GUIDELINES FOR THE USE OF MAGNETIC RESONANCE IMAGING IN NORTHERN IRELAND

CREST

CLINICAL RESOURCE EFFICIENCY SUPPORT TEAM

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This booklet has been produced by CREST (the Clinical Resource Efficiency Support Team) which is a small team of doctors, established under the auspices of the Central Medical Advisory Committee, to promote clinical efficiency in the Health Service in Northern Ireland while ensuring that the highest possible standard of clinical practice is maintained.

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Foreword

Magnetic resonance imaging (MRI) has been one of the major advances in clinical imaging investigation over the past 20 years. It offers many advantages over other more traditional forms of imaging being free from radiation hazards and producing clearer images. However, it is costly both in terms of capital investment for equipment and in the revenue consequences of operating the equipment to maximum potential. It is therefore important that MRI is used efficiently ensuring complementarity with other investigative modalities.

Northern Ireland has 2 MRI scanners, one in the Royal Victoria Hospital and the other in Musgrave Park Hospital. In order that MRI is used to maximum efficiency the Management Executive asked CREST to draw up clinical guidelines which could be issued to clinicians in Northern Ireland. CREST commissioned Dr Ann O'Doherty, a member of CREST, to produce clinical guidelines in conjunction with all the radiologists involved in MRI in Northern Ireland. This guideline document was presented to CREST who fully endorsed the report and recommended that it should be published and widely circulated to clinicians, purchasers and providers.

In August 1995 CREST issued the third edition of the Royal College of Radiologists booklet "Making the best use of a Department of Clinical Radiology". This booklet also contains guidance on the use of MRI and CREST recommends that the Northern Ireland guidelines be read in conjunction with the Royal College guidance.

CREST wishes to acknowledge its appreciation to Dr Ann O'Doherty, Dr Stephen McKinstry and the other radiologists involved who produced such a succinct report in a remarkably short time.

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Guidelines for the use of Magnetic Resonance Imaging

1. INTRODUCTION

There are two MRI scanners in Northern Ireland, one situated in the Royal Victoria Hospital and the other at Musgrave Park Hospital. In order that MRI is used to maximum efficiency CREST asked that clinical guidelines be produced as quickly as possible and issued to clinicians in Northern Ireland. This booklet contains such guidance which has been endorsed by the CREST Committee.

2. CONTRAINDICATIONS TO THE USE OF MRI

Patients with cardiac pacemakers, some intracranial aneurysm clips or cochlear implants are not suitable for MRI. Patients with small potentially mobile metal fragments, particularly in the eye or near blood vessels are usually unsuitable to be placed in the scanner. Other possible contraindications are severe obesity, involuntary movement, coughing, vomiting or hiccoughing. There are no known teratogenic effects associated with MRI, but it is generally agreed that MRI should not be performed in the first trimester of pregnancy.

3. NEUROLOGICAL USES OF MRI

(a) **Congenital or developmental abnormalities** - Avoidance of ionising radiation and three-dimensional imaging make MRI the investigation of choice. However high quality ultrasound and/or Computerised tomography (CT) may give sufficient information in congenital hydrocephalus and the necessity to use general anaesthesia for MRI should not be forgotten. MRI may not show intracranial calcified lesions.

(b) **Neonate** - Ultrasound remains the examination of choice in the acute phase but MRI will document the extent of leucomalacia in the chronic stages if the diagnosis is in doubt or for prognostic information.

(c) **Stroke** - Although MRI will show ischaemic changes earlier than CT, haemorrhage is not as easily differentiated from infarction and for practical clinical purposes CT remains the primary investigation in these patients. In equivocal cases of ischaemic stroke a repeat CT scan will give as much information as MRI. However, if venous infarction is suspected, MRI can directly demonstrate thrombosis in the superior sagittal sinus.

Subarachnoid haemorrhage is poorly detected on MRI.

(d) **White matter disease** - The diagnosis of multiple sclerosis remains a clinical judgement, supplemented where necessary by ancillary investigations such as CSF IgG and MRI. Following a single episode of neurological disturbance, a significant proportion of patients with white matter changes on MRI will not go on to develop MS and clinicians should therefore consider carefully the implications for the patient of the result of a scan. Although a negative scan can be reassuring, this does not exclude the disease.

(e) **Dementia** - CT remains the investigation of choice in excluding potentially surgical conditions such as normal pressure hydrocephalus and in demonstrating cerebral infarcts. MRI has shown changes in the medial temporal lobe structures in Alzheimer's disease but these are demonstrable by CT and the diagnosis in any case remains primarily a clinical judgement.

(f) **MR angiography (MRA)** - The technique is being increasingly used in screening for intracranial aneurysms but small aneurysms less than 3-4 mm in diameter may not be seen. Conventional angiography remains the primary investigation in acute subarachnoid haemorrhage. AVMs are adequately demonstrated by contrast enhanced CT and although further information may be provided by MRI, surgical or endovascular intervention will always require prior conventional angiography. Cavernous and capillary haemangiomas, venous angiomas and developmental venous anomalies are better seen by MRI but are usually asymptomatic incidental findings. MRA is the investigation of choice for venous sinus thrombosis.

(g) **Tumours** - Because of its wide availability and high sensitivity, CT is the primary investigation in the majority of cases, with some exceptions (see below). MRI may provide further preoperative anatomical information, but in the majority of cases is no more specific than CT. However, lesions in the posterior fossa are better demonstrated by MRI and early infiltrating lesions may only be detectable on MRI. For this reason, clinical suspicion in the presence of a normal CT should be an indication for MRI. CT is highly sensitive in the demonstration of intracerebral metastases but MRI may show further lesions if CT is normal and clinical suspicion is high, or where surgery is being considered for an apparently solitary lesion seen on CT. MRI is much more sensitive to meningeal disease which cannot be excluded by CT.

(h) **Suspected acoustic neuroma** - CT may be used as a screening test but should be supplemented by MRI due to its ability to detect small and intracanalicular tumours.

(i) **Pituitary lesions** - MRI is the investigation of choice for microadenomas, diabetes insipidus and pituitary dwarfism and gives excellent demonstration of the anatomical relationships of larger lesions. However, CT is as sensitive as MRI for macroadenomas and should be considered where this is clinically suspected, e.g. in acromegaly, associated visual field loss and sellar enlargement seen on plain X-ray. CT better demonstrates associated bony erosion and calcification.

(j) **Intracranial infection/inflammation** - Acute infection is best investigated where necessary by CT. A normal CT excludes cerebral abscess in most cases, but if a cerebellar lesion is suspected, MRI should be considered. Chronic inflammatory and granulomatous conditions such as neurosarcoid are much better defined on MRI. Secondary effects of vasculitis are well shown but no more specifically than by CT.

(k) **Orbit** - Acute infection, trauma and foreign bodies are best investigated with CT. Tumours of the globe and optic nerve may be initially investigated with CT but are better demonstrated with MRI, particularly in the region of the orbital apex. Thyroid ophthalmopathy is well shown by coronal and axial CT scanning.

(l) **Epilepsy** - For exclusion of surgical lesions in adults presenting with seizures, CT remains an acceptable screening test. In medically refractory cases MRI will show smaller lesions such as hippocampal sclerosis. In children with refractory or partial seizures, MRI is preferable to CT.

(m) **Trauma** - CT is the investigation of choice due to its speed, sensitivity to haemorrhage and ability to demonstrate bone damage and foreign bodies. There is also of course no need to screen the patient for metallic implants or other contraindications to MRI and monitoring of the patient is much easier. In the subacute and chronic stages post trauma, MRI can show small lesions but this is rarely of clinical significance.

(n) **Skull base/petrous bones** - MRI cannot provide the bony anatomical detail given by high resolution CT which thus remains superior for investigation of cholesteatoma, petrous bone fractures and chronic sinusitis. MRI is superior for the soft tissue lesions in and around the skull base and in most cases will be used in combination with CT.

4. SPINAL LESIONS

(a) **Sciatica** - CT is the investigation of choice if evaluation of acute lumbar disc lesions is required. It is widely available and can usually resolve the question. MRI may occasionally be required.

Gadolinium enhanced MRI is particularly useful in post-operative sciatica.

(b) **Back pain** - Low back pain in the absence of sciatica or neurological signs may be assessed with CT. If back pain persists for longer than six weeks, MRI is indicated particularly if other imaging has failed to diagnose the aetiology.

MRI is the investigation of choice for children with back pain.

(c) **Brachalgia** - MRI is the investigation of choice in this condition. CT requires intra-thecal contrast to be as effective.

(d) **Myelopathy** - Though MRI is effective in this condition the urgent nature of investigation often dictates that myelography is used.

(e) **Trauma** - MRI has potential to make enormous contribution to the management of acute spinal trauma but logistics often dictate that plain films and CT remain the mainstay of investigation.

(f) **Congenital** - MRI has an enormous contribution to make to the investigation of congenital spinal problems.

(g) **Spinal infection/inflammation** - MRI is the investigation of choice.

5. EXTRA-CRANIAL HEAD AND NECK

MRI is the method of choice for investigating soft tissue tumours of the salivary glands, naso and oro-pharynx and the larynx. MRI may also be useful in the investigation of parathyroid adenoma.

6. MUSCULO-SKELETAL SYSTEM

(a) **Knee** - MRI is the most cost effective technique for diagnosing meniscal and cruciate disorders. MRI is also useful in evaluating cruciate and collateral ligament tears and also in the evaluation of tibial collateral ligament bursitis, bone bruising, avascular necrosis and chrondromalacia.

(b) **Shoulder** - Dedicated surface coil MRI is the best method of investigation of rotator cuff disease, tendinitis, bursitis, acromial spurs and acromioclavicular arthrosis.

Arthrography may be more sensitive in gleno-humeral instability, but this is still open for debate.

(c) **Hip** - The major use of MRI of the hip is in the investigation of osteonecrosis. It can be used to demonstrate tears at the labrum.

(d) **Wrist and hand** - High resolution surface coil imaging can be used to evaluate triangular fibro-cartilage complex tears, scaphoid fractures and avascular necrosis and tumours.

(e) **Ankle and foot** - MRI can be used in the evaluation of pathology of the following: -

Achilles tendon

Tibialis posterior tendon

Ligamentous injuries

Plantar fascitis

Plantar fibromatosis

Tarsal tunnel syndrome

Tumours, including Morton’s neuroma

(f) **Tempero-mandibular joint** - MRI is the investigation of choice in evaluating this joint.

(g) **Bone and soft tissue tumours** - MRI is the method of choice in staging soft tissue and bony tumours.

(h) **Osteonecrosis** - MRI is the most sensitive method for investigating osteonecrosis.

(i) **Bone marrow** - MRI is the only imaging technique that directly images bone marrow and so is useful in diseases affecting bone marrow.

(j) **Soft tissue injuries** - MRI is very sensitive in investigating bone and soft tissue injury, especially haematomas.

(k) **Infection** - MRI is useful in evaluating osteomyelitis, discitis and psoas abscess.

(l) **Arthritis** - In general plain films are the investigation of choice, but in some situations, especially atlanto-axial subluxation MRI is useful.

7. PELVIS

MRI has many indications particularly for the female pelvis.

(a) **Staging malignancy** - MRI is the best method for staging endometrial and cervical carcinoma and its accuracy is higher than CT in staging bladder tumours.

(b) **Recurrent or metastatic disease** - MRI is more accurate than CT in assessing pelvic nodal disease and can be used to differentiate scar tissue from recurrent tumour.

(c) **Mass of unknown origin** -Because of its tissue characterisation MRI may be of value in assessing pelvic masses.

(d) **Obstetrics** - MRI should replace CT for pelvimetry.

(e) **Undescended testes** - MRI is more accurate than CT.

8. ABDOMEN

As techniques improve and faster scanning limits the problems with respiration, MRI is becoming increasingly useful in abdominal investigation.

(a) **Focal liver disease** - MRI is more sensitive than CT in evaluating metastatic disease and should be used prior to partial hepatectomy. It is useful in evaluating haemangiomas, cysts and haematomas.

(b) **Diffuse liver disease** - The role of MRI is not well defined.

(c) **Pancreas** - MRI is the best technique for evaluating endocrine tumours.

(d) **Adrenal** - MRI is becoming more widely used in adrenal investigation.

(e) **Kidney** - MRI is finding an increasing role in evaluation of renal masses.

(f) **Breast** - MRI is showing increasing promise in breast tumour evaluation, particularly in assessing recurrence in the breast after treatment.

9. CHEST

The multiplanar facility of MRI makes it particularly useful for thoracic investigations. CT remains the main investigation, but MRI is developing an increasing role especially in the following:-

(a) **Mediastinum** - Tumour invasion of vascular structures, superior vena cava obstruction, tumour invasion of the spine.

(b) **Thoracic wall** - Assessment of chest wall invasion by tumour. Primary bone and soft tissue tumours and localisation of juxta-disphragmatic pathology.

(c) **Lung** - Differentiation of tumour from fibrosis or atelectasis and differentiation of hilar mass or lymph node from vessels.

(d) **Indeterminate CT** - CT degraded due to metallic wires, contrast or allergies.

10. CARDIOVASCULAR

(a) **Congenital heart disease** - MRI can frequently replace angiography in demonstrating arterial anatomy. Because of its non-invasive nature and lack of ionising radiation, it is the obvious choice.

(b) **Great vessels** - MRI is particularly useful in the diagnosis and pre-operative assessment of abnormality of the thoracic aorta.

(c) **Cardiomyopathy** - MRI is a useful adjunct to ultrasound.

(d) **Cardiac and pericardiac masses** - Multiplanar MRI is particularly useful in evaluating cardiac masses.

(e) **Coronary artery disease** - MRI can demonstrate complications of coronary artery disease, including left ventricular infarction, aneurysmal formation, infarct, VSD and regional wall motion abnormalities. It is possible to demonstrate the proximal parts of the coronary arteries.

11. VISCERAL AND PERIPHERAL VASCULAR IMAGING

Angiography is the most rapidly developing field of MRI. Abdominal vasculature can be well demonstrated. With new software the peripheral vessels can also be very well demonstrated using MRI.