Original article

Assessment of cognitive impairments in people living with HIV/AIDS on antiretroviral therapy

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Abstract

Background: Cognitive declined that happens very slowly over a long period, may escape unnoticed until it reaches in advance stages. The early detection of cognitive impairment that disrupts CNS integrity may be life threatening, if not adequately controlled in time.

Aim: The present study aims to assess the cognitive impairments in people living with HIV/AIDS (PLWHA) on Anti-retroviral Therapy (ART).

Methodology: The present study was conducted on 30 patients of both genders between age range of 20-50 years, who were diagnosed as HIV Positive and receiving ART from ART Center at Guru Tegh Bahadur Hospital, Delhi: selected by using purposive sampling. Data was collected by using standardized neuropsychological tests like- Trail Making Test (Attention), PGI Memory Scale (Memory), Digit Symbol Substitution Test (Visuo motor coordination), Stroop color word and Wisconsin Card Sorting Test (Executive functions). Tools were selected from NIMHANS Neuropsychological Battery for assessment of attention, visuo-motor coordination and executive functions. Data obtained from assessment was analyzed by using descriptive data analysis.

Results: Findings revealed mild cognitive impairments in attention, visuo-motor coordination, response inhibition and moderate to severe impairment was observed on delayed recall, verbal retention for dissimilar pair, overall memory functions and set-shifting tasks.

Conclusion: Although most of the cognitive impairments have been mild, they exert a summated decline in the individual's behavioural adaptation, vocational efficiency and quality of life. Present study highlights the importance of early detection of cognitive deficits in PLWHA. Failure to identify cognitive deficits in people living with HIV/AIDS may directly influence successful management of their disease.

Key words: Cognitive Impairment, Neuropsychological assessment, Anti-Retroviral Therapy (ART), Virus, Rehabilitation.

Introduction:

Assessments are a directed at determining behavioral and sensory consequences of brain abnormalities. So, the need for early identification would be greater, identification of cognitive impairment could provide a stimulus for starting ART in ART-naïve patients, or signal the need for intensified adherence and counseling in those patients already receiving treatment, other potential benefits of early recognition may ensure, including protection from unsafe situation and financial abuse, and increased quality of life through information sharing and improved life planning. [1, 2]

Assessment and management of cognitive deficits in HIV/AIDS patients is integral part to an effective HIV/AIDS intervention program. Mental health professionals are required to assist the management of people living with HIV/AIDS. Early signs of HIV related neurocognitive impairment may be so subtle that affected individuals and their families and friends are not aware of them. From review of literature it has been seen that till now a little

research work have been done in India on this important issue. [2] So, the present study is an effort to assess cognitive impairments in HIV positive patients on antiretroviral therapy and draw a neuropsychological profile of these patients.

Aim of the study:

The present study aims to assess the pattern of cognitive impairments in people living with HIV/AIDS (PLWHA) on Antiretroviral Therapy (ART) .

Objectives:

- To assess the pattern of impairments in attention and memory functions in people living with HIV/AIDS on antiretroviral therapy using neurocognitive assessment.
- To assess the pattern of impairments in motor, visuo-motor and executive functions in people living with HIV/AIDS on antiretroviral therapy using neurocognitive assessment.

Methodology:

Design: It is exploratory research to explore the type and pattern of cognitive impairments in people living with HIV/AIDS on antiretroviral therapy using neurocognitive assessment.

Sample: This study was conducted on 30 patients, both males and females between the age range of 20-50 years who were diagnosed as HIV positive and were receiving antiretroviral therapy (ART). Subjects were selected using purposive sampling from Antiretroviral Therapy Centre at Guru Tegh Bahadur Hospital, Delhi.

Inclusion Criteria: Both males and females with diagnosis of HIV positive, who are on ART and attended OPD services at ART centre, GTB Hospital, Delhi.

1. Age range of subject between 20 to 50 years.
2. Have knowledge about reading and writing Hindi.

Exclusion Criteria:

1. Patients with history of head injury, seizures, substance dependence, and any other diagnosable organic illness.
2. Patients with h/o any diagnosed psychiatric illness.
3. Patients with any significant comorbid medical illness and acute infection.
4. Patients of dementia (will be excluded by MMSE cut off scores below 18).

Tools Used:

1. **Socio-demographic data sheet :** It was developed to obtain socio-demographic characteristics of subjects, i.e., age, gender, family type, education etc.

2. **Mini mental status examination Hindi :**[3] It consists of 22 items, which assesses different components of intellectual capabilities. It is relatively simple to administer and provides a quick, brief index of subject's current level of cognitive functioning. It is modified version of mini-mental state examination MMSE .[4]

3. **Trail Making Test :**[5] This test is used to measure focused attention, complex visual scanning and motor speed. It is also a measure of mental or conceptual tracking and cognitive flexibility. This test has two parts A & B. In part A circles are numbered 1 to 25 of two colours i.e. yellow and pink. All odd numbers are in pink and even numbered circles in yellow. The subject is required to serially connect the numbers 1 to 25 irrespective of colours, in ascending pattern. In part B, the circles include both numbers (1-13) and letters (A-L). Now the subject is required to draw the lines alternating between the numbers and letters (i.e. 1-A-2-B-3-C etc.). The subjects are instructed to connect the circles as quickly as possible, without lifting the pen or pencil from the paper. This test have good psychometric properties, reliability and validity. Test Retest scores range from 0.70 to 0.78 and interrater reliability from 0.96 to 0.98.

4. **PGI Memory Scale :** [6] This scale is a comprehensive and simple scale to assess different types of verbal and nonverbal memories on the basis of neurological theory. This scale contains 10 subtests i.e. (i) Remote memory, (ii) Recent memory, (iii) Mental balance, (iv) Attention concentration, (v) Delayed recall, (vi) Immediate recall, (vii) Retention for similar pairs, (viii) Retention for dissimilar pairs, (ix) Visual retention and (x) Recognition. It is applicable to literate and unsophisticated who constituted majority of subjects in the Indian hospitals and clinics. Reliability of PGI memory scale was tested by repeating the

scale after an interval of one week, quintile norms were developed for subjects in age range of 20-45 years for three educational levels (i.e. '0-5', '6-9' and '10+ above' years of schooling). Separately for each of the 10 subtests. Mean and standard deviation of this score were also provided for the subjects upto 60 years for three educational levels. PGI-MS has replaced the Boston Memory Scale and Wechsler Memory scale. Validity of this test was found to have correlation of 0.71 with Boston Memory Scale and 0.85 with Wechsler Memory Scale. Reliability was found applying test re-test reliability ranged between 0.70 and 0.84 for organic psychotic.

5. **Digital Symbol Substitution Test :**[7] This test was developed by Wechsler in 1981 is a test of visuo-motor coordination, motor persistence, sustained attention and response speed. Using a reference key, the examiner has to pair specific numbers with given geometric figures within a given time limit. Rapid information processing is required in order to substitute the symbols accurately and quickly.

6. **Stroop Colour Word Test :** [8] The stroop colour and word test was developed from the observations by early experimental psychologists that the naming of colour hues is always slower than the reading of colour names in literate adults. The research has examined the use of stroop in cognitive and personality research, in experimental psychopathology and in the diagnosis and understanding of organic brain dysfunction. The interest in Stroop's test concerned with the behaviour of subjects on the page where colour words printed in non-matching colour inks. When the subject was asked to read the words. It was found that this could be done as fast as when the words were printed in black ink. However, when the subject was asked to name the colour of the ink rather than read the word, the time to complete the page was almost 50% below the time to name coloured ink printed as rectangles. The large decrease in colour naming speed was called the "the colour word interference effect". Thus, this test is an effective instrument to evaluate an individual's ability to inhibit prepotent automatic responses thereby testing the role of executive functions in controlling behaviour.

7. **Wisconsin's Card Sorting Test :** [9] WCST can be considered a measure of "executive function", requiring the ability to develop and maintain an appropriate problem-solving strategy across changing stimulus conditions in order to achieve a future goal. The WCST consists of four stimulus cards and 128 response cards that depict figures of various forms (crosses, circles, triangles or stars), colours (red, blue, yellow or green) and number of figures (one, two, three & four). The client is handed a deck of 64 response cards and instructed to match each consecutive cards. Once the client has made a specified number of consecutive "correct" matches to the initial sorting principle, the sorting principal is changed. The WCST is proceeds in this manner through a number of shifts is set among the three possible sorting categories (colour, form and number). Normative data are now provided for individuals 6 years through 89 years of age and on additional correction for education is provided for individuals 20 years of age and older. Results of reliability and validity studies are reviewed, and new psychometric information is presented for child and adolescent clinical samples as well as for expanded samples of adults who have focal or diffuse cerebral disorders.

NIMHANS Neuropsychological Battery [10] was used for scoring and interpreting of data for attention, visuo-motor coordination and executive functions.

Procedure:

In the present study, a total of 30 patients between age range of 20 to 50 years who was diagnosed as HIV positive currently attended antiretroviral therapy centre situated at GTB Hospital, Delhi were selected using purposive sampling method. Before administering the tools, mini-mental status examination was conducted to screen out the patient whether they met the inclusion, exclusion criteria or not, if the criteria were met then the patient and accompanied family members were explained the nature and objectives of the research work, informed consent was taken, confidentiality issues and related

queries were clarified**.** Thereafter, the above mentioned cognitive/ neuropsychological tests were administered to all the patients with a view to plot their neuropsychological profile and identify areas of cognitive impairments. Cognitive assessment was done in four sessions of 50-60 minutes each**.**

Data analysis:
Since the present study was exploratory in nature, descriptive data analysis methods were used. Each participant's responses were scored and interpreted separately. The results were presented with the help of tables and graphs.

Results:

In present study, the patterns of cognitive impairments in people living with HIV/AIDS (PLWHA) on antiretroviral therapy (ART) were assessed by using neurocognitive assessments. The pattern of cognitive impairments in data sample has been represented in the different Tables.

Table 1 demonstrates the pattern of impairment of all the subjects on Trail Making Test (TMT) used for assessment of focused attention.

Table 1: Pattern of impairment on TMT (n=30)

	Part I	Part II
Not impaired	28 (93.33%)	21 (70.0%)
Impaired	2 (6.67%)	9 (30.0%)
Mild impairment	Moderate impairment	Severe impairment
6 (20.0%)	1 (3.33%)	2 (6.0%)

As shown in Table 1, out of 30, only 2 (6.67%) subjects had shown impairment on TMT Part-I, but 9 (30.0%) subjects had shown impairment on TMT Part-II in focused attention.

Table 2: Pattern of impairment of various memory functions on PGI Memory Scale (PGIMS) (n=30)

S. No.	Subscales of PGIMS	Number of cases and percentage		
		No impairment	Mild impairment	Moderate impairment
1.	Remote memory	27 (90.0%)	3 (10.0%)	0 (0%)
2.	Recent memory	27 (90.0%)	2 (6.0%)	1 (3.33%)
3.	Mental balance	24 (80.0%)	5 (16.67%)	1 (3.33%)
4.	Attention & concentration	17 (56.67%)	11 (36.67%)	2 (6.67%)
5.	Delayed recall	1 (3.33%)	5 (16.67%)	24 (80.0%)
6.	Immediate recall	27 (90.0%)	3 (30.0%)	0 (0%)
7.	Verbal retention for similar pairs	20 (66.67%)	7 (23.33%)	3 (30.0%)
8.	Verbal retention for dissimilar pairs	2 (6.0%)	8 (26.67%)	20 (66.67%)
9.	Visual retention	26 (86.67%)	3 (10.0%)	1 (3.33%)
10.	Recognition	13 (43.33%)	13 (43.33%)	4 (13.33%)
	Overall	5 (16.67%)	14 (46.67%)	11 (36.67%)

As shown in Table 2, out of 30, 24 (80.0%) subjects have shown moderate impairment on delayed recall and at the same time 20 (66.67%) subjects have shown impairments on verbal retention for dissimilar pairs and 11 (36.67%) gave shown impairment on attention and concentration task. With respect to overall memory functions on PGI memory scale, 14 (46.67%) subjects had shown mild / less impairment and 11 (36.67%) subjects had shown moderate impairment.

Table 3 demonstrates the pattern of impairment of all the subjects on Digit Symbol Substitution Test (DSST) used for assessment of visuo-motor coordination.

Table 3: Pattern of impairment in visuomotor coordination test on DSST (n=30)

Pattern of impairment	No. of case (%)
No impairment	12 (40.0%)
Impairment	18 (60.0%)
Mild	10 (33.33%)
Moderate	5 (16.67%)
Severe	3 (10.0%)

As shown in Table 3, out of 30, 18 (60.0%) subjects had shown impairment in visuo-motor coordination. Out of them, 10 (33.33%) subjects had mild, 5 (16.67%) subjects had moderate and rest 3 (10.0%) subjects had shown severe impairment.

Table 4: Pattern of impairment on executive functions (response inhibition) on SCWT (n=30)

Pattern of Impairment	No. of cases (%)
Impairment	7 (23.33%)
No impairment	23 (76.67%)

As shown in the Table 4, pattern of impairment on Stroop Colour Word Test (SCWT) which were used for assessing response inhibition ability of the subjects. Out of 30 subjects, only 7 (23.33%) subjects showed impairment on response inhibition task.

Table 5 demonstrates the pattern of impairment on Wisconsin's Card Sorting Test (WCST) of all the subjects.

Table 5: Pattern of impairment on executive functions (set shifting) on WCST (n=30)

	No. of correct responses	Category completed	% of preservative errors	
Impairment	11 (36.67%)	2 (66.67%)	8 (26.67%)	
No impairment	19 (63.33%)	28 (93.83%)	22 (73.33%)	
Overall	No impairment	Mild	Moderate	Severe
No. of cases (%)	17 (56.67%)	7 (23.33%)	4 (13.23%)	2 (6.67%)

Wisconsin Card Sorting Test (WCST) used to assess set shifting, planning, mental flexibility and executive functions. As shown in the Table 5, pattern of impairment on WCST of 30 subjects, 7 (20.0%) subjects had shown mild, 4 (13.23%) subjects moderate and 2 (6.67%) subjects had shown severe impairment.

Discussion:

The current study was done to assess the pattern of cognitive impairment in PLWHA on ART by using cognitive assessment. For this purpose various cognitive skills i.e. attention, verbal and non-verbal memory, visuo-motor coordination and executive functions (response inhibition and set shifting) were assessed.

With respect to focused attention task-I, findings revealed that out of 30, 28 (93.33%) subjects have shown no impairment, only 2 (6.67%) subjects have shown mild impairment,

but on focused attention part-II, out of 30, 9 (30%) subjects have shown impairments, out of which 6 (20%) had shown mild impairment. In one earlier study, Becker et al (1999)[11] also reported that among individuals classified as having NP impairment, the domains most frequently affected are attention and speed of information processing, learning, verbal abilities (primarily fluency), and motor functioning. Grey, Adle & Biassette et al (2001) reported that cognitive impairment is characterized by mental slowness, trouble with memory and poor concentration. [12]Ellis et al (2005) also reported the similar trend of findings subjects generally performed worse on the tests of psychomotor speed (digit symbol, Trails A) and cognitive flexibility (Trails B).[13]

With respect to various memory functions, findings revealed that out of 30, 24

(80%) subjects have shown moderate impairment on delayed recall and 20 (66.67%) subjects have shown impairment on verbal retention for dissimilar pairs. Only 3 (10.0%) subjects have shown impairment on recent and remote memory. In relation to overall memory functions on PGI memory scale out of 30, 14 (46.67%) subjects have shown mild/less impairment and 11 (36.67%) subjects have shown moderate impairment. The findings of present study revealed that in PLWHA more impairment was seen on delayed recall and verbal retention for dissimilar pair and mild impairments in overall memory functions. The findings of the present study are somewhat consistent with other earlier similar studies. Hinkin and Hardy et al (2002) reported that memory deficit (yet another example) is a symptom often reported with HIV and is believed to be the cause of NCD. Selnes (2005) reported again, in HAD, the recognition memory is relatively intact. In Alzheimer's and other cortical diseases, there is not selective preservation of recognition memory.[14]

With respect to visuomotor coordination task, research findings revealed that out of 30, 18 (60.0%) subjects have shown impairment in visuomotor coordination and 10 (33.33%) subjects have shown mild impairment, 5 (16.67%) moderate and only 3 (10%) have shown severe impairment. Likewise present study in some earlier studies relationship between visuomotor coordination and HIV infection was studied.

Mandal & Singh et al (2008) showed that specific deficits have been reported in digit symbol substitution test, trail making test and controlled word association test. [15]In a study by Carey and Woods et al (2009) it was noted that a combination of tests tapping verbal memory (Hopkins Verbal Learning Test—revised total recall) and psychomotor speed (Grooved Pegboard or digit symbol modalities) emerged as best predictors of rater-determined impairment. [16]

The advent of highly active antiretroviral therapy has prolonged the life expectancy of HIV patients and decreased the number of adults who progress to AIDS and HIV-associated dementia. However, neurocognitive deficits remain a pronounced consequence of HIV/AIDS. Neuropsychiatric complications are highly prevalent in HIV/AIDS

patients. The foundation for this area of research was laid decades ago. With the decreased incidence of AIDS and AIDS-related complications after the implementation of HAART, there appears to be less research in the neuropsychiatric impairments in AIDS and few new studies to help further expand the field. more research will be needed on preventative measures to delay the progression of the CNS involvement and minimize the morbidity and mortality seen in HIV-associated neurocognitive disorders (Watkins and Treisman, 2015). [17]The importance of these findings in prediction of early neurological disturbances is highlighted and their significance in the total management and rehabilitation of people living with HIV/AIDS (PLWHA) on antiretroviral therapy (ART).

Limitations and Suggestions:

First and foremost limitation of this work is its small sample size (n=30) Due to practical difficulties this study had to be confined to only single hospital setting hence limiting the heterogeneity of the sample. This study being purposive and highly focused could not provide for an exhaustive view of complete neuropsychological profile in PLWHA. Complete neuropsychological battery could not be used to measure the entire range of cognitive deficit due to paucity of time. Similar study could be done on large sample including more hospital settings, which could help in generalizing the results of the study. Cognitive skills like visuo-spatial ability, reasoning capacity, problem solving skills and language are also very important areas which are also influenced in the target population. In future researches, these skills can also be taken into account. In future research a complete neuropsychological battery could be used to assess a broader range of cognitive functions.[18]

Conclusion:

The identification of cognitive impairment could provide a stimulus for starting cART in ART-naive patients, or signal the need for intensified adherence counseling in those patients already receiving treatment. It is reasonable to believe that treatment may improve cognition. Counseling to avoid psychoactive medications and illicit drugs may also be advantageous. In summary, it is likely that identifying impairment may impact treatments aimed at improving quality of life. there is a complex but significant

interaction between mental health and HIV/AIDS. HIV/AIDS affects mental health by its direct neurobiological action. The impact of having the illness by its treatment, including that for opportunistic infections and by its impact on the family. In addition substance use and mental illness as vulnerability factors add to the complexity of assessment, differential diagnosis and management. In balance, there are important clinical needs that can be addressed by research aimed at demonstrating whether improved detection results in improved outcome. With the above discussion, it can be concluded here that, current work is a small contribution to the vast field, it is just like a drop in the ocean and still there is a lot more work need to be done in future for this sensitive group so that we can serve best to this population with our knowledge.

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