



CLINICAL ASSESSMENT AND NEUROIMAGING IN DEMENTIA

- The neurological history and examination are essential components of the diagnostic work up of dementia and may reveal important clues to the aetiology of the patient's cognitive decline. [1](#)
- Alzheimer's disease is the most common type of dementia and NINCDS-ADRDA criteria for probable AD includes: [2](#)
 1. The insidious onset and progressive worsening of dementia.
 2. Prominent difficulty with memory (especially retention and retrieval of new information).
 3. Onset after age 60.
 4. No focal signs or gait difficulties on neurological examination, especially early in the course.
 5. Exclusion of other causes of dementia (systemic or intracranial disorders)
- Neuroimaging (CT or MRI) is indicated to exclude other (treatable) intracranial disorders that might cause dementia, such as stroke, intra-axial or extra-axial tumours, subdural haematomas, hydrocephalus, and Creutzfeldt-Jakob disease. [1,2](#)
- The American Academy of Neurology recommends structural neuroimaging with either a noncontrast head CT or MRI in the routine initial evaluation of all patients with dementia. [22](#)



COMPUTED TOMOGRAPHY

- Useful for excluding causes of dementia other than Alzheimer's disease. [3,4](#)
- May show general or regionalised atrophy, white matter changes, space-occupying lesions, and vascular disease. [3,4,5](#)
- Permits detection of hippocampal atrophy, which may be specific for Alzheimer's disease and may be useful for early detection and differential diagnosis. [5-7](#)
- Limitations: [4](#)
 - Inability to distinguish grey and white matter.
 - May miss old haemorrhage or haemorrhage from severe anaemia.
 - Poor visualisation of the posterior fossa.
 - May miss cerebral infarction.

MAGNETIC RESONANCE IMAGING

- Higher sensitivity than CT in detecting most intracranial pathologies. [8](#)
- MR-based volumetric measurements of the hippocampal formation allow differentiation of patients with probable AD from normal elderly individuals. [9-10](#)
- Patients with normal pressure hydrocephalus with classic clinical triad (dementia, gait disturbance, and urinary incontinence) and CT/MRI findings of enlarged ventricles and absence of or only mild cortical atrophy, are more likely to respond to shunt and may benefit from further imaging with SPECT cisternography. [11](#)
- Advantages: [4](#)
 - Allows assessment of grey and white matter bulk; and global and regional volume.
 - More accurate assessment of the morphological features of hydrocephalus.
 - Ability to image small lacunar strokes and posterior fossa lesions.
 - Superior to CT in imaging subacute haemorrhage.
 - Permits direct visualisation of hippocampal formation.
- Disadvantages:
 - Contraindicated in patients with metallic implants.
 - Relative contraindications (claustrophobic, anxious patients).
 - Limited availability and high expense.

MAGNETIC RESONANCE IMAGING WITH CSF FLOW STUDIES

- By gating the MRI to the cardiac cycle and CSF oscillatory flow, movement of the CSF can be monitored to identify blockages, especially in the aqueduct between the third and fourth ventricles. Hyperdynamic flow demonstrated in the aqueduct supports a diagnosis of NPH. [23](#)





- Increased CSF flow void through cerebral aqueduct on MRI appears to correlate with a good response to shunt surgery. [12](#)

SINGLE PHOTON EMISSION COMPUTED TOMOGRAPHY (SPECT)

- Physiological imaging technique using a 99m-Tc, or 131-I tracer, that is most useful in providing information on neuronal function (eg cerebral blood flow). [4](#)
- May assist in the evaluation of the differential diagnosis of dementing illness. [13,14,16](#)
- Assists in confirming the diagnosis of Alzheimer's disease (reveals bilateral temporo-parietal, posterior cingulate gyrus and/or hippocampal hypoperfusion and hemispheric asymmetry in Alzheimer's disease - consistent functional patterns in Alzheimer's disease). [5,15-17](#)
- Routine use of SPECT for diagnosis of Alzheimer's disease is not currently recommended, as a normal SPECT does not exclude the diagnosis of Alzheimer's disease. [15-17](#)
- Advantages:
 - Gives functional information.
 - More widely available compared to PET scan.
- Limitations: lower spatial resolution than PET (does not identify deep structures as well).

POSITRON EMISSION TOMOGRAPHY

- Provides information on: [4](#)
 1. Neuronal function
 2. Glucose metabolism
 3. Cerebral blood flow
 4. Receptor characteristics (eg density, affinity).
- Assists in confirming the diagnosis of Alzheimer's disease (Shows characteristic reductions in glucose metabolic rates and cerebral blood flow in patients with probable and definitive AD in the parietal, temporal, and posterior cingulate regions). [14,19-21](#)
- Can differentiate patients with Alzheimer's disease from patients with other dementias (such as vascular dementia, fronto-temporal dementia, and Huntington's disease) and from cognitively intact people. [19-21](#)
- ~90% sensitivity and 70% specificity in the diagnosis of Alzheimer's disease. [20,21](#)

REFERENCES

1. Report of the Quality Standards Subcommittee of the American Academy of Neurology. Practice parameter for diagnosis and evaluation of dementia. (Summary statement) Neurology 1994;44(11):2203-6.
2. Mckhann G, Drachman D, Folstein M, et al. Clinical diagnosis of Alzheimer's disease: Report of the NINCDS-ARDA Work Group under the auspices of Department of Health and Human Services Task Force on Alzheimer's disease. Neurology 1984;34(7):939-44.
3. Scheltens P. Early diagnosis of dementia: neuroimaging. J Neurol 1999;246:16-20. (Review article)





4. Small GW, Leitter F. **Neuroimaging for diagnosis of dementia.** J Clin Psychiatry 1998;59(S11):4-7. (Review article)
5. Jobst KA, Hindley NJ, King E, et al. **The diagnosis of Alzheimer's disease: a question of image?** J Clin Psychiatry 1994;55(11, suppl):22-31. (Level II/III evidence)
6. Jobst KA, Smith AD, Szatmari M, et al. **Detection in life of confirmed Alzheimer's disease using a simple measurement of medial temporal lobe atrophy by computed tomography.** Lancet 1993;340:1179-83. (Level IV evidence)
7. De Leon MJ, George AE, Stylopoulos LA, et al. **Early marker for Alzheimer's disease: the atrophic hippocampus.** Lancet 1989; September 16:672-673.
8. Jagust WJ, Eberling JL. **MRI, CT, SPECT, PET: their use in diagnosing dementia.** Geriatrics 1991;46(2):28-35.
9. Jack CR Jr, Petersen RC, O'Brien PC, et al. **MR based hippocampal volumetry in the diagnosis of Alzheimer's disease.** Neurology 1992;42:183-8. (Level III evidence)
10. Pantel J, Schroder J, Schad LR, et al. **Quantitative magnetic resonance imaging and neuropsychological functions in dementia of the Alzheimer's type.** Psychol Med 1997;27:221-9. (Level III evidence)
11. Vanneste J, Augustijn P, Tan WF, et al. **Shunting normal pressure hydrocephalus: the predictive value of combined clinical and CT data.** Journal of Neurology, Neurosurgery, and Psychiatry 1993;56:251-6. (Level III evidence)
12. Bradley WG Jr, Whittemore AR, Kortman KE, et al. **Marked cerebrospinal fluid void: indicator of successful shunt in patients with suspected normal-pressure hydrocephalus.** Radiology 1991;178:459-66. (Level III evidence)
13. Osimani A, Ichise M, Chung D-G, et al. **SPECT for differential diagnosis of dementia and correlation of rCBF with cognitive impairment.** Can J Neurol Sci 1994;21:104-11. (Level III evidence)
14. Mielke R, Pietrzyk U, Jacobs A, et al. **HMPAO SPET and FDG PET in Alzheimer's disease and vascular dementia: comparison of perfusion and metabolic pattern.** Eur J Nucl Med 1994;21:1052-60. (Level III evidence)
15. Van Gool WA, Walstra GJ, Teunisse S, et al. **Diagnosing Alzheimer's disease in elderly, mildly demented patients: the impact of routine single photon emission computed tomography.** J Neurol 1995;242(6):401-5. (Level II evidence). [Click here to view reference](#)
16. Read SL, Miller BL, Mena I, et al. **SPECT in dementia: clinical and pathological correlation.** J Am Geriatr Soc 1995;43:1243-7. (Level III evidence)
17. Hanyu H, Abe S, Arai H, et al. **Diagnostic accuracy of single photon emission computed tomography in Alzheimer's disease.** Gerontology 1993;39(5):260-6. (Level III/IV evidence)
18. Larsson A, Arlig A, Bergh A-C, et al. **Quantitative SPECT cisternography in normal pressure hydrocephalus.** Acta Neurol Scand 1994;90:190-6. (Level II evidence). [Click here to view reference](#)





19. Silverman DHS, Cummings JL, Small GW, et al. **Added clinical benefit of incorporating 2-Deoxy-2-18F-Fluoro-D-Glucose with positron emission tomography into the clinical evaluation of patients with cognitive impairment.** Molecular Imaging and Biology 2002;4:283-93. (Level II evidence). [Click here to view reference](#)
20. Silverman DHS, Small GW, Chang CY, et al. **Positron emission tomography in evaluation of dementia: regional brain metabolism and long-term outcome.** JAMA 2001;286:2120-7. (Level II evidence). [Click here to view reference](#)
21. Hoffman JM, Welsch-Bohmer KA, Hanson M, et al. **FDG PET imaging in patients with pathologically verified dementia.** J Nucl Med 2000;41:1920-8. (Level III evidence)
22. DS K, et al. **FDG Practice parameter: diagnosis of dementia (an evidence-based review). Report of the Quality Standards Subcommittee of the American Academy of Neurology.** Neurology 2001 May;56(9):1143-53. (Level I evidence)
23. Factora R, Luciano M **Normal Pressure Hydrocephalus: Diagnosis and New Approaches to Treatment.** Clinics in Geriatric Medicine. 2006 August;22(3)(review article)

FURTHER READING

1. Savoiardo M, Griscoli M. **Imaging dementias.** Eur Radiol 2001;11:484-92.
2. McMahon PM, Araki SS, Neumann PJ, et al. **Cost-effectiveness of functional imaging tests in the diagnosis of Alzheimer disease.** Radiology 2000;217:58-68.
3. Silverman DHS. **Neuroimaging in the evaluation of dementia: the diagnostic value of FDG-PET and other imaging modalities.** Diagn Imag 2001;23:122-8.
4. JK, K. and H. B **Normal pressure hydrocephalus: survey on contemporary diagnostic algorithms and therapeutic decision-making in clinical practice.** Acta Neurochir (Wien). 2004 April; 146(4): 379-388.
5. JK, K., R. JP, et al. **Flow void of cerebrospinal fluid in idiopathic normal pressure hydrocephalus of the elderly: can it predict outcome after shunting?** Neurosurgery. 1997 Jan; 40(1): 67-74.

Website

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