HKCRRT

The Hong Kong College of Radiographers and Radiation Therapists

Standards of Practice for Nuclear Medicine and Positron Emission Tomography

By

Nuclear Medicine Faculty

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1 Brief information/background of nuclear medicine and positron emission tomography

1.1 Nuclear Medicine (NM) is a medical specialty in which radioactive substances are used for diagnosis by imaging and non-imaging techniques and for therapies of metabolic disorders and cancers under the prescription of a NM physician.

1.2 Positron Emission Tomography (PET) is an imaging modality in the specialty of NM.

1.3 In Hong Kong, NM technologists (NMTs) are termed NM radiographers (NMRs). Their training is highly specific to NM technology and the roles of NMTs are performed by NMRs.

1.4 NMRs in Hong Kong are registered radiographers who are highly specialized health care professionals that are able to undertake the whole range of NM procedures. They work with other health care professionals to provide patient care, management, radiation protection, imaging and radionuclide therapy in the course of their duties, which include radiopharmaceutical administration.

1.5 NMRs operate dedicated gamma cameras and hybrid scanners such as Single Photon Emission Computed Tomography (SPECT)/ Computed Tomography (CT), PET/CT and PET/Magnetic Resonance Imaging (MR) to provide functional and anatomical imaging and radioactivity quantification information for patients, upon request from registered medical practitioners.

1.6 Depending on the provision of patient services and facilities in the institute, some NMRs may perform or engage in:

1.6.1 Non-imaging roles in the radiopharmacy and laboratories.

1.6.2 Radionuclide therapy procedures.

1.6.3 Thyroid uptake test for the assessment of thyroid function.

1.6.4 Bone densitometry for bone density measurements.

2 Safety and precautions

2.1 Radiation protection

2.1.1 All people in the controlled area, including examination rooms and supervised areas, should have adequate radiation protection as appropriate, such as dosimeters, lead barriers, lead-lined waste bins, syringe shields, and lead aprons, etc. A written scheme of work should be in place. The workflow should be addressed to minimize the personal dose of occupants and radiation workers.

2.1.2 All radiation protection devices should be in good condition and regularly checked.

2.1.3 Patients, relatives, and staff must be properly informed before being exposed to radiation.

2.1.4 Prior to radiopharmaceutical administration, patient identification should be confirmed. Examination procedures and precautions should be explained and consent obtained from patients/guardians/relatives where appropriate.

2.1.5 The 10-day rule/28-day rule of the last menstrual period (LMP) should be observed and documented. A pregnancy test should be taken or the examination rescheduled when necessary.

2.1.6 Special precautions regarding radiation dose and clinical safety must be considered prior to deliver radiation/radiopharmaceuticals/radioactive substances to children/pregnant women, and justification for the requested examination should be well considered.

2.2 Safety specific to specialty

2.2.1 Perform environmental scanning for background radiation level and take necessary actions, including decontamination.

2.2.2 Apply safe and aseptic techniques during labeling procedures of red blood cells/denatured red blood cells.

2.2.3 Verify the name and quality of radiopharmaceutical during calibration/dispensing, including visual inspection for particulate matters, color, activity, concentration, volume, expiry date, and time, etc.

2.2.4 Verify quality of radiopharmaceuticals include labelling efficiency before administration.

2.2.5 Administer radiopharmaceuticals in a correct route, dosage, and time to the correct patient at the appropriate site/limb according to special clinical indications.

2.2.6 Alert any spillage of unsealed radioactive substances or environmental contamination; report and decontaminate accordingly.

2.2.7 Segregate, track and dispose clinical waste contaminated with radioactivity according to licensing condition.

2.2.8 Observe local radiation protection rules for radiation safety.

2.3 Risks and medical emergency

2.3.1 Observe patient's vital signs during and after examination procedure.

2.3.2 Observe safety to ensure intravenous route of access, avoid infiltration of vein, and monitor vasovagal response.

2.3.3 Perform regular cardiopulmonary resuscitation (CPR) drills with documentation for familiarization of workflow and to ensure safe management of patients during emergency situations.

2.3.4 Handle emergency situations encountered in nuclear medicine examinations including, but are not limited to, sinus tachycardia or patient collapse during treadmill exercise/pharmacological cardiac stress test for myocardial perfusion scan.

2.3.5 Familiarize with location of emergency trolley, life-saving equipment, and drugs.

3 Role and responsibilities of radiographers

3.1 Data integrity

3.1.1 Understand the clinical management system (CMS), radiology information system (RIS), hospital information system (HIS), picture archiving and communication system (PACS), and electronic health record sharing workflow (i.e., eHRSS in Hong Kong).

3.1.2 Confirm patient identity before examination and ensure study information are completed.

3.1.3 Ensure patient examinations and assigned images are stored as required by institute.

3.1.4 Perform virus/malicious program check provided by the management before importing data from external electronic media to the imaging system and network.

3.2 Patient privacy

3.2.1 Protect patient privacy and keep patient information confidential.

3.2.2 Patient data is retrieved on an as-needed basis to facilitate medical procedures of the patient, or when legally obliged.

3.3 Application of the ALARA principle

3.3.1 Carry out requested procedures when the benefit outweighs the risk.

3.3.2 Plan good clinical workflow to minimize prolong patient contact after radiopharmaceutical administration to minimize occupational exposure

3.4 Compliance with laws and regulations

3.4.1 Comply with the prevailing statutory laws of the Hong Kong Special Administrative Region, China while observing guidelines published by international professional organizations.

3.5 Integration of knowledge to clinical practice

3.5.1 Apply clinical knowledge of human anatomy, physiology, pathology and biochemistry.

3.5.2 Apply technical knowledge of radiation sciences, pharmacokinetics and imaging principles.

3.6 Simple radiopharmaceutical preparation for safe patient use, if required or when a scientific officer / radiochemist / radiopharmacist is not available.

3.6.1 Apply aseptic technique and use radioisotope generators in clean / aseptic environment.

3.6.1.1 Perform quality-control tests for radioisotope generators.

3.6.1.2 Elute radioisotope generators and perform quality-control tests on the eluate.

3.6.2 Perform compounding, assay, and quality-control tests on radiopharmaceuticals.

3.6.3 Operate equipment to generate gaseous/pseudo-gas radiopharmaceuticals.

3.7 Patient preparation

3.7.1 Provide appointment notice with examination preparation instructions to patients well before service day.

3.7.2 Give instructions and explanations to patients at a level that they can understand.

3.7.3 Assess patient’s compliance with preparations which are essential to the procedures before start.

3.8 NM examinations* with gamma cameras, SPECT/CT, and non-imaging equipment; PET examinations with PET/CT and PET/MR systems.

3.8.1 Perform quality control tests on equipment and take appropriate follow up actions.

3.8.2 Calculate appropriate dose and assay of radiopharmaceutical used in examinations according to in-house protocols and decay schemes of radioisotopes.

3.8.3 Administer correct radiopharmaceuticals/examination drugs and dosage to patient in the correct route, including intravenous injection, intravenous infusion, intravenous bolus, oral, inhalation, and intra-peritoneal infusion as appropriate.

3.8.4 Prepare and use appropriate radiopharmaceutical delivery systems.

3.8.5 Position patient accurately for specific clinical requirement and in a safe manner.

3.8.6 Perform image and data processing, including reconstruction, quality inspection, data analysis, and display, for interpretation by NM physicians.

3.8.7 Perform CT and MRI acquisitions where appropriate.

3.8.7.1 Operate CT and MR systems in a safe manner

3.8.7.2 Select appropriate imaging parameters for patient examinations

3.8.7.3 Perform contrast/non-contrast CT and MR examinations on body parts after discussing with NM physician on the modification of imaging protocols for desirable outcomes, if required.

3.9 Image post-processing and image registration for hybrid imaging.

3.9.1 Process image data sets (include multi-planar reformats and volume imaging).

3.9.2 Perform quality checking on the fused images.

3.10 Identification of uncommon outcomes

3.10.1 Recognize normal / altered / non-specific / suboptimal bio-distribution of radiopharmaceuticals used in the examination.

3.10.2 Recognize image artifacts

3.10.3 Understand the causes and take necessary actions.

3.11 In vitro laboratory procedures

3.11.1 Perform safe aseptic red blood cell/denatured red blood cell labeling procedures when necessary.

3.11.2 Operate, where available, laboratory equipment such as a dose calibrator, well counter, Geiger Muller counter, survey meter, centrifuge, water bath, fume hood, and biosafety cabinet, etc.

3.12 Bone densitometry

3.12.1 Perform daily and weekly quality-control tests according to manufacturer's recommendations.

3.12.2 Process patient's images according to manufacturer's program.

3.13 Handling of radioactive wastes

3.13.1 Segregate radioactive waste according to half-lives.

3.13.2 Store radioactive waste for decay in appropriately shielded storage.

3.13.3 Ensure low level radioactive waste have been surveyed and complies with requirements on license before disposal.

3.13.4 Keep record of radioactive waste disposal.

4 Requirements of radiographers

A qualified NMR should have the competency to practice in collaboration with NM physicians, scientific officers, radiochemists, radiopharmacists, medical physicists, nurses and other health care professionals when contributing to patient services.

4.1 Academic qualifications

4.1.1 Obtained a Professional Diploma in Diagnostic Radiography or bachelor's degree in Radiography from a local institution OR

4.1.2 Graduated in Radiography / Medical Imaging / Radiation Sciences / Nuclear Medicine from an overseas institution recognized by the Radiographers' Board of the Hong Kong Special Administration Region (HKSAR).

4.2 Professional qualifications at entry level

4.2.1 Registered with the Radiographers' Board (Category D), and hold a valid Annual Practicing Certificate AND

4.2.2 A valid Irradiating Apparatus Operator License issued by the Department of Health, the Government of the HKSAR.

4.3 Preferred attributes

4.3.1 A minimum of two years' post-registration clinical experience.

4.3.2 Being a certified NM radiographer of the Hong Kong College of Radiographers

and Radiation Therapists (HKCRRT).

4.3.3 Completed and passed Diploma in Nuclear Medicine Technology held by the former Hong Kong Society of Nuclear Medicine and the Hong Kong Hospital Authority.

4.3.4 Completed and passed the Distance Assisted Training Program for Nuclear Medicine Technologists (DAT for NMT) Level II, organized by joint collaboration of the International Atomic Energy Agency (IAEA) and the Hong Kong Society of Nuclear Medicine and Molecular Imaging (HKSNMMI).

4.3.5 Postgraduate diploma, degree, or other higher qualification in Radiography / Medical Imaging / Radiation Sciences / Nuclear Medicine / Research in the specialty.

4.3.6 Radiation protection supervisor / radiation protection advisor / handling of radioactive substances training from a local or international institution.

4.3.7 Good exposure to various NM examinations, PET/CT examinations, and radionuclide therapies.

4.3.8 Initiatives to improve patient care and management at a higher cognitive and clinical level.

4.4 Collaboration

4.4.1 Be able to collaborate with different disciplines, including NM physicians, medical physicists, nurses, scientific officers, radiochemists, radiopharmacists, and other health care professionals and vendors, in the process of patient service delivery.

4.5 Training and education

4.5.1 NMRs should continually strive to improve their knowledge and skill sets in evolving medical imaging.

4.5.2 NMRs are encouraged to maintain their level of expertise through continuing professional development (CPD) program. CPD points should be obtained annually according to the latest requirements of the Radiographers' Board.

4.6 Research and development

4.6.1 NMRs are encouraged to participate in clinical research, educational activities, development programs, and audit exercises.

5 Clinical applications

5.1 Conventional radionuclide imaging (planar and SPECT) and PET, with CT or MR

5.2 Non-imaging examinations

5.3 Radionuclide therapy and theranostics

5.4 Radiopharmacy

5.5 Bone densitometry

6 Examination* routines

6.1 Pre-examination

6.1.1 Prepare prescription order with appropriate dose and calibration time.

6.1.2 Patient preparation.

6.1.3 Confirm quality control test result of radiopharmaceutical(s) is/are acceptable before administration.

6.1.4 Administer radiopharmaceutical.

6.2 Operate imaging systems for patient examinations

6.2.1 Gamma camera and dedicated cardiac scanner

6.2.1.1 Control gantry and patient couch movement safely

6.2.1.2 Select appropriate acquisition parameters and accessories

6.2.1.3 Position patient and select body orientation

6.2.2 PET/CT and PET/MR scanners

6.2.2.1 Control gantry and patient couch movement safely

6.2.2.2 Select appropriate acquisition parameters and accessories

6.2.2.3 Input scan information such as radioisotope, body weight, injected dose, and time

6.2.2.4 Administer contrast agent, orally and/or intravenously as prescribed by NM physicians

6.3 Post-examination

6.3.1 Provide appropriate after care instructions to patient and care taker.

6.3.2 Process acquired data for display and reporting.

6.3.3 Store patient data sets and processed images

**Examinations include, but are not limited to, skeletal imaging, pulmonary imaging,*

infection imaging, oncology imaging, renal imaging, gastro-intestinal imaging, central nervous system imaging, endocrine imaging, cardiovascular system imaging, lymphatics system imaging, and theranostics. PET/CT studies include oncologic, cardiac, and neurologic PET examinations.

7 Declaration

The contents of this standard of practice (SOP) serve as a reference for radiographers, radiation therapists, and related professionals. It should not be considered comprehensive information for any related examination or procedure. Further elaboration of this document is subject to the decision of the council of the Hong Kong College of Radiographers and Radiation Therapists.

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