Autobiographical memory in progressive supranuclear palsy

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Background: We aimed to investigate recall of autobiographical memories across lifetime periods in patients with progressive supranuclear palsy (PSP).

Method: Patients with PSP (n = 10) were given a test of autobiographical and personal semantic information and the Addenbrooke's Cognitive Examination (ACE). The result was compared to 30 matched neurologically intact participants.

Result: A mild autobiographical memory impairment was observed in PSP without a temporal gradient for the recall of autobiographical or personal semantic information. Performance correlated with verbal fluency in ACE.

Conclusion: Patients with PSP show mild deficits in autobiographical memory, which is likely to reflect a frontal retrieval deficit.

Introduction

The term episodic memory refers to the capacity to recollect specific events and episodes from our lives. Autobiographical memory is therefore at the core of episodic memory. Semantic memory refers, by contrast, to memory for words, concepts, rules and abstract ideas, which are not specific to time or place. The hippocampus and related temporal lobe structures have been identified as critically important in the storage and retrieval of episodic memories [1], while the polar and infero-lateral temporal lobes appear vital for the representation of semantic memory [2]. The dorsolateral pre-frontal cortex plays an important complementary role in the retrieval and verification of episodic memories [3].

Progressive Supranuclear Palsy (PSP) is a common akinetic rigid syndrome that is characterized by widespread tau-positive neurofibrillary pathology in basal ganglia, and brain stem nuclei. Notably the hippocampus and related regions remain intact, even in the late stages of the disease [4]. Consistent with the pattern of pathology, characteristic clinical symptoms of PSP include impairment in voluntary and automatic eye movements, gait instability, bulbar dysfunction and parkinsonian signs.

Although originally conceptualized in terms of the motor deficits, cognitive deficits have been increasingly recognized as a core component of PSP. Frontal lobe involvement in PSP and its phenotypic variants has been characterized [5]. Impairment in frontal executive function has been clearly documented [6] and was thought initially to reflect functional frontal deafferentation secondary to the extensive sub-cortical/basal ganglia pathology, although more recent quantitative neuropathological and structural imaging studies have demonstrated frontal involvement in PSP [7]. In terms of memory, poor recall of verbal material with better performance on recognition-based tests has been documented [8]. Surprisingly there have been no reports of autobiographical memory in PSP. However, patients with Huntington's disease (HD), who have predominant subcortical pathology, show impairment of autobiographical memory without a temporal gradient, as opposed to Alzheimer's disease and other amnesic syndromes in which remote memory defects are more preserved for older than for more recent memories [9]. This flat profile in HD has been interpreted as a deficit in frontally based retrieval processes.

The aim of this study was to investigate the recall of autobiographical memory across lifetime periods in patients with PSP using the Autobiographical Memory Inventory [10]. We predicted an impairment secondary to frontal dysfunction but without a temporal gradient in PSP patients.

Methods

Participants

Ten participants with a diagnosis of PSP were included (six males and four females, mean age = 68.7,
All fulfilled recent research criteria for PSP [5]. The mean duration of the disease since diagnosis was 3.7 years (SD = 2.2; range = 2–9 years). The mean educational level was 11.4 years (SD = 2.2). The participants were identified through the Movement and Cognition Disorders Clinic at Addenbrooke’s Hospital. The study was approved by the Local Ethics Committee and all participants gave written informed consent. That all participants were seen by an experienced clinician (TB or JRH) and those with symptoms of clinically significant depression were excluded.

Thirty neurologically healthy control participants, matched on age and education level, (14 males and 16 females, mean age = 68.3, SD = 8.6) recruited from the MRC Cognition and Brain Sciences subject panel, underwent the same test battery. The mean educational level was 11 years (SD = 2.8). There was no difference in age or education level between the PSP and control groups.

Neuropsychological assessments

All participants completed the Addenbrooke’s Cognitive Examination [11], and the Autobiographical Memory Inventory or AMI [10]. The ACE is a screening test of cognitive function incorporating the MMSE and assesses cognitive performance on tests of orientation, attention, memory, verbal fluency, language, naming, and visuospatial function. The AMI is a standardized test of remote memory that assesses autobiographical and semantic memories from three time periods; childhood, early adulthood and recent. In the autobiographical memory section, the participant is asked to describe three particular personally experienced episodes, in detail, from each time period, which are then scored on a 0–3 point scale according to their richness and specificity. In the personal semantics section, the participant is asked to provide standardised factual information (for example, the names of friends, teachers, schools, jobs etc).

Data analysis

To study the complex interaction between PSP diagnosis, memory performance and time period that the memory was associated with, we used 3 × 2 factorial ANOVA. Factorial ANOVA allows us to evaluate all variables (parametric and non-parametric) and their possible additive effects on the result in one experiment. The measurements here are the personal semantic and autobiographical memory score, and the factors (main effects) are groups (PSP versus control), and the time periods associated with the memory (childhood, early adulthood and recent life). We carried out separate 3 × 2 factorial ANOVA for the two components of AMI (e.g. semantic and autobiographic information).

To investigate the relationship between performance on the AMI and cognitive performance on the ACE, Pearson product moment correlations were calculated. The Pearson product moment correlation is a parametric measure of association for two variables. It measures both the strength and the direction of a linear relationship.

Results

Factorial analysis revealed a significant main effect of group \( [F (1, 38) = 10.18, P < 0.05] \) and a significant main effect of test \( [F (1, 9) = 465.46, P < 0.001] \). There was no effect of time period and no significant interactions between the three factors. The absence of a group by time interaction suggests that the PSP patients showed an equivalent degree of impairment across the three time periods.

For the personal semantic component of the AMI, the factorial ANOVA revealed a significant effect of group \( [F (1, 38) = 13.21, P = 0.001] \), and again no main effect of time and no significant time by group interaction. For the autobiographical component, there was a trend towards a significant group effect \( [F (1, 38) = 3.56, P = 0.067] \) but no time effect and no significant interaction (see Fig. 1). The PSP groups score on the ACE (83.9 ± 9.2) was significantly lower than that of controls (93.8 ± 3.5, \( P < 0.01) \).

The total AMI score correlated with the memory \( (r = 0.67, P = <0.05) \), verbal fluency \( (r = 0.69, P = <0.05) \) and total ACE scores \( (r = 0.81, P < 0.01) \). The personal semantic score of the AMI correlated with verbal fluency subtest \( (r = 0.803, P = <0.01) \) and the total ACE score \( (r = 0.77, P = <0.01) \). Scores on autobiographical component of the AMI correlated the total ACE score \( (r = 0.77, P = <0.01) \) but not any of the subtest scores.

Discussion

We have demonstrated that patients with PSP have a mild non-temporally graded impairment in autobiographical memory. Separate analyses of the two components of the AMI suggested that the group difference was accounted for by impairment on the personal semantic, rather than the episodic component of the AMI.

The mild memory impairment demonstrated in the PSP group is probably secondary to frontal lobe dysfunction although it might be expected that such a deficit would result in disproportionately severe impairment in the recall of episodes, which places great
demands on frontal lobe based retrieval systems. Note however that the maximum score per life period is nine for the episodic and 21 for the semantic component, which makes it easier to detect mild defects in semantic memory.

It is possible that the impairment reflects loss of semantic memory but this seems unlikely since prior studies have given no indication of such deficits in PSP [12]. In addition, the key neural substrate for semantic memory, the polar and infero-lateral temporal neocortex is relatively free of pathology [13] although a recent study showed that the number of surviving neurons correlated with the disease duration in inferior temporal and superior frontal gyri [14]. By contrast, more specific pathological features of PSP such as neurofibrillary tangles, tufted astrocytes, glial inclusions, and abnormally enlarged neurons, showed no correlation with the progression of the disease in the cortical regions. In addition, a recent study correlating MRI volumes derived by voxel base morphometry showed that cortical atrophy is largely limited to superior pre-motor cortex, spreading to anterior bank of pre-motor gyrus. This study also showed a clear regional atrophy of anterior caudate in PSP subjects [15]. Caudate nucleus is an essential part of frontal network system that subserves autobiographic and semantic memory [16]. Unfortunately consistent imaging data was not available in our patient cohort.

Previous research has found superior performance on recognition rather than recall based memory tests in PSP [12,17], suggestive of impairment in retrieval processes rather than encoding and storage of information. In support of this we also found that performance on the AMI correlated with the verbal fluency subtest of the ACE, which also puts heavy demands on frontal retrieval processes. The findings of our study are in keeping with the notion that autobiographical memory impairment in PSP is mainly due to frontally based retrieval processes.

Finally, it is likely the neural mechanisms that cause poor retrieval of autobiographical memories in PSP also affects emotional changes and apathy. However, there is no evidence to support that these symptoms on their own could be the cause of the change in the gradient of autobiographic memory that we demonstrated here [18,19].

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Conflict of interest

Authors have no conflict of interest or financial relationship in this study.

References


