Clinical Competence in Myocardial Perfusion Scintigraphic Stress Testing

General Training Guidelines and Assessment

Prepared on behalf of the British Nuclear Medicine Society and British Nuclear Cardiac Society

Guideline development and writing group

Ian Jones, Nuclear Medicine Technologist, Derby Hospitals NHS Trust

Kate Latus, Clinical Nurse Specialist, Royal Brompton & Harefield NHS Trust

Luan Bartle, Nuclear Medicine Technologist, United Lincolnshire Hospitals NHS Trust

Mo Gardner, Clinical Physiologist

Vicki Parkin, Radiographer, United Bristol Healthcare Trust

Correspondence to

Ian Jones

Nuclear Medicine Technologist, Nuclear Medicine Department, Derby Hospitals NHS Trust, Uttoxeter Road, Derby, DE22 3NE.

ian.jones@derbyhospitals.nhs.uk

Kate Latus

Clinical Nurse Specialist (Cardiology), Nuclear Medicine Department,

Royal Brompton & Harefield NHS Trust, Sydney St, London SW3 6NP.

K.Latus@rbht.nhs.uk

Page 1 of 24
Advisory group

Dr C Anagnostopoulos Consultant and Honorary Senior Lecturer, Royal Brompton & Harefield NHS Trust,

Dr A Kelion, President British Nuclear Cardiac Society, Consultant Cardiologist, Harefield Hospital.

Jillian Riley. Past President, British Association for Nursing in Cardiac Care (BANCC), Head of Post-graduate Education for Nurses and Allied Health Professionals, Royal Brompton Hospital, Honorary Lecturer, Imperial College.

Audrey Taylor, Nuclear Medicine Technologist, Guy's and St Thomas' Hospital

Professor S R Underwood, Professor of Cardiac Imaging, Imperial College London & Royal Brompton Hospital,

Acknowledgements

This project was supported in part by Bristol-Myers Squibb in the form of an educational grant.
Life support training ................................................................. 15
Practical clinical skills training ............................................... 16
Exercise testing ........................................................................ 17
Pharmacological testing ............................................................ 17
Knowledge of indications and contra indications ...................... 17
Trainee accreditation ............................................................... 18
  Stress training record ............................................................. 18
  Clinical practical assessment .................................................. 20
Re-assessment of competence .................................................. 20
Audit ....................................................................................... 21
References ............................................................................ 22
Introduction

The average waiting time for myocardial perfusion scintigraphy (MPS) in the United Kingdom is 20 weeks (1). Several factors may have influenced this including financial, equipment availability or a deficiency of trained specialist staff to stress. Further problems may arise nationally if the proposed changes within the NICE appraisal of the technology (2) report are implemented, which would raise the current levels for MPS from 1200 to 4000 studies per million population per year. An aid to this expansion would be a broadening of the nature of health care professionals who perform MPS stress testing. This can reduce waiting times by increasing flexibility and use of imaging resources (3, 4).

Previous guidelines have advised that high-risk stress tests should be performed by doctors (5,6,7) and such patients can normally be identified during the process of referral because both the referrer and the supervising practitioner carry out risk assessments. However, some high-risk patients may only be identified at the time of the study and all registered health professionals are personally accountable for their practice (8, 9), and are required to make their own clinical decisions. Professionals who supervise MPS stress tests (stressors) therefore need to assess each patient as the first part of the procedure. This allows the stressor to determine whether medical assistance is necessary and it guides a safe and effective procedure for each patient (5, 10).

Non-medical professionals already use physical assessment to diagnose conditions in other settings such as rapid access chest pain clinics, pre-operative assessment units, and diagnostic outpatient clinics. Present practices such as these follow the British procedure guidelines (paragraph 4.1.3 iii), which require that a physical assessment be carried out (6). Experience and understanding of inspection, palpation, percussion, and auscultation are skills that are not included in the basic training of a number of non-medical professionals (11). Existing guidelines however do include this level of skill as a necessary competency of non-medical staff stressors (5).
English law, non-medical staff who undertake a medical task will be compared with the usual practice of a doctor performing the same task (8).

**Aim of these guidelines**

These guidelines outline the general and specific abilities required by non-medical stressors to perform a safe and efficient stress test during MPS (6, 12, 13). They also provide information about how to achieve and maintain competency. The goal is to provide a common standard for healthcare professionals irrespective of background training and experience and to empower staff from a variety of disciplines to lead nuclear cardiology stress (14,15,16).

**General guidance - protocols**

Authorised local procedures must give clear direction based upon national protocols, guidelines, and professional regulations.

Stress testing practice should be described in detail within a specific protocol. Ideally, this should include an outline of the stress test in the context of the overall procedure and team members plus the specific aspects of performing a stress test such as:

1. Communication – with patients, the MPS team, and other professionals.
2. Clinical assessment – taking a patient history, examination, justification and authorisation, obtaining patients consent
3. Physical preparation – venous cannulation, ECG & BP interpretation and equipment use
4. Choice of stress test – correct method, individual variations, plans for adverse events
5. Conducting a stress test, safety, observations and interpretation, handling radionuclides, knowledge and safe administration of stress drugs, use of equipment, patient needs and documentation
Protocols should also include training competencies for new staff, methods of assessing and maintaining individuals practice and importantly methods of auditing stressor practice. The choice of protocol used will depend upon local settings and the professionals involved. Two types of protocol are currently used in the UK.

**Patient specific protocols** are the easiest form to use and consist of a written description of practice that is agreed between those directly involved in the procedure. This type of document is useful because it accommodates local needs without involving other non-nuclear medicine professionals.

**Patient Group Directions** (PGD) are useful because they force written details and wider understanding of stress testing practice for certain groups. More importantly they provide a greater level of support if a serious adverse event were to occur. (10, 17). For those not yet included in the groups permitted to use PGD’s, adoption of its format and procedure where possible may support existing patient specific protocols.

### Safety of stress testing by different clinical groups

A brief summary of adverse event rates for physician led stress testing is shown in table 1. This indicates the low likelihood of any serious event occurring during these investigations when supervised by a physician.

<table>
<thead>
<tr>
<th></th>
<th>Exercise^{18}</th>
<th>Adenosine^{19}</th>
<th>Dipyridamole^{20}</th>
<th>Dobutamine^{21}</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n=518,448</td>
<td>n=9256</td>
<td>n=73806</td>
<td>n= 1012</td>
</tr>
<tr>
<td>Death</td>
<td>26 (0.005%)</td>
<td>0</td>
<td>7 (0.01%)</td>
<td>0</td>
</tr>
<tr>
<td>MI or serious arrhythmias</td>
<td>457 (0.08%)</td>
<td>647 (7%)</td>
<td>19 (0.03%)</td>
<td>42 (4.2%)</td>
</tr>
</tbody>
</table>
For the other health professional groups listed in table 2 there is a similar low likelihood of an adverse event. It must be recognised however that the numbers of patients studied here is lower than for physicians.

**Table 2 Adverse event rates by other professional groups**

<table>
<thead>
<tr>
<th></th>
<th>Nurse(^{22})</th>
<th>Radiographer(^{4})</th>
<th>Clinical Technologist(^{3})</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n= 467*</td>
<td>n=1197**</td>
<td>n=156***</td>
</tr>
<tr>
<td>Death</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Medical intervention</td>
<td>Not given</td>
<td>43 (3.5%)</td>
<td>3 (1.9%)</td>
</tr>
</tbody>
</table>

* Exercise, adenosine, dobutamine, dipyridamole

** Adenosine (850), dobutamine (261), dipyridamole (86)

*** Dipyridamole (156)

**Basic qualifications and experience to practice**

MPS stress testing requires a level of knowledge and experience beyond basic registration (7, 23).

These guidelines recommend that those eligible to begin training for this responsibility will normally have been qualified in their respective profession for a minimum of two years.

Exceptions may be considered for individuals with part of their basic training in cardiology.

This period of time allows for adequate consolidation of basic skills before taking on additional responsibilities. It also allows time to complete supportive education of specific areas of interest. Successful completion of post basic courses in cardiology, and pharmacology provide a suitable background before beginning MPS stress training.
If knowledge and experience in cardiology are not part of previous responsibilities, this must be acquired during training to the levels described within this document.

**Training in radiation protection**

The Ionising Radiation (Medical Exposure) Regulations 2000 state "no practitioner or operator shall carry out a medical exposure or any practical aspect without having been adequately trained" (Reg 11) (24).

Practitioners and operators are expected to have acquired knowledge of radiation use and radiation protection appropriate to their activities in accordance with regulation 11 (1), and as indicated in schedule 2 of the regulations.

Courses need to be designed for clinical stressors who have been identified by their employer as an operator.

A course should meet the theoretical training requirements of schedule 2 whilst the practical experience is gained within the trainee’s department.

**Typical theoretical content**

- IRMER
- Responsibilities of key personnel in the context of the regulations
- Duties and responsibilities of the employer, operator, practitioner and medical physics expert in the context of the regulations
- Justification, authorisation and optimisation of nuclear medicine exposures
- Ionising radiation, interactions, dose quantities
- Patient management
- Patient dose and its measurement

**Typical practical assessments**

- Handling of unsealed sources
Radioactive spills; including during cardiopulmonary resuscitation

Local rules

Communication of radiation risk to patient

It may be possible to perform and assess the theoretical training through distance-based learning.

Communication

Referral letters and patient records should be read before meeting the patient. These records are the most up to date written information about the individual and form the basis of a clinical assessment for this test.

After greeting the patient, a general description of the stress test should follow including administration of the radioisotope, the possible side effects of the stress drug and approximate times of each part of the test. This is also the most logical time to gain their verbal consent to proceed.

If an individual has difficulty understanding the requirements of the test or has any doubts, these must be rectified before proceeding. Information should be given to a patient in a language, and at a level, that they can understand.

Staff should continue to support and provide information to the patient throughout the stress test.

Consenting patients

Consent is a patient’s agreement for a health professional to provide care.

The health professional carrying out a procedure is responsible for ensuring that the patient has consented and it is they who are responsible if this is challenged later.

Details of the procedure must be provided verbally and in writing, which clearly identify risk, benefits and available alternatives (1).
Patients may indicate their consent either non-verbally (for example by presenting their arm for their injection to be given), orally, or in writing. Whatever method is accepted as valid, it is the stressor’s duty to provide enough information about the test for the individual patient to make an informed decision. Their decision must be made confidently and without duress. Written consent is not generally required, although local practice may differ.

Report writing

Following a stress test and MPS study the practitioner should write a report in an ordered format. A typical format for a report is:

- The patients name, age and weight.
- The referrers name & hospital
- Presenting risk factors
- Presenting signs and symptoms
- Recent medical history in chronological order including results of investigations
- Other details if significant e.g. hiatus hernia, breast size.
- Explanations of stress protocol details should follow if variations occur.

Further guidance and a sample of other typical report formats and documentation of test procedure is available from the British Cardiac Society (25).
Basic clinical skills

Local training and certification

This must be sufficient to expand the stressor’s knowledge and practice, enabling them to develop the necessary clinical skills to practise competently and safely (7, 26).

Peripheral Cannulation

The training should improve the understanding of clinical risks and benefits of intravenous (IV) cannulation. Stressors should be familiar with professional accountability and legal issues. The stressor must be able to discuss the appropriate equipment for peripheral cannulation describe potential complications and state the appropriate action to be undertaken.

Blood pressure monitoring

Auscultation is one of the most common ways of monitoring a patient's blood pressure, using a sphygmomanometer. Suitable local training and guidelines must be adopted to ensure competence to practice. Guidelines on the measuring blood pressure are available from the British Hypertension Society (27).

History taking and physical examination

Taking a clinical history is an essential part of the stress test. It establishes or confirms the information provided on referral and it provides information that can be used to guide a safe and efficient procedure (10, 11, 28).

It confirms that an appropriate referral has been made, which is an IRMER requirement.

A patient history should include coronary risk factors, presenting symptoms, a chronologically ordered past medical history and other details such as mobility.
and body habitus that may affect the test. In addition to these details an assessment typically involves a visual and physical examination of skin, respiration, pulse, blood pressure, mobility, and an electrocardiogram (ECG). This provides adequate information in uncomplicated cases but additional examination such as auscultation of heart and lungs support clinical judgments in more complex cases (26).
Knowledge and understanding required for EGG interpretation

A typical minimum standard of a competence-based assessment in the interpretation of an ECG is set by British Cardiac Society or SCST within their basic certificate of electrocardiography (29).

There are also clear guidelines on training available from the American College of Cardiology (ACC) and American Heart Association (AHA) in their clinical competence statement on electrocardiography and ambulatory electrocardiography (5).

With the advancement of national occupational standards (NOS) in health care science, standards have been developed for practitioners working at all levels and aim to provide national benchmarks for competence within the healthcare environment. These include basic standards such as HCS_CARD4 (perform a resting electrocardiogram) through to more advanced standards of competence with the HCS_CARD9 (produce a clinical interpretation for management of cardiac conditions) (30).

Training in electrocardiography should include the following as a minimum:

Instrumentation and technology

- Basic physiology and instrumentation
- Lead placement: skin preparation and lead location
- Equipment software and its effect on waveforms
- Technical artefacts
- Use of computer diagnosis
- Health and safety

ECG interpretation

- Review of the conduction system
- The ECG waveform
• Sinus rhythms & ectopics
• Atrial rhythms
• Junctional rhythms
• Ventricular rhythms
• AV heart blocks
• SA heart blocks
• Ischaemia & myocardial infarction
• Bundle branch blocks

General

• Normal variants with age, ethnicity
• Pathological terms applicable to the electrocardiogram.

Life support training

Immediate Life Support (ILS) would normally be a sufficient level of skill, however local circumstance must be taken into account and may dictate the need for advanced life support skills (ALS). The current procedure guidelines for MPS state (1).

4.1.3 ii. The healthcare professional supervising the stress test should be current in immediate life support (ILS) provided that there is rapid access to personnel trained in ALS and that appropriate assistance and emergency support is available.

The British Cardiac Society also advocates a similar level of competence for cardiac physiologist managed exercise stress testing (25). The protocol published in 2003 states that a stressor must,

“hold a current resuscitation certificate (minimum ILS)”
Practical clinical skills training

Clinical competence in the care of the acutely ill patient is an essential skill for non-medical staff that are training to perform MPS stress tests whether exercise or pharmacological. This is particularly relevant for stressors whose background knowledge of chronic conditions, acute coronary events and admissions is limited. There are many useful areas where these skills could be obtained such as a Coronary Care Unit, Medical Admissions Unit or Rapid Access Clinic. Alternative solutions may involve attendance on a recognized training course in the care of the acutely ill patient (31).

Stressors must be familiar with potential complications and must have a basic understanding of cardiac disease and the immediate management of acute coronary syndromes (32).

They must demonstrate knowledge of:

1. Acute coronary syndromes including
   - Unstable angina
   - Non-Q wave myocardial Infarct
   - Q wave myocardial infarct

2. The origin of the ECG and identification of the main cardiac rhythms associated with cardiac arrest and peri-arrest arrhythmias including
   - Brady arrhythmia
   - Heart block
   - Escape rhythms
   - Agonal rhythm
   - Tachy-arrhythmias

3. The use of anti-arrhythmic drugs used in the peri-arrest period
4 Understand the potential complications of exercise and pharmacological stress agents together with any associated ischaemic ECG changes

**Exercise stress**

There are several guidelines for training and performing exercise stress tests (6, 12, 25).

There are also programmes of professional education and training to achieve competence in stress testing, including the Society for Cardiological Science and Technology (SCST) or British Association for Cardiac Nursing in cardiac Care, Acute/Episodic Care Career Pathway - Cardiac Nursing Competency Statements, others include privately run professional courser and training (29, 33, 34).

**Pharmacological stress**

There is no specific training for those who want to perform pharmacological stress tests although a list of the cognitive skills required has been documented by the American College of Cardiology and American Heart Association in table 4 of their clinical competence statement on stress testing (12).

**Knowledge of indications and contraindications**

Stressors must have a good knowledge of the indications and contraindications of pharmacological stress agents and protocols for their use (5, 35).

The stressor must demonstrate a comprehensive understanding of

Effects of

- Vasodilators and inotropic drugs
- Properties and interactions of administer pharmacological agents
• Haemodynamic response

Knowledge of

• Pharmacokinetics of all pharmacological agents
• Physiological changes associated with pharmacological agents
• ECG changes associated with pharmacological agents

General drug information including;

• Storage
• Handling
• Management

Stressors must be able to recognize and treat complications, including the use of adenosine or dipyridamole antagonists such as aminophylline. They must understand commonly used cardiac medications in order to assess possible interactions or contraindications to the test.

Trainee accreditation

This will be gained through a formal assessment process of the trainee that should include;

• Written exam (probably multiple choice). This could be developed into a web based interactive solution.
• Log book detailing the clinical experience.
• practical assessment including a structured oral examination

If all sections are completed successfully, the trainee will be deemed competent to practice.

Stress training record

It has already been be recognised that
‘Both the performance of pharmacological stress and the integration of stress (exercise or pharmacological) studies with radionuclide cardiac imaging require training beyond that necessary for standard exercise testing alone’ (5).

Good practice for trainees, before instruction, is to observe a wide variety of stress techniques and patients to establish knowledge and experience of cardiology stress testing.

Accreditation of a trainee should be by mutual agreement between trainer and trainee after successful completion of all steps of training. Most good trainees should be capable of judging when they have sufficient experience to stress independently. It is not possible to state definitive numbers of stress tests that will provide adequate experience since this will depend upon the background and aptitude of the trainee. In general terms, a trainee should have demonstrated the ability to manage at least one of each of the more common complications of stress and this might be accomplished after a minimum of 100 stress tests for a trainee without a medical qualification or 50 stress tests for a trainee with a medical qualification. These should be considered minimum numbers and actual numbers may exceed this significantly. For secondary forms of stress such as pharmacological stress in centres where dynamic exercise is the default, or dobutamine or exercise where adenosine is the default, a minimum number for each of these to demonstrate competence should be 25 for non-medically qualified trainees or 12 for medically qualified trainees in addition to the numbers performed using the primary stress technique.

Once trained, errors that require unrequested intervention by a third party, retest or unnecessary radiation exposure should not be anticipated in more than 0.1% of studies.

The trainee in a logbook must record stress tests performed during training. The minimum information that must be recorded is:

- Stress method
- Date of test
The trainer should confirm safe and efficient practice of each test until training is completed by countersigning the logbook and should provide a summary of the trainee’s achievements.

**Clinical practical assessment**

During and towards the end of training the trainee’s skills should be assessed by direct observation using a structured and objective system. This should cover the ability to assess the patient and communicate with them, to select the appropriate stress technique, to administer drugs and radiopharmaceuticals safely and to adapt the test to observations as it proceeds. The number of tests observed and scored in this fashion should be sufficient to demonstrate competence in all areas of the test. During these assessments:

- The assessor should observe and only intervene for matters of safety
- When administering the trainee must be seen to consider the prescription, the patient (physical assessment) and the product (drug).
- Drug knowledge can be assessed during clinical practice and by formal questioning.
- The trainee must be deemed competent in all of the assessment criteria in order to pass. If not competent in any of the assessment criteria, this must be reassessed following feedback from the assessor (35).

Following successful assessment, a certificate must be issued to confirm competence in MPS stress testing.

**Maintenance of competence**

As with number of tests required to achieve competence, it is difficult to generalise the numbers of tests required to maintain competence. However,
if fewer than 100 tests are performed in a year, formal re-accreditation as
described above should be undertaken each year.

Audit

Stressors should audit their clinical practice and should compare their
incidence of adverse events with accepted standards if available. This should
ensure that safe and efficient practice is maintained and it will identify the
need for improvements where necessary (36, 37).
References


2 Technology Appraisal Guidance 73: Myocardial perfusion scintigraphy for the diagnosis and management of angina and myocardial infarction Issue date: November 2003

3 I Jones, J. Thornley, A Tukan, A. McCance April 2004 Stress Testing Performed By Clinical Technologists (Nuc Med Comm. Volume 25 (Abstracts) number 4 page 408

4 N Beharry, C White, R Coulden, Stone D., Non-medical supervision of pharmacological stress myocardial perfusion imaging (BNMS autumn 2002)


6 BNMS/BCS/BNCS Procedure Guidelines for Radionuclide Myocardial Perfusion Imaging 2004 Heart; 90: 1-10

7 Clinical Guidelines. Exercise testing when there is not a doctor present: recommendations at the medical practice committee and council of the British Cardiac Society. British Heart Journal 1993 70; 488 – 96


12 Clinical competence statement on stress testing, 2000; J Am Coll Cardiol 36, 1441-53

13 Joint Task Force, made up of representatives of the American College of Cardiology (ACC) and the American Society of Nuclear Cardiology (ASNC).


15 Hardwick S Jordan S. The impact of part time registration degrees on practice.
Advanced nursing. 2002; 38: 524 –35


17 Patient Group Directions Dissemination Website. NHS Executive (north west) Cited on 19/01/04. Available at: http://www.bradsoft.co.uk/services/PGD’s.


23 RJC Hall, RM Boyle, M Webb Peploe , DA Chamberlain, DJ Parker. Guidelines For Specialist Training In Cardiology (Approved by the Council of the British Cardiac Society and the Specialty Advisory Committee in Cardiovascular Medicine of the Royal College of Physicians)

24 The Ionising Radiation (Medical Exposure) Regulations, (2000), Statutory Instrument, The Stationery Office

25 British Cardiac Society Protocol for Cardiac Physiologist Managed Stress Testing 2003


27 British Hypertension Society

http://www.bhsoc.org/Guidelines_how_to_measure_blood_pressure.htm


29 4The Society for Cardiological Science and Technology (SCST)

Certificate of Electrocardiography

(http://www.scst.org.uk/exams/cert2000.htm)

30 Skills for Health

http://www.skillsforhealth.org.uk/view_framework.php?id=73

Resuscitation Council Uk Advanced Life Support

Adult Advanced Life Support, Resuscitation Guidelines 2000

http://www.resus.org.uk/pages/als.htm

British Association for Cardiac Nursing in cardiac Care, Acute/Episodic Care Career
Pathway - Cardiac Nursing Competency Statements January 2004


Drug Assessment for Preparation and Administration of Oral, Ophthalmic, ENT And
Topical Medicines to Patients Southern Derbyshire acute hospitals NHS Trust. Final
Draft 6

Principles For Best Practice In Clinical Audit, NICE

http://www.nice.org.uk/pdf/BestPracticeClinicalAudit.pdf

Dowling S, Martin R, Skidmore P, Doyal L, Cameron A, Lloyd S. Nurses taking on
junior doctors’ work: a confusion of accountability. British Medical Journal. 1996; 312:
1211–14