Cognitive function in patients with newly diagnosed HIV infection in a tertiary health facility in south – west Nigeria: Assessment using computer-assisted neuropsychological test battery

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ABSTRACT

Introduction: Cognitive dysfunction is common among patients with human immunodeficiency virus (HIV) infection however there are few reports from sub-Saharan Africa.
Methods: We studied fifty seropositive patients with human immunodeficiency virus (HIV) infection along with fifty matched seronegative control. Medical history taking and general physical and neurological examinations were done for all study participants. Laboratory evaluations and chest X-ray were done for all the patients. The cognitive function was done with the aid of 'Fepsy' automated test battery for all the study participants. The data was analyzed with statistical package for social sciences software version 21.0 (SPSS Chicago IL).
Result: About 70% of the HIV patients were in advanced disease stage. The auditory and visual reaction times, binary choice reaction times, and computerized visual scanning task time were more prolonged in the HIV group (p < 0.05). There were also increased memory accuracy and binary choice task accuracy in the HIV group (p < 0.05). However the vigilance task performance was similar between the two groups (p > 0.05). Among the patients with HIV infection, the presence of anemia and central nervous system toxoplasmosis infection was associated with prolonged auditory and visual reaction times.
Conclusion: There was a high rate of cognitive dysfunction in patients with HIV infection in this study.

1. Introduction

Human immunodeficiency virus (HIV) infection is a major cause of morbidity and mortality in the sub-Saharan Africa. As at the end of 2014, about 36.9 million people in the world were infected with HIV infection and 70% of these were living in sub-Saharan Africa. The annual mortality from HIV infection was 1.4 million [15].

Cognitive impairment may be a major manifestation of central nervous system (CNS) HIV infection. The cognitive deficits that have been described in people living with HIV/AIDs include impairment of attention/concentration, memory and psychomotor speed [20,36]. Several workers have documented that cognitive deficits seen in HIV infected patients affected those people with advanced HIV infection [42]. There are evidences that showed that HIV associated neurocognitive disorders

occur through the infiltration of HIV infected monocytes, macrophages and CD4 T cells into the brain by crossing the blood–brain barrier [4,17].

Neurocognitive impairment (NCI) could lead to impairment of activities of daily living, quality of life and poor medication adherence in patients with HIV infection [1,2,8,21,40]. Neurocognitive impairment could predict mortality in patients with HIV infection [30,47]. Various report showed that socio-demographic and some clinical variables affected cognitive functions in patients with HIV infection [10,23,38].

Evaluation of NCI in HIV-infected patients have been done with both traditional and computerized testing in the past but most studies [16,29,31] agreed that computerized assessment of cognitive function offers a standardized assessment in which timing of responses from the patients were very accurate (e.g. reaction times are measured in milliseconds). Also most of the cognitive domains that are affected in early stages of HIV infection such as psychomotor speed, executive functions amongst others were readily assessed by computerized test batteries. In this study, we assessed the burden and pattern of NCI in patients with newly diagnosed HIV infection as well as the influence of socio-

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demographic and some clinical variables on cognitive function in patients with HIV infection since there is paucity of literature on this topic in Nigeria Africans.

2. Methods

This is a cross-sectional study in which fifty patients with HIV infection and fifty age, sex and educationally matched controls were studied. The study was carried out at the Federal Medical Centre, Owo, Nigeria which is one of the tertiary health facilities appointed by the Federal Government of Nigeria as an HIV treatment centre with the major aim of providing free access to medical care including anti-retroviral therapy (ART) to patients with HIV infections.

The inclusion criteria for the patients were age greater than 18 years, seropositivity for HIV infection, minimum education of 6 years (as the test items require the study participants to be able to read English Language) and patients must not be on ART. The exclusion criteria were the presence of co-morbidities that could cause cognitive dysfunction (such as diabetes mellitus, hypertension, epilepsy, other metabolic diseases, cerebrovascular disease, Parkinson's disease, brain tumor among others) and subject must not be a known psychiatric patient. Other exclusion criteria include drug abuse, current use of psychoactive drugs, history of previous head injuries with loss of consciousness, severe functional impairment (Karnofsky performance less than 50%), alcohol intake greater than 13 units/week, presence of cardiac failure, use of anti-cholinergic medication and severe anemia (PCV < 20%). The same exclusion criteria were also applied to controls who were HIV seronegative individuals recruited from the general out-patient clinic and healthy members of staff of the hospital.

The study participants had general physical and neurological examinations. The patients were staged clinically for HIV infection using the World Health Organization (WHO) staging system. The presence of opportunistic infections in the patients were sought with the aid of chest X-ray and sputum examination (pulmonary tuberculosis) and empirical clinical response to anti toxoplasmosis drug was taken as evidence of toxoplasmosis infection. All the patients had laboratory testing which included serum electrolytes, urea and creatinine, full blood count, and liver function test and HIV serological testing with ELISA and CD4 cell count was estimated with automated flow cytometry.

3. Cognitive test assessment

The cognitive testing was done with the aid of a computer assisted neuropsychological test battery called 'iron psychology' with the acronym 'Fepsy' [32]. This instrument had been utilized in the study of cognitive function in various patients groups in Nigeria [35,44]. The 'Fepsy' consists of reaction times tasks, recognition memory tests, visual scanning task, seashore rhythm test, abstraction task and Corsi block task. In this study, we used the reaction time tasks, recognized memory test, computerized visual scanning task, recognition memory test and vigilance task only. Seashore task rhythm task and Corsiblock task were not utilized because they assess for brain damage which could also be done with computerized visual scanning task.

The study participants need not be computer literate to perform the tests as they only need to carry out instruction as they relate to each test. Language does not affect the performance on the test. The test was administered in a reasonably quiet and well lit room at a room temperature between 20 °C to 25 °C. The subject sat at a distance of 40 cm to 60 cm from the visual display screen of the computer. Effort was also made to ensure adequate brightness and contrast of the screen with adequate sound of the computer speakers. One of the authors (S.T.A.), a neurologist with experience in administration of Fepsy was always around to guide the patient during the cognitive assessment of all the study participants. The Fepsy test had been used in several institutions worldwide (www.fepsy.com). It took an average of 90 min to administer Fepsy to a subject.

4. Memory function

The memory function was assessed using the recognition memory test (RMT). The test involved the use of a study item consisting of three or four figures for the visual (non-verbal) memory and four to six words for the verbal memory test which were presented simultaneously. Details of this test were described elsewhere [35].

5. Mental or psychomotor speed

This was assessed using the simple reaction time test. The auditory version involved the presentation of a sound stimulus of $800H_2$ generated by the computer and the subject was asked to react by pressing the space bar as quickly as possible. For the visual version, the subject reacted as quickly as possible on seeing a white square in the middle of the computer by pressing the space bar. Thirty stimuli each were presented for the auditory and visual version.

6. Attention & concentration

Focused attention was assessed with continuous performance test (CPT) which involved the display of a string of eight characters either 'XXXXXXXX' or 'XAXXXXXX'. The subject had to decide on the appearance of a character 'A'. The task was a continuous performance test that lasted 10–20 min. The result yielded two parameters (d and β) d (perceptual sensitivity) ≥ 2 points to a good discriminating ability while β (response bias) value < 1 reflected impulsive behaviour while β value > 1 indicated a conservative way of responding.

Binary choice task is a complex form of continuous performance test. It has two components; binary choice reaction time which assesses psychomotor speed and binary choice reaction accuracy which assesses attention/concentration. Details of the binary choice task were described elsewhere [34,35]. The binary choice reaction time is weakly and positively correlated with binary choice accuracy.

7. Assessment of brain damage

The assessment of brain damage was done with the aid of computerized visual scanning task (CVST). The task involved finding a grid pattern out of 24 which matches the one in the centre. The grid patterns were displayed in the checker board fashion and were numbered 1 to 24. Twenty four patterns were presented and each subject had a total of 24 trials. Results showed accuracy and speed of response and were evaluated within the context of complex visual information processing and perceptual mental changes.

8. Statistical analysis

Data were analyzed using SPSS version 21. The mean scores of these tests were compared between patients with HIV infection and controls using student t-test. Student t-test and analysis of variance (ANOVA) were also utilized to evaluate the influence of the socio-demographic and clinical variables on cognitive function in the patients with HIV. The effect sizes were calculated with Cohen's d; d value less or equal to 0.2 was taken as small effect size. Cohen's d of 0.5–0.7 as medium effect size while d ≥ 0.8 was taken to be large effect size. p value was set at 0.5 and p < 0.5 was taken as being significant.

9. Results

One hundred and thirty-one participants were initially recruited for the study but 31 participants (20 patients with HIV infection and 11 controls were excluded from the study because of incomplete data and unwillingness to continue with the study). The results of the cognitive assessment of the participants were automatically displayed on the screen of the computer after a session of administration of Fepsy