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Legal medical consideration of Alzheimer's disease patients' dysgraphia and cognitive dysfunction: a 6 month follow up

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Background: The purpose of this study was to investigate the ability of Alzheimer's disease (AD) patients to express intentions and desires, and their decision-making capacity. This study examines the findings from a 6-month follow-up of our previous results in which 30 patients participated.

Materials and methods: The patient's cognition was examined by conducting the tests of 14 questions and letter-writing ability over a period of 19 days, and it was repeated after 6 months. The difference between these two cognitive measures (PQ1 before–PQ2 before), tested previously and later the writing test, was designated DΔ before. The test was repeated after 6 months, and PQ1 after–PQ2 after was designated DΔ after.

Results: Several markedly strong relationships between dysgraphia and other measures of cognitive performance in AD patients were observed. The most aged patients (over 86 years), despite less frequency, maintain the cognitive capacity manifested in the graphic expressions. A document, written by an AD patient presents an honest expression of the patient's intention if that document is legible, clear, and comprehensive.

Conclusion: The identification of impairment/deficits in writing and cognition during different phases of AD may facilitate the understanding of disease progression and identify the occasions during which the patient may be considered sufficiently lucid to make decisions.

Keywords: cognition, intentions, unfit to plead, consent

Introduction

Alzheimer's disease (AD) is an incurable and devastating neurodegenerative disease with progressive cognitive, functional, behavioral, and neuropathological changes,[1,2] and it affects >30 million people worldwide, which is expected to be tripled by 2050.[3,4]

Studies have shown that writing may identify a specific deficit in AD patients and its deterioration can be related to the pathological changes[5–7] and the further deterioration of cognitive functions.[8,9] Other strong relationships were observed between dysgraphia and cognitive performance (PQ1) in AD patients' marked deterioration.[10]

Moreover, floating attention, cognition, and writing skills have been observed in these patients. Between the two extremes, good health and absolute cognitive impairment, there exist a whole series of intermediate states with alternating phases of aggravation with loss of cognition and remission phases when the patient may have the capacity to understand, to make decisions, and express intentions. Thus, even if a person has AD, diagnosis cannot be equated with decisional incapacity.[11] Nevertheless, it is essential to distinguish between patients and episodes on the basis of functionality and nonfunctionality.

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As long as must, the AD patient is deemed capable to intentions and wishes it is necessary to make provisions for those results expressed on previous documents.

The present study examines the findings from a 6-month follow-up of our previous results in which 30 patients participated.[12] The purpose was to measure the patients' cognitive performance and the episodes during which the patients with serious AD may be considered sufficiently lucid to make decisions.

Materials and methods

Participants

Twenty-seven AD patients (6 months later from previous Onofri et al study) were selected to participate in the study: 13 males and 14 females. The previous number of 30 patients was reduced by three since these patients died. All the patients were presenting symptoms that indicated a diagnosis of AD from moderate-to-relatively severe level (mini-mental state examination [MMSE] range: 10.1–16.7).

The diagnoses according to the National Institute of Neurological and Communicative Disorders and Stroke, the Alzheimer's Disease and Related Disorders Association,[13] and the *Diagnostic and Statistical Manual of Mental Disorders*, 4th edition reference, were confirmed by resident neurologists of the Department of Neurology at the hospitals (Gemelli University Polyclinic-service neuropsychology, Rome, Italy, and the Alzheimer Evaluation Unit ASLRMF and Alzheimer Evaluation Unit ASLRMD, and Department of Neurology and Psychiatry, Sapienza Hospital, Rome, Italy) in the Lazio region.

The mean MMSE score ± standard deviation (SD) was 14.11±1.74 (male) and 13.4±2.27 (female). The control group of age- and education-matched healthy senior citizens was chosen as individuals who were not, in any way, influenced by AD and who presented the following characteristics: mean age 82.73 years (SD ±5.7 years). The mean amount of time spent upon education by the healthy controls was 12.8 years (SD ±4.04 years). The ethical review board of the Local Health Unit RM F of Lazio deemed ethical approval not necessary for this study. All principles outlined in the Declaration of Helsinki were followed. Written informed consent was obtained from subjects and patients or their relatives. All patients were examined by clinicians.

Procedure

The details of the methodology have been previously described in depth;[12] therefore, they will be summarized here.

A standard collection of 14 simple questions were given to the patients. For each correct answer, one point was attributed in proportion to the difficulty of the question. The sum of each test session was represented by PQ1 before (PQ1B). Following this, each patient was invited to write a letter to a close relative. The letter-writing task was interrupted when it seemed that the text written by the patient was substantially (pathologically) confusing (when the phrase offered no conceptual association with accompanying text although in the presence of otherwise "correct" syntax and when it had a sudden lack of readability, disjointedness, and incompleteness in meaning with intrusions, semantic substitutions, alterations in the spatial organization of handwriting, illegible words, incidence of paraphrases, incapacity to form complete sentences, graphemic substitutions [a grapheme is the smallest semantically distinguishing unit in a written language], omissions, and additions).

The patient's writing test was evaluated by two experts (physician and lawyer) who evaluated each AD patients' letter writing equally. After this, using a chronometer, the number of minutes that had been reached for each single patient was registered, and the complete sentences were counted (sentences/minutes = XF before [XFB]). The whole procedure involving the letter-writing graphia task was interrupted after 20 minutes.

The list of 14 questions given to the patients in PQ1B was also given to the patients in a repeated procedure that was designated PQ2 before (PQ2B). The difference between these two measures (PQ1B–PQ2B) was designated DΔ before. These procedures for testing, graphia test, 14-item test, were presented in an identical manner every second day over 10 days (days 1, 3, 5, 7, 9, 11, 13, 15, 17, and 19) at the same hour of day on test days to hold constant testing procedures over daily curriculum and any clinical interventions that the patients may be subjected to. These procedures for testing were presented in an identical manner after 6 months. The answers to the questionnaire before the written test were designated PQ1 after (PQ1A), and the answers to the questionnaire after the written test were designated PQ2 after (PQ2A); DΔ after was the difference between PQ1A and PQ2A (PQ1A–PQ2A).

Statistical analysis

Mean and SD were used to calculate PQ1B/A and PQ2B/A scores and XFB/A and DΔB/A of the AD patients and the healthy control group over consecutive days of testing. Scheffe's test was used to make unplanned comparisons of group mean of test days 1–9 with that of days 11–19.

Table 1 Clinical and neuropsychological characteristics of AD patient groups in this study

	Male (n=13)	Female (n=14)
Mean age (years)	77.22± SD 1.78	82.22± SD 2.04
Educational (years)	11.11± SD 2.5	12.77± SD 3.8
Apraxia (%)	88.8	77.7
Aphasia (%)	88.8	88.8
Agnosia (%)	22.2	33.3
MMSE[a] (mean)	M 14.11± SD 1.74	M 13.4± SD 2.27
ADL[b]	4.22± SD 0.44	3.88± SD 0.92
IADL[c]	4± SD 0	2.66± SD 1
Beginning of the disease (years)	4.11± SD 0.92	4.55± SD 1.13

Notes: [a]MMSE[14] (normal level score =30 points), modified by age and education. [b]ADLs[15] (normal level =6/6 for both males and females). [c]IADLs[16] (normal level =8/8 for both males and females).
Abbreviations: AD, Alzheimer's disease; ADLs, activities of daily living; IADLs, instrumental activities of daily living; MMSE, mini-mental state examination; SD, standard deviation; M, mean.

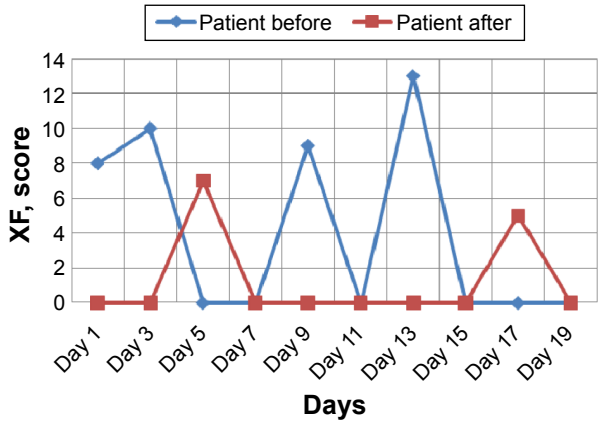

Figure 1 An example of an eldest aged patient.
Note: The peaks represent the moments of skills and good cognitive performance and handwriting.
Abbreviation: XF, sentences/minutes.

Results

The clinical characteristics of the participants in the study are presented in Table 1.

The cognitive performance of the AD patients deteriorated from PQ1B to PQ1A, and the XF value deteriorated before and after. The deterioration from PQ1A to PQ2A (DΔA) was significantly impaired as compared with DΔB (Table 2).

Figure 1 shows a 6-month follow-up of AD patients' dysgraphia and cognitive dysfunction.

Patients were divided into three age-groups, 73–79 years (aged), 80–85 years (elder aged), and >86 years (eldest aged) (Figures 2–4).

Discussion

This study examines cognitive process in AD patients and the relationships between initial cognitive performance (PQ1B), the deterioration in cognitive performance following a letter-writing task (PQ1B − PQ2B = DΔB), and XFB in a group of AD patients presenting a moderate-to-relatively severe stage of disorder and comparing with cognitive performance in the same group of patients observed after 6 months. Both the correlations between PQ1B and PQ2B over all test days and the deterioration of performance from PQ1A to PQ2A over all test days were marked. The relationships between initial cognitive performance (PQ1B/A) and extent and XF over both patients and test days were markedly impaired. The relationships between dysgraphia and cognitive deterioration (DΔB/A) were also markedly strong. A comparison of AD patients vs control patients are shown in Figure 5.

AD involves disorders of the memory[17] as well as of other cognitive functions[18] and leads to a progressive overall deterioration of the intellect and personality,[19,20] and it raises

Table 2 The performance of AD patients on the tests of cognition, PQ1B and PQ1A, the difference between PQ1 before and PQ2 before (DΔ before), and the difference between PQ1 after and PQ2 after (DΔ after) and on the writing test before and after

Days of testing	PQ1B[a]	PQ1A[b]	DΔB	DΔA	XFB[c]	XFA[d]	Number of patients
Day 1	12.18±4.9	6.07±5.9	8.11±4.9	3.74±4.7	9.25±6.7	2.77±3.8	27
Day 3	10.37±4.4	8.77±4.3	6.25±3.1	4.59±3.8	8.07±5.1	4.11±4.4	27
Day 5	9.51±5.2	7.51±4.6	5.1±4.0	3.77±3.9	7.74±7.0	3.18±3.9	27
Day 7	9.29±4.8	5.96±3.8	4.18±3.1	2.29±3.3	5.74±5.5	1.40±2.7	27
Day 9	11.96±3.1	6.07±4.4	6.44±2.7	2.59±3.8	8.11±6.0	2.0±3.8	27
Mean days 1–9	10.66±4.6	6.73±4.8	6.03±3.8	3.06±3.9	7.78±6.1	2.69±3.8	27
Day 11	8.48±4.4	6.18±3.1	3.59±2.5	1.96±3.0	4.74±5.15	1.55±3.5	27
Day 13	8.81±4.3	6.88±3.8	3.44±3.0	2.88±3.1	5.11±5.8	1.74±2.8	27
Day 15	8.62±4.5	6.29±3.4	3.8±2.9	2.59±3.0	5.11±5.5	1.77±3.1	27
Day 17	9.29±4.2	6.92±3.8	4.1±2.6	2.74±3.5	6.44±5.5	1.81±2.7	27
Day 19	9.55±5.2	6.11±4.1	5.07±2.8	2.77±3.2	6.96±7.1	2.18±3.6	27
Mean days 11–19	8.95±4.5	6.34±3.7	4.02±2.8	2.33±3.1	5.67±5.8	1.81±3.1	27

Notes: The performance comparisons of the mean of test days 1–9 with that of days 11–19 using Scheffé's test (days 1–9 vs days 11–19): [a]F (9, 260) =29.70; [b]F (9, 260) =1.97; [c]F (9, 260) =36.07; and [d]F (9, 260) =18.61.
Abbreviations: AD, Alzheimer's disease; DΔA, DΔ after; DΔB, DΔ before; PQ1A, PQ1 after; PQ1B, PQ1 before; XFA, XF after; XFB, XF before; XF, sentences/minutes.

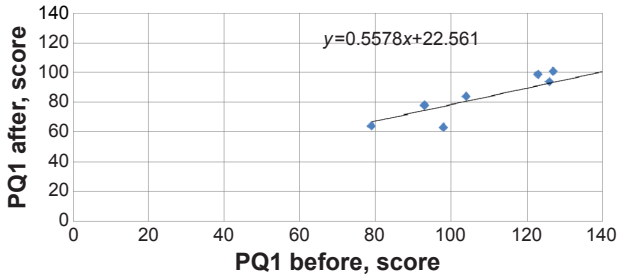

Figure 2 Comparisons of PQ1 before and PQ1 after of group 1 (aged).

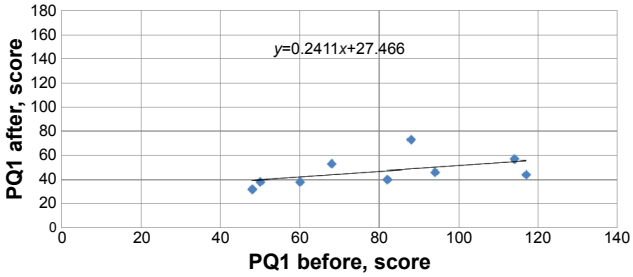

Figure 4 Comparisons of PQ1 before and PQ1 after of group 3 (eldest aged).

the question of impairment of ability to self-determination. In comparison with the extrapolated data after 6 months, the AD patients demonstrated deficits in initial cognitive performance (PQ1B), in dysgraphia, and in DΔB. We have noticed that the marked deterioration in the handwriting of AD patients is present when the level of the PQ, ie, cognition, is <11.

Furthermore, the graphs of Figures 2–4 show that the most aged patients have a greater loss of cognition than the less aged patients. Nevertheless, 6 months later, we note that the most aged patients, although with less frequency, maintain a level of cognition that may be manifested in the graphic gesture (Figure 1).

Low values of PQ2 and fluctuation of cognitive functioning, demonstrated with the test repeated for 10 days, confirm the hypothesis that the cognitive decrease is not due to diminution of number of neurons but due to synaptic modifications.[21]

Attention, construction, conceptualization, and memory disorders are correlated with AD dysgraphia,[22] and with this work, we have shown that a document written by an AD patient is an honest expression of the patient's intention, if this document is legible, clear, and comprehensive. Indeed, to write a document requires not only the ability to program skilled movements[23] and to represent graphemes but also the integration of memory with cognitive processes[24] (eg, developing personal thoughts).

Implications

The signature affixed to all legal documents, perfecting and making them valid, assumes that the person who has signed has the mental capacity and has understood the meaning of the document signed.

In AD patients, the apposition of signature is a mechanical process with subcortical anchorage,[25] and it is the last documental graphic sign that the AD patient is able to put in the course of the disease; consequently, the signature is not an indicator of understanding of the document on behalf of an AD patient.

If legal disputes occur, the documents are cancelable if the person who has made them was devoid of capacity when he or she issued his or her declaration of intent. Also, persons experiencing lucid intervals may be considered competent to execute legal document during such periods.

The few legal courts addressing the issue have held consistently that AD patients with moderate or relatively severe level of impairment are competent or not competent to execute legal document based on the testimony of those who interacted with the patient.

In this study, we show that the evaluation of a written document can be the proof of the AD patients' ability to understand and their will. In this case, if a person with dementia is able to write a document that makes complete sense, it is presumed he or she likely maintains the legal capacity. As long as the AD patient has legal capacity, he or she should take part in legal planning.[26] Therefore, the

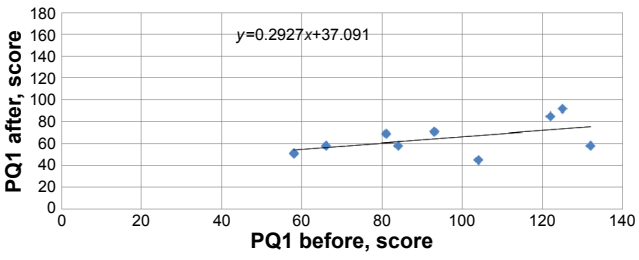

Figure 3 Comparisons of PQ1 before and PQ1 after of group 2 (elder aged).

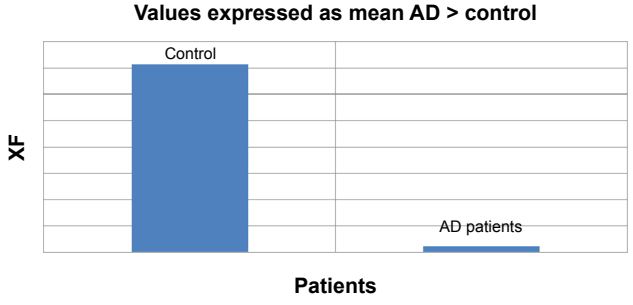

Figure 5 XF by AD patients and healthy controls expressed as mean ± SD in the graphia test, summated over all 12 days of testing.
Abbreviations: AD, Alzheimer's disease; SD, standard deviation; XF, sentences/minutes.

incapacity of judgment requires the existence of a mental disability (objective aspect), which results in the lack of capacity to act rationally (subjective aspect). By law, the capacity of judgment is assumed (statutory presumption), and the opposite has to be proved.[27]

Documents in which the incapable performs directly are temporarily effective, but they can be canceled (resulting in elimination of the effects that they have produced) by the initiative of his or her legal representative or him- or herself (if he or she has obtained the capacity). If legal disputes occur, the clinicians make a retrospective assessment of a patient's capacity evaluating patient's clinical records and MMSE. However, some authors imply that the MMSE is not an indicator of capacity,[28,29] and it cannot be used as the only instrument for evaluating the decisional ability,[30] capacity to consent.

Conclusion

To study the cognitive ability in relation to graphia may be useful for guiding decisions in everyday practice. Most of the available researches have focused on the nature and degree of decisional impairment associated with various clinical states, including psychiatric,[31,32] neurologic,[33] and general medical[34] conditions.

Prior research has shown considerable unexplained variability in clinicians' judgments.[35] Marson et al[36] showed that five experienced clinicians evaluating the capacity of AD persons are unable to agree.[37] In Italy, the ability to provide for its own interests is determined by the court with an examination of the interdicting and is sanctioned by a judgment (cd judicial interdiction).

The relatively lower proportion of participants who had undergone follow-up assessments is a limitation of this study.

Disclosure

The authors report no conflicts of interest in this work.

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