The Royal Wolverhampton NHS Trust

Introduction to Transthoracic Echocardiography

Cardiology Services Group

This booklet serves as an introduction to the practical element of TTE for individuals who have little or no scanning experience.

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Content

Role and Aim of TTE

Echocardiography is a non-invasive diagnostic test that utilises ultrasound to acquire still and moving images of the heart and its surrounding structures.

It is a popular diagnostic test as it is non-invasive, carries very few risks and is relatively quick and portable.

To perform and analyse TTE however requires high levels of user skill, experience and knowledge.

The sonographer must have an in depth understanding of the cardiac anatomy and potential pathologies, the machine settings and physics of ultrasound and the wide range of protocols and assessment methodologies for completing a TTE.

The aim of the TTE is to provide accurate and (if possible) quantitative data on the cardiac structures and their function, answering the clinical question posed. Results must then be clearly reported and communicated appropriately to ensure patients follow the correct pathway

Machine Components

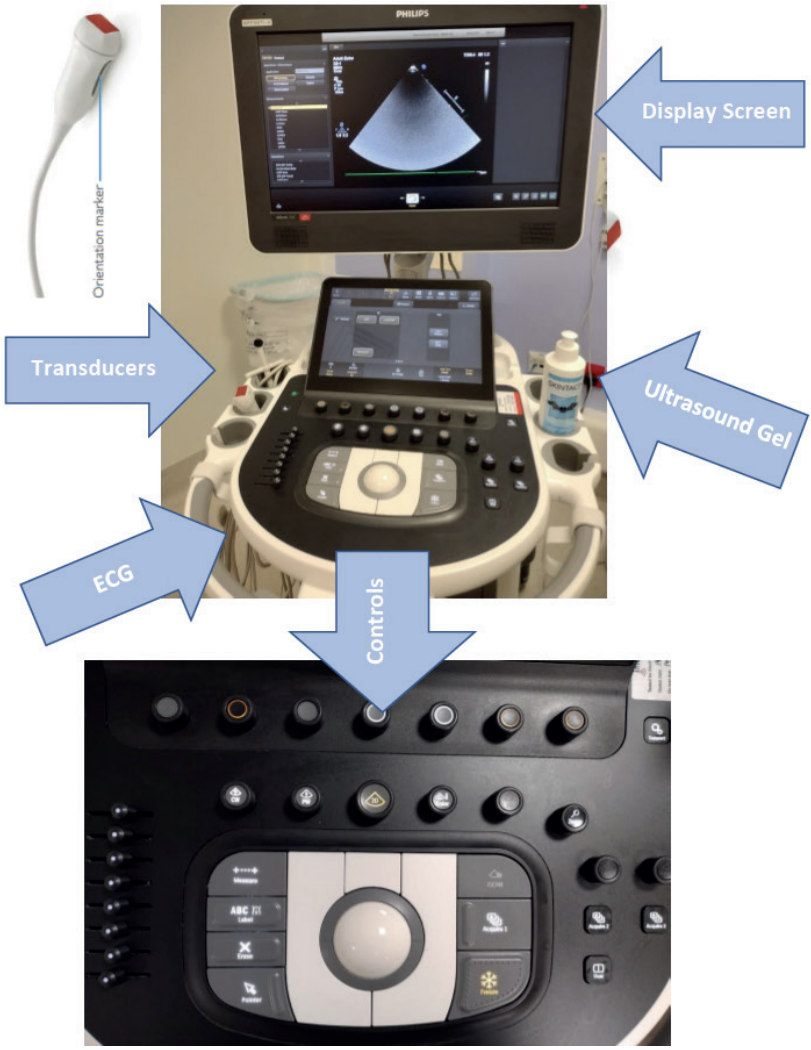

Figure 1: Phillips Echo machine with associated components and snapshot of the control panel

Patient Preparation

Always introduce yourself and your role

Check patient identity (3 points of ID)

Explain test and gain valid verbal consent

"Here to do an ultrasound scan of your heart, I will require access to your chest and for you to have a lie down on the bed, I will be putting some cold gel onto the chest in various locations to take the pictures. I might ask you to complete some breathing exercises."

Measure patient's height, weight and blood pressure (if indicated)

Offer the patient a gown and privacy whilst getting themselves ready (they can also request a chaperone if they desire)

Once the patient is ready and lying down:

Apply three lead ECG

If patient is able/mobile, ask them to then lie on their left-hand side and abduct their left arm for the parasternal and apical views

Patients will need to be supine for the subcostal and suprasternal views

Figure 2: Patient position left hand side for parasternal and apical views (left) and supine position for subcostal and suprasternal views

Probe manipulation

Each probe will have an orientation marker.

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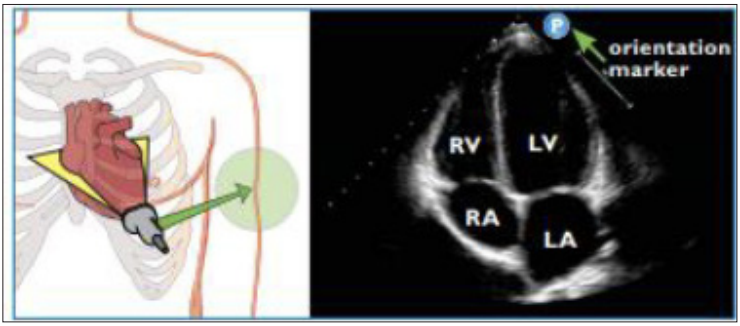


Figure 3: Example of apical probe alignment with orientation marker towards 3o'clock and its representation on the echo 2D image.

To obtain the correct echo views, requires correct alignment and manipulation of the transducer to obtain the optimal images.

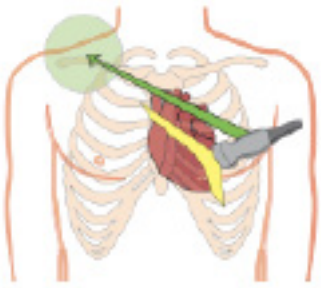
Sometimes movements can be small.

Every patient will require slightly different optimisation due to different body habitus; however key alignment should be similar.

Table 1: Probe manipulation

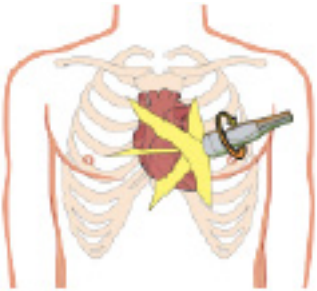
Align:

Align the probe with the patient's anatomy in the associated window. Ensure the orientation marker is in the correct position.



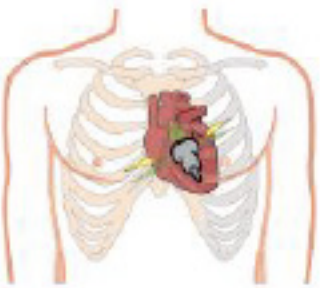
Rotate:

Keeping the same spot but rotating the probe either clockwise of anticlockwise

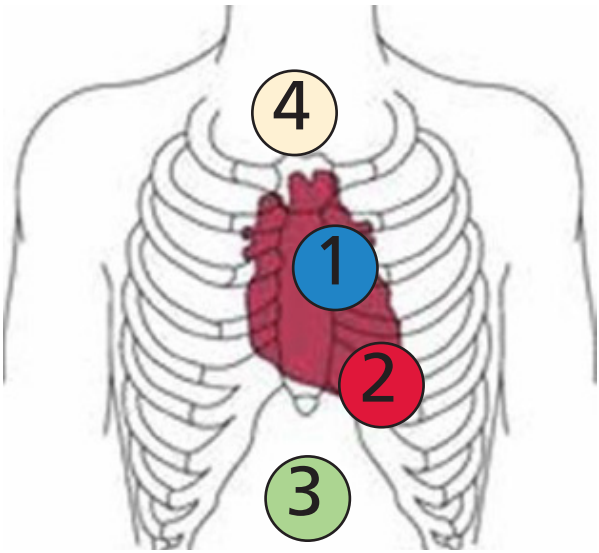


Tilt:

Tilting the tail of the probe either up/down, or side to side



Transthoriacic Echo Windows

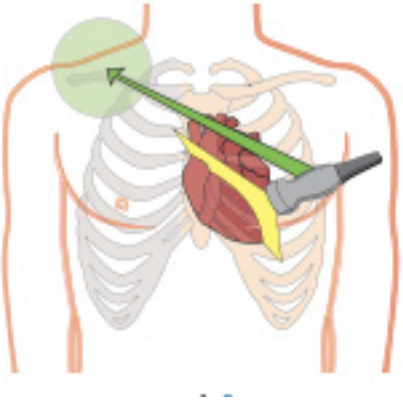


1. Parasternal
2. Apical
3. Subcostal
4. Suprasternal

Figure 4: Standard TTE windows location on the torso.

TTE Standard Views

Parasternal long axis (PLAX)



Orientation: Left third or fourth intercostal space, adjacent to sternum, probe marker to right shoulder.

Aim: Looking for ventricle to be horizontal and long (not rounded off), with 3-4cm of the ascending aorta visible. Clear visualisation of the mitral and aortic valve leaflets.

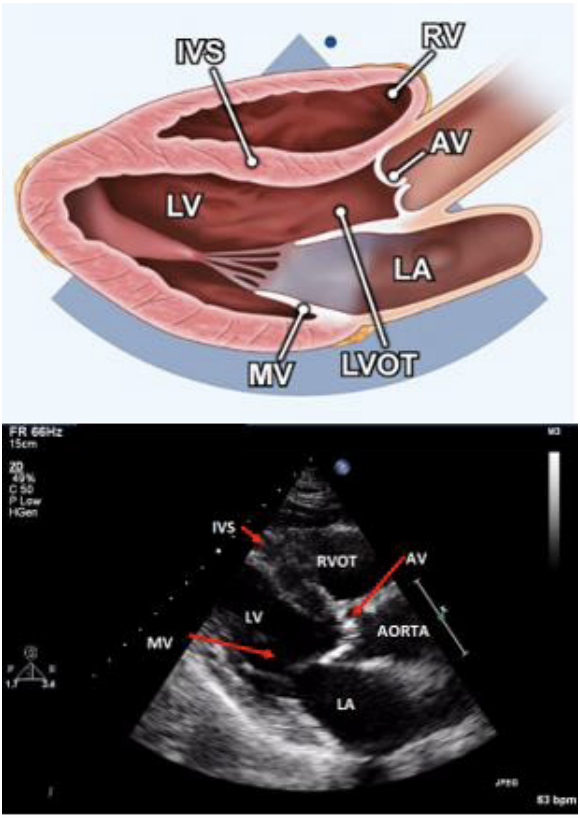


Figure 5: PLAX view and the associated structures visualised in animation and as a snapshot from a patient.

Parasternal: RV inflow

Orientation: From PLAX view, keep same marker orientation but tilt probe tail towards patients left shoulder (inferiorly and slightly medially)

Aim: Close off LV and bring in the RA, RV and TV. Should see the liver and diaphragm, which will help identify TV leaflets (anterior leaflet by the RV anterior wall and inferior leaflet by the inferior RV wall). If the septum remains in view, the septal TV leaflet is seen instead of the posterior TV leaflet.

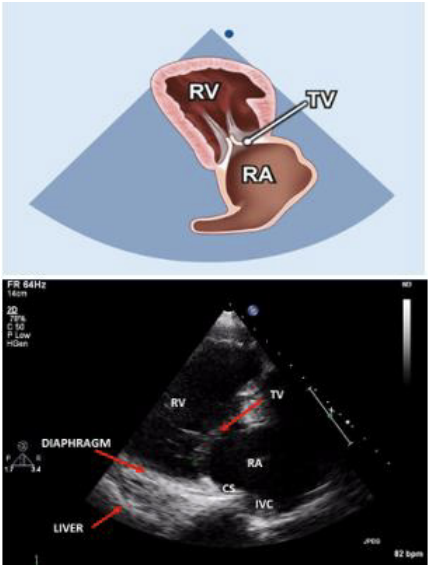


Figure 6: RV inflow view and the associated structures visualised in animation and as a snapshot from a patient.

Parasternal: RV outflow

Orientation: From PLAX view, keep same marker orientation but tilt probe tail towards patient's right hip (superiorly).

Aim: Centralise the RVOT and PV in the image with visualisation of the main pulmonary artery.

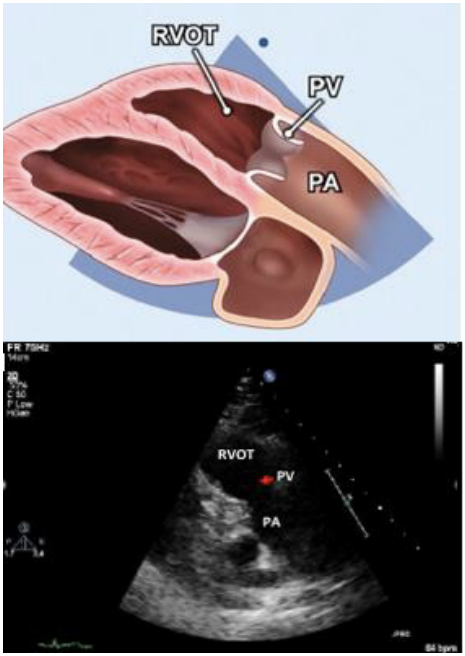
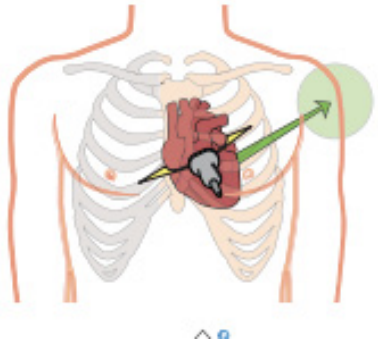


Figure 7: RV outflow view and the associated structures visualised in ani mation and as a snapshot from a patient.

Parasternal Short Axis (PSAX): AV level



Orientation: From PLAX rotate marker 90° clockwise towards the patient's left shoulder. Tilt probe tail towards bed slightly to bring in AV level.

Aim: Clear visualisation of the AV and its morphology – central to the image. Additional structures seen include the TV, RVOT and, PV and main PA.

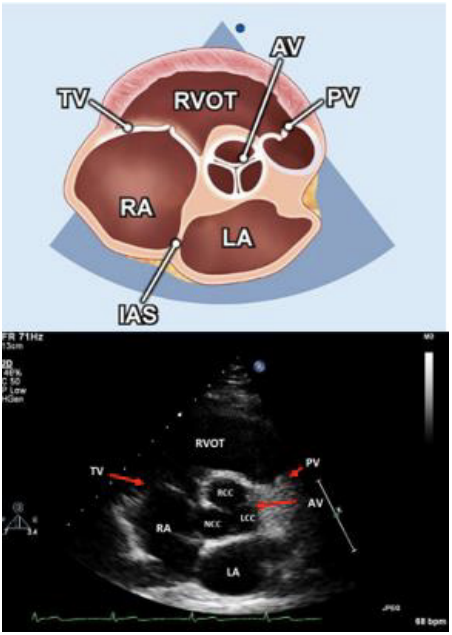
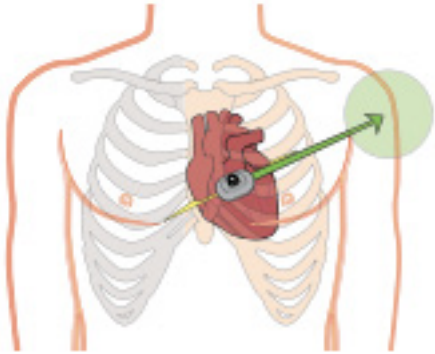


Figure 8: PSAX –AV level view and the associated structures visualised in animation and as a snapshot from a patient.

Parasternal Short Axis (PSAX): MV level



Orientation: From PSAX AV level, slightly tilt tail up towards patient's right shoulder so it is perpendicular to chest wall

Aim: LV should be central and round, MV leaflets should be visualised opening

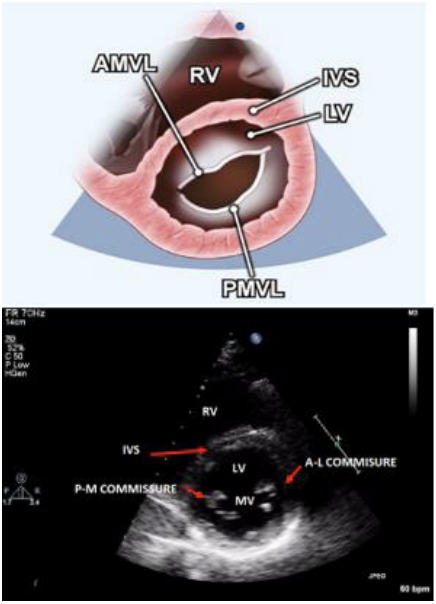
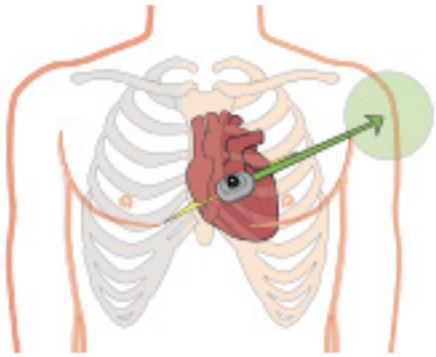


Figure 9: PSAX- MV level view and the associated structures visualised in animation and as a snapshot from a patient.

Parasternal Short Axis (PSAX): Mid LV Papillary level



Orientation: From PSAX MV level, slightly tilt tail up towards patient's right shoulder

Aim: LV should be central and circular, papillary muscles should be in view, the mid -apical portion of the RV should be seen anteriorly and to the left of the image.

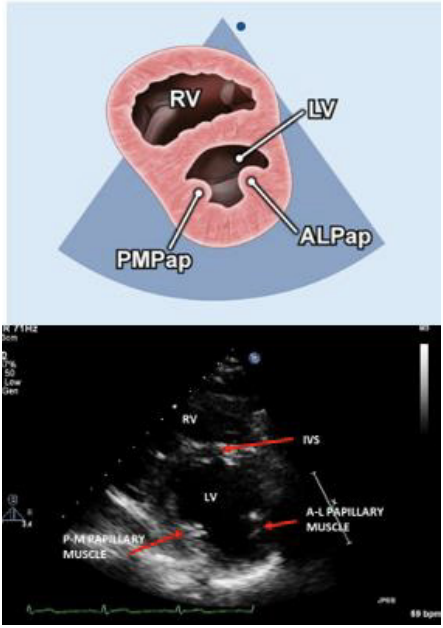


Figure 10: PSAX- Mid LV (papillary) level view and the associated structures visualised in animation and as a snapshot from a patient.

Parasternal Short Axis (PSAX): Apical level

Orientation: From PSAX mid-level, tilt tail up further towards patient's right shoulder (inferiorly)

Aim: LV should be central and circular, RV apex should no longer be in view

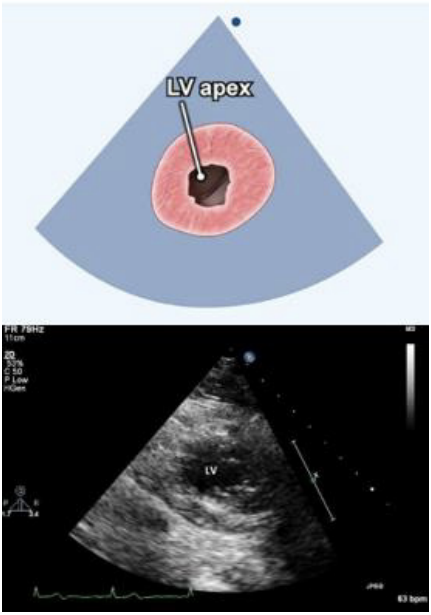
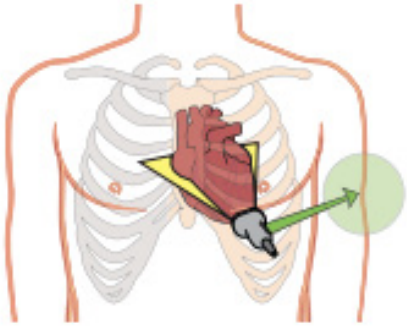


Figure 11: PSAX- apical level view and the associated structures visualised in animation and as a snapshot from a patient.

Apical 4 Chamber view



Orientation: Probe on the apical pulse/beat with orientation marker ~3oclock.

Aim: Looking for the septum to be vertical in the picture with all four chambers and walls clearly visualised. The LV shouldn't appear rounded or foreshortened.

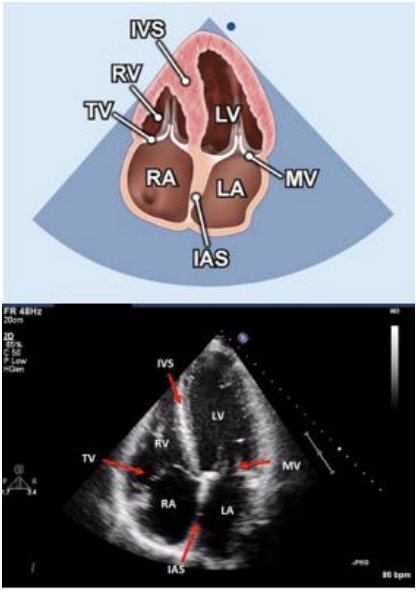


Figure 12: A4C view and the associated structures visualised in animation and as a snapshot from a patient.

Apical 4 Chamber – Modified RV view

Orientation: From A4C view slide and/or angulate the tail of the transducer along the horizontal plane to place the RV in the centre of the image. Rotate the transducer to obtain the maximum diameter

Aim: RV should be centralised and at max diameter, LVOT should not be in view.

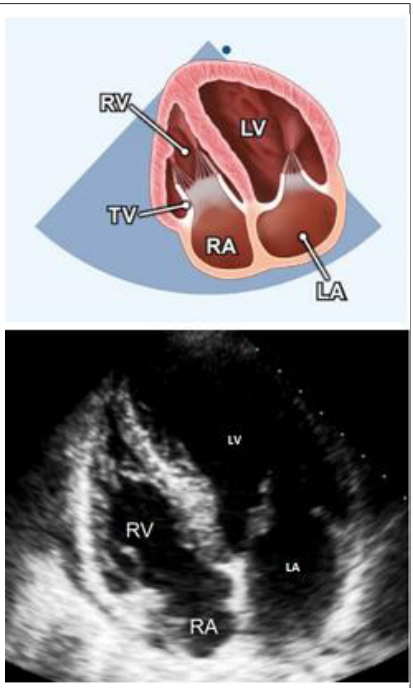
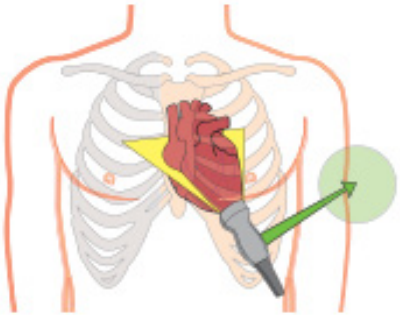


Figure 13: A4C –modified RV view and the associated structures visualised in animation and as a snapshot from a patient.

Apical 5 Chamber



Orientation: From Apical 4 chamber, tilt the probes tail down towards the bed to open up the LVOT and AV. Orientation marker remains ~3o'clock

Aim: Bring in the LVOT, AV and Aortic root. LV/RV will become foreshortened in this view.

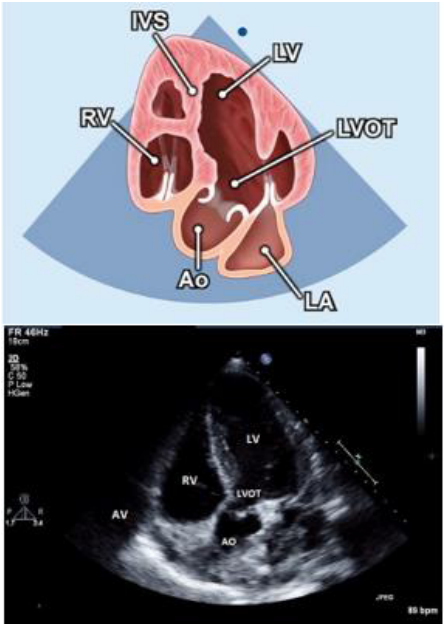


Figure 14: A5C view and the associated structures visualised in animation and as a snapshot from a patient.

Apical 2 Chamber View

Orientation: From the apical 4 chamber, rotate the orientation mark anti-clockwise approximately 60° to close off the RV.

Aim: Clear visualisation of the LV inferior and anterior walls, making sure the LV is not foreshortened and that the LA is fully opened up. In some patients the Left atrial appendage may be seen on the anterior aspect of the LA wall.

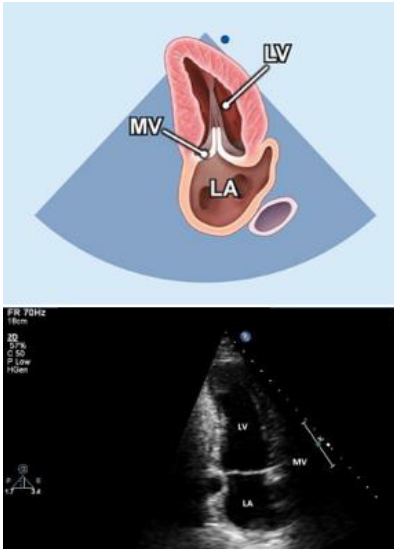


Figure 15: A2C view and the associated structures visualised in animation and as a snapshot from a patient.

Apical 3 Chamber view

Orientation: From the apical 2 chamber view, continue rotating anticlockwise ~60°

Aim: Clear visualisation of the LV (without foreshortening), LA and the aorta. Aim to seen the LV inferolateral and anterioseptum walls clearly.

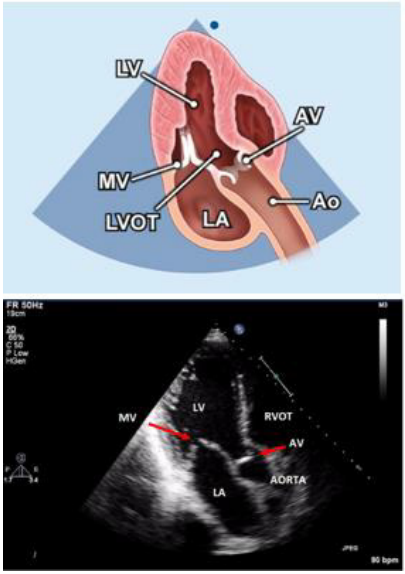
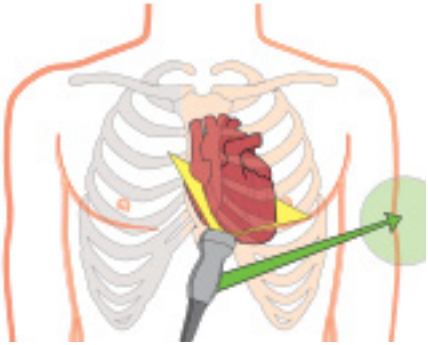


Figure 16: A3C view and the associated structures visualised in animation and as a snapshot from a patient.

Apical 5 Chamber



Reposition patient so they are lying supine. Ask the patient to relax their abdomen, bending the knees can help.

Orientation: The probe should be placed 2-3cm below the xyphoid process. Aim probe superiorly towards the heart, with the orientation marker towards 3 o'clock

Aim: Visualise the four chambers and highlight any pericardial effusions

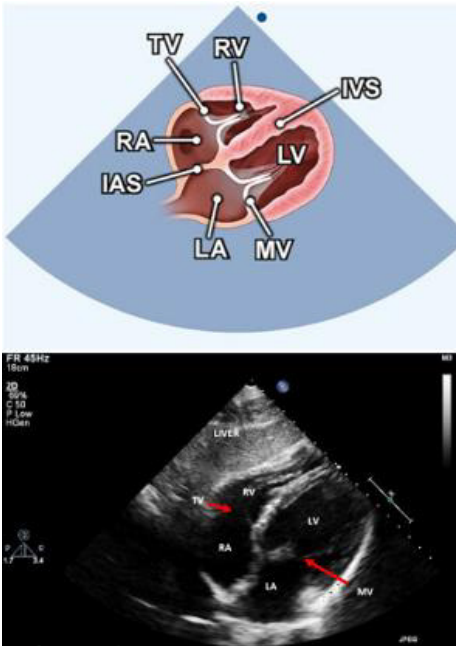


Figure 17: Subcostal –4 Chamber view and the associated structures visualised in animation and as a snapshot from a patient.

Subcostal view- IVC view

From 4 chamber view rotate orientation marker anti-clockwise 90° to ~12 o'clock. Aim to have the RA still in view to ensure visualising the IVC and not the aorta

Figure 13: Subcostal IVC view

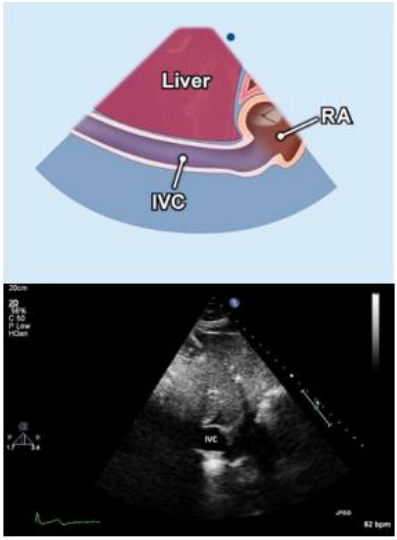


Figure 18: Subcostal –IVC view and the associated structures visualised in animation and as a snapshot from a patient.

Suprasternal view

Keeping the patient supine, ask the patient to lift their chin and if needed to turn head to left

Orientation: Gently place probe in suprasternal notch, aiming inferiorly towards the heart. Orientation marker ~1o'clock

Aim: To visualise aortic arch and the descending aorta.

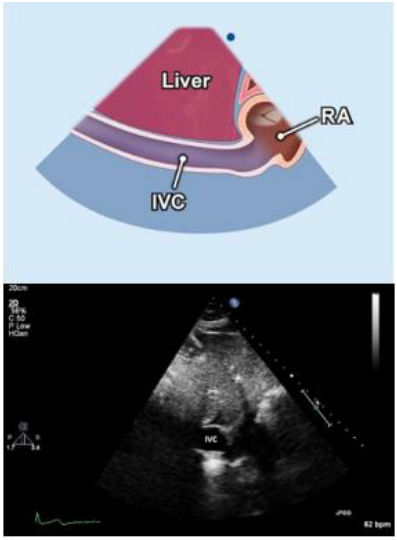


Figure 19: Suprasternal view and the associated structures visualised in animation and as a snapshot from a patient.

Suprasternal view

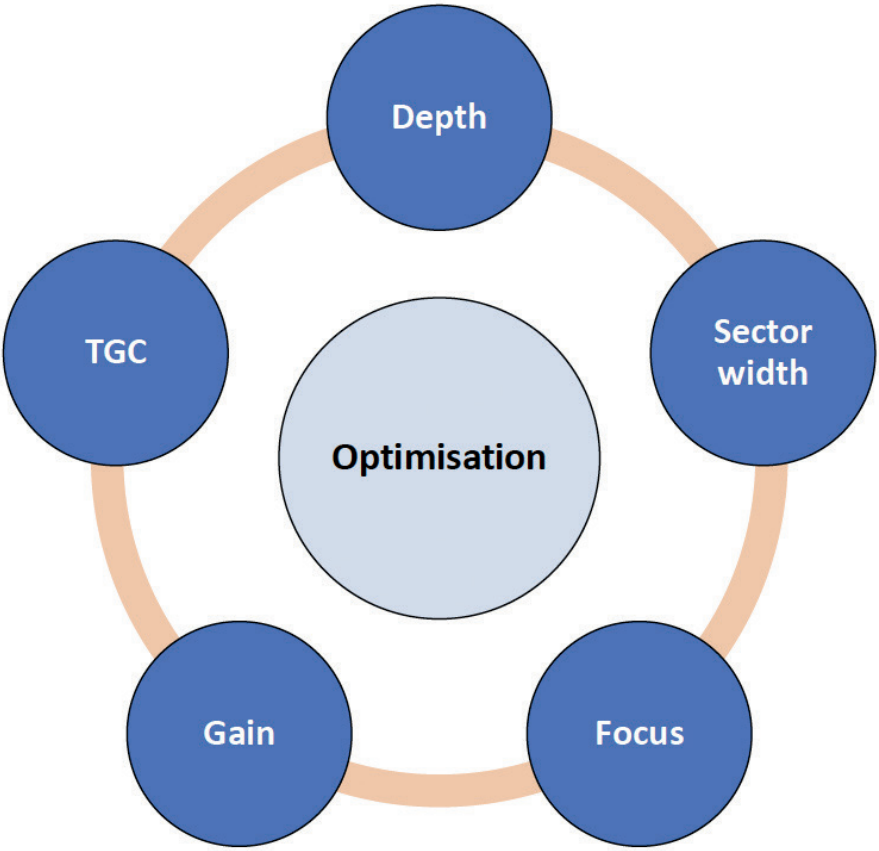


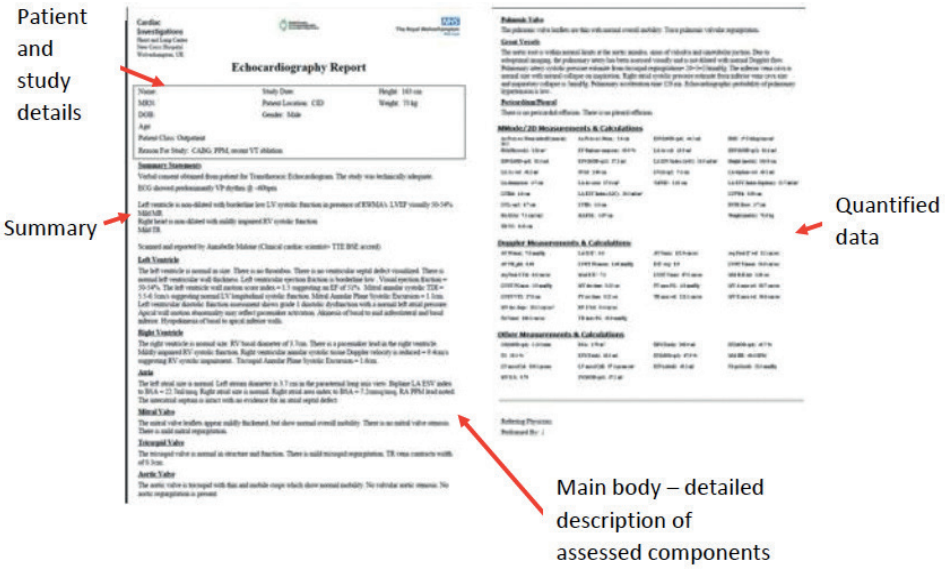
Figure 20: Diagram highlighting the key controls needed for optimisation on each image acquired.

Analysing and reporting a TTE

Aim of a TTE exam is firstly to answer the clinical question. Secondly, to systematically and, if possible, quantitatively assess the following:

1. Chamber size, structure, geometry and function
2. Valve morphology and competency
3. Cardiac vasculature size, geometry and function
4. Pericardial space
5. Probability of PHT
6. Any extra structures (normal variants, artefacts, abnormal variants/anomalies)

Reports have the following structure:



Appendices

Table2: Abbreviations	
A2C	Apical 2 Chamber
A3C	Apical 3 Chamber
A4C	Apical 4 Chamber
A5C	Apical 5 Chamber
A-L	Antero-lateral
AMVL	Anterior Mitral Valve Leaflet
Ao	Aorta
AV	Aortic Valve
CS	Coronary Sinus
IAS	Interatrial Septum
IVC	Inferior Vena Cava
IVS	Interventricular Septum
LA	Left Atrium
LCC	Left Coronary Cusp
LCCA	Left Common Carotid Artery
LSA	left Subclavian Artery
LV	Left Ventricle
LVOT	Left Ventricle Outflow Tract
MV	Mitral Valve
NCC	Non Coronary Cusp
PA	Pulmonary Artery
PHT	Pulmonary Hypertension
PLAX	Parasternal Long Axis
P-M	Posterio-medial
PMVL	Posterior Mitral Valve Leaflet
PSAX	Parasternal Short Axis
PV	Pulmonary Valve
RA	Right Atrium
RCC	Right Coronary Cusp
RPA	Right Pulmonary Artery
RV	Right Ventricle
RVOT	Right Ventricle Outflow Tract
TGC	Time-Gain Compensation
TTE	Transthoracic Echocardiogram
TV	Tricuspid Valve

References

Houghton A. 2014. Making Sense of Echocardiography – A Hands on guide. 2nd Edition. CRC Press.

Figure 3 and probe orientation images taken from:

Beraud, A. & Burkett, T. 2011. Introduction to transthoracic echocardiography Philips tutorial. Phillips. WWW. Available from: https://www.ultrasoundtraining.com.au/wp-content/uploads/2020/07/2015-philips-intro-to-tte.pdf

Animated echo views in Figures 5-19 from:

TechMed -Echocardiography Views and Videos. WWW. Available from: https://www.techmed.sk/en/echo/views/

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