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Neuropsychological functioning and delusions in dementia: A pilot study

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Abstract
The present pilot study investigated the pattern of neuropsychological functioning associated with the presence of delusions in mild-to-moderate dementia. Participants, all of whom met criteria for dementia, were divided into two groups, delusional ($n = 9$) and non-delusional ($n = 9$). Individuals with hallucinations were excluded. Participants completed a neuropsychological test battery. Global cognitive functioning (MMSE) and behavioral disturbance (BEHAVE-AD) were also assessed. Differences between the delusional and non-delusional group were most marked for immediate recall of stories, which was higher in the non-delusional group. Scores on semantic fluency, attention (mental control), and overall cognitive functioning (MMSE) were also lower in the delusional group. Conversely, simple attention span (Digit Span) was within normal limits in both groups. Floor effects were noted on measures of delayed recall and alternating attention. This study supports previous findings of greater neuropsychological impairment in delusional as compared to non-delusional individuals with dementia. However, some areas of cognitive functioning may be relatively preserved. Future research should examine semantic processing in persons with dementia with and without delusions.

Introduction

Delusions are common psychiatric symptoms in dementia and may present as delusions of theft, jealousy, or delusional misidentification (Gormley et al., 1998; Harwood et al., 1999; Hwang et al., 1997; Migliorelli et al., 1995). The presence of delusional thinking in dementia is associated with increased caregiver burden, aggressive behavior, and high rates of institutionalization (Gilley et al., 1997; Haupt et al., 1993, 1996; Magni, 1996; Rabins et al., 1982; Steele et al., 1990).

The prevailing view, based on studies examining global cognitive function done to date, is that delusions in patients with dementia are associated with more advanced cognitive decline (Flynn et al., 1991; Haupt et al., 1996; Jeste et al., 1992; Lopez et al., 1997; Paulsen et al., 2000; Rockwell et al., 1994) although a significant minority of studies do not support this (Ballard et al., 1997; Devenand, 1999; Jacoby & Levy, 1980; Kotrla et al., 1995; Tsai et al., 1997). Studies examining individual cognitive domains have either shown minimal differences in performance between patients with and without delusions (Flynn et al., 1991) or poorer performance among patients with delusions on measures of semantic memory (Paulsen et al., 2000) and frontal lobe functioning (Lopez et al., 1997; Paulsen et al., 2000). One study (Wilson et al., 2000) found that both delusions and hallucinations were associated with poorer baseline functioning, but only hallucinations predicted more rapid decline on cognitive tests. In a study by Heinik and colleagues (Heinik et al., 2001), severity of delusional symptoms was found to be correlated with performance on a clock drawing test but not with global cognitive functioning as measured by the MMSE. It should be noted that many of the above studies did not differentiate patients with delusions alone from those who also experienced hallucinations.

Increased understanding of the relationship between cognitive decline and delusions in dementia is important for the development of appropriate behavioral and pharmacological intervention. The present report describes the results of a pilot study that compared neuropsychological performance in demented patients with and without delusions.

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Table I. Neuropsychological test battery.

Test	Cognitive domain
WMS-R Logical Memory I and II	Immediate and delayed memory for short stories (narrative memory)
WMS-R Visual Reproduction I and II	Immediate and delayed memory for geometric designs
WMS-R Verbal Paired Associates I and II	Immediate and delayed memory for related and unrelated word pairs
WMS-R Digit Span	Auditory attention span
WMS-R Visual Span	Visual attention span
WMS-R Mental Control	Auditory working memory and speed of processing
WAIS-R Comprehension	Understanding of social conventions and problem solving
WAIS-R Digit Symbol	Psychomotor speed
Trail Making Test, Form A and B	Psychomotor speed and alternating attention (form B)
Phonemic Fluency	Ability to generate words beginning with a specific letter (F)
Semantic Fluency	Ability to generate words from a specific semantic category (Animals)

WMS-R, Wechsler Memory Scale—Revised (Wechsler, 1981); WAIS-R, Wechsler Adult Intelligence Scale—Revised (Wechsler, 1987).

The majority of participants in this study would be considered to have mild-to-moderate dementia. As such, this sample is representative of the population most often seen in out-patient memory disorders or geriatric psychiatry clinics. In contrast to most previous studies, which have examined the correlates of 'psychosis' in dementia, patients experiencing hallucinations were excluded from this study.

Based on previous studies, we predicted that patients with delusions would perform more poorly than patients without delusions on most, but not all, neuropsychological measures. The overall purpose of this pilot study was to generate hypotheses for future studies, as well as to identify potential challenges in conducting clinical research with this population.

Methods

Participants

Participants were recruited into the study from three programs at St. Michael's Hospital, the Elder's Clinic, Transitional Care Unit and the Medical Psychiatry Service. The eligibility criteria were: (1) age 65 or over; (2) a DSM-IV diagnosis of dementia; and (3) an MMSE score above 10. Delusions were identified based on patient interviews conducted by a psychiatrist or geriatrician. The continuous presence of these delusions for over 10 days was also corroborated by staff treating the patient or by family members. Patients who were experiencing hallucinations were excluded from the study. Individuals in the non-delusional group had to have been completely free of any indication of delusions for at least six months prior to the commencement of the study, as determined by interview and chart history, and confirmed by collateral information from caregivers where available.

Procedure

Once patients were identified and appropriate consent was obtained, a neuropsychologist who was blind to the patient's group classification administered a short battery of neuropsychological tests (Table I; see Spreen and Strauss, 1998, for detailed descriptions of individual tests). The battery required approximately two hours to complete.

Caregivers who accompanied participants were asked to complete the BEHAVE-AD scale (Behavioral Pathology in Alzheimer's Disease Scale; Reisberg et al., 1996) which provided separate measures of the severity of delusions and the severity of behavioral problems. Recent scores on the Mini Mental State Examination (MMSE), recorded within one month of testing, were obtained from medical charts.

Analysis

Differences between the two patient groups with respect to various neuropsychological measures were analyzed using *t*-tests. A statistical package (SPSS) was used to perform the analyses. Due to the exploratory nature of this small pilot study, comparisons were considered significant at $p < 0.05$ and correction for multiple comparisons was not performed.

Results

All patients in the final sample ($n = 18$) met DSM-IV criteria for dementia, the majority having probable Alzheimer's disease (AD) or mixed dementia. In the delusional group ($n = 9$), six patients met the criteria for probable AD, one had probable Lewy Body Disease, one had a probable vascular dementia, and one had a mixed dementia. In the non-delusional group ($n = 9$), eight had probable AD and one had probable Lewy Body Disease. All participants, with one exception, were living in the community (most with a caregiver) at the time of study participation. As a group, participants were receiving a variety of medications at the time of assessment. Some participants were taking antipsychotic medications and/or acetylcholinesterase inhibitors.

Table II. Comparison of groups with and without delusions.

Variable	Delusional ($n=9$)	Non-Delusional ($n=9$)	P value
Age	82.0 (5.5)	77.3 (6.9)	0.13
Education	12.3 (4.0)	12.8 (4.2)	0.82
Male / Female	2 M/7 F	5 M/4 F	0.15
MMSE*	20.8 (4.7)	24.6 (1.9)	<0.05
BEHAVE-AD	14.0† (9.5)	4.5†† (6.3)	0.06
WMS-R Digit Span	12.0 (3.4)	12.4 (3.0)	0.77
WMS-R Spatial Span	10.2 (3.3)	10.6 (1.9)	0.80
WMS-R Mental Control*	3.0 (2.0)	5.0 (1.7)	<0.05
WMS-R Logical Memory I**	4.1 (3.3)	11.2 (4.0)	<0.01
WMS-R Visual Reproduction I	10.9 (6.8)	16.3 (8.5)	0.15
WMS-R Verbal Paired Associates I	7.3 (3.5)	8.7 (2.9)	0.39
Phonemic Fluency (F)	6.9 (4.5)	10.6† (4.8)	0.12
Semantic Fluency (Animals)*	6.1 (3.6)	10.1† (2.4)	<0.05
WAIS-R Comprehension	14.1 (6.4)	18.6 (6.6)	0.16
WAIS-R Digit Symbol	14.3 (9.5)	17.5† (10.3)	0.52
Trail Making Test, Form A	164.1† (180.2)	89.4† (45.5)	0.27

* $p<0.05$; ** $p<0.01$. † $n=8$; †† $n=6$.

However, medication information for specific participants was not available.

Table II shows comparisons between the delusional and non-delusional groups on demographic and selected neuropsychological test performance variables (raw scores). Group differences in delayed memory measures were not examined due to poor performance in the sample as a whole. The percentages of participants with zero delayed recall were 50%, 61%, and 22% for Logical Memory II, Visual Reproduction II, and Verbal Paired Associates II, respectively. Similarly, a minority (41%) of participants were able to complete Part B of the Trail Making Test within a five-minute time limit. The delusional and non-delusional groups did not differ significantly with respect to age, level of education, or sex ratio. Participants with delusions performed more poorly than those without delusions on tests of immediate verbal memory for short stories (WMS-R Logical Memory I; $t(1,16)=2.24$, $p=0.001$). However, the mean performance of both groups was well below average for healthy older adults (Mayo Older Americans Normative Study, Spreen & Strauss, 1998; see Figure 1). Similarly, both groups showed below average performance on a semantic fluency task (Animals; Tombaugh et al., 1999, mean education-corrected z-scores $=-2.34$ for delusional and -1.49 for non-delusional), but mean performance in the delusional group was worse ($t(1,15)=2.69$, $p<0.05$). The delusional group also had a lower average score on the MMSE ($t(1,16)=2.24$, $p<0.05$) and WMS-R Mental Control ($t(1,16)=2.31$, $p<0.05$). The delusional group had a higher average score on the BEHAVE-AD, suggesting greater behavioral disturbance, but BEHAVE-AD data were not available for all participants and this difference did not reach statistical significance. No other significant differences were found on neuropsychological variables. In fact, as shown in Figure 1, digit span performance was within the average range in both groups.

Discussion

The results of this small pilot study support the conclusions of previous studies which showed that persons with delusions and dementia represent a more cognitively impaired group, compared to those with dementia but not delusions (Jeste et al., 1992; Paulsen et al., 2000). Other studies, however, found that this decline was most pronounced for frontal lobe functions (Lopez et al., 1997; Paulsen et al., 2000), while the current study found the greatest difference in immediate narrative memory. Differences in the other neuropsychological variables studied were not as pronounced, but any small differences found were in favor of the non-delusional group.

A study by Paulsen and colleagues (Paulsen et al., 2000) found that a sudden drop in digit span was one of the best indicators of delusional thinking in dementia. In contrast, the present study found digit span to be unimpaired in individuals expressing delusions when compared to non-delusional patients, as well as when compared to age-appropriate normative data. This raises the question of whether delusions are more likely to develop when immediate memory for more complex information is severely impaired in the context of intact basic attention span for simple information. Eichenbaum and Bodkin (2000) have shown that, in rats, hippocampal damage impairs the flexibility of memory while leaving the ability to learn and retain isolated units of information intact. In fact, Eichenbaum and Bodkin (2000) have speculated that it is this hippocampal-mediated ability to alter and revise learned information that differentiates knowledge from belief. In humans, Berrios and Brook (1985)

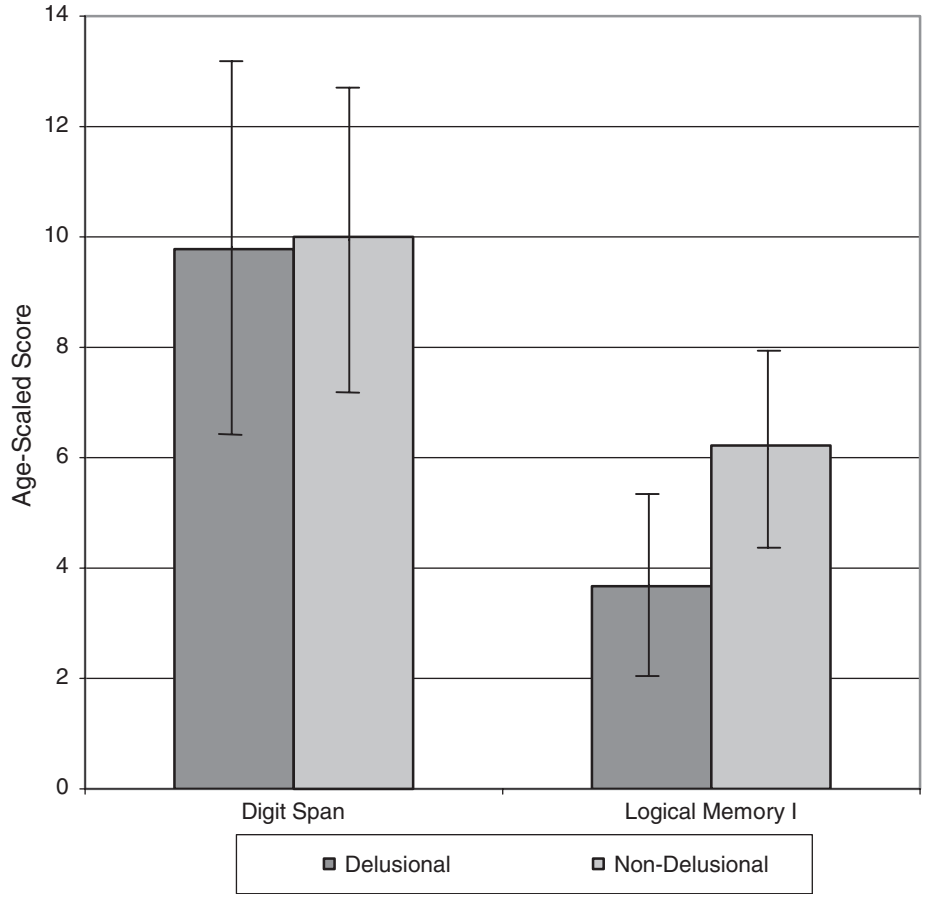

Figure 1. Digit span and logical memory I.

reported that delusions in patients with dementia were associated with higher information sub-scores on the Blessed Scale. A recent paper by Geroldi and colleagues (2002) found that a more abnormal pattern of brain atrophy was associated with the absence of delusions in a group of patients with Alzheimer's disease. These findings suggest that future research on delusions in dementia should focus on areas of functioning that may be relatively preserved, as well as those likely to be impaired.

Memory for narrative information was particularly impaired among patients with delusions in the present study. Similarly, Paulsen and colleagues (2000) found that decline in semantic memory was associated with the presence of hallucinations and delusions. Based on studies of persons with schizophrenia, disturbance in semantic processing has been suggested as an important factor in thought disorder (Goldberg et al., 1998). Future studies may include more comprehensive evaluation of semantic processing in persons with delusions and dementia.

Although previous studies have used much larger samples than the present pilot study, most studies did not separate those with delusions only from those with delusions and hallucinations. The results of our study suggest that neuropsychological correlates of delusions in dementia require more attention in a larger sample experiencing delusions only. Specific subtypes of delusions (e.g., delusions of jealousy) may be associated with particular patterns of neuropsychological function and dysfunction.

Challenges encountered in conducting this study included the need to exclude two participants due to severe hearing impairment, difficulty arranging assessment times with caregivers, and lack of availability of caregivers to complete the BEHAVE-AD (particularly for participants without delusions). As noted above, floor effects were evident on several neuropsychological measures, especially measures of delayed recall and alternating attention. No analyses were performed on variables for which floor effects were evident. Based on these difficulties, it is recommended that future studies in clinical settings consider screening patients for sensory impairment and use a shorter test battery composed of tests that are less susceptible to floor effects. Although recent MMSE scores (within one month of study participation) were obtained from patient charts, it is preferable for measures of global functioning to be administered at the same time as other cognitive tests. This would reduce potential confounding effects of different administration times (e.g., temporary fatigue or illness). Finally, both presence of delusions and education level were ascertained based on patient self-report (although information to corroborate delusions was also obtained from

caregivers). As the self-report of individuals with cognitive impairment may have questionable validity, it is recommended that future studies enroll participants who have caregivers to provide collateral information.

The participant groups in the present study were small but also heterogeneous. Although the groups did not differ significantly with respect to demographic variables, women and older individuals were somewhat over-represented in the group with delusions. Future studies should aim to match groups in terms of age, education, sex ratio, and overall level of cognitive impairment. Although most participants in this study met criteria for probable Alzheimer's disease, participants with other diagnoses were also included. The prevalence and severity of delusions may vary as a function of etiology. Therefore, future studies should restrict enrolment to individuals with a single dementia process, or enroll sufficiently large samples and perform *post hoc* analyses to examine profiles in subgroups with different diagnoses.

Several limitations of the present study (e.g., small heterogeneous sample) could be expected to reduce the likelihood of finding significant differences between the groups with and without delusions. Nonetheless, several differences reached statistical significance with large effect sizes (Cohen's $d = 1.95$, 1.29, and 1.08 for Logical Memory I, Animals, and Mental Control, respectively). Even if a conservative Bonferroni correction ($p < 0.0045$) was applied to comparisons of neuropsychological test variables, the difference in Logical Memory would still be significant. Thus, it appears likely that future studies will replicate a finding of greater impairment of semantic memory in patients with delusions and dementia.

In conclusion, this study suggests that in individuals with a diagnosis of dementia, several neuropsychological functions are more impaired when delusions are also present. However, in some domains, performance of patients with delusions was comparable to that of patients without delusions. Simple attention span was within the normal range in both groups. These findings, though limited, suggest the need for larger prospective studies to clarify the role of global and specific neuropsychological impairment in delusion formation.

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