NEW GUIDELINES

A Minimum Dataset for a Standard Transoesphageal Echocardiogram

From the British Society of Echocardiography Education Committee

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1. Introduction

• This document aims to provide a framework for performing an adult transoesophageal echo (TOE) in a variety of clinical settings e.g. cardiology outpatients, cardiac theatre, intensive care. The layout is not only a minimum dataset but also proposes a recommended sequence in how to perform a comprehensive study. This is supported by text which gives a brief description of important issues at each view.

• This will hopefully promote a systematic approach to TOE which is critical for education and training but also for reviewing studies performed by different operators or between different hospital sites.

• It is recognised that not all views may be possible in all patients and in particular there are certain views that are sometimes poorly tolerated e.g. deep transgatric, upper oesophageal. The decision to omit a view must therefore be made by the operator taking into account the balance between the risks of inadequate data versus patient safety and comfort.

2. Patient safety

• Transoesophageal echo is semi-invasive with the potential for serious complications, albeit rare. It is therefore mandatory to have a routine checklist for certain conditions and problems which may either contraindicate the study or be a cause for concern e.g. oesophageal stricture, previous gastrooesphageal surgery, loose teeth/dentures. This checklist should be documented, preferably in a specific transoesphageal document/careplan within the medical notes.

• Conscious sedation is used in many units as a routine to facilitate TOE. Only individuals trained in the use of such techniques should administer sedative drugs. Continuous monitoring of oxygen saturations during and after the procedure is mandatory with full resuscitation equipment being readily available.

• Echo labs should have written protocols for the decontamination of probes and sterility of the procedure room. These protocols should be agreed with local trust infection control departments.

3. Identifying Information

• Patient name

• A second unique identifier such as hospital number or date of birth

• Identification of the operator e.g. initials

4. An ECG should be attached ensuring good tracings to facilitate the acquisition of complete digital loops.

5. Intraoperative TOE

• Intraoperative TOE is now a well established procedure that may involve cardiologists, cardiothoracic anaesthetists or cardiac physiologists. It is strongly recommended that such studies follow precisely the same format as a TOE performed in different settings e.g. a diagnostic study in cardiology outpatients. This approach has a sound medico legal justification and minimises the risk of missing important diagnoses that may not be apparent on the preoperative transthoracic echo. With this in mind, this document has been prepared with the direct involvement of the Association of Cardiothoracic Anaesthetists and its representatives Justiaan Swanevelder, David Duthie and Donna Greenhalgh.

• To that end, intraoperative TOE needs to be well coordinated in order to allow time for a complete study. It is desirable to obtain most of the data before the chest/pericardium is open as this may affect the images e.g. dimensions of the tricuspid annulus.

• The clinician must be aware that the physiology of the patient may be significantly different during intraoperative TOE due to the effects of general anaesthesia, fluid status or vasoactive drugs. This is an important principle in deciding whether the TOE data should be obtained before the patient is listed for surgery. The most widely quoted example is in the assessment of the severity of mitral regurgitation which may vary widely dependent on the physiology at the time of the study.

6. Duration

• It is recommended that 45-60 minutes is allowed for each TOE, which includes preparation of the patient e.g. cannulation, consent etc, and may include a preparatory TTE. It is recognised that certain clinical circumstances may necessitate a more focused approach to the image acquisition but this is a clinical judgement.

7. Reporting

• All studies should be completed by the issue of a formal report, documented in the medical notes. Ideally this should be in the form of a standardised computerised report available on all contemporary echo systems. The TOE images should be stored in a format that is reliable and easy to access for review, with the current recommendation for digital storage and regular server back-up.

8. Measurements

• This document indicates several measurements which can be made during a routine TOE. However, it is expected that the vast majority of patients will have already had transthoracic echocardiography (TTE). There is a more extensive evidence base for TTE measurements which should therefore be used where possible.

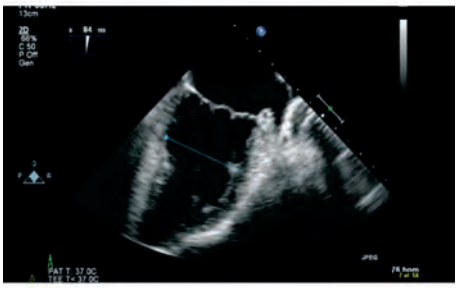
• Some TOE measurements are difficult to perform due to proximity of the transducer e.g. LA dimensions. Some measurements may be prone to error if off axis images have been obtained e.g. LV dimensions.

• However, certain measurements e.g annular dimensions or aortic root size, are usually more precise on TOE.

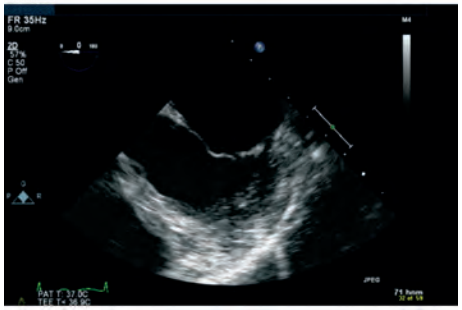
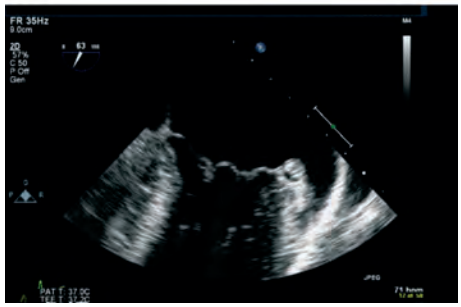
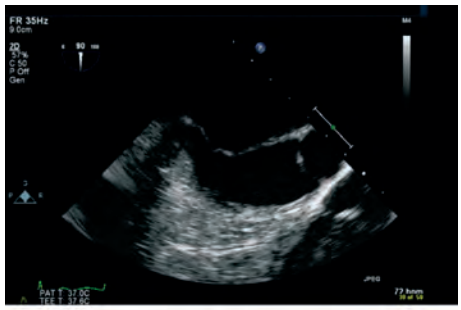
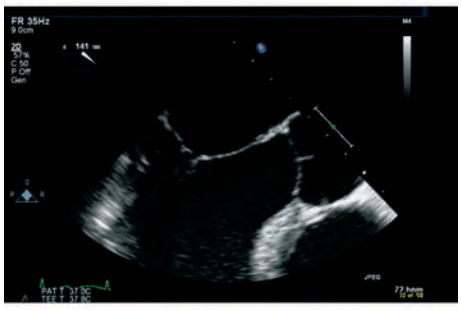
List of abbreviations

AS/AR	Aortic stenosis/Aortic regurgitation
ASD	Atrial septal defect
CFM	Colour flow mapping
CS	Coronary sinus
CW	Continuous wave doppler
DET	Deceleration time
FS	Fractional shortening
IAS	Interatrial septum
IS, antS, lat, inf, post	Inferior septum, anterior septum, inferior, posterior LV walls
LUPV, LLPV, RUPV, RLPV	Left upper, left lower, right upper, right lower pulmonary veins
LVDd/s	Left ventricular diameter in diastole and systole
LVSd/s	Left ventricular septal width in diastole and systole
LA/RA LV/RV	Left/right atrium Left/right ventricle
MS/MR	Mitral stenosis/Mitral regurgitation
PA	Pulmonary artery
PFO	Patent foramen ovale
PHT	Pressure half time
PISA	Proximal isovelocity surface area
PW	Pulse wave doppler
RVd	Right ventricular cavity diameter in diastole
RVSP	Right ventricular systolic pressure
TOE	Transoesophageal echo
TR	Tricuspid regurgitation
TTE	Transthoracic echo
VSD	Ventricular septal defect

Assessment of the LV

View	Modality	Measurements	Explanatory Note	Image
Mid oesophageal 4 chamber 0-20	2D		Assessment of LV function - inferoseptum and lateral walls. May require extension of probe to bring apex in to view. Focus can be moved towards the apex to improve quality of image. Careful assessment for apical thrombus/masses.	
Mid oesophageal 2 chamber 80-100°	2D	LVDd/s	Assessment of LV function – inferior and anterior walls. Measurements can be made with 2D calipers for LV dimensions at the junction of the basal and middle thirds of the LV.[1]	
Mid oesophageal long axis 120-150°	2D		Assessment of LV function - inferolateral and anteroseptal walls.	

Assessment of the mitral valve

View	Modality	Measurements	Explanatory Note	Image
Mid oesophageal 4 chamber 0-20°	2D		Assessment of MV. Several sections of the MV can be imaged in this view – (see diagram 1 for full explanation). Particular attention to the mitral annulus, leaflet morphology, leaflet motion and the subvalvar apparatus.	
Mid oesophageal 4 chamber 0-20°	2D		Assessment of MV: A1/P1. Flexion or withdrawal of the probe slightly will bring A1/P1 into view. The anterolateral commissure can be assessed.	
Mid oesophageal bicommisural view 60-70°	2D	Commissure to commissure annulus dimension (end diastole and end systole)	The imaging plane now brings both commissures into view. This is an appropriate anatomical plane to measure the annular dimension – diagram 1. A2 P3 P1	
Mid oesophageal Posteromedial commisure 90°	2D		Assessment of MV: A3/P3. The posteromedial commissure can be seen by turning the probe towards the aorta and then coming back to the MV.	
Mid oesophageal long axis 120-150°	2D	Anterior to posterior annulus dimension (end diastole and end systole).	Assessment of MV: A2/P2. This is the second anatomical plane which allows the mitral annulus to be measured – diagram 1.	

All of these views should be reassessed with colour flow Doppler over the mitral valve. PW and CW should be used in either the 4 chamber or long axis views.

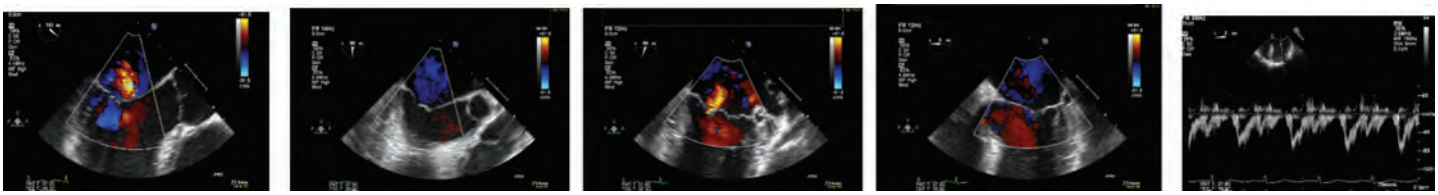
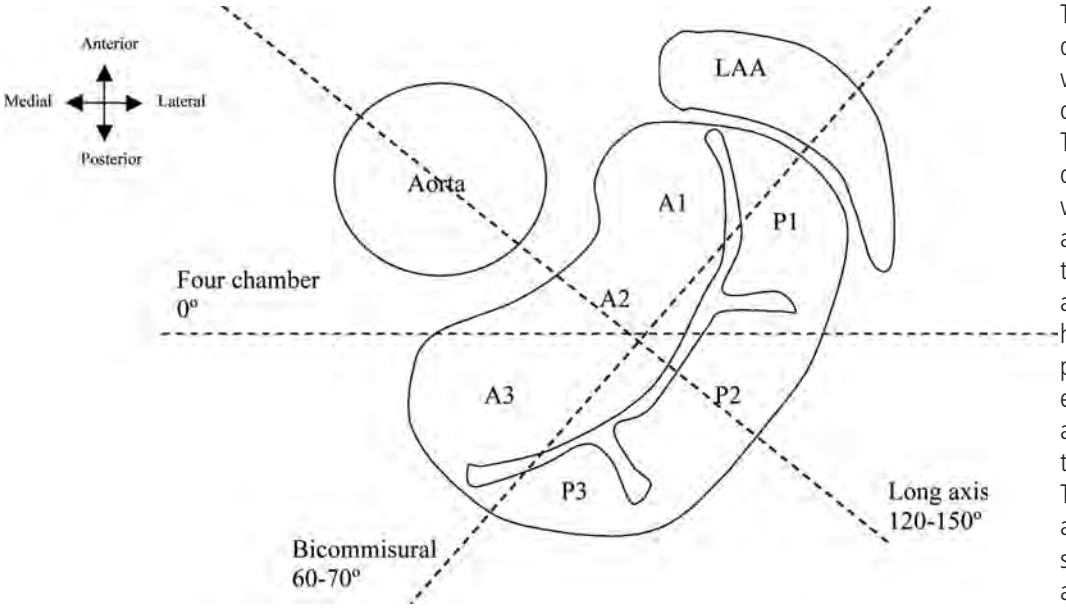
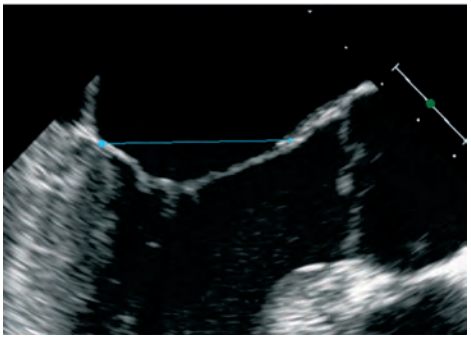


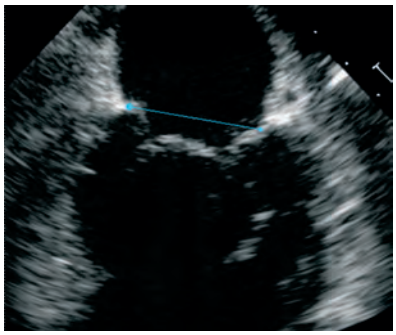
Diagram 1 - Standard imaging planes of the mitral valve from the mid oesophageal window



This diagram helps to understand the different sections of the MV that are visualized in the standard mid oesophageal imaging planes.
The four chamber view at 0° is an oblique cut through the MV and will visualize different parts of the valve according to the depth of probe insertion, the degree of flexion/extension and also the anatomical lie of the heart which may vary between patients. This means that A3/A2/A1 extending to P2/P1 may be in view at any one time. It is not usually possible to image A3/P3 at 0°.
The diagram also illustrates the correct anatomical planes for annular dimensions – the bicommissural view (major axis) and the long axis view (minor axis) [2]. These measurements in end diastole and end systole provide useful data for the cardiac surgeon in the setting of mitral repair. There is a paucity of data for normal ranges indexed for body surface area.

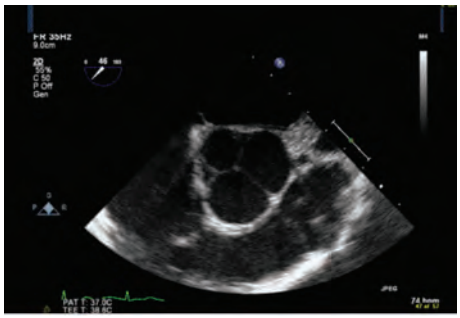
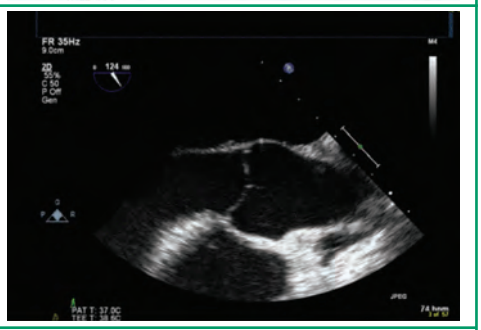
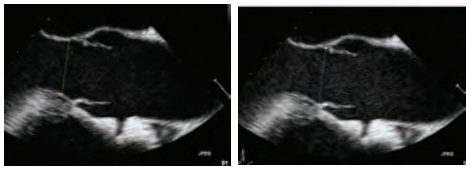


Anterior to posterior annular dimension – (end systole)



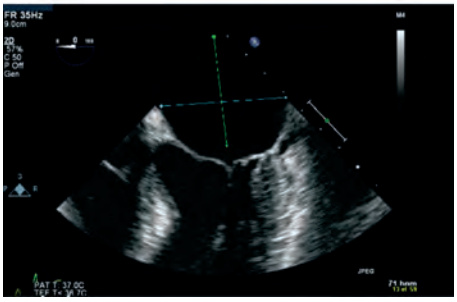
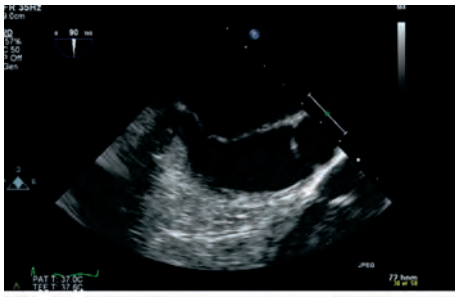
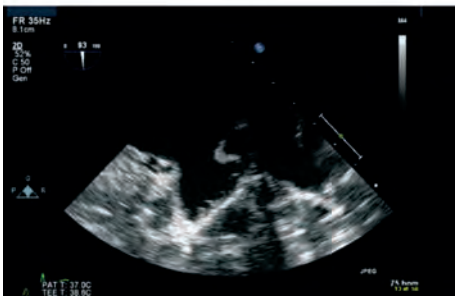
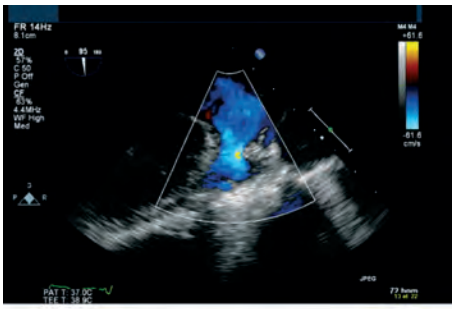
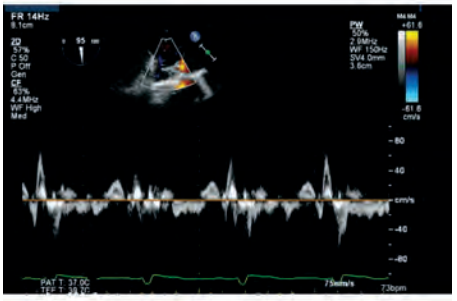
Commissure to commissure annular dimension – (end systole)

Assessment of the aortic valve

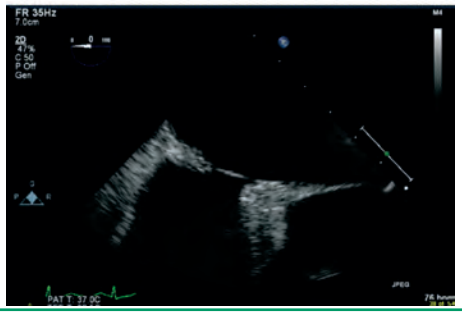
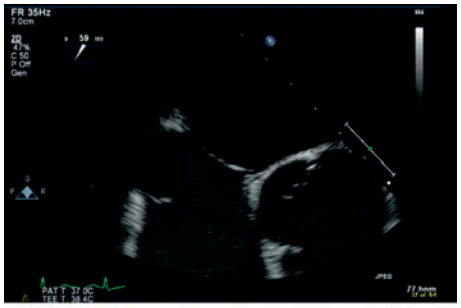
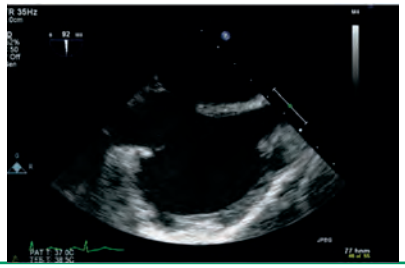
View	Modality	Measurements	Explanatory Note	Image
Mid oesophageal Short axis 40-60°	2D		Assessment of the AV. Flexion/extension or insertion and withdrawal of the probe will allow imaging above and below the valve making sure to image at the leaflet tips to assess opening. The coronary ostia can be seen above the valve.	
Mid oesophageal Long axis 120-150°	2D	LVOT/aortic annulus	The NCC is seen in the near field with the RCC in the farfield. Movement of the probe from left to right is essential in this view to image the extremities of the valve.	
Mid oesophageal Long axis 120-150°	2D	LVOT/aortic annulus	The LVOT dimension is measured in mid-systole from the septal endocardium to the anterior mitral valve leaflet approximately 0.5-1cm from the valve orifice.[5] The aortic 'annulus' is measured from the hinge points of the AV in mid-systole.	

These views should be repeated with colour flow Doppler. Alignment is not possible for spectral Doppler. The four chamber mid oesophageal view can also be used with slight flexion or withdrawal of the probe in order to assess the ventricular aspect of the AV and also to image aortic regurgitation.

Assessment of the left atrium/left atrial appendage

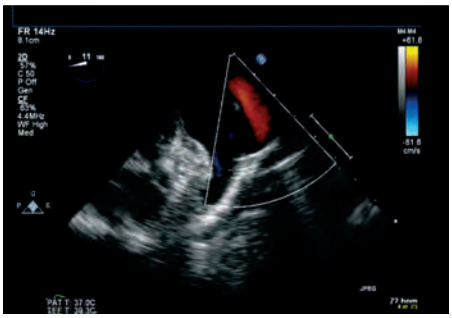
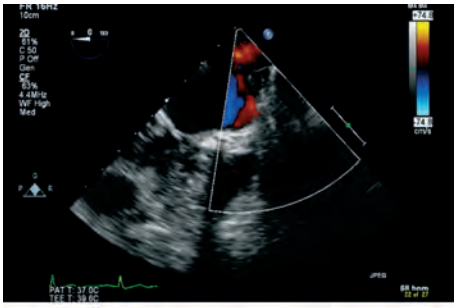
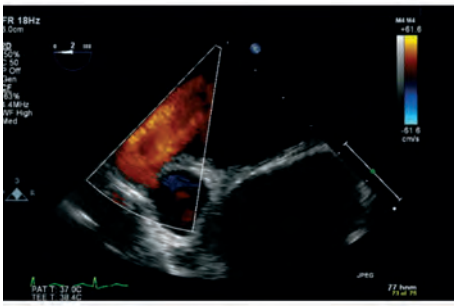
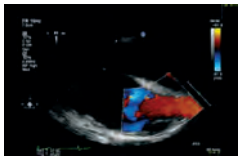
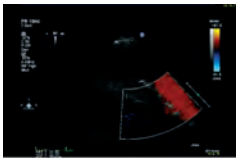
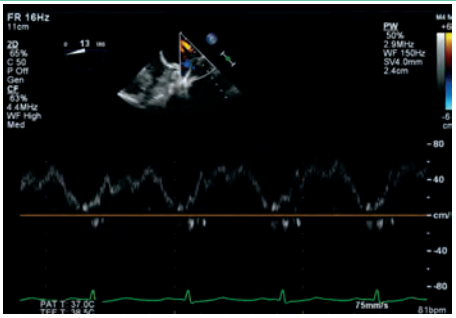
View	Modality	Measurements	Explanatory Note	Image
Mid oesophageal 4 chamber 0-20°	2D	LA dimension in two planes	The probe needs to be moved from left to right to image all parts of the LA completely. The LA area/volume can be difficult to obtain from TOE due to the proximity to the transducer. Dimensions in two planes can be measured in this view (semi-quantitative).	
Mid oesophageal 2 chamber 90°	2D		As above, movement of the probe from left to right will maximise the chance of imaging all corners of the LA.	
Mid oesophageal 4 chamber 0-20°	2D		The LAA can be imaged often helped by flexion or withdrawal of the probe slightly. Careful attention should be made to distinguish pectinate muscles from thrombus. The depth and focus can be adjusted to maximise the quality.	
Mid oesophageal LAA view 60-130°	2D		It is essential to image the LAA in at least 2 planes. One or more lobes can be seen when the multiplane is turned beyond 90°. Movement of the probe to the left can keep the LAA in view. Look out for spontaneous echo contrast.	
Mid oesophageal LAA view 0-130°	Colour doppler		Colour Doppler can help assess the extent of the LAA cavity.	
Mid oesophageal LAA view 0-130°	PW	Emptying velocities	PW Doppler can be placed within the mouth of the LAA (not more than 1cm) in order to quantify emptying velocities.	

Assessment of the interatrial septum

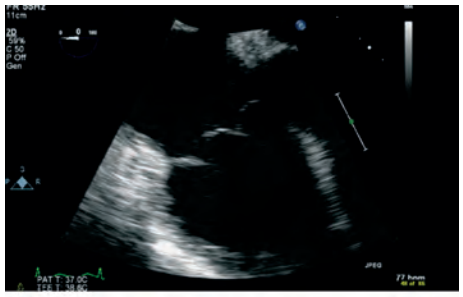
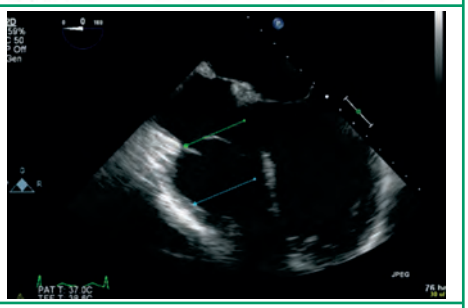
View	Modality	Measurements	Explanatory Note	Image
Mid oesophageal IAS 0-20°	2D		The interatrial septum is well seen on TOE due to its close proximity to the transducer. Lipomatous hypertrophy is frequently seen in this view.	
Mid oesophageal IAS 40-80°	2D		The presence of a patent foramen ovale can be assessed in this view. Note the insertion of the Eustachian valve near the inferior vena cava in the right atrium.	
Mid oesophageal bicaval 80-120°	2D		It is essential to image the IAS in multiple views to exclude ASD/PFO. Sinus venosus defects can be easily missed by incomplete imaging of the IAS near the insertion of the IVC and SVC.	

All of these views should be repeated with colour flow Doppler to look for ASD/PFO. Reducing the Nyquist limit may help to visualise low velocity flow across the septum. Always remember to reset the Nyquist limit for the rest of the study.

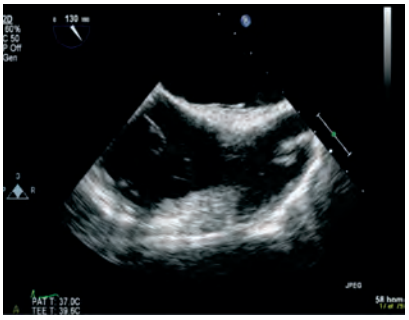
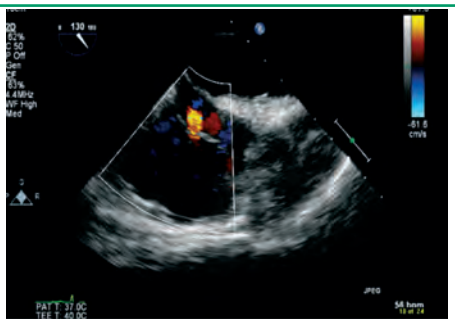
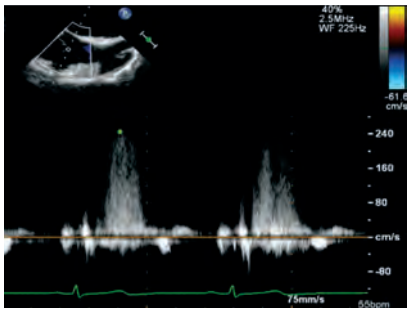
Assessment of the pulmonary veins

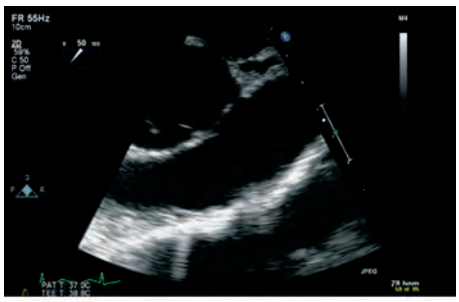
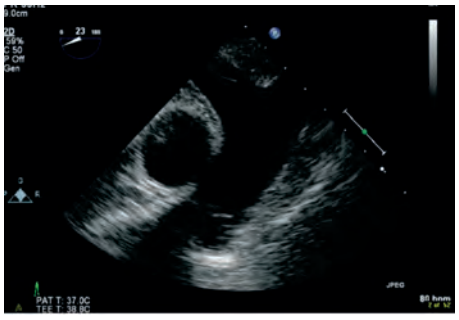
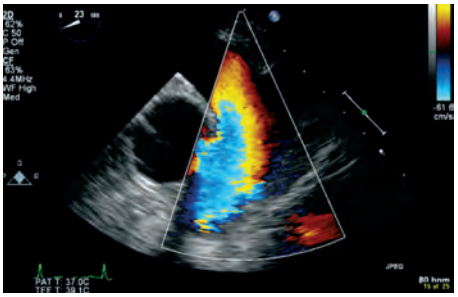
View	Modality	Measurements	Explanatory Note	Image
Mid oesophageal 4 chamber 0-20°	Colour doppler		The upper pulmonary veins tend to insert more vertically into the LA. Flexion or withdrawal of the probe can bring into view. Note the close relationship of the LUPV to the LAA.	
Mid oesophageal 4 chamber 0-20°	Colour doppler		The lower pulmonary veins tend to insert more horizontally into the LA. Inserting the probe further and turning further to the left can help image the LLPV.	
Mid oesophageal 4 chamber 0-20°	Colour doppler		After turning the probe to the right, flexion or withdrawal of the probe can help image the RUPV.	
Mid oesophageal modified bicaval view 90-110°	Colour doppler		The RUPV can often be easier to image by starting with the bicaval view to visualize the SVC and then turning the probe further to the right whilst keeping the colour doppler in position.	 SVC RUPV 
Mid oesophageal 4 chamber 0-20°	Colour doppler		Inserting the probe further and turning the probe to the right can bring in the RLPV.	
Mid oesophageal 4 chamber 0-20°	PW		The PW cursor is placed 1cm into the mouth of any pulmonary vein but usually the LUPV is the best aligned. Two pulmonary veins should be analysed in each patient.	

Assessment of the right heart

View	Modality	Measurements	Explanatory Note	Image
Mid oesophageal 4 chamber 0-20°	2D		The right ventricle can be assessed in more detail for regional and global function. The septal leaflet is on the right with the anterior or posterior leaflet on the left depending on how far the probe is inserted.[3]	
Mid oesophageal 4 chamber 0-20°	2D		RV size can be assessed at the base and the mid point in end diastole [1] The tricuspid annulus can be measured at end systole and end systole from hinge point to hinge point.	
Mid oesophageal RV inflow/outflow 60-80°	2D		Regional and global RV function can be further assessed. The posterior leaflet is on the left with the anterior leaflet to the right. The pulmonary valve can also be seen in this view.	

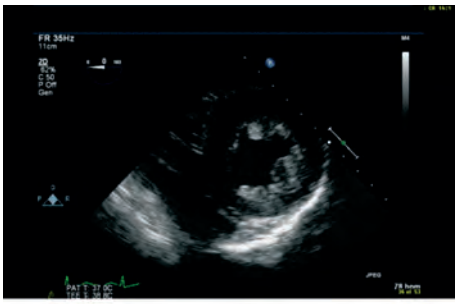
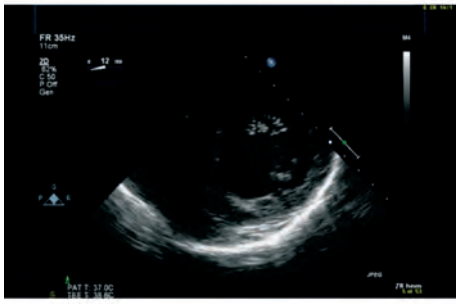
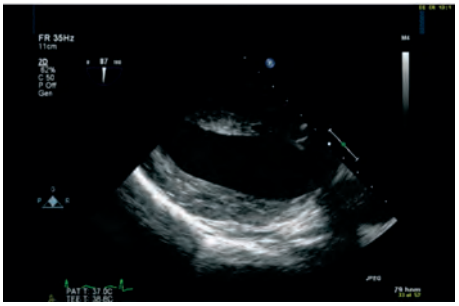
Tricuspid annular dimensions in the 4 chamber view provide useful data for the cardiac surgeon in the setting of tricuspid repair. There is a paucity of data regarding normal ranges indexed for body surface area.

Mid oesophageal modified RV inflow 110-130º	2D		The tricuspid valve can also be imaged at this multiplane angle aided by turning the probe to the right.	
Mid oesophageal modified RV inflow 110-130º	Colour Doppler		This view often allows TR to be assessed using CW Doppler due to the vertical alignment.	
Mid oesophageal modified RV inflow 110-130º	CW	TRmax	Doppler estimate of RVSP may be performed.	

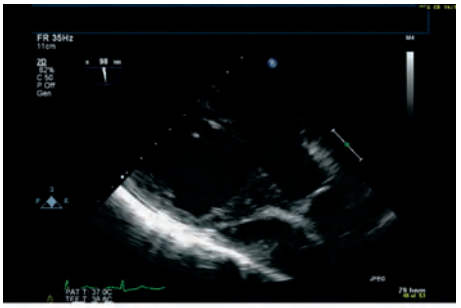
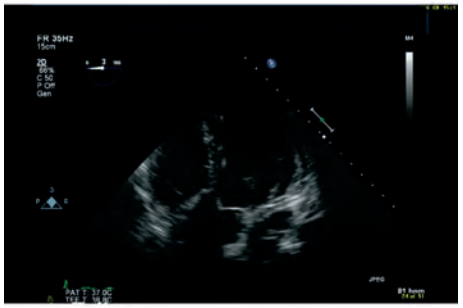
View	Modality	Measurements	Explanatory Note	Image
Mid oesophageal RV outflow 60-80°	2D	Pulmonary valve annulus	The pulmonary valve is often better imaged by using the zoom.	
Mid oesophageal main PA 0°	2D	Main pulmonary artery	The main pulmonary artery can be imaged by withdrawing the probe slightly at 0°. The pulmonary artery bifurcation is well seen with the right main pulmonary artery heading behind the ascending aorta.	
Mid oesophageal main PA 0°	Colour doppler		Colour Doppler will demonstrate flow towards the transducer in systole.	

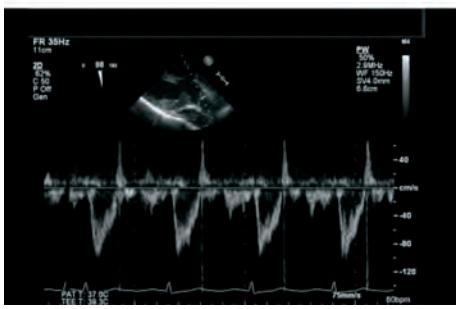
All of these views should be repeated with colour flow Doppler to assess the tricuspid and pulmonary valves. PW/CW can be used to assess flow through the pulmonary valve in the mid oesophageal view at 0°

Transgastric - Assessment of the LV

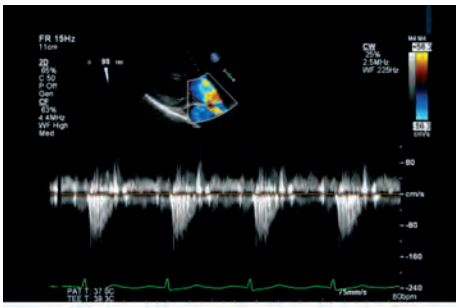
View	Modality	Measurements	Explanatory Note	Image
Transgastric mid LV short axis 0-20°	2D	LVSd LVDd/s	After insertion of the probe into the stomach, flexion will bring this image into view. Regional and global LV systolic function can be assessed. Chamber dimensions can be measured either with 2D callipers or M-mode placed vertically within the sector.[1]	
Transgastric basal LV short axis 0-20°	2D		Withdrawing the probe slightly will image the base of the LV with the MV en face. This is a good view for assessing the mitral commisures and imaging the site of MR with colour Doppler.	
Transgastric 2 chamber 80-100°	2D	LVDd/s	The inferior wall is seen within the near field with the anterior wall in the far field. LV dimensions may be obtained by 2D callipers or M-mode as for the short axis views.[1] L	

Transgastric - Assessment of the LV

View	Modality	Measurements	Explanatory Note	Image
Transgastric long axis 90-120°	2D Colour Doppler PW/CW	PW LVOT CW AVmax	Turning the probe slightly to the right may help image the AV. Colour Doppler guides the alignment of PW in the LVOT and CW through the AV. The mid oesophageal views do not allow spectral Doppler analysis of the AV.	
Deep transgastric 0°	2D Colour Doppler PW/CW	PW LVOT CW AVmax	The probe is inserted further in to the stomach with flexion in order to obtain this image which is similar to a transthoracic apical 5 chamber view. Colour Doppler can guide the use of PW in the LVOT and CW through the AV.	

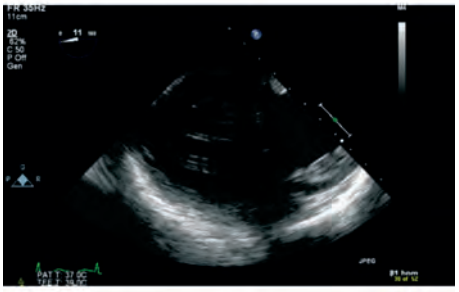
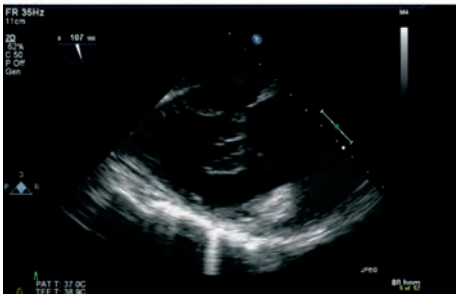


PW LVOT

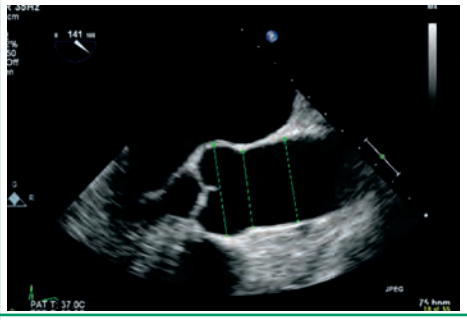
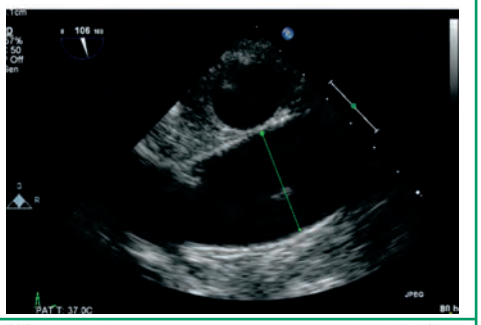
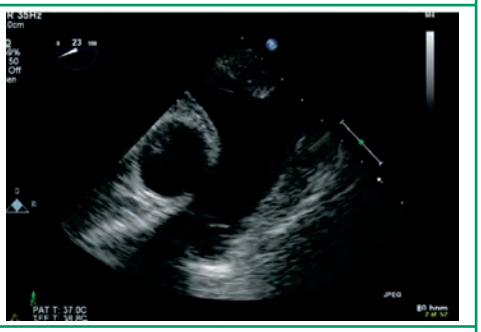
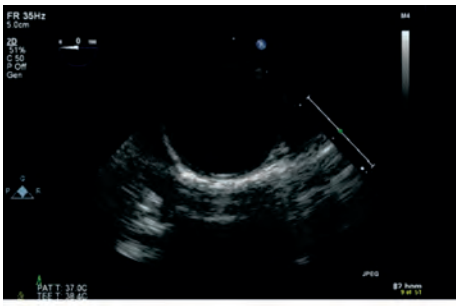
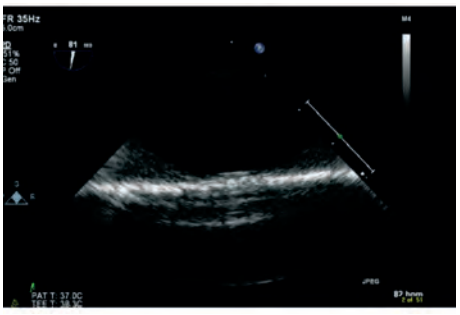
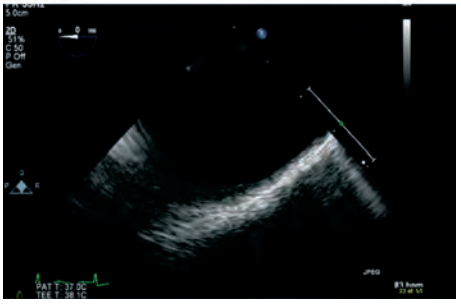


CW through AV

Transgastric - Assessment of the right heart

View	Modality	Measurements	Explanatory Note	Image
Transgastric Short axis RV 0-20°	2D		All 3 leaflets of the tricuspid valve can be seen in this view. RV regional and global function can be assessed.	
Transgastric RV inflow 80-100°	2D		The tricuspid leaflets and the subvalvar apparatus are well seen. This is also an excellent view for assessment of pacing wires in the RV.	

Assessment of the aorta

View	Modality	Measurements	Explanatory Note	Image
Mid oesophageal long axis aortic root 120-150°	2D	Sinuses of Valsalva, Sinotubular junction, Ascending aorta	Internal dimensions can be measured in mid diastole.[1] Measurements at the level of the sinuses of Valsalva should be indexed for body surface area.[4]	
Mid oesophageal long axis ascending aorta 100-120°	2D	Ascending aorta	The upper ascending aorta can be imaged by withdrawing the probe slightly and reducing the multiplane angle. The right pulmonary artery is in the near field.	
Mid oesophageal short axis ascending aorta 0°	2D		Withdrawal of the probe will image the ascending aorta in short axis above the leaflets of the AV. The main pulmonary artery is on the right.	
Mid oesophageal descending thoracic aorta 0°	2D	Descending thoracic aorta Descending thoracic aorta	The entire thoracic aorta can be assessed by withdrawing the probe. Abnormalities can be annotated at a level corresponding with the distance from the incisors as marked on the probe.	
Mid oesophageal descending thoracic aorta 90°	2D		Atheromatous plaque is often well seen in the long axis view.	
Upper oesophagus aortic arch 0°	2D		The upper oesophageal views are often poorly tolerated by the patient. The probe is turned to the right to keep the aorta in view. The proximal arch is to the left with the distal arch to the right.	

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