ORIGINAL ARTICLE

The role of PET/CT amyloid Imaging compared with Tc99m-HMPAO SPECT imaging for diagnosing Alzheimer's disease

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ABSTRACT

Background: Imaging such as Tc99m-HMPAO single photon emission computed tomography (SPECT), and positron emission tomography/ computed tomography (PET/CT) amyloid scans are used to aid the diagnosis of Alzheimer's disease (AD).

Objective: We aimed to correlate the ability of these modalities to differentiate Probable AD and Possible AD using the clinical diagnosis as a gold standard. We also investigated the correlation of severity of amyloid deposit in the brain with the diagnosis of AD.

Methods: A retrospective study of 47 subjects (17 Probable AD and 30 Possible AD) who were referred for PET/CT amyloid scans to our centre was conducted. Hypoperfusion in the temporo-parietal lobes on Tc99m-HMPAO SPECT and loss of grey-white matter contrast in cortical regions on PET/CT Amyloid scans indicating the presence of amyloid β deposit were qualitatively interpreted as positive for AD. SPECT and PET/CT were also read in combination (Combo reading). The severity of amyloid β deposit was semi-quantitatively assessed in a visual binary method using a scale of Grade 0-4. The severity of amyloid β deposit was assessed in a visual binary method and a semi-quantitative method using a scale of Grade 0-4.

Results: There was significant correlation of Tc99m-HMPAO SPECT, PET/CT amyloid findings and Combo reading with AD. The sensitivity, specificity, PPV and NPV were 87.5%, 73.7%, 58.3% and 93.3% (SPECT); 62.5%, 77.4%, 58.8% and 80.0% (PET/CT) and 87.5%, 84.2%, 70.0% and 30.0% (Combo reading) respectively. The grade of amyloid deposition was not significantly correlated with AD (Spearman's correlation, p=0.687).

Conclusion: There is an incremental benefit in utilizing PET/CT amyloid imaging in cases with atypical presentation and indeterminate findings on conventional imaging of Alzheimer's disease.

KEY WORDS:
F18-Florbetapir, neurocognitive deficit, molecular imaging, semi-quantitative assessment, binary visual assessment

INTRODUCTION

According to the Diagnostic and Statistics Manual of Mental Disorders 5th Edition (DSM-5) criteria, Alzheimer's disease (AD) is now termed as a major neurocognitive disorder (NCD). NCD, previously known with the term dementia, is a clinical spectrum that involves a progressive decline in cognitive function and is evidenced by reduced performance in a neuropsychiatric test in the absence of other mental illness or medical conditions. It is also associated with significant impairment in the ability to independently perform cognitive activities of daily living.[1] Historically, Alzheimer's disease was thought to be a neuropathological condition, whereby the presence of diffuse β amyloid (Aβ) neuritic plaques and neurofibrillary tangles (NFT) would indicate that the individual had the disease. Within the past 3 decades, however, we have become enlightened that AD is not purely a neuropathological condition but a broad spectrum of clinical diagnoses. This is because even cognitively normal elderly individuals have been noted to demonstrate some levels of amyloid depositions in the brain.[2] The standard practice is to use neuropsychological tests such as the Montreal Cognitive Assessment (MoCA) which has a suggested cut-off score of 26 over 30 to detect subtle deficits in cognitive ability.[3] Another commonly used test is the Mini Mental State Examination (MMSE) test which involves using a 30-point questionnaire that has a value of 24 and below to indicate the presence of cognitive impairment. Furthermore, scores 18-23 indicate mild cognitive impairment whereas, 0-17 indicate severe cognitive impairment.[4]

The National Institute on Aging and the Alzheimer's Association (U.S.A.) has recommended the integration of biomarkers to be included in the armamentarium of diagnostic tests that can be used to aid the diagnosis of AD, especially in dementia cases having an atypical presentation.[5] Conventionally, Technetium 99m-hexamethyl-propylene-amine oxime (Tc99m-HMPAO) single photon emission computed tomography (SPECT) imaging is used as diagnostic aids. Positron emission tomography / computed tomography (PET/CT) using the radioligand 18F-Fluorodeoxyglucose (FDG) has also been used to assess areas of glucose hypometabolism in the brain to aid in the diagnosis of dementia. With advances in molecular imaging, however, new radioligands that can cross the blood brain

This article was accepted: 19 April 2018
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barrier and selectively bind to β amyloid plaques have been developed. These include 11C-Pittsburgh compound B (PIB) and 18F-florbetapir (F-AV-45) also known as Amyvid™, which are being used in selective cases.[6] These radioligands have the potential to identify the pathology of AD *in vivo* and also act as a biomarker for preclinical diagnosis of AD.

One of the clinical indications for amyloid imaging is when there is uncertainty about the diagnosis of AD despite thorough clinical assessment and when the detection of amyloid plaques could improve the diagnostic certainty and alter management.[7] In the presence of significant neurocognitive deficit, subjects can be clinically divided into two subgroups of Probable AD and Possible AD. Probable AD is defined as patients who fulfil the DSM-5 criteria for neurocognitive disorders, have insidious symptom onset, progressive decline in cognitive function, have initial presentation which is usually amnestic in type i.e. short term memory loss, and does not apply to those with concurrent substantial cerebrovascular disease or prominent features of other subtypes of dementia e.g., dementia with Lewy bodies (DLB) or fronto-temporal dementia (FTD).[5] Possible dementia, on the other hand, is diagnosed when the neurocognitive disorder occurs with an atypical course or presents with mixed aetiology e.g., in the presence of other psychiatric or medical co-morbid conditions.[5] Although there have been many studies comparing the accuracy of amyloid imaging using positron emission tomography/ computed tomography (PET/CT) with postmortem results in AD and healthy controls, as well as in patients with AD and patients with mild cognitive impairment (MCI); there have been no clinical studies that correlated the performance of PET/CT amyloid imaging with Tc99m-HMPAO SPECT imaging in patients with atypical presentation of AD.

The aim of this study was to correlate the diagnostic performance of PET/CT amyloid imaging with Tc99m-HMPAO imaging in aiding the diagnosis of AD using the clinical diagnosis as the reference standard. We also assessed the accuracy of PET/CT amyloid imaging as a diagnostic aid and biomarker for the assessment of Alzheimer's disease with an atypical presentation. We also investigated the correlation of semi-quantitative grading of PET/CT amyloid scans with the diagnosis of Probable and Possible dementia.

MATERIALS AND METHODS

Participants

This is a retrospective study of subjects that were referred by expert practitioners for PET/CT amyloid imaging to our centre. We reviewed the medical database of 47 patients (22 men, 25 women, with age range 41 - 86 years, mean age 63 years) who were diagnosed with Probable AD and Possible AD and who underwent PET/CT amyloid scan imaging between the periods of July 2014 to July 2016. According to the clinical notes in the database, the clinical diagnosis was confirmed by interview of patients and close family members, clinical examination and neuropsychiatric testing which utilised the MoCA test. As this was a retrospective study and there were some missing data, we were not able to retrieve the MMSE results. The clinical data and diagnostic imaging scans, including Tc99m-HMPAO SPECT scans and PET/CT amyloid scans were anonymized at the time of re-analysis by a member of the clinical care team. As this study is based on anonymized data and because the implications of the study did not have any direct impact to individual patients, hence additional informed consent for patients to participate in this study was not deemed necessary. All patients were informed and have consented that their anonymized data could be used in research settings without the need for further consent. Subjects gave written informed consent in accordance with the declaration of Helsinki.

There were two cohorts in this study. The first cohort included all patients who had PET/CT amyloid scans conducted in our centre (n=47). The second cohort of patients was a subset of the first cohort that included patients who had a recent standard protocol of Tc99m-HMPAO scan within six months of the PET/CT scan (n=27). Images or reports of the scans were sourced and the results were tabulated.

Procedures

PET/CT Amyloid Imaging

The subjects had PET/CT amyloid imaging conducted on a Discovery ST16 PET/CT scanner (GE Healthcare, Milwaukee, USA). The brain scan was performed from vertex to orbito-meatal region. Subjects underwent 10-minutes of PET scan, which commenced 30 minutes post injection of an intravenous bolus of 370 MBq (10 mCi) of 18F-Florbetapir @ Amyvid™ (Elli Lilly and Company, Indianapolis, USA). Images were acquired with a 128 × 128 matrix and were reconstructed using iterative algorithms. Low-dose computed tomography (CT) acquisition was performed with 120 kV, 80 mA, 0.8 seconds per CT rotation. CT data was used for attenuation correction and anatomical correlation.

The studies were interpreted on a Hermes MultiModality workstation using Hybrid Viewer software (Hermes Medical Solutions, Stockholm, Sweden). Florbetapir-PET/CT fusion images were assessed visually by two experienced nuclear medicine physicians, using a qualitative binary classification, which assigned scans with no tracer deposits in the brain as 'negative' and scans with the presence of tracer deposits in the brain as 'positive'. These reviewers assessed the images by consensus and were blinded to the clinical diagnoses. For semi-quantitative analysis of the lesions, the volume of interest (VOI) was drawn around the largest and highest pathological tracer accumulated region. Semi-quantitative scores ranging from Grade 0 (no grey matter amyloid deposits) to Grade 4 (high levels of multiple or diffuse cortical amyloid deposits) relative to the cerebellar grey matter were given to each analysed scan as proposed by several studies such as Johnson et al.,[8] Clark et al.[9] and Sperling et al.[10] This scoring system assigned a score related to the intensity of tracer deposit; i.e., 0: No tracer deposit, 1: Low tracer deposit, 2: Low-moderate tracer deposit, 3: Moderate-High tracer deposit and 4:High tracer deposit involving two or more regions of the brain cortices. Some studies even further classified these rating score into 0-1 meaning Negative scans and 2-4 meaning Positive scans.[10]

Firstly, the maximum intensity projection (MIP) images were visually examined in varying scales, and then every single

Table I: Patient demographics

Variables	Probable AD	Possible AD	Pearson's correlation (p value)
Sample size (n)	17	30	
Age	45 – 81 (63.5 ± 9.2)	41 – 86 (62.7 ± 10.7)	0.429
Gender	Male: 6 (35.3%) Female: 11 (64.7%)	Male: 16 (53.3%) Female: 14 (46.7%)	0.358
Duration of symptoms(months)	9 – 60 (30.2 ± 17.7)	6 (6 ± 0)	0.418
Family history of AD	Yes: 3 (17.6%) No: 14 (82.4%)	Yes: 9 (30%) No: 21 (70%)	0.444
Co-morbids			
- None	5 (29.4%)	7 (23.3%)	0.454
- Vascular risk factors	5 (29.4%)	13 (43.3%)	
- Depressive symptoms	7 (41.2%)	9 (30.0%)	
- Others eg. treated hypothyroidism	0	1 (3.4%)	

Table II: Diagnostic Performance of SPECT, SPECT & PET/CT Combo reading and Amyloid PET/CT with Clinical Diagnosis of Alzheimer's disease

Modality	Tc99m_HMPAO SPECT	SPECT & PET Combo Reading	Amyloid PET/CT
Sample size (n)	27	27	47
Sensitivity	87.5%	87.5%	62.5%
(95% CI)	(46.7 – 99.3)	(46.7 – 99.3)	(35.9 – 83.7)
Specificity	73.7%	84.2%	77.4%
(95% CI)	(48.6 – 89.9)	(59.5 – 95.8)	(58.5 – 89.7)
PPV	58.3%	70.0%	58.8%
(95% CI)	(28.1 – 83.5)	(35.4 – 91.9)	(33.5 – 80.6)
NPV	93.3%	30.0%	30.0%
(95% CI)	(66.0 – 99.7)	(8.1 – 64.6)	(60.9 – 91.6)

transverse slice was scrutinized from vertex to the orbito-meatal region in combination with the corresponding CT image and the fused PET/CT image slice. Each cerebral cortical region that demonstrated focal abnormal tracer uptake that caused loss of contrast of grey-white matter differentiation at the cerebral cortices, was recorded based on nine pre-defined regions of interest. These regions included the right and left frontal lobes, right and left temporal lobes, right and left parietal lobes, anterior cingulate gyrus, posterior cingulate gyrus and precuneus.

For the brain perfusion single photon emission computed tomography (SPECT) scans using Tc99m-HMPAO (hexamethylene propylene amine oxime), detection of diffuse and bilateral regional hypoperfusion in the temporo-parietal lobes were considered positive for the diagnosis of AD. Regions that demonstrated focal hypoperfusion in a vascular distribution pattern were considered negative for AD and more likely to be due to vascular dementia. Atypical patterns of hypoperfusion on SPECT imaging were also considered negative for AD. Tc99m-HMPAO scans were read separately and also in tandem with PET/CT amyloid scans (combo reading). In combo reading of scans, hypoperfusion at the temporoparietal region with other confounding focal areas of cortical hypoperfusion on SPECT scans were interpreted as likely to be AD if the PET/CT amyloid scans were positive for amyloid deposit and vice versa.

Statistical Analysis

The statistical analyses were performed using Statistical Package for Social Science (SPSS, version 22, IBM, Armonk, NY). Correlations of PET/CT amyloid scans qualitative readings and quantitative results were made with clinical diagnosis as the gold standard by the other members of this research team. The correlations between the PET/CT amyloid scans with Tc99m-HMPAO results were evaluated using the Pearson's correlation coefficient. Paired comparisons between the two groups of Probable AD and Possible AD were performed. Covariates in the analysis were age, gender, as well as medical and psychiatric co-morbidities. Descriptive statistics namely the mean and standard deviation for age and the frequency and percentage of the categorical variables were calculated. Two by two tables were created for Tc99m-HMPAO SPECT scans, PET/CT Amyloid scans, and SPECT and PET/CT combination reading (Combo reading); to identify the sensitivity, specificity, PPV and NPV in delineating between the two groups with 95% confidence intervals. Pearson's chi-squared correlation test was performed to assess the statistical significance of the diagnostic tests using the clinical diagnosis as the gold standard, with $p<0.05$ considered as statistically significant. We also correlated the statistical significance of semi-quantitative grading of PET amyloid scans with clinical diagnosis using Spearman's correlation test and used a bar chart to illustrate the pattern of grading between Probable AD and Possible AD. Fisher's exact test was conducted under the situation when a subcategory had a frequency of less than five.

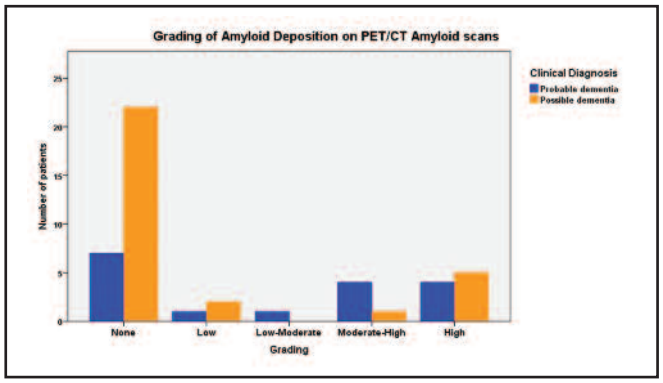

Fig. 1: Grading of Severity of Amyloid Deposition on PET/CT Amyloid Scans.
The graph indicates Grade 0 as having no Amyloid deposition detected, Grade 1 indicated low deposition, Grade 2 indicated low-moderate deposition, Grade 3 indicated moderate-high and Grade 4 indicated high amyloid tracer depositions as seen on visual rating assessment of 18F-Florbetapir PET/CT scans.

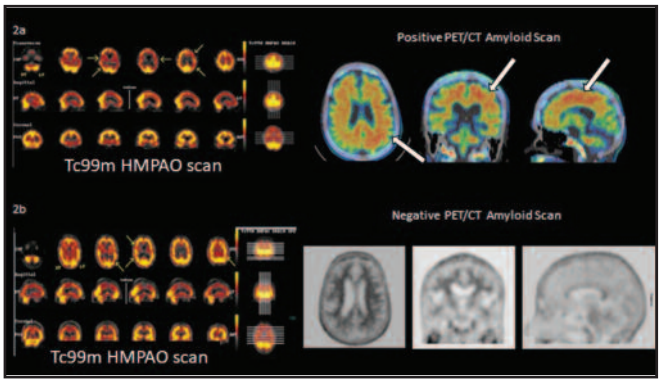

Fig. 2: Multiplanar Imaging of Tc99m-HMPAO SPECT and PET/CT Amyloid Scans.
(a) shows Tc99m-HMPAO SPECT scan with diffuse hypoperfusion in the temporo-parietal lobes (yellow arrows) and PET/CT amyloid scans with poor grey-white matter contrast in the cortical regions (white arrows), which indicates a diagnosis favourable of AD. Conversely, the diagnosis of AD is unlikely with normal PET/CT Amyloid scans (Figure 2b), and multiple foci of hypoperfusion in the vascular territories (yellow arrow) in the Tc99m-HMPAO SPECT scan. Thus, other diagnoses need to be considered for, e.g., Vascular AD.

RESULTS

In the primary analysis cohort (n=47), the subjects were divided into two groups i.e. Probable AD and Possible AD based on clinical diagnosis. In the Probable AD group (n=17), there were 6 male and 11 female subjects, aged 45 – 81 years old (63.5±9.17) and in the Possible AD group (n=31), there were 16 male and 15 female subjects aged 41 – 86 years old (62.7±10.7). Subjects with Probable AD had symptoms ranging from 9 – 60 (30.2±17.7) months and subjects with Possible AD had symptoms for approximately 6 months prior to performing PET/CT amyloid scans. A positive family history of AD was noted in 17.6% of Probable AD and 30% of Possible AD subjects (Table I). Co-morbid factors of cardiovascular risk factors (41.2% in Probable AD group and 43.3% in Possible AD group), symptoms of depression (29.4% in Probable AD group and 30.0% in Possible AD group) and reversible medical causes such as treated hypothyroidism (3.4% in Possible AD group) were detected in our subjects (Table I). Pearson's chi-squared correlation did not detect any statistically significant association of age, gender, duration of symptoms, family history of AD and co-morbid factors with the clinical diagnosis of dementia (all p values were >0.2). Fisher's exact test did not detect any significant association between family history of AD and diagnosis of AD (p= 0.347).

The diagnostic performance of all the modalities was assessed based on clinical diagnosis as a gold standard (Table II). The sensitivity, specificity, PPV, and NPV of Tc99m-HMPAO SPECT scans were 87.5%, 73.7%, 58.3%, and 93.3% respectively. Tc99m-HMPAO SPECT scans results were significantly correlated with the clinical diagnosis of Probable AD (p = 0.014). The sensitivity, specificity, PPV, NPV and accuracy of PET/CT amyloid scans were 62.5%, 77.4%, 58.8%, and 80.0% respectively. PET/CT amyloid scans results were significantly correlated with t he clinical diagnosis of Probable AD (p = 0.007). The sensitivity, specificity, PPV, and NPV of Tc99m-HMPAO SPECT scans read in combination with PET/CT scans were 87.5%, 84.2%, 70.0%, and 30.0% respectively. Tc99m-HMPAO SPECT scans read in combination with PET/CT scans results were significantly correlated with the clinical diagnosis of Probable AD (p = 0.002).

Semi-quantitative assessment of severity of the grade of β amyloid deposition as evidenced by PET/ CT amyloid scans was not significantly associated with the clinical diagnosis of AD; Spearman's correlation coefficient of 0.687. One way ANOVA did not demonstrate any significant association among the grades of severity of amyloid deposition with age (p=0.804) or duration of symptoms (p=0.668). Post hoc test using Bonferonni and Games-Howell comparisons also did not reveal any statistically significant findings. Nevertheless, there was a pattern of increasing trend of the number of subjects diagnosed as Probable AD with increasing grade of Aβ deposition in the brain (Figure 1).

DISCUSSION

Molecular imaging using amyloid PET/CT scans can provide in vivo functional information regarding the Aβ neuritic plaque burden in the brain which is associated with Alzheimer's disease. Radioligands that have been used in PET/CT amyloid scans to aid in the diagnosis of AD include C11-labelled Pittsburgh compound (PiB) and 18F-Florbetapir. The 20 minutes half-life of C11-PiB, however, makes its use limited to research centres but the half-life of 110 minutes for F18-Florbetapir makes it suitable for clinical use.[11] Several other ligands that have been labelled with F18 including Flutemetamol (Vizamyl, GE Healthcare), and Florbetaben (Neuraceq, Piramal Imaging) have shown high affinity and specific binding to Aβ plaques[12-14] and marked binding has

been noted in subjects with AD compared with healthy controls.[15] Currently, it is known that Aβ plaques can be detected in some elderly subjects who do not demonstrate clinical evidence of AD, suggesting a possibility of preclinical detection of AD as well as a prognostic risk factor for eventually developing AD.[6] As a matter of fact, several clinical studies have shown that the addition of PET/CT amyloid imaging can increase the diagnostic accuracy of AD.[7]

We identified that Tc99m-HMPAO SPECT is able to correlate well with the clinical diagnosis but can occasionally be difficult to interpret in elderly subjects with multiple brain pathologies causing variable patterns of hypoperfusion. Previous studies have cited that the sensitivity, specificity, and PPV of this modality in diagnosing Probable AD to be 75%, 52% and 78% respectively.[16] Tc99m-HMPAO SPECT has also been noted to have improved performance in differentiating AD from vascular dementia, having sensitivity and specificity of 71.3% and 75.9% respectively as well as differentiating AD from FTD, having sensitivity and specificity of 71.5% and 78.2% respectively.[17] In this study, we noted that the combined reading of Tc99m-HMPAO SPECT with PET/CT amyloid scans in indeterminate cases of neurocognitive deficit achieved improved specificity in diagnosing AD.

Good agreement for the diagnosis of AD was achieved between the modalities when Tc99m-HMPAO SPECT demonstrated hypoperfusion in the temporo-parietal lobes and PET/CT amyloid scans demonstrated poor grey-white matter contrast in the cortical regions (Figure 2a). Conversely, the diagnosis of AD is unlikely with normal PET/CT Amyloid scans (Figure 2b), thus efforts need to be intensified to find a secondary cause for the neurocognitive deficit. Our interpretation of PET/CT Amyloid scans were more conservative as we demonstrated a sensitivity of 62.5% and specificity of 77.4% as compared to a study by Clark et al. which had a sensitivity of 96% and specificity of 100% in detection of beta amyloid plaques in subjects with AD and which was later confirmed at post mortem autopsy.[9] The reason for the large discrepancy between Clark et al.'s study and ours is likely due to two main reasons. These include the fact that the subjects recruited by the former study were much older and had higher likelihood of having amyloid depositions detected in the brain by both imaging and autopsy. Secondly, the reference standards used were different, whereby ours used clinical assessment but the former study used autopsy results to correlate with imaging findings.

It is clear from the present data that there are substantial number of young individuals below 65 years with Possible AD in whom quantifiable deposition of Aβ neuritic plaques are not detected i.e. negative scans, suggesting that their deteriorating neurocognitive function is unlikely to be due to AD, thus other causes of neurocognitive deficit need to be considered. Positive PET/CT amyloid scan, can however, tip the clinician to favour the diagnosis of AD, especially when there is an indeterminate mixed pattern of hypoperfusion demonstrated by Tc99m-HMPAO SPECT imaging.

Figure 2a demonstrates diffuse hypoperfusion at the temporo-parietal lobes on a Tc99m-HMPAO SPECT scan and positive PET/CT Amyloid scan as evidenced by high cortical uptake on the colour map which is a classical appearance for diagnosis of Alzheimer's disease. Figure 2b demonstrates some focal uptake in the temporo-parietal lobes and negative PET/CT Amyloid scan as evidenced by the absence of cortical uptake seen in this gray scale map which is not suggestive of a diagnosis of AD, thus other causes for neurocognitive deficit such as vascular aetiology needs to be considered.

Although the detection of Aβ plaques is not diagnostic of AD, negative scans are inconsistent with the diagnosis of AD, thus efforts need to be intensified to find non-AD cause of the neurocognitive deficit.[18] Patients with persistent or progressive unexplained MCI, and patients who have fulfilled the basic clinical criteria of Possible AD but have mixed presentation or atypical course of illness may benefit from PET/CT amyloid scans.[7,19] Nevertheless, subjects who are asymptomatic but desire to undergo PET/CT amyloid scans instead of genotyping studies for suspected autosomal mutation carriers or AD subjects wanting to know the severity of their disease are not advised to perform this scan.[7]

Semi-quantitative analysis demonstrated that there was no significant difference in the severity of amyloid deposition with the diagnosis of Probable AD or Possible AD. There was however, an increasing trend of the number of Probable AD cases with increasing grade of amyloid deposition in the brain, suggesting the potential of PET/CT amyloid scans as a prognostic factor for diagnosing AD. This corresponds to previous findings by Doraiswamy et al., in their 18 months PET/CT amyloid scan follow-up of subjects with mild cognitive impairment (MCI), healthy controls and AD patients, which detected a greater decline in memory and mini mental state examination (MMSE) performance in subjects with higher baseline Aβ deposits.[20] Furthermore, they noted that MCI subjects with positive scans converted to AD at a higher rate compared to subjects with negative scans. Many studies have also incorporated to use in quantifying the severity of Aβ deposition in the brain by incorporating standardized uptake value ratio (SUVr) which has been impactful in assisting clinical decision making.[21,22]

Although we suggest PET/CT amyloid scan to be a useful adjunct tool to non-invasively help in the diagnosis of AD *in vivo*, it is important to note that positive PET/CT amyloid scan report will not constitute and is not equivalent to a clinical diagnosis of AD dementia.[7] Furthermore, PET/CT amyloid imaging can help improve the quality of life of patients as it can help to revise the diagnosis and prevent suboptimal treatment of AD.[23] Imaging is a tool that clinicians should use prudently to manage patients and it is not a replacement for a thorough history and clinical examination in the process of diagnosing and managing AD cases.

Our study has several limitations, including the relatively small sample size of the Tc99m-HMPAO SPECT cohort and no comparison made with healthy controls. Furthermore, we used the clinical diagnosis of AD as a reference standard, which in itself could have some flaws to confirm the diagnosis of AD as compared to autopsy results. The flaws

include a human error in the interpretation of patients' symptoms which can be atypical and misleading at times and the performance of patients in the neuropsychiatric tests can vary with regards to it not being robust enough to evaluate all cognitive domains. It is however, the most practical and reliable way to clinically diagnose AD without the benefit of histopathological correlation. Future prospective studies with larger sample size and healthy controls will be helpful in elucidating whether the addition of PET/CT amyloid imaging has a significant impact on patient outcome and whether it can improve quality of life and overall survival of patients with Alzheimer's disease. Future works should include performing quantitative assessment using standardized uptake value ratios (SUVr) using the cerebellum as a reference standard.

CONCLUSION

PET/CT Amyloid scans can be used to complement Tc99m-HMPAO SPECT imaging in certain clinically inconclusive cases to help increase the specificity of diagnosing Alzheimer's disease.

ACKNOWLEDGEMENT

We would like to acknowledge the International Atomic Energy Agency (IAEA) in sponsoring Dr. Subapriya Suppiah's Fellowship in Nuclear Medicine at the Nuclear Medicine Department, Royal Liverpool and Broadgreen University Hospitals, NHS Trusts, Liverpool, UK. Also, we would like to thank the Nuclear Medicine Department at the Royal Liverpool University Hospital, Liverpool, NHS Trusts, UK in providing anonymized patient data and images for this study; and Dr. Loh Jia Ling for proofreading and preparing the figures for this article.

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