RATIONAL IMAGING

Suspected early dementia

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This article explores how imaging can be used to investigate a patient with suspected early dementia.

A 58 year old right handed woman was referred with a three year history of word finding difficulty and poor memory. Problems with reading, calculation, and spelling had emerged more recently. She could find her way around and was still driving. She was more irritable and less outgoing. Her symptoms were slowly progressive with a suggestion of day to day variability. There was no significant past medical history and she took no medications. There was a family history of depression, and insidious rather than stepwise cognitive decline, should be considered. Alzheimer’s disease is the most common neurodegenerative cause of dementia. The history of memory and executive decline in the context of fluctuations makes dementia with Lewy bodies possible, even without parkinsonism or visual hallucinations. Naming and behavioural problems are commonly seen within the frontotemporal lobar degeneration spectrum, which includes behavioural variant frontotemporal dementia (previously Pick’s disease), progressive non-fluent aphasia, and semantic dementia (fluent speech with loss of word meaning).

Critically, distinguishing these causes from one another has implications for management, as acknowledged in UK national dementia guidelines. Surgery for an intracranial mass lesion is potentially curative, as is pharmacotherapy for depression. Even in the absence of disease modifying therapies, other dementia disorders still require specific treatment strategies, such as modification of vascular risk factors in vascular cognitive impairment, and acetylcholinesterase inhibition for Alzheimer’s disease and dementia with Lewy bodies, for example. Accurate diagnosis facilitates prognosis and counselling, referral to appropriate services and voluntary organisations, applications for relevant benefits, and important lifestyle, occupational, and legal decisions, including those related to driving.

How can brain imaging help?

Although a detailed clinical assessment remains the mainstay of the evaluation of a patient with early dementia, UK, European, and US guidelines recommend that all patients with cognitive impairment should undergo structural imaging as part of the diagnostic work up. Brain imaging is increasingly used to help distinguish different forms of dementia from one another, whereas in the past it was principally undertaken to exclude treatable intracranial mass lesions, haematomata, and hydrocephalus, which account for less than 1% of all cases of dementia.

Computed tomography

Where magnetic resonance imaging (MRI) is not available or contraindicated, computed tomography (which does involve exposure to ionising radiation) can usefully exclude major space occupying lesions, hydrocephalus, and large infarcts. Modern multidetector computed tomography scanners make it possible to acquire volumetric imaging data of the whole brain in a few seconds, which allows high resolution multiplanar reconstructions to be performed. Images reconstructed in the coronal plane allow detailed assessment of the medial temporal lobe structures (fig 1).

LEARNING POINTS

All patients with suspected dementia should have structural brain imaging

Structural imaging is useful not only for excluding intracranial space occupying lesions, but also for arriving at a specific dementia subtype diagnosis

The pattern of regional brain atrophy—particularly using high resolution volumetric magnetic resonance imaging (MRI)—has value in distinguishing the common neurodegenerative causes of dementia

T2 weighted and fluid attenuated inversion recovery (FLAIR) MRI sequences are highly sensitive to ischaemic damage in the cerebral white matter

Other MRI sequences and imaging modalities (including positron emission tomography (PET) and dopamine transporter (DAT) scans) have diagnostic value in particular clinical settings.
Magnetic resonance imaging

MRI, with its superior contrast resolution, is increasingly preferred over computed tomography in the evaluation of suspected dementia. A basic dementia sequence including a high resolution structural volumetric T1 weighted scan and T2 weighted or fluid attenuated inversion recovery (FLAIR) sequences can be obtained in approximately 20 minutes. MRI does not involve ionising radiation, but claustrophobia may be a limiting factor in some patients. MRI is contraindicated in patients with pacemakers and certain metallic implants, and earplugs should be worn to prevent the possibility of cochlear damage.

T1 weighted volumetric MRI scanning provides a very detailed assessment of brain structure, allowing for the assessment of the presence or absence and pattern of brain volume loss—that is, atrophy. When evaluating a patient with cognitive impairment it is particularly valuable to assess for medial temporal lobe atrophy on coronal reformats, either qualitatively or using simple rating scales. The presence of bilateral, symmetrical hippocampal atrophy distinguishes mild Alzheimer’s disease from controls with approximately 80-85% sensitivity and specificity (fig 2A). Alzheimer’s disease is also associated with relatively greater and more disproportionate hippocampal atrophy than dementia with Lewy bodies (fig 2B). In contrast, asymmetric temporal lobe atrophy with an anterior-posterior gradient is at least 85% specific for frontotemporal lobar degeneration, and focal left inferior/anterior temporal lobe atrophy is highly suggestive of semantic dementia (fig 2C). The presence of medial temporal lobe atrophy in patients with isolated memory impairment (mild cognitive impairment) has high predictive value for the subsequent development of Alzheimer’s disease, and this has been incorporated into new proposed diagnostic criteria. However, the absence of medial temporal lobe atrophy does not exclude a diagnosis of Alzheimer’s disease, and patients with young onset Alzheimer’s disease may have prominent posterior atrophy with relative sparing of medial temporal lobe structures.

T2 weighted or FLAIR sequences are highly sensitive for detecting white matter abnormalities, which can reflect demyelination but, much more commonly in this age group, cerebrovascular disease. As well as detecting major strokes, these sequences allow visualisation of small strategic infarcts (such as within the thalamus and other subcortical nuclei) and small vessel ischaemic white matter damage. Although an increased white matter lesion load suggests vascular disease, particularly in combination with lesions in the basal ganglia and brain stem, the pathophysiology and cognitive consequences of MRI white matter hyperintensities remain the subject of ongoing research, and it is important not to over-interpret minor vascular disease that commonly accompanies ageing. Significant white matter and other ischaemic changes in the presence of hippocampal atrophy support a diagnosis of mixed vascular cognitive impairment/Alzheimer’s dementia (fig 2D).

MRI scanning using a variety of additional sequences can provide other valuable diagnostic information. Thus, in the correct clinical context, the presence of temporal lobe signal change is suggestive of infection or inflammation (fig 3A); diffusion weighted imaging can help distinguish acute from chronic vascular disease, and the finding of neocortical or striatal abnormalities can aid the diagnosis of Creutzfeldt-Jakob disease (fig 3B); and T2* sequences sensitive to iron deposition can demonstrate microhaemorrhages due to amyloid angiopathy (fig 3C) or vascular disease.

Metabolic and functional imaging

Although metabolic or functional imaging is typically not performed routinely, it can provide valuable diagnostic information in certain circumstances. Where dementia with Lewy bodies is suspected, demonstration of central dopamine depletion using positron emission tomography (PET) (fig 4A) or single photon emission computed...

10 MINUTE CONSULTATION

The Hajj

A R Gatrad,1 A Sheikh2

A 68 year old Muslim man with diabetes, which is reasonably well controlled on twice daily insulin, and who has a history of myocardial infarction 12 months previously wants advice on his fitness to go on pilgrimage (the Hajj) to Mecca.

What you should cover

Explore his understanding of the Hajj

Hajj is one of the five pillars of Islam that is compulsory for every Muslim, once in a lifetime. Is he aware that those who are physically unable to perform the Hajj because of illness or infirmity are exempt from going?

Does he experience angina?

Ask if he has chest pain at rest or on exertion. More than 40% of deaths during Hajj are related to cardiovascular disease.1

Does he appreciate the possible effects of heat, exertion, crowds, and altered routine on his health?

Annually, more than two million people travel to Mecca for the Hajj, with recent myocardial infarction. The Hajj period alters physical health. If your assessment is that it is not, make account, among other things, his age and mental and physical state, and altered routine might affect the control of his diabetes.2

PRACTICE

16 Cordierion, van der Flier WM. Brain microbleeds and Alzheimer’s disease: innocent observation or key player? Brain 2011;134:33-44.
example, building up to walking a few miles a day—before he travels.

Explain the need to ensure adequate diabetic control by eating regular meals, maintaining good compliance with treatment, and frequent checking of blood sugar. Provide him with a letter detailing his diagnosis and his need to carry syringes and needles through airports, and remind him to store insulin away from direct sunlight. The time difference between—for example, the UK and Saudi Arabia—is 2-3 hours. Generally, time zone changes of less than four hours do not require major alteration in the injection schedule. With the advent of the basal bolus regimen less disruption should occur with the crossing of time zones.

Discuss strategies for avoiding heat and dehydration—for example, avoiding the midday sun, using an umbrella to reflect the sun (head coverings are prohibited for men during the Hajj), and for always having access to ample water. Explain that exposed skin needs protection with a high factor sun cream. Walking long distances in the heat can cause the groin area to get irritated with associated risk of fungal infection; a barrier agent such as petroleum jelly can help. Emphasise the importance of appropriate footwear and explain that it is easy to burn or injure feet by walking barefoot on hot sand.

Advise against visiting roadside “barbers”—shaving the head is a ritual marking the end of the Hajj—and to use designated ones. He should insist on use of a new blade to minimise the risk of acquiring blood borne infections.

Arrange for him to be vaccinated against meningococcus at least 10 days before he travels, and discuss the merits of the new conjugated vaccine. Emphasise the need for typhoid and hepatitis A vaccines, and any others that could be relevant if there are plans for onward travel. Offer the flu and pneumococcal vaccines.

Ensure that he has adequate supplies of drugs and that he is aware of the need to seek medical help if he develops fever, headaches, photophobia, jaundice, or diarrhoea, particularly on his return.

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ANSWERS TO ENDGAMES, p 645. For long answers go to the Education channel on bmj.com

PICTURE QUIZ

A man with back pain

1 The image shows an anterior wedge fracture of T11 (fig 1). There is abnormal high signal within the T10/11 disc space and destruction of the adjacent vertebral endplates with associated angulation of the spine. Soft tissue is projecting posteriorly and causing narrowing of the spinal canal and compression of the distal cord. Oedema is seen within the T10/11 vertebral bodies.

2 The clinical history and features on magnetic resonance imaging are consistent with a diagnosis of infective discitis. Discitis is an infection or inflammation of the intervertebral disc space or vertebral endplate. The presence of intractable back pain and fever should alert the clinician to the possibility of this condition.

3 Magnetic resonance imaging with contrast imaging is the most sensitive and specific test for discitis (fig 2). This can be supplemented with disc space biopsy (either needle or open), which can help confirm the diagnosis if the clinical or imaging findings are equivocal.

4 The mainstay of management of infective discitis is a prolonged course of targeted antimicrobial treatment, usually given intravenously. This can be supplemented by surgical debridement if necessary.

STRICTLY QUESTION

Hazard ratios

Answer a is true, while b, c, and d are false.

Essential medical travel kit for those travelling on Hajj

Analgesics

Anti-diarrhoeal drugs

Antiseptic cream

Clove oil for toothache

Good footwear

Petroleum jelly

Plasters, bandages, scissors

Throat lozenges

Sunglasses

Water flask

Water sterilisation tablets

Promot Health

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