Investigations in Medicine: echocardiography

Elizabeth Jones

Cardiologist

Austin Health

17-Nov-20

Topics

- Echo in heart failure:
  - HFrEF, HFpEF, diastology, constriction
- Pulmonary hypertension
- Valve disease:
  - aortic stenosis
  - society guidelines
- Echo in COVID-19

Supplementary slides

- Modalities of echocardiography
- Stress echo
- Transoesophageal echo
  - stroke, endocarditis

Typical echo request

faxed 10/9/20

Austin Health

[redacted]

Printed 9/09/20 M/C No. 30088521182 HNC / PUB F

Postcode ....

6 East HNC

Austin HEALTH

CARDIOLOGY REQUEST

Department of Cardiology
Austin Hospital Tower, Level 5 North
145 Studley Rd., HEIDELBERG 3084
Ph: 9496 6527 Fax: 9496 6630
Email: cardiology@austin.org.au

DIAGNOSTIC TESTS:

- ☑ Transthoracic Echo
- ☐ Transoesophageal Echo
- ☐ Treadmill Stress Echo
- ☐ Dobutamine Stress Echo
- ☐ ECG
- ☐ Holter Monitor
- ☐ Event Recorder
- ☐ Pacemaker Check

RECEIVED 10 SEP 2020 BY:

APPOINTMENT:

Date: __/__/____

Time: __:__

CLINICAL DETAILS:

90yo F c̄ adm for Exac CCF, last TTE 2015 @ the Northern mild regmental systolic dysfunction EF 53%. moderate mitral regurgitation. mid-distal LAD tenting MI. for outpatient TTE to enable consideration ? ACEi/ARB + spironolactone. PMHx IHD NSTEMI 25 years ago, asthma, CCF, AF, T2DM, HTN, hyperlipidaemia, hyperthyroidism.

Requesting Doctor: (Please Print) Date: 10/9/20

Name: [redacted] Signature: [signature]

Prov. No: [redacted] Phone: 9496 5000 Fax: ....

Address: 145 Studley Road Heidelberg Post Code: 3084

Report: Mail ☐ **Phone** ☐ **Fax** ☐ **Email** ☐ email address: ....

Cc: GP Faulkner Health Care 9357 3824

1092 08/17 UPDATED (see over for Map)

Heart failure – a syndrome, not a diagnosis!

- Final common pathway for most cardiac conditions
- Clinical syndrome characterised by:
  - Dyspnoea
  - Fluid retention (pulmonary venous congestion, peripheral oedema, elevated JVP)
- Supportive findings:
  - Clinical examination
  - CXR
  - Elevated NT-proBNP

What might be the cause of your patient's heart failure?

- Abnormalities of:
  - Myocardium eg:
    - Dilated or ischaemic cardiomyopathy
    - Hypertrophy (eg hypertensive heart disease)
    - Infiltration (eg amyloidosis, sarcoidosis, Fabry)
  - Valves (stenosis or regurgitation)
  - Endocardium (endomyocardial fibrosis)
  - Pericardium (constriction)
  - Increased RV afterload (pulmonary hypertension)
- Impairment of:
  - ventricular ejection (HFrEF)
  - filling (HFpEF, “diastolic heart failure”)

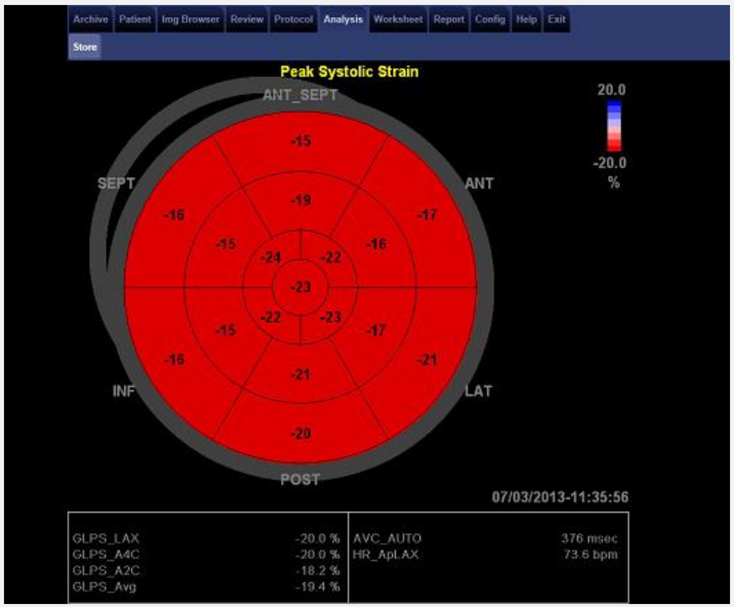
Echo can sort this out for you!

- LV ejection fraction
  - < 40% indicates HFrEF
  - > 50% indicates HFpEF
  - Regional vs global suggests ischaemic vs dilated cardiomyopathy
- Wall thickness
  - Hypertrophy or infiltration
- Valve dysfunction
- Myocardial strain
- Diastolic function assessment
  - Normal or elevated filling pressures
  - Restrictive filling pattern
- Pericardial constriction
- Pulmonary artery pressure
  - Pre-capillary or post-capillary pulmonary hypertension

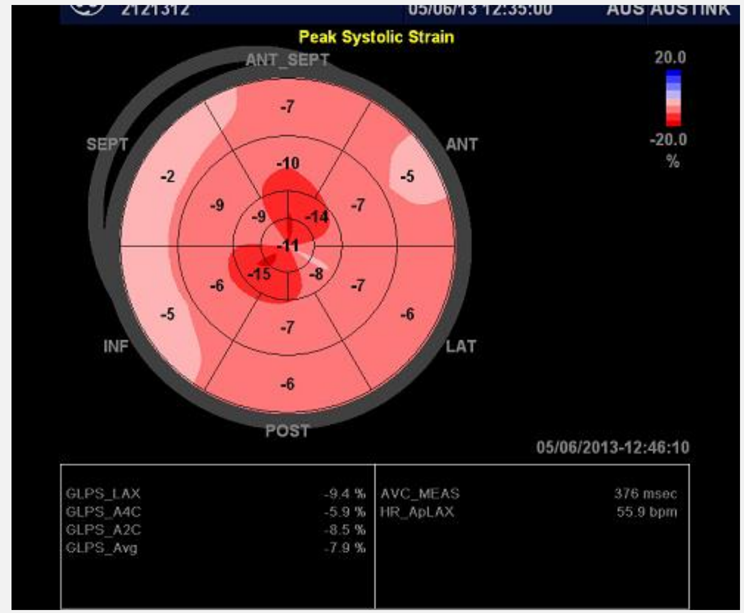
Myocardial strain

- Longitudinal myocardial fibres shorten during contraction
- Can measure this using speckle tracking or tissue Doppler
- Normal global longitudinal strain is more negative than -18%
- Abnormal is less than -16%
- May detect decrease in LV contractile function before ejection fraction decreases
- May have a role in early detection of diffuse myocardial dysfunction:
  - Amyloidosis (apical sparing pattern)
  - Systemic sclerosis
  - Hypertrophic cardiomyopathy vs athlete's heart
  - Chemotherapy
  - Aortic stenosis

Global longitudinal strain



Normal LV
GLS -19%



Amyloidosis
GLS -8%

Cardiac amyloidosis

- Infiltrative cardiomyopathy:
  - HFpEF
  - “Right heart failure” often predominates
  - Atrial fibrillation and conduction disease
  - Unexplained increase in LV wall thickness
  - Biatrial enlargement
  - Abnormal strain pattern
- Usually associated with:
  - AL amyloidosis (monoclonal light chains)
  - ATTR amyloidosis (wild type or mutated transthyretin)
- Probably under-recognised:
  - eg elderly; TAVI candidates

If the echo suggests amyloid...

- Technetium pyrophosphate scan (bone scan)
- Look for monoclonal paraprotein and talk to your haematologists
- Cardiac MRI
- Consider bone marrow biopsy
- Other tissue biopsy
  - abdominal fat
  - carpal tunnel tendons
  - endomyocardial
- Aggressive diuresis +/- rhythm control +/- anticoagulation
  - avoid beta blockers, ACEI, ARB, Ca antagonists, digoxin

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 SEPTEMBER 13, 2018 VOL. 379 NO. 11

Tafamidis Treatment for Patients with Transthyretin Amyloid Cardiomyopathy

CONCLUSIONS

In patients with transthyretin amyloid cardiomyopathy, tafamidis was associated with reductions in all-cause mortality and cardiovascular-related hospitalizations and reduced the decline in functional capacity and quality of life as compared with placebo. (Funded by Pfizer; ATTR-ACT ClinicalTrials.gov number, NCT01994889.)

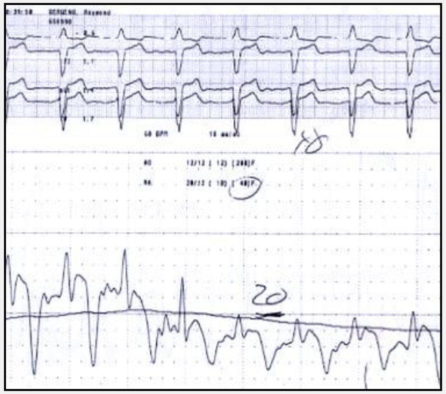
Diastology

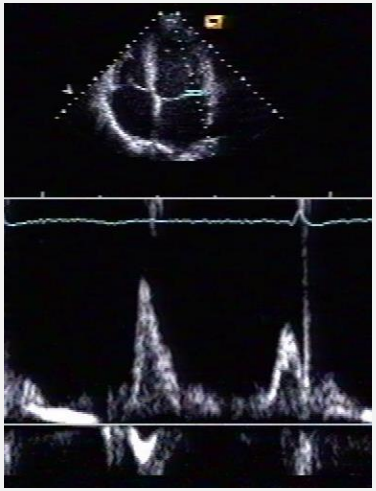
Basic diastology

- Active relaxation:
  - Energy requiring; early phase of diastole
    - Impaired with ageing, ischaemia, LV hypertrophy
- Passive stretch:
  - Later phase of diastole
    - Impaired by restrictive or constrictive processes

Tools for assessing diastolic function

- Invasive
  - Pulmonary capillary wedge pressure (LA pressure)
  - LV end-diastolic pressure
- Non-invasive (echo)
  - **Left atrial size**
  - **Mitral inflow**
  - **Doppler tissue imaging**
  - **Tricuspid regurgitation velocity**
  - Pulmonary vein flow
  - Colour M-mode
  - Hepatic vein flow





Causes of diastolic dysfunction

COMMON

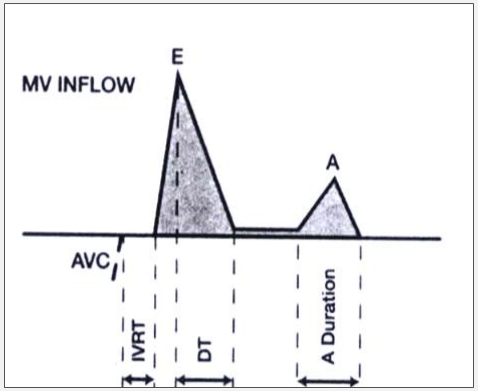
- Systolic dysfunction
- Left ventricular hypertrophy:
  - aortic stenosis
  - hypertension
  - hypertrophic cardiomyopathy
- Episodic myocardial ischaemia
- Diabetes
- HFpEF

RARE

- Pericardial diseases:
  - tamponade
  - constriction
  - constrictive-effusive disease
- Restrictive cardiomyopathy:
  - amyloid heart disease
  - idiopathic

Echo assessment of filling pressures

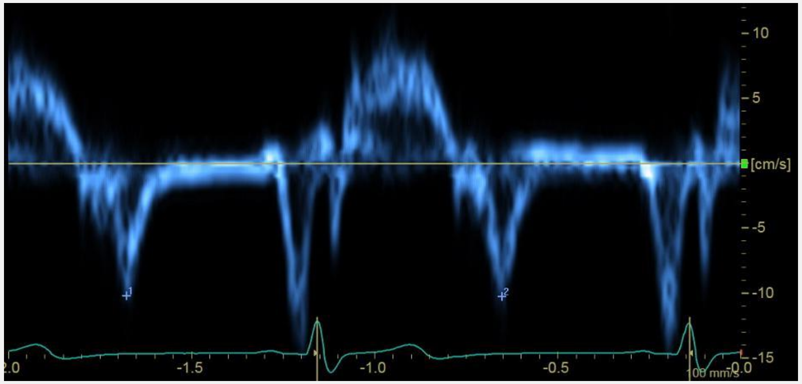
1. Mitral inflow



E wave – flow from LA to LV during active relaxation
Deceleration time – flow slows as LA and LV pressures equalise
A wave – atrial contraction into LV at end-diastole

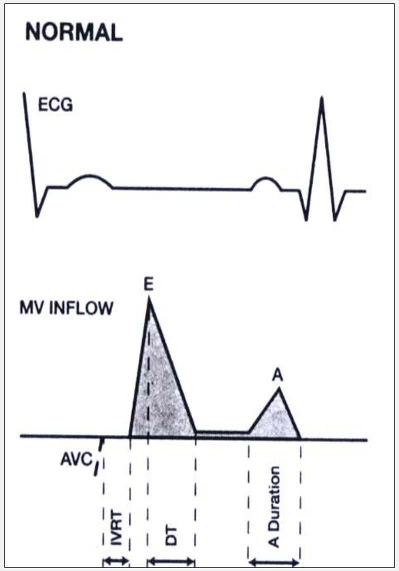
2. Tissue Doppler

e' represents active relaxation of myocardium (velocity of mitral annular descent away from apex)



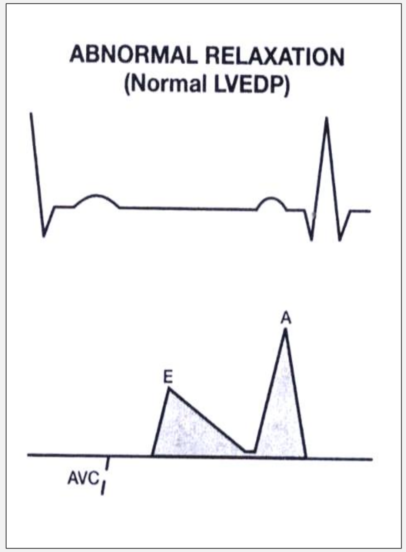
E/e' ratio reflects LA pressure

Progression of diastolic dysfunction



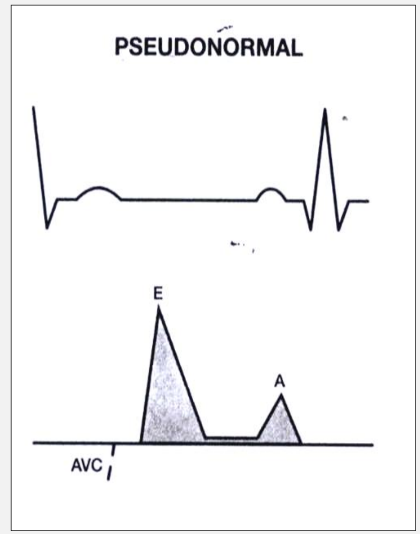
Septal e’ > 7
Lateral e’ > 10

Grade 1 (easy)



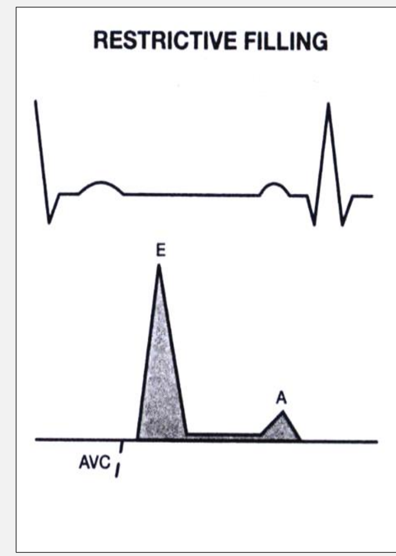
Septal e’ < 7
Lateral e’ < 10
Average E/e’ < 14

Grade 2 (tricky)



Septal e’ < 7
Lateral e’ < 10
Average E/e’ > 14
LAVI > 34 ml/m^2
TR > 2.8m/sec

Grade 3 (easy)



Average E/e’ >> 14

Diastology - summary

1. Abnormal relaxation pattern (grade 1)

   means relaxation is slow but complete. Asymptomatic at rest.

   eg. normal ageing, hypertension

2. Pseudonormal pattern (grade 2)

   means relaxation is slow and incomplete, therefore LVEDP and LA pressures have risen. LA usually enlarged. Symptomatic on mild exertion.

   eg. hypertensive heart disease, diabetic cardiomyopathy

3. Restrictive pattern (grade 3)

   means LVEDP and LA pressures are very high. Very symptomatic.

   eg. severe heart failure, cardiac amyloidosis

4. Irreversible restrictive pattern (grade 4)

And another thing…..

1. Restrictive pattern doesn't always mean restrictive cardiomyopathy; may be seen in any situation where filling pressures are very high (grade 3 or 4 diastolic dysfunction).

2. Restrictive pattern is predictive of poor prognosis in patients with systolic LV dysfunction.

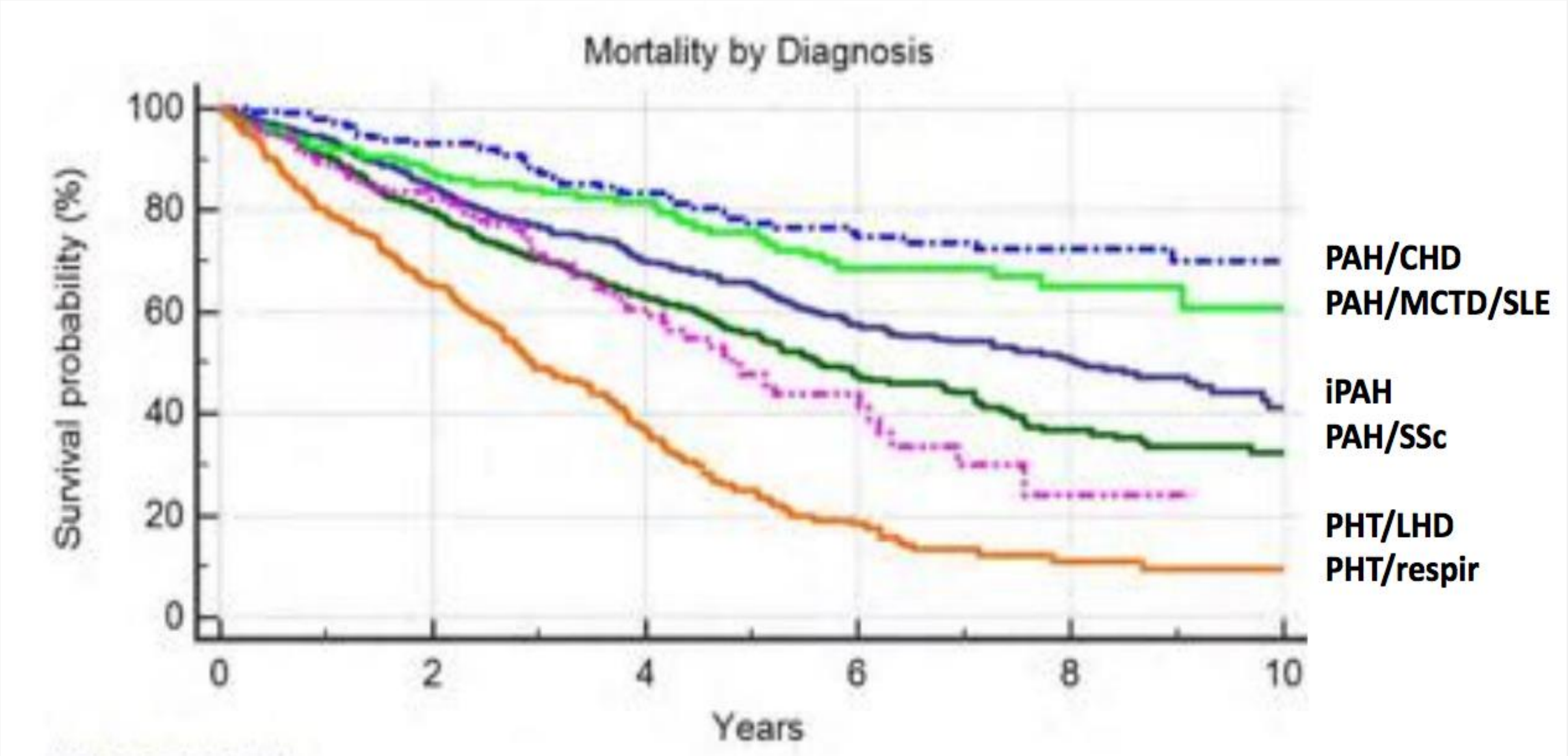
3. Patients may move between different diastolic filling patterns according to fluid status.

Pulmonary hypertension

Pulmonary hypertension

- Definition:
  - Mean PAP > 25mmHg (or 20mmHg?) at rest;
  - > 30mmHg exercise
- Symptoms:
  - Dyspnoea, weakness, chest pain, (pre)syncope, fatigue
  - Similarities with CCF, especially when RV fails
- Natural history:
  - Progressive
  - ~70% 5-year survival overall

Pulmonary Hypertension



WHO Classification

- Group 1: Pulmonary Arterial Hypertension
  - IPAH
  - FPAH
  - APAH
    - Connective Tissue Disease esp. scleroderma
    - Congenital Heart Disease
    - Porto-pulmonary hypertension
    - Drugs and toxins (e.g. anorexigens)
    - Venous/capillary
- Group 2: Pulmonary Hypertension Associated with Left Heart Disease
  - HFpEF or HFrEF
  - Valvular disease
- Group 3: Pulmonary Hypertension Associated with Respiratory Disease ± Hypoxia
  - COPD
  - ILD
  - OSA
  - Altitude
- Group 4: Chronic Venous Thromboembolic Disease
  - Proximal (± surgically amenable)
  - Distal
- Group 5: Miscellaneous

Easy Mode Classification

(thanks Joe O’Brien successful FRACP candidate!)

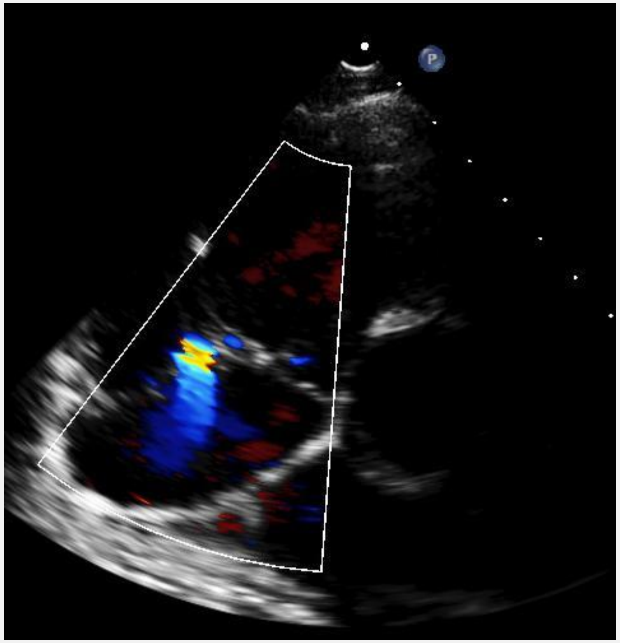
- Group 1:
  - Pulmonary arterial hypertension
- Group 2:
  - Left heart disease (“post-capillary PHT”)
- Group 3:
  - Lung disease and chronic hypoxia
- Group 4:
  - Chronic thromboembolic (CTEPH)
- Group 5:
  - Mixed bag (includes HIV, chronic haemolysis, myeloproliferative disorders, CKD…)

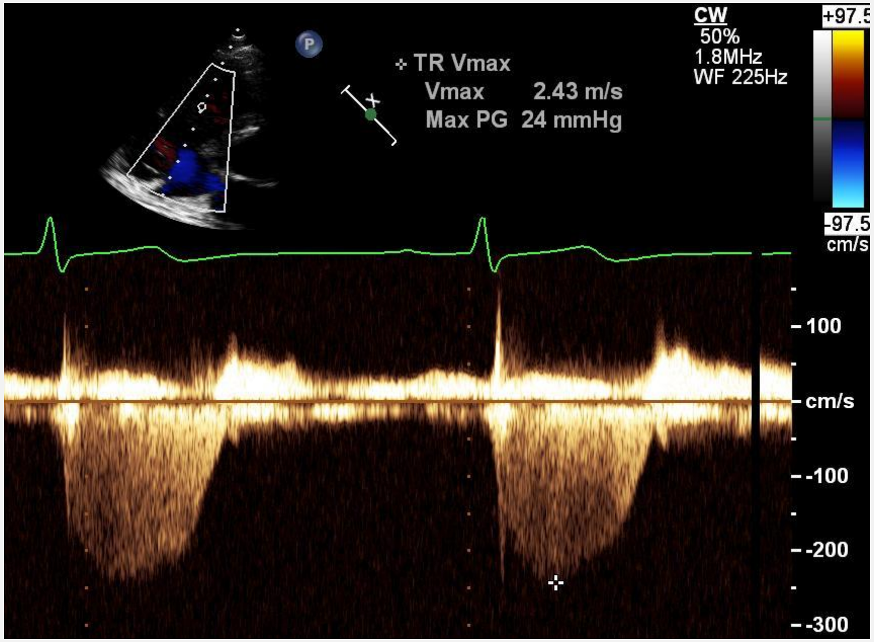
Invasive evaluation with right heart catheterisation

- mPAP = mean Pulmonary Artery Pressure
  - Normal < 20mmHg
- PCWP = Pulmonary Capillary Wedge Pressure ~ LAp
  - Normal 4 to 12mmHg
- Cardiac output
  - Normal 4 to 8 L/min
- TPG = TransPulmonary Gradient
  - (mPAP - mean PCWP)
  - Normal < 12mmHg
- PVR = Pulmonary Vascular Resistance
  - Transpulmonary gradient/cardiac output
  - Normal < 3 Wood units

Non-invasive evaluation with echo

- Systolic PA pressure:
  - From peak velocity (Vmax) of tricuspid regurgitation Doppler signal
  - Systolic pressure difference between RV and RA = **$4V^2$**
  - Therefore **PASP = $4V^2$ + RAP** assuming no RVOT obstruction





Further evaluation with echo

- Other measurements available:
  - Mean PAP, diastolic PAP
  - Estimated LA pressure (PCWP)
  - Estimated PVR
- Allows identification of Group 2 PHT:
  - PCWP < 15mmHg suggests pre-capillary PHT
  - PCWP > 15mmHg suggests post-capillary PHT

Pericardial disease

Pericardial disease

- Constriction – thick, non-compliant pericardium
  - Chronic inflammation (pericarditis), tuberculosis, after cardiac surgery
  - Impairs filling of ventricles in diastole and atria in systole
- Tamponade – increased fluid volume in pericardial space
  - Pericarditis; after cardiac surgery; malignancy
  - Impairs filling of ventricles in diastole and atria in systole
  - May also cause compression of cardiac chambers when pericardial pressure exceeds intracavitary pressure (early diastole for ventricles, early systole for atria)

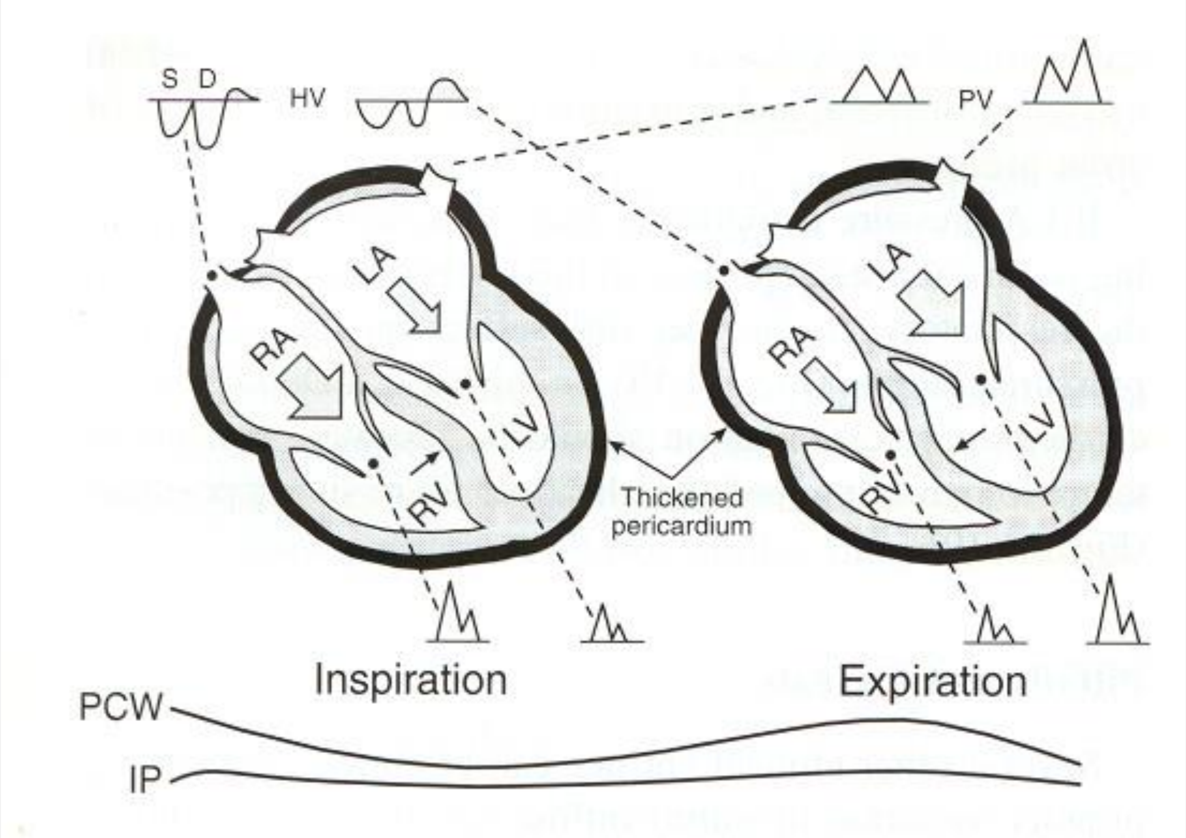
Echo findings in pericardial disease

- Ventricular interdependence:
  - Abnormal septal motion
- Dissociation of intrathoracic and intrapericardial pressures:
  - Exaggerated respiratory variation in flow velocities
- Preserved myocardial relaxation velocity (e’) despite clinical syndrome of heart failure
  - “annulus paradoxus”
- Reduced lateral wall contractility (strain and tissue Doppler)
  - “annulus reversus”

Tamponade and constriction

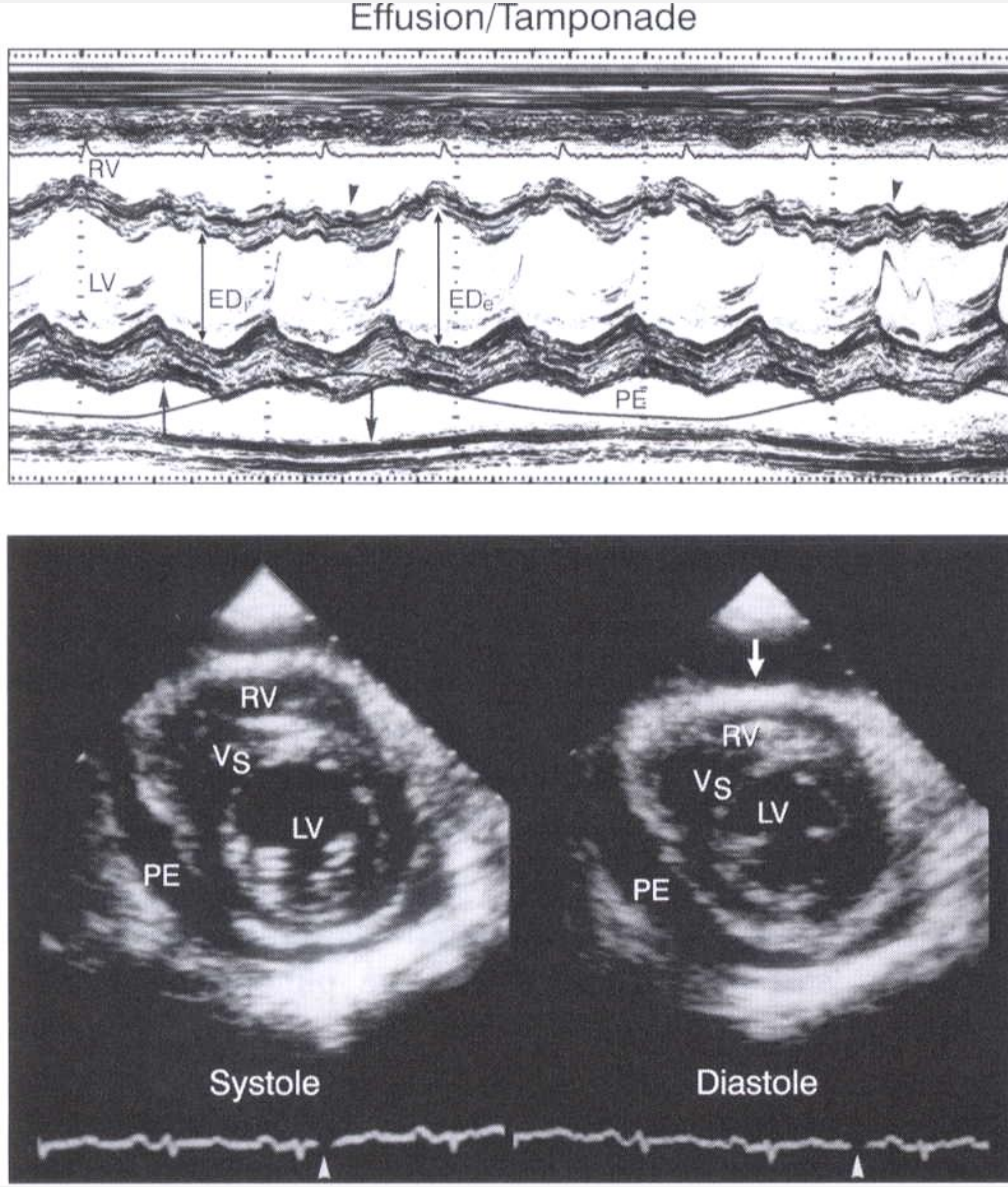
Shared features:

1. Ventricular interdependence
2. Dissociation of intrathoracic and intrapericardial pressures



M-mode:
Reciprocal respiratory variation in LV and RV cavity size and septal motion
(could be tamponade or constriction)

2D:
RV collapse in early diastole due to high intrapericardial pressure
(tamponade)



Valve disease

Aortic stenosis – not so simple!

1. Severe high gradient aortic stenosis:

   Peak velocity > 4m/sec; mean gradient > 40mmHg; **AVA < 1cm^2**

2. Low gradient aortic stenosis:

   Peak velocity < 4m/sec; mean gradient < 40mmHg; **AVA < 1cm^2**

Classical low-flow low-gradient
(LVEF < 50%; SVi < 35ml/m^2)

↓

DSE:
True severe AS
Pseudo-severe AS

Paradoxical low-flow low-gradient
(LVEF > 50%; SVi < 35ml/m^2)
Often small LVESV, marked LVH, AF, hypertension, mitral regurgitation

↓

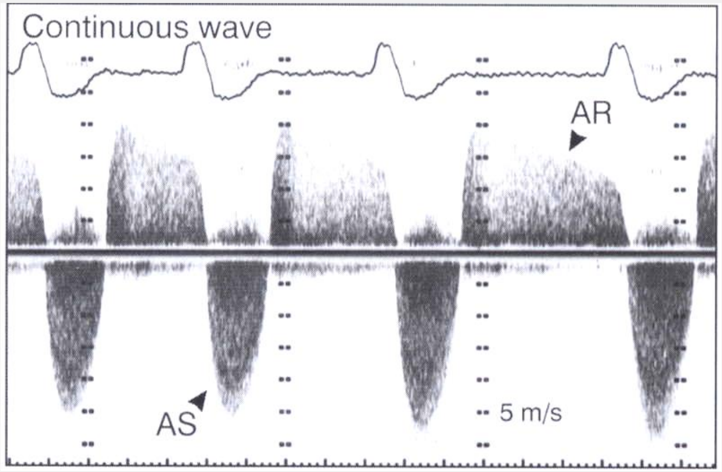
CT to measure AV calcification

Asymptomatic valve disease: observation or intervention?

- Symptomatic valve disease usually requires intervention
  - Refer promptly
- Asymptomatic patients may be monitored at regular intervals for:
  - Development of symptoms
  - Development of adverse prognostic features
    - LV dysfunction
    - Pulmonary hypertension
  - Then refer promptly

When to consider intervention in:
asymptomatic aortic valve disease

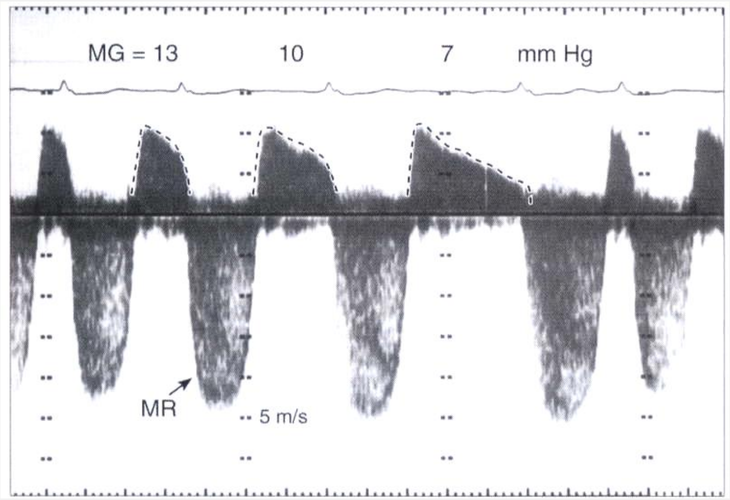
- Severe aortic stenosis:
  – Mean gradient > 40mmHg
  – Peak velocity > 4m/sec
  – Aortic valve area < $1cm^2$
  – Valve area index < $0.6cm^2/m^2$
  – ?reduced strain
  – ?elevated BNP levels
  – (Exercise test may be useful)



- Severe aortic regurgitation:
  – LV dysfunction (LVEF < 50%)
  – EF > 50% but LVEDD > 65-70mm or LVESD > 50mm)

When to consider intervention in:
asymptomatic mitral valve disease

- Severe mitral stenosis:
  - Mean gradient > 10mmHg
  - PA systolic pressure > 30mmHg
  - Valve area < 1.5cm^2
  - Exercise test may be useful



- Severe mitral regurgitation:
  - LVEF > 60% and LVESD < 40mm – ***well-compensated***
  - Onset of atrial fibrillation – ***consider intervention***
  - Pulmonary hypertension – ***consider intervention***
  - LVEF 30-60% and/or LVESD > 40-45mm – ***consider intervention***
  - LVEF < 30% - ***high risk but still consider intervention***

Journal of the American College of Cardiology
Published by Elsevier Inc.
Vol. 63, No. 22, 2014
ISSN 0735-1097/$36.00
http://dx.doi.org/10.1016/j.jacc.2014.02.536

PRACTICE GUIDELINE

2014 AHA/ACC Guideline for the Management of Patients With Valvular Heart Disease

A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines

Developed in Collaboration With the American Association for Thoracic Surgery, American Society of Echocardiography, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Anesthesiologists, and Society of Thoracic Surgeons

CrossMark

Circulation

MY ALERTS SIGN IN JOIN

HOME ABOUT THIS JOURNAL ALL ISSUES SUBJECTS BROWSE FEATURES RESOURCES AHA JOURNALS

AHA/ACC GUIDELINE

2017 AHA/ACC Focused Update of the 2014 AHA/ACC Guideline for the Management of Patients With Valvular Heart Disease: A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines

Rick A. Nishimura, Catherine M. Otto, Robert O. Bonow, Blase A. Carabello, John P. Erwin, Lee A. Fleisher, Hani Jneid, Michael J. Mack, Christopher J. McLeod, Patrick T. O'Gara, Vera H. Rigolin, Thoralf M. Sundt, Annemarie Thompson

European Heart Journal

2017 ESC/EACTS Guidelines for the management of valvular heart disease FREE

Helmut Baumgartner, Volkmar Falk, Jeroen J Bax, Michele De Bonis, Christian Hamm, Per Johan Holm, Bernard Iung, Patrizio Lancellotti, Emmanuel Lansac, Daniel Rodriguez Muñoz ... Show more

European Heart Journal, Volume 38, Issue 36, 21 September 2017, Pages 2739–2791,
https://doi.org/10.1093/eurheartj/ehx391
Published: 26 August 2017

New(ish) relevant topics

- Defining severity of aortic stenosis
- Timing of intervention in asymptomatic aortic stenosis
- Percutaneous interventions:
  - TAVR: indications, post-procedural management
  - MitraClip in secondary MR (recent Mitra-FR and COAPT trials)
  - PFO closure in cryptogenic stroke
  - LAA occlusion for AF
- COVID-19

Echo and COVID-19

- Detection of preexisting cardiovascular disease
- Detection of cardiovascular abnormalities associated with COVID-19:
  - left ventricular systolic dysfunction, either global or regional (think myocarditis; stress-induced cardiomyopathy; epicardial or microvascular coronary thrombosis)
  - pericardial effusion
  - DVT and pulmonary embolism secondary to hypercoagulable state, with RV strain and acute pulmonary hypertension
- Avoid prolonged scanning (focussed study)
- Appropriate PPE
- Avoid TOE and stress echo unless urgent (droplet and aerosol risk)

Supplementary slides

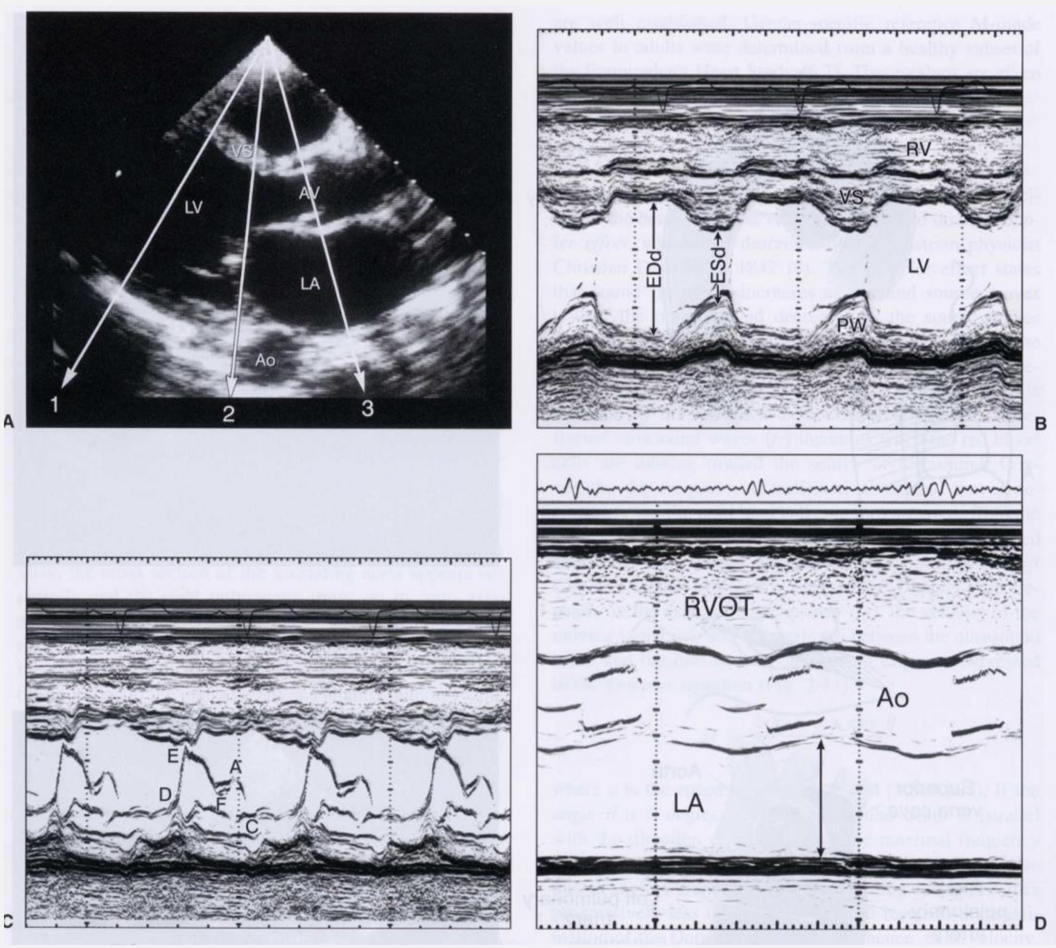
Modalities of echocardiography

- M-mode imaging
- 2-D imaging
- Doppler (measures velocity of red blood cells or myocardium)
  - Spectral (pulsed or continuous wave)
  - Colour flow Doppler
- Contrast echo
- 3D echo
- Strain

M-mode imaging

- “Ice-pick” view:
  - standardised measurements of LV, LA, aortic root
  - LV wall thickness
  - fractional shortening

1



2

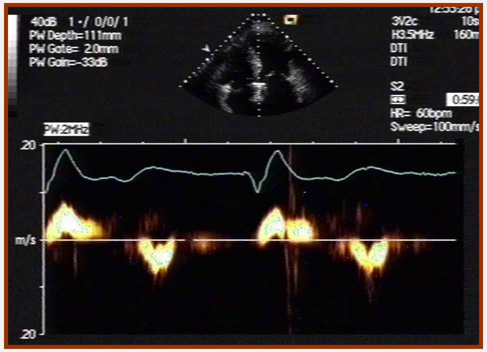
3

2-dimensional imaging

- 8 standard views:
  - Parasternal long and short axis
  - Apical 4 chamber, 2 chamber, long axis
  - Subcostal long and short axis
  - Suprasternal
  - Right parasternal (occasionally, for ascending aorta)

Spectral Doppler

- Pulsed wave up to 2m/sec (most normal flows)
- Continuous wave for higher velocities (stenosis, regurgitation)
- Allows non-invasive assessment of:
  - Valve gradient
  - Valve area
  - Regurgitant volumes
  - RV systolic pressure (usually equates to PA systolic pressure)
  - Stroke volume/cardiac output
  - Calculation of shunt ratios
  - Diastolic function
    - ***blood flow*** velocities across mitral valve, pulmonary veins
    - ***myocardial*** velocities at mitral annulus



Colour flow Doppler

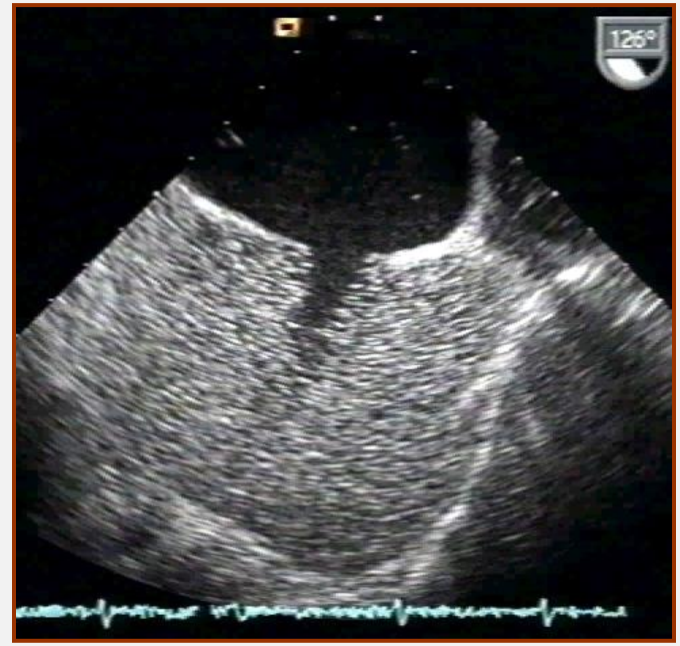
- Portrays different velocities as different colours
- Provides visual map of intracardiac blood flow
- Allows instantaneous detection of high velocity or turbulent flow:
  - Stenotic lesions (valves, LVOT in HOCM)
  - Regurgitant jets
  - Intracardiac shunts

Contrast echo

Usually normal saline agitated with blood

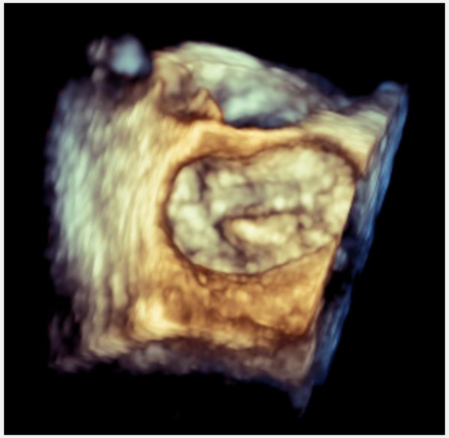
- To opacify cardiac chambers:
  - Detection of intracardiac right to left shunts eg. PFO
  - Detection of intrapulmonary shunts eg. hepatopulmonary syndrome
  - To clarify communications within the heart eg. persistent left-sided SVC, anomalous pulmonary venous connections
  - To highlight blood/endocardial interface in stress echo (commercial agents)
- To opacify myocardium:
  - Assessment of myocardial perfusion (commercial agents; not widely used at present)

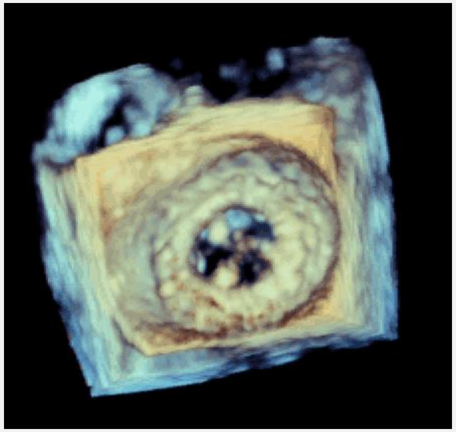
Small atrial septal defect with bidirectional flow



3D echo

- Continual technological advances
- Transthoracic or transoesophageal
- Ventricular volumes and function
- Mitral valve pathology
- Atrial septal defects
- Other structural abnormalities
- Interventional cardiology
  - eg. ASD closure, TAVI, Mitraclip, LAA closure

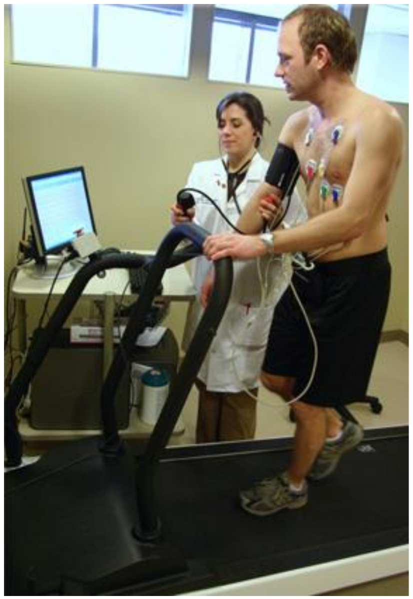




Stress echo

Stress echo: inducing ischaemia

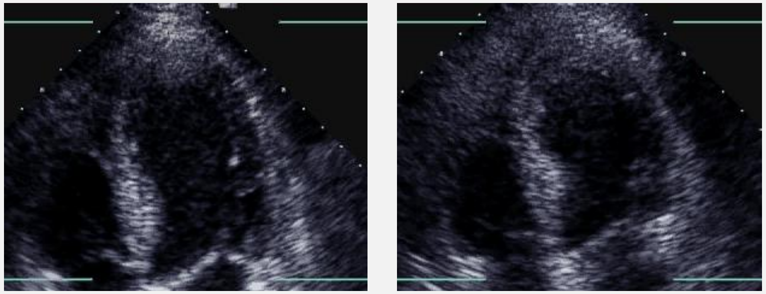
- Physical stress:
  - Treadmill
  - Bicycle



- Pharmacological stress:
  - Dobutamine
    - Inotrope
    - Chronotrope
    - Vasodilator
  - Dipyridamole
    - Coronary vasodilator
  - Atropine
    - Anticholinergic

Stress echo: detecting ischaemia

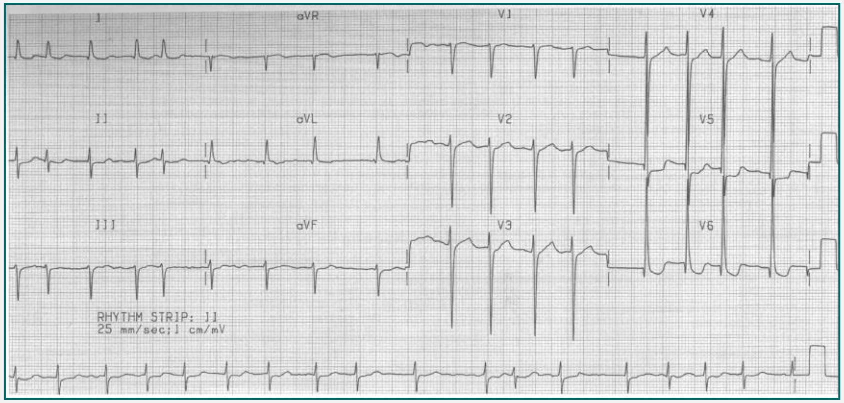
- Myocardium subject to ischaemia demonstrates wall motion abnormalities
  - reduced myocardial excursion
  - reduced myocardial thickening
  - delayed excursion (tardokinesia)



- Resting images in 5 views
- Repeat images within 60 seconds of completing symptom-limited exercise
- Highly dependent on image quality
  - Beware obesity, COAD

Stress echo vs stress ECG in IHD

- Abnormal resting ECG:
  eg. LVH, digoxin, LBBB, paced rhythm, pre-excitation



- Need for structural information:
  eg. murmur
- Assessment of myocardial viability:
  - dobutamine stress echo
- Inability to exercise:
  - dobutamine stress echo
- Assessment of functional significance of a fixed stenosis
- Identifying a culprit lesion in multivessel disease
- Pre-operative risk assessment

Other indications for stress echo

- Assessment of diastolic function:
  eg. exertional dyspnoea

- Assessment of valve disease:
  - Objective assessment of symptoms
  - Exercise gradient
  - PA pressure
  - Low-gradient aortic stenosis (dobutamine stress echo)

Stress echo: contra-indications

- Unstable angina
- Critical aortic stenosis
- Sustained ventricular arrhythmia
- Uncontrolled hypertension
- Decompensated heart failure
- Acute myocarditis
- Acute pericarditis
- High grade atrioventricular block
- (Continued B-blocker therapy)

Accuracy of stress testing in diagnosis of coronary artery disease

	Exercise ECG	Stress echo	Nuclear stress
Sensitivity	50-70%	80-90%	80-95%
Specificity	70-80%	85-100%	85-100%
Other	Inexpensive Limited accuracy	Inexpensive No radiation Viability information (DSE)	Expensive Radiation Less dependent on image quality

Transoesophageal echo

Transthoracic or transoesophageal?

- Transthoracic echo first for most indications
- Consider TOE first for:
  - Suspected aortic dissection
  - Suspected mechanical prosthetic endocarditis
- Tricky areas:
  - Ischaemic stroke
  - Suspected native valve endocarditis

Echo in ischaemic stroke:
what are we looking for?

1. Cardiac source of embolism

2. Coexisting cardiac disease:
   - Evidence of coronary artery disease (stroke may be presenting feature)
   - Underlying abnormalities in patients with atrial fibrillation

Echo in ischaemic stroke: cardiac sources of embolism (1)

- Valve abnormalities
  - Prosthetic valves (thrombus)
  - Infective endocarditis
  - Non-infective vegetations/thrombi eg. in SLE
  - Papillary fibroelastoma
- Cardiac thrombi and masses
- Paradoxical embolism
- Aortic pathology

Echo in ischaemic stroke: cardiac sources of embolism (2)

- Valve abnormalities
  - TTE first
- Intracardiac thrombus
  - Nearly always AF or LV dysfunction; ECG and TTE first
- Other cardiac masses
  - May see on TTE; rare
- Patent foramen ovale
  - May see on TTE; TOE required if candidate for closure
- Aortic arch atheroma
  - Only see on TOE; doesn’t change management

Echo in ischaemic stroke

- Transthoracic echo in all:
  - to detect evidence of coronary artery disease
  - to detect underlying abnormalities in AF (eg mitral stenosis)
  - might also detect an unexpected source of embolism (eg atrial myxoma)

- Transoesophageal echo if:
  - suspected endocarditis from clinical findings and TTE
  - suspected prosthetic AV or MV dysfunction
  - recurrent unexplained stroke, especially if young
  - evaluation for PFO closure (anatomy; magnitude of shunt)

TOE for diagnosis of infective endocarditis

APPROPRIATE USE OF ECHOCARDIOGRAPHY

ACCF/ASE/AHA/ASNC/HFSA/HRS/SCAI/SCCM/SCCT/SCMR 2011 Appropriate Use Criteria for Echocardiography

J Am Soc Echocardiogr 2011;24:229-67

- To diagnose infective endocarditis with a low pretest probability (e.g. transient fever, known alternative source of infection, or negative blood cultures/atypical pathogen for endocarditis) INAPPROPRIATE
- To diagnose infective endocarditis with a moderate or high pretest probability (e.g. staph bacteremia, fungemia, prosthetic heart valve, or intracardiac device) APPROPRIATE

Modified Duke criteria for diagnosis of infective endocarditis 2000

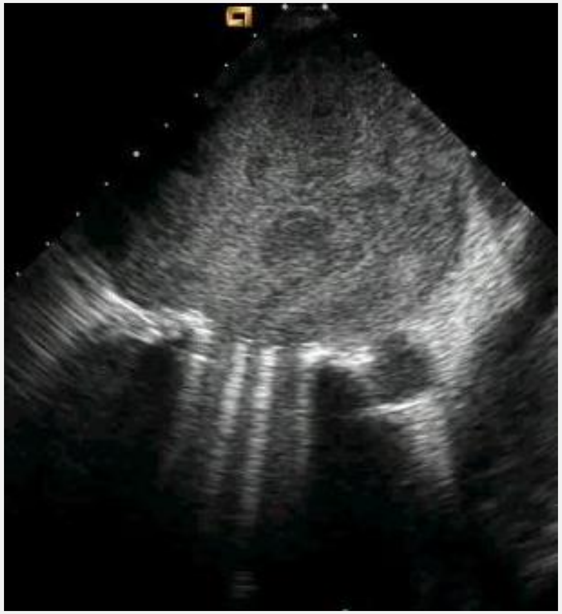
TEE recommended in patients with prosthetic valves, rated at least "possible IE" by clinical criteria, or complicated IE [paravalvular abscess]; TTE as first test in other patients

Austin Health protocol:

Recommendations for echocardiography in suspected or diagnosed endocarditis		
INITIAL IMAGING	No intracardiac prosthetic material	TTE
	Prosthetic valve, intracardiac device or other intracardiac prosthetic material	TOE
TTE FINDINGS	**NEGATIVE:** clinical suspicion low clinical suspicion high	Stop imaging TOE
	POSITIVE or **POOR QUALITY**	TOE
TOE FINDINGS	**NEGATIVE or INDETERMINATE:** clinical suspicion low clinical suspicion high	Stop imaging REPEAT TOE IN 7-10 DAYS
	POSITIVE	Treat appropriately as definite or presumed endocarditis
PROGRESS OF DEFINITE OR PRESUMED ENDOCARDITIS	**CLINICALLY UNCOMPLICATED:** No intracardiac prosthetic material	TTE at end of treatment
	CLINICALLY COMPLICATED or **DESTRUCTIVE OR ABSCESS-FORMING ORGANISM or** **INTRACARDIAC PROSTHETIC MATERIAL or** **IMMUNOCOMPROMISED PATIENT**	REPEAT TOE IN 7-14 DAYS

Other indications for TOE

- Mitral regurgitation:
  - Mechanism
  - Suitability for repair vs replacement
- Prosthetic valve dysfunction
  - Particularly the mitral valve
- Thoracic aortic pathology
- Congenital cardiac defects
- Evaluation for structural heart intervention
- Inadequate transthoracic echo study



(Relative) contra-indications to TOE

- Oesophageal disease:
  - Varices
  - Stricture
  - Malignancy
  - Previous surgery or radiotherapy
- High risk for sedation:
  - Severe respiratory disease
  - Severe pulmonary hypertension
- Poor dentition:
  - Risk of dislodging teeth