



Promoting Excellence In Ultrasound

Policies and Statements

E4

Education Protocol:
Competences Required of Cardiac Sonographers Who Practice Adult
Transthoracic Cardiac Ultrasound Examinations

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Preface:

The following echocardiography protocol outlines what competences an echo cardiac sonographer should be able to demonstrate, and apply as appropriate in the examination of patients.

This protocol represents a minimum standard adult echocardiographic acquisition and analysis protocol and should be extended according to the clinical features and findings. It is recognised that examination protocols, while a useful tool for standardisation of practice, may vary from laboratory to laboratory. Adherence to a simple protocol cannot substitute for competent acquisition, analysis and reporting of echocardiographic images.

All personnel performing cardiac ultrasound examinations should be cardiac sonographers, student cardiac sonographers or suitably qualified medical practitioners.

A complete echocardiographic examination should be conducted of each patient referred for echocardiography.

The cardiac sonographer should assess the clinical indications and patient history prior to conducting the echocardiogram and form an examination plan. If the indications are unclear or outside the capabilities of the procedure, sonographer or laboratory, the cardiac sonographer should seek further information and/or consult the supervising or referring physician.

It is recommended that blood pressure, height and weight of all patients referred for echocardiography be measured and recorded at the time of examination.

Definitions:

An adult transthoracic echocardiographic examination - Multi-modal diagnostic ultrasonic examination of the adult heart and paracardiac regions from multiple transthoracic acoustic windows. This includes two-dimensional (2D) imaging, M-mode and Doppler (spectral and colour flow) imaging and analysis. 2D imaging without colour flow and spectral Doppler is not acceptable.

A complete echocardiographic examination - An adult transthoracic echocardiographic examination with comprehensive multi-modal evaluation of all cardiac and paracardiac morphology and haemodynamics from multiple transthoracic acoustic windows.

A limited echocardiographic examination (also called a problem/clinically directed, screening, focused or modified examination) - An adult transthoracic echocardiographic examination modified according to clinical indications in exceptional circumstances to acquire specific information. A limited examination does not include all of the detail of a complete study and may be a component of a specialised procedure such as stress echocardiography, pericardiocentesis or be related to post surgical or emergency evaluation. It is usual for a limited examination to have had a recent previous comprehensive examination.

Examination Duration:

- Patient exposure to ultrasound should be minimised in all circumstances.¹⁵
- A complete echocardiographic examination will take 45-60 minutes from patient encounter to patient departure³.

- A limited echocardiographic examination may take less than 45 minutes from patient encounter to patient departure. When the limited examination is a component of a specialised procedure the overall duration may be greater than 45 minutes.

Multiple patient-specific and pathology-specific variables determine the examination duration and it is recognised that examinations of shorter than recommended duration may be adequate while examinations of longer duration may be essential.

Documentation of the Echocardiographic Examination:

The cardiac sonographer is responsible for the documentation of the echocardiographic examination. Documentation of the echocardiographic examination includes entry into a departmental log of examination particulars including patient name, examination date, examination type, file particulars, and indications and observations. A record of imaging should be on video tape or digital storage media. Recorded images must display the patient identification, examination date and institution in which the study was performed and/or reported. Annotation or voice-over is recommended for non-imaging CW or unconventional views. The permanent record should consist of representative cardiac cycles of each cardiac chamber, valve and great vessel using standard 2D, M-mode, colour flow Doppler imaging, as well as pertinent evidence of diagnostic abnormalities.

The duration for which the adult patient record should be stored varies. Local requirements are available from the Health Information Department of public hospitals.

Conventional Transducer Locations and Patient Positioning:

The conventional acoustic windows and patient positions, as listed below, are recommended to be used in conjunction with out-of-plane medial, lateral, anterior and posterior angulated scanning and unconventional positioning as required for a comprehensive evaluation of the heart and paracardiac regions.

- Left parasternal - left lateral decubitus position
- Apical - left lateral decubitus position
- Subcostal – supine with knees flexed
- Suprasternal – supine with neck hyperextended over a pillow
- Right parasternal - right lateral decubitus position

ECG monitoring: Lead II is recommended.

Respirometric monitoring: Recommended for complex Doppler examinations.

2D EXAMINATION AND RECORDINGS

<u>Transducer location</u>	<u>View</u>	<u>Scan</u>
Left parasternal	Long axis	Left and right heart chambers, atrio-ventricular and ventriculo-arterial valves and thoracic aorta
	Long axis oblique	Right heart, outflow tract, pulmonary valve and artery
	Short axis	Pulmonary bifurcation to the left ventricular apex
Apical	Four chamber	Chambers, valves and aorta
	Three chamber	Chambers, valves and aorta

Two chamber Chambers, valves and aorta

Subcostal

Four chamber Interatrial and ventricular septa, hepatic veins and pericardium and abdominal aorta

	Short axis	Interatrial and ventricular septa, hepatic veins, pericardium
Suprasternal	Long axis	Ascending, arch (including main branches) and descending thoracic aorta and pulmonary artery
	Short axis	Ascending, arch (including main branches) and descending thoracic aorta and pulmonary artery Inter atrial and ventricular septa.

2D MEASUREMENTS & CALCULATIONS^{1,2,5.}

The following two-dimensional measurements and calculations are recommended in accordance with the American Society of Echocardiography (ASE) guidelines.¹

Left heart dimensions.

- A quantitative estimation of ventricular systolic performance such as ejection fraction and left ventricular outflow tract systolic dimension for estimation of cardiac output.
- Measurements as required for assessment of valvular pathology.

M-MODE EXAMINATION

<u>Transducer location</u>	<u>Structures examined</u>
Parasternal (long or short axis) Aortic root	Aortic valve Left atrium Left ventricle Mitral valve Right ventricle Pericardium +/- space

Colour flow Doppler may be used in conjunction with M-mode to aid in the timing of haemodynamic events in the cardiac cycle including flow propagation.

M-MODE MEASUREMENTS & CALCULATIONS

The following recordings, measurements and calculations are recommended in accordance with the ASE guidelines.⁶

Measurements:

- Aortic root dimension - end diastole
- Maximal aortic cusp separation
- Left atrial dimension - end systole
- Left ventricular internal dimensions - end diastole and peak systole
- Intraventricular septal thickness - end diastole
- Right ventricular dimension - end diastole

Calculations:

Left ventricular fractional shortening

COLOUR FLOW DOPPLER EXAMINATION AND RECORDINGS

Colour flow Doppler examination using orthogonal acoustic access, usually from the parasternal and apical acoustic windows, should be used to define normal and pathologic haemodynamics in the following:

- Cardiac valves and chambers
- Inflow and outflow vessels (aortic and pulmonary arteries, IVC and SVC)
- Thoracic aorta (ascending, arch and descending)
- Pulmonary artery to bifurcation
- Inter atrial and ventricular septa

COLOUR FLOW DOPPLER MEASUREMENTS AND CALCULATIONS

Measurements as required for the assessment of valvular pathology.

SPECTRAL DOPPLER EXAMINATION AND RECORDINGS

Pulsed-wave (PW) Doppler flow profiles should be acquired from all cardiac inflow veins, outflow tracts and intracardiac valves (atrio-ventricular and ventriculo-arterial).

Continuous-wave (CW) Doppler in either imaging or non-imaging mode is recommended to assess peak transvalvular flow profiles (stenotic and regurgitant) and any pathologic high velocity flow, greater than that which can be unambiguously measured by PW Doppler.

It is specifically recommended that non-imaging CW Doppler be used from multiple transducer locations to assess aortic stenosis.

SPECTRAL DOPPLER MEASUREMENTS AND CALCULATIONS⁴

Spectral Doppler signals are ideally acquired from insonation parallel to blood flow. Timing of cardiac events can be achieved without parallel flow/beam insonation. **Angle correction is not recommended.** Parameters derived from spectral flow profiles, including peak instantaneous velocity, peak instantaneous and mean pressure gradients and time velocity integral (tvi), are used to describe normal and pathologic haemodynamics. The rate of pressure decay (dP/dt) is used to describe specific pathologies including aortic regurgitation and mitral stenosis.

Pulsed-wave Doppler

PW Doppler measurements are recommended in the assessment of:

- Cardiac output (in conjunction with 2D measurements)
- Valves (in conjunction with 2D and continuous-wave Doppler)
- Left ventricular diastolic function

Continuous-wave Doppler

CW Doppler measurements are recommended in the assessment of:

- Stenotic valves
- Regurgitant valves
- Right sided pressure estimates (peak systolic pulmonary artery pressure derived from peak tricuspid regurgitant pressure)

EQUIPMENT RECOMMENDATIONS

Ultrasound Equipment

The minimum recommended requirements for instrumentation are:

- Two-dimensional imaging
- M-mode imaging
- Colour flow M-mode
- Colour flow Doppler imaging
- Pulsed-wave Doppler
- Imaging Continuous-wave Doppler
- Non-imaging Continuous-wave Doppler
- Phased array transducer construction (it is recognised that mechanical transducers are in use but have been superseded by phased array construction in the latest equipment)
- Sector scan of at least 80 degrees
- Image depth at least 24 cm
- Fundamental transducer frequency range of 2.5 MHz -5MHz in single or multiple transducers
- System for permanently recording and reviewing studies

Digital acquisition and storage with offline analysis capabilities are considered to be desirable in new equipment purchases.

Harmonic imaging capabilities are considered essential in new equipment purchases, particularly for laboratories where stress echocardiography is practiced.

Examination Couches

Access to the apical transducer position via a removable section facilitating steep left lateral decubitus patient positioning is desirable. This issue is further covered in the section the Australasian Society for Ultrasound in Medicine (ASUM) Standards of Practice Document "Occupational Health and Safety".

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