

The Heart's Story:

how echo measurements tell a tale of health and disease

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Protective Life

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Underwriting
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How echo measurements tell a tale of health and disease

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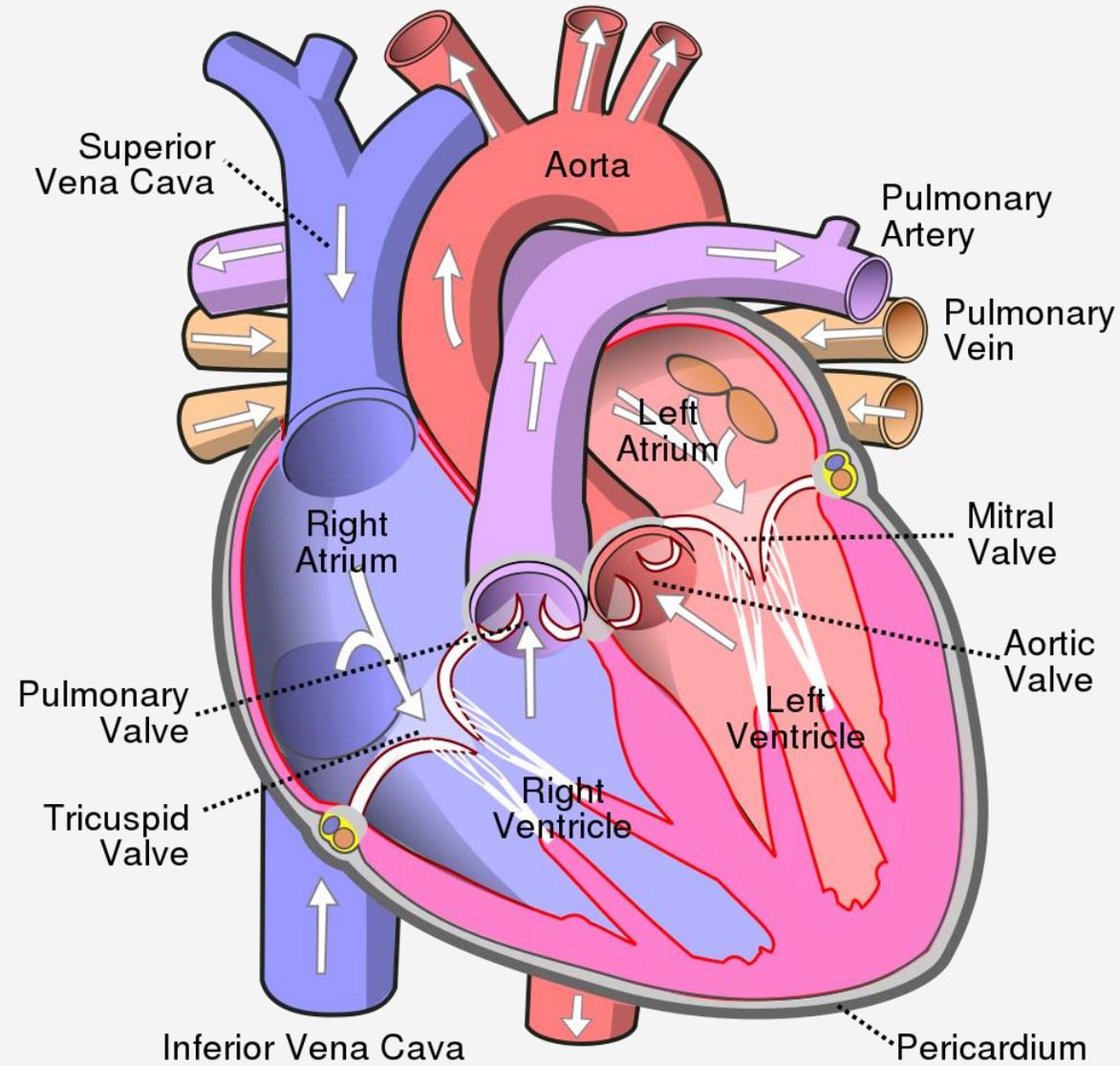
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Agenda

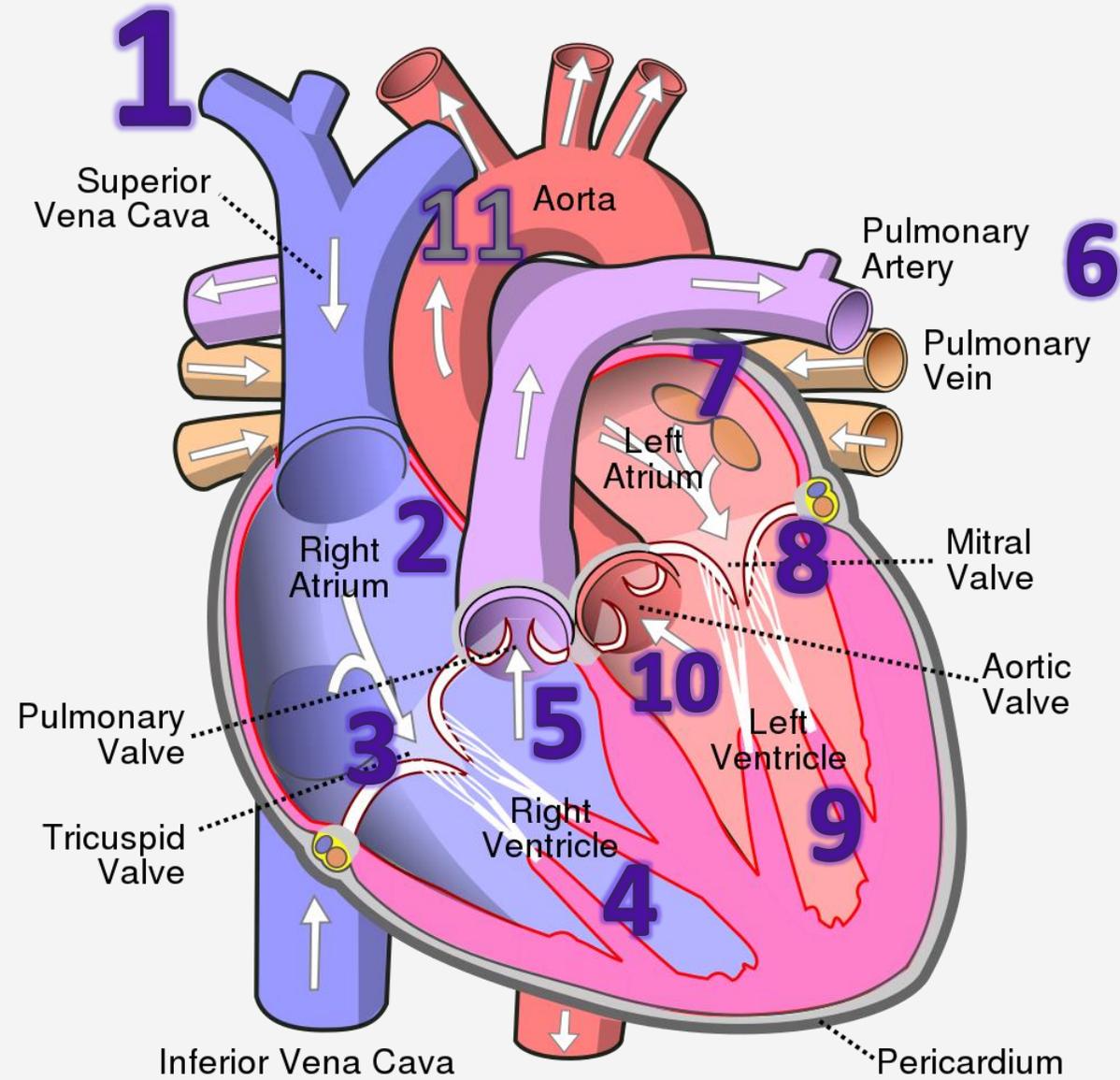
1. Cardiac Anatomy
2. Key Echo measurements
3. Normal vs. Abnormal
4. Related diseases
5. Case examples



Anatomy



Anatomy



Echo measurement	Normal value*	High mortality	Abnormal references
Ejection Fraction	≥50%	<40%	CAD, CHF, cardiomyopathy, diastolic dysfunction
Left atrium (LA) diameter LA volume index	1.9 – 4.0 cm (40mm) 16 – 34 ml/m ²	> 5.2 cm > 48 ml/m ²	Atrial fibrillation, mitral valve disease, hypertrophy, cardiomyopathy
Left Ventricle LV(d) LVEDD LVIDD LV volume index	3.5 – 5.6 cm (56mm) 34 – 75 ml/m ²	> 6.5 cm	Aortic valve disease (regurgitation), hypertrophy, cardiomyopathy
Posterior Wall PW(d) diastole	0.6 – 1.1 cm (11mm)	>1.8 cm	LVH and septal hypertrophy, cardiomyopathy
Septal Wall IVS(d) diastole	0.6 – 1.1 cm (11 mm)	>1.8 cm	LVH and septal hypertrophy, cardiomyopathy
Aortic Root AoR	2.0-3.7 cm (37mm)	> 5.0 cm	Aortic aneurysm
Ascending Aorta	≤ 3.8 cm (38mm)	> 5.5 cm	
Aortic gradient	AV mean < 10 mmHg AV area > 3.0 cm ²	AV mean > 60 mmHg AV area < 0.8 cm ²	Aortic stenosis
Pulmonary pressure PASP or RVSP	< 35 mmHg	> 45mmHg	Pulmonary Hypertension, Elevated Pulmonary Artery Pressure Tricuspid valve disease / regurgitation

*Note: there are variances in normal values by age, sex, facility and society standards

- **No perfect measurement**
- **Age**
- **Sex**
- **Body habitus**
- **Technique**
- **Society standards**
- **Disease process**

Why large
variances in
normal ranges?

Additional Factors

Echo type:

TTE (thoracic)
TEE (esophageal)
3D or 2D

Measurement:

Linear
Volume
Weight

Cardiac test:

Echo
Cardiac MRI
Chest CT

Others:

Trend over time
Comorbidities

Measurements:

LV Function	
SV (MOD sp-4)	22 mL
EF (A4C)	61%
EDV (A4C)	36 mL
ESV (A4C)	14 mL
Aorta:	
Ao Root Diam M Mode	2.65 cm

LV Function (MMode)	
SV (Teich) MMode	35.08 mL
EF (Teich) MMode	64%
EDV (Teich) MMode	55.25 mL
ESV (Teich) MMode	20.16 mL

Pulmonic Valve:	
PV Vmax	78 cm/s
PV Max PG	2 mmHg

Mitral Valve:	
MVA (P1/z1)	3.96 cm ²
MV Peak A Vel	90 cm/s
MV Peak E Vel	77 cm/s
MV E/A	0.86
MV Decel Time	191.36 ms
MV Dec Slope	4.02 cm/s ²
MV EPSS	0.23 cm

Let's Practice!

Measurements: Result:

- Ejection Fraction (61%)
- Left Atrium (3.19 cm, 16.37 ml/m²)
- Left Ventricle (3.62 cm)
- Posterior Wall PWd (1 cm – in diastole)
- Septal Wall IVSd (1.11 cm – in diastole)
- Aorta (root / ascend) (2.65 cm)
- Aortic AV gradient (Mean 4 mmHg)
- Pulmonary pressure (31 mmHg)

M-Mode Measurements:	
RVIDd MMode	1.9 cm
IVSd MMode	1.11 cm
IVSs MMode	1.53 cm
LVIDs MMode	2.4 cm
LVIDd MMode	3.62 cm
LVPWd MMode	1 cm
LVPWs MMode	1.33 cm

Left Atrium:	
LA Dimen	3.19 cm
LA LENGTH	4.62 cm
LA/Ao	1.2
LA Area 2C	11.37 cm ²
LA Area 4C	11.08 cm ²
LA Volume	28.65 mL
LA EDV Index (A-L)	16.37 mL
LA volume index 2c	16.37 mL/m ²

Tricuspid Valve:	
TR Vmax	232 cm/s
TR Max PG	21 mmHg

Aortic Valves:	
AV Vmax	131 cm/s
AV Vmean	92 cm/s
AV Max PG	7 mmHg
AV Mean PG	4 mmHg
AV V1	31.46 cm
AV Cusp Sep	1.52 cm

TDI:	
Lat E' Vel	0.1 m/s
E'/Med E'	8.8
E' Vel	0.09 m/s

Right Atrium:	
RA Pressure	10 mmHg

Bibtrial Dimensions:			
LA	3.4 cm	x	4.1 cm
RA	3.1 cm	x	4.6 cm

Left Ventricle:	
IVS Th ckening	37.84%
FS (Teich)	33.73%
A4Cs LV Length	5.04 cm
A4Cd LV Length	6.36 cm

Aortic Valve: The aortic valve is tricuspid. There is no evidence of aortic stenosis. There is no evidence of aortic regurgitation.
Mitral Valve: There is no evidence of mitral stenosis. There is evidence of trivial (trace) mitral regurgitation. There is flattened closure of the mitral valve leaflets.
Pulmonic Valve: The pulmonic valve was not well visualized.
Tricuspid Valve: There is evidence of mild tricuspid regurgitation. The right ventricular systolic pressure is estimated to be 30 - 35 mmHg.

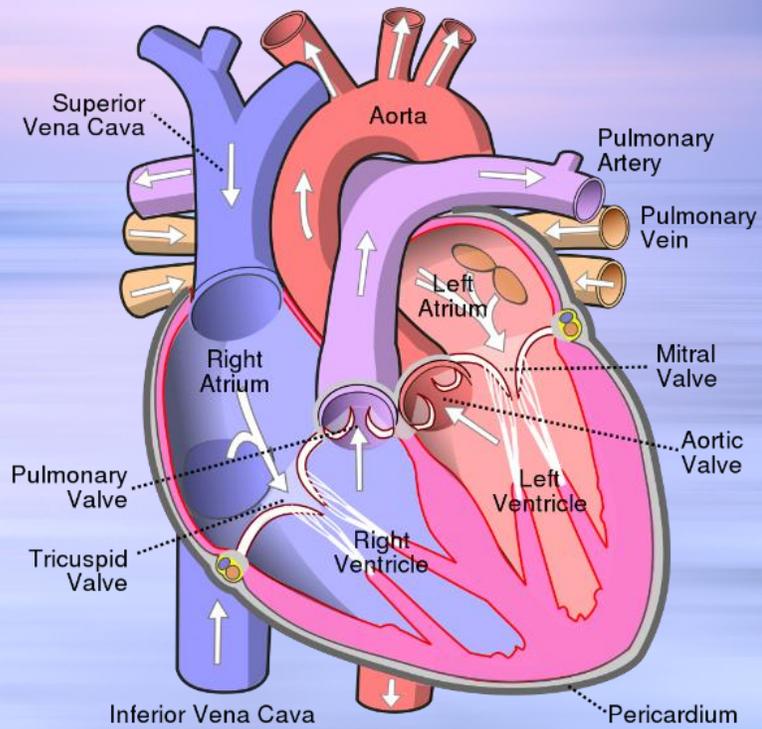
Right Ventricle:	
RVSP	31 mmHg
RVSP (TR)	31 mmHg

Conclusions
 1. Visually estimated ejection fraction is 60-65%. The left ventricular cavity size appears normal. Diastolic filling is normal for the patient's age.

69-year-old female Height 67 inches, Weight 142 lbs.

Echocardiogram: key components & related conditions

Ejection Fraction



Normal

EF \geq 50%

High Risk

EF $<$ 40%

Medical Conditions

CAD, CHF
Cardiomyopathy
Diastolic Dysfunction

What is it?

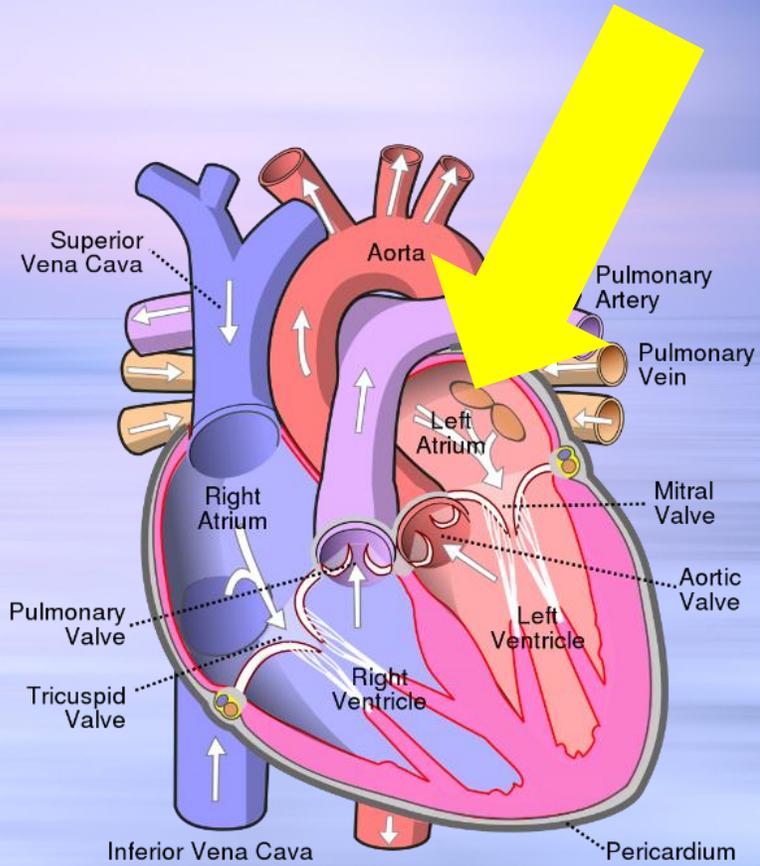
The percentage of total blood pumped out with each heartbeat

Correlation with NTproBNP

Signs/Symptoms

- Fatigue
- Weight gain/fluid retention
- Persistent cough
- Tachycardia or arrhythmia
- Dyspnea
- Orthopnea
- Edema

Left Atrium



Normal

1.9 – 4.0 cm; LAVI 16-34 ml/m²

High Risk

> 5.2 cm; LAVI > 48 ml/m²

Medical Conditions

Atrial fibrillation

Mitral valve disease

Hypertrophy, Cardiomyopathy

Left atrium

Dimension measured in systole – when atrium is largest

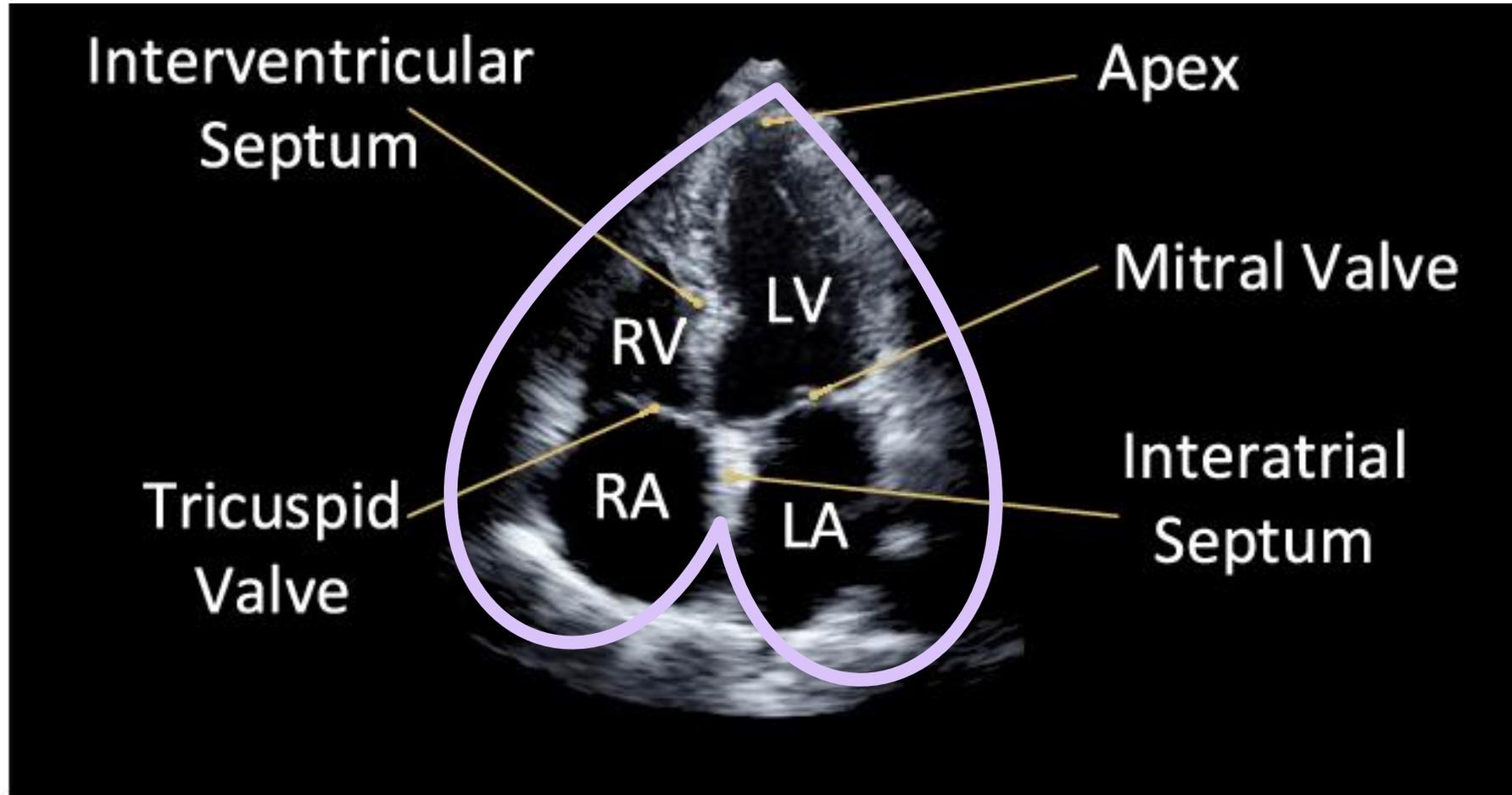
Measurement

cm or mm *used in UW

Volume by BSA (body surface area) ml/m² *used clinically

Multiple different measurements used for overall sizing purposes

Left Atrium

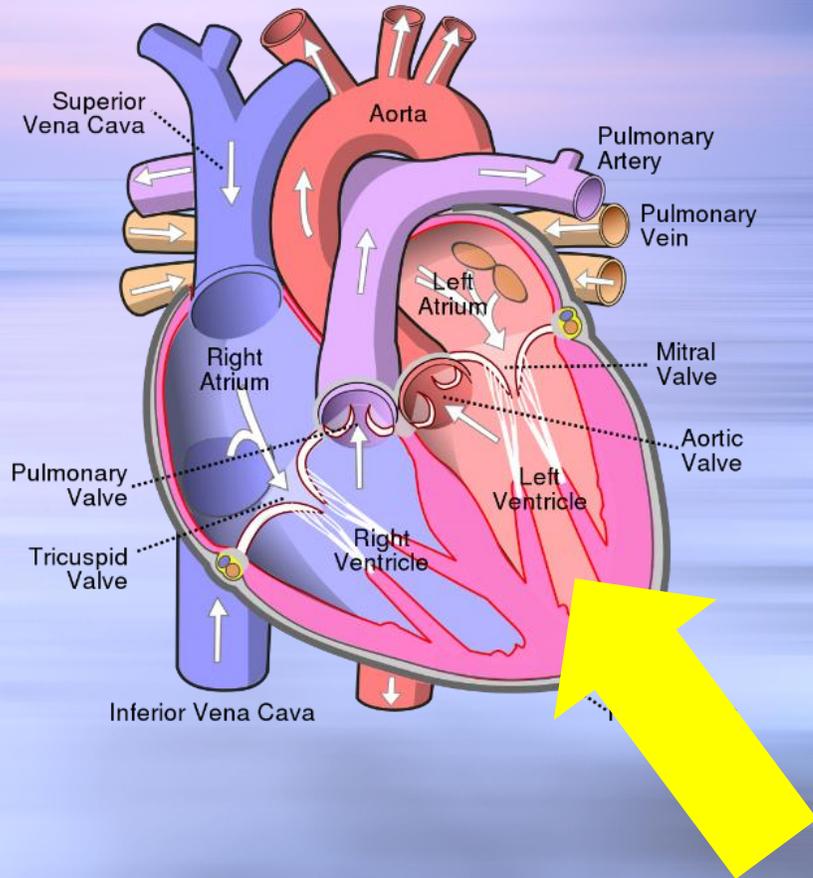


Multiple measurements:

- Transverse (L to R)
- Longitudinal (T to B)
- Anterior Posterior (F to B)

Source: Automatic Quality Assessment of Echocardiograms Using Convolutional Neural Networks: Feasibility on the Apical Four-Chamber View - Scientific Figure on ResearchGate. Available: https://www.researchgate.net/figure/A-typical-apical-four-chamber-echocardiogram-depicting-the-four-chambers-mitral-valve_fig1_315844642 [accessed 17 Oct 2025]

Left Ventricle



Normal

LV 3.5 – 5.6 cm

High Risk

> 6.5 cm

Medical Conditions

AV stenosis or regurgitation

Hypertrophy

Cardiomyopathy

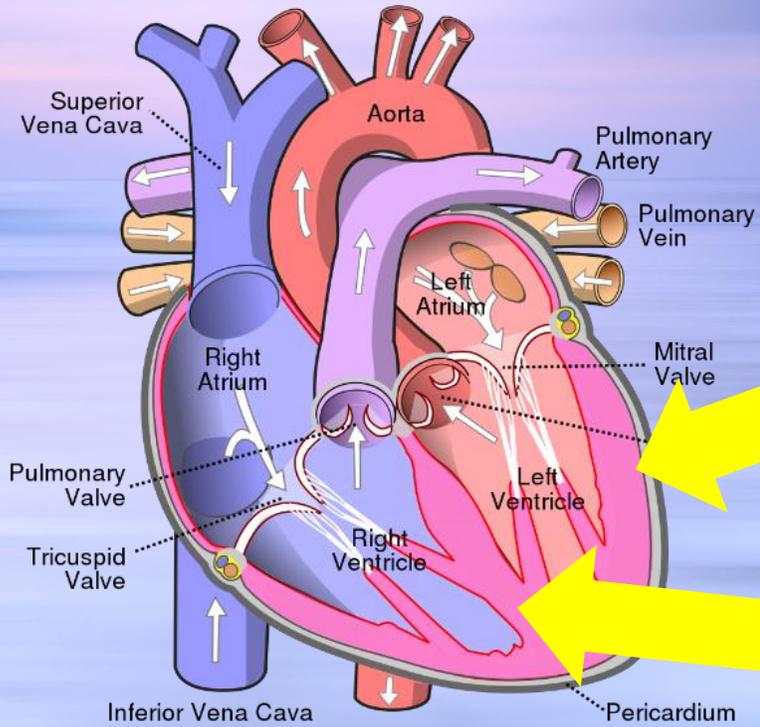
Left Ventricle

Measured in diastole – when ventricle is largest

LVOT obstruction – restriction or obstruction of blood flow out LV

Diastolic Dysfunction – improper relaxation during diastole/relaxation phase

Wall Thickness



Normal

PW and IVS 0.6 – 1.1 cm

High Risk

PW and IVS > 1.8 cm

Medical Conditions

Hypertrophy

Cardiomyopathy

Posterior Wall (PW)d

Measured in diastole

Septal Wall (IVS)d

Measured in diastole

Related findings

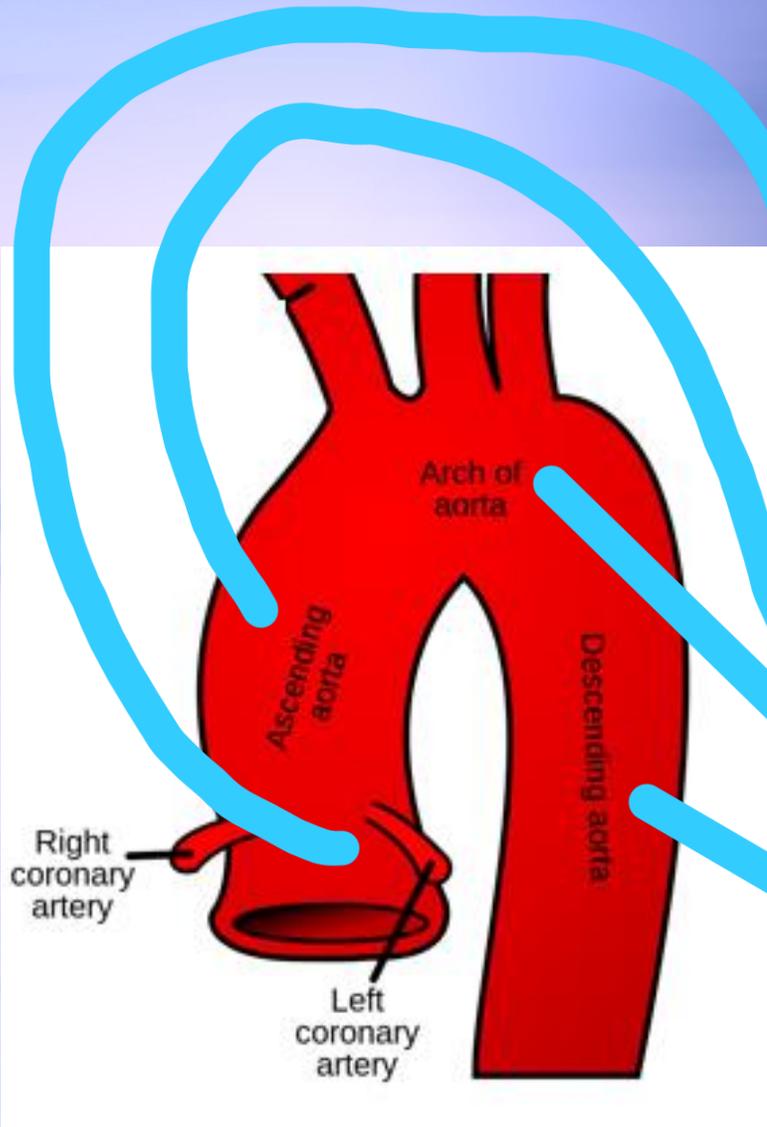
Left Ventricular Hypertrophy (LVH)

Asymmetric Septal Hypertrophy (ASH)

Hypertrophic Cardiomyopathy

Athletic Heart Syndrome

Aorta



Normal

Root 2.0 – 3.7 cm; Asc < 3.8 cm

High Risk

Root > 5.0 cm; Asc >5.5 cm

Medical Conditions

Aortic Aneurysm

Locations:

Aortic root / Sinus of Valsalva (largest measurement)

Ascending Aorta

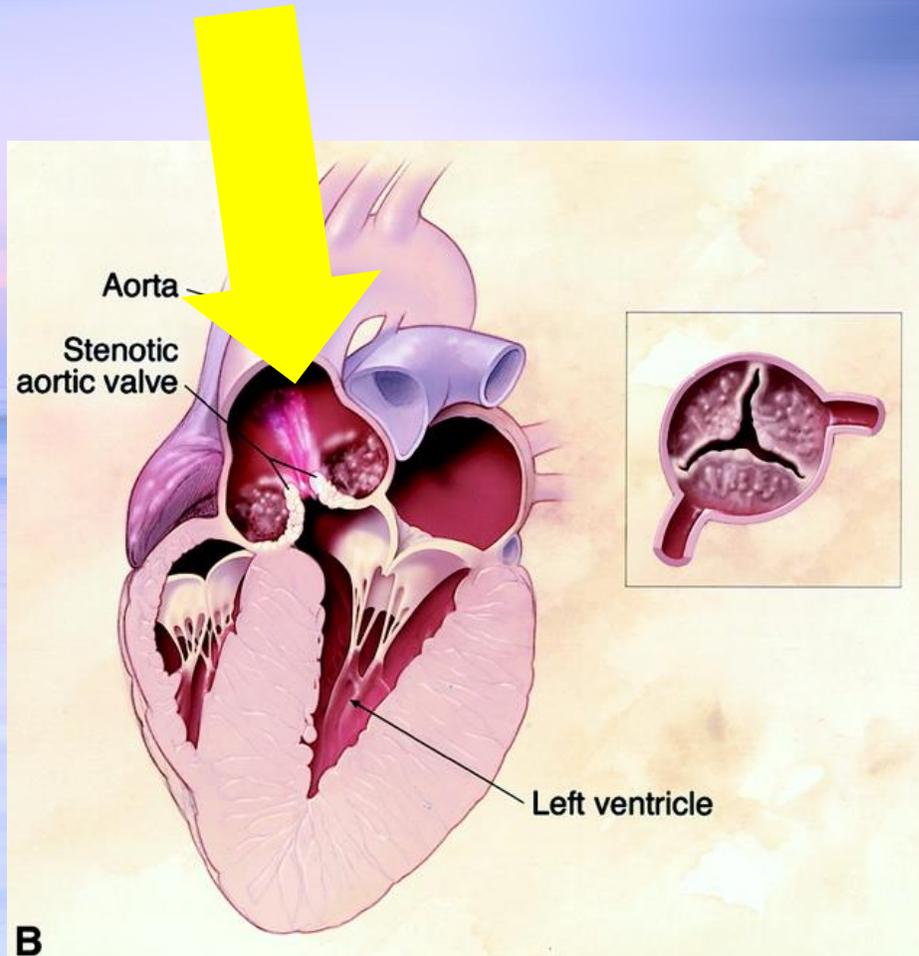
Aortic Arch

Descending Aorta

Consider age, sex, body size and habitus

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Aortic Pressure Gradients



Normal

AV mean gradient <10 mmHg

High Risk

AV mean gradient >60 mmHg

Medical Conditions

Aortic stenosis

Aortic Valve

Calcifications caused by:

- Congenital (BAV bicuspid)
- Rheumatic fever
- Atherosclerosis

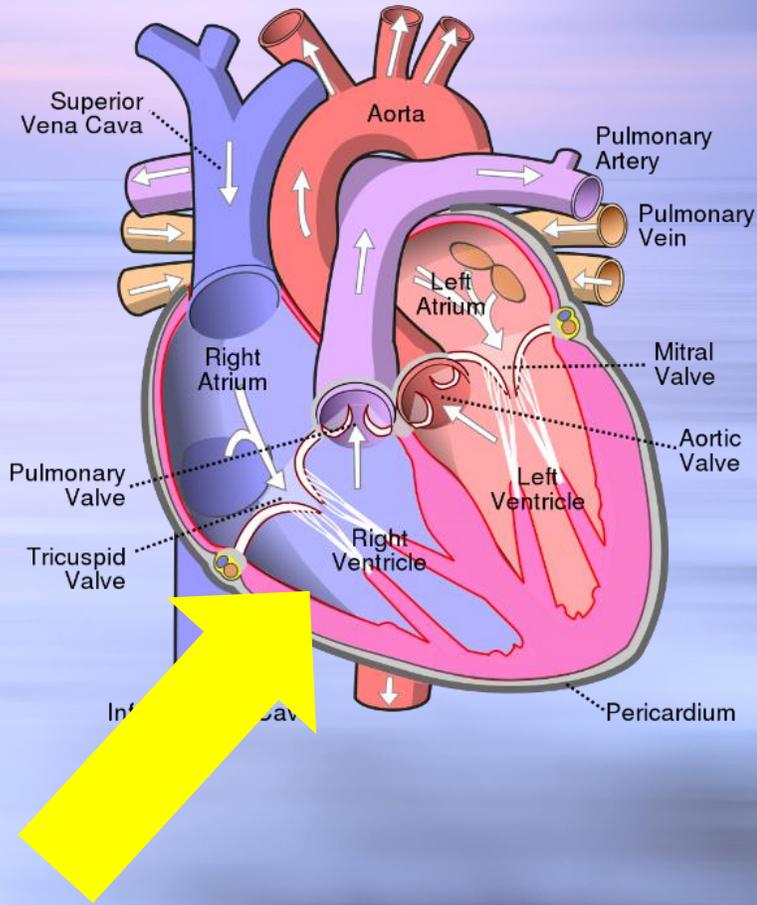
Aortic Stenosis

More common in men

Symptoms don't appear until late in disease course

Symptomatic aortic stenosis lower survival than other valvular lesions

Pulmonary Pressure



Normal

PASP or RVSP < 35 mmHg

High Risk

PASP or RVSP > 45 mmHg

Medical Conditions

Pulmonary Hypertension
Tricuspid or Pulmonary
valve diseases

PASP -

Pulmonary Artery Systolic
Pressure

RVSP -

Right Ventricular Systolic
Pressure

RVSP is synonymous with
PASP in the absence of RV
outflow tract obstruction

Cath is gold standard for this
measurement

Secondary Pulmonary HTN:

- COPD
- ILD (interstitial lung disease)
- OSA
- Pulmonary emboli
- Sickle cell anemia
- Collagen vascular disease
(like scleroderma or lupus)

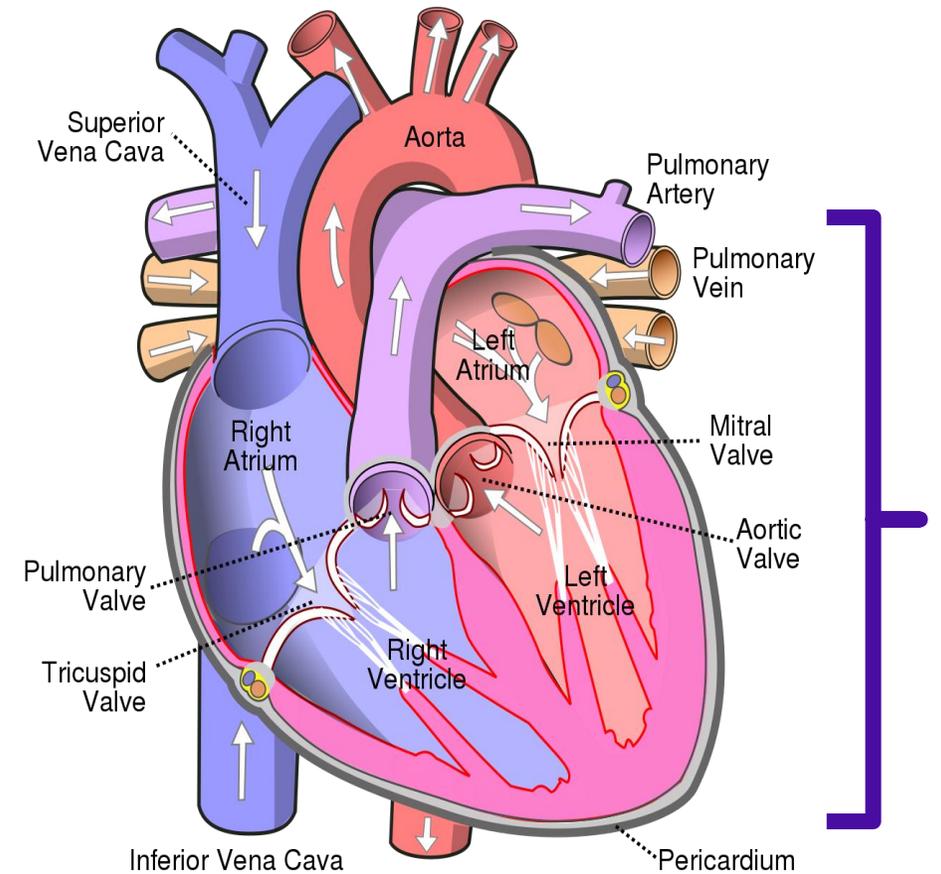
Valvular Disease - Left side

Aortic Valve

- Aortic regurgitation – slow disease progression
- Aortic stenosis
- Hypertrophy
- Cardiomyopathy
- Heart Failure

Mitral Valve

- Most common valvular disease
- Mitral regurgitation
- Mitral stenosis (infrequent)
- Left atrial size is key



Left side valvular disease is more common than right side

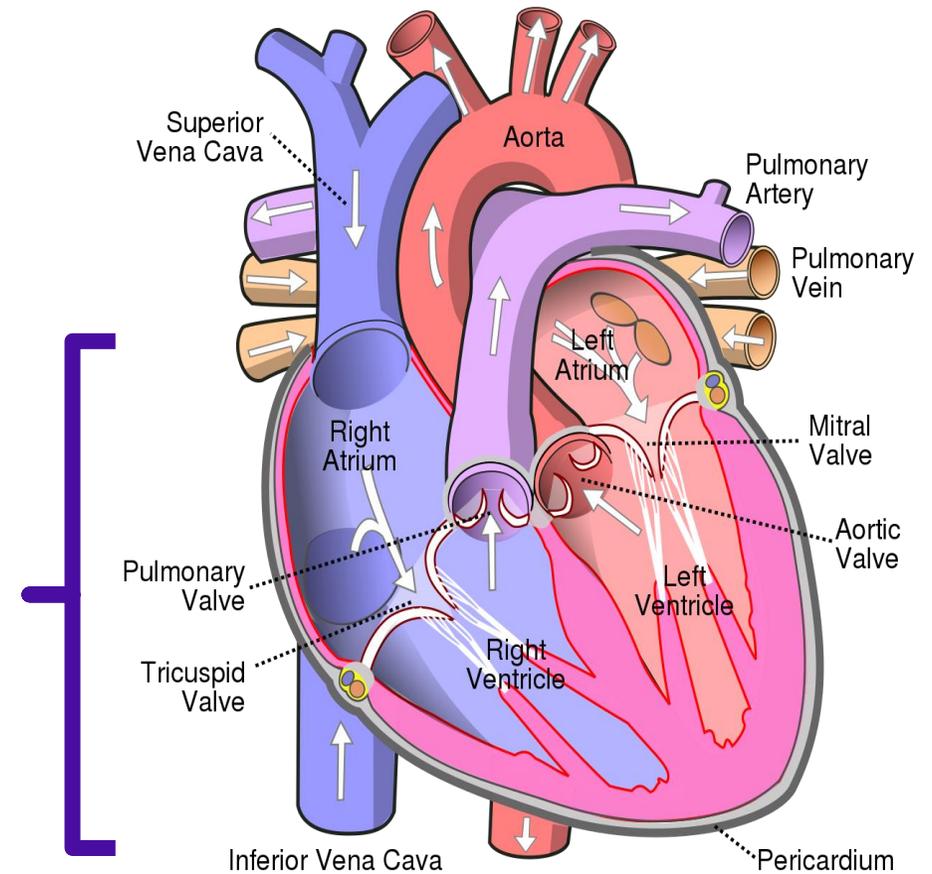
Valvular Disease - Right side

Pulmonary Valve

- Predominantly congenital from Pulmonary Stenosis
- Secondary to cardiac, liver or pulmonary disease
- Treatment aimed at underlying condition (R heart failure, pulmonary hypertension)

Tricuspid Valve

- Treatment options:
 - balloon valvuloplasty
 - surgical valve repair
- Tricuspid regurg or stenosis
 - Trivial, trace, or mild is not a significant mortality risk



Less commonly seen in underwriting

Echocardiogram: case studies

Case #1 – Left Ventricular Hypertrophy

65-year-old male

BP 129/82

Build 5ft 8 inches, 229 lbs. (BMI 35)

Concern for LVH on EKG

Echo measurements

Left Ventricle LVIDd 5.6 cm

Posterior Wall PWd **1.4 cm (H)**

Septal Wall IVSd **1.2 cm (H)**



Mild Rating for LVH



Case #1 – Left Ventricular Hypertrophy

65-year-old male

BP 129/82

Build 5ft 8 inches, 229 lbs. (BMI 35)

Concern for LVH on EKG

Why RMD when
measurements
are small?

What about
athletic heart?



Athletic Heart vs. LVH or Cardiomyopathy

Endurance training

- rowing, running
- LVEDD increased with proportional increase in wall thickness
- EF normal, diastolic function normal

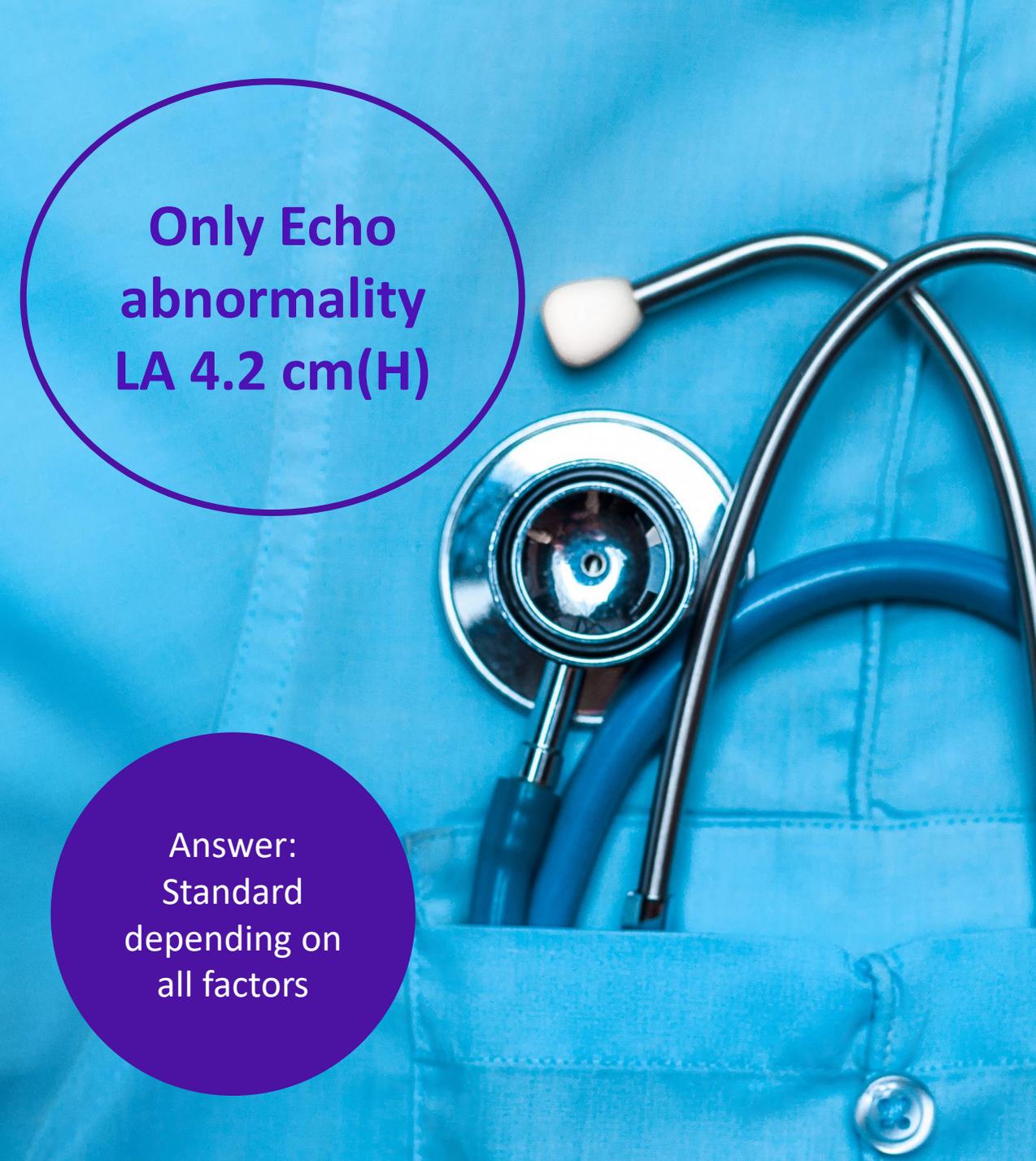
Strength training

- football, weight-lifting
- concentric hypertrophy
- Wall thickness > 1.5 cm is rare
- Mitral regurgitation is rare
- Diastolic dysfunction is not common

What's NOT athletic heart ?

When:

- Asymmetric hypertrophy is present
- LVEDD size is normal or small
- significant mitral regurgitation is present
- diastolic dysfunction is present



Only Echo
abnormality
LA 4.2 cm(H)

Answer:
Standard
depending on
all factors

Left Atrial enlargement

Key Critical Thinking Questions:

Any regurgitation?

- Aortic valve normal, no AR
- Mitral valve normal, no MR

Any Atrial fibrillation?

- No, no arrhythmia history

Any cardiomyopathy or LVH?

- No, all other echo sizes are WNL

Any Pulmonary disease or Pulmonary HTN?

- No, pulmonary pressure is normal

Any other measurements to compare?

- LA volume index is normal 20 ml/m²

Client's age and sex?

What's build or BMI?

Any NTproBNP?

Reason for ordering echo?

Case Study #2 – Mitral Valve

49-year-old male
HTN with echo evaluation for LV function

Findings describe **mild mitral regurgitation**

Echo size and descriptions:

- MV structurally normal
- LV size 5.1 cm (WNL)
- LA size 3.5 cm (WNL)

Answer:
Standard ?
Or
Debit +50 ?
Or
Higher ?

Echocardiogram

Patient: 49 Male 5'10" 220# BMI 31.5
Indications: HTN, LV function systolic/diastolic

<u>Measurements:</u>		<u>Normal</u>			<u>Normal</u>
Ejection Fraction	60	50-72%		MV Pk E vel MV Pk A vel MV E/A ratio	1.3 0.7 – 1.2 m/s 0.4 – 0.7 m/s 0.73 – 2.33
IVSd	0.9	0.6 – 1.1 cm		AV Pk Grad	7.83
LVPWd	0.9	0.6 – 1.1 cm		AV mean Grad AVA	4.04 2.9
LVIDd	5.1	3.5 – 5.6 cm		AoD (Root/sinus)	3.7
LVIDs	2.7	2.5 – 4.0 cm		Prox Asc Aorta	3.6
LV Mass Index	74.6	49 – 115 g/m ²			
LA	3.5	1.9 – 4.0 cm		RVSP	18-35 mmHg
LA vol/BSA (LAVI)	16	16 – 34 ml/m ²			

Findings:

Left ventricle: normal in size, normal global wall motion. Normal diastolic filling pattern
 Left Atrium: normal in size
 Right atrium: normal in size
 Aortic Valve: Mild aortic valve leaflet thickening with no aortic regurgitation
 Mitral Valve: structurally normal mitral valve with mild regurgitation
 Tricuspid valve: structurally normal tricuspid valve with trace regurgitation
 Pulmonic valve: no pulmonic valve regurgitation
 Pericardium: no evidence of significant pericardial effusion
 Aortic root: the aortic root is normal

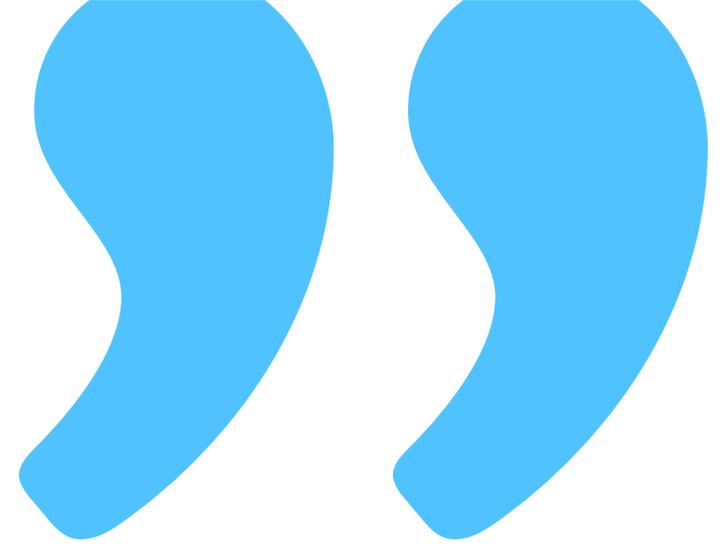
NL Valve, mild MR

Conclusions:

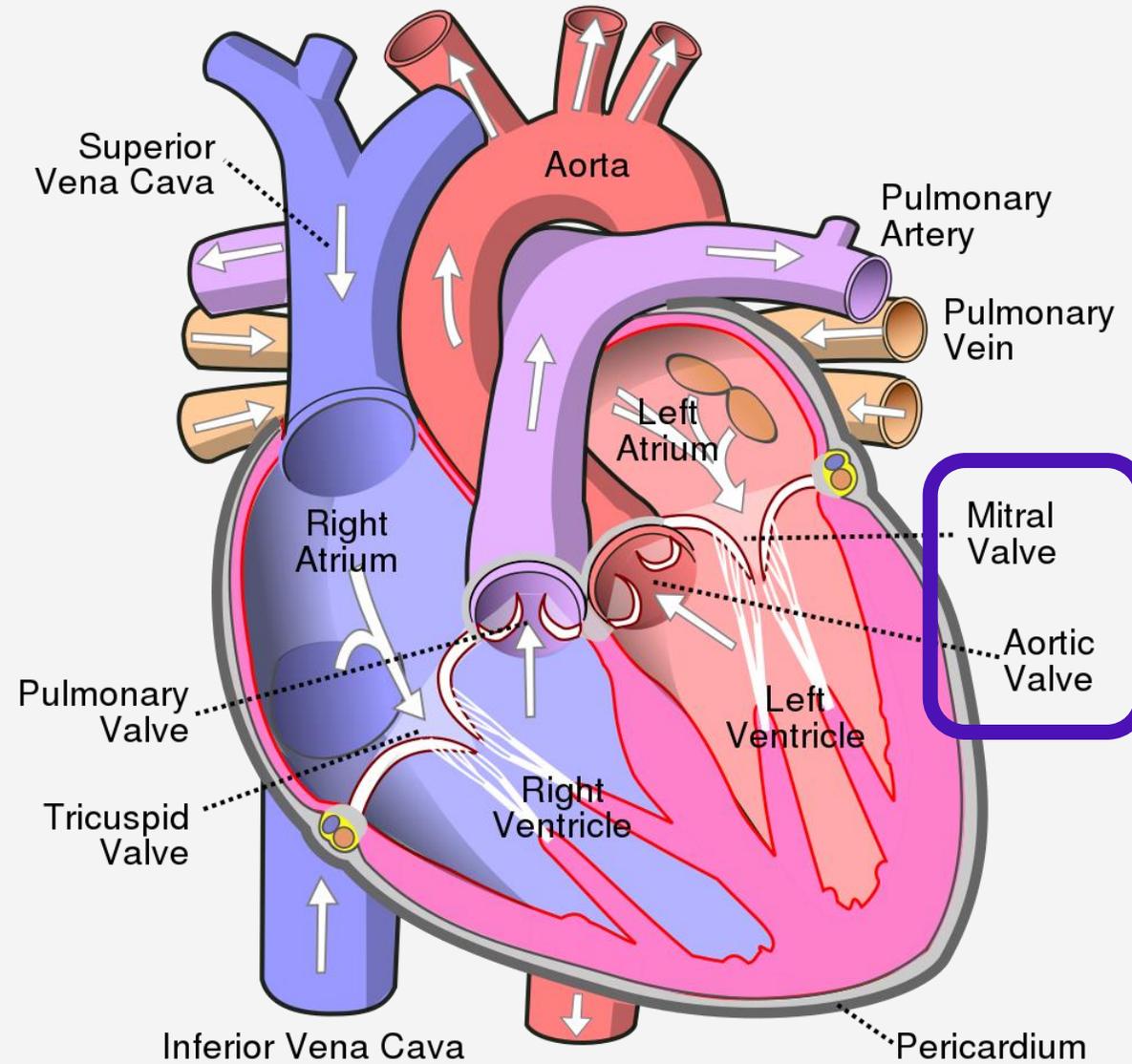
1. Normal LV size with normal LV systolic function. Visual LVEF estimated at 60%
2. Mild mitral regurgitation in otherwise essentially normal echocardiogram

Trivial, Slight or Mild Mitral
Regurgitation with
structurally normal valve
and normal measurements
is

OK to accept +0, Standard



Anatomy



Case Study #3 – Aortic Valve

Left Ventricle								
EF (Teich)	58 %	Normal						
IVSd	0.6 cm	(0.6 - 1)						
IVSd (Mm)	0.8 cm	(0.6 - 1)						
LVIDd	4.9 cm	(4.2 - 5.8)						
LVIDd / BSA	2.51 cm/m ²	(2.2 - 3.1)						
LVPWd	0.7 cm	(0.6 - 1)						
LVPWd (Mm)	0.7 cm	(0.6 - 1)						
LV FS (midwall)	31 %	(14 - 22)						
LVIDs	3.4 cm	(2.5 - 4)						
LVIDd (Mm)	4.7 cm	(4.2 - 5.8)						
LVRWT	0.27							
Left Atrium		Normal						
LA	3.9 cm	(3 - 4)						
LA / BSA	2.00 cm/m ²	(1.5 - 2.3)						
LA Volume	44.0 ml	(18 - 58)						
LA Volume / BSA	22.00 ml/m ²	(16 - 34)						
Mitral Valve		Normal						
MV Pk E Vel	0.9 m/s	(0.7 - 1.2)						
MV Pk A Vel	0.5 m/s	(0.4 - 0.7)						
MV E/A Ratio	1.80	(0.73 - 2.33)						
Septal e'	11.94 cm/s	(10.1 - 20.9)						
Septal E/e'	7.40	(<8)						
Lateral e'	16.18 cm/s	(14 - 25.6)						
Lateral E/e'	5.40	(<=10)						
MV E/e'	6.26	(<8)						
MR Vel	3.0 m/s							
MV Reg Pressure Gr	36.5 mmHg							
Tricuspid Valve		Normal						
TR Pk Vel	1.7 m/s							
TR Pk Grad	12.1 mmHg							
RVSP	22 mmHg	(18 - 25)						
RAP	10.0 mmHg	(<5)						
Aorta		Normal						
AoD	2.9 cm							
Aortic Valve		Normal						
LVOT Diam	2.6 cm	(1.8 - 2.2)						
LVOT Pk Vel	1.39 m/s							
LVOT Pk Grad	7.7 mmHg							
LVOT SV	63.8 ml	(60 - 100)						
AV Pk Vel	1.56 m/s	(<10)						
AV Pk Grad	9.7 mmHg	(3 - 4)						
AVA (Vmax)	4.73 cm ²							
AV index	0.9							
AI PHT	666.0 ms							
AR Vel	5.0 m/s							
AR Pk Grad	101.7 mmHg							
Pulmonary Valve		Normal						
PV Pk Vel	1.3 m/s							
PV Pk Grad	6.9 mmHg							
IVC/Pulmonic Vein		Normal						
IVC Dim	1.5 cm	(<2.1)						

A complete Transthoracic Echocardiogram was performed.

Findings:

LEFT VENTRICLE: Left ventricle cavity is normal in size. Normal global wall motion.

Normal diastolic filling pattern.

LEFT ATRIUM: Left atrial cavity is normal in size.

RIGHT ATRIUM: Right atrial cavity is normal in size.

RIGHT VENTRICLE: Right ventricle cavity is normal in size.

Normal right ventricular function.

AORTIC VALVE: Mild to moderate aortic regurgitation.

Mild aortic valve leaflet thickening.

MITRAL VALVE: Structurally normal mitral valve with trace regurgitation.

TRICUSPID VALVE: Structurally normal tricuspid valve with trace regurgitation.

PULMONIC VALVE: No pulmonic valve regurgitation.

PERICARDIUM: No evidence of significant pericardial effusion.

AORTIC ROOT: The aortic root is normal.

INFERIOR VENA CAVA: IVC is normal.

Conclusions:

Calculated EF 58%.

Left ventricle cavity is normal in size.

Normal global wall motion.

Normal diastolic filling pattern.

Mild to moderate aortic regurgitation.

Mild aortic valve leaflet thickening.

Structurally normal mitral valve with trace regurgitation.

Structurally normal tricuspid valve with trace regurgitation.

Is this MILD or MODERATE Aortic Regurgitation ?



42-year-old male
Echo Findings and Conclusion:
Mild to Moderate aortic regurg

Measurements are WNL:

- EF 58%
- LA 3.9 cm and 22 ml/m²
- LVIDd 4.9 cm
- PWd 0.7 cm
- IVSd 0.6 cm
- AoD 2.9 cm
- AV peak gradient 9.7 mmHg
- RVSP 22mmHg

Case Study #3 – Aortic Valve

Is this MILD or MODERATE
Aortic Regurgitation ?

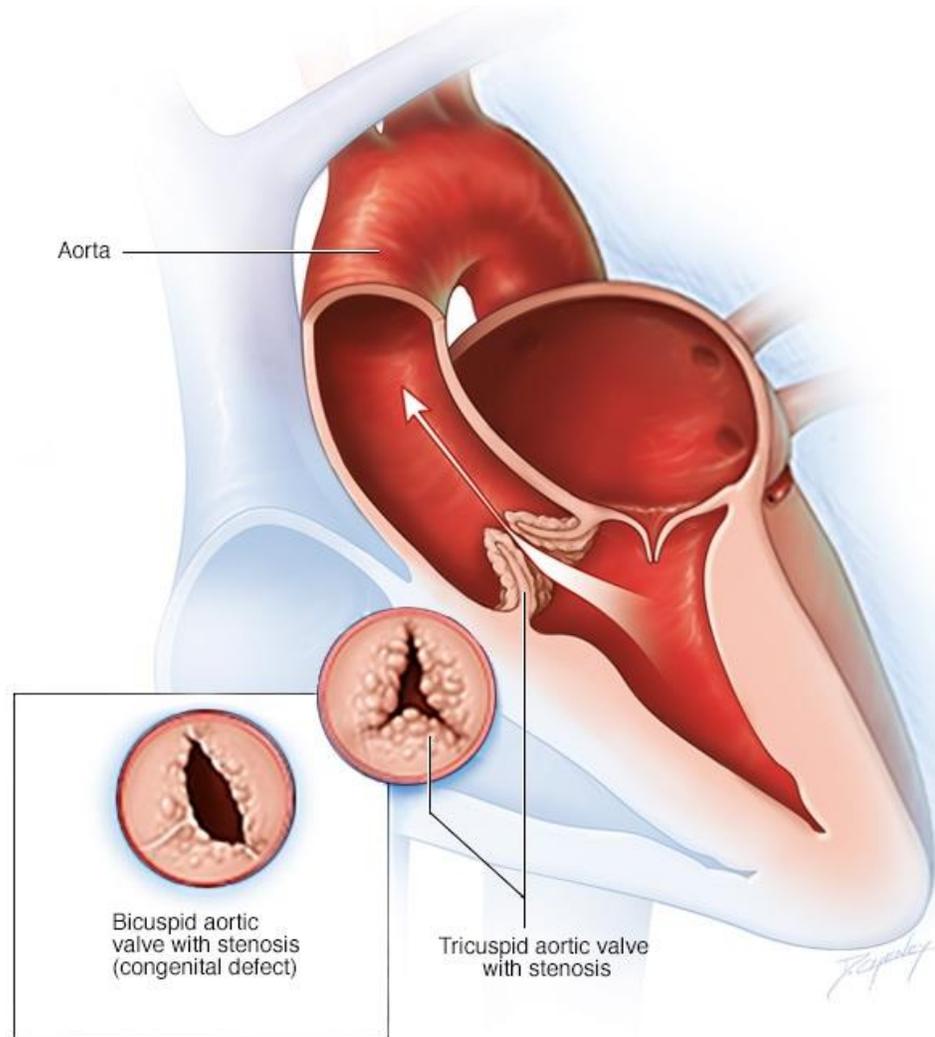


If all echo measurements are
normal, can we go standard?

No

**42-year-old male = mild to moderate aortic regurgitation
debits could range +50 to +75 to +100 to +200**

Case Study #3 – Aortic Valve



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Aortic Regurgitation

- Aortic regurgitation is not a normal finding.
- 3 cusp aortic valve will normally prevent retrograde flow of blood from aorta backward into ventricle
- Aortic regurgitation may be asymptomatic until well advanced
- Younger ages <50 is higher risk compared to older ages >65
- Serial echos will establish how rapidly the disease progresses

Case Study #4 – Aortic Valve

Left Ventricle		Normal	Mitral Valve		Normal	Aortic Valve		Normal
EF (Teich)	58 %	(52 - 72)	MV Pk E Vel	0.9 m/s	(0.7 - 1.2)	LVOT Diam	2.6 cm	(1.8 - 2.2)
IVSd	0.6 cm	(0.6 - 1)	MV Pk A Vel	0.5 m/s	(0.4 - 0.7)	LVOT Pk Vel	1.39 m/s	
IVSd (Mm)	0.8 cm	(0.6 - 1)	MV E/A Ratio	1.80	(0.73 - 2.33)	LVOT Pk Grad	7.7 mmHg	
LVIDd	4.9 cm	(4.2 - 5.8)	Septal e'	11.94 cm/s	(10.1 - 20.9)	LVOT SV	63.8 ml	(60 - 100)
LVIDd / BSA	2.51 cm/m ²	(2.2 - 3.1)	Septal E/e'	7.40	(<8)	AV Pk Vel	1.56 m/s	<10
LVPWd	0.7 cm	(0.6 - 1)	Lateral e'	16.18 cm/s	(14 - 25.6)	AV Pk Grad	9.7 mmHg	(3 - 4)
LVPWd (Mm)	0.7 cm	(0.6 - 1)	Lateral E/e'	5.40	(<=10)	AVA (Vmax)	4.73 cm ²	
LV FS (midwall)	31 %	(14 - 22)	MV E/e'	6.26	(<8)	AV index	0.9	
LVIDs	3.4 cm	(2.5 - 4)	MR Vel	3.0 m/s		AI PHT	666.0 ms	
LVIDd (Mm)	4.7 cm	(4.2 - 5.8)	MV Reg Pressure Gr	36.5 mmHg		AR Vel	5.0 m/s	
LVRWT	0.27		Tricuspid Valve		Normal	AR Pk Grad	101.7 mmHg	
Left Atrium		Normal	TR Pk Vel	1.7 m/s		Pulmonary Valve		Normal
LA	3.9 cm	(3 - 4)	TR Pk Grad	12.1 mmHg	(18 - 25)	PV Pk Vel	1.3 m/s	
LA / BSA	2.00 cm/m ²	(1.5 - 2.3)	RVSP	22 mmHg	(<5)	PV Pk Grad	6.9 mmHg	
LA Volume	44.0 ml	(18 - 58)	RAP	10.0 mmHg		IVC/Pulmonic Vein		Normal
LA Volume / BSA	22.00 ml/m ²	(16 - 34)	Aorta		Normal	IVC Dim	1.5 cm	(<2.1)
			AoD	2.9 cm				

A complete Transthoracic Echocardiogram was performed.

Findings:

LEFT VENTRICLE: Left ventricle cavity is normal in size. Normal global wall motion.

Normal diastolic filling pattern.

LEFT ATRIUM: Left atrial cavity is normal in size.

RIGHT ATRIUM: Right atrial cavity is normal in size.

RIGHT VENTRICLE: Right ventricle cavity is normal in size.

Normal right ventricular function.

AORTIC VALVE: Mild to moderate aortic regurgitation.

Mild aortic valve leaflet thickening.

MITRAL VALVE: Structurally normal mitral valve with trace regurgitation.

TRICUSPID VALVE: Structurally normal tricuspid valve with trace regurgitation.

PULMONIC VALVE: No pulmonic valve regurgitation.

PERICARDIUM: No evidence of significant pericardial effusion.

AORTIC ROOT: The aortic root is normal.

INFERIOR VENA CAVA: IVC is normal.

Conclusions:

Calculated EF 58%.

Left ventricle cavity is normal in size.

Normal global wall motion.

Normal diastolic filling pattern.

Mild to moderate aortic regurgitation.

Mild aortic valve leaflet thickening.

Structurally normal mitral valve with trace regurgitation.

Structurally normal tricuspid valve with trace regurgitation.

Is this MILD or MODERATE Aortic Regurgitation ?



42-year-old male
Echo Findings and Conclusion:
Mild to Moderate aortic regurg

ANSWER:

Mild Aortic Valve regurgitation
is appropriate classification

Normal echo measurements
No other valvular co-morbidities

At his age, apply mild debit class.

This is not Standard risk

UW Tip: terminology
“eccentric jet” is at least
moderate regurgitation

Summary

- ✓ Anatomy
- ✓ Focus on KEY ECHO MEASUREMENTS
- ✓ Variations by:
 - ✓ Age, sex, body size, mode, technique
 - ✓ Different qualifiers for “normal”
- ✓ Understand disease processes
 - ✓ Mitral vs. Aortic valve differences



Thank you!

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Thank You

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