Referring Patients for Nuclear Medicine Procedures in Greater Glasgow and Clyde

Introduction

The Ionising Radiation (Medical Exposure) Regulations [IR(ME)R] 2017 make it necessary for all investigations using ionising radiation to be justified on an individual patient basis. To meet this requirement, the Nuclear Medicine service have produced the following table of referral criteria which, if met, would justify a nuclear medicine procedure under most circumstances. These are taken from professional body guidelines including:

- British Nuclear Medicine Society
  www.bnms.org.uk
- European Association of Nuclear Medicine
  www.eanm.org
- Society of Nuclear Medicine
  www.snm.org
- Royal College of Radiologists, in particular their Making the Best use of Clinical Radiology which can be accessed via staffnet at
  www.irefer.scot.nhs.uk
  Follow the link ‘Accessing iRefer’ click on the ‘iRefer’ link under the NHS Scotland heading and use the green’ ‘Log in automatically’ button.

Referring Patients

Referrals are accepted from any hospital doctor who is, or is acting on behalf of, a Consultant or any General Practitioner (GP referrals are only accepted in limited situations, **not** including PETCT) or an approved non-medical referrer. The name of the Consultant or General Practitioner must be clearly stated on the request.

Clinical Information

Under the IRMER regulations it is essential that requests for nuclear medicine procedures contain sufficient clinical detail to allow the justification and authorisation of the procedure by Nuclear Medicine staff. Part of the regulations clearly states the responsibility of the referrer…"*The referrer must supply the practitioner with sufficient medical data (such as previous diagnostic information or medical records) relevant to the exposure requested by the referrer to enable the practitioner to decide whether there is a sufficient net benefit*." Please note that the referrer remains responsible for the referral even if the task is delegated to another hospital doctor acting on their behalf. The practitioner for a Nuclear Medicine procedure will always be a clinician holding a Practitioner’s license issued by ARSAC.

Patient Information on Request

The following information about the patient is required as a minimum:

- Patient's surname
- Patient's forename
- Date of Birth
- Address
- CHI Number
- Examination requested
- **Sufficient clinical information relevant to justify the medical exposure requested**
- **Indication of pregnancy, LMP and breast feeding as appropriate**
- **In the case of pregnancy the referrer should confirm that a risk benefit discussion with the patient has taken place**
- Indication of known potential medical complications associated with examination requested e.g. allergy, renal function (for CT contrast)
- Signature of referrer (this may be physical or in terms of an electronically validated request)
- NAME of referrer
- Date of referral
- Name of consultant
- Hospital / Ward / Department / GP surgery
- Research projects should be clearly identified

Please be patient if Nuclear Medicine staff contact you to ask for more information.

Radiation Protection of Other People

Nuclear Medicine investigations are different from other radiological investigations because the patients themselves become radioactive and may therefore pose a radiation risk to others. Please pay particular attention to any instruction sent back with the patient, with particular regard to whether urine and blood samples can be taken, bearing in mind these may both be radioactive. Occasionally, investigations or treatments cannot be carried out because of the patient's family circumstances.

Radiation Dose to the Patient, Pregnancy and Breastfeeding

The list of investigations following contains information about the radiation dose received (in mSv) by the patient from the procedure and this must be borne in mind when considering the suitability of using a nuclear medicine procedure. As a guide, the natural background radiation dose received by any person is about 2.5 mSv per annum. In the pregnant patient there is also a radiation dose to the foetus and this must be strictly limited and a referrer should have a risk benefit discussion with the patient prior to the referral. Furthermore, many radiopharmaceuticals appear in breast milk, so the breast-fed infant would receive a radiation dose. **For these reasons the fact or possibility of pregnancy or breastfeeding must be clearly stated in the request for all individuals of childbearing potential in the age range 12-55 years old.**

Supplementary Drugs

In addition, some investigations require the administration of other, non-radioactive pharmaceuticals as an essential part of the test. These are specified in italics after the relevant referral criteria. Your request for an investigation will be taken as implying agreement to the administration of the specified supplementary drug (this includes the administration of saline). If you are unhappy about your patient being given these drugs or you feel they are contraindicated this must be **clearly** stated in the request. Details of the dosages used are available in the appendix.

SPECT-CT

Nuclear medicine is a functional imaging modality it does however have poorer resolution than many other types of imaging. Most nuclear medicine departments now have access to a low dose CT along with the nuclear medicine equipment and this can be used in SPECT-CT to allow anatomical localisation and in some cases characterisation of lesions. Some investigations have this undertaken in all cases (the use of SPECT-CT is indicated on the table), in others experienced staff within nuclear medicine will decided whether SPECT-CT would be beneficial. All PET investigations involve a CT exposure as standard.

Less Common Procedures

Certain Investigations are not carried out by all Nuclear Medicine Departments. If necessary the request may be sent to another site. There may be other procedures which fall into the category of research investigations and the Practitioner should be contacted.

Please note that if a Trakcare or Ordercomms referral is made and then cancelled by the referrer the department **MUST** be contacted (see details below) to cancel the request, as Trakcare does not inform the imaging department of the cancelation and there is a potential for a radiation incident.

Contact Points

General Nuclear Medicine	Email	Telephone
NE Sector (dealing with requests from) Glasgow Royal Infirmary Stobhill Hospital Inverclyde Royal Hospital Lightburn Hospital Dental Hospital	nucmed.northeast@ggc.scot.nhs.uk	0141 242 (2)9885
South Sector (dealing with requests from) Queen Elizabeth University Hospital Institute of Neurological Sciences Victoria Hospital Royal Alexandra Hospital Dykebar Hospital	nucmed.south@ggc.scot.nhs.uk	0141 452 (8)3659
	NuclearMedicine.Gartnavel@ggc.scot.nhs.uk	0141 301 (5)7900
NW Sector (dealing with requests from) Gartnavel General Hospital including Beatson Oncology Centre Vale of Leven Hospital Drumchapel Hospital		

Specialised Departments

Nuclear Cardiology – North Glasgow		0141 211 (5)8500
PET	ggc.petct@nhs.scot	0141 301 (5)7800
Paediatrics		0141 452 (8)3688

Nuclear Medicine Investigation Groups

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Referral Criteria

***** dose received from ARSAC diagnostic reference level (DRL)

1. SNM Guidelines
2. BNMS Guidelines (including EANM)
3. RCR Guidelines

Bone Imaging

Isotope bone imaging with ^{99m}Tc HDP is highly sensitive for osteoblastic activity but has poor specificity.

SPECT-CT (low dose CT) is often used to increase specificity and provide accurate localisation.
In lytic disease (e.g. myeloma) ^{99m}Tc HDP imaging can give misleading information.

Investigation and clinical history		**Radio-pharm / *Pharmaceutical***	**Dose mSv***
Investigation of neoplasia [1]		^{99m}Tc-HDP	3
	Staging or re-staging [2]	^{99m}Tc-HDP	3
	assessment of bone pain with known or suspected malignancy [2]	^{99m}Tc-HDP	3
	increased tumour marker levels (e.g. PSA)	^{99m}Tc-HDP	3
	monitoring disease progression and response to chemo or radiotherapy [2]	^{99m}Tc-HDP	3
	Investigation of imaging abnormality	^{99m}Tc-HDP	3
Investigation of bone pain/loosening/infection post joint replacement (> 1 year post-op)		^{99m}Tc-HDP	3
Investigation of Paget's disease		^{99m}Tc-HDP	3
Investigation of stress fracture, shin splints [3]		^{99m}Tc-HDP	3
Investigation of mandibular disorders (Condylar disease)		^{99m}Tc-HDP	5
Investigation of bony pain which is otherwise unexplained [1]		^{99m}Tc-HDP	3
Investigation of osteomyelitis [1]		^{99m}Tc-HDP	3
Investigation of arthritides [1]		^{99m}Tc-HDP	3
Assessment of x-ray abnormality		^{99m}Tc-HDP	3
Investigation of hypercalcaemia		^{99m}Tc-HDP	3
Investigation of low back pain		^{99m}Tc-HDP	3
Investigation of occult fracture [1]		^{99m}Tc-HDP	3
Distribution of osteoblastic activity prior to therapy [1]		^{99m}Tc-HDP	3
Investigation of distribution of osteoporotic fractures		^{99m}Tc-HDP	3
Investigation of osteoid osteoma		^{99m}Tc-HDP	3
Investigation of complex regional pain syndrome CRPS (RSD) [1]		^{99m}Tc-HDP	3
Investigation of hypocalcaemia (osteomalacia) [3]		^{99m}Tc-HDP	3
Investigation of bone infarcts [1]		^{99m}Tc-HDP	3
Investigation of bone graft viability [1]		^{99m}Tc-HDP	3
Bone marrow imaging for the investigation of systemic haematological disorders		^{99m}Tc-colloid	4

Brain Imaging

The following procedures are undertaken within general nuclear medicine departments within GGC.

Investigation and clinical history	Radio-pharm / *Pharmaceutical*	Dose mSv*
Investigation of encephalitis [3]	^{99m}Tc-HMPAO	7
Investigation of dementia [1,3]	^{99m}Tc-HMPAO	7
Investigation of epilepsy (inter-ictal) [1,3]	^{99m}Tc-HMPAO	7
Investigation of regional cerebral blood flow [1,3]	^{99m}Tc-HMPAO	7
Evaluation of suspected brain trauma[1]	^{99m}Tc-HMPAO	7
Investigation of tumour viability	^{201}Tl -chloride	14
Investigation of movement disorder, ET, Drug-induced or vascular parkinsonism or a parkinsonian syndrome.	^{123}I-DaTSCAN *Potassium iodate/iodide*	4.6
Dementia with Lewy Bodies	^{123}I-DaTSCAN *Potassium iodate/iodide*	4.6
Cardiac sympathetic innervation imaging in movement disorders (Parkinson's disease etc.) /Lewy body dementia	^{123}I-mIBG *Potassium iodate/iodide*	5

Specialist Brain Imaging - NeuroSPECT

The Institute of Neurological Sciences at Southern General Hospital has a specialist NeuroSPECT centre and as such has specific referral criteria – please refer to this section for Specialist Brain Imaging.

Investigation and clinical history	**Radio-pharm / *Pharmaceutical***	**Dose mSv***
Brain SPECT using HMPAO produces images of cerebral metabolic perfusion (usually reflecting brain function) and is used in: • Evaluation of cerebrovascular disease, vasculitis and stroke • Differential diagnosis of dementia • Detection and evaluation of encephalitis (especially herpes encephalitis) • Functional localisation of epileptic foci (only in presurgical context) • Determination of brain death	^{99m}Tc-HMPAO	7
Brain SPECT using FPCIT produces images of the pre-synaptic dopamine transporters (density is highest in the striatum). • Used in patients with symptoms of Parkinsonism or a tremor disorder and the scan will provide an accurate differential diagnosis of degenerative parkinsonism (Parkinson's Disease, Progressive Supranuclear Palsy, Multiple System Atrophy, Corticobasal Degeneration, Lewy Body Dementia) versus non-degenerative conditions, such as essential tremor, drug-induced pseudo-parkinsonism and vascular parkinsonism. • Differential diagnosis between Lewy Body Dementia and Alzheimer's Disease.	^{123}I-FPCIT Datscan	4.4

Specialist Brain Imaging – NeuroSPECT cont'd

Investigation and clinical history	Radio-pharm / *Pharmaceutical*	Dose mSv*
Brain SPECT using Thallium (a potassium analogue) produces images of ATP-ase activity in brain regions where there is some disruption of the blood-brain-barrier. It is indicated in: • Differential diagnosis of brain tumours • Determination of malignancy grade of gliomas • Differential diagnosis of recurrent brain tumour and radiation necrosis • Selection of biopsy site • Tumour delineation for therapy planning • Follow-up of primary brain tumours and malignant transformation • Differential diagnosis of Toxoplasmosis and Lymphoma in AIDS	201Tl-chloride	14
Brain SPECT using alpha-methyl-tyrosine produces images of amino-acid transport within the brain. It is used in: • Differential diagnosis of brain tumours and non-neoplastic lesions • Follow-up of primary brain tumours • Detection of residual and recurrent glioma • Selection of biopsy site • Tumour delineation for therapy planning	123I-alpha-methyl-tyrosine	2.0
Brain SPECT using Octreoscan produces images of somatostatin receptors. The density of somatostatin receptors is characteristically high in most meningiomas. The scan is used in: • Differential diagnosis of meningioma vs other brain masses • Localisation of brain tumours (usually meningioma) • Follow-up of meningiomas.	^{111}In-octreotide or ^{99m}Tc-Tektrotyd	12 3.7

Cardiac Imaging

Investigation and clinical history	Radio-pharm / *Pharmaceutical*	Dose mSv*
Diagnosis of coronary artery disease [1,2] presence [1,2] location (coronary territory) [1,2] Extent(number of vascular territories)[1,2]	^{99m}Tc-tetrofosmin or ^{201}Tl-chloride *Adenosine* *Dobutamine* *Regadenoson*	6 (stress) 6 (rest) 11.2
Assessment of the degree of coronary stenosis and impact on regional perfusion [1]		
Myocardial viability assessment [1,2] Ischaemia vs. scar [1] predict improvement in function following revascularization [1,2]		
Risk assessment (prognosis) in patients [1,2] post myocardial infarction [1] pre-operative for major surgery who may be at risk for coronary events [1]		
Monitoring treatment effect [1] after coronary revascularization [1,2] Medical therapy for congestive failure or angina [1] Lifestyle modification [1]		
Pre cardiac transplant assessment		
Post cardiac transplant assessment		
Assessment of congenital cardiac abnormalities		
Assessment of arrythmias		
Assessment of right ventricular dysplasia		
Assessment of patients with Syndrome X_2		
Assessment of cardiac ejection fraction Regional wall motion, ventricular volumes and stroke volume ratios	^{99m}Tc-normal erythrocytes *Pyrophosphate*	5.6
Monitoring cardiac ejection fraction following administration of cardiotoxic drugs	^{99m}Tc-normal erythrocytes *Pyrophosphate*	5.6
Investigation of cardiac amyloid in patients with known or suspected amyloidosis	^{99m}Tc-DPD	5.6

Eye Imaging

Investigation and clinical history	Radio-pharm / *Pharmaceutical*	Dose mSv*
Investigation of lacrimal drainage	^{99m}Tc-pertechnetate ^{99m}Tc-colloid	0.05 0.04

Gastro-Intestinal Imaging & Investigation

Investigation and clinical history		Radio-pharm / *Pharmaceutical*	Dose mSv*
Investigation of gastric emptying [1] Patients with suspected gastroparesis, nausea, vomiting, upper abdominal bloating or chronic aspiration			
	Investigation of gastric emptying (solid phase)	^{99m}Tc-solid meal	0.3
	Investigation of gastric emptying (liquid phase)	^{111}In-DTPA or ^{99m}Tc colloid	3.8 0.9
Investigation of oesophageal transit and reflux[1]		^{99m}Tc-solid meal	0.9
Investigation of Meckel's diverticulum as a source of unexplained GI bleeding [1,3]		^{99m}Tc-pertechnetate *Cimetidine (GRI, RHSC)*	5
Investigation of Gastrointestinal bleeding [1,3]		^{99m}Tc-normal erythrocytes *Pyrophosphate*	3.6
Investigation of bile salt absorption		^{75}Se- SEHCAT	0.3

Haematological Imaging & Investigation

Investigation and clinical history	Radio-pharm / *Pharmaceutical*	Dose mSv*
Measurement of blood volume (e.g. in polycythaemia)	125I-HSA *Potassium iodate/iodide* and ^{111}In-normal erythrocytes	0.04 2.8
Red cell turnover and sites of sequestration	^{111}In-normal erythrocytes or ^{99m}Tc-normal erythrocyes	2.8 1.0
Investigation of splenic function in patients with thrombocytopenia[1]	^{99m}Tc-denatured red cells	2
To check if mass is functioning splenic tissue and or/ assess localisation of spleen tissue [1]	^{99m}Tc-denatured red cells or ^{99m}Tc-colloid ± SPECT-CT	2 or 1.8

Hepatobiliary Imaging

Investigation and clinical history	Radio-pharm / *Pharmaceutical*	Dose mSv*
Evaluation of suspected acute cholecystitis [1]	^{99m}Tc-IDA	2
Evaluation of chronic biliary tract disorders [1]	^{99m}Tc-IDA	2
Evaluation of common bile duct obstruction [1]	^{99m}Tc-IDA	2
Detection of bile extravasation [1]	^{99m}Tc-IDA	2
Evaluation of abnormalities of biliary tree [1]	^{99m}Tc-IDA	2
Investigation of pain post cholecystectomy	^{99m}Tc-IDA	2
Investigation of pain in suspected biliary hypertension	^{99m}Tc-IDA	2
Investigation of gall bladder kinetics	^{99m}Tc-IDA *Fatty meal stimulated (Calogen)*	2
Investigation of bile duct kinetics	^{99m}Tc-IDA	2
Investigation of hepatic hemangioma [1,3]	^{99m}Tc-normal erythrocytes *Pyrophosphate*	5.6
Evaluation of liver trauma	^{99m}Tc-colloid	0.8

Infection, Inflammation Imaging & Investigation

Investigation and clinical history	Radio-pharm / *Pharmaceutical*	Dose mSv*
To detect sites of infection/inflammation in patients with fever of unknown origin [1]	Labelled leucocytes are preferred Labelling can be achieved with: ^{111}In-leucocytes or ^{99m}Tc-exametazime leucocytes	7.2 2
To localize an unknown source of sepsis and to detect additional site(s) of infection in patients with persistent or recurrent fever and a known infection site 1(any renal or bone or any chronic infection)		
To detect and follow-up osteomyelitis primarily when there is existing bone pathology such as infected joint prostheses, non-united fractures or sites of metallic hardware from prior bone surgery [1]		
To detect osteomyelitis in diabetic patients when degenerative or traumatic changes, neuropathic osteoarthropathy or prior osteomyelitis have caused increased bone remodeling [1]		
To detect osteomyelitis involving the skull in postoperative patients and for follow-up of therapy [1]		
To detect mycotic aneurysms, vascular graft and shunt / fistula infections [1]		
In cases of osteomyelitis when there has been orthopaedic intervention such as infected joint prostheses, or sites of metallic hardware from prior bone surgery [1]	^{111}In-Leucocytes or ^{99m}Tc-exametazime leucocytes ± ^{99m}Tc-colloid (for marrow delineation)	7.2 or 2 ± 4
To detect site(s) and extent of inflammatory bowel disease [1]	^{99m}Tc-exametazime leucocytes	2
To detect site(s) and extent of Crohn's disease [1]	^{99m}Tc-exametazime leucocytes	2
To survey for site(s) of abscess or infection in a febrile post-op patient without localizing signs or symptoms. Fluid collections, ileus, bowel gas and/or fluid, and healing wounds reduce the specificity of CT and ultrasound 1	^{111}In-leucocytes or ^{99m}Tc-exametazime leucocytes	7.2 2
Diagnosing osteomyelitis and/or disk space infection. Ga-67 is preferred over labeled leukocytes for disk space infection [1]	^{67}Ga	15
Evaluation and follow-up of Malignant Otis Externa	^{67}Ga	15

Lung Imaging

Investigation and clinical history	Radio-pharm / *Pharmaceutical*	Dose mSv*
Investigation of acute PTE [1,2]	Perfusion : ^{99m}Tc-MAA	2
Monitor changes in perfusion after PTE [2]		
Preoperative ventilation-perfusion assessment		
Investigation and follow up of chronic PTE	Ventilation : ^{81m} Kr or ^{99m}Tc-Technegas	0.2
Investigation of right ->left intracardiac shunts [1]		
Investigation of chronic lung disease		
Post pneumonectomy assessment		0.6

Lymphatic Imaging & Investigation

Sentinel node investigation for some cancers require specialist ARSAC approval and the individual departments should be contacted directly about such investigations, e.g. head and neck, penile, vulval…

Investigation and clinical history	Radio-pharm / *Pharmaceutical*	Dose mSv*
Sentinel node localisation melanoma patients	^{99m}Tc-colloid	0.08
Investigation of poor lymph drainage	^{99m}Tc-colloid	0.08
Sentinel node localisation breast patients	^{99m}Tc-colloid	0.08
Sentinel node localisation penile cancer	^{99m}Tc-colloid	0.08
Sentinel node localisation head and neck	^{99m}Tc-colloid	0.08

Renal Imaging & Investigation

Investigation and clinical history	Radio-pharm / *Pharmaceutical*	Dose mSv*
Assessment of split renal function or function of one or more moieties [2]	^{99m}Tc-MAG3 or ^{99m}Tc-DMSA	0.7 0.7
Assessment of obstruction	^{99m}Tc-MAG3 *Frusemide*	0.7
Dilation of collecting system [2]		
Suspected PUJ obstruction [2]		
Post surgical evaluation of a previously obstructed system [2]		
Indirect micturating cystogram for vesico-ureteric reflux [2]	^{99m}Tc-MAG3	0.7
Assessment of kidney and scarring [2]	^{99m}Tc-DMSA	0.7
In acute UTI [2]		
Post UTI infection [2]		
Assessment of horseshoe or ectopic kidney [2]	^{99m}Tc-DMSA	0.7
Localisation of poorly functioning kidney [2]	^{99m}Tc-DMSA	0.7
Assessment of kidney function in presence of an abdominal mass [2]	^{99m}Tc-DMSA	0.7
Assessment of perfusion of renal transplants	^{99m}Tc-pertechnetate	10
Assessment of kidney perfusion	^{99m}Tc-pertechnetate	4.4
Assessment of urine leak post surgery	^{99m}Tc-MAG3	0.7
Assessment of patients with nephrotic syndrome	^{99m}Tc-MAG3	0.7
Measurement of Glomerular Filtration Rate (GFR)	^{99m}Tc DTPA	0.05
Assessment of live kidney donor	^{99m}Tc-MAG3 + ^{99m}Tc DTPA	0.7 + 0.05

Salivary Imaging

Investigation and clinical history	Radio-pharm / *Pharmaceutical*	Dose mSv*
Investigation of dry mouth [3]	^{99m}Tc-pertechnetate	1.0

Thyroid & Parathyroid Imaging & Investigation

Investigation and clinical history	Radio-pharm / *Pharmaceutical*	Dose mSv*
Assessment of functionality and structure of thyroid nodules [1,2]	^{123}I or ^{99m}Tc-pertechnetate	6 or 1
Assessment of goitre including hyperthyroid goitre [2]	^{123}I or ^{99m}Tc-pertechnetate	6 or 1
Assessment of uptake function prior to radio-iodine therapy [1,2]	^{123}I or ^{99m}Tc-pertechnetate or I131 ± SPECT-CT	6 or 1 or 20
To locate ectopic thyroid tissue (i.e. lingual) or determine whether a suspected “thyroglossal duct cyst” is the only functioning thyroid tissue present [1,2]	^{123}I or ^{99m}Tc-pertechnetate	6 or 1
To assist in evaluation of congenital hypothyroidism [1]	^{123}I or ^{99m}Tc-pertechnetate	6 or 1
To evaluate a neck mass. Radionuclide scintigraphy may be helpful to confirm that the mass is functioning thyroid tissue [1]	^{123}I or ^{99m}Tc-pertechnetate	6 or 1
To investigate retro-sternal goiter or sub-sternal mass	^{123}I	6
To differentiate thyroiditis (i.e. subacute or silent) and factitious hyperthyroidism from Graves’ disease and other forms of hyperthyroidism [1,2]	^{123}I or ^{99m}Tc-pertechnetate	6 or 1
To investigate the suspected misuse of thyroxine / triiodothyronine	^{123}I or ^{99m}Tc-pertechnetate	6 or 1
Thyroid uptake studies in the investigation of thyroid disease (uptake counter) [1]	^{123}I or ^{99m}Tc-pertechnetate	0.6 or 0.5
Whole-body 123-I / 131-I imaging for thyroid metastases[1]	I123 or I131 ± SPECT-CT	8 or 20
Investigation of thyroid binding defects	^{123}I *Perchlorate (for discharge)*	6
Investigation of thyroid cancers [1]	^{123}I ^{131}I ± SPECT-CT	5 20
Investigation of hyperparathyroidism [1] To localize tissue prior to surgery or in patients with persistent or recurrent disease	^{99m}Tc-sestamibi + ^{123}I + SPECT-CT	8 6
Differentiation of type of amiodarone induced thyrotoxicosis	^{99m}Tc-sestamibi	2

Therapeutic

Please note these therapies have very specific radiation protection needs and therefore are only performed on a limited number of specific sites.

Investigation and clinical history	Radio-pharm / *Pharmaceutical*
Thyrotoxicosis	^{131}I
Toxic diffuse goitre [2]	^{131}I
Uni-nodular toxic goitre (toxic adenoma) [2]	^{131}I
Multi-nodular toxic goitre (multifocal autonomy) [2]	^{131}I
Nodular goitre – non-toxic	^{131}I
Thyroid cancer [2]	^{131}I
Neuroendocrine tumours [2]	^{131}I –mIBG *Potassium iodate/iodide*
Bone metastases (palliative pain relief) [1,2]	^{89}Sr or ^{186}Re-HEDP
Treatment of Polycythemia rubra vera and essential thrombocythaemia	^{32}P
Treatment of arthritic conditions / synovitis [2]	^{90}Y
Treatment of cystic brain tumours	^{90}Y
Treatment for bone pain in prostate cancer	^{223}Ra-chloride
Treatment for lymphoma	^{90}Y-Zevalin
Treatment for carcinoid	^{90}Y-peptides
Treatment for carcinoid	^{177}Lu-peptides *Amino acid solution*

Tumour Imaging

Investigation and clinical history	Radio-pharm / *Pharmaceutical*	Dose mSv*
Investigations of neuroendocrine tumours	^{123}I-mIBG ± SPECT-CT *Potassium iodate/iodide*	5
Investigation of somatostatin producing tumours and neuroendocrine tumours	^{99m}Tc-Tektrotyd SPECT-CT	3.7
Thyroid cancers – see Thyroid Investigations		
Investigation of active tumour (brain)	^{201}Tl ± SPECT-CT	14

PET-CT

Investigation and clinical history	Radio-pharm / *Pharmaceutical*	Dose mSv*
PET/CT in Scotland is a national service and as such, the referral criteria have been produced by the Scottish PET Advisory Board. (Note all scans include CT with a dose of up to 8 mSv) Referral criteria can be found at: PET-CT Guidelines – Scottish Clinical Imaging Network PET CT referral form can be found at: PET request form - NHSGGC		
Lung Cancer	^{18}F FDG	7.6
PET1a NSCLC staging pre surgery		
1b NSCLC staging pre radical radiotherapy		
1c Characterisation solitary pulmonary nodule		
1d Radiotherapy field planning		
1e Lung cancer, other		
1f Pleural malignancy		
Lymphoma		
2a HD staging		
2b HD interval (2-3 cycles of chemo)		
2c HD residual mass post chemo		
2d HD other		
2e NHL staging		
2f NHL residual mass post chemo		
2g NHL other		
2h Staging		
2i Assessing response		
Colorectal Cancer		
3a Pre resection lung / liver metastasis		
3b (Pelvic) mass post treatment		
3c Rising CEA with normal CT/MRI		
3d CRC other		

PET-CT cont…

Investigation and clinical history		Radio-pharm / *Pharmaceutical*	Dose mSv*
Other Malignancy		^{18}F FDG	7.6
4a	Head & neck cancer		
4b	Testicular cancer		
4c	Melanoma/Skin tumours		
4d	Gastro-oesophageal carcinoma		
4e	Breast carcinoma		
4f	Cervix carcinoma		
4g	Thyroid cancer		
4h	CUP		
4j	Paraneoplastic syndrome		
4k	CNS tumour		
4l	Thymic		
4m	Gastrointestinal stromal tumours		
4n	Hepato-pancreatic-biliary		
4o	Urological		
4p	Anal and penile carcinoma		
4q	Myeloma		
4r	Musculoskeletal tumours		
4s	Neuroendocrine tumours		
4t	Rare tumours in children and adults		
4z	Other		

PET-CT cont…

Investigation and clinical history		Radio-pharm / *Pharmaceutical*	Dose mSv*
Non-Cancer			
9a	Neurological	^{18}F FDG	7.6
9b	Cardiac		
9c	Vasculitis		
9d	Sarcoidosis		
9e	Infection		
9f	Pyrexia of unknown origin		
Prostate Cancer			
7a	Biochemical recurrence after radical prostatectomy	^{18}F-PSMA	5.5
7b	Biochemical recurrence after radical radiotherapy/brachytherapy		
7c	Biochemical recurrence after salvage		
7d	Pre Lutetium PSMA therapy		
7e	Staging equivocal lesions		
7f	Other		

Appendix – Pharmaceuticals used with doses

	Dosage
Potassium iodate	2 x 85mg
Potassium iodide	2 x 65mg
Adenosine	140 mcg per kg per minute
Dobutamine	5 – 40 µg per kg per minute
Regadenoson	400 µg
Pyrophosphate	6.7 mg †
Cimetitine	Adult patients: 400mg
Furosemide	Adult patients: 40mg Paediatric patients: 1mg per kg – Maximum dose 20mg
Perchlorate	50 mg
Thyrogen	0.9 mg (daily for 2 days)
Saline	Various
Amino acid solution	1litre amino acid solution (containing 25g lysine and 25g arginine) at 250ml per hour

†refer to sector specific documentation