NEUROIMAGING IN DEMENTIA: A BRIEF REVIEW

Dr Dipanjan Banerjee, Dr Abilash Muralidharan, Dr Abdul Rub Hakim Mohammed, and Dr Bilal Haider Malik

Abstract

Dementia is a clinical syndrome that manifests itself with impairment in cognitive functions owing to various neurodegenerative etiologies causing severe disability in the older population. Although the diagnosis is largely dependent on clinical examination, biomarkers can significantly aid in early diagnosis of dementia, especially in those without any clinical evidence of neurocognitive impairment. These biomarkers can be discovered in cerebrospinal fluid (CSF) or can be assessed by neuroimaging. Our goal was to discuss and assess the role of different neuroimaging techniques in the early diagnosis of relatively common etiologies of dementia. We used PubMed as search engines to look for helpful articles; most of the sources used were peer reviewed. We discussed the utility of various neuroimaging techniques, such CT, MRI, positron emission tomography (PET) scan, and single-photon emission computed tomography (SPECT), in the diagnosis of dementia. We concluded that various modern neuroimaging techniques prove to be very helpful in early identification, diagnosis, and differentiation between subtypes. However, the actual clinical utility of these tests in terms of their cost-effectivity and availability remains to be seen. Ongoing research is required to further develop biomarkers for early identification and monitor the progression of different etiologies of dementia.

Method and Results

For our review article, we have used PubMed as our search engine and database. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses) guidelines have not been followed. As inclusion criteria we selected studies that were done within the past five years specifically on humans. We excluded any studies done on other species or older than five years. A total of 50 articles were extracted, and most of the articles used were peer reviewed. Data have been collected ethically and legally.

Keyword	Database	Results
Neuroimaging	PubMed	42,780
Dementia	PubMed	38,726
SPECT	PubMed	5,151
Frontotemporal dementia	PubMed	2,269
PET scan	PubMed	22,319
Dementia with Lewy bodies	PubMed	1,631
Alzheimer's disease	PubMed	26,716
Vascular dementia	PubMed	2,472

Table 1: Keywords, database, and results
SPECT: single-photon emission computed tomography; PET: positron emission tomography

Discussion

FRONTOTEMPORAL DEMENTIA

In terms of amyloid PET, most of the FTD patients are revealed to be negative for Aβ deposition; however, patients with lopogenic variant may show positive findings due to their association with AD pathogenesis. PET shows areas of hypometabolism, which correlates well with areas of atrophy found in structural imaging as mentioned above. The areas of hypometabolism in FTD as evidenced by FDG-PET scan have been summarized in Table 2.

Keyword	Database
bvFTD	Medial prefrontal cortex and anterior temporal region
Semantic	Asymmetrical left hemispheric involvement, primarily localized in the inferior temporal region entorhinal and perirhinal cortex
Non-fluent	Inferior frontal gyrus (primarily left hemispheric
Lopogenic	left frontotemporoparietal and posterior cingulate region

Table 2: Areas of hypometabolism in FTD seen in FDG-PET
bvFTD: behavioural variant of frontotemporal dementia; FTD: frontotemporal dementia; FDG-PET: fludeoxyglucose positron emission tomography

Conclusion

Hence, after careful review, we conclude that neuroimaging not only establishes its crucial role in the diagnosis of various etiologies of dementia but also it is proven to be exceedingly helpful in differentiating between multiple subtypes within a particular etiology. It also plays a leading role of neuroimaging in early diagnosis of dementia, which will pave the way for early initiation of treatment, thus delaying the progression of the disease by pharmacological means leading to better patient care. Some of the more sophisticated imaging techniques, although with their proven benefits, may face limited clinical utility, taking into consideration their cost or limited availability. The future focus of neuroimaging in dementia is very likely to shift towards multimodal imaging combining various metabolic, functional, and structural imaging to diagnose the condition, predict the progression, and monitor therapeutic benefits.

References:

1. Imaging of amyloid plaques and cerebral glucose metabolism in semantic dementia and Alzheimer's disease. Drzezga A, Grimmer T, Henriksen G, et al. Neuroimage. 2008;39:619–633.
2. In vivo amyloid imaging with PET in frontotemporal dementia. Engler H, Santillo AF, Wang SX, et al. Eur J Nucl Med Mol Imaging. 2008;35:100–106.
3. A comparison of FDG-PET and blood flow SPECT in the diagnosis of neurodegenerative dementias: a systematic review. Davison CM, O'Brien JT. Int J Geriatr Psychiatry. 2014;29:551–561.
4. FDG-PET improves accuracy in distinguishing frontotemporal dementia and Alzheimer's disease. Foster NL, Heidebrink JL, Clark CM, et al. Brain. 2007;130:2616–2635.
5. Evaluation of the new consensus criteria for the diagnosis of primary progressive aphasia using fluorodeoxyglucose positron emission tomography. Matias-Guiu JA, Cabrera-Martín MN, García-Ramos R, et al. Dement Geriatr Cogn Disord. 2014;38:147–152.
6. Longitudinal changes of cerebral glucose metabolism in semantic dementia. Diehl-Schmid J, Grimmer T, Drzezga A, et al. Dement Geriatr Cogn Disord. 2006;22:346–351.
7. Cerebral perfusion and glucose metabolism in Alzheimer's disease and frontotemporal dementia: two sides of the same coin? Verfaillie SCJ, Adriaanse SM, Binnewijzend MAA, et al. Eur Radiol. 2015;25:3050–3059.
8. Anatomical and functional alterations in semantic dementia: a voxel-based MRI and PET study. Desgranges B, Matuszewski V, Piolino P, et al. Neurobiol Aging. 2007;28:1904–1913.
9. Frequent amyloid deposition without significant cognitive impairment among the elderly. Aizenstein HJ, Nebes RD, Saxton JA, et al. Arch Neurol. 2008;65:1509–1517.

Further Reading:
www.ncbi.nlm.nih.gov/pmc/articles/PMC7370590/