Manual of operation

POSTNATAL ECHO

CORE LABORATORY ECHOCARDIOGRAPHY

Pediatric Cardiac Center
Queen Silvia Children´s Hospital
Sahlgrenska Academy
University of Gothenburg
Sweden

General instructions

- Display the ECG at all times with upright “R” wave
- Acquire a minimum of three (3) cardiac cycles at quiet respiration
- Obtain all views at optimal depth settings. Avoid frequently changing depth settings throughout the exam.

Optimizing and Obtaining Images

Color Doppler

- Employ an adequate color sector or color region of interest
- Utilize optimal Nyquist limit

Spectral Doppler and M-mode

- Acquire a minimum of three (3) cardiac cycles at frozen spectral display with sweep speed between 50-100 mm/sec
- Employ optimal gain control and minimal filter setting
- Adjust scale to optimize display of the entire flow

Store and transfer Echo images - DICOM format

- Still images and clips should be transfered to the FTPS server using DICOM-format

2D measurements

- The 2-dimensional measurements are measured at the maximal dimension of the structure
- Valve dimensions from hinge point to hinge point
- Vascular structures from inner edge to inner edge

2D measurements

- Dimensions are measured in millimetres (mm)
- All dimensions are noted with one decimal

Mitral valve

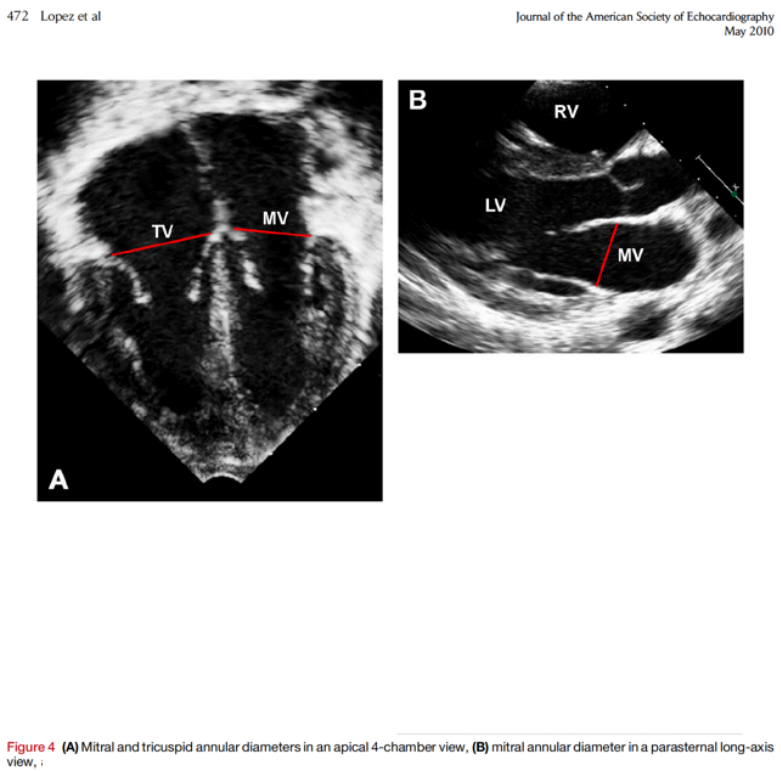
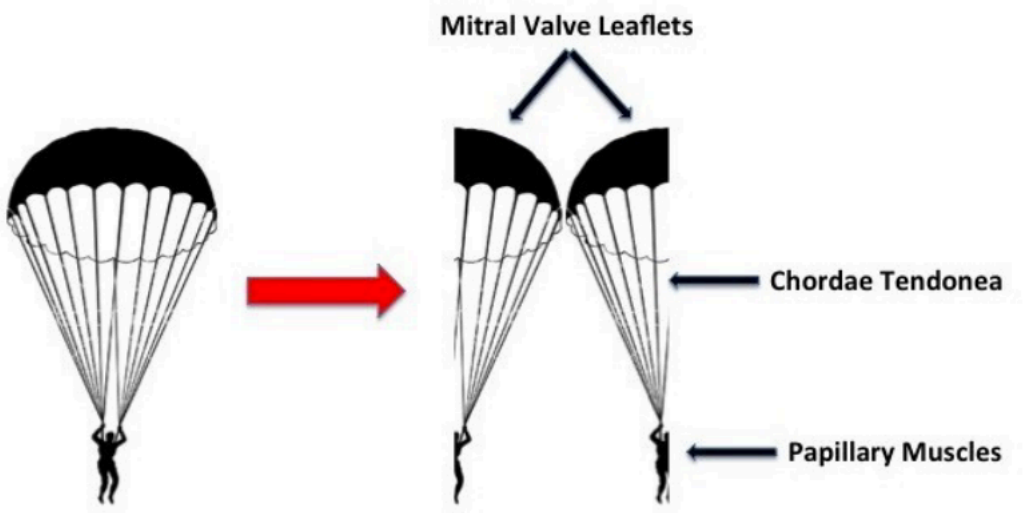


Figure 4 **(A)** Mitral and tricuspid annular diameters in an apical 4-chamber view, **(B)** mitral annular diameter in a parasternal long-axis view, ı

- Mitral valve, apical 4-chamber view
- Mitral valve, anterior posterior, AP- view

Recommendations for Quantification Methods During the Performance of a Pediatric Echocardiogram; Lopez et al; Journal of the America Society of Echocardiography, 2010

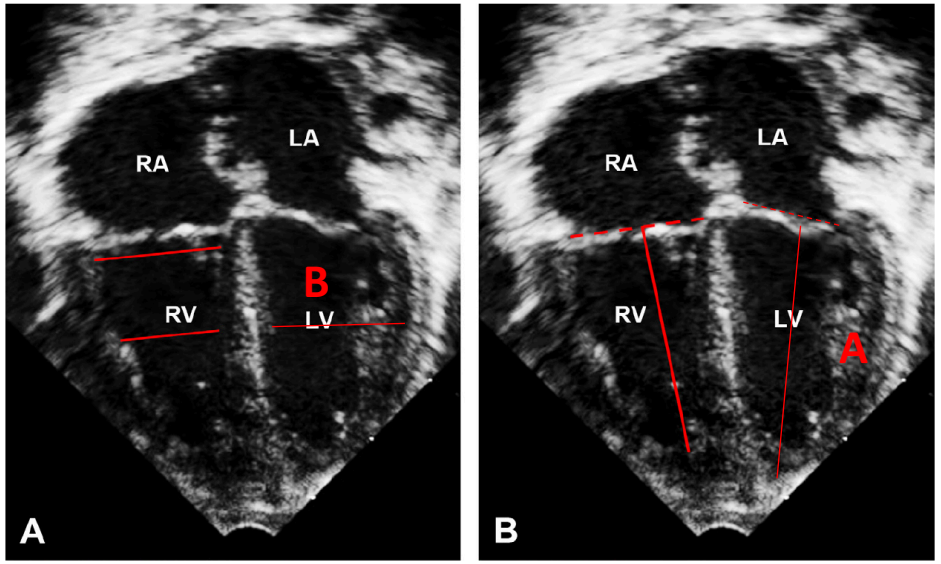
Parachute mitral valve



- Single papillary muscle or one severely hypoplastic papillary muscle

LV- inlet length and diameter

Journal of the American Society of Echocardiography
May 2010



End-diastole

Note; Red lines A and B added to the original image

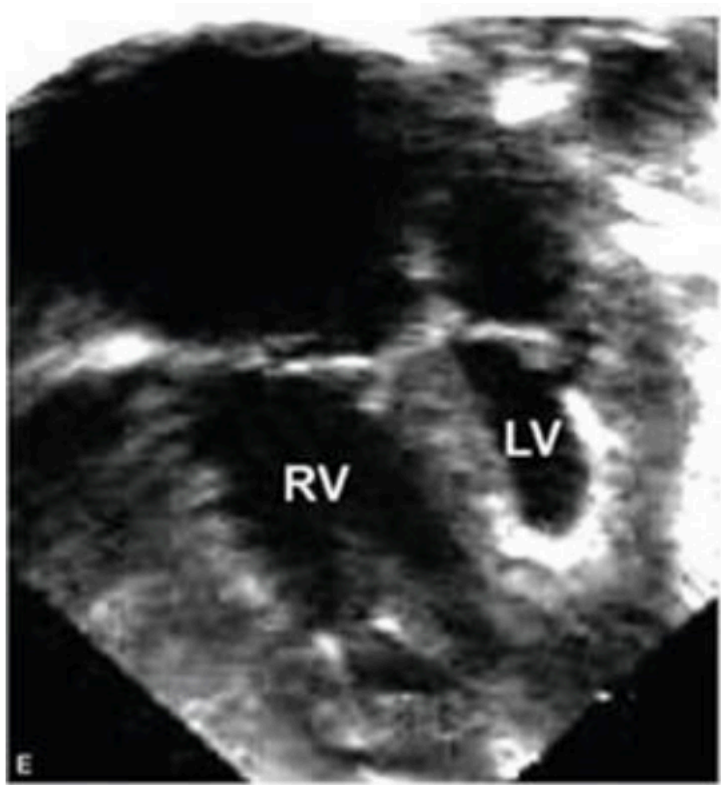
- LV inlet length (A)
- LV diameter mid-cavity (B)
- End-diastole just before the start of systole

LV systolic function/contractility

- Visual estimation of LV function, eyeballing

Gollum, Lord of the rings

Endocardial fibroelastosis, EFE



- Mild

- Only the papillary muscles

- Moderate

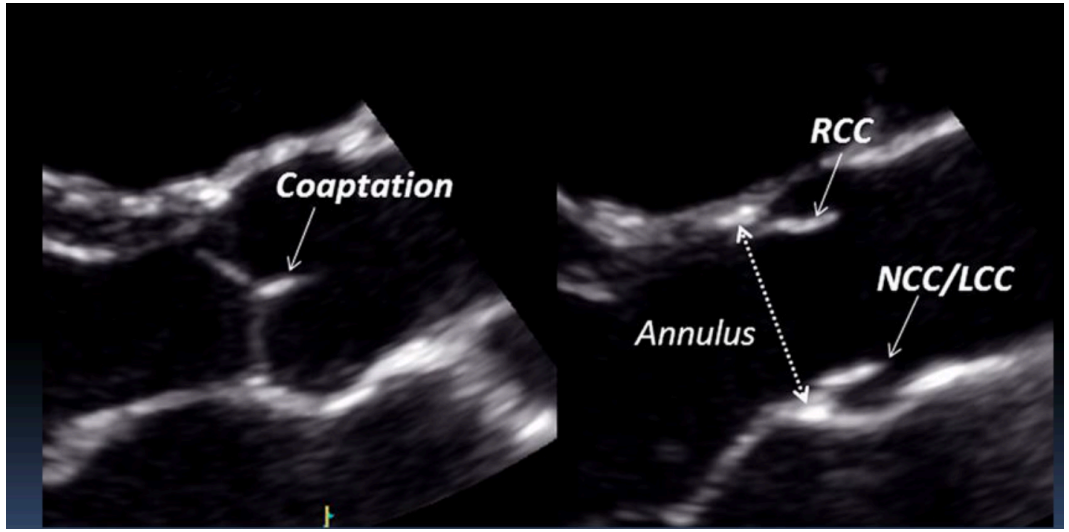
- Papillary muscles and partly lining the LV cavity

- Severe

- Papillary muscles and outlining the entire LV cavity

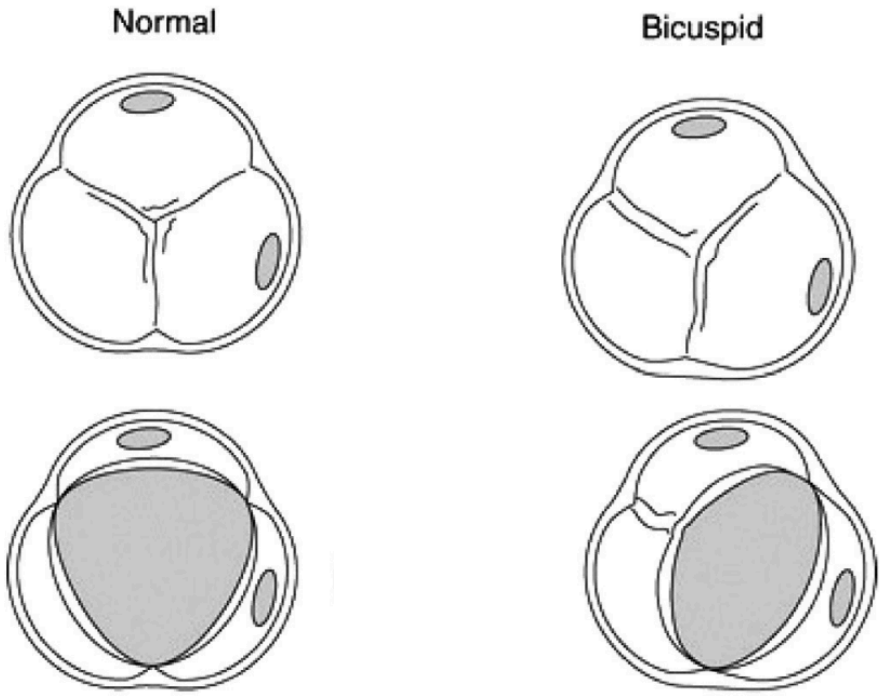
Prof. Robert H. Anderson, Institute of Child Health, London, United Kingdom

Aortic valve annulus



- Zoom PLAX
- During systole
- Distance from hinge point to hinge point

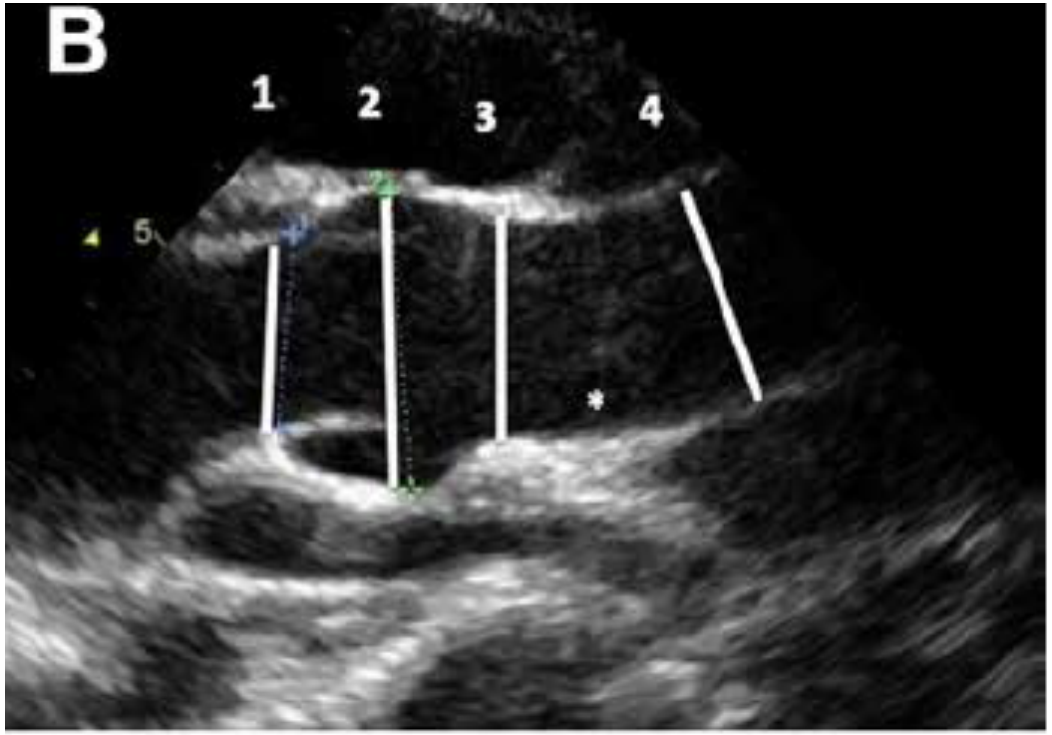
Aortic valve, number of cusps



- PSAX view
- Assess the number of cusps in systole

European Heart Journal - Cardiovascular Imaging (2017) 18, 254–275 doi:10.1093/ehjci/jew335

Aortic root dimensions

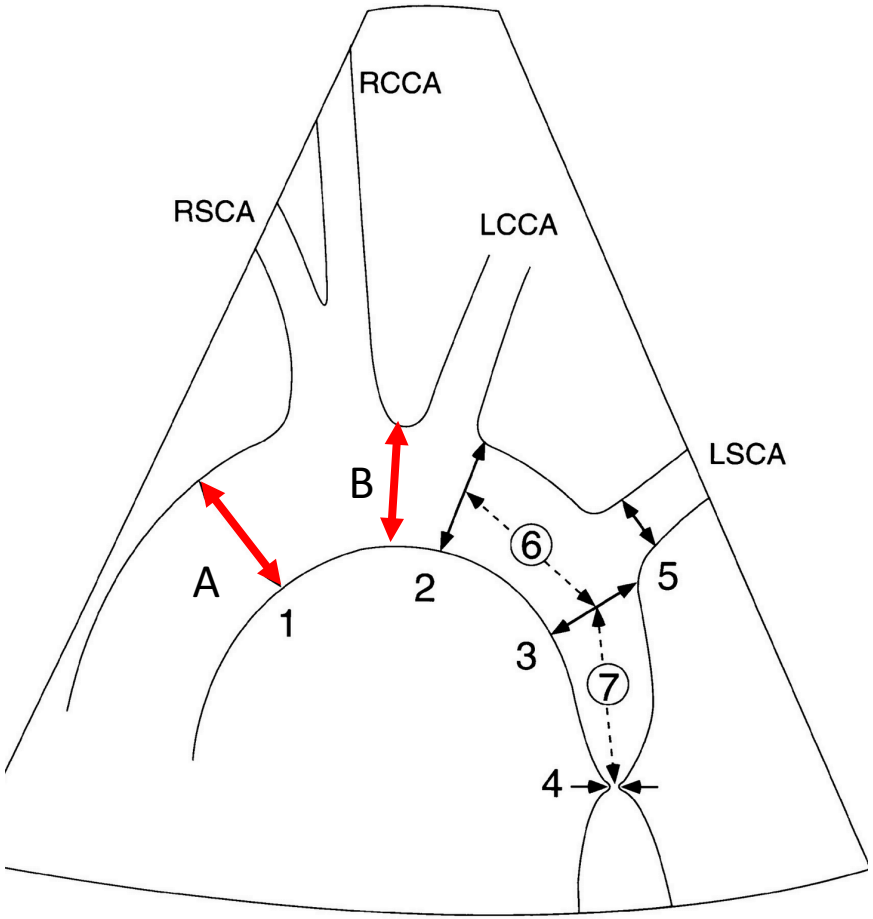


- Measurement locations of the aortic sinuses and ascending aorta

1. aortic annulus
2. aortic sinus
3. sinotubular junction
4. ascending aorta

Grattan et al, Circ Cardiovasc Imaging. 2020;13:e009717. DOI: 10.1161/CIRCIMAGING.119.00971

Aortic arch



Sites of echocardiographic measurements of the aortic arch:

A. Ascending aorta

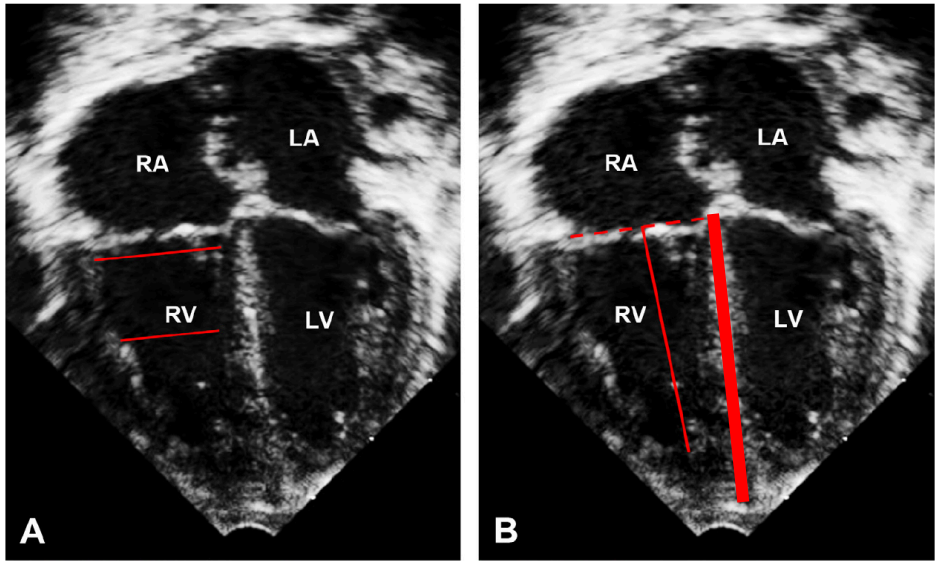
B. Aortic arch

1. ascending aorta diameter
2. distal transverse aortic arch diameter
3. aortic isthmus diameter;
4. coarctation site diameter
5. left subclavian artery diameter
6. distal transverse aortic arch length
7. aortic isthmus length.

Stephen F. Kaine. Circulation. Quantitative Echocardiographic Analysis of the Aortic Arch Predicts Outcome of Balloon Angioplasty of Native Coarctation of the Aorta, Volume: 94, Issue: 5, Pages: 1056-1062, DOI: (10.1161/01.CIR.94.5.1056)

Long axis of the heart

Journal of the American Society of Echocardiography
May 2010



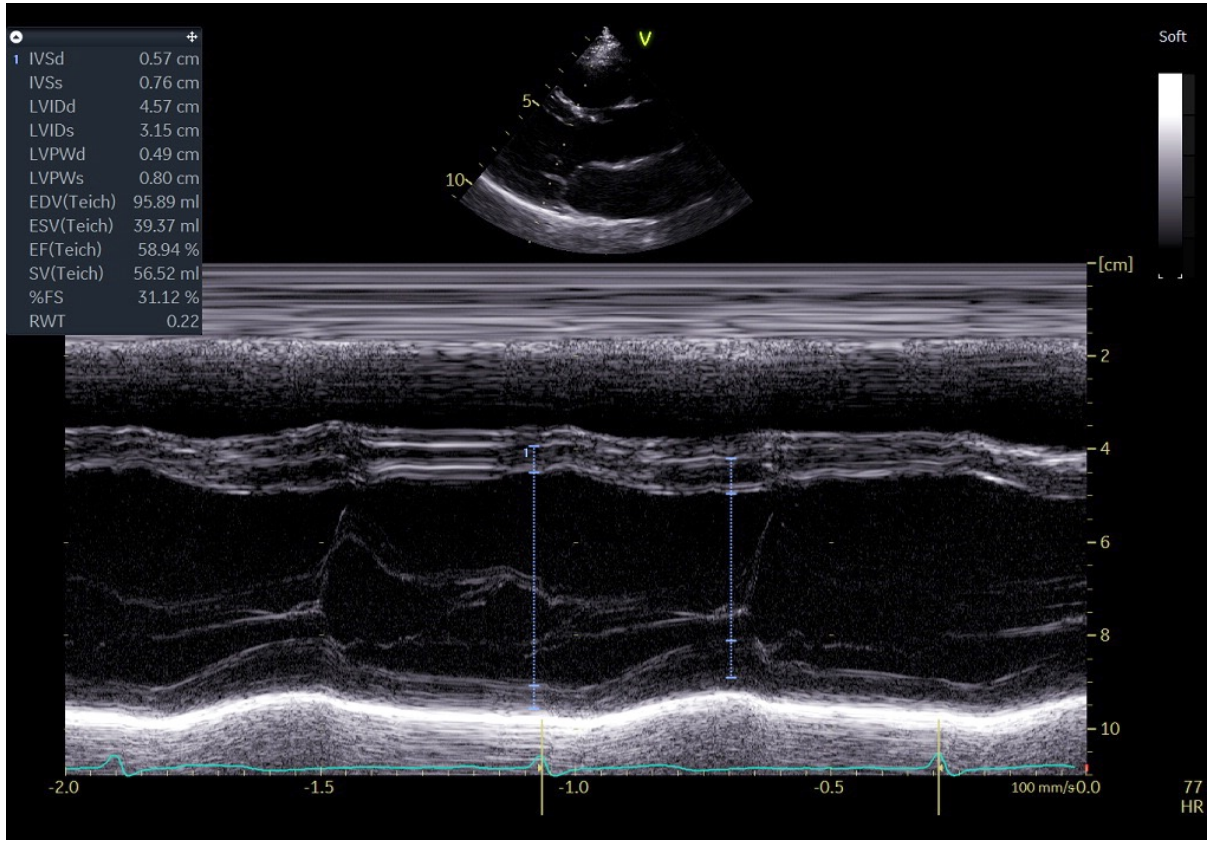
End-diastole

Note: Heart axis is added to the original image

- Heart long axis

  - from crux of the heart to apical endocardium of right or left ventricle, whichever forms the apex of the heart (CHSS-2 score)

M-mode - LV end-systolic and end-diastolic diameter



- PSAX - recommended in the literature
- PLAX - if preferred by site

Doppler registrations

- Velocities are measured in m/s
- Pressure gradients in mmHg

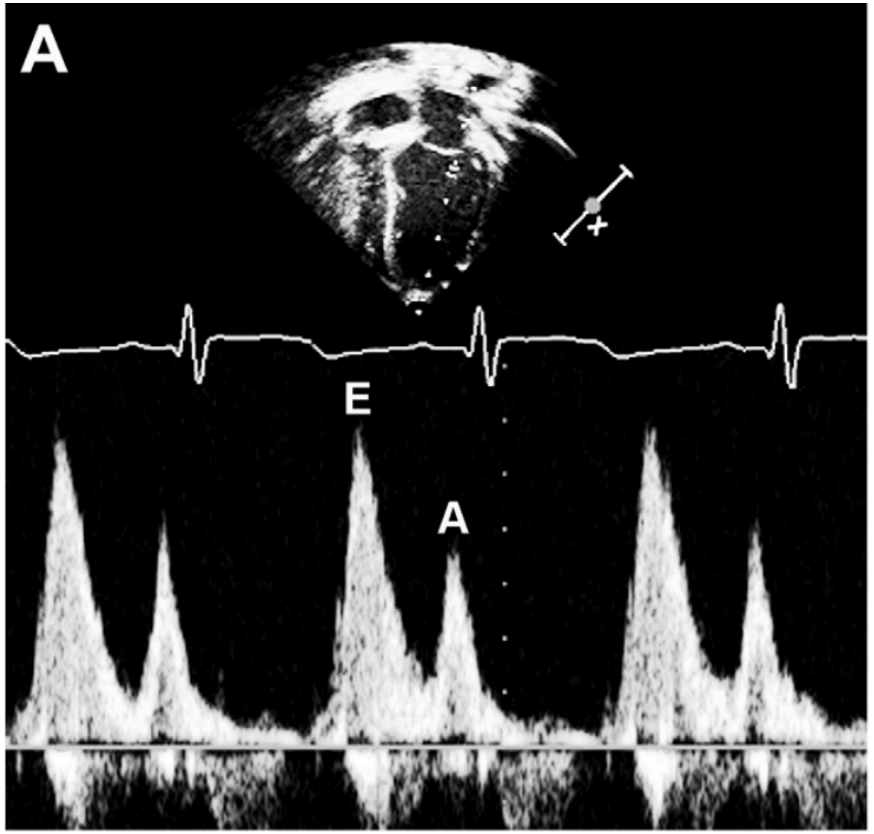
Mitral regurgitation

- A regurgitant jet detected by colour Doppler
- Qualitative grade based on subjective assessment of 2D and Doppler findings
  - Mild
  - Moderate
  - Severe

Echocardiographic examination of mitral valve abnormalities in the paediatric population: current practices, Cantinotti et al, Cardiology in the Young, January 2020

Recommendations for Noninvasive Evaluation of Native Valvular Regurgitation, ASE, Zoghbi et al, 2017

Mitral inflow



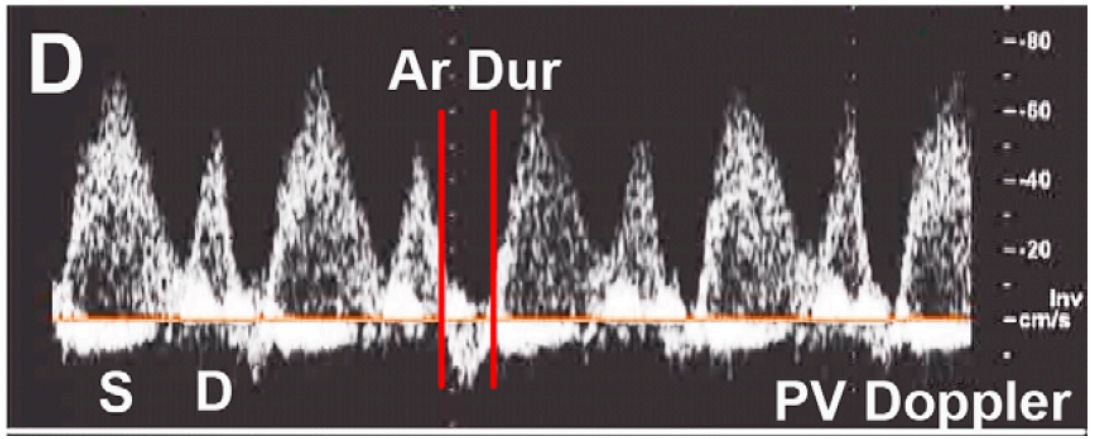
- Doppler interrogation of ventricular inflow is best performed with the help of color mapping in apical views where transducer position and angulation changes are frequently needed to optimize alignment
- When MV stenosis is suspected, the VTI of the inflow tracing from CW Doppler interrogation is used to calculate the mean gradient and assess the severity of obstruction

Recommendations for Quantification Methods During the Performance of a Pediatric Echocardiogram; Lopez et al; Journal of the America Society of Echocardiography, 2010

Tricuspid regurgitation

- A regurgitant jet detected by colour Doppler
- Qualitative grade based on subjective assessment of 2D and Doppler findings
  - Mild
  - Moderate
  - Severe
- Trace TR is considered normal

Pulmonary veins



- A-wave reversal, when A-wave is below baseline
- A-wave duration and velocity should be noted only if below baseline

Recommendations for Quantification Methods During the Performance of a Pediatric Echocardiogram; Lopez et al; Journal of the America Society of Echocardiography, 2010

Aortic valve max velocity (I)

CW Doppler (dedicated transducer)

- Multiple acoustic windows (e.g. apical, suprasternal, right parasternal)
- Decrease gain, increase wall filter, adjust baseline, curve and scale to optimize signal
- Gray scale spectral display with expanded time scale
- Velocity range and baseline adjusted so velocity signal fits but fills the vertical scale

European Heart Journal - Cardiovascular Imaging (2017) 18, 254–275 doi:10.1093/ehjci/jew335

Aortic valve max velocity (II)

- Maximum velocity at peak of dense velocity curve. Avoid noise and fine linear signals
- VTI traced from outer edge of dense signal
- Mean gradient calculated from traced velocity curve
- Report data from the maximum velocity obtained

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Aortic valve mean Doppler gradient

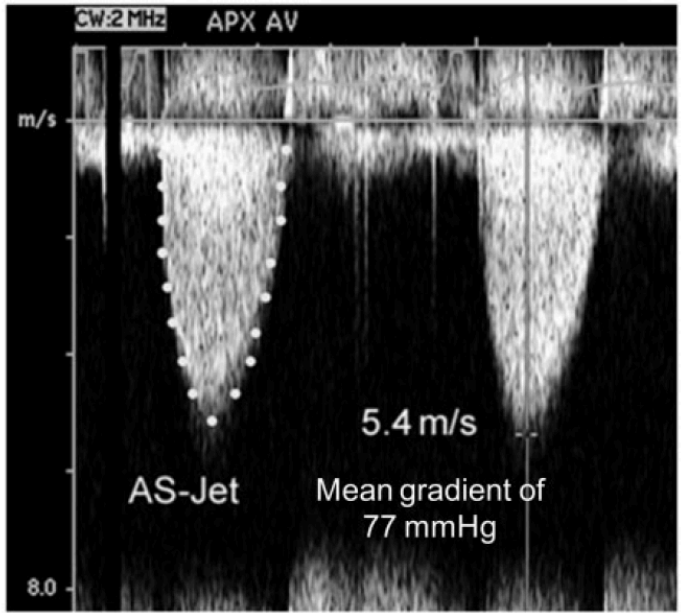

Figure 2 Continuous-wave Doppler of severe aortic stenosis jet showing measurement of maximum velocity and tracing of the velocity curve to calculate mean pressure gradient.

The mean gradient is calculated by averaging the instantaneous gradients over the ejection period, a function included in currently available clinical instrument measurement packages using the traced velocity curve.

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Aortic valve stenosis

FIGURE 6. Comparison of normal and abnormal ventricular morphology in autopsy specimens cut to simulate the parasternal long-axis two-dimensional echocardiographic scan. *a*, Normal ventricular morphology in an infant who died of noncardiac causes. *b*, Severe right ventricular dilation and biventricular hypertrophy in an infant with severe aortic stenosis plus coarctation. Abbreviations are as in figure 1.

- Echocardiographic findings of a hypoplastic and/or congenitally abnormal aortic valve.
- Increased flow velocity across the aortic valve

Specimen; Echocardiography in the diagnosis and management of symptomatic aortic valve stenosis in infants, Huhta et al, Circulation, 1984

Grading of aortic stenosis - neonate

Grade	Definition
Critical	Ductal dependent systemic circulation and/or depressed LV function
Severe	Indication for surgery/balloon before 30 days of life but not ductal dependent and normal LV function
Mild to moderate	Increased flow velocity across the aortic valve but probably not indication for surgery/balloon before 30 days of life
None	Normal flow velocity and normal LV function. No indication for surgery

Grading of aortic stenosis after the neonatal period (I)

- The severity of aortic valve stenosis is estimated by measurement of the Doppler derived pressure drop across the aortic valve
- Classification is valid if left ventricular function is well preserved and cardiac output is normal

Anomalies of the Left Ventricular Outflow Tract Aortic Valve, Simpson and Miller, Echocardiography in Pediatric and Congenital Heart Disease: From Fetus to Adult. doi.org/10.1002/9781118742440.ch19

Grading of aortic stenosis after the neonatal period (II)

Grade	peak Doppler velocity*	mean Doppler gradient**	
Mild	< 3 m/s		
Moderate	3-4 m/s	< 50 mmHg	
Severe	> 4 m/s	≥ 50 mmHg	

**Anomalies of the Left Ventricular Outflow Tract Aortic Valve, Simpson and Miller, Echocardiography in Pediatric and Congenital Heart Disease: From Fetus to Adult. doi.org/10.1002/9781118742440.ch19*

***Congenital Aortic Valve Stenosis, Singh, Children 2019, 6, 69; doi:10.3390/children6050069*

Aortic valve regurgitation

- A regurgitant jet detected by colour Doppler. Qualitative grade based on subjective assessment of 2D and Doppler findings

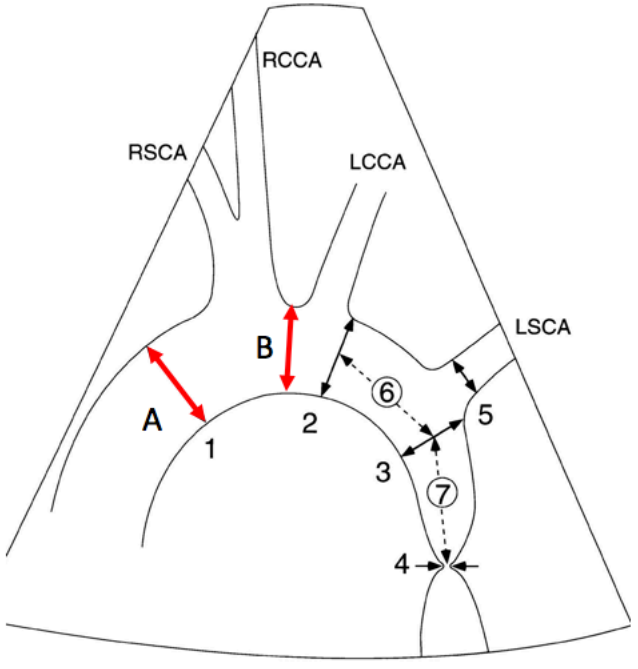
- Mild
- Moderate
- Severe

Grading of aortic regurgitation

	Mild	Moderate	Severe
Structural parameters			
Aortic leaflets	Normal or abnormal	Normal or abnormal	Abnormal/flail, or wide coaptation defect
LV size	Normal	Normal or dilated	Usually dilated
Qualitative Doppler			
Jet width, color flow	Small in central jets	Intermediate	Prominent holodiastolic reversal
Flow convergence, color flow	Incomplete or faint	Dense	Dense
Jet decceleration rate, CW (PHT, msec)	Slow, > 500 ms	Medium 500-200 ms	Steep, < 200 ms
Diastolic reversal in descending aorta, PW	Brief early diastolic reversal	Intermediate	Prominent holodiastolic reversal

Recommendations for Noninvasive Evaluation of Native Valvular Regurgitation, ASE, Zoghbi et al, 2017

Flow in the aortic arch



- Aortic arch defined as the segment of the arch between the innominate and the left common carotid artery (B)
- Antegrade
- Retrograde

Thanks for your cooperation and support

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