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Original Research Article

Auditory Reaction Time and Visual Reaction Time in Asymptomatic HIV

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Abstract

Background: Auditory reaction time and visual reaction time were measured in asymptomatic HIV positive persons and corresponding controls to detect impaired central information processing mechanisms in the early stages of HIV.

Objective: To perform auditory reaction time and visual reaction time in asymptomatic HIV positive persons and corresponding controls.

Material and Methods: In this study,100 participants were selected in the age group 25-45 years. In study group, 50 participants were included, who were HIV positive and asymptomatic (CD4 count > 350 cells/mm3) and were not on Anti Retro Viral Treatment (ART). In control group 50 healthy age matched HIV negative individuals were included. We measured auditory reaction time (AR Time) using low frequency and high frequency sounds and visual reaction time (VR Time) using red and green lights.

Results: Study of auditory reaction time and visual reaction time in asymptomatic HIV revealed that, auditory reaction time for high frequency (ART HF), auditory reaction time for low frequency (ART LF), visual reaction time for red light (VR Time Red) and visual reaction time for green light (VR Time Green) were significantly prolonged in study group than control group.

Conclusion: Study of auditory reaction time and visual reaction time in asymptomatic HIV positive persons suggests impaired central information processing mechanisms in the early stages of HIV. Hence, auditory reaction time and visual reaction time can be important to detect impaired central information processing mechanisms in the early stages of HIV.

Keywords: Auditory Reaction Time, Visual Reaction Time, Human Immunodeficiency Virus, Acquired Immunodeficiency Syndrome, Asymptomatic.

Introduction

The Human Immunodeficiency Virus (HIV) attacks immune system and makes person susceptible to infections as well as some types of cancers. So far, HIV has claimed 40.1 million [33.6–48.6 million] lives. Transmission of HIV can occur via blood, breast milk, semen, and vaginal secretions. Infected individuals eventually become immunodeficient as the virus kills and inhibits the activity of immune cells. Immune function is typically measured by CD4 cell count. [1] Cytopathic effects of HIV can be either direct or indirect. In a high percentage of patients with HIV, significant morbidity is due to disease of the nervous system. In HIV affected individuals, neurological involvement can be either primary to the pathogenic

processes of HIV infection or secondary to opportunistic infections or neoplasms. [2]
Lymphotropic and neurotropic nature of HIV has been demonstrated by virological and clinical evidence. Various inflammatory disorders, neuronal loss along with dendritic damage and synaptic loss is caused due to primary pathology of HIV. [3] HIV infected individuals are prone to the development of neurological impairment. Some studies have reported impaired neurocognitive function tests in HIV infected individuals. [4]
HIV has shown cognitive decline from subclinical symptoms of forgetfulness to severe symptoms, such as dementia. HIV associated cognitive decline includes memory dysfunction, higher order attentional difficulty, executive dysfunction, and cognitive slowing. Such cognitive slowing represents important symptom of HIV associated neurocognitive disorder. The study of the time course of information processing in the human nervous system is called as Mental Chronometry, which can be measured by the reaction time (RT), which is an overt response to a single stimulus. As cognitive slowing is central feature of HIV associated neurocognitive disorder, chronometric methods such as reaction time (RT) are well suited in HIV infected individuals. [5]
Study of auditory and visual reaction time in advanced HIV has shown prolonged auditory and visual reaction time. [6] Hence, we studied auditory reaction time & visual reaction time to detect cognitive deficits in HIV infected asymptomatic persons of Central India.

Materials and Methods

This study was carried out in the Physiology Department of Indira Gandhi Government Medical College, Nagpur, India. Approval was obtained from the Institutional Ethics Committee. This cross-sectional study took place over a two-year period. The participants who were selected for the study belonged to the age group of 25–45 years. A sample size of 100 participants was selected and divided into study group and control group. The study group had 50 HIV-positive individuals detected from the Anti-Retroviral Therapy Center of the institute. HIV-positive persons who were Elisa test positive for HIV, had a CD4 count >350 cells/mm3, and were not started on Anti-Retroviral Treatment were included in the study group. The control group consisted of 50 healthy age-matched HIV-negative individuals from the same population. Individuals with a history of alcoholism, smoking, drug abuse, diabetes mellitus, hypertension, visual abnormalities, CNS impairment due to any other disease, tuberculosis, autoimmune disease, or immunosuppressant drug treatment were excluded from the study. Written informed consent was obtained from all participants. The detailed clinical history of each participant was obtained, and a thorough systemic clinical examination was carried out in every participant prior to the test.

We measured auditory reaction time (AR Time) using low-frequency and high-frequency sounds and visual reaction time (VR Time) using red and green lights by a device "Response Analyzer" by Yantrashilpa system, Pune. The device had a display range from 0 to 9.999 seconds with display resolution of 0.001 second. The instrument had an accuracy of ± 0.002 second, power consumption up to 12 watts maximum, power supply of 220 volts, 30 Hz A.C., and working voltage of 12 volts D.C. The Device was exclusively designed to measure the response time in milliseconds. It had four modes of stimuli i.e., audio, visual, cutaneous, and electrical. The response can be given by either the hand or foot. The auditory and visual reaction times of all subjects in the present study were measured in a quiet room with good visibility conditions. Participants were asked to sit comfortably in an armchair near the table on which the Response Analyzer was placed.

Participants were explained about the details and procedure of the test. For recording auditory reaction time, audio mode was selected. The required interval to apply the stimulus was adjusted, and then sound was set for low frequency, as required. The display was reset to zero by using a reset switch. The subjects were instructed to respond as soon as the participant heard the sound by pressing the response key with an index finger on it. To record the reaction time, the visual mode was switched on. The required color light (i.e., Red, Green) was then set on the visual stimulus box. The display was set to zero by using a reset switch. Participants were instructed to respond, as soon as they saw the glow by pressing the response key with an index finger already on it. [7] All the participants were right-handed and they responded with their right hand. For statistical analysis, the values of reaction time (RT) parameters were expressed as mean with standard deviation. The values of each parameter in the study and control groups were compared and analyzed using an unpaired Student's t-test. A p value less than 0.05 was considered as an indicator of statistically significant difference between the compared values.

Results

Anthropometric parameters were compared between the control and the study groups. The mean values with a standard deviation of age, height, weight, and BMI of the control and study groups are shown in Table 1. No significant differences in age, height, weight, or BMI were observed between the control and study groups ($P > 0.05$).

Table 1: Showing comparison and analysis of various anthropometric parameters of control and study groups

Parameter	Control Group (n=50) Mean ± SD	Study Group (n=50) Mean ± SD	p value
Age (years)	33.34 ± 5.64	32.34 ± 5.52	0.373
Height (cm)	166.82 ± 3.76	166.90 ± 3.56	0.913
Weight (kg)	59.58 ± 2.20	58.94 ± 2.68	0.195
BMI (kg/m^2)	21.42 ± 0.71	21.16 ± 0.84	0.106

BMI: Body mass index, SD: Standard deviation

Table 2 shows the mean values with standard deviations of auditory reaction time for high frequency (ART HF) and low frequency (ART LF) in the control and study groups. ART HF and ART LF were significantly prolonged in the study group compared to the control group.

Table 2: Comparison and analysis of auditory reaction times for high frequency and low frequency in the control and study groups

Parameter	Control Group (n = 50) Mean ± SD	Study Group (n = 50) Mean ± SD	p value
AR Time HF	0.1554 ± 0.00644	0.1642 ± 0.00672	0.000
AR Time LF	0.1569 ± 0.00666	0.1648 ± 0.00646	0.000

SD: Standard deviation
AR Time HF= Auditory reaction time for high frequency
AR Time LF = Auditory reaction time for low frequency

Table 3 shows the mean values with standard deviations of visual reaction time for red light (VR Time Red) and visual reaction time for green light (VR Time Green) in the control and study groups. From the table, it is observed that VR Time Red and VR Time Green were significantly prolonged in the study group compared to the control group.

Table 3: Comparison and analysis of visual reaction times for high frequency and low frequency in the Control and Study groups

Parameter	Control Group(n = 50) Mean ± SD	Study Group(n = 50) Mean ± SD	p value
VR Time Red	0.1813 ± 0.00623	0.1879 ± 0.00605	0.000
VR Time Green	0.1800 ± 0.00719	0.1887 ± 0.00566	0.000

SD: Standard deviation
VR Time Red = Visual reaction time for red light
VR Time Green = Visual reaction time for green light

Discussion:

The study was carried out to assess auditory reaction time and visual reaction time in normal healthy and HIV seropositive individuals. The results of the study showed that auditory reaction time for high frequency (ART HF), auditory reaction time for low frequency (ART LF), visual reaction time for red light (VR Time Red), and visual reaction time for green light (VR Time Green) were significantly prolonged in the study group than in the control group.

Above results are in accordance with Karlsen N et al, Ayuso-Mateos J L et al, Law W. et al. [4,8,9] Mellagran A et al studied HIV-1 infected patients without Acquired Immunodeficiency Syndrome (AIDS) and patients with chronic Hepatitis C. HIV-1 infected patients showed 5-47 ms longer reaction time than patients with Hepatitis C. They concluded that a subgroup of HIV-1 infected individuals had slower reaction time compatible with cerebral deterioration early in the course of infection. [10]

Jabbari B et al found slowed reaction time in asymptomatic HIV individuals which was correlated significantly with EEG abnormality. [11] Amador F et al studied reaction time in neurologically asymptomatic HIV-1 individuals and found that HIV-1 seropositive group was slower in reaction time performance than seronegative group. [12] Martin EM et al Studied reaction time in asymptomatic HIV and found significantly longer decision times, which emphasized use of reaction times as marker of central nervous system involvement in HIV-1 infection. [13] Wilkie FL et al studied cognitive functions in asymptomatic HIV and they concluded that cognitive inefficiency occurs during early HIV infection. [14]

Whereas Ogunrin O et al assessed the reaction time in Nigerian Africans with HIV. They did not find any significant difference between controls and asymptomatic HIV-positive individuals. [15]

The strength of our study was that we studied auditory reaction time & visual reaction time in asymptomatic HIV, which was useful in the early detection of impaired central information processing mechanisms in HIV. However, we did not study auditory reaction time & visual reaction time in symptomatic HIV. This would have been useful in comparing the impaired central information processing mechanisms of asymptomatic and symptomatic individuals, which was a limitation of our study.

Infection with the Human Immunodeficiency Virus-1 has been shown to cause cognitive decline in a significant proportion of infected individuals. The characteristic neuropsychological symptoms related to HIV infection include memory dysfunction, higher order attentional disturbance, executive dysfunction and cognitive slowing. [5]

Cognitive slowing is the earliest sign of cognitive-motor disorder related to HIV-1 infection; hence, reaction time (RT) is the most suitable measure to detect cognitive deficits in neurologically asymptomatic

HIV infected individuals. Evidence suggests that it is more likely that tasks which require a greater degree of central processing will be sensitive to the effect of HIV-1 infection. This suggests that the reaction time deficits shown by HIV-infected individuals in the initial stages could be caused by the slowing of central information processing mechanisms. [12] Therefore, prolonged auditory reaction time and visual reaction time in our study suggests impaired central information processing mechanisms in asymptomatic HIV.

Conclusion

The study of auditory reaction time and visual reaction time in asymptomatic HIV positive persons suggests impaired central information processing mechanisms in the early stages of HIV, as evidenced by prolonged auditory reaction time for high frequency (ART HF), auditory reaction time for low frequency (ART LF), visual reaction time for red light (VR Time Red), and visual reaction time for green light (VR Time Green). Hence, auditory reaction time and visual reaction time can be important for detecting impaired central information processing mechanisms in the early stages of HIV.

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