Bilingualism delays the onset of behavioral but not aphasic forms of frontotemporal dementia

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A B S T R A C T

Bilingualism has been found to delay onset of dementia and this has been attributed to an advantage in executive control in bilinguals. However, the relationship between bilingualism and cognition is complex, with costs as well as benefits to language functions. To further explore the cognitive consequences of bilingualism, the study used Frontotemporal dementia (FTD) syndromes, to examine whether bilingualism modifies the age at onset of behavioral and language variants of Frontotemporal dementia (FTD) differently. Case records of 193 patients presenting with FTD (121 of them bilingual) were examined and the age at onset of the first symptoms were compared between monolinguals and bilinguals. A significant effect of bilingualism delaying the age at onset of dementia was found in behavioral variant FTD (5.7 years) but not in progressive nonfluent aphasia (0.7 years), semantic dementia (0.5 years), corticobasal syndrome (0.4 years), progressive supranuclear palsy (4.3 years) and FTD-motor neuron disease (3 years). On dividing all patients predominantly behavioral and predominantly aphasic groups, age at onset in the bilingual behavioral group (62.6) was over 6 years higher than in the monolingual patients (56.5, p=0.006), while there was no difference in the aphasic FTD group (60.9 vs. 60.6 years, p=0.851). The bilingual effect on age of bvFTD onset was shown independently of other potential confounding factors such as education, gender, occupation, and urban vs rural dwelling of subjects. To conclude, bilingualism delays the age at onset in the behavioral but not in the aphasic variants of FTD. The results are in line with similar findings based on research in stroke and with the current views of the interaction between bilingualism and cognition, pointing to advantages in executive functions and disadvantages in lexical tasks.

1. Introduction

Current research suggests that the clinical expression of dementia is modifiable by lifelong factors protecting against cognitive decline by enhancing the “cognitive reserve” (Stern, 2002). One of potential protective factors is bilingualism, reported to improve cognitive functioning in healthy ageing (Bak et al., 2014) and to delay the onset of dementia by 4–5 years (Bialystok et al., 2007; Woumans et al., 2015). Although the mechanism and degree of this effect remain controversial (Freedman et al., 2014), the cognitive domain implicated most consistently are executive functions (Valian, 2015). In contrast, a well-documented cognitive cost of bilingualism is slowing in lexical tasks, such as picture naming (Gollan et al., 2005).

Accordingly, we can expect bilingualism to have different effects on
brain diseases depending on the cognitive domains involved, with strongest positive effects on executive and weakest on language function. Indeed, such a pattern was found recently in stroke patients: bilinguals had a lower frequency of post-stroke dementia and mild cognitive impairment than monolinguals, but the same frequency of aphasia (Alladi et al., 2016). Likewise, the only study to date examining systematically the relation between bilingualism and different types of dementia found the longest bilingualism-related delay in dementia onset in frontotemporal dementia (FTD), a disease characterised by a prominent frontal-executive dysfunction (Alladi et al., 2013).

The present study goes one step further by examining the effects of bilingualism on the onset of different variants of FTD: the behavioral variant (Rascovsky et al., 2011), progressive aphasias (Gorno-Tempini et al., 2011) as well as associated movement disorders: corticobasal degeneration, progressive supranuclear palsy and motor neuron disease (Bak, 2011; Kertesz, 2003). We hypothesise that the beneficial effect of bilingualism will be largest in the behavioral and smallest (or absent) in the aphasic forms of FTD.

2. Methods

2.1. Patients and diagnosis

Case records of 193 consecutive FTD patients diagnosed in a specialist clinic located in Hyderabad, between 2006 and 2015 were reviewed. All patients were participants in an ongoing longitudinal dementia registry project. All subjects were evaluated by an experienced behavioral neurologist (S.A.) using a diagnostic protocol adapted from the Cambridge Memory Clinic model (Hodges et al., 2000). The assessments were performed by trained psychologists using a structured procedure. The Mini-Mental State Examination and Addenbrooke’s Cognitive Examination—revised (ACE-R), were adapted for Telugu, Dakhini, and Hindi speaking populations of Hyderabad (Alladi et al., 2016). The Clinical Dementia Rating (CDR) scale was used to determine severity of dementia. Additional diagnostic tests used were Frontal Systems Behavior Scale (FrSBe) (Grace et al., 1999) to identify frontal behaviors and the Indian adaptation of the Cambridge semantic battery test (Alladi et al., 2010) to diagnose language and semantic memory deficits.

Patients were diagnosed on the basis of clinical features at first presentation to the clinic. The presence of amnesia, aphasia, visuospatial deficits, changes in social behavior, frontal behaviors, specifically apathy, disinhibition and executive dysfunction, stereotypic behaviors, apraxia, other neuropsychiatric features; delusions, hallucinations, agitation and depression and motor signs; extrapyramidal features, bulbar and pyramidal involvement, were recorded in all patients. Diagnosis of FTD was made based on FTLD consensus criteria (Neary et al., 1998) and patients were categorized into subtypes of behavioral variant FTD (bvFTD) and two aphasic variants: progressive nonfluent aphasia (PNFA) and semantic dementia (SD). In addition, we included patients with three motor syndromes associated with FTD as part of the ‘Pick Complex’ (Kertesz, 2003; Strong et al., 2009): frontotemporal dementia- motor neuron disease (FTD-MND) (Strong et al., 2009), corticobasal degeneration (CBD) (Armstrong et al., 2013) and progressive supranuclear palsy (PSP) (Litvan et al., 1996). All FTD-MND, CBD and PSP patients included in this study presented with early FTD features as well as motor features. In contrast to the bvFTD with its behavioral presentation and SD and PNFA with their aphasic features, the motor variants of FTD can be characterised by a behavioural or aphasic clinical picture, as well as a combination of both (Burrell et al., 2016; Sha et al., 2006). Therefore, we divided patients into two groups: predominantly behavioral (n = 90) in subjects with frontal behavioral symptoms of apathy, disinhibition or executive dysfunction at first presentation and predominantly aphasic (n = 95) in subjects with predominant language impairment on history or on language tests, excluding those in whom both types of symptoms were equally pronounced based on available clinical information (n = 8).

2.2. Data collection and evaluation

Case records were reviewed by research fellows who were not involved in data collection (AR and DR) for the following details: age of patient, sex, age at onset of dementia, educational status, bilingualism, occupation and family history of dementia. All information was obtained from a reliable family member. Age at onset of dementia was defined as the age at which the first clinical symptom suggestive of dementia was noticed. Bilingualism was defined as the ability to communicate in two or more languages in interaction with other speakers of these same languages (Mohanty, 1994). Educational status was derived from years of formal education received. Illiterate individuals were defined as those who had no formal education and were unable to read and write in any language. In keeping with the skill levels defined to suit Indian conditions, we used the National Classification of Occupations—2004 to classify subjects into different occupational statuses. The institutional ethics committee of Nizam’s Institute of Medical Sciences approved the study.

2.3. Statistical analysis

Clinical and demographic characteristics of FTD subtypes and monolingual and bilinguals were compared using independent samples t-test/One-way analysis of variance for continuous variables and chi-square test for categorical variables. Posthoc tests were done using Bonferroni adjustments for continuous variables. A univariate general linear model (GLM) was used to assess the effect of bilingualism on age at onset of dementia in bvFTD after adjusting for years of education, literacy, occupation, gender, rural/urban dwelling and family history of dementia. Interaction effects of bilingualism with these various demographic and clinical variables were also calculated by using univariate GLM. Statistical analysis was performed using SPSS 20.0 for windows software (SPSS Inc., Chicago, IL).

3. Results

3.1. Clinical and demographic characteristics of the study cohort

A total of 193 patients were diagnosed with FTD during the study period (Table 1). The most common diagnosis was bvFTD in 67 patients (34.7%), followed by PNFA in 39 (20.2%), PSP in 31 (16.1%), SD in 23 (11.9%), CBD in 23 (11.9%), and FTD-MND in 10 (5.2%). The mean age at presentation was 63.0 years (SD 9.5, Range = 40–91 years); bvFTD and FTD-MND patients tended to be younger at presentation than the other groups, but this trend did not reach significance. The proportion of men/women was 57.5% versus 42.5%; 172 patients (89.1%) were literate. Mean duration of symptoms was 2.5 years and was significantly shorter in the motor presentations of FTD: CBD, PSP and FTD-MND than in the classical behavioral and aphasic variants. Family history of dementia in a first degree relative was present in 38 patients (19.7%); 23 of them were in patients with bvFTD.

3.2. Comparison of monolingual and bilingual patient groups

Hundred twenty one patients (62.7% of the cohort) were bilingual, of whom 48 spoke two languages and 73 three or more languages. The most commonly encountered language combinations were Telugu and Hindi, Telugu, English and Hindi, and Telugu and Dakhini. The severity of dementia as measured by ACE-R and CDR was not different between mono and bilinguals. There was also no difference in the duration of illness, and family history of dementia between the two groups (Table 2). The bilingual cohort had more men, more literate individuals, and higher skill levels in their occupation compared with monolinguals. Overall, bilinguals were found to be 3.3 years older at...
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