Physiologist Led Bike Stress Echo

# INTRODUCTION

Stress echo (SE) provides a dynamic evaluation of myocardial structure and function under conditions of physiological stress. The images obtained during SE allow us to match symptoms with cardiac involvement. SE can unmask structural or functional abnormalities, which are not apparent in the resting patient. Under conditions of activity wall motion abnormalities, valvular dysfunction or other signs of haemodynamic dysfunction may be revealed.

Exercise stress echo (ExSE) is considered the stress echo test of choice for most assessments of myocardial ischemia, valve disease and cardiomyopathies because it preserves the normal electromechanical response to stress and can provide important prognostic information about functional status. There are limited data to indicate similar sensitivity of ExSE during treadmill exercise to semi-supine bicycle but this is technically difficult, although sensitivity of the test does not appear to fall providing imaging is performed above 85% of the maximum heart rate and maximal exercise1.

Dobutamine stress echo (DSE) is used when patients are unable to exercise sufficiently to achieve target heart rate, or when the assessment of contractile reserve and viability is the key clinical question.

# INDICATIONS

* Diagnostic assessment of patients with suspected Coronary Artery Disease (CAD)
* Prognostic assessment of patients with known CAD
* To guide strategies for revascularisation by determining the haemodynamic significance of coronary lesions.
* Risk stratification and suitability assessment for patients undergoing non cardiac surgery
* Provocation of left ventricular outflow tract obstruction (LVOTO) in patients with symptomatic hypertrophic cardiomyopathy (HCM) but no significant gradient at rest.
* Assessment of mitral regurgitation severity
* Assessment of patient with unexplained breathlessness.

# CONTRAINDICATIONS1

* Patients weight exceeds the semi-supine bicycle couch
* Acute myocardial infarction (within 2 days)
* Uncontrolled cardiac arrhythmias causing symptoms or haemodynamic compromise.
* Symptomatic severe aortic stenosis
* Uncontrolled heart failure
* Acute myocarditis or pericarditis
* Hypertension >200/110 mmHg at baseline
* Mobility issues preventing the patient pedalling the bike.
* Mobility issues preventing the patient from transferring on and off the bike independently.

# RELATIVE CONTRAINDICATIONS *a cardiologist with stress echo experience should be present / immediately available.*

* Angina which is <1 month post MI, post PTCA/stent, post CABG
* Known left main stem stenosis
* History of sustained ventricular arrhythmias

# MEDICATION

The sensitivity of detecting ischaemia is increased by achieving adequate workload and therefore in most patients it is sensible to stop rate slowing drugs 48h prior to the test. However, this needs to be done with the consent of the requesting doctor or an imaging consultant. If medication is continued a note should be made in the report.

Rate limiting medications include; beta blockers, calcium channel blockers, Ivabradine and digoxin (examples can be found in appendix 1). Reasons for potentially continuing with medication include, but are not limited to:

* Problematic hypertension
* Patients who have a history of arrhythmia (known AF or paroxysmal AF)
* Prognostic testing - Assessing ischaemia with known CAD on medical therapy
* Assessment of risk during non-cardiac surgery, when medication is to be continued prior to surgery

# STAFFING REQUIREMENTS

* Physiologist led Ex. Stress echo should be performed by experienced physiologists who preferably holds stress echo accreditation.
* Two physiologists or a physiologist and a nurse / ATO should be present at all times during the test. Both should hold ILS certification.
* A resuscitation team will be available immediately on activation of a cardiac arrest call
* A named clinician trained in SE should be available to answer queries if required.
* A nurse/physiologist with appropriate training to deliver contrast

# EQUIPMENT REQUIREMENTS1

* Digital echocardiography machine with appropriate SE analysis package.
* Automated blood pressure machine with manual back up if needed.
* Continuous ECG monitoring.
* Fully equipped resuscitation trolley.
* Oxygen supply and suction.
* Availability of transpulmonary contrast when echo window is suboptimal.
* Drugs to manage severe allergic reactions and anaphylactic shock.
  + To include – IV/IM adrenaline 1:1000, IV chlorpheniramine, IV hydrocortisone, salbutamol nebuliser – in dose and preparation to meet current Resuscitation UK guidelines
* Cannulation equipment
* Appropriate contrast and relevant equipment
* Semi-supine bike with protocol options.

# PRE PROCEDURE

* A 3 point ID check of the patient should be completed (name, DOB, 1st line of address)
* Explain the test to the patient and gain verbal consent.
* Ascertain if there has been any recent and relevant change to the patient’s symptoms and medical history.
* Perform a resting BP and 12 lead ECG and ensure any ECG irregularities are compared to the patients previous ECG.
* Move the V2 – V6 chest leads 1 – 2 rib spaces down to allow access for imaging.

# THE TEST

* Baseline echo images and measurements should be obtained to assess valvular and ventricular function and exclude contraindications. Patients who have undergone a full TTE within the last 6 months do not need a full baseline study however the previous images and report should be reviewed by the physiologists prior to SE.
* ExSE increases patient motion, chest wall movement and hyperventilation, all of which can hinder the acquisition of high quality images in exercise stress echo. Therefore there should be a lower threshold for the use of contrast.
* The recommended protocol to use is the World Health Organisation 25 Watt programme with load increased in increments of 25 Watts every 2 or 3 mins1
* The patients should be encouraged to maintain a constant rate of 60 revs / minute.
* Echocardiographic images and measurements should be obtained at 25 watts, 50 watts, peak stress and recovery. (see table 1).
* A 12 lead ECG and BP should be obtained at the end of each stage.
* Once an end point is reached, the workload should be significantly reduced however the patients should continue to pedal to allow acquisition of peak stress images and to avoid physiological issues associated with a sudden cessation in exercise.
* Patients should be monitored closely in recovery until BP and ECG return to a resting state.
* The physiologist should be aware of conditions and symptoms that require imaging in recovery and tailor their approach to post stress imaging appropriately.

Table 1: Echo assessments and observations according to indication for stress echo

|  |  |  |  |
| --- | --- | --- | --- |
| **Indication** | **Assessment Intervals** | **Imaging** | **Additional Assessments** |
| ? inducible ischaemia | Baseline, 25 watts, 50 watts, peak stress, recovery + additional imaging if symptomatic / ECG changes. | Apical 4 chamber, apical 2 chamber, PLAX (or apical long axis), PSAX at papillary muscle level. | Heart rate, BP, symptoms, 12 lead ECG recorded |
| ? myocardial viability | Baseline, 25 watts, 50 watts, peak stress, recovery + additional imaging if symptomatic / ECG changes. | Apical 4 chamber, apical 2 chamber, PLAX (or apical long axis), PSAX at papillary muscle level. | Heart rate, BP, symptoms, 12 lead ECG recorded |
| HCM ?inducible LVOTO | Baseline, 25 watts, 50 watts, peak stress, recovery + additional imaging if symptomatic / ECG changes. | LV outflow Doppler, colour Doppler of MV, CW of mitral valve, LV views as above. | Heart rate, BP, symptoms, 12 lead ECG recorded. Special attention should be paid to the blood pressure in the recovery phase. |
| Mitral regurgitation | Baseline, 25 watts, 50 watts, peak stress, recovery. | Colour Doppler of the mitral valve, CW Doppler of the mitral valve, PISA, TR velocity, E/e’, LV views as above, TAPSE.2 | Heart rate, BP, symptoms, 12 lead ECG recorded |
| Unexplained breathlessness on exertion. | Baseline, 25 watts, 50 watts, peak stress, recovery. | Colour Doppler of the mitral valve, CW & PW Doppler of the mitral valve, TR velocity, LV views as above, E/e’, RV function, TAPSE, MAPSE, strain analysis if required software available. | Heart rate, BP, symptoms, 12 lead ECG recorded |
| Mitral Stenosis | Baseline, 25 watts, 50 watts, peak stress, recovery. | Mitral valve mean gradient, MR assessment, TR velocity, LV views as above, E/e’, RV function, TAPSE.2 | Heart rate, BP, symptoms, 12 lead ECG recorded |

# TEST END POINTS1

**ABSOLUTE**

* Drop in SBP† >10 mmHg from baseline with symptoms
* Sustained VT\*
* ST elevation >1 mm with symptoms (other than aVR or V1)
* Central nervous system symptoms (ataxia, pre-syncope)
* Left ventricular thrombus

**RELATIVE**

* Predicted maximum heart rate >85% and maximal effort
* New wall motion abnormality
* Progressive LV dilatation
* New onset or progressive global LV dysfunction
* Drop in SBP >10 mmHg from baseline without other evidence of ischaemia
* ST depression >2 mm or axis shift
* Stress-induced arrhythmia: AF, SVT, NSVT\*\*
* Severe hypertension >230 mmHg
* HR falling >20% starting rate

**THE RESULTS**

Results should include, but not limited to:

* Patient details, date of procedure, details of staff present and staff member reporting, indication for test
* Contrast – if used details of contrast medium
* Standard echo report, if full echo performed prior to test
* Height, weight, BSA/BMI
* Resting HP, Resting BP
* Peak HR, Peak BP
* Predicted max HR and % of peak achieved
* HR and BP response
* Exercise effort and reason for termination
* Duration of exercise and maximum Watts achieved
* Target achieved / not achieved and reason for not achieving target
* Echo findings depending on clinical indication (see table 1)
* Description of LV function at rest and at peak
* ECG interpretation
* Arrhythmias
* Symptoms
* Significant events during recovery.
* The patient should be made aware of who will be interpreting the results, who will be receiving the report and an estimated time frame.
* The physiologist performing the test should write a provisional report which must be reviewed by an imaging consultant before authorisation unless the supervising physiologist holds BSE Stress Echo Accreditation.

REFERENCES

1. Steeds, R. P., Wheeler, R., Bhattacharyya, S., Reiken, J., Nihoyannopoulos, P., Senior, R., Monaghan, M. J., and Sharma, V. (2019). Stress echocardiography in coronary artery disease: a practical guideline from the British Society of Echocardiography. *Echo Research and Practice 6*, 2, G17-G33, available from: <<https://doi.org/10.1530/ERP-18-0068>> [Accessed 26 July 2021]
2. Lancellotti P, Dulgheru R, Go YY*, et al.* Stress echocardiography in patients with native valvular heart disease. *Heart*2018;**104:**807-813.

E**xercise Stress Echocardiogram**

**Checklist**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Patient name: | | Date of birth. | | |  |  |
| Hospital number: | | Appointment date : | | |  |  |
| Referring consultant: | | Supervising consultant: | | |  |  |
| Indication: | |  | | |  |  |
| Contraindications | | | | | | |
| Does the patient have any contraindications: | |  |  |  |  |  |
|  | Patients weight exceeds the semi-supine bicycle couch | |  |  |  | **Y/N** |
|  | Acute myocardial infarction (within 2 days) |  |  |  |  | **Y/N** |
|  | Uncontrolled cardiac arrhythmias causing symptoms or haemodynamic compromise. | | | |  | **Y/N** |
|  | Symptomatic severe aortic stenosis |  |  |  |  | **Y/N** |
|  | Uncontrolled heart failure |  |  |  |  | **Y/N** |
|  | Acute myocarditis or pericarditis |  |  |  |  | **Y/N** |
|  | Hypertension >200/110 mmHg at baseline |  |  |  |  | **Y/N** |
|  | Mobility issues preventing the patient pedalling the bike. | |  |  |  | **Y/N** |
|  | Mobility issues preventing the patient from transferring on and off the bike independently. | | |  |  | **Y/N** |
| **If yes to any of the above please discuss with the supervising cardiologist or referring consultant**  **and do not proceed to test unless clinically supervised** | | | | | | |
| Consent | | | | | | |
| Has the patient received an information sheet prior to the day of procedure | | | | | | **Y/N** |
| Has the patient had a verbal explanation of the test | |  |  |  |  | **Y/N** |
| Is the patient happy to proceed | |  |  |  |  | **Y/N** |
| **Health Professional Signature:** | |  |  |  |  |  |
| **Job Title** | |  | **Date** |  |  |  |
| Pre test checks | | | | | | |
| Identification Correct: | | **Y/N** |  |  |  |  |
| Last fluids: | | Fluid: |  |  |  |  |
| Is the patient diabetic: | | **Y/N** | Details: |  |  |  |
| Allergies | | **Y/N** | Details: |  |  |  |
| Any change in symptoms since referral | | **Y/N** | Details: |  |  |  |
| Recent hospital admission since referral | | **Y/N** | Details: |  |  |  |
| Recent cardiac investigations | | **Y/N** | Details: |  |  |  |
|  | Recent echo (within 3 months) | **Y/N** | Details: |  |  |  |
| Other relevant medical history | | **Y/N** | Details: |  |  |  |
| Pregnant? | | **Y/N** | Details: |  |  |  |
| Does the patient take any heart rate reducing medications | | | Details: |  |  |  |
| When was this last taken | | **<48hrs >48hrs** | Details: |  |  |  |
| Current medication | |  |  |  |  |  |

Patient Name:

Date of birth:

NHS / K Number

Weight………………..kg Height……………..cm BSA:………………. Target heart rate………………… bpm

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| --- | --- | --- | --- | --- | --- |
| Exercise Time | Workload  (W) | HR  (bpm) | BP  (mmHg) | Symptoms | Comments |
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Max HR achieved…………. Bpm Max BP achieved………………..mmHg Max workload achieved………… Total exercise time………….. Contrast used **Y/N**

**Reason for termination:**

Symptoms Target HR achieved ECG changes

Complications (please state):

**Symptoms:**

Chest pain Shortness of breath Chest tightness Patient usual symptoms? **Y/N**

None Hypotension Vasovagal Nausea/ vomiting

