East Lancashire Hospitals NHS Trust
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Clinical Radiology Referral Guidelines

Neurological Referrals

Safe | Personal | Effective

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EAST LANCASHIRE HOSPITALS NHS TRUST

CLINICAL RADIOLOGY REFERRAL GUIDELINES

These guidelines are intended to be used by all "referrers" requesting imaging at East Lancashire Hospitals NHS Trust. They are appropriate for both primary and secondary care clinicians and Non-Medical Referrers (NMR) to promote the best use of imaging and resources for the benefit of our patients.

The Ionising Radiation (Medical Exposure) Regulations (IR(ME)R) provide for the health protection of individuals undergoing medical exposures involving ionising radiation. All diagnostic tests should therefore be carefully considered prior to referral and should only be requested appropriately. Diagnostic tests which do not utilise Ionising Radiation (such as ultrasound and magnetic resonance imaging) carry their own potential risks and as such are as strictly governed in terms of justification. This not only serves to protect patients, but also to manage demand appropriately and keep waiting times to a minimum.

The aim for all examinations should be to obtain the maximum information with the minimum of radiation. This means that on occasions the imaging undertaken may not be what the referring clinician/NMR expects. Radiology has set examination protocols utilised for the legal authorisation and justification of requests.

Optimising radiation dose

The use of radiological investigations is an accepted part of medical practice justified in terms of clear clinical benefits to the patient, which should far outweigh the small radiation risks. However, even small radiation doses are not entirely without risk. A small fraction of the generic mutations and malignant diseases that occur in the population can be attributed to natural background radiation. Diagnostic medical exposures account for one-sixth of the total population dose.

The Ionising Radiation (Medical Exposure) Regulations (IR(ME)2017 require that the unnecessary exposure of patients to radiation is kept to a minimum and ELHT must comply with these regulations. This is achieved by avoiding undertaking investigations unnecessarily (especially repeat examinations) and the use of dose optimisation utilising locally set diagnostic reference levels (DRLs).

The effective dose for a radiological investigation is the weighted sum of the doses to a number of body tissues, where the weighting factor for each tissue depends on its relative sensitivity to radiation-induced cancer of severe hereditary effects. This provides a single dose estimate related to the total radiation risk, no matter how the radiation dose is distributed around the body (Table 1).

Typical effective doses for some common diagnostic radiology procedures range over a factor of about 1,000 from the equivalent 1-2 days of natural background radiation.

Table 1

Typical effective doses from diagnostic medical exposure			
Diagnostic Procedure	**Typical effective dose (mSv)**	**Equivalent number of chest x-rays**	**Approximate equivalent period of natural background radiation**
Radiographic examinations			
Limbs & joints (except hip)	<0.01	<0.5	<1.5 days
Chest (single PA film)	0.02	1	3 days
Skull	0.06	3	9 days
Thoracic spine	0.7	35	4 months
Lumbar spine	1.0	50	5 months
Hip	0.4	20	2 months
Pelvis	0.7	35	4 months
Abdomen	0.7	35	4 months
IVU	2.4	120	14 months
Barium swallow	1.5	75	8 months
Barium meal	2.6	130	15 months
Barium follow-through	3	150	16 months
Barium enema	7.2	360	3.2 years
CT Head	2	100	10 months
CT Chest	8	400	3.6 years
CT abdomen or pelvis	10	500	4.5 years
Radionuclide Studies			
Lung ventilation (Xe-133)	0.3	15	7 weeks
Lung perfusion (Tc-99m)	1	50	6 months
Kidney (Tc-99m)	1	5	6 months
Thyroid (Tc-99m)	1	50	6 months
Bone (Tc-99m)	4	200	1.8 years
Dynamic cardiac (Tc-99m)	6	300	2.7 years
PET head (F-18 FDG)	5	250	2.3 years
*UK average background radiation = 2.2 mSv per year: regional averages 1.5-7.5 mSv per year			

Please note that the doses from some CT examinations are particularly high and the demand for CT imaging continues to rise. **It is therefore particularly important that referrals for CT are thoroughly justified and that techniques that minimise dose while retaining essential diagnostic information are adopted.**

In these referral guidelines, the doses are grouped to support the referrer in understanding the order of magnitude of radiation doses of the various investigations (Table 2).

Table 2 **Typical effective doses of ionising radiation from common imaging procedures**		
Symbol	Typical effective dose (mSv)	Examples
None	0	Ultrasound (US), Magnetic Resonance Imaging (MRI)
☢	<1	Chest, limbs & pelvis X-ray, mammography
☢ ☢	1-5	Lumbar spine X-ray, Nuclear Medicine (NM) (e.g., bone), Computed tomography (CT) head and neck
☢ ☢ ☢	5-10	CT chest or abdomen, NM (e.g., cardiac)
☢ ☢ ☢ ☢	>10	Extensive CT studies, some NM studies (e.g., some Position Emission Tomography co-registered with CT (PET-CT)
The average annual background dose in most parts of Europe falls within the 1-5 mSv range ☢ ☢		

Pregnancy and Protection of the foetus

Irradiation of a foetus should be avoided whenever possible. This includes situations in which the woman herself does not suspect pregnancy. The prime responsibility for identifying such patients lies with the referring clinician. Radiology also checks the pregnancy status of patients when they attend for examination.

Persons of childbearing potential presenting for an examination in which the primary beam irradiates the pelvic area (essentially, any ionising irradiation between the diaphragm and the knees), directly or by scatter, or for a procedure involving radioactive isotopes, will be asked whether they are or may be pregnant.

If the patient can exclude the possibility of pregnancy, the examination can proceed. If the patient is definitely pregnant, or if pregnancy cannot be excluded, the justification for the proposed examination should be reviewed by the radiologist and the referring clinician/NMR, with a decision taken on whether to defer the investigation until after delivery. However, a procedure of clinical benefit to the parent may also be of indirect benefit to the unborn child and a delay in an essential procedure may increase the risk to the foetus as well as the parent. This consideration is especially relevant in an emergency situation and all decisions must be documented.

Guidelines Key

The pages of each section are composed five columns:

Clinical/diagnostic problem	Situation for requesting an examination
Investigation	Possible imaging techniques
Dose	Level of exposure to radiation ☢
Recommendation	Recommendation on appropriateness of the investigation
Comment	Explanatory notes

Neurological System

Clinical/diagnostic problem	Investigation	Dose	Recommendation	Comment
Acute stroke				▪ Brain imaging should be undertaken as soon as possible in all patients, within 24h (at most) of onset of unless there are good clinical reasons otherwise. ▪ Brain imaging should be undertaken as a matter of urgency if the patient has: i. Been taking anticoagulant treatment. ii. A known bleeding tendency iii. A depressed level of consciousness iv. Unexplained progressive or fluctuating symptoms v. Papilloedema, neck stiffness, or fever vi. Severe headache at onset vii. Indications for thrombolysis or early anticoagulation (image within 3h) ▪ If the patient deteriorates unexpectedly further brain imaging should be considered to identify intracranial complications – e.g., hydrocephalus or haemorrhagic transformation. ▪ If the underlying pathology is uncertain, or the diagnosis of stroke is in doubt after CT, MRI should be considered. ▪ MRI should be undertaken when imaging has been delayed for more than 10 days after stroke
	CT	☢ ☢	Indicated	The main reason for early CT is to differentiate haemorrhagic from ischaemic stroke. CT angiography may be useful for patients being worked up for thrombolysis. Local availability and expertise will determine which imaging investigation is considered and needed.
	MRI	None	Specialised investigation	MRI should be considered in young patients with stroke, in patients presenting late where it is essential to know whether they have previously had a haemorrhage and or suspected posterior fossa lesions. Diffusion-weighted imaging is more sensitive technique than unenhanced CT for acute stroke imaging.

	US neck arteries (+/- transcranial Doppler)	None	Indicated only in specific circumstances	US neck arteries should only be used in: (1) those with full recover in which carotid endarterectomy is considered for secondary prevention; (2) cases of suspected dissection; or (3) young patients, whether with disabling or non-disabling ischaemic stroke. Patients with TIA or mild stroke are a high risk of subsequent stroke with the rise greatest early after the index event, and so should receive US as soon as possible and certainly within 2 weeks. Patients with symptomatic severe carotid stenosis should ideally be offered revascularisation within 2 weeks of the clinical event.
	MR CT angiography	None ☢ ☢	Indicated only in specific circumstances	MR/CT angiography are alternative to US neck arteries and are useful to show arterial lesions.
TIA	CT MR	☢ ☢	Indicated	CT may be normal. It can detect established infarction and haemorrhage and exclude disease processes that can mimic stroke syndromes, such as glioma, extracerebral haemorrhage, and cerebritis
	US	None	Indicated	Neck Doppler to assess suitability for carotid endarterectomy or angioplasty.
	MR	None		MRA is an alternative to show the vessels. MRI can be used to show function
Demyelinating and other white matter disease	MRI	None	Indicated	MRI is regarding as the most sensitive and specific investigation for establishing s a diagnosis of multiple sclerosis. The diagnosis is made by showing dissemination of clinical events and lesions in space and time.
Space occupying lesion	MRI	None	Indicated	MRI is more sensitive for early tumours, in resolving exact position (useful for surgery) and for posterior fossa lesions. MRI may miss calcification
	CT	☢ ☢	Indicated	CT is often sufficient in supratentorial lesions.
Headache: sudden onset, sever;				*Clinical red flags for imaging are hemiparesis, papilloedema, drowsiness, confusion, memory impairment and loss of consciousness.*

subarachnoid haemorrhage	CT	☢ ☢	Indicated	CT is the investigation of choice.
	MRI	None	Specialised investigation	MRI is better than CT for inflammatory causes. MRI may be indicated when acute subarachnoid haemorrhage has been excluded.
	CT angiography	☢ ☢	Indicated only in specific circumstances	CT angiography can be used as the primary triage tool in treatment planning for patients with proven aneurysmal subarachnoid haemorrhage (CT or lumbar puncture) where equipment and expertise is available (and with local agreement). It is not an investigation for the cause of headache.
	MR Angiography / Venography	None	Indicated only in specific circumstances	MR or CT venography is of particular value in the diagnosis of cerebral venous thrombosis
Headache: chronic	CT MRI	☢ ☢ None	Indicated only in specific circumstances	In the absence of focal features imaging is not usually useful. These features significantly increase the odds of finding a major abnormality on CT or MRI: ▪ Recent onset and rapidly increasing frequency and severity of headache. ▪ Headache causing patient to wake from sleep. ▪ Associated dizziness, lack of coordination, tingling or numbness. ▪ Headache made worse by coughing, sneezing, or straining.
	XR sinus XR cervical spine	☢ ☢	Indicated only in specific circumstances	XR of the cervical spine or sinuses may help elucidate cause of headache when CT/MRI is normal. SXR is of little use in the absence of focal symptoms and signs.
Pituitary and juxtasellar problems	MRI	None	Specialised investigation	Urgent referral is necessary when vision is deteriorating
	CT	☢ ☢	Indicated only in specific circumstances	A dedicated pituitary CT is useful if MRI is either contraindicated or not possible. Enhanced multiplanar CT images will show large masses and compression if the optic chiasm. It should not be used if MRI is available. CT may also have a further role in characterisation of masses and assessment of skull base involvement.

Posterior fossa signs (lower cranial nerve palsies; signs of cerebellar of brainstem dysfunction)	MRI	None	Indicated	MRI is the investigation of choice. Diffusion-weighted images are helpful for investigation of brainstem ischaemia
	CT	☢ ☢	Indicated only in specific circumstances	MDCT is an alternative to MRI, especially for excluding haemorrhage and in those unable to undergo MRI. Ct is an appropriate first-line investigation in some patients and is especially helpful in the acute case to exclude a mass or bleed. Ct may be complementary in evaluating base-of-skull tumours.
Hydrocephalus: shunt malfunction (For hydrocephalus in children see P03, P06)	MRI CT	None ☢ ☢	Indicated	MRI is more suitable in children but may cause problems with programmable valves.
	XR	☢	Indicated	If there is evidence of hydrocephalus on CT, XR can show the whole valve system.
Dementia and memory disorders, first-onset psychosis	MRI CT	None	Specialised investigation	▪ For dementias: Structural neuroimaging with either unenhanced CT or MRI is useful for establishing a diagnosis and predicting likely prognosis. In a small minority of cases CT/MRI will show an alternative cause such as a tumour, hydrocephalus, or subdural collection. The yield for these lesions is higher if imaging is restricted to those with a rapid or atypical presentation, patients with focal signs, history of gait ataxia, incontinence, or head injury. MRI may be useful in acute dementias, including limbic encephalitis and conditions such as Creutzfeldt-Jakob disease. ▪ For first-onset psychosis: Structural neuroimaging may be indicated after specialist (psychiatric) assessment
Orbital lesions:	CT	☢ ☢	Specialised investigation	CT remains the investigation of choice. MRI may be of value if CT is unhelpful or gives insufficient detail. Consider US for intraocular lesions.
	XR	☢	Not indicated	Suspected orbital lesions require specialist referral.

Orbital lesions: Trauma	CT	☢ ☢	Specialised investigation	CT is indicated when orbital trauma may be combined with major facial fracture. If a less severe blowout fracture is suspected, CT is used only if the patient is a candidate for surgery.
Orbital lesions: Suspected foreign body.	XR Orbits	☢	Indicated	A single radiograph is required to exclude a metallic foreign body; eye-moving images are only for confirmation of the intraocular position of a foreign body once shown. Before MRI, a posteroanterior XR is adequate to exclude a significant metallic foreign body. If a foreign body is confirmed, CT may be required by some specialists.
	US	None	Indicated	US may be indicated for radiolucent foreign bodies or where XR is difficult.
	CT	☢ ☢	Specialised investigation	CT is indicated when XR does not show a strongly suspected foreign body which may not be metallic, when multiple foreign bodies are present or when it is not certain whether a foreign body already shown is intraocular.
Acute visual loss: visual disturbances	MRI CT	None ☢ ☢	Specialised investigation	MRI is preferable for suspected lesions of the optic chiasm. CT is preferable for orbital lesions.
	Cerebral angiography	☢ ☢ ☢	Specialised investigation	Specialise referral is indicated.
	SXR	☢	Not Indicated	Specialist can diagnose many cases without resorting to imaging.
Epilepsy (adult)	MRI	None	Specialised investigation	MRI is the best investigation, but is of little value in idiopathic, generalised epilepsy. All adult patients with first fir should undergo neuroimaging, preferably MRI within 4 weeks of a request from an epilepsy specialist. MRI is especially valuable in the evaluation of temporal lobe epilepsy.
	CT	☢ ☢	Specialised investigation	CT is useful in acute assessment of seizure disorder if the clinical situation suggests an acute neurological illness, or when MRI is contraindicated, CT may complement MRI in the characterisation of lesions e.g., calcification.

Screening for intracranial aneurysm in patients with a strong family history (two or more first-degree relatives) of aneurysmal subarachnoid haemorrhage	CTA MRA	☢ ☢ None	Specialised investigation	Assessment and counselling at a neurosciences centre is essential.
	Cerebral angiography	☢ ☢ ☢	Indicated only in specific circumstances	
Movement disorders / parkinsonism	MRI	None	Specialised investigation	Imaging is not normally required for Parkinson's disease. MRI is the investigation of choice for imaging the basal ganglia and brainstem but if contraindicated. CT is the alternative.
	CT	☢ ☢	Specialised investigation	
Suspected cerebral venous sinus thrombosis.	MRI MR venography	None None	Specialised investigation	Although MRI or CT may show venous infarction and other complications, MR venography (with or without contrast) or CT venography will usually be required to show venous sinus thrombosis. Transcatheter cerebral angiography is rarely necessary unless non-invasive imaging is equivocal.
	CT CT Angiography	☢ ☢ ☢ ☢	Specialised investigation	
	Cerebral angiography	☢ ☢ ☢	Indicated only in specific circumstances	
Brain and spial cord tumours: diagnosis	MRI	☢ ☢	Indicated	MRI is the investigation of choice since CT may miss small tumours. MRI or contrast-enhanced CT is required to demonstrate brain metastases.
	CT	None	Indicated	
Brain and spinal cord tumours:	MRI	None	Specialised investigation	Referral should be made to a neurosciences centre where imaging protocols are dictated by navigation equipment.

staging and planning.	CT	☢ ☢	Specialised investigation	
	Angiography	☢ ☢ ☢	Specialised investigation	Only in a neurosciences centre. CT angiography, MR angiography or catheter angiography assessment of tumour may be indicated in cases of vascular tumours- e.g., meningiomas.
Brain and spinal cord tumours: follow-up	MRI	None	Indicated	▪ MRI is preferable to CT for most tumours. CT may be considered as an alternative. ▪ Contrast enhancement is advisable and techniques such as spectroscopy and perfusion imaging may be suitable according to local expertise and availability. ▪ Serial follow-up imaging should use on the same MR or CT system. ▪ Frequency of follow-up will depend on the histological type of the tumour, the sire of the tumour, the previous treatment, and the local policies established by the regional tumour site-specific group or MDT
	CT	☢ ☢	Indicated	
	PET-CT	☢ ☢ ☢ ☢	Specialised investigation	PET-CT may help to distinguish recurrent brain tumour from radiation necrosis.
Asymptomatic carotid bruit				*There is some evidence that carotid endarterectomy or carotid stenting is of small benefit in carefully selected patients with high-grade asymptomatic carotid stenosis. This view is controversial and medical treatment may be favoured over intervention.*
	US	None	Indicated only in specific circumstances	US of the carotid arteries is the investigation of choice.
	MR Angiography	None	Indicated only in specific circumstances	MR angiography without or with contrast medium may be appropriate if available.
	CT angiography	☢ ☢	Indicated only in specific circumstances	Ct angiography may be appropriate if available.
Congenital disorders	MRI	None	Indicated	MRI is the definitive investigation for all malformations. CT may be needed to define bone and skull base anomalies. Sedation or general anaesthesia may be required for infants and young children.