HONG KONG COLLEGE OF RADIOLOGISTS

TRAINING REGULATIONS (NUCLEAR MEDICINE)

[This document should be read in conjunction with the Working Principles for Accreditation of Training Centres and Conduction of Training Programmes and Guidelines on Training (Nuclear Medicine).]

TRAINING REQUIREMENTS

(A) *Entry Requirement & Duration of Training*

1.0 All trainees must hold registration with the Medical Council of Hong Kong that is deemed acceptable by the College and must enrol with the Hong Kong College of Radiologists at the commencement of their training.

1.1 The duration of training shall last for a minimum of 6 years.

(B) *Basic Specialist Training*

1.0 This stage of training comprises four years of training, including 6-month full-time post-registration recognised clinical experience outside Nuclear Medicine (Clinical Oncology, Emergency Medicine, Internal Medicine, Neurosurgery, Obstetrics and Gynaecology, Orthopaedics and Traumatology, Paediatrics, Psychiatry, and Surgery). The relevant clinical experience obtained within 5 years before joining as Nuclear Medicine trainee can be retrospectively recognised. The relevant clinical experience can be counted to a maximum of 12 months if the trainee has obtained higher qualification of the relevant specialty. The respective higher qualification would be assessed by the Training and Examination Subcommittee (Nuclear Medicine).

1.1 Up to 6 months of the required post-registration clinical experience may be exempted on the basis of equivalent overseas clinical experience. The exact duration of the required post-registration clinical experience that can be exempted will be considered on an individual basis, at the discretion of the Education Committee and the College Council.

1.2 Trainees are required to have 9-month equivalent of rotation to an accredited Radiology training centre (with emphasis on CT and MRI) during the Basic Specialist Training. Trainees are required to have consecutive 3-month rotation to Radiology training centre within the first year of Nuclear Medicine training, and to fulfil the remaining 6-month equivalent of rotation to Radiology training centre in the remaining Basic Specialist Training period. Trainees with prior Radiology training in the College before joining Nuclear Medicine training may be counted up to 6 months, subject to assessment on the comparable experience in cross-sectional imaging, and final approval from the Education Committee and the College Council.

1.3 Fellowship Basic and Advanced Training Courses on principles of Nuclear Medicine and science and on clinical Nuclear Medicine are organised by the College specially for the registered trainees. A minimum of 80% attendance on the structured training courses will be required before trainees are allowed to attempt the respective First (Part I) and Final (Part II) Fellowship Examinations.

2.0 Scope of Basic Specialist Training

2.1 Basic Nuclear Medicine and Science training

2.1.1 The Basic Nuclear Medicine and Science training programme should include the following topics:

- *Physical Science*: structure of matter, modes of radioactive decay and particle and photon emissions, and interactions of radiation with matter.

- *Instrumentation:* Nuclear Medicine instrumentation with special emphasis on the different types of radiation detectors, gamma scintillation cameras, solid-state detector technology, PET and PET/CT scanners, radiation detector collimation, associated electronic instruments and computers, and image production and display.

- *Mathematics, Statistics, and Computer Sciences* including probability distributions, medical decision making, basic aspects of computer structure and function, programming and processing.

- *Radiation Biology and Protection:* biological effects of ionizing radiation, means of reducing radiation exposure, calculation of the radiation dose, evaluation of radiation overexposure, medical management and disposal of radioactive substances and establishment of radiation safety programmes.

- *Radiopharmaceuticals:* production of radionuclides and radiotracers, principles of cyclotron, generators, radiochemistry, pharmacokinetics and formation of radiopharmaceuticals, knowledge of radiopharmacy design and the Good Manufacturing Practice (GMP) requirements.

- *Diagnostic Uses of Radionuclides:* clinical indications, technical performance and interpretation of in vivo imaging and function studies using radionuclides; use of scintillation cameras and external detectors; physiologic gating techniques; patient monitoring during intervention studies; and an understanding of the relationship between Nuclear Medicine procedures and other pertinent imaging modalities such as computed tomography, ultrasonography, and magnetic resonance imaging.

- *Therapeutic Uses of Radionuclides:* patient selection, indications, justification, administration, and therapeutic applications of radiopharmaceuticals and administrable or implantable medical devices, dosimetry, radiation protection and follow-up after therapy.

- *Anatomy, Biochemistry and Physiology:* the trainee is required to be familiar with the basic anatomy, biochemistry and physiology relevant to common Nuclear Medicine imaging examinations. There should be a clear understanding of topographic and cross-sectional anatomy as displayed by SPECT and PET imaging. Knowledge of normal variation in anatomy will also be expected.

2.2 Clinical Nuclear Medicine training

2.2.1 This will lead up to the Final (Part II) Fellowship Examination of the College.

2.2.2 For this stage of training, there should be general knowledge of current clinical Medicine, Surgery and Pathology, especially in relation to Nuclear Medicine.

2.2.3 There should be ample opportunity to attain competence in correlating the patient's problem with optimum selection of Nuclear Medicine studies, performing these studies, interpreting the information obtained, correlating this information with other diagnostic studies and following up patients receiving radionuclide diagnoses.

2.2.4 The trainee should directly participate in the performance of a sufficient number and wide variety of studies (imaging, non-imaging and therapy) under adequate supervision.

2.2.5 A general awareness of current trend is desirable, including updated Nuclear Medicine and radiological literature, relevant radiation protection measures and emerging technologies such as artificial intelligence, machine learning, deep learning and radiomics.

2.2.6 During the whole period of clinical training, emphasis would be put on the cultivation of a high level of professional conduct and ethics. Communication skills would be developed to ensure sound communication among professionals and good patient-doctor relationship.

2.2.7 After completing relevant periods of Nuclear Medicine training, Radiology rotation and relevant clinical experience outside Nuclear Medicine, trainees may be allowed to attempt the Final (Part II) Fellowship Examination of College, provided that the trainee has already passed the First (Part I) Fellowship Examination of College.

(C) *Higher Specialist Training*

1.0 This stage of training comprises the two years of training after passing the Final (Part II) Fellowship Examination.

1.1 The two years of Higher Specialist Training should consist of General Nuclear Medicine, Subspecialty Training, and training in relevant attributes. Trainees are required to have 3-month equivalent of Radiology training within the Higher Training period, with emphasis on CT and MRI.

1.2 For a broad knowledge-based exposure, the two years of training should consist of:

(A) Minimum of 9 months fulltime training in General Nuclear Medicine
(B) Minimum of 6 months in Subspecialty Training in Positron Emission Tomography / Computed Tomography
(C) 3-month equivalent of Radiology training
(D) Remaining period: minimum of 6 months in another subspecialty subject or minimum of 3 months in each of other two subspecialty subjects

2.0 Scope of Higher Specialist Training

2.1 Emphasis will be made on providing the trainee with opportunities for practical experience, increased responsibility, independent thinking and action in various disciplines of Nuclear Medicine through a system-based structured programme.

2.2 There should be in-depth knowledge and application of General Nuclear Medicine. Subspecialty development is also encouraged, with training and interest in more than one Subspecialty.

2.3 The Higher Specialist Training differs from Basic Specialist Training with emphasis on independent performance and supervising responsibility.

2.4 There should be knowledge of the ethical standards and legal responsibilities of Nuclear Medicine practice.

2.5 Active participation in intra- and inter-departmental meetings is required.

2.6 Teaching activities (to clinicians, younger trainees, radiographers, nurses and medical students) are required to attain in-depth knowledge of a subject and to improve on presentation skills.

2.7 Management of and contribution to film museum and teaching files are required.

2.8 Audit and quality assurance activities are required.

2.9 Trainees should participate in academic Nuclear Medicine: research techniques, presentation skills, literature review.

2.10 During the entire period of Basic and Higher Specialist Training, trainees should participate actively in research activities.

1) At least one project must be accepted at College scientific meetings, or regional / international scientific conferences with the trainee as the oral presenter or first author of a poster presentation; and
2) At least one Nuclear Medicine article with the trainee as the first author, must be published / accepted for publication in the Journal of the College or other indexed medical journals.

Training centres should facilitate trainees to participate in research projects.

2.11 Training on administrative skills relevant to Nuclear Medicine practices is required.

EXAMINATIONS

1.0 The College Examination for Basic Specialist Training will be in two parts (First and Final).

2.0 First (Part I) Fellowship Examination:

2.1 Entry requirements of First (Part I) Fellowship Examination

2.1.1 Minimum period of 18 months accredited Basic Specialist Training with a minimum of 12 months of Nuclear Medicine training and a minimum of 3-month equivalent of Radiology training.

2.1.2 Satisfactory attendance of the Fellowship Basic Training Course (Nuclear Medicine) organised by the College is mandatory before trainees are allowed to attempt the First

(Part I) Fellowship Examination.

2.1.3 Trainees need to hold a formal Nuclear Medicine training post, in which they are actively receiving Nuclear Medicine training, (or to have held such a post in the past) in order to enter the First (Part I) Fellowship Examination.

2.2 Format of First (Part I) Fellowship Examination

2.2.1 First (Part I) Fellowship Examination consists of written papers (True-False type questions) and an oral examination.

2.2.2 Two True-False type question papers, one of which will cover topics in Physics, whilst the rest will be devoted to questions on Anatomy and Physiology, Radiopharmacy, Procedures and Techniques of Nuclear Medicine studies.

2.2.3 An oral examination of 1 hour duration consisting of two 30-minute vivas: one with a pair of Nuclear Medicine physicians, and one with a Nuclear Medicine physician plus a physicist.

2.2.4 Unsuccessful candidates in any component of the First (Part I) Fellowship Examination will be required to re-sit all two components.

3.0 Final (Part II) Fellowship Examination

3.1 Entry requirements of Final (Part II) Fellowship Examination

3.1.1 Trainees who have passed the First (Part I) Fellowship Examination are permitted to enter the Final (Part II) Fellowship Examination upon completion of relevant periods of Nuclear Medicine training, Radiology rotation and relevant clinical experience outside Nuclear Medicine. Each trainee's training supervisor is required to provide confirmation that the candidate has completed the required training.

3.1.2 Satisfactory attendance of the Fellowship Advanced Training Course (Nuclear Medicine) organised by the College is mandatory before trainees are allowed to attempt the Final (Part II) Fellowship Examination.

3.2 Format of Final (Part II) Fellowship Examination

3.2.1 Final (Part II) Examination consists of written papers (Single Best Answer paper), a reporting session and an oral examination.

3.2.2 Two Single Best Answer (SBA) papers

- Questions will cover all the major subspecialties included in the syllabus.
- Questions will also be set on clinical subjects, physiology and pathology, though within the general framework of Nuclear Medicine.
- Relevant aspects of basic sciences (e.g. physics, radiopharmacy and equipment), physiology, biochemistry, anatomy and techniques will be included in the context of Nuclear Medicine practice.

3.2.3 A reporting session

- In the reporting session of 1-hour duration, candidates are required to provide

reports on 8 clinical cases. Each case comprises images and results of data analysis with brief clinical details.

- The cases are chosen so as to include a selection of the main subspecialties of Nuclear Medicine. Cases are not of equal difficulty, and candidates should ensure that they allow sufficient time to report each case adequately.
- Up to 5 questions are asked for each case. Answers must be brief and relevant, and laid out to include the relevant positive and negative findings, interpretation, conclusion and recommendations for further investigation as appropriate.

3.2.4 An oral examination

- An oral examination of 1-hour duration consisting of two 30-minute vivas each with a different pair of Nuclear Medicine physicians.
- During each of the two vivas a wide range of material of varying complexity will be shown. A higher level of performance will be expected in interpreting the common and routine examinations than will be the case with the highly specialized investigations.
- Candidates will be given the opportunity to demonstrate their powers of observation and deduction, and a logical and informed approach to image interpretation and data analysis. There should be a clear ability to discuss the merits, relevance, and role of techniques which might assist in further investigation of diagnostic problems will be expected.

3.3 Unsuccessful candidates in any component of the Final (Part II) Fellowship Examination will be required to re-sit all three components.

3.4 Review of Performance at Examinations

3.4.1 Candidates who fail the examination will be informed of their performance at each paper/session. It is expected that the Training Head at each training centre will provide counselling.

3.4.2 After 2 unsuccessful attempts at Final (Part II) Fellowship Examination, a candidate's performance will be reviewed by the Warden, one examiner of the examination together with the trainee and the respective supervisor, to advise on the required improvement areas and remedial actions.

3.4.3 The Review Committee of the College will consider queries and appeals.

EXIT ASSESSMENT FOR COLLEGE FELLOWSHIP

1.0 After completion of the required period of Higher Specialist Training, a trainee can apply for consideration of the Fellowship of the College.

2.0 Exit Assessment exercises are conducted by the College twice a year, normally in January and July.

3.0 A panel of assessors comprising the following members would carry out a formal assessment of the trainee's completion of training:

(i) The Warden.

(ii) Two other experienced College Fellows of the trainee's profession, who should NOT be the trainee's supervisors, appointed by the Education Committee and approved by the Council.

4.0 The procedure of assessment would include:

(i) Scrutiny of the training records of the trainee for completeness of training.

(ii) Appreciation of the regular continuous appraisal reports of the respective supervisor.

(iii) Further supportive documents may need to be furnished by the trainee or the respective training centre on request.

(iv) Oral assessment of the trainee by the panel of assessors will be held to evaluate the trainee's professional attitude, communication skills, ability in solving clinical or management issues and appreciation of radiology & Nuclear Medicine literature.

5.0 After an unsuccessful attempt at Exit Assessment, a candidate's performance will be reviewed by the Warden, one assessor of the Panel together with the trainee and the respective supervisor, to advise on the required improvement areas and remedial actions.

SYLLABUS

1. FIRST (PART I) FELLOWSHIP EXAMINATION:

1.1 ANATOMY, BIOCHEMISTRY and PHYSIOLOGY

1.1.1 The candidate should be familiar with the basic anatomy, biochemistry and physiology relevant to all the common scintigraphic examinations, and the cross-sectional anatomy in the axial, coronal, sagittal and, where appropriate, oblique planes, as displayed in SPECT and PET imaging. A knowledge of normal anatomical variations will be expected. The formal teaching course will build on the basic science knowledge already expected of a trainee.

1.1.2 Anatomy, biochemistry and physiology as shown by Nuclear Medicine studies include the following systems:

- The musculoskeletal system
- The respiratory system
- The gastrointestinal and hepatobiliary system
- The genitourinary system

- The cardiovascular system
- The haematological and lymphatic system
- The central nervous system
- The endocrine system

1.2 RADIOPHARMACEUTICALS

1.2.1 Principles of radiochemistry and radiopharmacy.

1.2.2 Production, pharmacokinetics, dosage (including doses for children) and contraindications of radiopharmaceuticals.

1.2.3 Relative advantages and choice of the different types of agents.

1.2.4 Side effects, prevention and treatment of adverse reactions.

1.2.5 Quality assurance.

1.3 DRUGS

Knowledge is expected of those drugs commonly used in Nuclear Medicine practice, including their dosage and side effects.

1.4 INDICATIONS, PROCEDURES AND TECHNIQUES

1.4.1 Candidates will be expected to demonstrate knowledge of the standard procedures and positioning relating to various Nuclear Medicine procedures and organ systems, including the underlying basic principles. Candidates should, therefore, be able to give practical advice on improving the quality of the film. Knowledge of infrequently used projections will not be expected.

1.4.2 Knowledge of and practical familiarity with the following will be expected:

- Positioning of patients and detector. The use of immobilizing devices and protective devices. Detection and correction of errors in data acquisition and positioning.
- Data acquisitions: frame mode and list mode; dynamic and static; gated; SPECT and PET.
- The principal indications and contra-indications of common Nuclear Medicine studies.
- Patient preparation.
- Principal complications and their treatment.

1.5 PHYSICS

1.5.1 A basic knowledge of physics is assumed.

1.5.2 The whole of the syllabus should be covered in approximately 45 hours of formal teaching.

1.5.3 Basic atomic and nuclear physics

- Structure of the atom and nucleus, terminology and notation, binding energy, atomic and nuclear emissions.
- Periodic table, radionuclide chart, isotopes and characteristics of stable nuclei.

1.5.4 Ionizing radiation and radioactive decay

- Types of ionizing radiation and their properties.
- Modes of decay including alpha decay, beta decay, positron emission, isomeric transition, internal conversion and electron capture.
- Principles of exponential decay, decay constant, half-life (physical, biological and effective), mean life, specific activity and units of activity.
- Interaction of radiation with matter: coherent, photoelectric, Compton scatter and pair production processes; concepts of attenuation, absorption and scatter.

1.5.5 Mathematics and statistics for Nuclear Medicine

- Convolution and modulation transfer function.
- Tracer theory and kinetics such as compartmental analysis, Patlak plot and receptor-ligand kinetics.
- Types of measurement errors.
- Basic statistics, receiver operating characteristic (ROC) curves and nuclear counting statistics.

1.5.6 Computer applications in Nuclear Medicine

- Basic knowledge of computer.
- Computer systems in Nuclear Medicine.

1.5.7 Radiation measurement and instrumentation

- Radiation detectors; operation principles and characteristics.
- Pulse height analyzer, multichannel analyzer, scaler and ratemeter.
- Counting systems: scintillation probe, well counter, liquid scintillation counter, dose calibrator and whole body counter.

1.5.8 Imaging systems

Principles, functions and quality assurance of:

- Gamma camera
- Single photon emission computed tomography (SPECT)
- Positron emission tomography (PET)
- Bone densitometer

1.6 RADIOPHARMACEUTICALS

- Desirable characteristics, mechanisms of localization and choice of radiopharmaceuticals for imaging.
- Radionuclide production and principle of generator systems.
- Preparation of radiopharmaceuticals, design and operation of laboratories.
- Therapeutic use of radionuclides.
- Quality assurance.

1.7 DOSIMETRY

Internal radiation dosimetry: calculation of dose, dose models and dose estimation techniques.

1.8 RADIATION PROTECTION

- Statutory responsibilities: an appreciation of relevant legislation and Codes of Practice.
- The content of the “core of knowledge” as specified by the current Radiation

- Ordinance, the ICRP and other international radiation protection standards and recommendations.
- Genetic and somatic effects of ionizing radiations.
- Relative risks of ionizing radiations.
- The principles of radiation protection, safe handling of radioactive materials,
- Decontamination procedures, transport and storage of radioactive materials and disposal of radioactive waste.
- Radiation monitoring.
- Comprehension of the practical measures required in a department of Nuclear Medicine.

2. <u>FINAL (PART II) FELLOWSHIP EXAMINATION:</u>

2.1 General remarks

2.1.1 Candidates are expected to keep abreast with the most recent advances in Nuclear Medicine.

2.1.2 Clinical skills necessary to supervise and administer the various physical, physiological and pharmacological interventions associated with practice of Nuclear Medicine are expected.

2.1.3 Correlation with other imaging and diagnostic modalities as deemed relevant to the practice of Nuclear Medicine is expected.

2.1.4 The applicability of SPECT and PET technique should be considered in all situations.

2.1.5 Integration of physics, instrumentation, dosimetry, anatomy, biochemistry and pathophysiology relevant to or specific to each individual Nuclear Medicine study is expected.

2.1.6 Principle and methodology of data acquisition, analysis and interpretation of each individual procedure are expected.

2.2 Central Nervous System:

2.2.1 Radiopharmaceuticals

Clinical Applications:

(i) Four basic categories:
   a. Cerebral blood flow
   b. Neuroreceptor and neurotransmitter imaging
   c. Metabolism
   d. CSF flow

2.2.2 (ii) Specific indications:
   a. Cerebrovascular disorders: carotid stenosis and occlusion; stroke; subarachnoid haemorrhage; pharmacological intervention (e.g. acetazolamide).
   b. Dementia, movement disorders and psychiatric disorders: Dementia including Alzheimer's disease, FTD, DLB and AIDS dementia; Parkinsonism; Hungtington chorea; schizophrenia.

c. Brain tumours: Grading of tumours; differentiation between viable tumour and radiation; necrosis/edema.
d. Epilepsy.
e. Evaluation of hydrocephalus, shunt patency and CSF leakage.

2.3 Cardiovascular System:

2.3.1 Radiopharmaceuticals

2.3.2 Clinical Applications:

(i) Myocardial perfusion, viability and infarct-avid imaging:
   a. Planar vs SPECT (gated vs non-gated, attenuation corrected / non-corrected)
   b. PET/CT and PET/MR
   c. Methods of quantitation including Bull's eye display, summed stress / rest / difference score
   d. Pharmacological intervention (e.g. dipyridamole, adenosine, dobutamine)

(ii) Myocardial function imaging:
   a. First-pass vs gated blood pool imaging
   b. Rest vs stress study
   c. Shunt quantitation

(iii) Myocardial neurotransmitter imaging
(iv) Myocardial metabolism imaging
(v) Venography (flow and blood pool venography)
(vi) Thrombus imaging

2.4 Respiratory System:

2.4.1 Radiopharmaceuticals

2.4.2 Clinical Applications:

(i) Pulmonary embolic disease: Various diagnostic criteria.
(ii) Non-embolic disease

2.5 Lymphoscintigraphy:

2.5.1 Radiopharmaceuticals

2.5.2 Clinical Applications:

(i) Staging of tumour
(ii) Evaluation of lymphoedema
(iii) Detection of sentinel node

2.6 Hepatobiliary System:

2.6.1 Radiopharmaceuticals

2.6.2 Clinical Applications:

(i) Acute cholecystitis
(ii) Biliary dyskinesis
(iii) Neonatal jaundice
(iv) Biliary tract obstruction

(v) Congenital disorders
(vi) Post-operative evaluation
(vii) Duodenogastric bile reflux and afferent loop obstruction
(viii) Liver transplant

2.7 Liver and Spleen:

2.7.1 Radiopharmaceuticals

2.7.2 Clinical Applications:
(i) Evaluation of abdominal mass.
(ii) Evaluation of focal and diffuse hepatic diseases.
(iii) Detection and follow up of liver metastasis.
(iv) Detection and follow up of abdominal, hepatic and splenic trauma.
(v) Detection of ectopic / residual splenic tissue (post-splenectomy).
(vi) Functional hyposplenism.

2.8 Gastrointestinal System:

2.8.1 Radiopharmaceuticals

Clinical Applications:
(i) Salivary scintigraphy :
   a. Evaluation of salivary flow (e.g. Sjogren syndrome).
   b. Evaluation of salivary gland mass including tumour or abscess.
(ii) Oesophageal transit and reflux studies :
   a. Evaluation of the cause and follow up of dysphagia.
   b. Detection and follow up gastroesophageal reflux.
(iii) Gastric emptying including both solid and liquid phases: Detection and follow up patients with delayed gastric emptying.
(iv) Localization of ectopic gastric mucosa.
(v) Detection and localization of lower gastrointestinal bleeding using Tc-99m red blood cells or colloid.
(vi) Evaluation of abdominal sepsis.
(vii) Gastrointestinal absorption and loss studies including quantitative methods
   a. Protein loss
   b. Blood loss
   c. B12 absorption (Schilling test)
   d. Iron absorptionVarious breath tests

2.9 Genitourinary System:

2.9.1 Radiopharmaceuticals

2.9.2 Clinical Applications:
(i) Differential renal function
(ii) Location, shape, number of kidneys
(iii) Detection and follow up of renal scars
(iv) Evaluation of hydronephrosis
(v) Renovascular hypertension
(vi) Evaluation of renal mass

(vii) Urinary tract infection
(viii) Renal transplant evaluation
(ix) Evaluation of vesico-ureteric reflux
(x) Measurement of GFR and ERPF
(xi) Testicular imaging

2.10 Musculoskeletal System:

2.10.1 Radiopharmaceuticals

2.10.2 Clinical Applications:
(i) Infection
(ii) Inflammatory disorder
(iii) Neoplasm (staging and follow up)
(iv) Trauma
(v) Avascular necrosis
(vi) Evaluation of prosthesis
(vii) Metabolic bone disease
(viii) Evaluation of bone and joint pain
(ix) Bone density measurement using densitometer including its application in osteoporosis

2.11 Endocrinology:

2.11.1 Radiopharmaceuticals

2.11.2 Clinical Applications:

(i) Thyroid:
a. Evaluation of the causes of hyperthyroidism
b. Evaluation of goitre or thyroid nodule
c. Neonatal hypothyroidism
d. Localization of ectopic thyroid tissue
e. Hormonal dysgenesis or organification defects
f. Thyroid cancer
(ii) Parathyroid:
a. Parathyroid adenoma and hyperplasia
(iii) Adrenal cortex and medulla:
a. Cushing syndrome
b. Hyperaldosteronism
c. Phaeochromocytoma
d. Adrenal incidentoma

2.12 Infection:

2.12.1 Radiopharmaceuticals

2.12.2 Clinical Applications:
(i) Fever of unknown origin
(ii) Bone and joint infection
(iii) Inflammatory bowel diseases

(iv) Graft and prosthesis infection

2.13 Haematology:

2.13.1 Radiopharmaceuticals

2.13.2 Clinical Applications:
- (i) Measurement of red cell volume, plasma volume and blood volume
- (ii) Red cell and platelet survival
- (iii) Ferrokinetics
- (iv) Bone marrow imaging

2.14 Oncology:

2.14.1 Radiopharmaceuticals

2.14.2 Clinical Applications:
- (i) Diagnosis and staging of tumours
- (ii) Monitor response to treatment
- (iii) Radionuclide therapy

2.15 Radionuclide Therapy:

2.15.1 Radiopharmaceuticals

2.15.2 Clinical Applications:
- (i) Hyperthyroidism, multinodular goiter
- (ii) Thyroid carcinoma
- (iii) Neuroendocrine and neuroectodermal tumours
- (iv) Lymphoma
- (v) Hepatocellular carcinoma and liver metastases
- (vi) Polycythemia rubra vera
- (vii) Bone pain due to skeletal metastasis
- (viii) Radiation synovectomy
- (ix) Malignant pleural effusion or ascites

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