

Clinical Competence in Myocardial Perfusion Scintigraphic Stress Testing: General Training Guidelines and Assessment

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Introduction

The typical 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 recent NICE (2) report are implemented. This would raise the current levels for MPS from 1.2% to 4% per 1 million patients, creating a huge increase in service demand. One solution is for other health care professionals to supervise the routine myocardial stress sessions and therefore negate the need for a clinician to attend. This has already been shown to significantly reduce waiting times (3, 4), since it implicitly allows improved flexibility in planning session availability, attendance times and patient numbers.

Professional guidelines advise the medical supervision of high-risk tests (5,6,7). This category of patient is usually identified and managed accordingly during the referral process for Myocardial Perfusion Scintigraphy (MPS). Both the referring cardiologist and the nuclear physician, who justify the request for the procedure, carry out risk assessments. However, patients with a range of conditions with varying severities may present in non-physician led clinics at a later date. In addition to this difficulty, all registered health professionals are personally accountable for their practice (8, 9), and are required to make their own clinical decisions. These two factors make it necessary for those that supervise MPS stress tests (stressors) to perform an assessment of each patient as the first part of the procedure. This firstly provides information from which to determine whether a test is beyond the stressors' skills and therefore whether medical assistance is necessary. Secondly, it also provides details that guide a safe and effective procedure for each individual patient (5, 10).

Non-medical professionals already use physical assessment to diagnose conditions in other settings such as rapid access chest pain clinics, preoperative 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, which 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 that performs

stress tests (5). In English law, non-medical staff that adopt a medical responsibility will be compared to the usual practice of a doctor performing the same responsibility (8).

Aim of these Guidelines

These guidelines outline the general and specific abilities required by non-medical stressors to perform a safe, efficient MPS procedure (6, 12, 13). They also provide information about how to achieve and maintain competency. The goal is to provide a common standard of stress testing for patients and professionals. This standard should give individual professionals freedom to contribute whilst maintaining the quality of practice. It welcomes a variety of disciplines and attempts to avoid conflict that can make professional and legal support of those with extended role responsibilities difficult (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 radio-nuclides, knowledge and safe administration of stress drugs, use of equipment, patients needs and documentation

Protocols should also include training competencies for new staff, methods of assessing and maintaining individuals practice and importantly methods of auditing general 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 where 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 1 Adverse event rates during physician led stress testing

	Exercise ¹⁸ n=518,448	Adenosine ¹⁹ n=9256	Dipyridamole ²⁰ n=73806	Dobutamine ²¹ n= 1012
Death	25.9 (0.005%)	0	7 (0.01%)	0
MI or Serious arrhythmias	457 (0.08%)	647 (7%) (19 (0.03%)	42 (4.2%)

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

	Nurse ²² n= 467*	Radiographer ⁴ n=1197**	Clinical Technologist ³ n=156***
Death	0	0	0
Medical intervention	Not given	43 (3.5%)	3 (1.9%)

* Exercise, Adenosine, dobutamine, Dipyridamole

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

*** Dipyridamole (156)

Basic qualifications and experience to practice

Myocardial perfusion scintigraphic stress testing is a responsibility that requires a level of knowledge and experience that is 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 those individual professionals having part of their basic training in a 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 staff that perform MPS stress tests and 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 trainees 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 to patient of radiation risk.

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

Communication

Referral letters and patients 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 always 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 the procedure is ultimately responsible for ensuring that the patient is actually consenting to what is being done: it is they who will be held responsible in law if this is challenged later.

Details of the procedure must be provided verbally and in writing, which clearly identify risk, benefits and available alternative procedures (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 stressors 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 thought to be required, although local guidance from the Trust must be sought. A draft statement has been prepared by The British Nuclear Medicine Society (BNMS) on consent issues in Nuclear Medicine that states (24);

iv. Written consent may be obtained from patients undergoing procedures such as myocardial perfusion imaging and captopril renography. This is not a requirement and the decision regarding written consent can be taken at local/Trust level.

Report writing

Following a stress test the practitioner should write a test report in an ordered format. A typical format for a report is suggested as:

- 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 practitioner'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 intra venous (IV) therapy. Stressors should be familiar with professional accountability and legal issues. The practitioner should 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 this test. It establishes and confirms diagnosis and provides the information of individual patients that can be used to guide a safe, efficient procedure (10, 11, 28).

Initially, a clinical history is used to confirm an appropriate referral for the test. This must be made in addition to IR(ME)R justification and authorization regulations because practitioners have individual responsibility for their own practice.

A patient history should include: cardiac 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, general mobility, and an electrocardiogram (ECG). This provides adequate information in uncomplicated cases and is supported with additional skills such as auscultation of heart and lungs that provide further details to 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 MPI 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 myocardial perfusion stress tests whether exercise or pharmacological. This is particularly relevant for practitioners 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 (CCU), Medical Admissions Unit (MAU) or Rapid Access Clinic (RAC). Alternative solutions may involve attendance on a recognized training course in the care of the acutely ill patient (31).

It is necessary to familiarise practitioners with potential complications that may arise during a stress procedure. Stressors must obtain a basic understanding of cardiac disease processes and the management of the patient in both the chronic and acute stages and after recovery from an acute coronary syndrome (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 (three types)
 - Escape Rhythms
 - Agonal Rhythm
 - Tachyarrhythmias
3. The use of antiarrhythmic 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 that may occur during a stress test.

Exercise testing

There are numerous 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 (S.C.S.T) or British Association for Cardiac Nursing in cardiac Care, Acute/Episodic Care Career Pathway - Cardiac Nursing Competency Statements, others include privately run professional courses and training (29, 33, 34).

Pharmacological testing

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

Knowledge of indications and contra indications

Practitioners must have a good knowledge of the indications and contra indications of using pharmacological agents. They must also know the appropriate test regimes of various pharmacological agents (5, 35).

Overall a practitioner 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

Practitioners must have the skills and capability to recognize and appropriately treat complications, including the use of adenosine or dipyridamole antagonists such as theophylline and aminophylline. They must also understand the routine cardiological formulations included in the patients' current medication so that the stressor can assess for possible interactions or contraindications to the test.

Trainee accredited

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.
- Clinical practical assessment that will include a viva aspect.

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

Stress training record

It is suggested that a trainee would need to perform a minimum number of stress tests in order to demonstrate safe efficient practice in all stress technique. Within these numbers, all should be conducted without adverse events that require supervisor intervention, retest or unnecessary radiation exposure. Current practices advocate a need to allow either full accreditation or to choose a specific technique to become accredited.

For full accreditation it is suggested that a minimum of 50 exercise, 40 vasodilator and 20 inotropic techniques need to be performed.

Or

Chose 1 or more technique and become accredited for those specific techniques, minimum in any section would be 50 i.e. 50 exercise or 50 vasodilator or 50 inotropic.

Within these numbers, all should be conducted without adverse events that require supervisor intervention, retest or unnecessary radiation exposure.

These must be recorded in the trainee's logbook.

The minimum information that must be recorded is:

- Stress method
- Date of test
- Test report
- Outcome

The trainee will maintain this training record. An appointed clinical supervisor will confirm safe efficient practice of each test until the desired number is achieved. The supervisor will confirm satisfactory training by countersigning logbook details and providing a summary of the trainees achievements.

Clinical practical assessment

Following initial training and additional to indirect supervision, the trainee must be assessed by direct observation of practice. Their ability to perform various stress tests, administer drugs safely and knowledgeably to a varying group of patients must be formally assessed preferably using some form of scoring system. The number of observational assessments should be chosen to fit in with local routines and be of a quantity that demonstrates competence in all areas of the responsibility. During these assessments:

- The assessor should observe and only intervene for matters of safety
- The assessment is made to correspond with cardiac stress sessions
- 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 formal certificate must be issued to confirm that the trainee is competent to perform myocardial perfusion stress tests. It is envisaged that BNMS and BNCS will accredit appropriate courses and centres and that these will be authorised to issue certification.

Re-assessment of competence

It will be necessary for the practitioner to have written evidence of completing a minimum of 50 tests per annum and perform a practical assessment to confirm ability to maintain clinical competency.

It is expected that a written exam should be retaken every 5 years to confirm preservation of core knowledge.

Audit

Individuals must be prepared to audit their clinical care, service and incident rates compared to national levels. This will not only help improve individual practice, but should also improve patient care and outcomes. It will provide evidence to confirm the quality of clinical services provided and will guide but may also highlight the need for any improvements to services (36, 37).

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Review

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