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# Imaging In Dementia With Multi- Slice Computed Tomography: A Practical Approach

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## Abstract

To help to specify the diagnosis of dementia structural neuroimaging with computed tomography or magnetic resonance imaging is recommended in current guidelines. Computed tomography has many advantages in everyday clinical imaging. It is fast, robust, widely available and there are no relevant contraindications. In this short review a practical approach for imaging in dementia with multi- slice computed tomography is presented.

## INTRODUCTION

Dementia is a syndrome, which is characterized by a progressive impairment of cognitive performance. The classic symptom is memory impairment. It is estimated that about 10% of people older than 65 years are affected (1). As especially western societies are getting older the importance of dementia will increase. Until now for most of the causes of dementia there is no cure, but symptomatic and disease modifying therapies are already available. For example acetylcholinesterase inhibitors for Alzheimer's dementia or modification of vascular risk factors in vascular dementia. To help to specify the diagnosis of dementia structural neuroimaging with computed tomography (CT) or magnetic resonance imaging (MRI) has been recommended in current guidelines (1). In this short review a practical approach for imaging dementia with multi- slice computed tomography (MSCT) is presented.

## ADVANTAGES AND TECHNIQUE OF COMPUTED TOMOGRAPHY IN DEMENTIA IMAGING

The implementation of CT scanners in clinical practice prompted structural research in neuropsychiatric diseases and the first imaging studies in dementia were published in the late seventies. A paucity of papers concerning dementia and CT were published. With the advance of MRI and its inherent better contrast resolution and the possibility of acquiring images in different planes it became the favoured method in neuroimaging (2). Especially in research newer applications in MRI like functional imaging, spectroscopy or tractography are attracting investigators. But CT has many

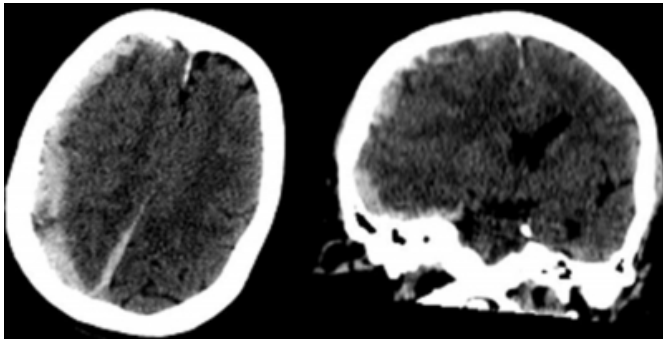
advantages in everyday clinical imaging. It is fast, robust, widely available and there are no relevant contraindications like pace- makers. Especially the speed of the scan is an advantage in demented patients, who can be very agitated. MSCT scanners offer the possibility to acquire high quality multiplanar reformations and have overcome the limits of classic incremental CT scanning. Radiation exposure is no concern in the most elder patients undergoing imaging for dementia. Recently Watjes et al. have shown that comparable diagnostic information concerning imaging in dementia can be obtained from MSCT and MRI (3).

## FIRST RULE OUT TREATABLE CONDITIONS

It has been shown in large studies that up to 10% of patients with dementia are suffering from treatable causes (2). There are three main causes of treatable dementia: Chronic subdural hematoma, tumour and normal pressure hydrocephalus.

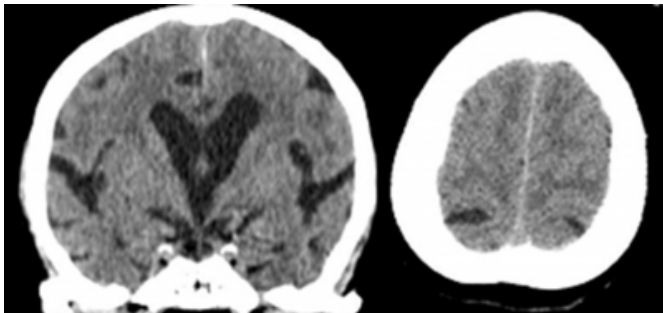
**Figure 1**

Figure 1: Axial and coronal CT images of 74 year old patient with recent cognitive decline and history of trauma showing typical subdural hematoma



**Figure 2**

Figure 2: Disproportionate small outer liquor spaces near the vertex and prominent fissure of Sylvii in this 78 year old patient in accordance with normal pressure hydrocephalus.

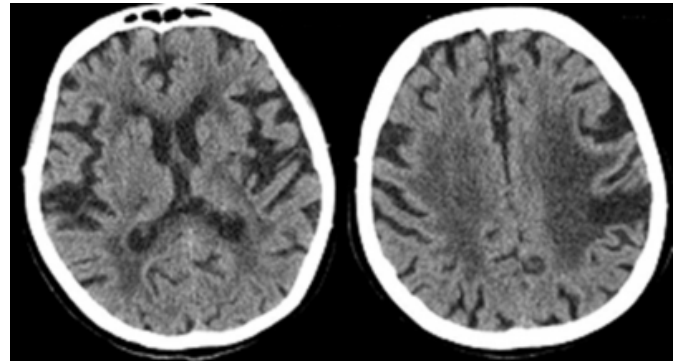


### **ARE THERE SIGNS OF VASCULAR DEMENTIA?**

Vascular dementia or multi infarct dementia is the second most common form of dementia and accounts for 10- 38 % of all dementias (4). Typical it shows a stepwise cognitive decline accompanied by focal neurological signs which are representing the occurring cerebral ischemias, but only the half of the patients are showing this typical clinical finding (5). The documentation of cerebrovascular disease on neuroimaging is requested in diagnostic criteria. For example using the NINDS- AIREN criteria for diagnosis one or a combination of the following findings on structural neuroimaging is requested for diagnosis: extensive white matter disease, multiple large vessel infarctions, multiple basal ganglia or white matter lacunes (6). Interestingly in a study by Massoud et al. a large portion of patients with dementia showed previously not expected extensive white matter disease (7).

**Figure 3**

Figure 3: Signs of vascular dementia in an 80 year old patient. There is an infarction in the left media territory, lacunary defects and extensive leucencephalopathy.



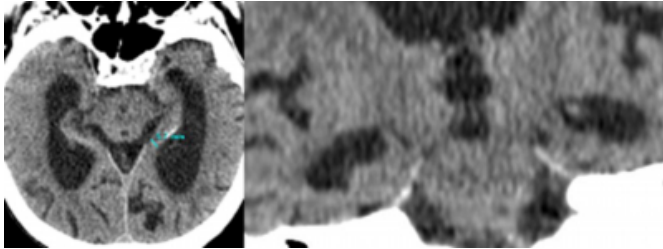
### **COULD IT BE ALZHEIMER'S DISEASE?**

Alzheimer's disease (AD) is the most common form of dementia. Neuropathologically it is characterized by nerve cell loss and gliosis mainly in the hippocampus, whereas the rest of the brain parenchyma remains relatively unaffected (8). Corresponding to the pathologic findings atrophy of the medial temporal lobe, which contains the hippocampus, is the most commonly reported finding on neuroimaging (2). Incremental computed tomography had the shortcoming that only angulated axial slices could be obtained. Proper planning and positioning was mandatory, this made reproducible imaging somewhat troublesome. Now with MSCT the obtained images can be viewed in all three dimensions without loss in quality, which makes evaluation of the hippocampus easily applicable.

For everyday imaging two different methods appear most promising. The method after Jobst et al. relies on measurement of the minimum thickness of the temporal lobes on temporal lobe orientated CT scans. These measurements significantly distinguished patients with AD from controls. Using a cut-off value of 0.79 cm for the minimum thickness of the medial temporal lobe they reported about a detection rate of 92% and a false positive rate of 5 % (9). In the same year Scheltens et al. proposed a grading system based on semi- quantitative assessment of the medial temporal lobe on coronal images acquired parallel to the brainstem (10). Recently a good correlation between CT and MRI was shown using this grading system (3).

**Figure 4**

Figure 4: Evaluation of the medial temporal lobe in a 96 year old patient with dementia after the Method by Jobst et al. showing a minimum thickness of 0.52 mm (left) and the Method by Scheltens et al. (right). With both methods atrophy of the medial temporal lobe can be found, this is suggestive of AD.



**Figure 5**

Figure 5: In contrast to Figure 4 there are no signs of medial lobe atrophy in this 83 year old and otherwise healthy patient undergoing imaging after trauma



Other approaches to measure the medial lobe atrophy have been proposed (11). The reliability of the concept has been confirmed using pathologic examinations (12). As there is some overlap between patients with AD and controls in all mentioned studies the atrophy of the medial temporal lobe is suggestive of AD but not pathognomonic.

**THE PROBLEM OF OVERLAPPING NEUROPATHOLOGY BETWEEN AD/ VASCULAR DEMENTIA**

It is noteworthy that the pathological and radiological findings of vascular dementia and AD show considerable overlap. Postmortem examinations revealed that vascular changes are present in almost every AD patient. On the other hand in a large portion of patients diagnosed with vascular dementia on post-mortem examinations typical AD plaques can be found. In most cases a dominant component can be found, for the remaining patients the category of mixed dementia has been proposed (13).

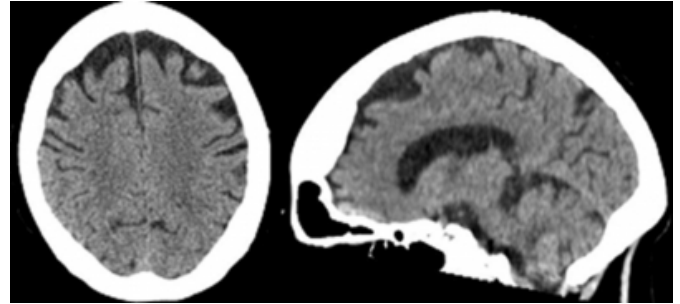
**ESPECIALLY IN YOUNG PATIENTS THINK OF FRONTOTEMPORAL DEMENTIA**

Especially in younger patients frontotemporal dementia (FTD) has to be considered. Ratnavalli et al. have shown that

its incidence can be as high as early onset AD in patients younger than 65 years (14). This form of dementia is also known as Pick's disease. Changes in personality are often the prominent clinical finding.

**Figure 6**

Figure 6: Marked bifrontal atrophy in this demented 78 year old patient, in accordance with FTD/ Pick's disease



**RARE CAUSES OF DEMENTIA**

A lot of other pathologies can lead to the syndrome of dementia, for example HIV- encephalopathy, multiple sclerosis or prion diseases (15). In a lot of these cases there are anamnestic informations. Further diagnostic work- up with MRI should be undertaken in complicated and ambiguous cases, which can give additional informations (15).

**CONCLUSIONS**

In conclusion the use of modern MSCT neuroimaging of dementia is fast, safe and reliable. As shown above the most common forms of dementia can be classified. Especially important treatable causes of dementia can be ruled out.

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