Dementia is an acquired global impairment of intellect, memory and personality, but without impairment of consciousness. There is often an associated deterioration in emotional control, social behaviour and motivation. Dementing disorders can be classified into different types; the NINDS-NIH classification includes the following:

- **Cortical dementia**: dementia where the brain damage primarily affects the brain’s cortex, or outer layer. Cortical dementias tend to cause problems with memory, language, thinking, and social behaviour.
- **Subcortical dementia**: dementia that affects parts of the brain below the cortex. Subcortical dementias tend to cause changes in emotions and movement in addition to problems with memory.
- **Progressive dementia**: dementia that gets worse over time, gradually interfering with more and more cognitive abilities.
- **Primary dementia**: dementia, such as Alzheimer’s disease (AD), that does not result from any other disease.
- **Secondary dementia**: dementia that occurs as a result of a physical disease or injury.

Dementia, due to its impact on individuals, families, and healthcare systems throughout the world, is a major medical, social, and economic problem. Not surprisingly, considerable attention and resources have been devoted to the medical aspects of dementia, with the dual aims of improving understanding of the various causes of the diseases that produce dementia’s debilitating symptoms, and of finding effective treatments. As the population of older adults – and thus the number of persons affected by dementia – increases, it is expected that the subjective experiences of individuals with dementia will become the focus of even greater interest.

Dementia can now be accurately diagnosed through clinical evaluation, cognitive screening, basic laboratory evaluation and structural imaging. The Third Canadian Consensus Conference on the Diagnosis and Treatment of Dementia (3rd CCCDTD), held in March 2006, provided recommendations and guidance on the diagnosis of dementia. As specified in the 3rd CCCDTD and in the last European Federation of Neurological Societies (EFNS) guideline, dementia is a clinical diagnosis, in which laboratory and imaging tests as yet play only a supporting role. Indeed, although many ancillary techniques are available to aid in the diagnosis, their role is controversial. Neuroimaging is now the most important ancillary investigation in the work up of dementia, aiding in differential diagnosis and management decisions.

According to the 3rd CCCDTD and the EFNS guideline, structural cerebral neuroimaging examinations [computed tomography (CT), magnetic resonance imaging (MRI)] are a mandatory part of the diagnostic process, at least at the time of the initial diagnosis in order to achieve a differential diagnosis versus surgical or reversible lesions and vascular disease (assessing the possible vascular component), and whenever there are particularly important variations in a patient’s clinical course.

Volumetric studies of the hippocampus are currently restricted to research protocols, as are MR-spectroscopy studies. Functional cerebral neuroimaging examinations such as single photon emission CT (SPECT) and position emission tomography (PET) and functional MRI (fMRI), which provide information on metabolic status and cerebral function, are indicated in the case of dementias with an atypical presentation or evolution.

Diagnosis of single pathologies causing dementia is a problem pertaining to a subsequent diagnostic step, following the initial identification of subjects with dementia syndromes (Table 1, over). To attempt the diagnosis of each pathology which causes dementia there are shared clinical criteria and the role of neuroimaging in the differential diagnosis course of primary dementias is controversial.
However, since clinical criteria, indicated by various guidelines as the primary instruments of differential diagnosis, are used as the standard for evaluating the performance of neuroimaging techniques applied in studies of differential diagnosis, it is practically impossible to identify the added value of imaging techniques in this setting. For this reason, the routine use of imaging techniques in the differential diagnosis of primary dementia is not presently recommended and the diagnosis of the single diseases causing dementia syndrome remains clinical. Imaging techniques are supplementary diagnostic instruments to be used in dubious cases where the case history/clinical evaluation does not allow a reasonably certain diagnosis. In particular, the following are recommended: MRI and CT in differential diagnosis between AD and vascular dementia (VD) and between AD and fronto-temporal dementia (FTD); ¹²³I-FP-CIT SPECT in differential diagnosis between AD and Lewy Body dementia (LBD); ⁹⁹mTc-HMPAO SPECT in differential diagnosis between AD and VD and between AD and FTD; PET-FDG SPECT in differential diagnosis between AD and VD; PET-FDG (stereotactic surface projection, SSP) in differential diagnosis between AD and FTD.

The debate about the use of imaging techniques for predicting progression of dementia is substantially limited to patients with mild cognitive impairment (MCI) with a risk to conversion into AD. Although non-conventional imaging techniques are under investigation and show promising results as regards their predictive value, the evidence regarding their sensitivity, specificity, reproducibility and ease of use is still insufficient. Therefore, their routine use for predicting progression to dementia in patients with MCI cannot yet be advocated. Some combination of cognitive testing and imaging may, in the future, allow more accurate prediction. Until then, annual clinical follow up is the best recommendation. In view of this situation, it is desirable that further studies be undertaken with respect to the use of MRI, spectroscopy, PET and SPECT in the identification of MCI patients with a higher risk of conversion into AD, in order to allow available time-dependent therapeutic options to be applied as early as possible.

With respect to the monitoring of medical therapies, current guidelines do not make any reference to the role played by imaging techniques, and this is also confirmed by the literature. In fact, there are very few studies available, relating to a small population; furthermore, their results are limited, very often referring to generic correlations between radiological and clinical signs. For this reason the use of neuroimaging techniques is not recommended in the follow up of the effectiveness of medical therapy in dementia.

In conclusion, guidelines for the diagnosis of dementing disorders are clinical and notwithstanding the remarkable evolution of imaging techniques, including non-conventional ones, neuroimaging can only be used in support of the clinical diagnosis.

On the other hand, the routine use of imaging techniques is not recommended in the differential diagnosis of the diseases that are the primary causes of dementia, in the evaluation of dementia progression or in monitoring the effectiveness of medical treatments in pathologies causing dementia. Clinical criteria, which are indicated in various guidelines as the primary instruments of differential diagnosis and monitoring of disease progression, provide the standards through which the performance of imaging techniques is evaluated. This makes it impossible to identify the additional contribution of imaging techniques.

It is to be hoped that the results of the numerous studies of advanced non-conventional neuroimaging will be standardised, as this could allow the coding of specific patterns that may then be integrated into the diagnostic criteria for the differential diagnosis of diverse forms of primary dementia, especially in those cases for which, to date, clinical assessment by itself is not decisive.

We hope that, in the near future, neuroimaging will become a fundamental instrument not only in experimental protocols but also, indeed particularly, in differential diagnosis and disease monitoring.

**Essential bibliography**

3rd Canadian Consensus Conference on Diagnosis and Treatment of Dementia. Approved Recommendations Final - July 2007


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