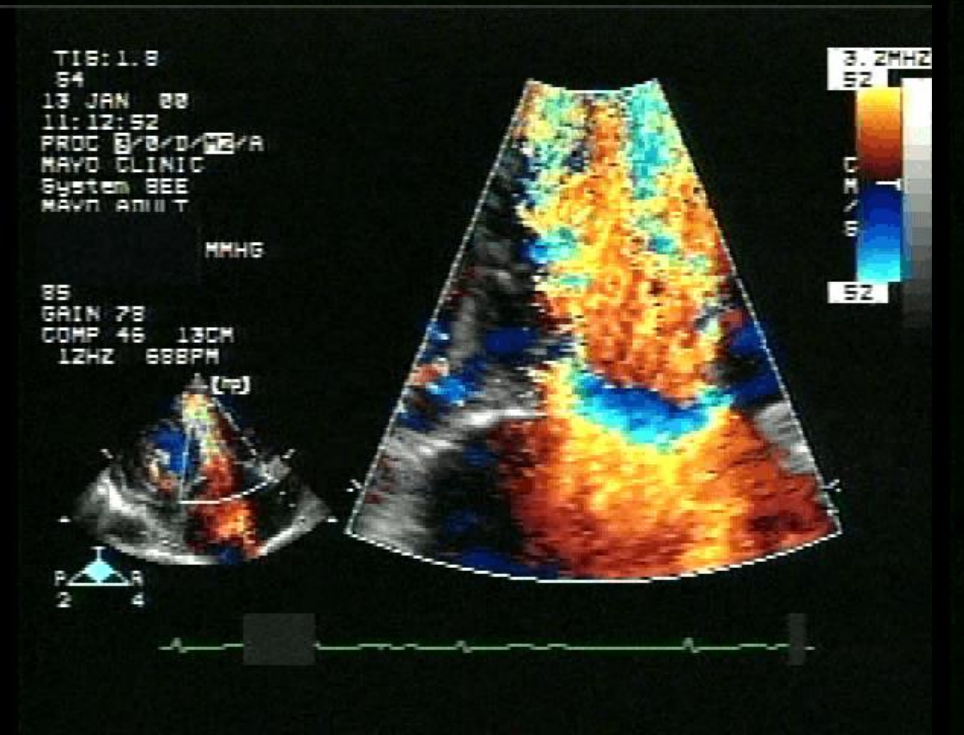
Tricuspid Regurgitation
Carcinoid Heart Disease



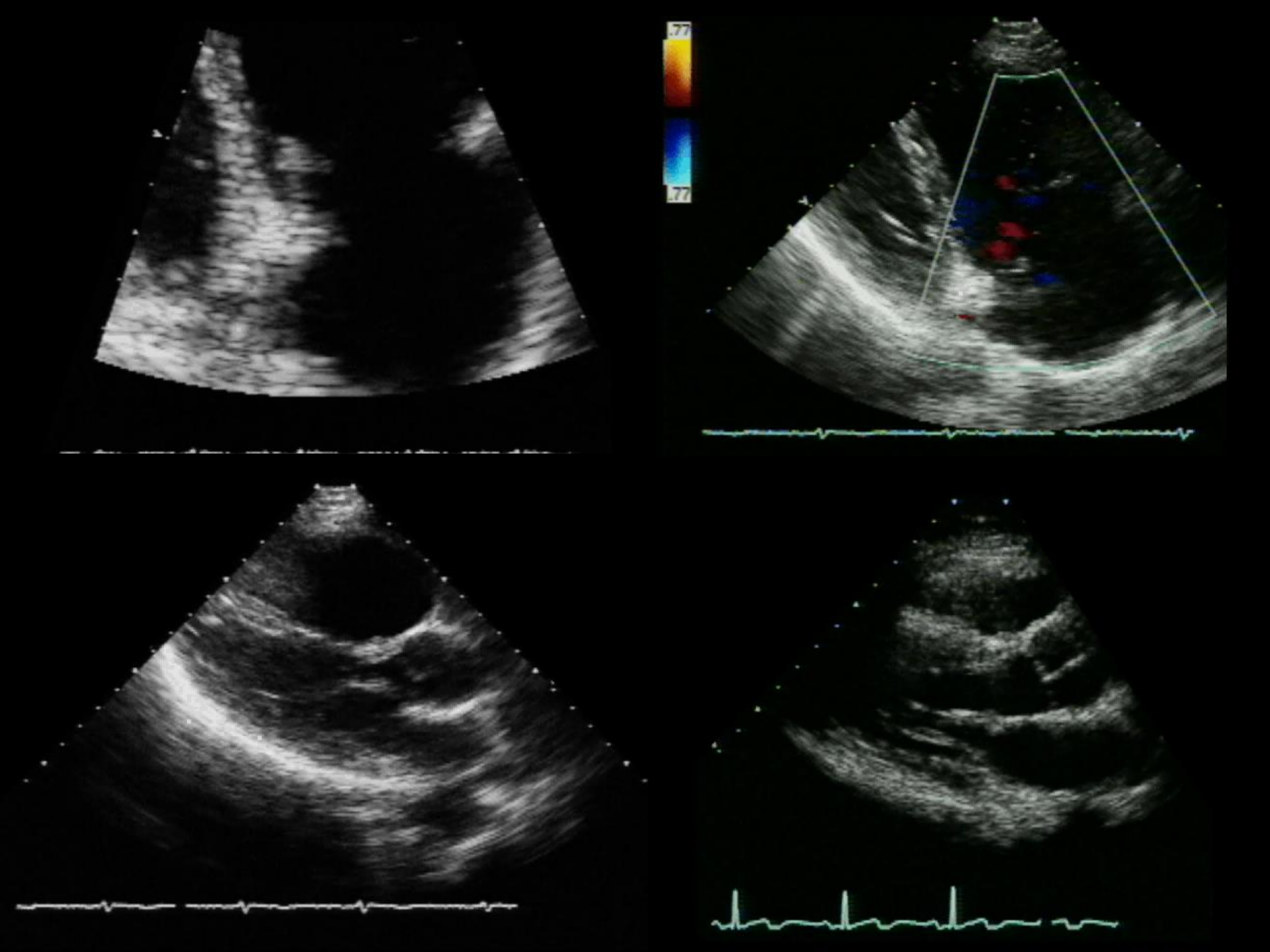
Autopsy Specimen (From RV Apex)

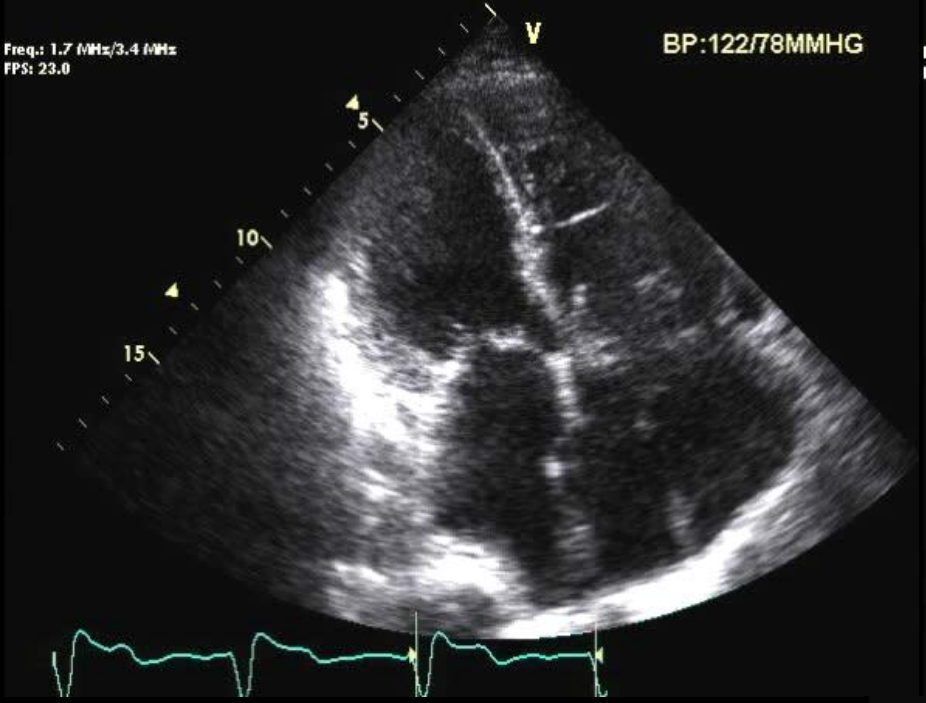

MI:1.6
64 1.8/3.6
13 JAN 00
10:35:53
PROC B/0/D/FA
MAYO CLINIC
System BEE
MAYn AnnT
MMHG
85
GAIN 63
COMP 55
65BPM
14CM
30HZ
1.8 3.6

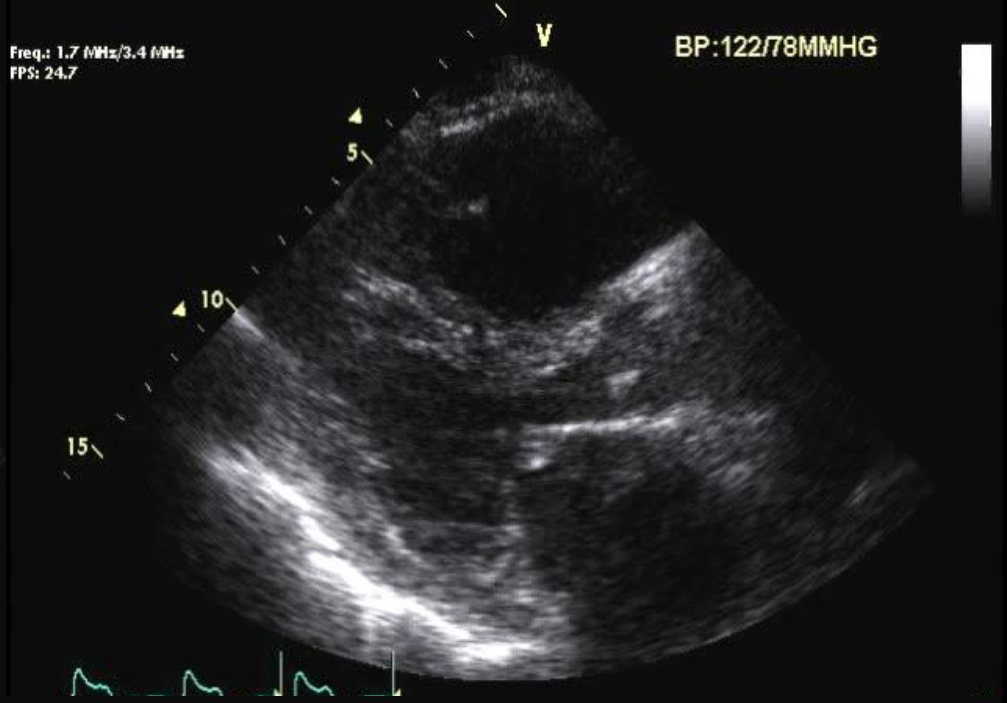

TIS:1.8
64 1.8/3.6
13 JAN 00
10:46:19
PROC B/0/D/WB/A
MAYO CLINIC
System BEE
MAYn AnnT
MMHG
85
GAIN 53
COMP 55 13CM
14HZ 64BPM
1.8 3.6
3.2MHZ
92
CM/S
92


TIS:1.8
64
13 JAN 00
11:12:52
PROC B/0/D/WB/A
MAYO CLINIC
System BEE
MAYn AnnT
MMHG
85
GAIN 78
COMP 46 13CM
12HZ 68BPM
P A
2 4
3.2MHZ
92
CM/S
92

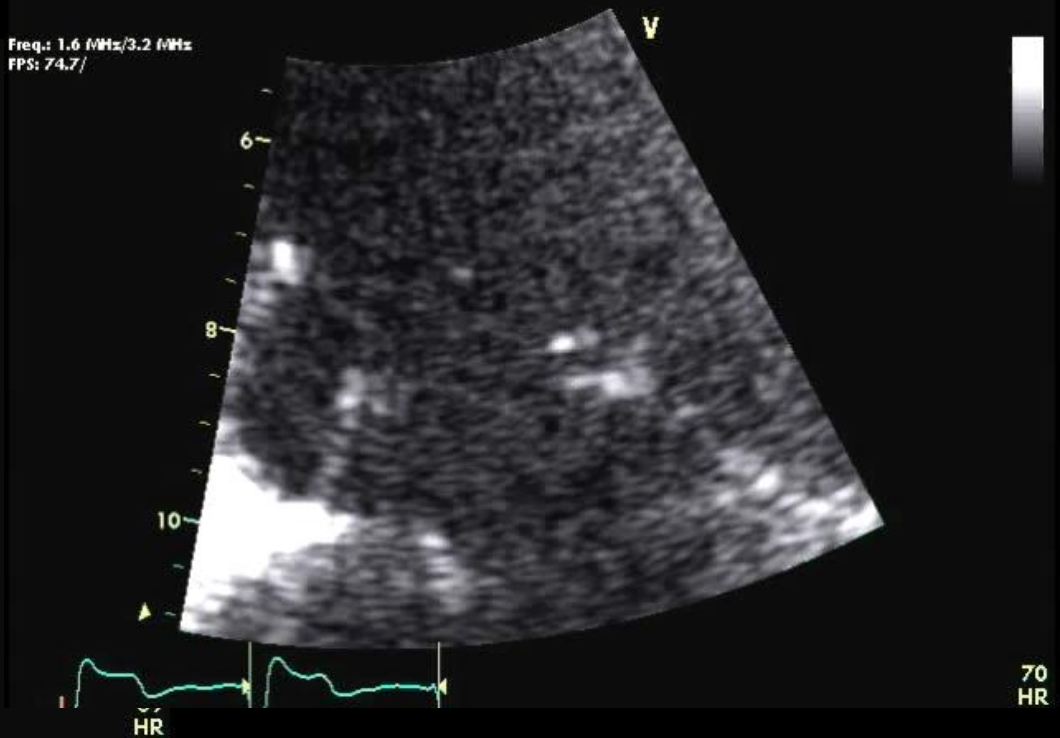

TIS:0.9
64
GAIN 78 COMP 46
MAYO CLINIC
13CM
PROC B/0/D/WB/A
288PM
MAYMN 111. cm/s
VTI 69.5 cm
MAX 12.7 mmHg
MN 5.86 mmHg
13 JAN 00
11:13:58
85
1.8MHZ
3.2MHZ
74
CM/S
74
300
200
100
0
100
200
FOCUS: 7.0CM
0: 0
+= 100
DELAY1 0 MS
EVERY 5 BEATS


.77
.77


Freq.: 1.7 MHz/3.4 MHz
FPS: 23.0
V
BP:122/78MMHG
5
10
15

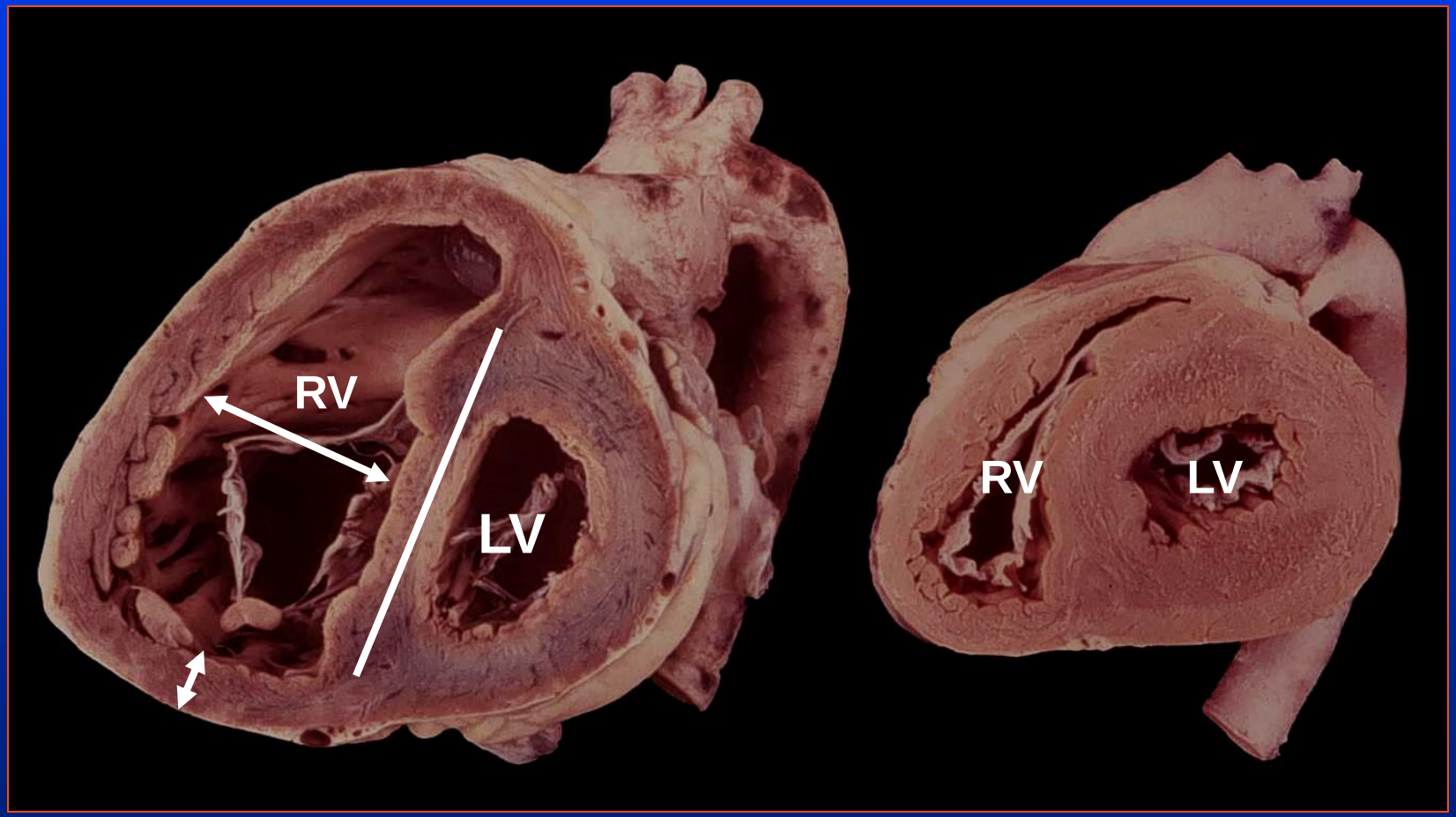

Freq.: 1.7 MHz/3.4 MHz
FPS: 24.7
V
BP:122/78MMHG
5
10
15


Freq.: 1.6 MHz/3.2 MHz
FPS: 25.8/25.8
V
5
10
15

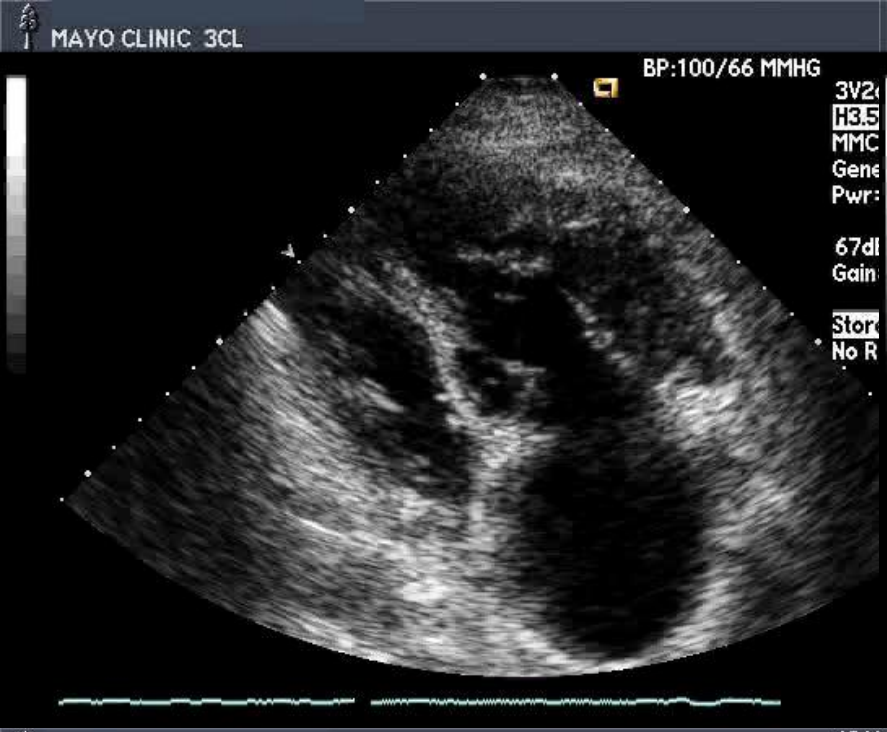

Freq.: 1.6 MHz/3.2 MHz
FPS: 74.7/
V
6
8
10
70
HR

Tricuspid Regurgitation

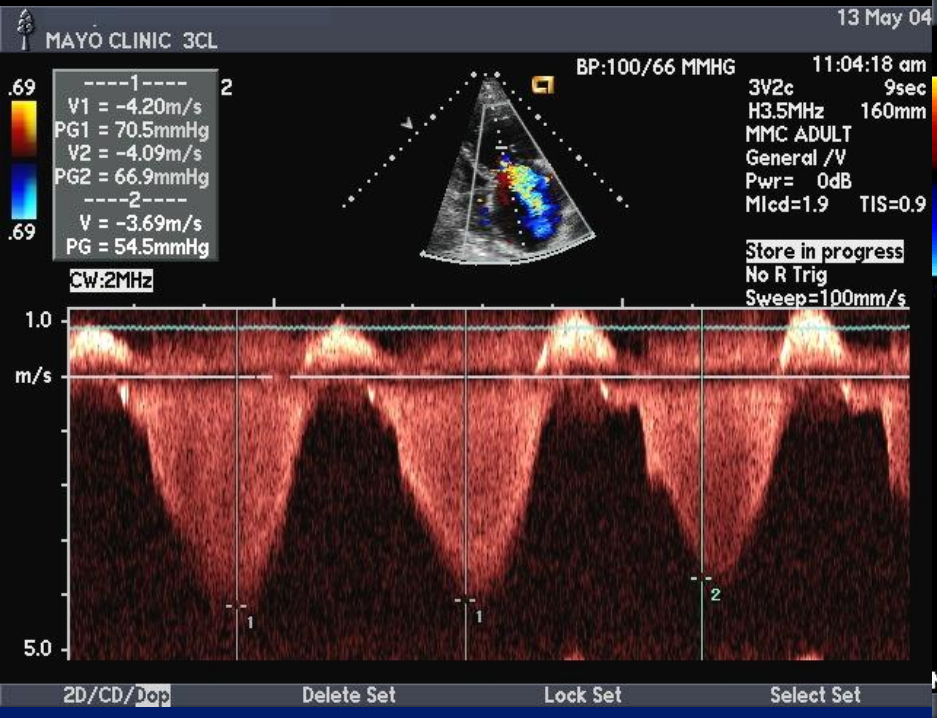
Pulmonary Hypertension

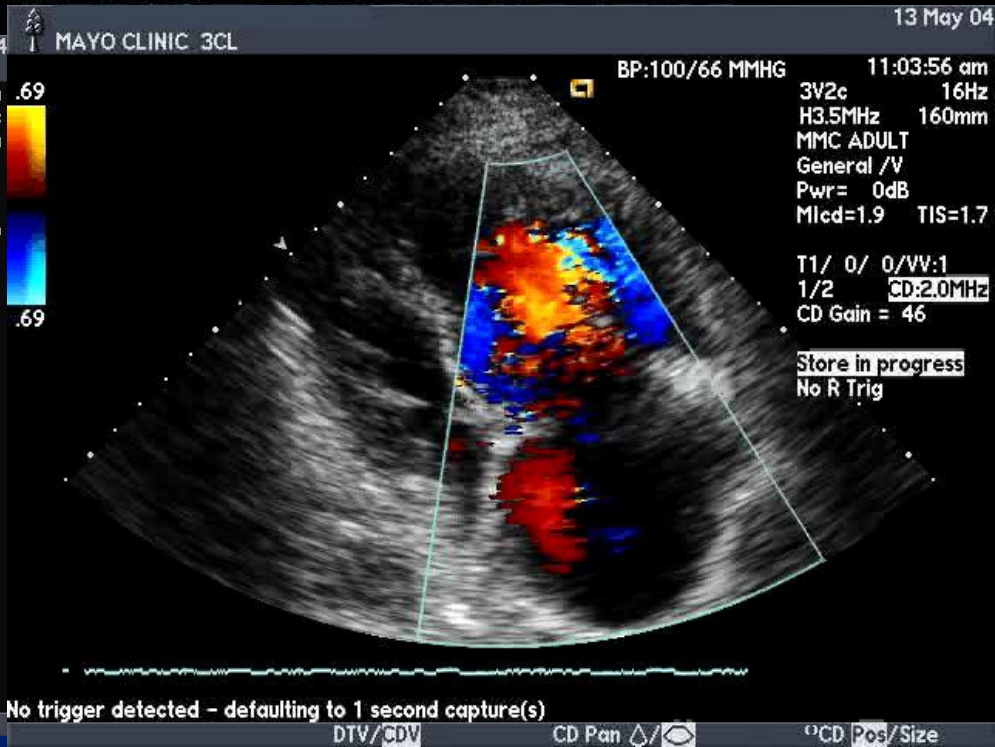


Autopsy Specimens


MAYO CLINIC 3CL
BP:100/66 MMHG

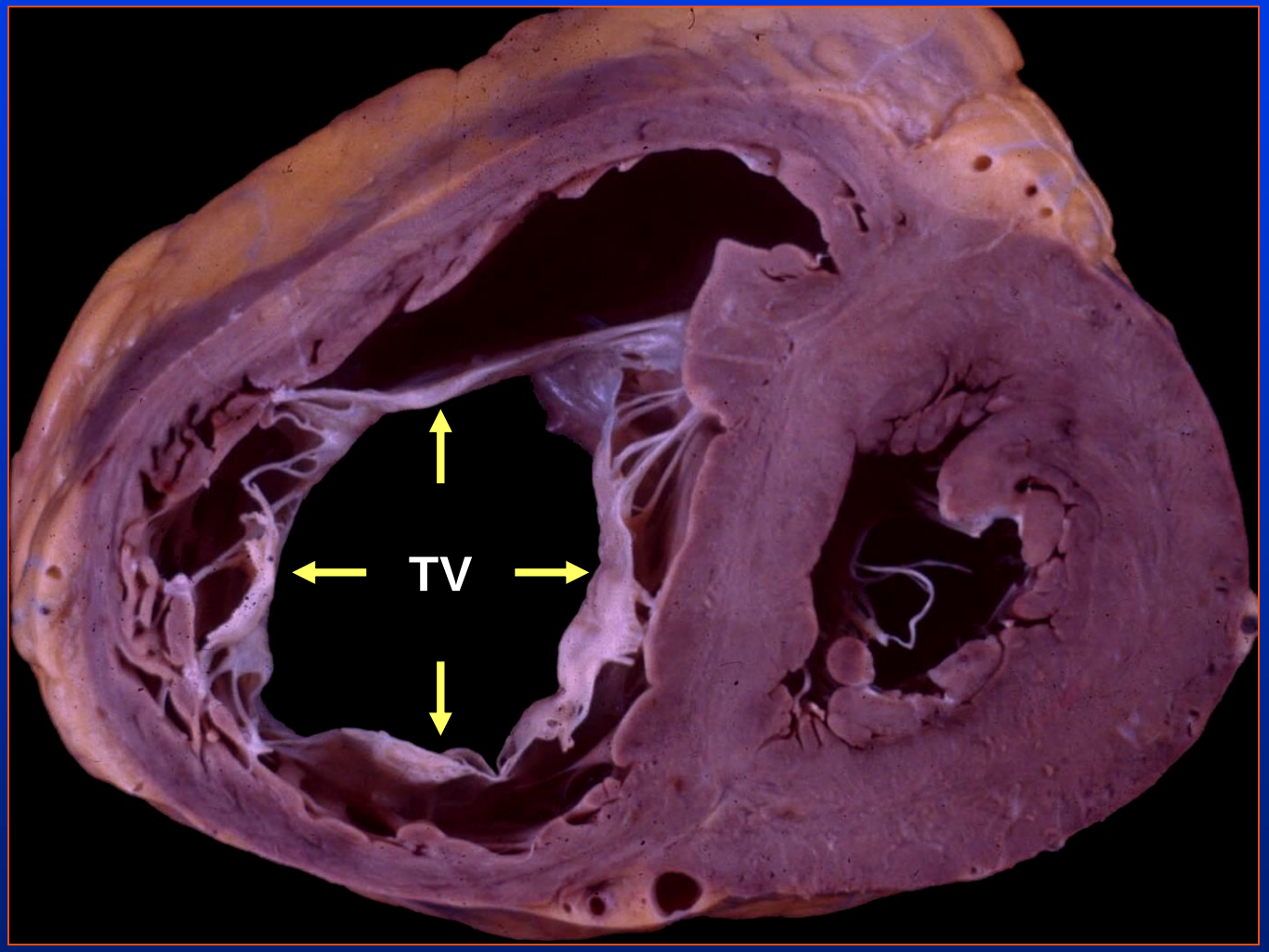

13 May 04
MAYO CLINIC 3CL
BP:100/66 MMHG
11:01:38 am
3V2c 38Hz
H3.5MHz 160mm
MMC ADULT
General /V
Pwr= 0dB MI=1.0
67dB S1/ 0/0/6
Gain= -4dB Δ=1
Store in progress
No R Trig


13 May 04
MAYO CLINIC 3CL
BP:100/66 MMHG
11:04:18 am
3V2c 9sec
H3.5MHz 160mm
MMC ADULT
General /V
Pwr= 0dB
MIcd=1.9 TIS=0.9
Store in progress
No R Trig
Sweep=100mm/s
----1----
V1 = -4.20m/s
PG1 = 70.5mmHg
V2 = -4.09m/s
PG2 = 66.9mmHg
----2----
V = -3.69m/s
PG = 54.5mmHg
CW:2MHz
1.0
m/s
5.0
2D/CD/Dop
Delete Set
Lock Set
Select Set

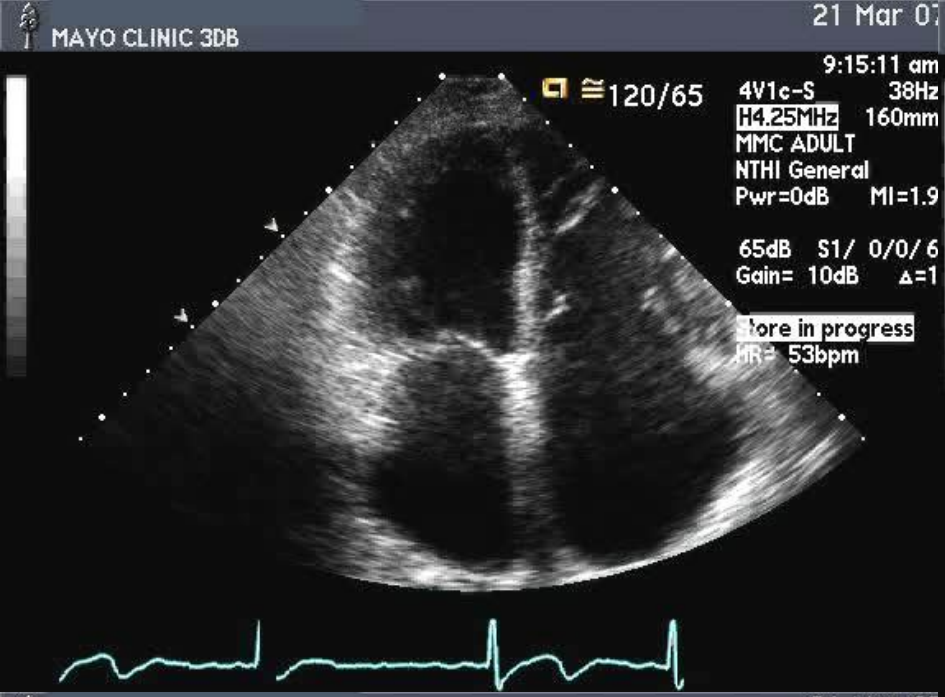

13 May 04
MAYO CLINIC 3CL
BP:100/66 MMHG
11:03:56 am
3V2c 16Hz
H3.5MHz 160mm
MMC ADULT
General /V
Pwr= 0dB
MIcd=1.9 TIS=1.7
T1/ 0/ 0/VV:1
1/2 CD:2.0MHz
CD Gain = 46
Store in progress
No R Trig
No trigger detected - defaulting to 1 second capture(s)
DTV/CDV
CD Pan
CD Pos/Size

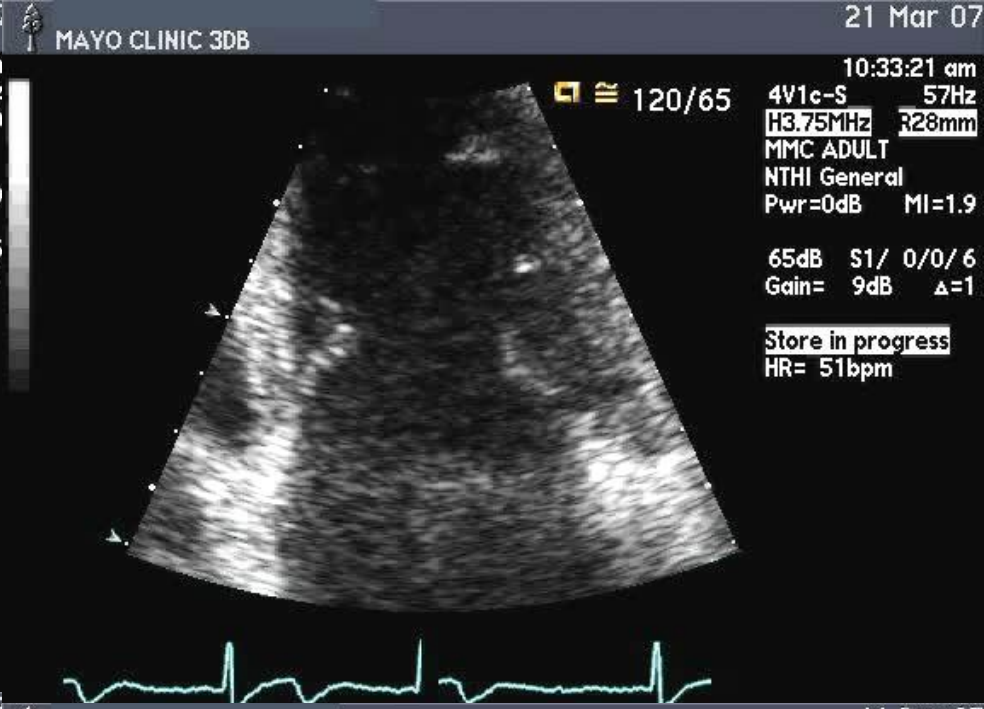
Idiopathic Tricuspid Regurgitation

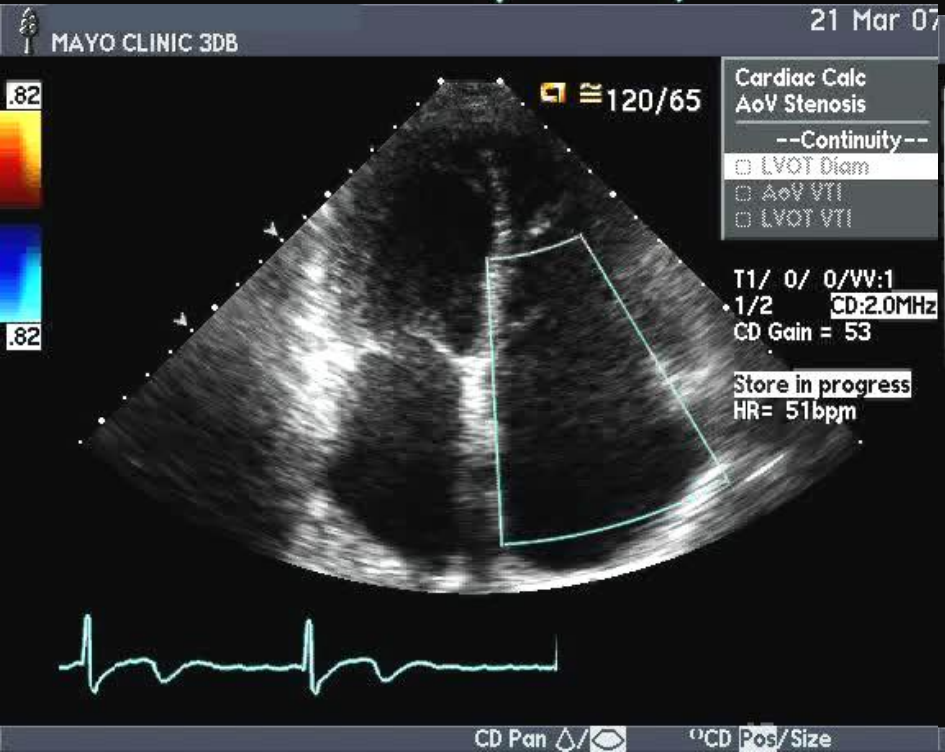
Dilated Annulus

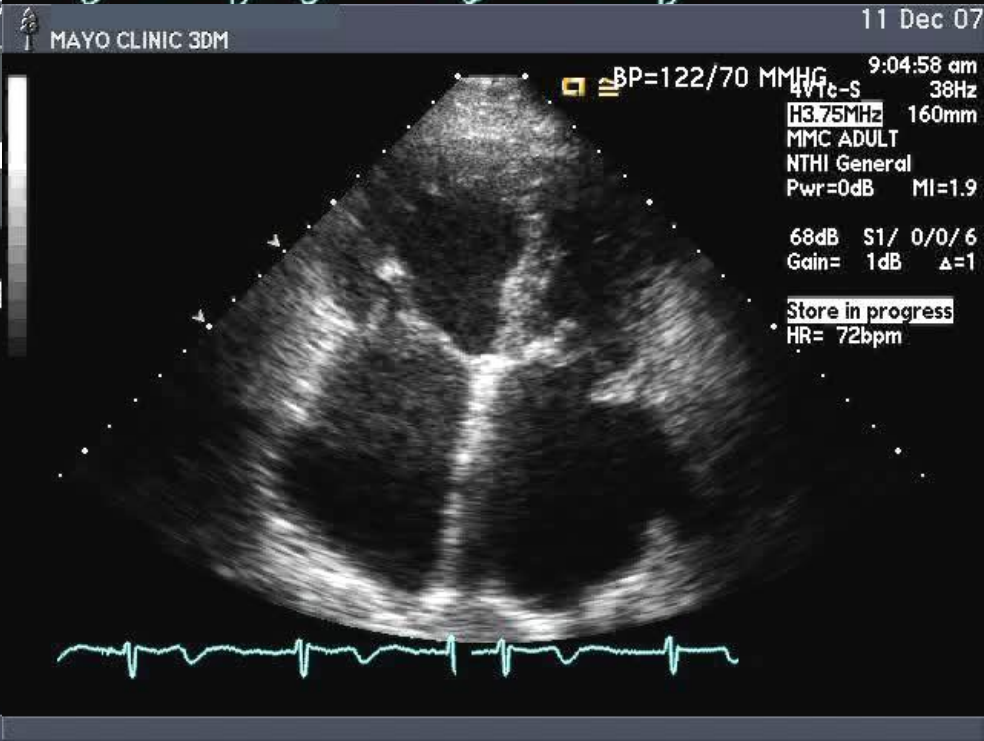


Autopsy Specimen


MAYO CLINIC 3DB
21 Mar 07
9:15:11 am
120/65
4V1c-S 38Hz
H4.25MHz 160mm
MMC ADULT
NTHI General
Pwr=0dB MI=1.9
65dB S1/ 0/0/6
Gain= 10dB Δ=1
Store in progress
HR= 53bpm


MAYO CLINIC 3DB
21 Mar 07
10:33:21 am
120/65
4V1c-S 57Hz
H3.75MHz R28mm
MMC ADULT
NTHI General
Pwr=0dB MI=1.9
65dB S1/ 0/0/6
Gain= 9dB Δ=1
Store in progress
HR= 51bpm


MAYO CLINIC 3DB
21 Mar 07
.82
.82
120/65
Cardiac Calc
AoV Stenosis
--Continuity--
LVOT Diam
AoV VTI
LVOT VTI
T1/ 0/ 0/VV:1
1/2 CD:2.0MHz
CD Gain = 53
Store in progress
HR= 51bpm
CD Pan
CD Pos/Size


MAYO CLINIC 3DM
11 Dec 07
BP=122/70 MMHG
9:04:58 am
4V1c-S 38Hz
H3.75MHz 160mm
MMC ADULT
NTHI General
Pwr=0dB MI=1.9
68dB S1/ 0/0/6
Gain= 1dB Δ=1
Store in progress
HR= 72bpm

Tricuspid Regurgitation Uncertain management

#1: Heterogeneity

Etiology and Mechanism should be comprehensively described by Doppler-Echo

Reason #2:

Grading Uncertainty

Assessment of TR severity is difficult

TR Severity Assessment

Table 8 Echocardiographic and Doppler parameters used in grading tricuspid regurgitation severity

Parameter	Mild	Moderate	Severe
Tricuspid valve	Usually normal	Normal or abnormal	Abnormal/Flail leaflet/Poor coaptation
RV/RA/IVC size	Normal*	Normal or dilated	Usually dilated**
Jet area-central jets (cm^2)[§]	< 5	5-10	> 10
VC width (cm)[ϕ]	Not defined	Not defined, but < 0.7	> 0.7
PISA radius (cm)[ψ]	≤ 0.5	0.6-0.9	> 0.9
Jet density and contour–CW	Soft and parabolic	Dense, variable contour	Dense, triangular with early peaking
Hepatic vein flow†	Systolic dominance	Systolic blunting	Systolic reversal

CW, Continuous wave Doppler; *IVC*, inferior vena cava; *RA*, right atrium; *RV*, right ventricle; *VC*, vena contracta width.

* Unless there are other reasons for RA or RV dilation. Normal 2D measurements from the apical 4-chamber view: RV medio-lateral end-diastolic dimension ≤ 4.3 cm, RV end-diastolic area ≤ 35.5 cm^2 , maximal RA medio-lateral and supero-inferior dimensions ≤ 4.6 cm and 4.9 cm respectively, maximal RA volume ≤ 33 ml/m^2(35;89).

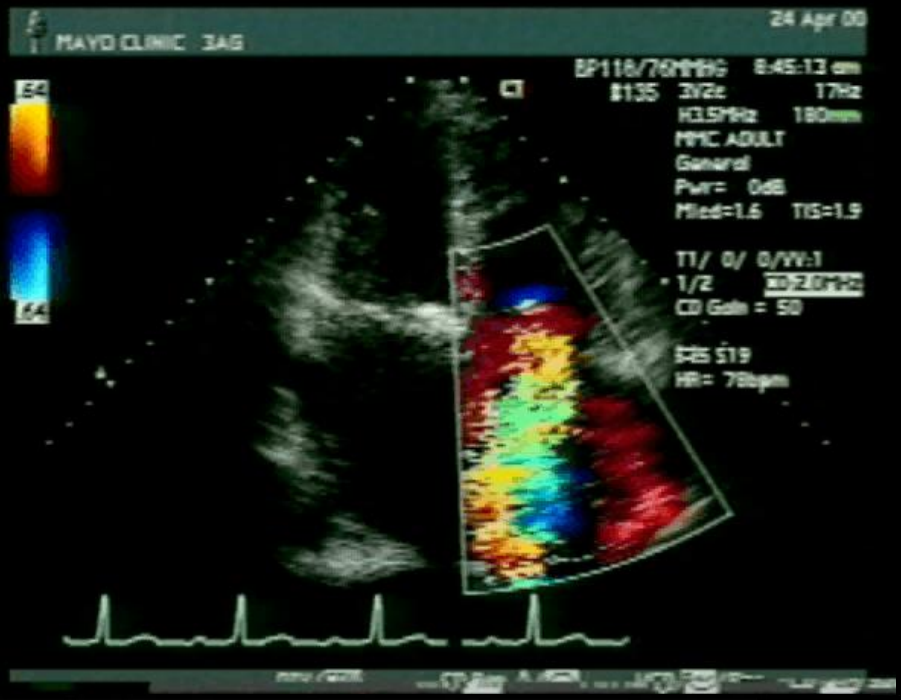
** Exception: acute TR.

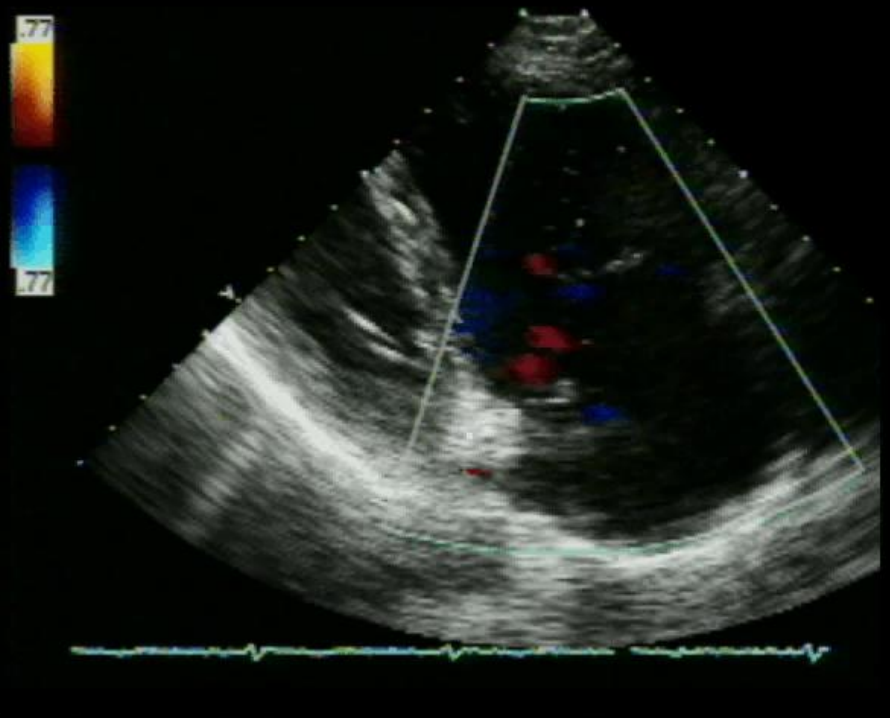
§ At a Nyquist limit of 50-60 cm/s. Not valid in eccentric jets. Jet area is not recommended as the sole parameter of TR severity due to its dependence on hemodynamic and technical factors.

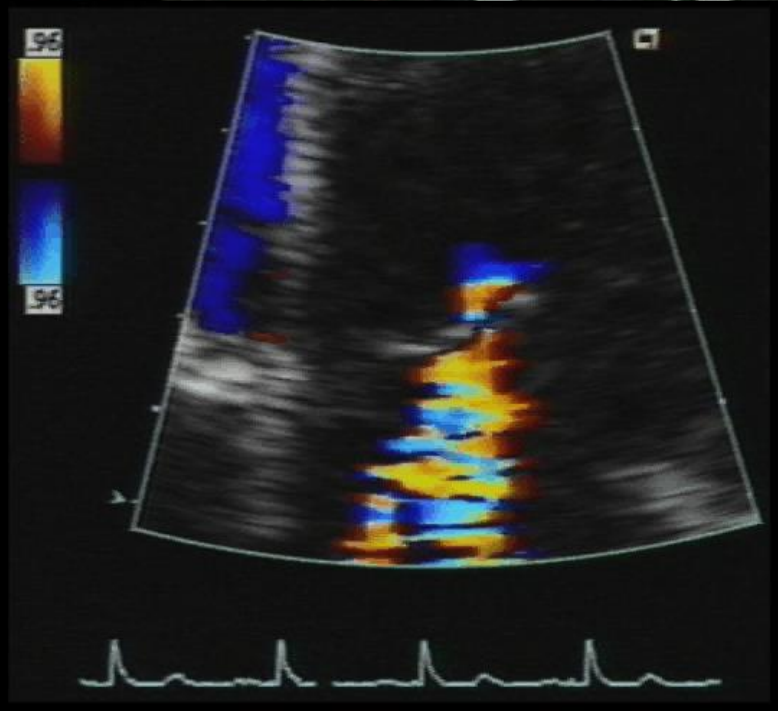
ϕ At a Nyquist limit of 50-60 cm/s.

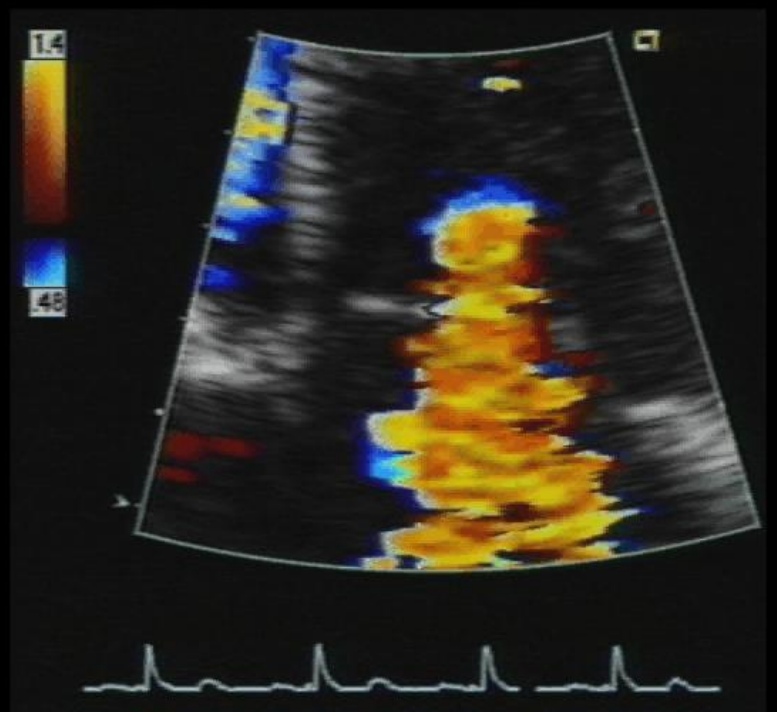
ψ Baseline shift with Nyquist limit of 28 cm/s.

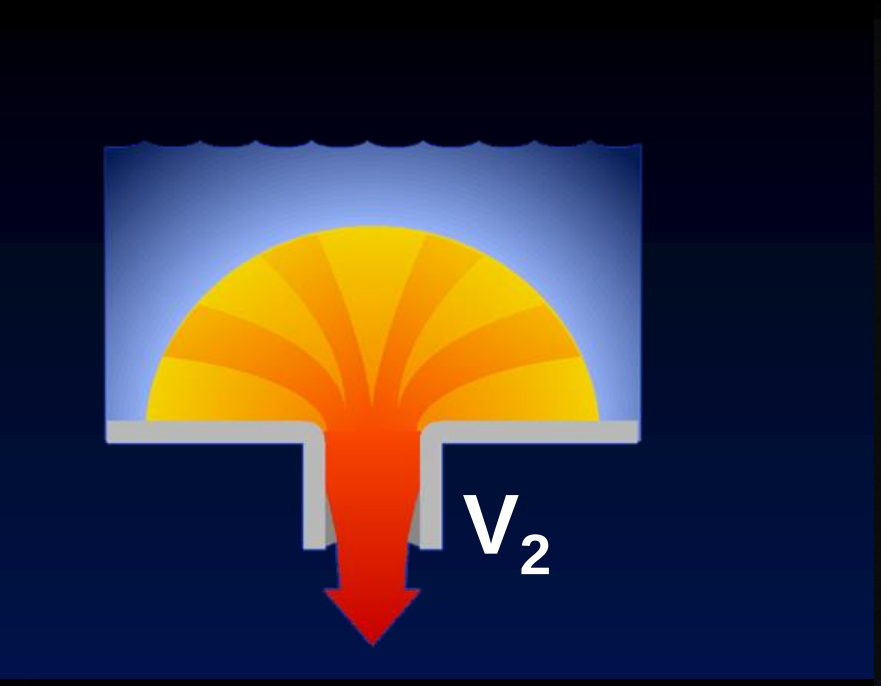
† Other conditions may cause systolic blunting (eg. atrial fibrillation, elevated RA pressure).

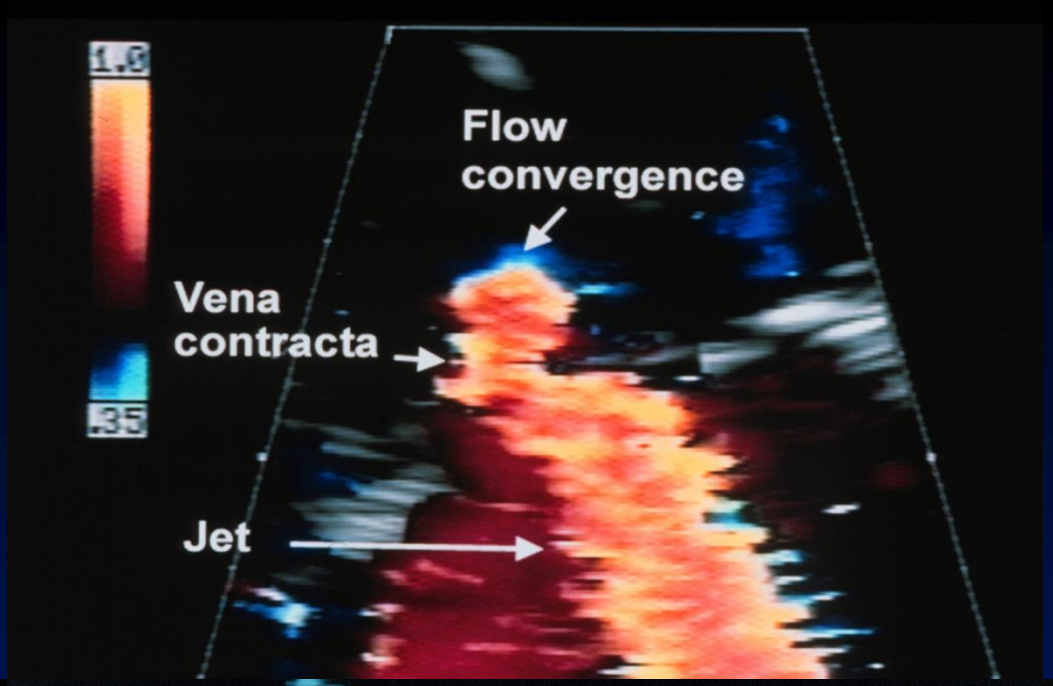

MAYO CLINIC 3AG
24 Apr 00
64
64
CD Gain = 50
HR= 78bpm

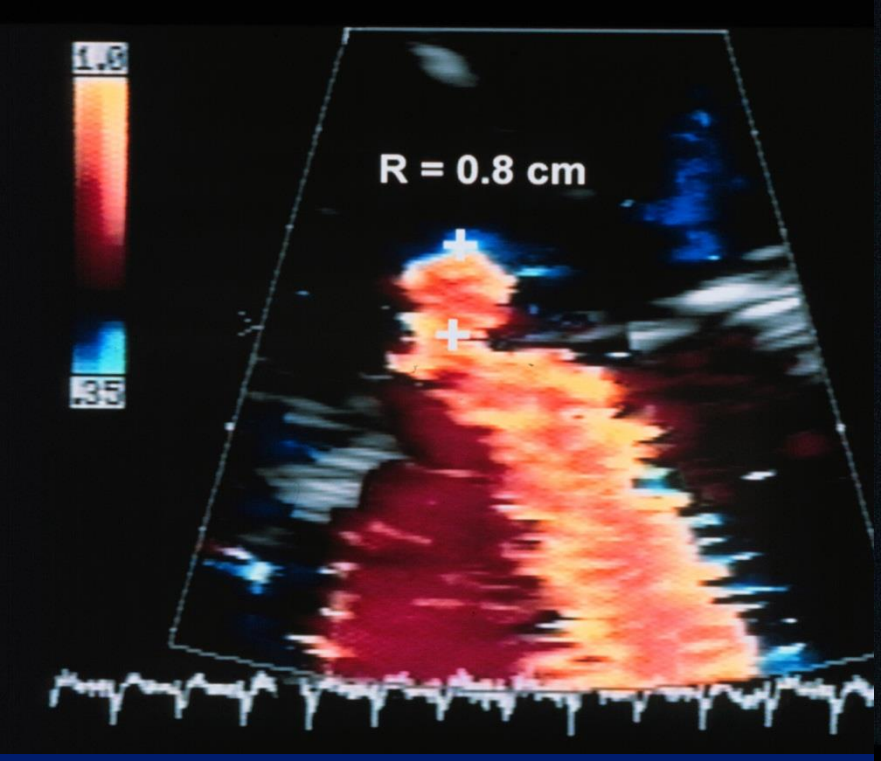

77
77

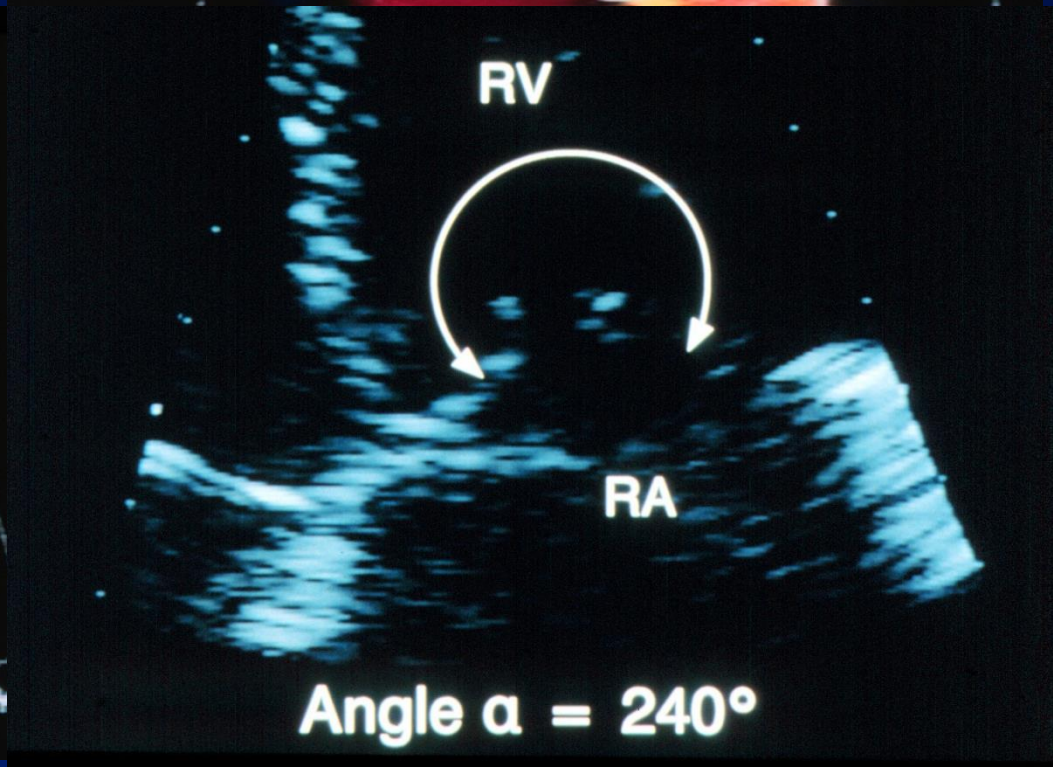

96
96


1.4
48


V_2


Flow convergence
Vena contracta
Jet

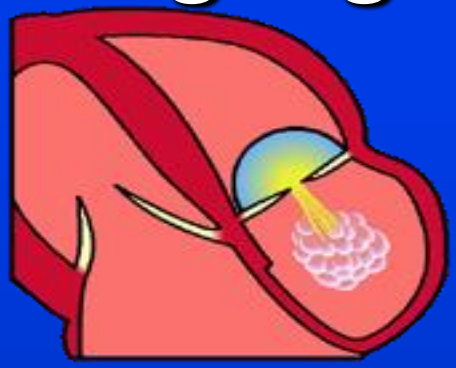

R = 0.8 cm


RV
RA
Angle α = 240°

Tricuspid Regurgitation

ERO

=



R flow

R Vel

=

x

R vol ERO RTVI

Quantitation of Regurgitations Criteria for Severe Regurgitation

	AR	MR	TR
ERO (mm2)	30	40	40
Rvol (mL)	60	60	45

Tricuspid Regurgitation Uncertain management

#2: TR assessment

Assessment of TR should be Comprehensive and Quantitative

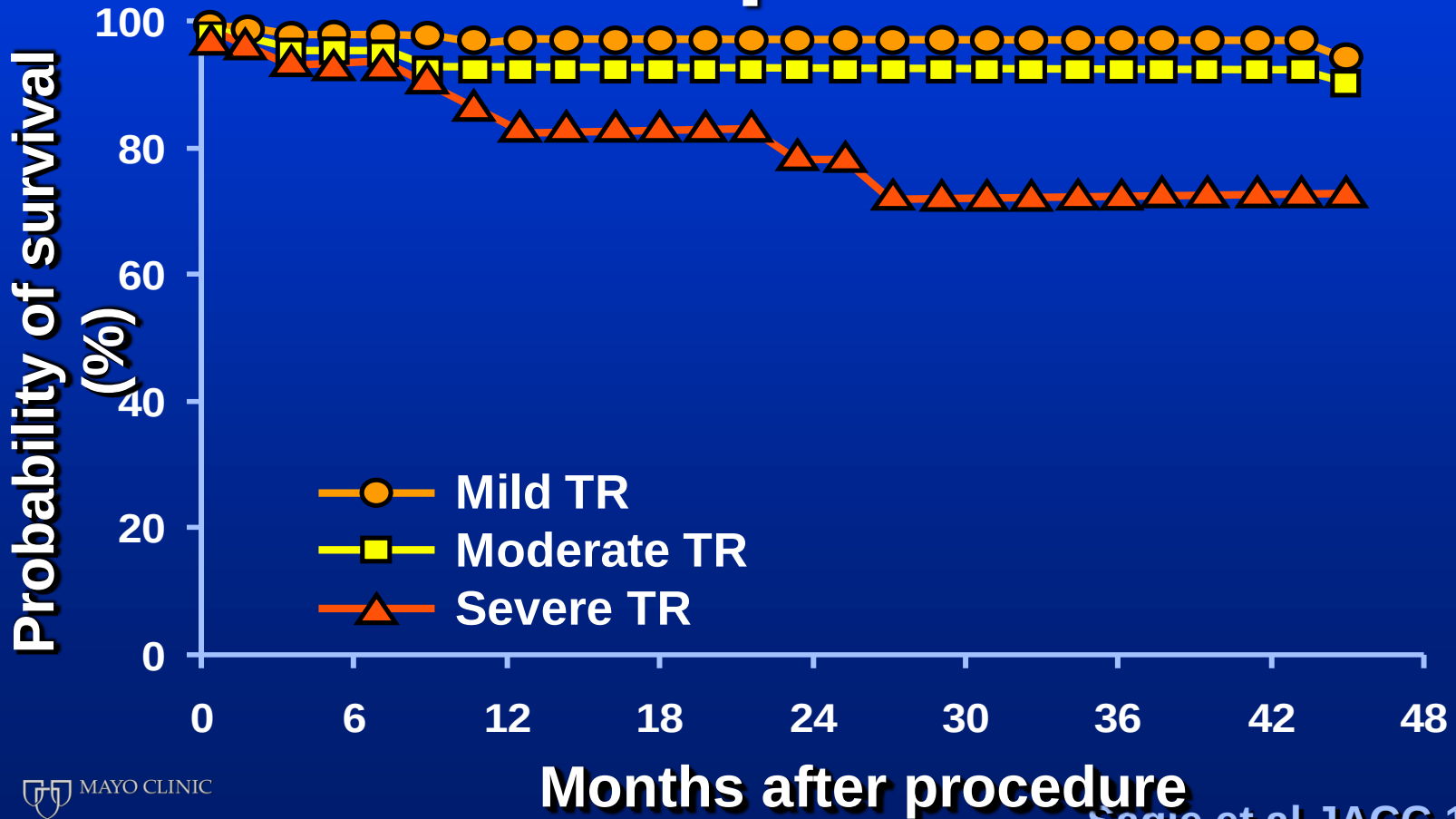
Reason #3: Outcome Uncertainty

TR is often the consequence of another disease—Does it affect outcome ?

TR Uncertain management

Reason #4: Outcome Uncertainty

Survival post-PBMV

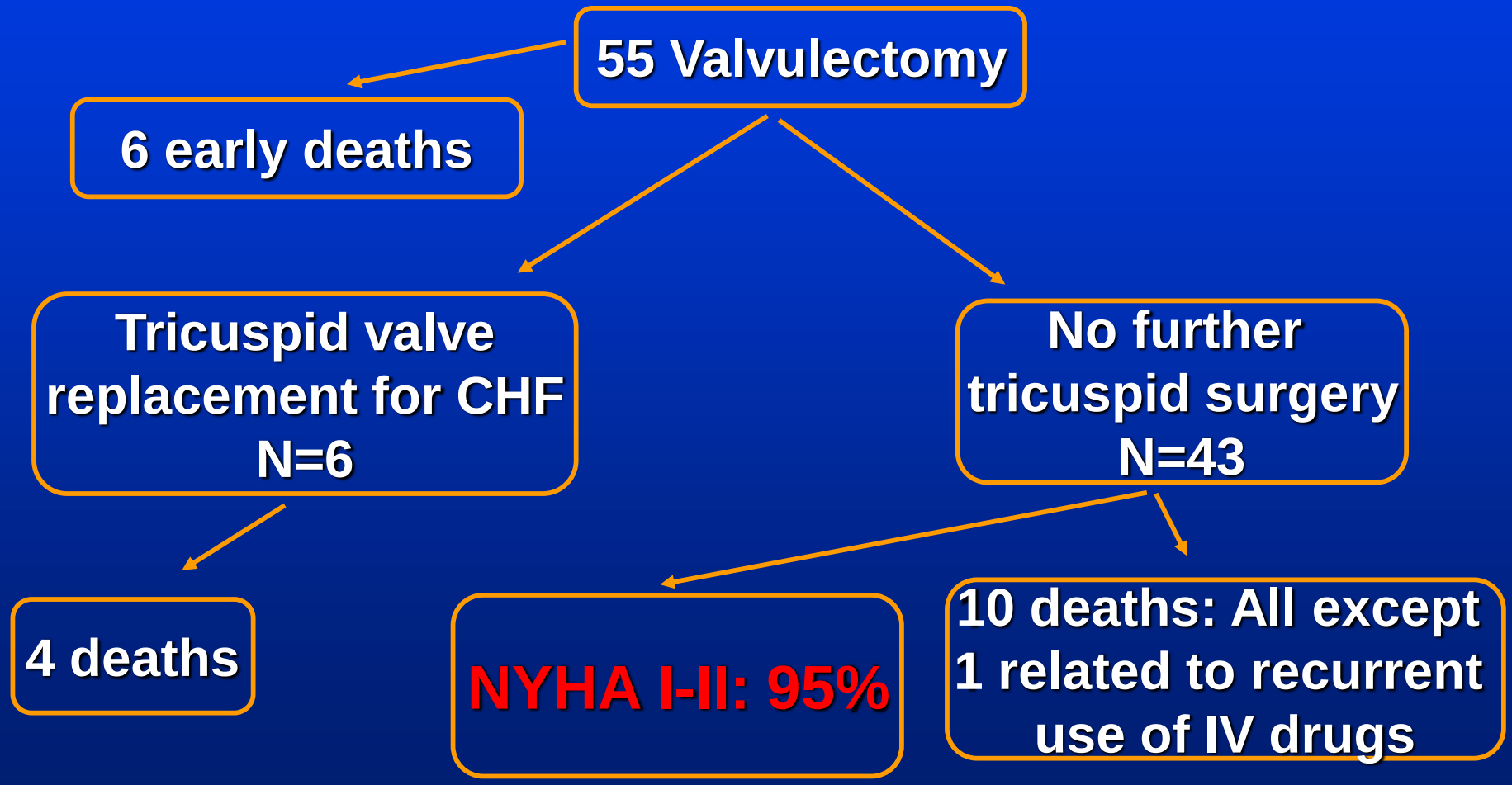


MAYO CLINIC

Sagie et al JACC 1994; 24:696

Tricuspid Valvulectomy without replacement

Drug-addict patients with intractable right-sided endocarditis



Arbulu et al J Thorac CV Surg 1991

The independent effect of TR on Outcome under medical management remains unclear.

A serious problem
or
An unimportant color spot,
surrogate of
the causal condition

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Impact of Tricuspid Regurgitation on Long-Term Survival

Jayant Nath, MD,* Elyse Foster, MD, FACC,† Paul A. Heidenreich, MD*
Palo Alto

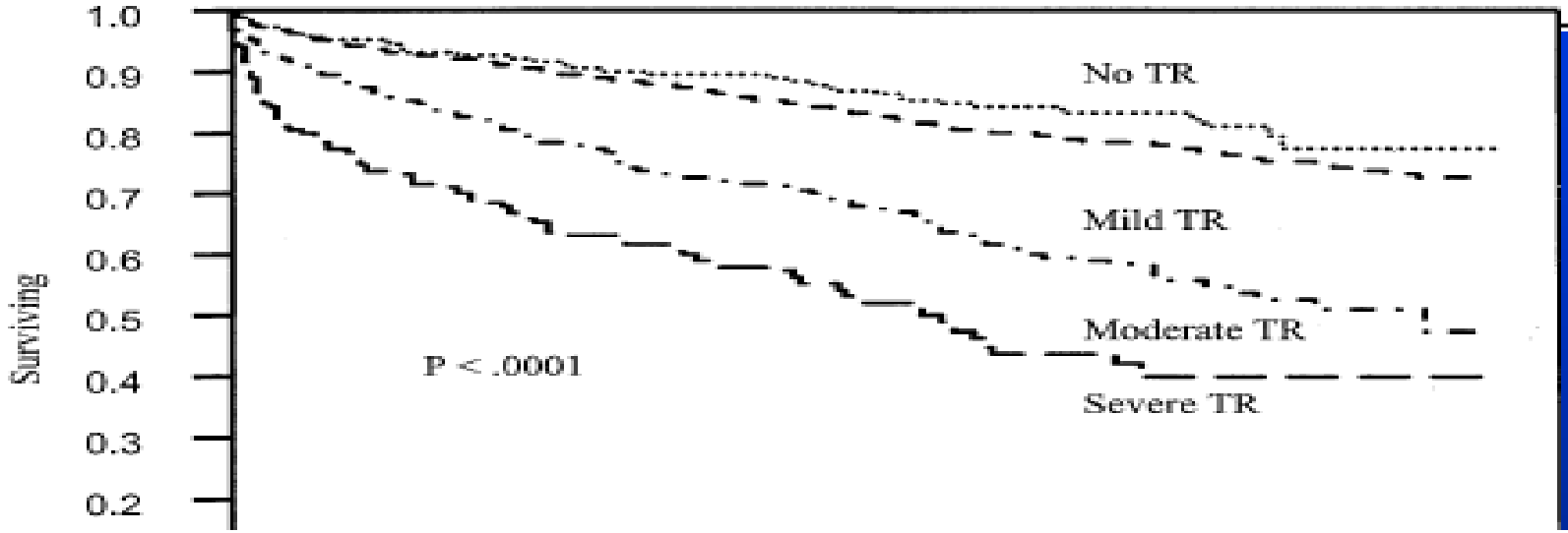
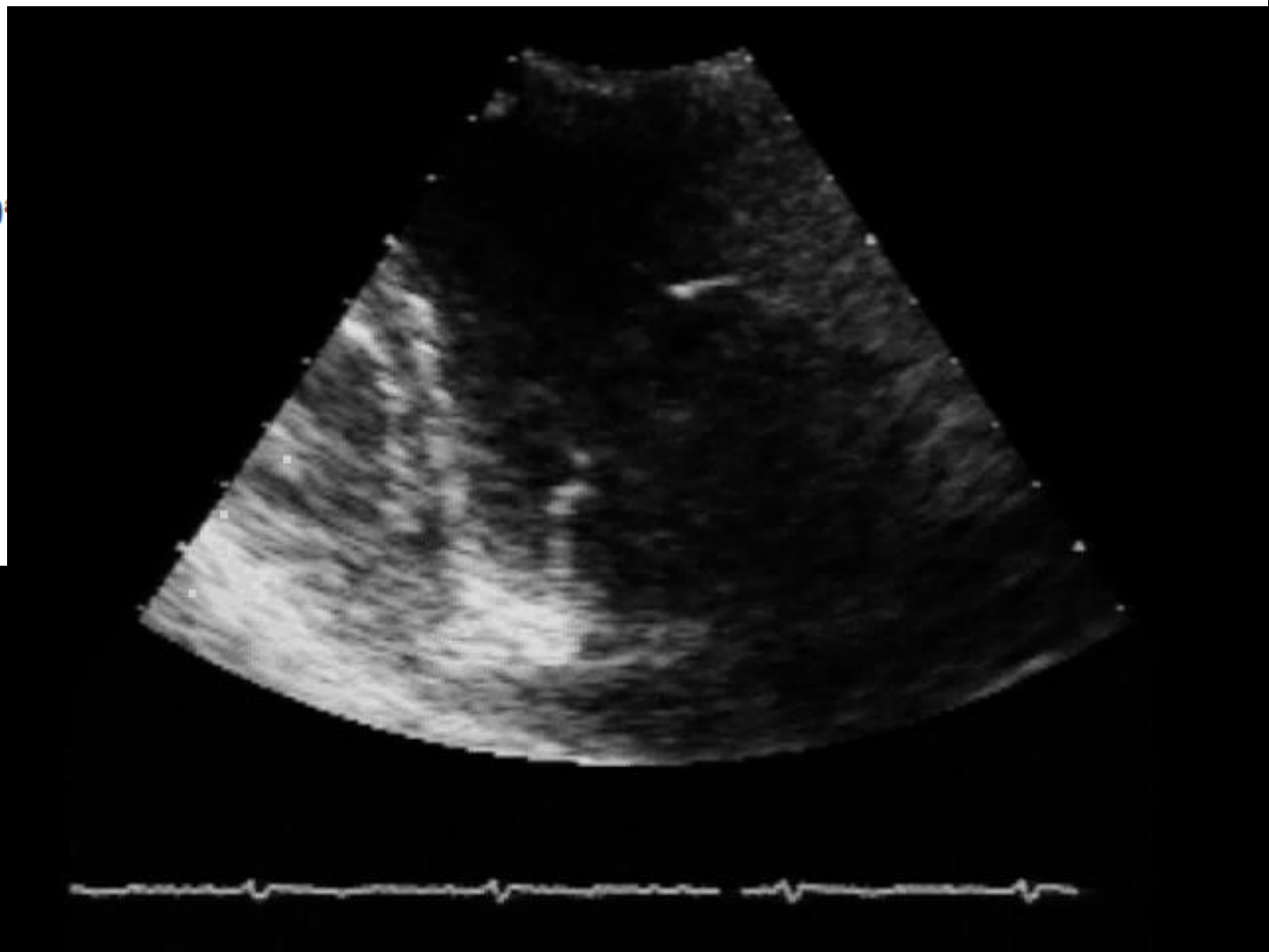


Table 1. Clinical and Echocardiographic Features of Patients With Tricuspid Regurgitation

	No TR (n = 600)	Mild TR (n = 3,804)	Moderate TR (n = 620)	Severe TR (n = 199)	p Value
Age (yrs)	62.2 ± 12.8	66.0 ± 12.6	71.9 ± 11.7	71.9 ± 12.4	< 0.0001
LVEF (%)	57.3 ± 9.1	55.4 ± 11.6	47.1 ± 15.6	40.4 ± 17.2	< 0.0001
RV dilation	8%	11%	35%	66%	< 0.0001
RV dysfunction	3%	8%	30%	61%	< 0.0001
Dilated IVC	6%	11%	44%	76%	< 0.0001

Medical and surgical outcome of tricuspid regurgitation caused by flail leaflets

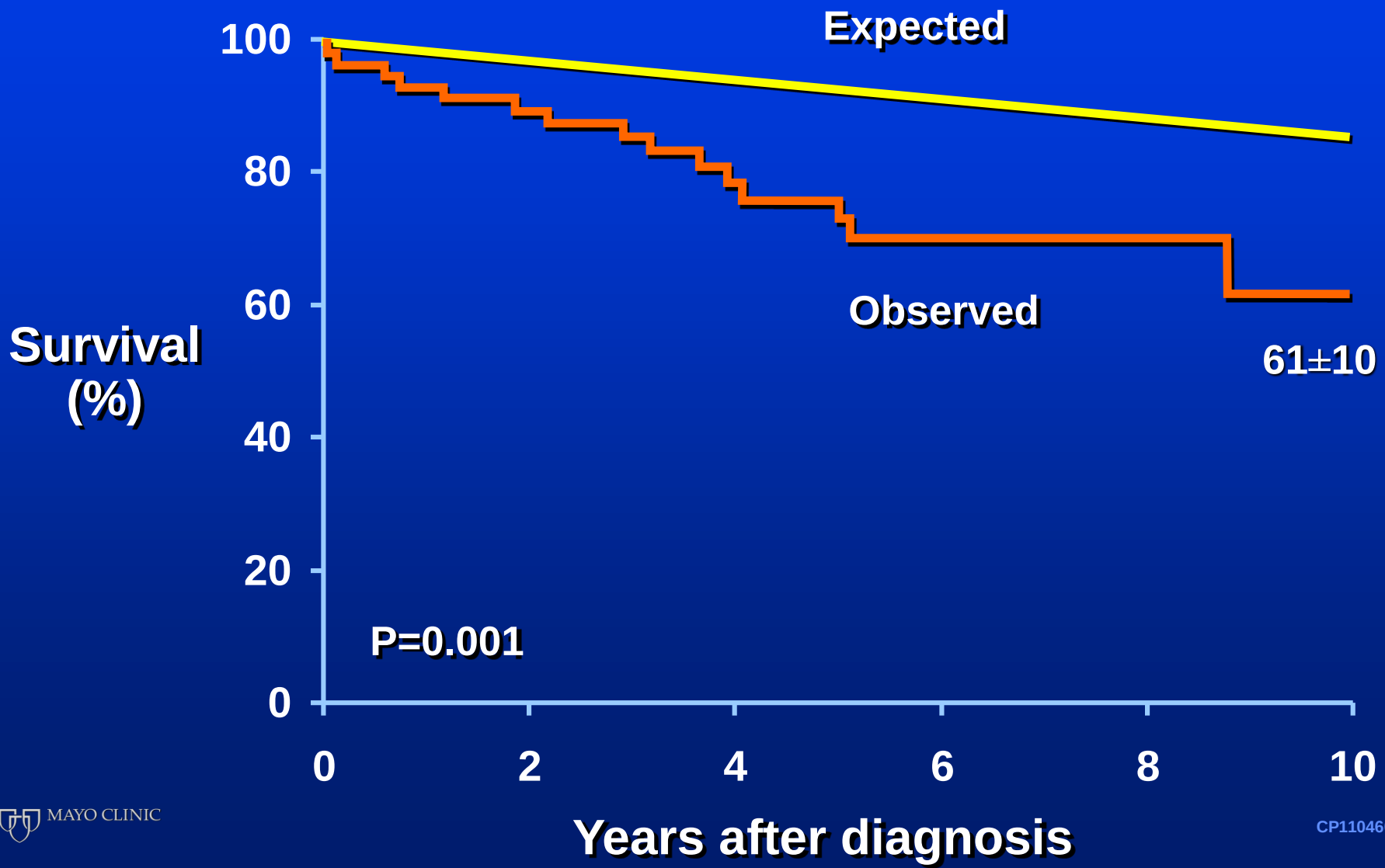
David Messika-Zeitoun, MD[a]
Helen Thomson, MD[a]
Michael Bellamy, MD[a]
Christopher Scott, MS[b]
Christophe Tribouilloy, MD[a]
Joseph Dearani, MD[c]
A. Jamil Tajik, MD[a]
Hartzell Schaff, MD[c]
Maurice Enriquez-Sarano, MD



MAYO CLINIC

TR due to Flail Leaflets

overall population



Usefulness of Echocardiographic Determined Tricuspid Regurgitation in Predicting Event-Free Survival in Severe Heart Failure Secondary to Idiopathic-Dilated Cardiomyopathy or to Ischemic Cardiomyopathy

Judy Hung, MD, Todd Koelling, MD, Marc J. Semigran, MD, G. William Dec, MD, Robert A. Levine, MD, and Thomas G. Di Salvo, MD

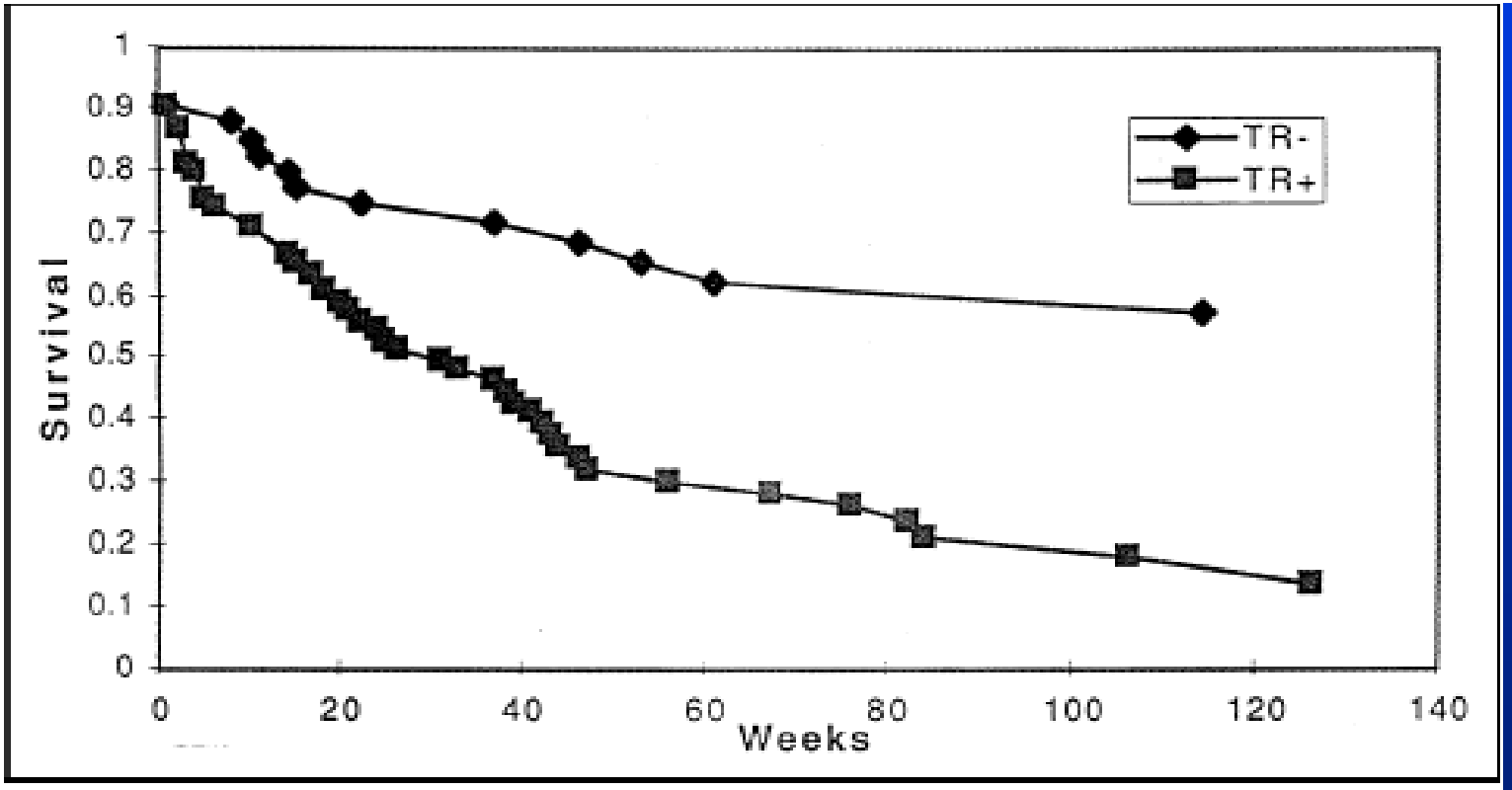
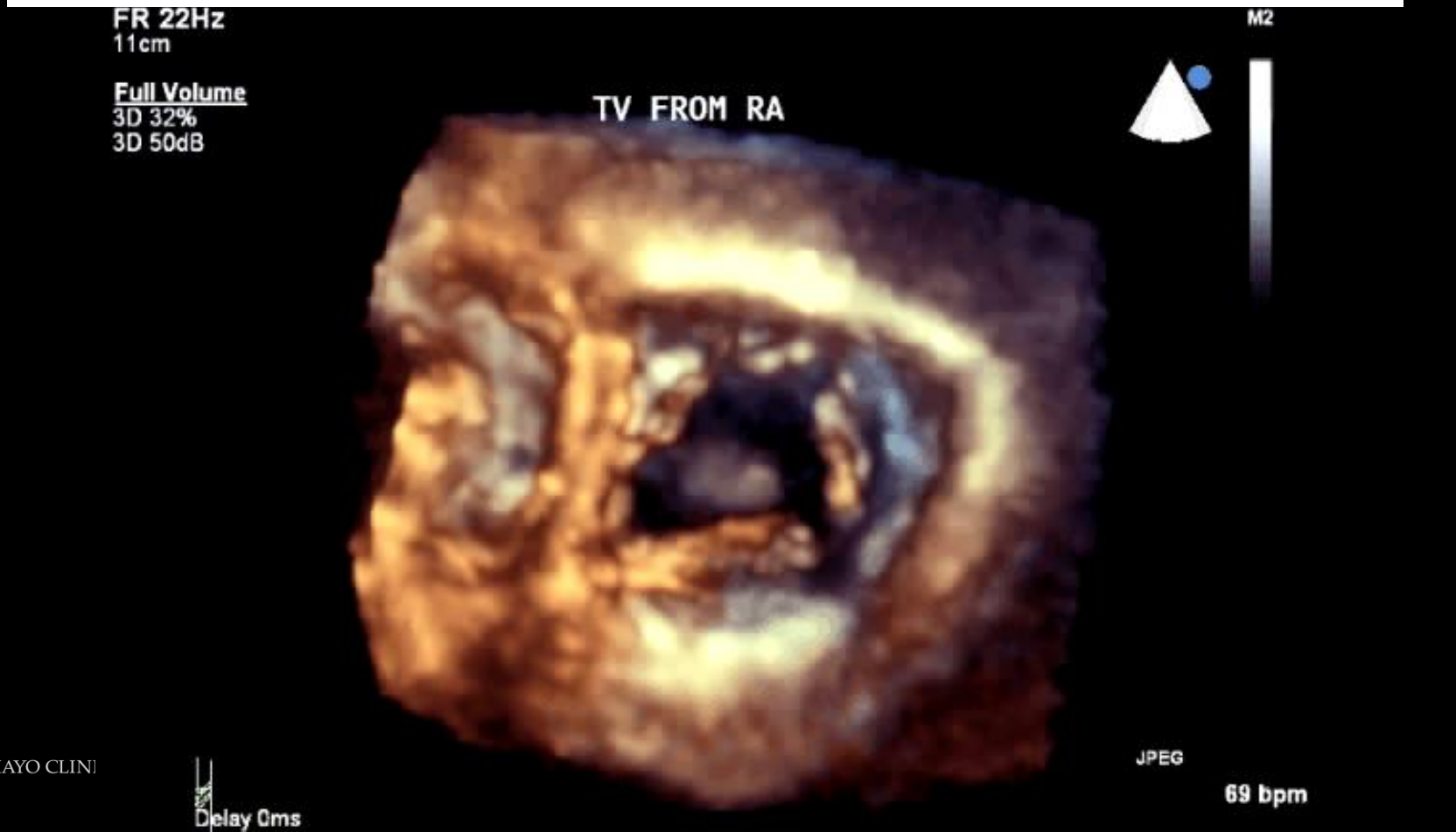


FIGURE 1. Echocardiographic TR and event-free survival. The actuarial event-free survival of the patients without echocardiographic TR *(diamonds)* and the patients with echocardiographic TR *(squares)* is shown. Event-free survival was significantly better for patients without echocardiographic TR. Log-rank: $p = 0.002$. (Mean follow-up: 357 ± 428 days.)

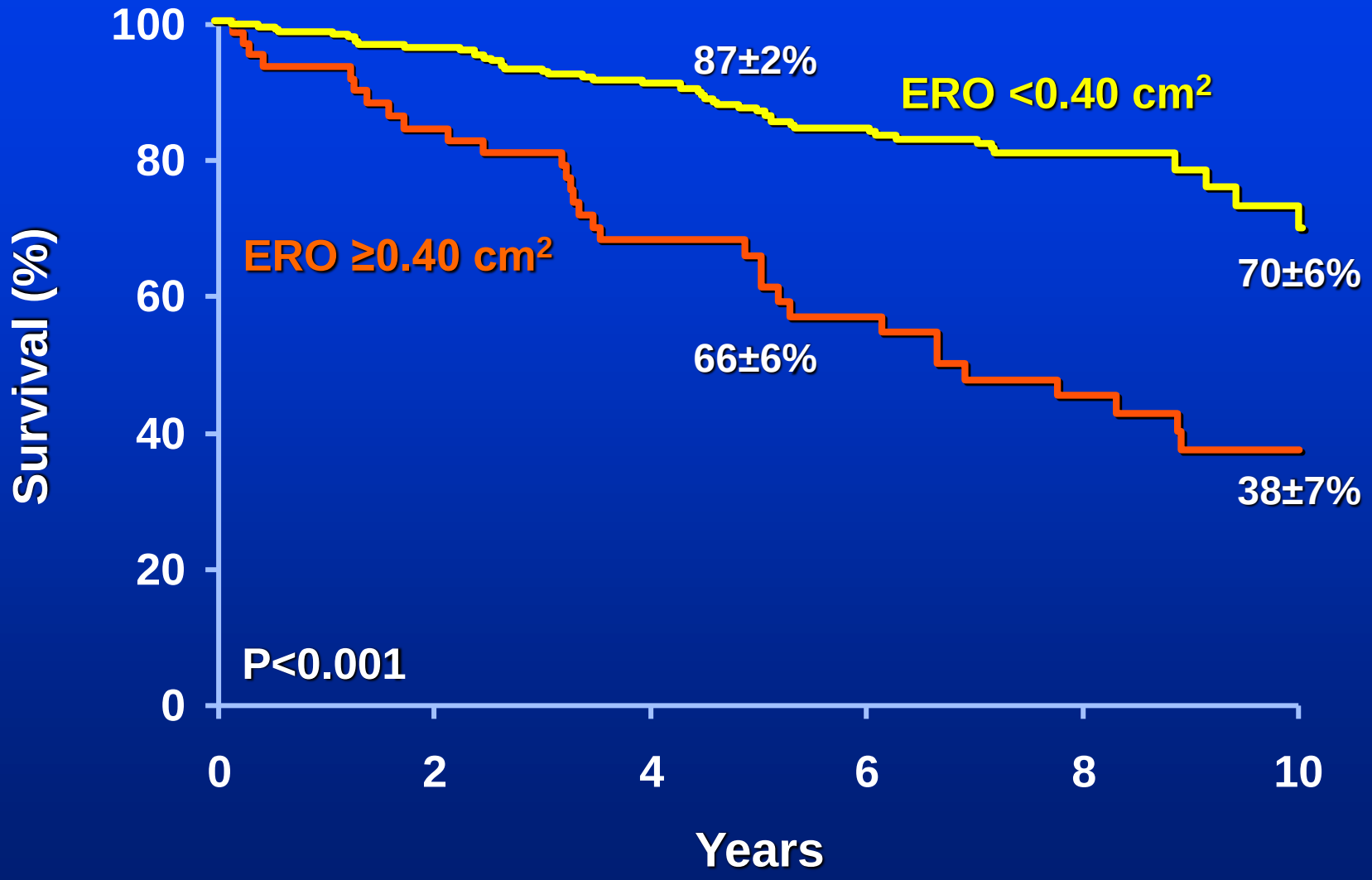
ORIGINAL RESEARCH

Clinical Outcome of Isolated Tricuspid Regurgitation

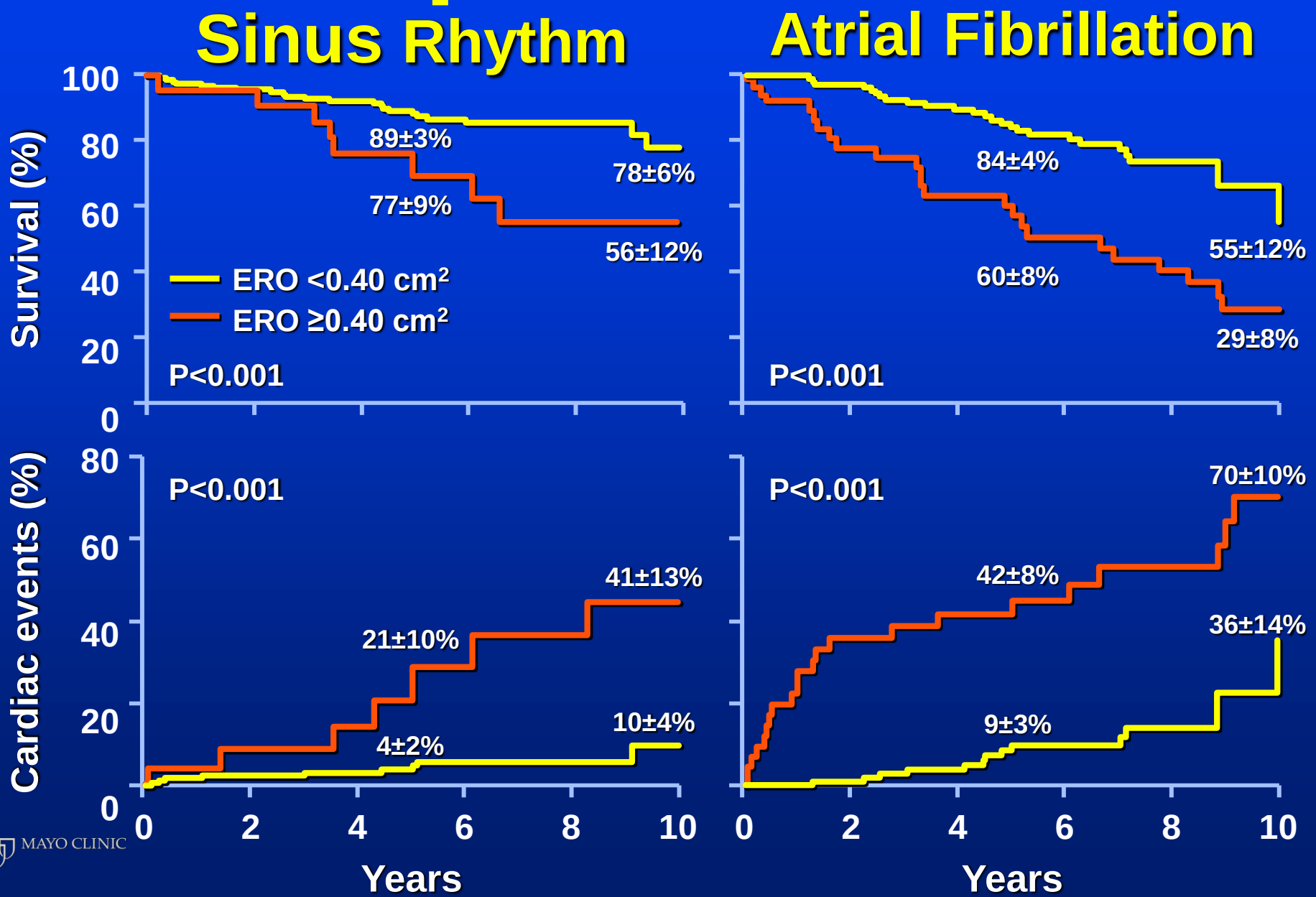
Yan Topilsky, MD,* Vuyisile T. Nkomo, MD,† Ori Vatury, MD,† Hector I. Michelena, MD,† Thierry Letourneau, MD,† Rakesh M. Suri, MD, DPhil,† Sorin Pislaru, MD,† Soon Park, MD,† Douglas W. Mahoney, MSc,§ Simon Biner, MD,* Maurice Enriquez-Sarano, MD†



Idiopathic TR



Idiopathic TR



MAYO CLINIC

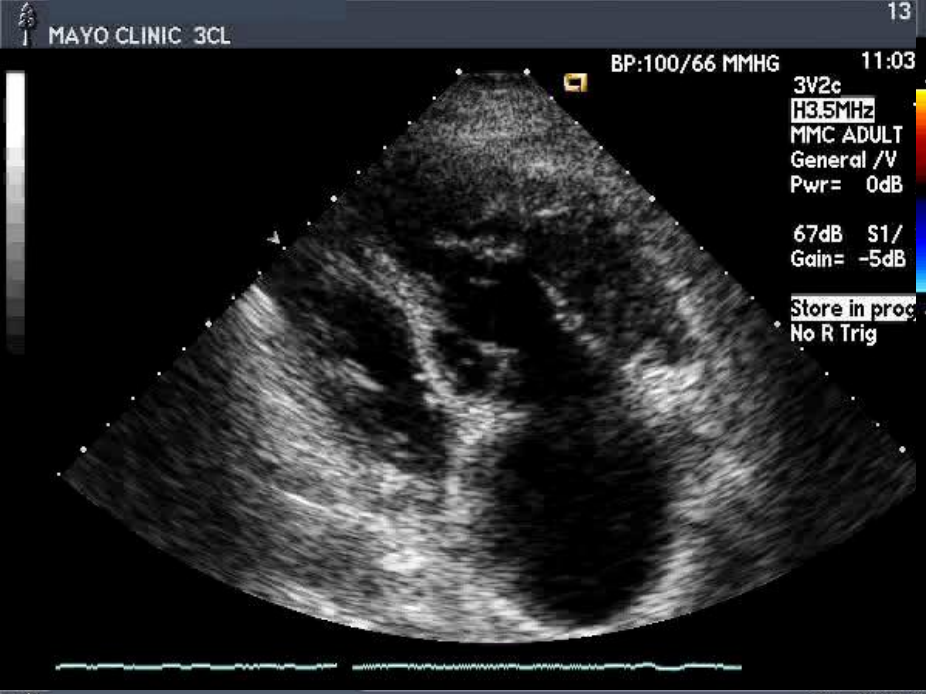
Tricuspid Regurgitation Uncertain management

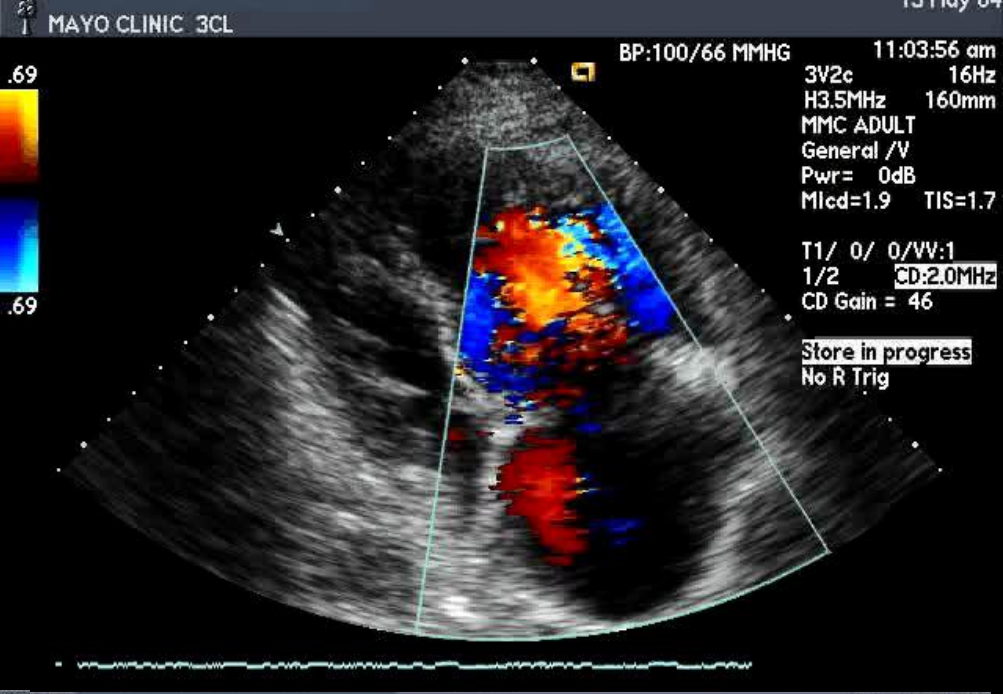
#3: Outcome of TR

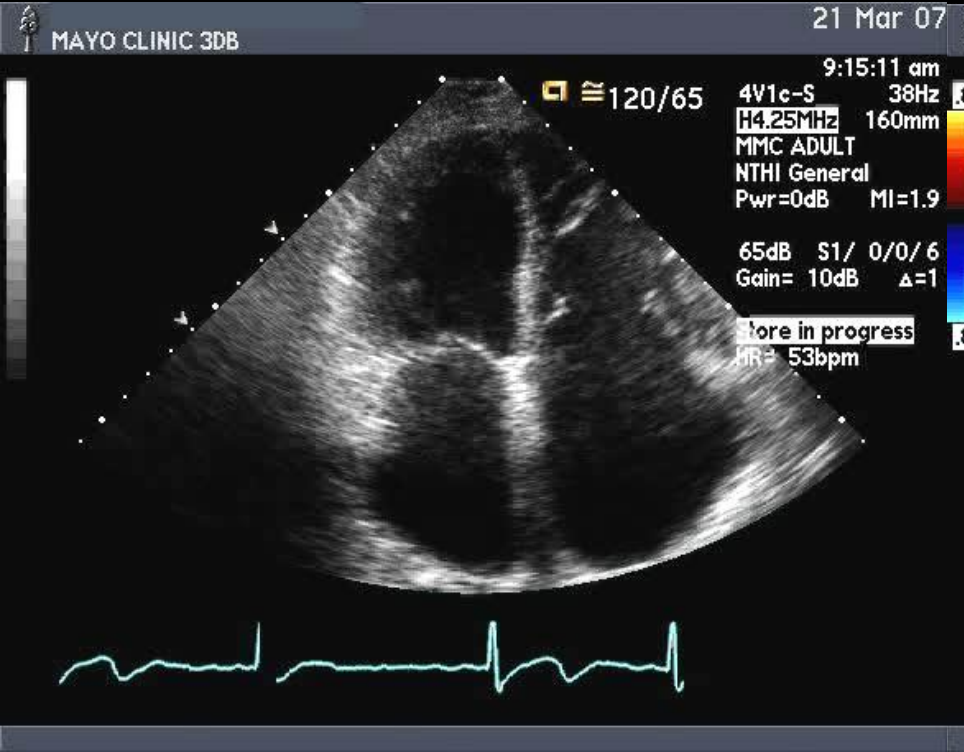
TR affects outcome and should be treated

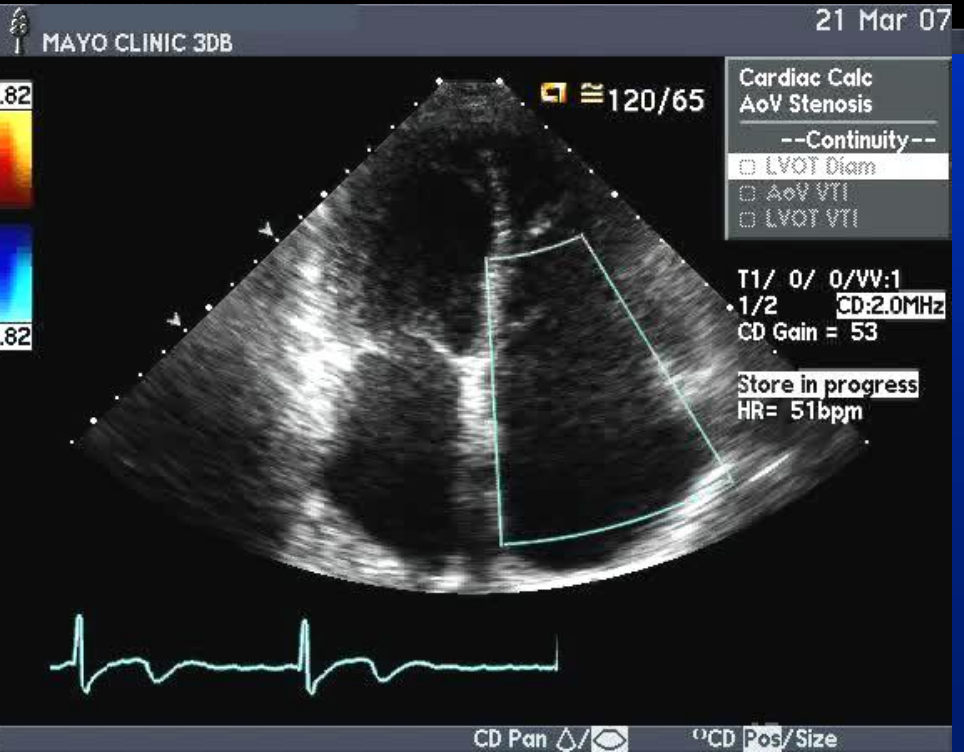
Reason #3: Procedure Uncertainty

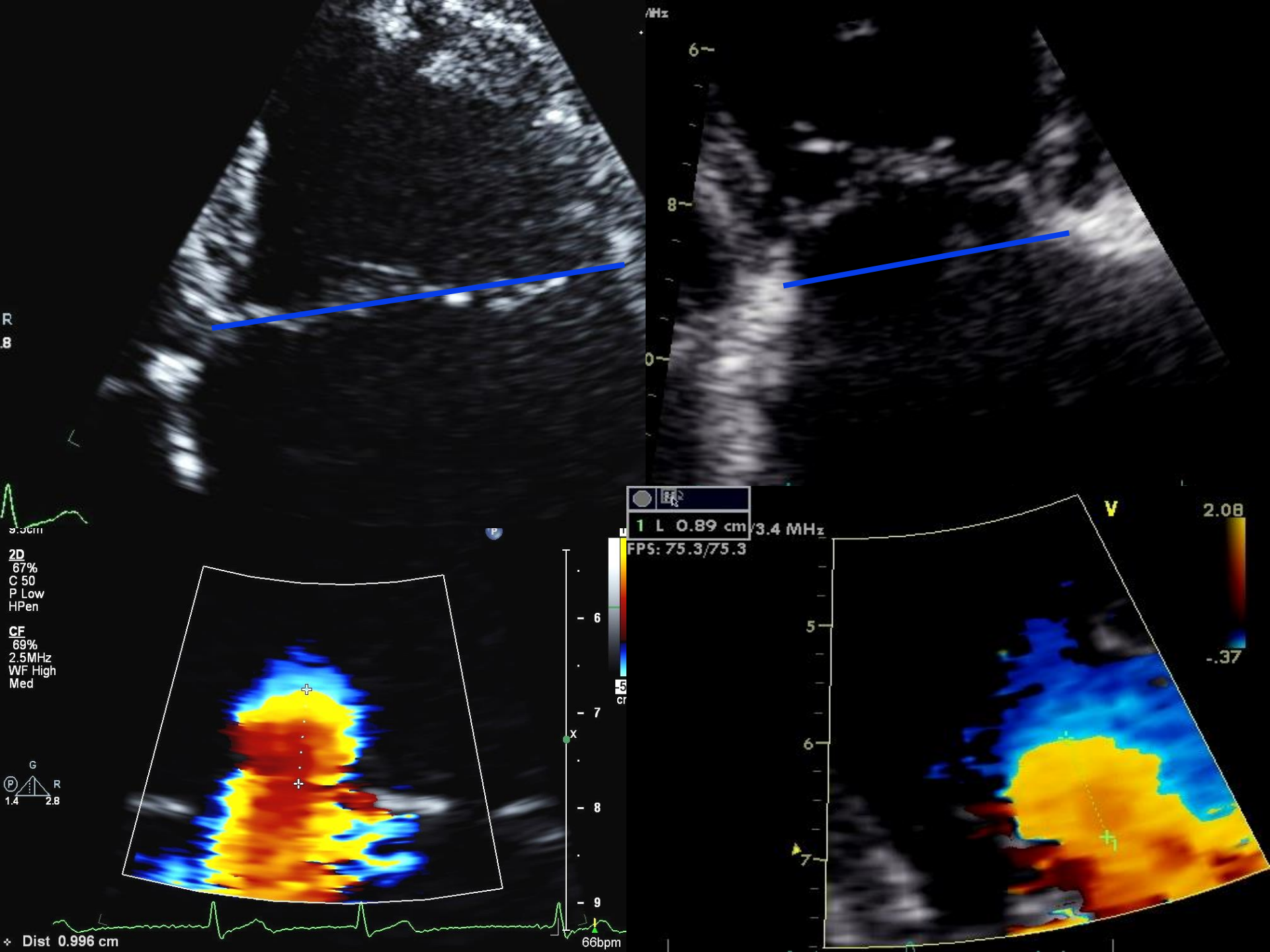
Should we advise Tricuspid valve repair ou replacement ?


MAYO CLINIC 3CL
BP:100/66 MMHG
11:03
3V2c
H3.5MHz
MMC ADULT
General /V
Pwr= 0dB
67dB S1/
Gain= -5dB
Store in proc
No R Trig
.69
.69


MAYO CLINIC 3CL
BP:100/66 MMHG
11:03:56 am
3V2c 16Hz
H3.5MHz 160mm
MMC ADULT
General /V
Pwr= 0dB
MIcd=1.9 TIS=1.7
T1/ 0/ 0/VV:1
1/2 CD:2.0MHz
CD Gain = 46
Store in progress
No R Trig


MAYO CLINIC 3DB
21 Mar 07
9:15:11 am
120/65
4V1c-S 38Hz
H4.25MHz 160mm
MMC ADULT
NTHI General
Pwr=0dB MI=1.9
65dB S1/ 0/0/ 6
Gain= 10dB Δ=1
ore in progress
HR= 53bpm
.82
.82


MAYO CLINIC 3DB
21 Mar 07
120/65
Cardiac Calc
AoV Stenosis
--Continuity--
LVOT Diam
AoV VTI
LVOT VTI
T1/ 0/ 0/VV:1
1/2 CD:2.0MHz
CD Gain = 53
Store in progress
HR= 51bpm
CD Pan
CD Pos/Size


2D
67%
C 50
P Low
HPen
CF
69%
2.5MHz
WF High
Med
1 L 0.89 cm
FPS: 75.3/75.3
3.4 MHz
2.08
-.37
Dist 0.996 cm
66bpm

Tricuspid Valve Tethering Predicts Residual Tricuspid Regurgitation After Tricuspid Annuloplasty

Shota Fukuda, MD; Jong-Min Song, MD; A. Marc Gillinov, MD; Patrick M. McCarthy, MD; Masao Daimon, MD; Vorachai Kongsaerepong, MD; James D. Thomas, MD; Takahiro Shiota, MD

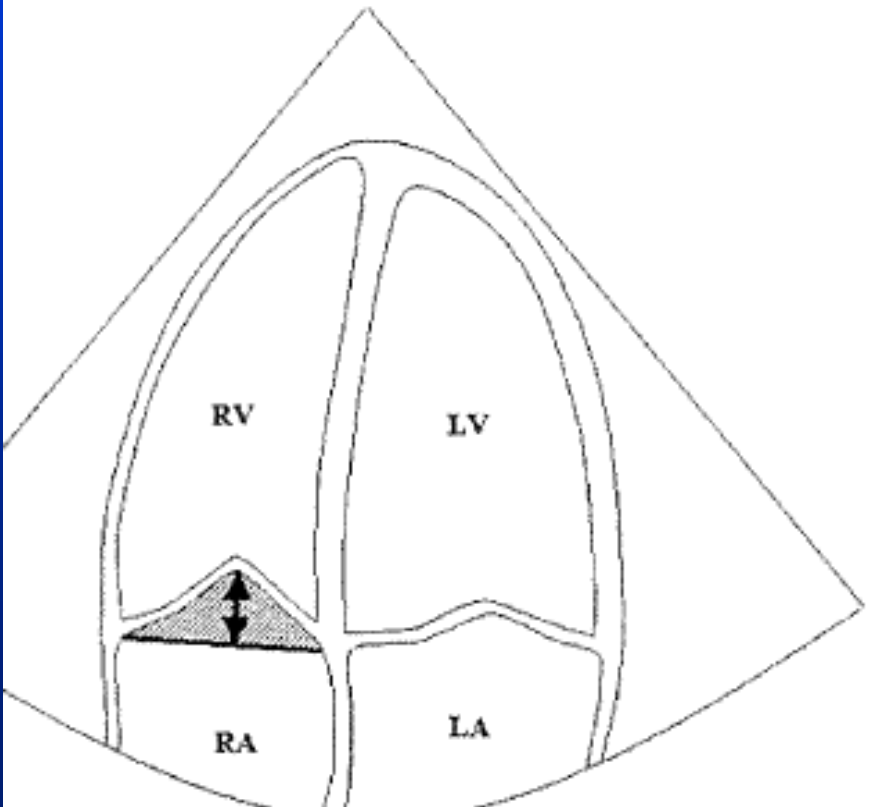


TABLE 1. Effect of Characteristic and Echocardiographic Findings on Residual TR After TV Annuloplasty

	r	Univariate *P*	Multivariate *P*
Age	0.28	<0.001	<0.001
LV ejection fraction	0.19	0.005	0.6
RV fractional area change	0.18	0.01	0.5
RA area	0.02	0.8	
RV systolic pressure	0.02	0.8	
TV annulus diameter	0.07	0.3	
TV tethering distance	0.56	<0.001	<0.001
TV tethering area	0.52	<0.001	0.4
Preoperative %TR	0.32	<0.001	<0.001

patients and 4 techniques of annuloplasty, we used 1-way ANOV
We used logistic regression to correlate variables of interest. Mul
variate stepwise regression analysis was performed to identi
factors of severity of residual TR (measured continuously as %TR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5

Tricuspid Regurgitation

- TR is poorly understood: comprehensive mechanistic assessment
- Severe TR adversely affects clinical outcome
- Surgical (interventional ?) treatment: Severe TR, even isolated, should be more often treated (repair if adequate)


TRICUSPID
REGURGITATION
An imperious need for data
Thank you
MAYO