The diagnosis of vascular dementia (VD) is difficult because there is no consensus on clinical criteria. Additionally, cerebral arteriosclerosis frequently is present in elderly patients and even small infarcts or white matter lesions occur in elderly subjects without cognitive impairment or with degenerative dementia. There is a tendency to diagnose VD on the basis of MRI which has a high sensitivity for cerebrovascular lesions. In many cases, therefore, the differentiation between degenerative dementia, mainly Alzheimer’s disease and VD, is uncertain as mixed pathologies might be involved causing mixed dementia. Additionally, vascular factors promote degenerative and molecular changes vascular dementias.

Neuroimaging, e.g. positron emission tomography (PET) can support the clinical diagnosis by visualizing cerebral functions in typically affected brain regions. PET of 18F-2-fluoro-2-deoxy-D-glucose (FDG) for measurement of regional cerebral glucose metabolism (rCMRGl) has shown a typical metabolic pattern in patients with probable AD: hypometabolism in temporoparietal and frontal association areas, but relative recessing of primary cortical areas, basal ganglia and cerebellum. In VD a different pattern is seen. It consists of scattered areas with reduction of rCMRGl typically extending over cortical and subcortical structures. Severity of dementia is correlated with rCMRGl reduction in the temporoparietal association cortex, irrespective of the cause of dementia. Also the total volume of hypometabolic regions is related to severity of dementia but did not differ between AD and VD, even in patients with small lacunar infarction. This indicates that the total volume of functional tissue loss is more important since it also includes the effects of incompletely infarcted tissue and morphologically intact but deafferented cortex. The characteristic metabolic pattern has a high diagnostic accuracy for the discrimination between probable AD, normals and VD, even in patients with mild cognitive impairment. Under clinical and therapeutic aspects the analysis of longitudinal changes of rCMRGl has shown that neuropsychological and metabolic changes are closely related in both, AD and VD.

Other, more rare forms of dementia, can also be distinguished by a typical pattern of abnorm regional glucose metabolism in the brain. Dementia with Lewy bodies (LBD)
has a pattern similar to AD, but involves additionally the visual cortex, which is spared in AD. Fronto-temporal dementia (FTD) affects predominantly frontomesial and frontolateral regions and the anterior part of the temporal lobe. In Creutzfeldt-Jakob disease glucose metabolism was severely reduced in a multifocal fashion involving most of the brain with progression of symptoms. Brain damage after hypoxia or global ischemia is associated with widespread cortical hypometabolism sometimes including hippocampal regions and the thalamus.

Additional PET tracers can further support the diagnosis of a type of dementia and also yield information on the underlying pathophysiology: Tracers permit the study of selectively affected transmitter / receptor systems, e.g. the cholinergic system in AD or the dopaminergic system in LBD, and the detection of pathogenetic depositions, e.g. amyloid and tau in AD or inflammatory reactions with microglia activations as in VD. These studies also provide insight in early changes of these diseases and might be useful to detect preclinical stages in which therapeutic efforts might be promising.