MRI Biomarkers in Mild Cognitive Impairment and Alzheimer Disease

Y. Abo El-Naga¹, M. F. EL-Shater², A. Gaber¹, Sohair A. A. Hindawi³, T. M El-Gammal²
Department of Neurology¹, Radiology³, Ain Shams University, Neurology², Tanta University

ABSTRACT

Background: Recently there has been increased interest in identifying patients at the earliest stages of Alzheimer disease (AD), so that effective treatment (when this is developed) can be initiated at an early stage. Therefore, neuroimaging studies have been performed on non-demented subjects who are at increased risk for AD, including family history of AD and non-demented patients with mild cognitive impairment (MCI). Objectives: Our purpose was to use volumetric MR imaging to explore the extent of atrophy of the volumes of two temporal lobe structures, the entorhinal cortex (ERC) and the hippocampus, in patients with AD and MCI compared with normal cognition (NC) and to determine the powers of the ERC and the hippocampus for discrimination between these groups. Subjects and Methods: This study included 42 subjects with NC, 32 patients with MCI, and 36 patients with AD. Volumes of the ERC and hippocampus were measured based on coronal T1 weighted MR images. Results: Both ERC and hippocampal volumes were reduced in MCI (ERC 13%, hippocampus 11%, p<0.05) and AD (ERC 41%, hippocampus 30%, p<0.01) compared with NC. Furthermore, AD showed greater volume loss in the ERC than in the hippocampus (p<0.01). There was a significant correlation between ERC and hippocampal volumes in MCI and AD (both p<0.001), but not in NC. Using ERC and hippocampus together improved discrimination between AD and NC but did not improve discrimination between MCI and NC. The ERC was better than the hippocampus for distinguishing MCI from AD. Conclusion: Volume reduction in the ERC and hippocampus may be early signs of AD pathology that can be measured using MRI. (Egypt J. Neurol. Psychiat. Neurosurg., 2006, 43(1): 563-574)

INTRODUCTION

A clinical hallmark of Alzheimer disease (AD) during its initial stages is a disturbance of memory, especially characterized by difficulty in the acquisition of new information about events and things (declarative knowledge). The nature of this mnemonic dysfunction is similar to that seen with bilateral lesions, dysfunction or disconnection of the hippocampal formation and related structures,¹,² thus implicating the pathophysiological disruption of this neural system in early AD. It is not surprising, therefore, that mesial temporal lobe regions have received special attention in postmortem and in vivo investigations on the pathophysiology of AD.

Both entorhinal cortex (ERC) and hippocampus are essential parts of the medial temporal lobe system that supports declarative (conscious) memory.¹ Consistent with the observation that memory impairment is a prominent symptom of AD, histopathologic studies found both structures involved early in AD pathology. In addition neurohistologic studies of patients with AD show that the ERC is particularly vulnerable to neurofibrillary tangle pathology and neuron loss.¹,² Furthermore, there is increasing evidence that the ERC is an early site for AD pathology,³,⁶ before the disease extends to the hippocampus and neocortex.

In accordance with these findings, MRI studies have shown significant atrophy of the ERC and hippocampus in patients with AD⁷,⁸ in addition to generalized brain atrophy, loss of grey matter, and increased white matter lesions.
However, whether atrophy rate of ERC is better than that of hippocampus to discriminate AD from CN or MCI has not been determined. Therefore, we try to compare atrophy rates of ERC and hippocampus to discriminate AD from CN or MCI.

Accordingly our specific goals were to determine; (1) Whether the ERC and hippocampal volumes are significantly reduced in patients with MCI compared with subjects with NC, (2) Whether ERC and hippocampal volumes are significantly reduced in patients with AD compared with patients with MCI, (3) Whether ERC volume is more sensitive than hippocampal volume to distinguish AD from MCI, AD from NC, and MCI from NC, and (4) the extent to which ERC and hippocampal volumes are correlated with each other and the extent to which ERC and hippocampal volumes measurements are correlated with the cognitive impairment, measured by the mini mental state examination (MMSE). Finally, we compared the powers of the ERC and hippocampus to classify between groups and, in addition, assessed the value of using the ERC and hippocampus together for classification.

SUBJECTS AND METHODS

The sample consisted of 36 patients (17 men and 20 women) with Alzheimer disease (AD group). All AD patients represented the recently diagnosed AD patients in a period of 6 months and fulfilled the criteria for probable Alzheimer disease according to the criteria of the National Institute of Neurological and Communicative Disorders and Stroke and the Alzheimer's Disease and Related Disorders Association (NINCDS-ADRDA)40.

The second group of patients was 32 patients with mild cognitive impairment (MCI group) (14 men, 18 women) collected in the same mentioned period. Patients were diagnosed with MCI if they performed 1.5 SD below average for their age and education on at least one neuropsychological test, did not fulfill the diagnostic criteria for dementia according to DSM-IV criteria, and did not have evidence of impairment in social or occupational functioning41,42. Neuropsychological testing was classified as normal or not according to the clinical judgment of neuropsychologists expert in the evaluation of dementia, and took into account all relevant factors including estimated premorbid functions. However, the final diagnosis was not solely based on the test interpretation.

All patients underwent a complete physical and neurological examination, an extensive battery of laboratory tests to exclude secondary causes of dementia, neuropsychological tests and MR imaging of the brain. The cognitive function of each patient was screened with the Mini-Mental State Examination (MMSE)43. The ERC and hippocampal volumes were manually measured in all subjects. All patients were scanned using the same protocol. All patients or their guardians gave written informed consent before participating in the study.

The control subjects [normal cognition (NC) group] (21 men, 21 women) were randomly selected and all of them had neurological and neuropsychological tests performed by the same staff that examined patients with MCI and those with AD and had test scores within the normal range. Furthermore, subjects with NC were included only if they had no clinical histories of alcoholism, psychiatric illnesses, epilepsy, hypertension, diabetes, major heart disease, or head trauma, and no sign on the MRI data of other major neurodegenerative diseases.

The mean age of the control subjects was 73±4 years (range, 64 to 79 years) and that of MCI was 74.1±6.2 (range, 62 to 76 years) and that of AD patients was 74±8.5 years (range, 50 to 83 years). The groups did not differ significantly in age or sex.

The average score in the Mini-Mental State Examination was 19.7±3.7 (range, 10 to 24) in the group with Alzheimer disease, 25.6±3.6 (range, 22 to 27) in MCI group and 29.0±0.9 (range, 27 to 30) in the control group (NC group).
MRI Examination

All studies were performed on a 1.5T Magnetom VISION system (Siemens Inc, Iselin, NJ, USA) equipped with a standard quadrature head coil. The MRI protocol consisted of sagittal T1 weighted scout view images, oblique axial double spin echo (DSE) scans parallel to the axis of optic nerve, and volumetric magnetisation prepared rapid acquisition gradient echo (MP-RAGE) perpendicular to the DSE images yielding T1 weighted coronal images roughly perpendicular to the long axis of the hippocampus. The measurement parameters of DSE were TR/TE1/TE2 2500/20/80 ms, field of view (FOV) 192 × 256 mm², matrix size 154 × 256, in plane resolution 1.25 × 1.00 mm², and 3 mm slice thickness covering the whole brain from the vertex to the most inferior part of the cerebellum. The measurement parameters of MP-RAGE were TR/TI/TE 10/250/4 ms with a 15 degree flip angle, FOV 192 × 256 mm², matrix size 192 × 256, and 1.4 mm thick partition, yielding 1.0 × 1.0 × 1.4 mm³ spatial resolution.

Measurement of ERC and Hippocampal Volume

Quantitative volumes of the ERC and hippocampus were obtained by manually drawing the boundary of the structures as seen in the coronal T1 weighted MP-RAGE images shown in figure (1). Measurement of ERC volume was performed according to the protocol developed by Insausti et al. Briefly, ERC was measured from one section caudal to the level of the limen insulae, and until the section behind the posterior limit of the gyrus intralimbicus. The medial margin of the ERC was marked along the ventral border of the gyrus semilunaris that is, the fundus of the sulcus semiamnularis. The lateral margin of the ERC was in the medial bank of the collateral sulcus, where it borders the perirhinal cortex. The borders of the ERC and perirhinal cortex depended on the depth of the collateral sulcus. Boundaries of the hippocampus were drawn following the guidelines of Watson et al., including the hippocampus proper, dentate gyrus, subiculum, fimbria, and alveus. One rater (ATD), who was blinded to the diagnosis and all other clinical information, performed all measurements of the ERC and hippocampus. Rater reliability was determined by marking the ERC and hippocampus of 10 subjects twice and expressing the coefficients of variation (CoV). The CoV was 2.6% for the ERC and 1.0% for the hippocampus.

Fig. (1): Entorhinal cortex (ERC) (right) and hippocampal (left) volume measurement in MP-RAGE images. (A) Normal cognition (NC); (B) mild cognitive impairment (MCI); (C) Alzheimer’s disease (AD).
Statistics

Statistical analysis was guided by a statistician and was performed SPSS version 10.0. Group effects of ERC and hippocampus adjusted by age and sex were tested using analysis of variance (ANOVA). Percent volume loss of the ERC and hippocampus within MCI and AD groups were compared using t student test. Our a priori hypothesis of differences between the groups in ERC and hippocampal volumes was tested using α=0.05 as level of significance. Pearson correlation coefficients were used to analyze the correlation between volumes of the ERC, hippocampus and MMSE in each group. Only subjects who had complete ERC and hippocampal volumetry were included for classification analysis. The powers of the ERC and hippocampus for group classification were tested using logistic regression analysis, followed by McNemar's X² statistics to verify whether the differences were significant, and receiver operator characteristics (ROC) analysis. Stepwise logistic regression analysis was used to test combinations of the ERC and hippocampus for the power to discriminate between the groups.

RESULTS

Table (1) shows that all groups were well matched according to age (p=0.86) and sex (p=0.89). The MMSE score of patients with AD (19.7 ± 3.7) was significantly lower than that of patients with MCI (25.6±3.6) (p<0.001) and those with NC (29.0 ± 0.9) (p<0.001), and the MMSE score of patients with MCI was significantly lower than that of persons with NC (p<0.001).

Figure (2) shows the percentage changes of total ERC and hippocampal volumes for all subjects relative to mean volumes of NC, demonstrating the prominent ERC volume losses in AD. Table (2) shows volumes of the ERC and hippocampus in NC, MCI, and AD groups.

Total ERC volume of patients with NC was 2627 (SD 608) mm³. This was significantly reduced by 11% to 2345 (SD 632) mm³ in patients with MCI (F=4.6, p<0.05) and by 41 % to 1542 (SD 436) mm³ in patients with AD (F=58.9, p<0.01). When AD was compared with MCI, the ERC was 34% significantly smaller in AD (F=29.1, p<0.01).

Total hippocampal volume of patients with NC was 6723 (SD 779) mm³. This was significantly reduced by 13% to 5865 (SD 794) mm³ in patients with MCI (F=6.8, p<0.05) and 30% to 4706 (SD 998) mm³ in those with AD (F=63.2, p<0.01). When AD was compared with MCI, hippocampus was 24% significantly smaller in AD (F=18.9, p<0.01).

Furthermore, when AD was compared with NC, 41% reduction of the ERC was significantly greater than 30% reduction of hippocampus (t test, p=0.01). However, when MCI was compared with NC, 11% reduction of the ERC was not significantly different from 13% hippocampal reduction in MCI (t test, p>0.05). In addition, when patients with AD were compared with those with MCI, 34% reduction of the ERC was significantly greater than the 24% reduction of the hippocampus (t test, p<0.05).

There was no significant group by side interaction neither for ERC volume changes (F=0.07, p=0.93, ANOVA) nor for hippocampal volume changes (F=0.12, p=0.89, ANOVA), providing no evidence for a laterality effect in ERC and hippocampal atrophy.

Figure (3) shows the correlation of ERC and hippocampal volumes in MCI and AD. There was significant correlation between the ERC and hippocampus in MCI (r=0.66, p<0.001) and AD (r=0.68, p<0.001). However, there was no significant correlation between the ERC and hippocampus in NC (r=0.25, p=0.28). When all subjects were combined, there was a significant correlation between MMSE and the ERC (r=0.48, p<0.001), and MMSE and hippocampus (r=0.48, p<0.001), as shown in figure (4). However, there was no significant correlation between MMSE and the ERC, and MMSE and hippocampus in any of the individual groups.
In order to compare the ERC and hippocampal volumes for their power to distinguish NC, MCI, and AD, logistic regression analysis was used to predict group memberships either with the ERC or hippocampus as independent variables. The overall classification between MCI and NC was 59% with the ERC and 64% with the hippocampus.

The classification with the hippocampus was significantly better than with the ERC (p<0.05, McNemar). The overall classification between AD and NC was 80% with the ERC and 86% with hippocampus. In this case, however, the difference between the ERC and hippocampus was not significant (p>0.05, McNemar), implying that the discriminatory powers of the ERC and hippocampus were comparable. Finally, the overall classification between AD and MCI was 74% with the ERC and 72% with hippocampus and classification with the ERC was better than with hippocampus (p<0.05, McNemar).

On the other hand, to compare sensitivity and specificity between the ERC and hippocampus for group classification, receiver operator characteristics (ROC) analysis was performed. Discriminating between MCI and NC, the area under the curve (AUC) of the ROC was 0.64 with the ERC and 0.71 with the hippocampus. Discriminating between AD and NC, AUC was 0.92 with the ERC and 0.79 with the hippocampus. Finally, differentiating between AD and MCI, AUC was 0.83 with the ERC and 0.79 with the hippocampus.

Finally, we employed stepwise logistic regression analysis to explore combinations of the ERC and hippocampus for their powers to discriminate between the groups. Firstly, the hippocampus was added to the regression model, and then the ERC was added to test whether the ERC significantly contributed to the discrimination. The results are listed in Table (3).

Mild cognitive impairment and NC were classified with 52% sensitivity, 79% specificity, and an overall classification of 70% using the hippocampus (p<0.01) alone in the stepwise logistic regression model. Adding the ERC to the model did not improve classification (p=0.31).

AD and NC were classified with 78% sensitivity, 90% specificity, and an overall classification of 86% using the hippocampus (p<0.01) alone. Adding the ERC (p<0.01) significantly increased sensitivity to 78%, specificity to 92%, and overall classification to 89%.

Finally, AD and MCI were classified with 74% sensitivity, 70% specificity, and an overall classification of 72% using the hippocampus (p<0.01) alone. Adding the ERC to the model, the ERC significantly contributed to the discrimination, and increased sensitivity to 81%, specificity to 85%, and overall classification to 83%.

Table 1. Demographics.

<table>
<thead>
<tr>
<th>Category</th>
<th>No of patients</th>
<th>Male</th>
<th>Female</th>
<th>Age</th>
<th>MMSE</th>
</tr>
</thead>
<tbody>
<tr>
<td>NC</td>
<td>42</td>
<td>21</td>
<td>21</td>
<td>73.7±4.1</td>
<td>29.0 ± 0.9</td>
</tr>
<tr>
<td>MCI</td>
<td>32</td>
<td>14</td>
<td>18</td>
<td>74.1±6.2</td>
<td>25.6 ± 3.6</td>
</tr>
<tr>
<td>AD</td>
<td>36</td>
<td>17</td>
<td>20</td>
<td>74±8.5</td>
<td>19.7 ± 3.7</td>
</tr>
</tbody>
</table>

Values in parentheses are SD
* p<0.001 for MCI v NC, and AD v NC.
+ p<0.001 for MCI v AD.
NC=Normal cognition; MCI=mild cognitive impairment; AD=Alzheimer's disease; MMSE=mini mental state examination.
Table 2. Volumes (mean (SD)) of entorhinal cortex and hippocampus.

<table>
<thead>
<tr>
<th></th>
<th>NC (n=40)</th>
<th>MCI (n=36)</th>
<th>AD (n=29)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Volume (mm³)</td>
<td>Volume (mm³)</td>
<td>Volume (mm³)</td>
</tr>
<tr>
<td></td>
<td>% change</td>
<td>% change</td>
<td>% change</td>
</tr>
<tr>
<td>ERC:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left</td>
<td>1344 (363)</td>
<td>1113 (347)</td>
<td>785 (276)</td>
</tr>
<tr>
<td>Right</td>
<td>1383 (310)</td>
<td>1232 (335)</td>
<td>757 (252)</td>
</tr>
<tr>
<td>Total</td>
<td>2627 (608)</td>
<td>2345 (632)</td>
<td>1542 (436)</td>
</tr>
<tr>
<td>HP:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Left</td>
<td>3332 (403)</td>
<td>2882 (511)</td>
<td>2342 (506)</td>
</tr>
<tr>
<td>Right</td>
<td>3391 (432)</td>
<td>2983 (401)</td>
<td>2364 (545)</td>
</tr>
<tr>
<td>Total</td>
<td>6723 (799)</td>
<td>5865 (864)</td>
<td>4706 (1009)</td>
</tr>
</tbody>
</table>

% Change is compared with NC.

* p<0.01; ** p<0.05 for MCI v NC, and AD v NC. † p<0.01 for MCI v AD. ≠ p<0.01 for % change of ERC larger than hippocampus in each group.

NC=Normal cognition; MCI=mild cognitive impairment; AD=Alzheimer's disease; ERC=entorhinal cortex; HP=hippocampus; Left=left side; Right=right side.

Fig. (2): Percentage changes from the normal mean volumes of entorhinal cortex and hippocampus in normal cognition, mild cognitive impairment, and Alzheimer's disease. This figure shows that the most severe volume loss is the entorhinal cortex in Alzheimer's disease.
Fig. (3): Correlation between entorhinal cortex and hippocampal volumes in mild cognitive impairment and Alzheimer's disease.

Fig. (4): Correlation of mini mental state examination with the entorhinal cortex and with the hippocampus in the whole group.
Table 3. Discrimination by volumes of entorhinal cortex and hippocampus and segmentation data.

<table>
<thead>
<tr>
<th></th>
<th>MCI and NC</th>
<th>AD and NC</th>
<th>AD and MCI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sensitivity</td>
<td>Specificity</td>
<td>Classif</td>
</tr>
<tr>
<td>HP</td>
<td>52%</td>
<td>79%</td>
<td>70%</td>
</tr>
<tr>
<td>P+ ERC</td>
<td>52%</td>
<td>79%</td>
<td>70%</td>
</tr>
</tbody>
</table>

Logistic regression is used to calculate sensitivity, specificity, and classification (classif).
ERC=Entorhinal cortex; HP=hippocampus; NC=normal cognition; MCI=mild cognitive impairment; AD=Alzheimer's disease.

DISCUSSION

In an attempt to determine which brain region showed the greatest change in AD, several MRI studies\(^9\)\(^10\) compared changes in the ERC and hippocampus.\(^7\)\(^11\)\(^12\) Using a small sample of subjects, Bobinski et al.\(^12\) reported that changes in the ERC showed greater discrimination between patients with early AD and controls with normal cognition (NC) than changes in the hippocampus. But Frisoni et al.\(^11\) reported that hippocampal changes had superior diagnostic accuracy over ERC changes in patients with AD compared with those with NC. By contrast, Juottonen et al.\(^7\) and Xu et al.\(^13\)\(^19\) found little difference between the ability of the ERC and the hippocampus to distinguish patients with AD from subjects with NC.

Recently there has been increased interest in identifying patients at the earliest stages of AD, so that effective treatment (when this is developed) can be initiated at an early stage. A large number of cross-sectional MRI investigations\(^14\)\(^35\) have demonstrated atrophy of both the entorhinal cortex and the hippocampus not only in patients diagnosed with mild to moderate AD but also in those with mild cognitive impairment (MCI), who are at high risk of developing AD.

The hippocampus was found to be significantly reduced in subjects with MCI compared with those with NC\(^16\)\(^37\). Recently, two publications\(^15\)\(^38\) addressed ERC volume in patients with MCI. Both reported that the ERC was significantly reduced in patients with MCI compared with those with NC and Xu et al.\(^13\)\(^29\) found that the ERC and the hippocampus had roughly equivalent discrimination power between MCI and NC; however, the discrimination powers of ERC shown in these two papers were quite different.

ERC and hippocampus volumes obtained at a single time point have limited ability to distinguish patients with early AD from cognitively normal subjects, presumably because of the large variability in brain volumes between subjects. Previous cross-sectional MRI studies\(^13\) reported that volumes of ERC and hippocampus were comparable in discriminating between AD and NC.\(^13\) In addition, a longitudinal MR study\(^39\) showed that atrophy rates of ERC were better than volume measurements at a single time point in the discrimination between these two groups.

The present study has revealed that the ERC and hippocampal volume were significantly reduced in MCI compared with NC. The magnitude of ERC atrophy was similar to that of hippocampal atrophy in MCI. The ERC volume losses were greater than hippocampal volume losses in AD compared with NC. There was significant volume loss in the ERC and hippocampus in AD compared with MCI. There
was significant correlation between the ERC and hippocampus in MCI and AD, not in NC. Finally, adding the ERC was only useful to improve the classification between AD and NC.

**Comparison of ERC and Hippocampus in MCI and NC**

The first major finding of this study was a significant reduction of ERC and hippocampal volume in MCI compared with NC. Patients with MCI are generally considered to represent a non-demented group with a high likelihood of progressing to AD. Previous studies have shown that the ERC and hippocampus were significantly reduced in MCI compared with NC. However, the discriminatory power of the ERC reported before between MCI and NC was quite different. Xu et al reported that overall classification with the ERC between MCI and NC was less than 70%\(^\text{13,15,29}\), however, Killiany et al reported that overall classification between MCI and NC with the ERC was more than 85%\(^\text{29}\). Our study confirmed that the ERC and hippocampus were significantly reduced in MCI compared with NC. In addition, we also showed that reductions of the ERC and hippocampus were of similar magnitude and no trend of laterality of the ERC and hippocampal atrophy in MCI existed. However a considerable overlap in both ERC and hippocampal volume between MCI and NC remains a matter of debate. Furthermore, an overall classification of 70% between MCI and NC is moderate given that 50% classification can be achieved by chance. Both McNemar's test and logistic regression showed that the hippocampus was better than the ERC to distinguish MCI from NC and even adding the ERC to the hippocampus did not improve classification. This suggests that the ERC offers no advantage over the hippocampus in differentiating MCI from NC.

**ERC and Hippocampus in AD Compared with MCI**

The third major finding of this study was a significant reduction of the ERC and hippocampus in AD when compared with MCI. Our study showed that there was a 30% reduction of the ERC and 19% reduction of the hippocampus in AD compared with MCI. Both the ERC and the hippocampus could distinguish MCI from AD. This is consistent with previous studies\(^\text{13,34}\). Furthermore, the ERC had greater volume losses than the hippocampus in AD compared with MCI. Discrimination analysis also showed that the ERC had greater discrimination power than the hippocampus in separating AD and MCI. This was not consistent with the finding of Xu et al that the ERC and hippocampus had equivalent power to distinguish AD from MCI\(^\text{13}\).

**Correlation of the ERC and Hippocampus in NC, MCI, and AD**

The fourth major finding was that there were similar significant correlations between the ERC and hippocampus in MCI and AD, but not in NC.
Necropsy studies of brains from patients with AD implied early pathology in the ERC with progression to the hippocampus. The conversion rate of MCI to AD has been reported to be 12% in 1 year and 19.5% in 2.7 years. The significant correlation of the ERC and hippocampus in MCI and AD is consistent with the view that AD pathology affects both these structures in parallel in MCI and AD. Recent reports suggested that hippocampal volume changes may help to predict MCI conversion to AD.

Conclusion
In conclusion, the ERC did not help the hippocampus to distinguish MCI from NC. However, the ERC was a better marker than the hippocampus in distinguishing AD from MCI and similar to the hippocampus in distinguishing AD from NC. Classifications between MCI and NC, and AD and NC were improved after the ERC was combined with hippocampus data.

Recommendation
The present work recommends longitudinal study of clinical, MRI volumetry and MRI spectroscopy of subjects with NC and those with mild cognitive impairment in order to address precisely the early specific and follow up changes of cognitive compromization. Furthermore, post-mortem pathological study of patients with AD and those with MCI will improve clinical diagnostic accuracy.

Acknowledgement
We are greatly indebted to Dr. Mohamed Al-Awady, Prof. of Family and Community Medicine, Faculty of Medicine, Ain Shams University for his unlimited help in statistics.

REFERENCES


الملخص العربي

الدليل التشخيصي للتصوير الحمضي لأشعة الرنين المغناطيسي للدماغ في مرضى اضطراب القدرات الذهنية المعرفية الطفيفة ومرض الزهايمر

مراجعات البحث: تتجة الأبحاث الطبية الحديثة إلى التشخيص المبكر لمراحل مرض الزهايمر وبالتالي بدء العلاج في مراحل مبكرة من المرض الأولى. وقد يساعد التصوير الحمضي للدماغ في فهم المخطط التشريحي للدماغ لدى المرضى المصابين بمراحل مبكرة من الزهايمر.

أهداف البحث: يهدف هذا البحث إلى تحديد مدى قدرة نظام الرنين المغناطيسي في قياس حجم الهيبوكامب والقشرة الشمئية الثانوية للتمييز بين الأصحاء ومرضى اضطراب القدرات الذهنية المعرفية في مرحلة مبكرة من مرض الزهايمر.

النتائج: أظهرت نتائج البحث أن وجود نسبة مختلفة من الأصحاء في حجم القشرة الشمئية الثانوية بنسبة 13% وحجم الهيبوكامب بنسبة 11% في مرضى الاضطراب الطفيف في القدرات الذهنية المعرفية، وكان نقص الحجم لدى مرضى الزهايمر ذو دلالات احصائية علائية بنسبة 41% في حجم القشرة الشمئية الثانوية، ونسبة 30% في حجم الهيبوكامب مقارنة بالأصحاء من ذوى القدرات الذهنية المعرفية. كما وجدت علاقات ذات دلالات إحصائية في حجم القشرة الشمئية الثانوية وحجم الهيبوكامب في مرضى الاضطراب الطفيف في القدرات الذهنية المعرفية ومرض الزهايمر.

خلاصة البحث: من الممكن أن يكون نقص حجم القشرة الشمئية الثانوية والهيبوكامب علامة مرضية مبكرة والتي تساعد على تشخيص مرضى الاضطراب الطفيف في القدرات الذهنية المعرفية ومرض الزهايمر.