Original research article

A Study of Patients with Parkinson's Disease Using the Frontal Assessment Battery

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Abstract

Background: A special study design known as the frontal assessment battery (FAB) was developed to evaluate frontal lobe impairment. Numerous researchers have used the FAB test to evaluate the integrity of the frontal lobe because Parkinson's disease (PD) is frequently linked to difficulties with cognitive and other higher mental functions. The Mini Mental State Examination of Folstein (MMSE), on the other hand, is another regularly used test used to evaluate mental status; however, because it does not only examine frontal brain functioning, its validity has been questioned in PD.

Material and Methods: The goal of the current study was to compare the FAB test with the MMSE scale and see whether the test could be applied to Indian patients.

Results and Conclusions: The FAB test was found to correspond with the patient's age and educational level. Despite the fact that the MMSE research is not regarded as a test that can only evaluate the condition of the frontal lobe, the results also correlated with that study's findings. To the best of our knowledge, this is the first study of its kind to be conducted in India.

Key Words: Cognitive function, frontal assessment battery, frontal lobe, higher mental function, Mini Mental Scale examination of Folstein, Parkinson’s disease

Introduction

Soviet neuropsychologist Alexander Luria developed the frontal assessment battery (FAB) in 1966. It is a screening test to evaluate the frontal lobe's functional integrity in clinical settings. [1-3] It consists of six components, including conceptualization (which uses abstract reasoning to assess interpretation of a proverb or similarities between two objects), literal fluency (which measures mental flexibility), Luria motor test or fist palm edge test (which measures motor programming and executive control), Stroop test and go-no-go paradigm test (which measures resistance to interference), Stroop test and go-no-go paradigm test (which measures inhibitory control), and go-no-go paradigm test (which measures environmental autonomy). The global performance on these six subtests gives a composite score summarizing the severity of the dysexecutive syndrome, whereas the individual subscores help in classifying the pattern of these problems in a given patient.

The FAB is a sensitive test for determining frontal lobe disease, according to a validation study done on patients with various degenerative conditions. [3] According to research by Dubois et al., the FAB scores correlate favourably with other sensitive measures of executive dysfunctions as the Wisconsin card sorting test's perseverative errors and the Mattis dementia rating scale (MDRS). Tests like the mini-mental scale examination of Folstein (MMSE), Addenbrooke cognitive examination (ACE), Wisconsin card sorting test, and MDRS often fail to pick up subtle executive deficits; and ACE was designed to detect cognitive

dysfunctions in Alzheimer's disease and, therefore, some domains specific for cognitive impairment in Parkinson' disease (PD) may remain unidentified by the sole use of this test.[3] It has been seen in a number of works that FAB is a useful bedside test to pick up even subtle dysexecutive problems in PD, the fundamental neuropsychological deficit in this disease.[4-8]

METHODS

The FAB test was administered to 80 control persons and 170 consecutive PD patients. On a particular day, the patients were chosen from the outpatient department and investigated separately in the neurology department. The wards also received some of these patients. The patients' written consent was obtained, and the caregiver's consent was acknowledged if the patient was at an advanced stage. The Institutional Ethics Committee gave its approval for the project to be completed. One or more of the department's leading neurologists conducted the clinical evaluation, and one of them administered the exams with a licenced psychologist and psychoanalysis.

The Hughes' UK PD Society Brain Bank Clinical Diagnostic Criteria were used to develop the inclusion and exclusion criteria. The inclusion criteria included characteristics including bradykinesia, rigidity, tremor, or postural instability, as well as unilateral onset, initial asymmetry, and a positive response to levodopa. The exclusion criteria included early falls, early severe autonomic involvement, early dementia, bilateral abnormalities at the outset, the existence of additional neurological features such ocular signs, cerebellar features, extensor plantar response, and a poor response to levodopa. [9]

The control and test population were distributed across various age groups, different levels of education, and gender category. Additionally, the baseline MMSE evaluation was performed on both the test and control population. The parameters like age, sex, frequency distribution, motor disability in terms of the Hoehn and Yahr staging, mean duration of illness, and level of education of the patients were taken into account and the results are shown below in a tabular manner.

RESULTS

The test group consisted of 117 male and 53 female patients, with a mean age of 58.26 years and 56.62 years, respectively, for the male and female subjects. The mean ages of the 39 male and 41 female participants in the control group were 64.26 and 65.88 years, respectively. In the current investigation, patients were divided into the following groups based on their years of education: low (0–3 years), middle (4–7 years), mid-high (8–11 years), and high (12 years or more) level of education. 15.29% of patients are low educated, followed by 19.41% who are middle educated, 27.06% who are mid-high educated, and 30.24% who are high educated. The FAB scale was used to evaluate all patients, and the results were recorded in each of the subdomains: prehension, go no go, conflicting, Luria motor, and lexical fluency, in that order. For each patient, a total score was created. The patients' educational categories were examined, and the FAB scores were contrasted between the groups. The analysis of variance (ANOVA) test was used to compare the FAB scores as well as the scores in each subcategory between the groups. In this study, the FAB scores in all the subdomains have varied significantly among patients with different education, with low scores being recorded in the lower education group. The P values were recorded at $P = 0.038$ for the prehension, $P = 0.029$ for the go-no- go, $P = 0.00$ for the conflicting, $P = 0.001$ for the Luria motor, $P = 0.00$ for the

lexical fluency, and P = 0.00 for the similarity subdomains. The P value of 0.00 obtained for the total score was considered as significant.
The subjects were also analyzed by the MMSE, and the results of the FAB total scores and the subdomain scores and MMSE scores were compared between the test and control population by utilizing t-test. Both the MMSE and the FAB scores were significantly different (P = 0.00) between the test and control population. The P values between the various FAB subgroups were recorded at P = 0.084 for the prehension, P = 0.00 for the go-no- go, P = 0.00 for the conflicting, P = 0.00 for the Luria motor, P = 0.00 for the lexical fluency, P = 0.00 for the similarity subdomains.

DISCUSSION

The Mini Mental State Examination (MMSE) is one of the most often used tools for diagnosing cognitive deficiencies in clinical practise. It assesses orientation, memory, visual ability, attention and arithmetic, as well as language, writing, reading, and constructional skills. However, it is not sensitive enough to accurately detect visuospatial dysfunctions and frontal executive deficiencies. Additionally, it has a low sensitivity for early-stage dementia detection. The Stroop test depends on a specific executive dysfunction brought on by frontal lobe injury, which may or may not be present in a particular PD patient. [11,12]

However, Kaszás et al. have demonstrated that the sensitivity and specificity of scores obtained using the FAB test were not equivalent to those of the MMSE scores. As a result, the FAB test may not be adequate when used as the only screening tool for Parkinson's disease dementia (PDD). [20] The six subtests examined several cognitive and behavioural domains related to the frontal lobe, as has been correlated with sophisticated imaging studies and metabolic activities in various parts of the brain, even though the FAB global score does not distinguish between the cortical and subcortical frontal involvement. [21]

Our study, however, showed that although the FAB and MMSE scores were significantly reduced in PD patients, compared with age, sex, and education matched controls, no correlation could be established regarding whether or not the FAB scale was a superior tool compared with the MMSE scale in the assessment of cognitive dysfunction in PD.[3,12] Neurophysiological and neuropsychological assessments as well as functional imaging suggest that the cognitive and behavioral domains might involve distinct and disparate neural networks. Conceptualization appears to be associated with dorsolateral frontal areas,[22,23] word generation with medial frontal areas,[24,25]and inhibitory control with orbital or medial frontal areas.[26,27]

One Chinese study has shown a link between severe neuropsychiatric symptoms and frontal behavioural alterations in PD patients, and a Turkish study found that individuals with low FAB scores also had severe neuropsychiatric symptoms. [28,29] In patients in Hoehn and Yahr stage III, Kataoka et al. have demonstrated that a low FAB score is linked to a higher frequency of falls, while Lees and Smith's research has revealed that individuals with PD experience much increased set shifting difficulty and perseverative error rates. [30,31] Furthermore, the loss of the ascending dopaminergic mesocorticolimbic circuits in PD may be responsible for modest cognitive abnormalities that characterise mental rigidity. [16]

Finally, Paviour et al., reported a low FAB score in 82% cases of progressive supranuclear palsy (PSP), in 36% cases of multiple system atrophy (MSA), and in only 8% of cases of PD after a study on 17 patients with progressive PSP, 11 with MSA and 12 with PD and,

therefore, the authors concluded that this test can differentiate between the various akinetic-rigid syndromes.[32]

A number of workers from other countries observed a low FAB score in patients of PD and it correlated with the age of the patients and their level of education.[4,7,28] The nature of executive dysfunctions most commonly encountered were in phonemic and semantic verbal fluency tests.[4] Some studies again found a correlation between the FAB and MMSE score, but not with age, education, or the UPDRS.[7] A Turkish and a Brazilian work, published independently of each other, reported that FAB was related to the level of education alone and did not correlate with age or gender.[29,33] A Chinese article observed a weak correlation between the FAB scores and male patients, as well with the early onset and late onset disease groups.[28] In a 2-year longitudinal study, Bugalho et al., observed that cognitive function scores did not decrease significantly in the FAB test, except in the domain of lexical fluency score.[34,35]

CONCLUSION

In conclusion, our investigation on the use of the FAB to identify executive dysfunctions in Parkinson's disease revealed that scores in all categories were lower in PD patients compared to controls, and that there were significant differences in the FAB and MMSE scores between the test and control groups. The FAB score was found to directly correlate with the MMSE score despite having an inverse relationship with the patient's age. Comparison research revealed that the FAB scores dramatically decreased with lower levels of education because the population under study included participants with diverse levels of education. Although FAB is thought to be a better instrument overall and MMSE typically underestimates pure frontal lobe functioning, it was not found to be a better tool when compared to MMSE in this investigation.

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