

## **Accreditation in Adult Echocardiography**

### **Information Pack**

**This pack is for the use of all candidates undergoing the accreditation process and becomes effective as of March 2015.**

**This document supersedes all previous versions.**



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**Welcome message from Accreditation Chair**

Dear Candidate,

The process underlying Accreditation is set up to assist the echocardiographer in training and it is important that you read all the information carefully before commencing your specific speciality logbook.

The written section of the Assessment is held twice each year in several venues around the UK and Republic of Ireland. The practical assessment will be held 4 times per year in a variety of locations. Full details and registration forms are on the website [www.bsecho.org](http://www.bsecho.org).

We would like every BSE member to undertake the relevant Accreditation process, which has, as its ultimate aim, the achievement and maintenance of high standards of clinical echocardiography for the benefit of our patients.

A list of Accredited members is maintained on the BSE website. The process has to be regulated, and the standard of proficiency required for each specific Accreditation has to be set at a high enough level to command the respect of our professional colleagues. Subject to these constraints, we want to make it possible for as many members as possible to obtain Accreditation, and not to put any unnecessary barriers in their way.

Please let us know if we can assist you in this process.



Jane Lynch  
Chair, BSE Accreditation Committee

## Introduction and Aims

- Accreditation is run as a service for members of the British Society of Echocardiography and is not a compulsory or regulatory certificate of competence or excellence.
- Accredited echocardiographers are expected to be able to perform and report echocardiographic studies unsupervised.
- Accreditation is a minimum requirement and cannot be regarded as a guarantee of competence.
- The accreditation process comprises a written exam (theory and case reporting sections), a practical (logbook and cases submission) assessment which includes a live observed practice assessment.
- Echo skills can only be maintained by continued education and practical involvement in echocardiography. The importance of this underlined by limiting Accreditation to 5 years after which re accreditation must be sought.

## Summary of process requirements

- You must be a member of the British Society of Echocardiography
- You should address all queries regarding accreditation to:  
BSE Accreditation Administrator, address details are available on the website [www.bsecho.org](http://www.bsecho.org), Tel: 020 7345 5185, Fax: 020 7345 5186, Email: [accreditation@bsecho.org](mailto:accreditation@bsecho.org)
- You should register for the written and practical assessment using the form found on the BSE website. This will advise the date and location of the next examination.
- You must pass the written assessment before attending the practical assessment (logbook and cases)
- The practical assessment cases should be collected over a period of no more than 24 months around the written examination and the practical assessment being taken at the end of the collection period. You must submit:
  - 5 full cases accompanied by reports signed by yourself
  - A logbook containing 250 reports of a specific case mix (or 150 cases if you hold BSE TOE Accreditation)
  - The full mentor sheet -appendices 6.
- Extensions to the 24 month deadline may be granted only following periods of maternity or extended sick leave or in exceptional circumstances. Extension requests must be submitted in writing to the Chair (c/o the accreditation administration office) **before the case COLLECTION deadline**. Extension request forms can be obtained by contacting the BSE Accreditation Administrator. Requests received after the case deadline may not be reviewed.
- EXTENSIONS ARE NOT GUARANTEED. A non-refundable charge of £100 will be made for each extension request regardless of the outcome.

- A fee of £150 is charged for the complete Accreditation process. This fee is payable, in advance upon registration for the written section of the examination and will also cover the logbook submission. Candidates who are unsuccessful in the written section of the examination will be charged a reduced fee of £75 to re-sit this section. This reduced fee only applies to candidates who re-sit the examination within two sittings of the unsuccessful attempt. Resubmission of logbook reports/cases is subject to a fee of £75. Candidates are entitled to 1 resubmission in the practical assessment, after which the entire process must be undertaken again.
- The full training syllabus is available in appendix 2.
- Appeals - Please see the Appeals section on the website for details.

### **Details of written assessment and practical assessments**

#### **Written section**

- The written assessment is held on two occasions each year. The Spring and Autumn examination is held at multiple locations. Full details of dates and venues, and registration forms, are circulated with the BSE Newsletter and on the BSE website.
- The written assessment is conducted under formal examination conditions. It is comprised of two parts: the Theory section and the Reporting section. The suggested reading list is available in appendix 1.
- Both parts of the examination will be computer marked - guidelines in appendix 5.
- In the written assessment it is necessary to pass both the multiple choice and imaging questions at the same exam sitting. The approximate pass mark for the Theory Section is 95/125 marks (76%) and for the Reporting Section 30/50 (60%).
- There is no bar to re-sitting the written assessment.
- Accreditation will only be awarded once a candidate has also successfully completed the practical assessment (logbook and cases). A satisfactory performance at the written assessment alone does not allow 'partial accreditation'.

#### **Theory Section**

- This consists of 25 questions which must be answered within 60 minutes. The questions test knowledge of echocardiographic findings with some additional questions on basic cardiology and up to 5 questions on physics.
- The subject matter reflects the spectrum of clinical practice according to both frequency and technical complexity. Thus valve disease is more frequently represented than ischaemic disease since, though seen less commonly in clinical practice, it presents a greater challenge to the echocardiographer.
- This part of the examination will be marked +1 for correct answers, 0 for incorrect or unanswered questions (no negative marking).
- There are no 'trick' questions.
- Each question comprises a brief statement followed by 5 questions relating to the statement. Candidates are required to say whether each question is 'true' or

'false' a blank response is used for 'don't know'. Some example questions are provided in Appendix 3.

- There are no fixed number of correct answers i.e. for each question it is possible for every answer to be false or every answer to be true, or any combination of true or false.
- The maximum possible mark is 125.

### Reporting (imaging)

- This will consist of 50 questions, typically 5 questions on each of 10 case studies. Each question will have 4 possible answers and candidates will be asked to select the best answer. These reflect the range of clinical material seen in routine echocardiographic practice. Normal or near-normal studies may be presented.
- Each case will have 5 associated MCQ questions asking the candidate to select the best response from four answers (single best answer). The clips and stills will last 1-3 minutes, and will contain sufficient information to answer the questions.
- An example question is provided in appendix 4. Each case is worth a total of 5 marks giving a total of 50

### Practical assessment

- All candidates will be required to attend a Practical assessment at the end of collecting their cases over 24 months. The written examination must have been passed before attending. The Practical assessment will be held 4 times per year. Dates and locations will be published on the BSE website. Candidates will be given an appointment time and should arrive at the venue up to 30 minutes prior to this. Latecomers will only be admitted in exceptional circumstances. The assessment will consist of 3 Stations. The first station will be the Logbook station.
- **Logbooks and cases must be fully anonymised – please read the BSE Policy on the Non-Anonymisation of Patient data in appendix 12. A major breach of this policy will result in a fail.**
- Logbook submission: The Logbook should be submitted in **one ring binder/file folder with the different categories separated by dividers**. Any Logbooks **not** submitted in this format will fail. Further details regarding logbook can be found on page 7.
- If the candidate is successful at this station they will progress to Station 2.
- Station 2 will consist of a practical assessment. The candidate will be asked to acquire a number of views on a normal volunteer. The assessor will be present in the room and may help adjust the echo machine buttons as directed by the candidate if the machine is unfamiliar. This will be done in a specified timescale.
- The candidate will be informed which views will be required prior to the assessment day. If the candidate is successful in obtaining the required views to the required standard, the candidate will progress to Station 3. Station 3 will be a Viva assessing the video cases. Further details can be found on Page 8. If the candidate is successful at station 3, they will be deemed to have passed the Accreditation process and will receive their certificate in the post shortly afterwards.

- Your practical section should be testified by an experienced echocardiographer.

### Logbook

- The Logbook should comprise details of 250 **transthoracic** cases personally **performed and reported** by you during the specified period of 24 months (or 150 cases if you hold BSE TOE Accreditation). It is not acceptable to include cases reported by you that have been performed by someone else.
- The format for the Logbook is a set of copies of actual clinical reports enclosed in a folder or binder. The reports should ensure:
  - **All** patient data has been removed including: full date of birth, name or address. See appendix 12
  - All cases have been collected in accordance with local requirements for data protection i.e. your trust policy.
  - Inclusion of cavity and Doppler measurements, objective observations and a comment - appendices 7 and 8.
  - The signature and full name of the candidate is included. At least the final 150 cases should be reported primarily by the candidate alone although they may be checked by another operator.
- The studies should reflect the normal case-load of a general adult department with the following constraints:
  - At least 25 cases should be for left ventricular function assessment.
  - At least 50 cases should be for valve disease assessment.
  - At least 10 should show replacement valves.
  - At least 10 should be for assessment of the right ventricle.
  - At least 5 should show pericardial disease/effusion.
  - At least 5 should show diseases of the aorta (e.g. aortic root or ascending aorta dilatation, aortic dissection).
  - There should be at least 5 cases of suspected endocarditis.
  - At least 5 should show left ventricular hypertrophy.
  - There should be at least 5 cases of cardiomyopathy including at least 2 with hypertrophic cardiomyopathy.
  - There should be some cases showing mass or thrombus.
  - There should be some cases of simple congenital disease (e.g. ASD)
  - No more than 20 studies should be specialised studies (e.g. Stress or Bubble Contrast). These studies are not a compulsory inclusion in your logbook, however if you do include any, there should be no more than 20 in total.  
No more than 25 studies should be completely normal.
- The different categories of echoes should be separated by dividers.
  - A tally of the primary diagnosis assigned to each case must be entered on the appropriate enclosed summary sheet - appendix 9.

- If possible there should be one or more examples of unusual diagnoses such as myxoma. More than one candidate from the same institution is permitted to study the same patient if the diagnosis is unusual but each candidate must independently scan and do their own report.
- If you have problems finding enough specific cases, discuss this with your mentor who may consider arranging for you to attend a larger centre.

### Case Submission

- Five full studies with reports must be submitted. The cases **must** be anonymised. This is the section that is often done least well and is where many candidates fail. It is worth spending extra time doing this to make sure the submission is as good as it can be. Remember that it is assumed you will submit your best cases, so we will expect the studies to be complete and of a high standard. Also, remember we are assessing your echo skills not the pathology you are sending in. The following diagnoses and minimum criteria's are required:
  - A normal study demonstrating appropriate use of machine settings for optimal imaging and correct use of standard views as per BSE minimum dataset (parasternal, apical, subcostal, suprasternal), M Mode (minimum Ao/LA, MV, LV) and 2D, CW, PW and Colour Doppler to assess chambers and valves.
  - Moderate or severe aortic stenosis (you must include a good demonstration of the use of the stand alone CW Doppler probe from apical and either right parasternal or suprasternal). You should also calculate the valve area using the continuity equation and show all measurements used in the calculation.
  - Moderate or severe mitral or aortic regurgitation carefully demonstrating quantification of the degree of regurgitation as per BSE guidelines.
  - Previous or recent myocardial infarct describing regional wall motion abnormalities and carefully quantifying overall ejection fraction using the Simpson's Biplane method. You must show the measurements taken in diastole and systole in both apical 4 chamber and 2 chamber views.
- The fifth case should show an example of one of the following:
  - a) Prosthetic valve with size and type noted and reference to normal values for that specific valve
  - b) Mass or thrombus with differential diagnoses
  - c) simple congenital eg ASD, VSD or PS
  - d) significant LVH including Amyloid, HCM

There will be a limited number of PCs available to review these cases. In order to ensure that your cases play properly at the assessment it is recommended that you bring your own laptop to the centre having checked that the cases play on this.

- The studies must demonstrate all appropriate echocardiographic views and must show the methods of measuring all dimensions on M-mode or 2D and all parameters on Doppler echocardiography.
- **All** cases must have patient data removed. Some machinery cannot do this post-examination so please ensure due care is taken to put 'case 1' instead of patient's name or patient's personal details. Alternatively you may wish to use descriptions of pathology such as "aortic stenosis". It does not matter so long as it is very clear to the marker.
- Please ensure that each case presented is clearly labelled so that the marker is able to easily match the case with the report.
- Reports should include quantitative measurements, observations and a conclusion or summary.
- The candidate must demonstrate the appropriate use of a stand-alone continuous wave probe, and the use of standard Doppler equations.
- The cases must be submitted as digital loops and stills within a PowerPoint presentation.
- A guide to getting the cases right is available in appendix 10.
- Cases that are of high quality may be copied to be used in subsequent BSE written exams.

### **Appendix 1 -Suggested Reading List**

The syllabus is set by the Accreditation Committee of the British Society of Echocardiography and is presented as a guide to candidates.

The reading list is provided by the Accreditation Committee of the British Society of Echocardiography.

There are many excellent books on echocardiography and some examples are listed below. In addition to those listed there are many small basic texts which are a useful introduction to the subject.

- Authoritative textbooks (starting with the simpler texts as a suggestion)
- Echo made Easy Sam Kaddoura Churchill Livingstone 2001 ISBN 0443061882
- Echocardiography: Guidelines for reporting – a practical handbook Helen Rimington and John Chambers Taylor & Francis 1998 ISBN 1850700117
- Cardiac Ultrasound Leonard M Shapiro & Antoinette Kenny Manson Publishing 1999 ISBN 1874545081
- Feigenbaum's Echocardiography H. Feigenbaum Lippicott, Williams & Wilkins 2004 ISBN 0781731984
- Textbook of Clinical Echocardiography Catherine Otto W. B. Saunders 2004 ISBN 0721607896

**Useful review articles:**

- Wranne B, Baumgartner H, Flachskampf FA, Hasenkam M, Pinto F. Stenotic lesions (editorial). *Heart* 1996; 75 (Suppl.2);36-42. Downloadable from <http://heart.bmjournals.com/supplements.shtml>
- M Enriquez-Sarano, C Tribouilloy. Quantitation of mitral regurgitation: rationale, approach, and interpretation in clinical practice. *Heart* 2002; 88 (Suppl 4): iv1-iv3. Downloadable from <http://heart.bmjournals.com/supplements.shtml>
- S Y Ho Anatomy of the mitral valve. *Heart* 2002; 88 (Suppl 4): iv5-iv10. Downloadable from <http://heart.bmjournals.com/supplements.shtml>
- T Irvine, X K Li, D J Sahn, A Kenny. Assessment of mitral regurgitation. *Heart* 2002; 88 (Suppl 4): iv11-iv19. Downloadable from <http://heart.bmjournals.com/supplements.shtml>
- D Pellerin, S Brecker, and C Veyrat. Degenerative mitral valve disease with emphasis on mitral valve prolapse. *Heart* 2002; 88 (Suppl 4): iv20-iv28. Downloadable from <http://heart.bmjournals.com/supplements.shtml>
- Gardin JM, Adams DB, Douglas PS, Feigenbaum H, Forst DH, Fraser AG, Grayburn PA, Katz AS, Keller AM, Kerber RE, Khandheria BK, Klein AL, Lang RM, Pierard LA, Quinones MA, Schnittger I; American Society of Echocardiography. Recommendations for a standardized report for adult transthoracic echocardiography: a report from the American Society of Echocardiography's Nomenclature and Standards Committee and Task Force for a Standardized Echocardiography Report. *J Am Soc Echocardiogr.* 2002 Mar;15(3):275-90. Downloadable from [www.asecho.org](http://www.asecho.org)
- Zoghbi WA, Enriquez-Sarano M, Foster E, Grayburn PA, Kraft CD, Levine RA, Nihoyannopoulos P, Otto CM, Quinones MA, Rakowski H, Stewart WJ, Waggoner A, Weissman NJ. Recommendations for Evaluation of the Severity of Native Valvular Regurgitation with Two-dimensional and Doppler Echocardiography. *J Am Soc Echocardiogr* 2003;16:777-802. Downloadable from <http://www.asecho.org/freepdf/valvularregurg.pdf>
- Cheitlin MD, Armstrong WF, Aurigemma GP, Beller GA, Bierman FZ, Davis JL, Douglas PS, Faxon DP, Gillam LD, Kimball TR, Kussmaul WG, Pearlman AS, Philbrick JT, Rakowski H, Thys DM. ACC/AHA/ASE 2003 guideline update for the clinical application of echocardiography—summary article: a report of the American

College of Cardiology/American Heart Association Task Force on Practice Guidelines (ACC/AHA/ASE Committee to Update the 1997 Guidelines on the Clinical Application of Echocardiography). *Circulation*.2003

- [http://www.acc.org/clinical/guidelines/echo/summary\\_article.pdf](http://www.acc.org/clinical/guidelines/echo/summary_article.pdf)
- BSE website [www.bsecho.org](http://www.bsecho.org), downloads, BSE Echo report – Recommendations.

## **Appendix 2 -Training syllabus for BSE accreditation**

Topics that maybe included in the multiple choice examination

General Concepts

### **1. The place of echocardiography**

Clinical role of echocardiography and Doppler

- Information that echocardiography can, and cannot provide 'Ruling out' pathology (sensitivity, specificity & Baye's theorem)
- Likelihood of findings influencing patient management
- Undesirable outcomes: inaction while waiting for results, clinical 'red herrings'
- Indications for echocardiography
- Competing and complementary technology
- Cardiac catheterisation (ventriculography and coronary angiography) C-T imaging
- Magnetic resonance imaging
- Nuclear Cardiology

#### **1.1 Service Provision**

- Advantages/disadvantages of technician-led versus physician-led service
- Costs: fixed and variable
- Provision and indication for specialised techniques, e.g. TOE. Stress echo, Contrast echo
- Availability and access
- Controlling workload
- Training & motivation of staff
- Audit, Quality Control, Clinical Governance
- Infection control

#### **1.2 Relationship with patients**

- Explaining the procedure in terms relevant to the particular patient
- Respect for patients' dignity and cultural backgrounds
- Relationships with colleagues
- Handling requests for information about the study findings

#### **1.3 Reporting and Documentation**

- Standard methods & terminology
- Distinction between Technical and Clinical reports
- Responsibility for reporting Medico-legal considerations(Data Protection Act)

## **2. Imaging Physics & Instrumentation**

### **2.1 Concepts and Terminology**

- Concept of compression waves

- Definitions: frequency, wavelength, propagation velocity
- Units of measurement: Hz and MHz
- Decibel Comparison of Ultrasound with audible sound.

## **2.2 Propagation of ultrasound through tissues**

- Speed of sound in different body tissues.
- Frequency range used for diagnostic imaging
- Distinction between specular reflection and backscatter
- Principles of attenuation and scattering

## **2.3 Ultrasound Transducers**

- Piezo-electric effect
- General concepts of 2D and 3D transducer construction
- Characteristics of the ultrasound beam: Far (Fraunhofer) & Near (Fresnel) zones, side lobes
- Beam steering methods: mechanical & electronic
- Focusing methods, including dynamic receive focusing
- Focus position and use of dual focus
- The role of intracardiac echocardiography

## **2.4 Imaging physics**

- Factors affecting choice of imaging frequency: typical practical values for adults & children
- Broad-band imaging
- Harmonic imaging
- B mode and M Mode methods.
- Curved Anatomical M Mode
- Scanning speed limitations, relationships between pulse repetition frequency, frame rate, lines per frame, field of view, depth to be imaged.
- Concept of Parallel Processing and its influence on frame rate and image quality
- Effect on evaluation of rapid motion
- Temporal resolution.
- Grey scale and dynamic range
- Measurement and optimisation of Resolution: axial, azimuthal and elevation
- Lateral resolution and grating artefacts
- Reverberation artefacts
- Limiting factors for detecting small targets

## **2.5 Echo Instrumentation**

- Function of machine controls: Transmit power; overall gain; time gain compensation; reject, logarithmic compression, signal processing, dynamic range, pre-processing; post processing
- Optimisation of imaging parameters, including transducer frequency, scan angle, gamma correction, spatial and temporal smoothing

- Optimisation of 3D volume acquisitions including cropping and manipulation of viewing plane
- The advantages of 3D echocardiography over 2D echocardiography e.g. appreciation of mitral valve pathology, elimination of geometric assumptions in cardiac chamber volume estimations

## 2.6 Optimising Images

- Use of gel (infection risk from transducer, operator)
- Positioning of the subject
- Standard views: Parasternal, apical (4, 5 and 2-chamber), subcostal, suprasternal, right parasternal), long and short axis
- Use of non-standard views
- Adapting for subjects with difficult echo windows, ventilated patients, ward-based echo's, emergency room echos

## 2.7 Storage and Display of Images

- Basic concept of digital acquisition and storage systems. Scan converters and digital memories.
- Display devices and controls, recording techniques

## 3. Doppler physics & fluid dynamics

### 3.1 Basic Fluid Dynamics

- Fluid flow: significance of peak & mean velocities
- Determination of volumetric flow Continuity equation
- Laminar & turbulent flow: Reynolds' equation (qualitative)
- Transition from Laminar to turbulent flow: inlet jet Bernoulli equation

### 3.2 Principles of Doppler

- Interaction of ultrasound waves with moving blood: the Doppler effect
- The Doppler equation: factors influencing magnitude of Doppler shift
- Spectral analysis: fast Fourier transform (qualitative)
- The spectral Doppler display: determination of mean, modal and peak velocities
- Limitation of CW Doppler caused by lack of depth discrimination
- Audible range of Doppler shift frequencies
- The effect of beam angle errors on Doppler velocities
- Aliasing: how it is caused and how it manifests in practice: the Nyquist limit
- Influence on aliasing of: transducer frequency; sample depth (range x velocity product); and beam angle
- High pulse repetition frequency (extended range) PW Doppler and the phenomenon of range ambiguity
- Relative advantages and disadvantages of CW, PW and HPRF modes
- Concept of colour flow imaging as multi-sampled PW
- Velocity estimation, by moving target indication and autocorrelation (qualitative)
- Limitations of mean velocity: use of velocity variance to show high

- Aliasing in colour Doppler
- The principles of pulse wave tissue Doppler
- Packet size, colour mode and sector size and their effect on frame rate and aliasing

#### **4. Deformation Analysis**

##### **4.1 Principles of Myocardial Deformation**

- The definition of displacement, velocity, strain and strain rate
- The cardiac ultrasound co-ordinate system for describing motion and deformation: longitudinal, radial, circumferential and rotational axes
- Quantifying myocardial deformation as opposed to velocity or **displacement**
- Concept of shear deformation; rotation of the base and apex of the left ventricle, and the resultant twisting deformation or torsion

##### **4.2 Quantifying myocardial strain and strain rate by tissue Doppler**

- The concept of the myocardial velocity gradient
- The concept of strain and strain rate to define deformation
- Tissue Doppler imaging for deriving strain and strain rate: practical parameters in measuring strain and strain rate (e.g. sample size and shape, offset distance, drift compensation, spatial and temporal averaging, tracking of sample volume)
- Reproducibility issues

##### **4.3 Speckle Tracking Echocardiography/2D strain**

- Familiarity with the concept of speckles and speckle tracking in greyscale 2D loops
- Speckle tracking for angle-independent derivation of velocities, displacement, strain and strain rate, in 2 dimensions
- The impact of frame rates on the quality of speckle tracking
- Speckle tracking vs. tissue Doppler techniques for assessing myocardial motion and deformation
- Speckle tracking for measuring left ventricular rotation and torsion
- Kindred technologies

#### **5. Doppler instrumentation**

##### **5.1 Spectral Doppler Instrumentation**

- Duplex Doppler using imaging transducers
- The 'Stand-alone' Doppler probe
- Features of the spectral display: positive & negative velocities; scale & baseline controls.
- Effect of high-and low-pass filter and intensity threshold ('reject') settings
- Pulsed Doppler sample volume: influence of gate length and distance (beam width)
- Representation of signal strength by image intensity

spectral display

- How aliasing manifests on the

## 5.2 Colour Flow Instrumentation

- The colour display: BART convention
- Colour maps to show velocity scales
- Image domination and additive colour modes
- Difference between velocity and power (signal amplitude) displays
- Basic principles of Tissue Doppler Imaging, including optimisation of filters for detecting tissue versus blood velocities, sample volume and size, impact of interrogation angle on measured velocities, minimising aliasing, and maximising frame rates to detect short duration myocardial motion
- Differences between colour Doppler tissue Doppler Imaging and pulsed wave tissue Doppler imaging
- Minimisation of myocardial translational movements during acquisition.
- The concept of tracking on colour Doppler tissue Doppler imaging to ensure that sample volume remains in the region of interest
- Parametric (curved M-mode) display of tissue Doppler images
- The relevance of importing cardiac cycle time points, such as aortic valve closure, into tissue Doppler traces

## TOE Instrumentation

- Transducer types: single plane, biplane, multiplane
- Optimising machine settings for TOE Patient monitoring for TOE and general safety considerations
- Control of infection

## Safety of ultrasound

- Potential hazardous biological effects: heating, resonance and cavitation effects
- Measurement of beam intensity (SPTA)
- Practical precautions: power levels, use of colour and CW Doppler

## Recording methods

- Advantages/disadvantages of recording on videotape and digitally
- Basic understanding of digital image processing and recording methods: pixel density, volume of data, the DICOM standard, concept of data compression (JPEG, AVI, etc), archiving of echocardiographic studies on magneto-optical discs, CD/DVD, portable solid-state memories, ECG-gated acquisitions vs. continuous recording, facility to review acquired loop prior to storage, facility to choose the number and type of cardiac cycles to be recorded, facility for offline image properties adjustment and further quantitative analysis.

## 6. Cardiac Anatomy and Physiology

### 6.1 Anatomy of the thorax

- Thorax contained by rib cage & diaphragm

- Lungs & pleura; heart & pericardium; mediastinum
- Blood vessels within the thorax

## **6.2 Gross anatomy of the heart**

- Basic cardiac embryology
- Nomenclature of chambers and valves
- Major relationships of chambers, valves and blood vessels
- Distinguishing features of valves and chambers as related to echocardiography
- The pericardial sac

## **6.3 Cardiac anatomy and physiology as demonstrated by echocardiography**

- Detailed structural anatomy of the heart, great vessels and pericardium
- Visualisation of normal cardiac anatomy and normal variants in standard echocardiographic planes
- Normal valve function, normal Doppler parameters and normal variants
- The phases of atrial function: reservoir, conduit and contractile phases
- The LV remodelling process in response to disease: eccentric (chronically elevated preload) vs. concentric hypertrophy (chronically elevated afterload)

## **6.4 The Cardiac Cycle**

- Temporal relationships of the ECG, chamber pressures and valve movements
- Typical values for intracardiac pressures
- Relationship of valve movements to heart sounds
- Identification of valve opening and closure signals on Doppler recordings
- The timing of aortic valve closure as a marker of end-ejection, as derived from M-mode, blood flow Doppler or tissue Doppler

## **7. Cardiac functional parameters**

### **7.1 Measurements and calculations**

- On-screen measurement of length, slope, area, volume and time interval, and their significance for 2-D, 3D images, M-mode and spectral Doppler displays
- Standard M-mode measurements (including MAPSE) and calculations, both using machine software and manual methods
- Derivation of Stroke Volume, Ejection Fraction and LV Mass
- Methods of measuring LV volume, including biplane area, area-length, Simpson's rule methods and 3D.
- Limitations of single plane estimations of LV ejection fraction e.g. Teicholtz formula method
- Limitations of single plane measurements of LA size
- Geometric assumptions used in estimation of cardiac chamber volumes with M mode and 2D imaging
- The advantages of deriving volumes and ejection fraction by 3D echocardiography
- Limitations of measurement and/or calculation validity in presence of poor quality

and/or off-axis images

## **7.2 Doppler determination of cardiac output, ejection time and velocity acceleration**

- Methods of measuring diastolic dysfunction: E/A ratio, deceleration time, pulmonary venous flow patterns, the ratio of the peak early diastolic transmitral velocity and the peak early diastolic tissue velocity of the mitral valve annulus (the E/E' or E/Ea) ratio for estimating LV filling pressures, the mitral valve propagation velocity
- Peak and Mean pressure gradient measurements by Doppler and their relationship to catheterisation data
- Measurement of pulmonary pressures from tricuspid and pulmonary regurgitant flow velocities and assessment of inferior vena cava contraction during inspiration

## **8. Contrast Studies**

- Significance of spontaneous echo contrast
- Optimisation of machine control settings for detecting contrast
- Main indications for a bubble contrast study: diagnosis of intracardiac shunts and PFO, diagnosis of left sided SVC
- Manoeuvres to provoke right –to-left passage of bubbles during assessment for PFO
- Relevance of injecting bubble contrast through upper arm vein vs. femoral vein for detecting PFO
- Technique for performing a hand-agitated contrast study
- Clinical precautions

### **8.1 Awareness of encapsulated contrast agents and techniques**

- Interaction of ultrasound with encapsulated agents
- Generation of harmonic energy by bubble distortion and fracture
- Doppler signals generated by bubbles (Power Mode)
- Main indications for LV and RV opacification: enhancing endocardial definition for assessment of regional contractility and accurate cardiac volume estimations, detection of intracardiac masses, distinguishing thrombus from a vascular tumour, diagnosis of cardiomyopathies e.g. non-compaction, arrhythmogenic right ventricular dysplasia, Doppler enhancement
- Use of contrast in stress echocardiography for improving detection of wall motion abnormalities and for assessment of myocardial perfusion

## **9. Pathology**

### **9.1 Mitral Valve Disease, 2D, 3D, M-mode and Doppler features of the normal mitral valve**

- Mitral Stenosis
- Recognition of rheumatic mitral stenosis
- Qualitative description of valve and sub-valve calcification and fibrosis
- Measurement of orifice area by planimetry
- Factors favouring successful balloon valvuloplasty
- Doppler assessment of mean and end-diastolic gradient
- Doppler assessment of area by 'pressure half-time': technique and limitations
- Role of exercise echocardiography in assessing the change in transmitral gradient and pulmonary systolic pressures with exercise, as decision aid in the timing of surgery/balloon valvuloplasty

## 9.2 Mitral regurgitation

Assessment of severity by:

- Chamber sizes and volume overload
- CW Doppler – shape and density of contour of Doppler signal
- Vena contracta, PISA and effective regurgitant orifice area
- Size of colour jet relative to atrial size by colour flow Doppler Regurgitant fraction , regurgitant volume
- Pulmonary vein flow patterns
- Indirect effects on LV and LA
- Role of echocardiography in determining timing of surgery for primary mitral valve disease: ejection fraction, end-systolic LV diameter, EROA
- Role of TOE in assessing mitral valve pathology and in determining likelihood of repair as opposed to replacement

## 10. Aortic Valve Disease

### 10.1 2D, 3D, M-mode and Doppler features of the normal aortic valve

### 10.2 Aortic Stenosis

Aetiologies and echocardiographic features:

- Rheumatic
- Bicuspid
- Senile degenerative
- Sub-and supra-valve obstruction
- Assessment by CW Doppler
- Peak and Mean gradients
- Apical, right parasternal and suprasternal positions
- Continuity equation
- Assessment of left ventricular hypertrophy and use of stress echocardiography for distinguishing fixed anatomical stenosis from pseudostenosis in low flow aortic stenosis and for assessing LV contractile reserve
- Difference between transaortic pressure gradients derived from echocardiography

and from cardiac catheterisation

### **10.3 Aortic Regurgitation**

Aetiologies and typical echocardiographic features of:

- Rheumatic
- Bicuspid valve
- Aortic root disease
- Infective endocarditis (including root abscesses)

Assessment of severity by:

- Chamber sizes/volume overload (regurgitant volume, regurgitant fraction)
- CW Doppler – shape and density of contour of Doppler signal, pressure half time
- Colour Doppler – size of jet relative to left ventricular outflow tract diameter
- Vena Contracta
- Effective regurgitant orifice area
- Diastolic flow reversal in descending aorta
- Indirect effects on LV
- Role of echo in determining timing of surgery
- Role of TOE in assessing aetiology and severity

## **11. Tricuspid Valve Disease**

### **11.1 2D, M-mode and Doppler features of the normal tricuspid valve**

#### **11.2 Rheumatic tricuspid valve stenosis**

- Echocardiographic features
- Assessment of severity by imaging and Doppler

#### **11.3 Tricuspid Regurgitation**

Aetiologies and echocardiographic features of:

- Rheumatic
- Prolapse
- Congenital
- Endocarditis
- Carcinoid
- Functional

Assessment of severity by:

- 2D imaging and M-mode
- CW Doppler – shape and density of contour of Doppler signal
- Colour Doppler
- Hepatic vein flow pattern

- Indirect effects on RV and RA

## **12. Pulmonary Valve Disease**

### **12.1 2D, M-mode and Doppler features of the normal pulmonary valve**

### **12.2 Pulmonary Valve Stenosis**

- Echocardiographic features

Assessment of severity by:

- Spectral Doppler
- Detection of infundibular obstruction by spectral Doppler

### **Pulmonary Regurgitation**

- Aetiologies and echocardiographic features

Assessment of severity by

- CW Doppler – deceleration rate, density and contour of Doppler signal
- Colour Doppler
- Indirect effects

### **Infective Endocarditis – Risk factors for I.E**

- Typical echocardiographic appearance of vegetations in bacterial and fungal endocarditis
- Preferred locations for vegetations
- ‘Jet’, ‘kissing’ lesions
- Endocarditis associated with congenital disease and HCM
- Complications: abscess, fistula, perforation, valve regurgitation
- Role of TOE in suspected endocarditis
- Monitoring of IE

## **13. Prosthetic Valves**

### **13.1 2D, M-Mode and Doppler features of the main types of replacement valves**

- Tilting Disc
- Bi-leaflet
- Ball & cage
- Bioprostheses (stented and stentless)
- Age-related deterioration of bioprostheses
- Role of TOE in examining normal and malfunctioning prosthetic valves

### **13.2 Prosthetic valve stenosis**

- Assessment by 2D, M-mode and Doppler
- Normal ranges
- Use of Continuity Equation for aortic prostheses
- The phenomenon of pressure recovery
- The diagnosis of patient-prosthesis mismatch

### **13.3 Prosthetic valve regurgitation**

- Trans-versus para-valvar regurgitation
- Normal versus abnormal regurgitation
- Assessment by CW, PW and Colour
- Doppler Colour artefacts from mechanical prostheses

## **14. Cardiomyopathies**

### **Dilated Cardiomyopathy**

#### **14.1 2D, M-mode and Doppler features of dilated cardiomyopathy**

- Detection and assessment of associated lesions:
- Functional valve regurgitation
- Thrombus in cardiac chambers
- Pericardial effusions
- Role of echocardiography in assessment and follow-up

#### **14.2 Hypertrophic Cardiomyopathy**

- 2D, M-mode and Doppler features of Hypertrophic Cardiomyopathy
- Differentiation from other causes of hypertrophy, e.g. hypertension, athletic heart', amyloidosis, Fabry's disease, Friedreich's ataxia cardiomyopathy
- Techniques for measurement of left ventricular wall thickness, detection of left ventricular outflow tract obstruction and intracavity gradient
- Assessment of right ventricular involvement
- Associated abnormalities, e.g. systolic anterior motion mitral valve

#### **14.3 Restrictive Cardiomyopathy**

- Causes e.g. primary amyloidosis, sarcoidosis, idiopathic, endomyocardial fibrosis
- 2D, Doppler & TDI features of impaired ventricular filling – increased ventricular wall thickness, dilated atria, increased E/A ratio, reduced deceleration time, increased E/E' ratio, reduced S'

#### **14.4 Main features of LV non-compaction**

#### **14.5 Intracardiac Masses**

- Typical locations for formation of intracardiac thrombus
- Echocardiographic features of typical LA Myxoma
- Differentiation of myxoma from other cardiac tumours
- Features suggestive of malignancy
- Role of TOE in assessment of intracardiac masses
- Role of contrast in the assessment of intracardiac masses

## **15. Pericardial Disease**

### **15.1 Anatomy of the normal pericardium**

- Relationships of serous pericardium to heart and great vessels
- Transverse and oblique sinuses of the pericardium

### **15.2 Echocardiographic features of pericardial fluid**

- Location of fluid in relation to patient position and fluid volume
- Differentiation from pleural effusion
- Assessment of volume of pericardial fluid
- Role of echocardiography in pericardiocentesis

### **15.3 Features of tamponade**

- Collapse of RA and/or RV walls
- Effect on IVC and hepatic vein flow pattern
- Effect on A-V valve flow velocities during respiratory cycle

### **15.4 Features of pericardial constriction**

- Pericardial thickening/appearance
- Effect on A-V valve flow velocities
- Effect of respiration
- SVC/hepatic vein flow
- Differentiation from restrictive cardiomyopathy including use of tissue Doppler

## **16. Coronary Artery Disease and Systolic LV function**

- Anatomy & nomenclature of the major branches of the coronary arteries
- Relationship of coronary anatomy to standard echocardiographic imaging planes
- Nomenclature for describing myocardial segments (16 & 17 segment model)
- Analysis of segmental systolic myocardial function
- Use of stress echo to assess for myocardial ischaemia
- Diastolic dysfunction in coronary artery disease

Global measures of LV function:

- Ejection Fraction
- Stroke Distance
- Stroke Volume and Cardiac output
- Use of tissue Doppler and speckle tracking echocardiography for assessment of



regional myocardial velocities and

deformation in ischaemic heart disease, at rest and with stress

- Longitudinal function of the left ventricle, as assessed by M-mode (MAPSE) and tissue
- Doppler of the mitral valve annulus
- The concept of post-systolic contraction
- The concept of isovolumic acceleration by tissue Doppler
- Left ventricular torsion and its implications for systolic function of the LV

### **17. Diastolic function of the LV**

- The 4 stages of diastolic dysfunction as assessed by transmitral flow Doppler (including DT); impaired filling pattern and restrictive flow pattern
- The limitations of transmitral flow

Doppler for assessing diastolic dysfunction:

- Effect of LA
- Pressures and pseudonormalisation, effect of mitral regurgitation
- The use of Valsalva manoeuvre in reducing LA pressures to differentiate normal from pseudonormal transmitral
  
- Flow Doppler patterns
- The use of left atrial size, IVRT, tissue Doppler (diastolic longitudinal velocities of the mitral valve annulus, the  $E/E'$  ratio), pulmonary vein flow pattern and mitral propagation velocity for assessing diastolic function
- The importance of untwisting in left ventricular filling

### **18. LV dyssynchrony and assessment by echocardiography**

- Techniques for measuring interventricular and intraventricular dyssynchrony for predicting response to cardiac resynchronisation treatment
- Tissue Doppler quantitation of intraventricular dyssynchrony and their limitations
- Techniques for optimising settings of the cardiac resynchronisation device after implantation

### **19. Stress Echocardiography**

- Indications and basic knowledge of techniques for exercise, dobutamine or vasodilator stress echocardiography
- Exercise or pharmacological stress echocardiography for diagnosis of ischaemic heart disease and myocardial viability
- The concept of viable and hibernating myocardium, and the relevance of the various responses of the myocardium to stress
- The concept of contractile reserve
- The American Society of Echocardiography regional wall motion scoring system
- Dobutamine stress echo in 'low flow' aortic stenosis

- Exercise stress echo in valvular heart disease and pulmonary hypertension

## **20. Myocardial Infarction and its sequelae**

- 2D, 3D, M-mode and Doppler features of: post-infarction VSD
- Mitral papillary muscle rupture
- Tamponade
- Mural thrombus
- Myocardial scarring
- Dressler's syndrome
- Left ventricular aneurysm – true aneurysm vs. pseudoaneurysm
- Main features of stress-induced (Takotsubo) cardiomyopathy as differential diagnosis of acute myocardial infarction

## **21. Pulmonary Hypertension and functional assessment of RV**

- 2-D, M-mode and Doppler features of pulmonary hypertension
- Aetiologies: primary; post pulmonary embolism; secondary to left-sided lesions; lung disease
- Assessment of global systolic function of the RV: Tricuspid annular peak systolic excursion by M-mode (TAPSE), fractional area change of the RV, tissue Doppler of the RV
- Right ventricular dysfunction in pulmonary embolism, chronic pulmonary diseases, cardiomyopathy, Eisenmenger's syndrome, and systemic right ventricle

## **22. Diseases of the Aorta**

Technique for examining the ascending and descending thoracic aorta  
Echocardiographic features of the normal aortic root, sinuses of Valsalva, ascending aorta and aortic arch  
2-D, M-mode and Doppler features of:

- Marfan syndrome
- sinus of Valsalva aneurysm
- thoracic aortic aneurysm
- aortic dissection
- additional features related to aortic dissection:
  - aortic cusp prolapse
  - aortic regurgitation
  - fluid in pericardium

Role of transoesophageal echocardiography in the diagnosis of aortic dissection  
Assessment of aortic root for patients undergoing transcatheter aortic valve replacement

### **23. Adult Congenital Heart Disease**

Anatomy, pathophysiology and natural history of common congenital lesions present in adults:

- 2-D, M-mode and Doppler features of the following, pre-operatively and post-operatively, as seen in the older child or adult
- Ostium Secundum Atrial septal defects
- Perimembranous and muscular ventricular septal defects
- Partial and complete atrio-ventricular septal defects
- Persistent ductus arteriosus
- Bicuspid aortic valve and associated aortopathy
- Sub-and supra-valve aortic stenosis
- Aortic coarctation
- Pulmonary stenosis
- Ebstein's anomaly
- Fallot's tetralogy
- Transposition and corrected transposition of the great arteries
- Role of contrast echocardiography in evaluating shunts in adults
- Calculation of shunts
- Role of TOE in adult congenital disease

### **24. Likely echocardiographic findings for common clinical presentations:**

- Heart failure or breathlessness
- Arrhythmia
- Ejection systolic murmur
- Hypertension
- Collagen abnormalities (including systemic sclerosis)
- Renal failure
- Stroke

### **25. Emergency and ICU Echo**

#### **25.1 General**

- Constrained environment (multiple arterial/venous lines, ventilator, lighting issues etc)

#### **25.2 The hypotensive/shocked patient and post cardiac arrest**

- Role of focused peri-arrest study (FEEL) and appreciation of limited echo windows
- Evaluation of LV (systolic and diastolic) and RV function.
- Exclusion of severe valve disease (e.g. severe AS, endocarditis) and acute aortic dissection
- Assessment for pericardial effusion and cardiac tamponade, hypovolaemia and underfilling, and high output cardiac failure
- Septic shock – assess for LV systolic/diastolic dysfunction

- Value of repeated echo studies to assess any deterioration/improvement in underlying state

### **25.3 Suspected acute pulmonary embolus**

- Echocardiographic evaluation of RV size and function, tricuspid regurgitation and pulmonary artery systolic pressure assessment, IVC size and respiratory variation, thrombus presence in IVC/RA

### **25.4 Blunt and penetrating cardiac trauma**

- Typical echocardiographic features including pericardial effusion, right and left ventricular contusion, acute valve lesions, aortic dilation and dissection/transection, VSD, pleural effusion

### **25.5 Echo in the ventilated patient**

- Awareness of echocardiographic findings in the presence of mechanical ventilation.
- Value of echo in difficult to wean patients
- Role in differentiating hydrostatic and inflammatory causes of pulmonary oedema
- Assessment in persistent hypoxaemia despite pulmonary recruitment strategies (e.g. exclude PFO, proximal PE)
- Acute arrhythmias such as fast AF (assessment for chamber abnormalities, valve disease, LV impairment, pericardial effusion)
- Cardiac source of embolus – CVA/peripheral embolic event in ventilated patients (LV/LA thrombus, endocarditis, myxoma)
- Value of TOE in ventilated patients (if poor transthoracic echo window)

### **25.6 Post surgery patient**

- Appreciation of effects of general anaesthesia and cardio-pulmonary bypass on LV function
- Assessment of post surgery haemodynamic compromise/ acute deterioration e.g. cardiac surgery (tamponade, wall motion abnormalities, valvular dysfunction), general surgery (air/fat embolism, venous thromboembolism, acute MI, volume overload)

### **25.7 Assessment of filling status**

- Awareness of the role of echocardiography in assessing filling using LV and RV systolic and diastolic function, IVC, SVC and hepatic vein size and reactivity, atrial septal motion, chamber sizes and variation in Doppler velocities.
- Role of repeated echo studies in assessing effects of fluid challenge and inotropes

## **26. Additional topics**

The level of knowledge expected is that of a competent echocardiographer performing transthoracic studies and sustaining knowledge through the BSE and other educational resources, including issues relevant to clinical scanning and practice raised in the BSE Newsletter

### Appendix 3 -Proficiency Examination: Example Theory Questions

Answer 'True' (T) or 'False' (F) to each of the following. Each correct answer gains one mark, whilst each incorrect answer. A question left blank does not gain any marks.

<b>Q1</b>	<b>In an ultrasound imaging system:</b>	
a)	Sector width, sector depth and frame rate can all be controlled independently	F
b)	Frame rate falls as sector width increases	T
c)	Using a lower frequency transducer improves the frame rate	F
d)	The frame rate increases as sector depth increases	F
e)	Using Colour Flow Doppler reduces the frame rate	T
<b>Q2</b>	<b>On a Spectral Doppler display:</b>	
a)	The velocity at which aliasing occurs increases at higher ultrasound frequencies	F
b)	The velocity at which aliasing occurs increases at greater depths	F
c)	The velocity at which aliasing occurs increases at greater sector angle	F
d)	At 2 MHz the aliasing velocity at 10 cm is approximately 1.5 m/s	T
e)	The aliasing velocity can be increased by increasing the pulse rate (High PRF)	T
<b>Q3</b>	<b>In assessing Tricuspid Regurgitation:</b>	
a)	Pulmonary systolic pressure (PAP) can be calculated using the formula $PAP = 4 \times (\text{Peak TR Velocity})^2$	F
b)	Presence of proximal flow acceleration indicates at least moderately severe TR	T
c)	Both apical and parasternal views should be used to view the colour jet	T
d)	In very severe ('free') regurgitation, the calculation of pulmonary pressure is invalid	T
e)	Additional information can be obtained from flow patterns in the SVC and IVC	T
<b>Q4</b>	<b>In a patient with systemic hypertension:</b>	
a)	Mean LV wall thicknesses are always greater than 1.1 cm	F
b)	Peak aortic ejection velocity is increased	F
c)	Typically the trans-mitral e-wave has reduced amplitude and increased deceleration time	T
d)	Typically the Isovolumic Relaxation Time (IVRT) is reduced	F
e)	The presence of mitral or aortic regurgitation indicates additional pathology	F

<b>Q5</b>	<b>An Atrial Septal Defect (ASD) may be associated with:</b>	
a)	Paradoxical interventricular septal motion	T
b)	No obvious defect of the atrial septum on imaging	T
c)	Right ventricular dilatation	T
d)	Left ventricular dilatation	F
e)	Flow of blood from left atrium to right atrium	T

#### **Appendix 4 -Proficiency Examination: Example Reporting Questions**

Clips and stills will be shown lasting 1-3 mins and below is an example of a question with all relevant information provided.

SELECT THE SINGLE BEST ANSWER There is no negative marking. One mark added for a correct answer, no mark deducted for an incorrect answer.

##### Case 1

Male age 46

Request: Systolic murmur

Data: IVS 1cm; LVIDD 4.2cm; PWT 1cm; LVIDs 3cm; LA 3.6cm; Ao valve 2.7cm; PA 2.2cm; Pulmonary FVI 32; LVOT 2.2cm; LVOT FVI 29; LV to RV pressure gradient 118mmHg; BP 150/88

1. Describe the main abnormality

- a. Apical VSD
- b. Endocardial cushion defect
- c. Subaortic VSD X
- d. ASD

2. What is the likely aetiology?

- a. Congenital X
- b. Inferior myocardial infarction
- c. Anterior myocardial infarction
- d. Endocarditis

3. What is the pulmonary to systemic flow ratio

- a. 0.9
- b. 1.0
- c. 1.1 X
- d. 1.3

4. What is the RV systolic pressure?

- a. 20mmHg
- b. 32mmHg X
- c. 38mmHg
- d. 42mmHg

5. Which of these is correct?

- a. RV and LV are normal X
- b. RV is dilated and LV is normal
- c. LV is dilated and RV is normal
- d. LV and RV are both dilated

## Appendix 5 -Computerised Marking Sheets – Guidance Notes

Instructions will be given on the day of the exam. However, please try to familiarise yourself with the process beforehand. The exam is marked by computer so these instructions need to be followed exactly.

### Part 1 Theory Section

**A. Time**

The theory section will last 60 minutes.

**B. Format**

The theory section will consist of multiple choice questions.

**C. Answers**

A column for answers is provided on the question sheet but final answers must be marked on the computer marking sheet.

For one paper the answers will be either TRUE or FALSE

Please mark like this  using an HB pencil. If you make a mistake, use an eraser.

To answer TRUE mark through the [T] [T]

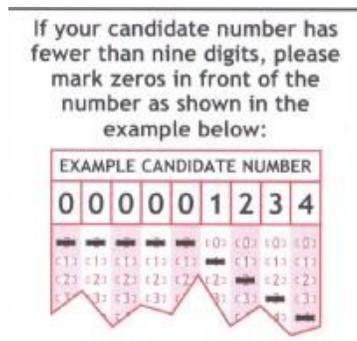
To answer FALSE mark through the [F] [F]

To cancel a response you can use an eraser

There will be NO negative marking for this paper – each correct answer will receive a score of 1. Incorrect or unanswered questions/stems will receive a score of 0.

**D. Additional Information**

You will need to write your Candidate Registration Number, with additional leading zeros if necessary to make nine digits in the box labelled Candidate No. Then code this into the boxes underneath. If, for example, your Candidate Registration Number is 09-123, you should place a line through 0 in the first five columns, through 9 in the sixth column, through 1 in the seventh column, 2 in the eighth and 3 in the ninth.



## Part 2 Reporting Section

### A. Time

The reporting section will last 90 minutes

### B. Format

The section will consist of 10 cases, each with 4 single best answer questions relating to it

### C. Answers

A column for answers is provided on the question sheet but final answers must be marked on the computer marking sheet

For each question there is only one correct answer, a choice of A B C or D

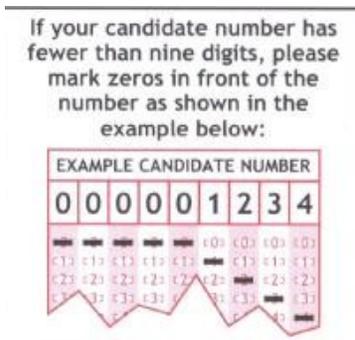
Please mark like this  using an HB pencil. If you make a mistake, use an eraser.

To cancel a response use an eraser

There will be NO negative marking for this paper – each correct answer will receive a score of 1. Incorrect or unanswered questions/stems will receive a score of 0.

### D. Additional Information

You will need to write your Candidate Registration Number, with additional leading zeros if necessary to make nine digits in the box labelled Candidate No. Then code this into the boxes underneath so if, for example, your Candidate Registration Number is 09-123, you should place a line through 0 in the first five columns, through 9 in the sixth column, through 1 in the seventh column, 2 in the eighth and 3 in the ninth.



The College Number is 92 and the Test No for this section is ###, they will be given again on the day of the exam.

## Appendix 6 - Curriculum Based Competency Assessment Tool

### MENTOR TO COMPLETE DURING CANDIDATE'S TRAINING PERIOD

How to use this document:

You should keep it with you throughout your training period

At each hospital, you must have a mentor who should be a senior and experienced echocardiographer.

Your mentor should initial and date each entry once he or she is satisfied that you are competent to perform and report it unsupervised. This competency checklist should be submitted with your logbook.

The theory component will be self-taught. Your department should have suitable text-books

#### 1. BASIC ECHOCARDIOGRAPHY

##### Knowledge

Basic principles of ultrasound

Basic principles of spectral Doppler

Basic principles of colour flow Doppler

Basic instrumentation

Ethics and sensitivities of patient care

Basic anatomy of the heart

Basic echocardiographic scan planes

Parasternal long axis standard, RV inflow, RV outflow

Parasternal short axis including aortic valve, mitral valve and papillary muscles

Apical views, 4- and 5-chamber, 2-chamber and long-axis.

Subcostal and suprasternal views

Indications for transthoracic and transoesophageal echocardiography

Normal variants and artefacts

##### Practical competencies

Initials and date

Interacts appropriately with patients

Understands basic instrumentation

Cares for machine appropriately

Can obtain standard views

Can optimise gain setting, sector width, depth, harmonics, focus, sweep speed, Doppler baseline and scale, colour gain

Can obtain standard measurements using 2D or M-mode

Can recognise normal variants;

Eustachian valve, chiari work, LV tendon

Can use colour examination in at least two planes for all valves optimising gain and box-size

Can obtain pulsed Doppler at

a) left ventricular inflow (mitral valve)

b) left ventricular outflow tract (LVOT)

c) right ventricular inflow (tricuspid valve)

d) right ventricular outflow tract, pulmonary valve & main pulmonary artery

#### 2. LEFT VENTRICLE

##### Knowledge

Coronary anatomy and correlation with 2D views of left ventricle.

Segmentation of the left ventricle (16 and 17 segment models)

Wall motion

Measurements of global systolic function. (LVOT VTI, stroke volume, fractional shortening, ejection fraction using Simpson's rule)

Doppler mitral valve filling patterns & normal range

Appearance of complications after myocardial infarction

Aneurysm, pseudoaneurysm,  
Ventricular septal and papillary muscle rupture  
Ischaemic mitral regurgitation  
Features of dilated, and hypertrophic cardiomyopathy  
Common differential diagnosis  
Athletic heart, hypertensive disease

Practical competencies

Initials and date

Can differentiate normal from abnormal LV systolic function  
Can recognise large wall motion abnormalities  
Can describe wall motion abnormalities and myocardial segments  
Can obtain basic measures of systolic function VTI, FS, LVEF  
Understands & can differentiate diastolic filling patterns  
Can detect and recognise complications after myocardial infarction  
Understands causes of a hypokinetic left ventricle  
Can recognise features associated with hypertrophic cardiomyopathy  
Can recognise hypertensive heart disease

3. MITRAL VALVE DISEASE

Knowledge

Normal anatomy of the mitral valve, and the subvalvar apparatus and their relationship with LV function  
Causes of mitral stenosis and regurgitation  
Ischaemic, functional, prolapse, rheumatic, endocarditis

Practical competencies

Initials and date

Can recognise rheumatic disease  
Can recognise mitral prolapse  
Can recognise functional mitral regurgitation  
Can assess mitral stenosis  
2D planimetry, pressure half-time, gradient  
Can assess severity of regurgitation, chamber size, signal density,  
proximal flow acceleration & vena contracta

4. AORTIC VALVE DISEASE and AORTA

Knowledge

Causes of aortic valve disease  
Causes of aortic disease  
Methods of assessment of aortic stenosis and regurgitation  
Basic criteria for surgery to understand reasons for making measurements

Practical competencies

Initials and date

Can recognise bicuspid, rheumatic, and degenerative disease  
Can recognise a significantly stenotic aortic valve  
Can derive peak & mean gradients using continuous wave Doppler  
Can measure valve area using the continuity equation  
Can recognise severe aortic regurgitation  
Can recognise dilatation of the ascending aorta  
Knows the echocardiographic signs of dissection

5. RIGHT HEART

Knowledge

Causes of tricuspid and pulmonary valve disease  
Causes of right ventricular dysfunction  
Causes of pulmonary hypertension

The imaging features of pulmonary hypertension  
The estimation of pulmonary pressures

Practical competencies

Initials and date

Recognises right ventricular dilatation

Can estimate PA systolic pressure

Can estimate right atrial pressure from the appearance of the IVC

#### 6. REPLACEMENT HEART VALVES

Knowledge

Types of valve replacement

Criteria of normality

Signs of failure

Practical competencies

Initials and date

Can recognise broad types of replacement valve

Can recognise paraprosthetic regurgitation

Can recognise prosthetic obstruction

#### 7. INFECTIVE ENDOCARDITIS

Knowledge

Duke criteria for diagnosing endocarditis

Echocardiographic features of endocarditis

Criteria for TOE

Practical competencies

Initials and date

Can recognise typical vegetations

Can recognise an abscess

Can recognise complications just on valve regurgitation

#### 8. INTRACARDIAC MASSES

Knowledge

Types of mass found in the heart

Features of a myxoma

Differentiation of atrial mass

Normal variants and artifacts

Practical competencies

Initials and date

Can recognise a LA myxoma

Can differentiate LV thrombus and trabeculation

#### 9. PERICARDIAL DISEASE

Knowledge

Features of tamponade

RV collapse, effect on IVC, A-V valve flow velocities and respiratory variation.

Features of pericardial constriction

Differentiation of pericardial constriction from restrictive myopathy

Practical competencies

Initials and date

Can differentiate a pleural and pericardial effusion

Can recognise the features of tamponade

Can judge the route for pericardiocentesis

Can recognise restrictive physiology

Differentiation of pericardial constriction from restrictive myopathy

10. ADULT CONGENITAL HEART DISEASE

Knowledge

Anatomy and echo features of basic congenital disease:

ASD, VSD, partial & complete atrio-ventricular defects

Patent ductus arteriosus

Sub and supra-avalvular aortic stenosis

Sub valvar, valvar and supra-valvar pulmonary stenosis

Ebstein's anomaly

Fallot's tetralogy

Role of contrast

Shunt calculation

Estimation of pulmonary artery pressure

Practical competencies

Initials and date

Can recognise a secundum ASD

Can calculate a shunt

Mentor

Name \_\_\_\_\_

Signature \_\_\_\_\_

**Appendix 7 -Suggested format for a report**

This is a basic framework for a report; Appendix 4 includes further details for candidates to look through. Guidelines are also available on the BSE website:

A report should have a section for objective M-mode or 2D dimensions and Doppler measurements. There should be a section for describing observations and a short conclusion. Please see "Minimum Data set for Transthoracic Echocardiography" at [www.bsecho.org](http://www.bsecho.org).

Measurements - Measurements of intracardiac dimensions can be useful in monitoring, disease progression. These can be made using M-mode or 2D and must be interpreted in the light of the size and sex of the patient. Many pragmatic normal ranges are outdated and modern data based on large populations include upper dimensions previously regarded as abnormal. Doppler measurements should be listed (see normal valves chart on BSE Website).

Text - This should include a description of observations made in a logical order. The order will vary for the operator and the study. The most important feature might be described first. Alternatively each anatomical region might be discussed in turn. Interpretation should not be a part of this section and even minor abnormalities are best described. These can be put into context in the conclusion. It is usually not advisable to describe each modality in turn or to describe findings at each window as is sometimes done. This

is confusing since small differences can emerge between different windows or repetitions occur. It is better to integrate all windows and all modalities. Normal findings should also be stated and if a region could not be imaged this should also be admitted. This gives the reader the confidence that a systematic study has been undertaken rather than a study focused on only a region of interest.

Conclusion - This should summarize the whole study and be easily understood by a non-echocardiographer. It should identify any abnormality, its cause and any secondary effect. No interpretation should be offered that is not derived from the recorded study, and no medical advice should normally be given.

## **Appendix 8 – Report Format**

**THIS IS A SUGGESTED FORMAT FOR A REPORT WITHIN THE WORKPLACE. PLEASE NOTE – ALL REPORTS SUBMITTED IN THE LOGBOOK AND ACCOMPANYING THE CASES MUST BE ANONYMISED AS PER APPENDIX 14**

The report should comprise the following sections:

Demographic and other Identifying Information

Obligatory information

Patient's name

Medical record number, NHS number or other unique identifier

Age

Gender

Indications for test

Referring clinician identification

Interpreting echocardiographer identification

Date of study

Additional, optional information

Location of the patient (e.g. outpatient, inpatient, etc.)

Location where study was performed

Study classification (routine, urgent, emergency)

Date on which the study was requested, reported

Height and weight

Blood pressure

Videotape or disk number/identifier)

Echocardiographic study

This covers the main content of the report. For each cardiac structure, the report is divided as follows:

- Descriptive terms: phrases that are used to construct the text content of a report, describing morphology (e.g. mitral leaflet -thickened tips) and function (e.g. mitral leaflet –reduced mobility of the PMVL) of cardiac structures.
- Measurements/analysis: (e.g. peak gradient, mean gradient, MVA) – recommended measurements and calculations are included in Section 3 of this document (also, please refer to BSE Minimum Dataset2)
- Diagnostic statements: phrases that add echocardiographic interpretation to descriptive terms (e.g. appearance of rheumatic mitral valve disease, suitable for commissurotomy)

### **Summary**

This important section should contain final comments that address the clinical question posed by the TTE request. This may comprise simple repetition of key descriptive terms from within the main part of the report (e.g. “severe LV dysfunction”). It may add clinical context to the technical aspects of the report, particularly with respect to abnormal findings. Where possible, comparison with previous echocardiographic studies or reports should be made and important differences (or similarities) highlighted. Technical limitations of the study or its interpretation should be included.

**Appendix 9 -Transthoracic Proficiency: Summary Sheet**

Complete this sheet and place it at the front of your Logbook

Name:..... Membership No.....

Date of Passing Adult Written Examination.....

Case collection period .....

Only one diagnosis can be assigned to each study.

Summarise the primary diagnosis assigned to each case in your Logbook. (Note the target guidelines for case mix)

Primary Diagnosis	Number of cases
Left Ventricular Function Assessment ( $\geq 25$ )	
Valve Disease Assessment ( $\geq 50$ )	
Replacement Valves ( $\geq 10$ )	
Assessment of the Right Ventricle ( $\geq 10$ )	
Pericardial Disease/Effusion ( $\geq 5$ )	
Aortic Disease ( $\geq 5$ )	
Endocarditis ( $\geq 5$ )	
Left Ventricular Hypertrophy ( $\geq 5$ )	
Hypertrophic Cardiomyopathy ( $\geq 2$ )	
Dilated Cardiomyopathy ( $\geq 3$ )	
Mass/Thrombus (some)	
Congenital Heart Disease (some)	
Stress Echo/Contrast Bubble Study ( $\leq 20$ ) [Not compulsory]	
No Significant Cardiac Abnormality ( $\leq 25$ )	
Other Pathology	
<b>Total Cases (250)</b>	

## **Appendix 10 - Getting the Cases right**

This section of the submission will be reviewed in great detail by the assessors.

Candidates are most often failed at this stage of the process.

The 5 cases are assumed to be your best work. Do not choose patients who are poorly echogenic.

Optimise the 2D and Doppler images. Make sure you have optimised the gain setting, sector width, depth, harmonics, focus, sweep speed, Doppler baseline and scale, colour gain. Candidates may be failed on just this aspect. If these points are not done well in your submission it may be assumed that you will have poor quality images on your routine cases.

Read the mark sheet that the central markers will be using to assess the study. You need to show all normal views, including the subcostal and suprasternal views.

Only include loops and stills that you wish to be assessed. Ensure that loops and stills with measurements shown match the parameters quoted in the report.

Ensure that the M-mode correctly aligned. If it is too difficult take your measurements from the 2D images or the measurements may be very inaccurate.

Get the Doppler right. Place the cursor correctly and alter the Doppler scale and sweep speed appropriately. Get the best signal before recording. Optimise the colour Doppler gains before recording. Use the stand alone probe for the aortic stenosis case (and other cases, if appropriate) and demonstrate you are able to obtain a CW Doppler signal from the apical, right parasternal and suprasternal windows in your search for the peak gradient.

You must be able to use the common Doppler equations e.g. continuity equation, calculation of a shunt, estimation of pulmonary artery systolic pressure.

Each case should be accompanied by a full and comprehensive report. This should include a summary that can be understood by any non-echocardiographer.

**GOOD LUCK**

**Appendix 11 –Mentor statement to accompany the Practical Assessment**

Re: (Candidates name) \_\_\_\_\_

	Initial
I certify that the candidate has undergone a programme of training in echocardiography	
I certify I have observed the candidate scanning and I am satisfied that he/she is competent at completing a full transthoracic echo study.	
I certify that the candidate has reached a standard of training to be able to independently perform and report a transthoracic echocardiographic study. He/she has reached all of the mandated competencies. I have signed off the candidate's competency sheet.	
I certify that the candidate above has <b>performed</b> and <b>reported</b> the cases included in the accompanying Log Book within a 24 month period.	
I certify that all cases are fully anonymised (no patients personal details such as names, full date of births or addresses) as per Appendix 14	
I certify that all cases are signed with name printed of the candidate	
I certify that these cases are being handed in as per Trust policy Guidelines	

Mentor's name: \_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

I am satisfied that the candidate above has performed and reported the cases included in the accompanying Log Book within a 24 month period in this department and five cases are also enclosed.

Head of Echocardiography's name: \_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Medical/Technical Head of Echocardiography's name: \_\_\_\_\_

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

## **Appendix 12 – BSE Policy on the Non-Anonymisation of Patient Data**

### Introduction

The duty of confidentiality arises out of the common law of confidentiality, professional obligations and also staff employment contracts. Breach of confidence may lead to disciplinary measures, bring into question professional reputation and possibly result in legal proceedings.

Guidance is provided to NHS staff in the 'NHS Code of Practice on Confidentiality' (November 2003).

[http://www.dh.gov.uk/prod\\_consum\\_dh/groups/dh\\_digitalassets/@dh/@en/documents/digitalassets/dh\\_4069254.pdf](http://www.dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/@dh/@en/documents/digitalassets/dh_4069254.pdf)

Patient information that can identify individual patients is confidential and must not be used or disclosed. In contrast, anonymised information is not confidential and may be used.

Key identifiable information includes:

Patient's name, address, full post code, date of birth;  
NHS number and local identifiable codes;  
Anything else that may be used to identify a patient directly or indirectly. For example, rare diseases, drug treatment or statistical analyses which have very small numbers within a small population may allow individuals to be identified.

Anonymisation requires the removal of such information from all reports and images.

For accreditation purposes, BSE Administrators and BSE Markers must not be able to identify the patient from the detail or combination of details given.

Speakers presenting on behalf of the BSE at meetings and speakers on courses/meetings awarded BSE re-accreditation points must ensure that all presentation material is anonymised.

Guidance to candidates submitting Logbooks and Cases for Accreditation

The NHS Code of Practice on confidentiality means that evidence submitted for the practical part of the Accreditation process must have all patient identification removed.

In order for evidence to be considered to have been anonymised, BSE Administrators and BSE Markers must not be able to see any of the identifiers listed above. As age is relevant to the assessment either the age or year of birth must be provided however a full date of birth must not be shown.

## Reports

Please note that correction fluid may still allow data to be visible if you look at the back of the page, as does placing a sticker over the patient data. Marker pen often fades so that data may be correctly disguised at the point of posting to us but not when we are posting it back to you.

We therefore advise:

Cutting out the patient data or

Deleting data electronically prior to printing or  
Using corrective fluid or marker pen, then photocopying the sheet

## Cases

In order for cases to be classed as anonymous BSE Administrators and BSE Markers must not be able to gain personal information about the patient that is not directly relevant to the echocardiogram. This means that name, address, NHS/Hospital number and full date of birth must not be visible on the report that is enclosed with the images nor on the images themselves. If the age is not given separately the year of birth must be left visible on the report.

Please see the notes above about correctly removing patient ID from the paper report that is enclosed with the cases.

We appreciate that the removal of patient ID from cases may be difficult depending on the machine being used, we therefore advise that the cases are specifically collected for the BSE and the data inputs are made relevant to your cases.

E.g. Patient Name could be 'BSE Case 1' or 'Aortic Stenosis', Patient Number could be your membership number followed by case number, '1111-1'

Explanatory notes for the inclusion of patient identifiable data in any medium are NOT acceptable.

Breach of NHS Code of Practice on Confidentiality

Major breach:

One or more examples of detailed patient demographics (e.g. name and address)

OR

One or more examples of patient data sufficient to allow a patient to be traced in any way

OR

Multiple examples of patient identifiable information insufficient alone to trace the patient (on more than 5% of the reports within the logbook or more than 5% of the images in the cases).

Minor breach:

Rare examples of patient identifiable information found within the logbook (on less than 5% of the reports in the logbook or less than 5% of the images in the cases). These might include, for example, name or date of birth but insufficient information to identify the patient.

In the event of a major breach:

The candidate will automatically fail.

The BSE Administrator will remove the evidence containing patient identifiable information.

The candidate will be informed of the fail and notified of the reason for it.

The data in question will be placed in an envelope, which will be sealed. Two BSE Administrators will sign across the seal and the envelope will be marked 'PRIVATE AND CONFIDENTIAL' and clearly marked with the candidate's BSE membership number.

The candidate will have 4 weeks from the date of notification of a major breach to collect the envelope from the BSE Office in person. There will be no opportunity to anonymise data at this time. Dates and times of collection must be arranged with the BSE Office beforehand and photo identification produced at the time of collection.

After 4 weeks from the date of notification BSE Administrators will destroy uncollected data.

The Chair of the Accreditation Committee will be notified of all major breaches and will make the decision as to whether the Head of Information Governance at the candidate's place of employment should be notified.

In the event of a minor breach:

The BSE Administrator will remove the evidence containing patient identifiable information.

The candidate will be informed of the breach and notified of the reason for it.

The data in question will be placed in an envelope, which will be sealed. Two BSE Administrators will sign across the seal and the envelope will be marked 'PRIVATE AND CONFIDENTIAL' and clearly marked with the candidate's BSE membership number.

The candidate will have 4 weeks from the date of notification of a minor breach to attend the BSE Office in person and anonymise the data. Dates and times of attending must be arranged with the BSE Office beforehand and photo identification produced at the time of attendance.

After 4 weeks from the date of notification BSE Administrators will destroy non-anonymised data and the submission will be classified as a fail.

**Appendix 13 - Final check list**

To be filled in by the candidate and submitted at the front of the logbook.

Before submitting your Practical Assessment, ensure that you have complied with all the following requirements. If you do not have an enrolled supervisor, ignore point 4.:

- I am a BSE Member and my Subscription is up to date
  - This has been handed in per my agreed deadline
  - The Mentor sections (Appendix 6 and 11) are fully completed and enclosed
  - I Name, Address and Membership Number are clearly marked on the Log Book, Case Submission and case reports
  - The completed Log Book Summary Sheet and this checklist are at the front of the logbook.
  - My cases are on (delete as necessary) CD/ DVD / Memory Stick/Other (please specify)
- 
- The 5 reports relating to the cases are enclosed, in the correct order in an envelope along with Disc/Memory stick, 2 copies
  - My return address is also on the outside of the package.

Signed \_\_\_\_\_

Date \_\_\_\_\_