ORIGINAL ARTICLE

Visual Acuity and Contrast Sensitivity among Subjects with Human Immunodeficiency Virus Infection Receiving Highly Active Anti-Retroviral Therapy

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Abstract:

Objectives: To assess visual acuity and contrast sensitivity among subjects with Human Immunodeficiency Virus (HIV) infection receiving Highly Active Anti-Retro Viral Therapy (HAART) and compare with the duration of treatment.

Methods: A total of 85 participants with Human Immunodeficiency Virus infection receiving HAART therapy were assessed for both visual acuity (VA) and contrast (CS) sensitivity. VA was taken for right eye and left eye separately with Log Mar chart. Refraction was done for refractive error. For Contrast Sensitivity, Pelli-Robson chart was used. Contrast Sensitivity was taken binocularly. Data was analyzed through (SPSS) software version 22.

Results: In this study, the total number of participants was 85, among which 82 were males and 03 were transgenders, who were receiving highly active antiretroviral therapy (HAART) for HIV infection. The mean age of the participants was 31.41 ± 5.19 years. The majority of subjects (84.7%) had VA of 0.00 log Mar (6/6) or better, while 15.3% had mild visual impairment. Normal contrast sensitivity was observed in 50.6% of subjects, while 45.9% had poor CS. The duration of HAART did not show any significant association with visual acuity (p=0.407); however, a significant association was observed between contrast sensitivity and duration of HAART (p=0.003).

Conclusion: People with HIV receiving HAART may experience changes in their visual function, specifically in contrast sensitivity. The duration of HAART treatment was found to be significantly associated with contrast sensitivity, while it has no effect on visual acuity. *Al-Shifa Journal of Ophthalmology 2025; 21(1): 9-16. © Al-Shifa Trust Eye Hospital, Rawalpindi, Pakistan.*

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Introduction:

Around 39 million people (0.7%) were infected with HIV globally in 2022.[1] Prevalence was higher among sex workers, gay and bisexual men, people who inject drugs, transgender people, and prisoners. The prevalence of HIV-related eye diseases varies depending on the geographic region, access to healthcare, and stage of the HIV infection [2]. Human Immunodeficiency Virus is an RNA virus that kills CD4 cells (T-helper cells). These T-helper cells protect our body from infection and disease[3,4]. If left untreated, Human Immunodeficiency Virus infection leads to Acquired Immunodeficiency Syndrome (AIDS). Apart from systemic disorder, it has a profound impact on the eyes, which leads to a decrease in visual functions such as visual acuity, contrast

sensitivity, color vision, and visual fields, which can be irreversible [5]. Disease processes affect these functions of the eye even in the absence of retinitis [6]. A study conducted in China has reported that before the introduction of HAART, there was a moderate to severe decrease of visual acuity in HIV-positive patients. Visual acuity dramatically improved from 1.00 Log MAR (6/60) to 0.50 Log MAR(6/18) with the use of HAART.[7]

A study conducted on HIV positive pediatric population using HAART therapy has shown significant improvement in visual acuity but changes in contrast sensitivity lead to poor performance in daily activities throughout life.[8,9] Active Anti-Retroviral Therapy (HAART) has led to a dramatic decrease in HIV-related morbidity and mortality in the developed as well as developing world[10]. It has been also effective in reducing rapidly progressive retinopathies due to HIV infection[11]. In 1992 before HAART availability in North America and Europe, about 50%–75% of the HIV-infected individuals were estimated to develop non refractive visual problems, and Cytomegalovirus (CMV) retinitis which was the leading cause of vision loss while this complication dropped dramatically since HART started [12,13.] In 2003 a study reported the incidence of (CMV) retinitis has decreased by 95% to 55% as compared to the rates seen in the early 1990s, presumably because of the widespread use of HAART [14]. A study at the University Malaya Medical Centre compared retinal nerve fiber layer (RNFL) thickness and visual function between people living with HIV (PLWH) and HIV-negative individuals in Malaysia. The average age of PLWH was 46.1 years, and all were on antiretroviral therapy (ART), with 61.2% having a CD4+ T-cell count over 500 cells/µl. There was no significant difference in visual acuity between the two groups, but PLWH had lower contrast sensitivity. Additionally, PLWH had significantly thinner RNFL in the temporal quadrant compared to HIV-negative controls[15]. The review examined the impact of HIV and antiretroviral therapy (ART) on retinal structure and function in people living with HIV (PLHIV) without retinitis. It found that PLHIV experienced noticeable thinning of the retinal nerve fiber layer (RNFL), particularly in the superior and inferior areas. Additionally, visual function was affected, with changes observed in various tests, including transient pattern VEP, electroretinograms (ERGs), contrast sensitivity, color vision accuracy, and perimetry tests, showing reduced mean deviation and pattern standard deviations[16]. This study can help raise awareness among healthcare professionals regarding the importance of monitoring visual function in patients with HIV receiving HAART treatment. Overall, the study has significant implications for improving the health and quality of life of patients with HIV in Pakistan.

Methodology:

This study was cross-sectional and conducted from June 2022 to November 2022 in the center of Human Immunodeficiency Virus (HIV) and Acquired Immune Deficiency Syndrome (AIDS), in Hayatabad Medical Complex (HMC), Peshawar. The study aimed to assess visual acuity and contrast sensitivity among subjects with human immunodeficiency virus infection receiving HAART and to compare visual acuity and contrast sensitivity with duration of HAART therapy among subjects with human immunodeficiency virus infection. Ethical approval was taken from the research committee of Hayatabad Medical Complex (HMC), Peshawar. Non-probability consecutive sampling technique was used. All participants, males, females, and transgender were included in this study who were aged 18 to 40 years and were already receiving active retroviral therapy for HIV infection. All those participants with HIV infection were excluded from the study who had ocular complications due to retinal disorders secondary to systemic

diseases such as diabetic mellitus, hypertension, tuberculosis, etc.

A proforma was used to collect data on medical records, current treatment, socio-demographic data, and duration of the disease and duration of HAART. Visual acuity was recorded on the EDTRS visual acuity chart in Log MAR. Both objective and subjective refraction were performed. A contrast sensitivity test using a Pelli-Robson chart was used to record contrast sensitivity at one meter. The values were recorded and noted on the Performa. Data were entered and analyzed using SPSS software version 22. Descriptive statistics and chi-square test analyses were carried out to describe variables and to identify factors associated with visual function and association between dependent and independent variables. A probability value (p-value) was calculated using Spearman's test for categorical values comparison and a p-value of <0.05 was considered statistically significant.

Results:

The total number of participants of this study was 85. Among them 82 (96.5%) were male and 03 (3.5%) were cross-gender.

There were 40 (47.1%) participants from ages 34-40 years and 13(15.3%) were from 18-25 years. The mean age of the participants was 31.41 ± 5.192.

Among them, 61 (71.8%) were married and 24 (28.2%) were unmarried. Most of the participants were having higher education 26(30.6%). 25(29.4%) of the participant were drivers followed by labor 21(24.70%)

Table 1: Demographic profile of the participants

Gender		Male N (%)	Transgender N (%)	Total N (%)
Age (Years)	18 to 25	12 (14.1)	01 (1.2)	13 (15.3)
	26 to 33	38 (44.70)	02 (2.4)	40 (47.1)
	34 to 40	32 (37.6)	0	32 (37.6)
	Total	82 (96.5)	03 (3.5)	85 (100)
	Mean age (Mean ± SD)	31.41 ± 5.192		

Table 2: visual impairment with best possible correction among patients receiving HAART therapy

Categories of visual impairment (range)		With best possible correction N (%)
Visual impairment	Normal 0.3 (6/12) or better	72 (84.7%)
	Mild VI <0.3 (6/12) to 0.5 (6/18)	13 (15.3%)
	Moderate VI < 0.5 (6/18) to 1.0 (6/60)	0

Table 3: Status of contrast sensitivity among patients receiving HAART therapy

Categories (range)		Number N (%)
Contrast sensitivity	Normal = 2.00	43 (50.6%)
	Poor < 2.00	39 (45.9%)
	Sever <1.5	03 (3.5%)

Table 4: Comparison of visual impairment with duration of highly active anti-retroviral therapy

Visual acuity (Log MAR)		Duration of HAART (in years)						
		1-3 N (%)	4-6 N (%)	7- 9 N (%)	10-12 N (%)	13-15 N (%)	Total N (%)	P value
Visual acuity with best possible correction	Normal 0.3 (6/12) or better	36 (42.4)	25 (29.4)	07 (08.2)	03 (3.50)	01 (1.20)	72 (84.7)	0.407
	Mild VI <0.3(6/12)-0.5(6/18)	04 (04.7)	06 (07.1)	02 (02.4)	0	01 (01.20)	13 (15.3)	
	Total	40 (47.1)	31 (36.5)	09 (10.6)	03 (3.50)	02 (02.4)	85 (100)	

Table 5: Comparison of contrast sensitivity with duration of highly active anti-retroviral therapy among people with human immune deficiency virus

Contrast Sensitivity		Duration of HAART (in years)						
		1-3 N (%)	4-6 N (%)	7-9 N (%)	10-12 N (%)	13-15 N (%)	Total N (%)	P-value
Contrast Sensitivity (CS)	Normal =2.00	25 (29.4)	10 (11.8)	07 (8.2)	03 (3.5)	0	72 (84.7)	0.003
	Poor CS <2.00	14 (16.5)	20 (23.5)	02 (2.4)	0	01 (1.2)	37 (33.6)	
	Sever CS <1.5	01 (1.2)	01 (1.2)	0	0	01 (1.2)	03 (3.6)	
	Total	40 (47.1)	31 (36.5)	09 (10.6)	03 (3.5)	02 (2.4)	85 (100)	

Discussion:

A cohort study was conducted on 1300 patients at 19 clinical trial centers, standardized measurements of visual acuity and contrast sensitivity were analyzed. They concluded that visual dysfunction is common in patients with AIDS without retinitis[17]. The same is the case in our study. According to a study conducted in Maryland, USA in 2006, 379 subjects with AIDS with follow-up of three months. Those subjects whose immune recovery with HAART therapy was stable or improved had a 50% lower risk of visual acuity loss.[18]. while in our study with a long duration of HAART therapy, the visual

acuity improved Defects in contrast sensitivity have been observed in an American study by Mueller A J et al in which they analyzed visual dysfunction in HIV-positive patients without retinitis in receiving Highly Active Antiretroviral Therapy (HAART) [19]. We also observed defects in contrast sensitivity in subjects taking HAART therapy.

A review was done on the low contrast sensitivity chart in HIV patients receiving HAART therapy, the low contrast sensitivity of the HIV-positive patients without retinopathy was found to be significantly lower than the age-matched controls ($p < 0.01$). This finding is probably attributable to pathology related to HIV in the visual pathways. Contrast sensitivity charts were found to be a useful diagnostic tool for HIV patients and presumed neuropathy [20]. A study was conducted in 2006 in Los Angeles, California in which the best corrected Visual acuity was 6/9 or better, with no media opacities, and no retinal pathologies. The mean age of subjects was 46 years. The abnormal contrast sensitivity was 7.0% [21]. The reason for the higher number of contrast sensitivity defects than our study may be because of starting late treatment, geographic differences of patients, or a smaller number of enrolled patients than our study. A study conducted in Thailand showed the incidences of VA loss to ≤20/50 and ≤20/200 were 0.22/eye-year (EY) and 0.12/EY, respectively. Risk factors for the incidence of VA loss to ≤20/50 were low CD4+ T-cell count (adjusted hazard ratio [aHR], 3.1), large area of retinitis (aHR, 3.7), and no immune recovery (IR) (aHR, 13.9). Risk factors for the incidence of VA loss to ≤20/200 were not receiving highly active antiretroviral therapy (HAART) (aHR, 4.4) and large retinitis area (aHR, 2.1) [22]. In our study, the duration of HAART therapy was one to three years and the visual outcome was better than 0.3 (6/12). The difference may be due to the mean duration of HAART therapy, which was one to three years in our study, which is less than the mean duration of HAART therapy in their study conducted in Singapore.

A study was done on patients who have control of disease in HAART treatment time. They reported a relationship between contrast sensitivity and duration of HAART treatment. They reported that contrast sensitivity was going low as the duration of HAART therapy was prolonged [23]. This study resembles our study (table 5).

In British, a study was conducted on 75 patients who were examined with their normal control with different durations of HAART treatment time. They used a highly sensitive computer graphics system to measure color vision and contrast sensitivity, they reported a relationship between contrast sensitivity and duration of HAART therapy with progression of HIV disease[24]. Contrast sensitivity is also affected in our study with the duration of HAART therapy.

A one-year longitudinal study was done in Ethiopia. They enrolled 240 patients who were on HAART therapy. Females accounted for 66.6% of the study participants, with male to female ratio of 1:2. Their mean age was 35.4 years. Visual acuity was normal in 90.1% of the patients, 7.2% had visual impairment and 2.7% were found to be bilaterally blind. Visual impairment and blindness was significantly associated with the duration of HAART in their study[25]. While in our study with a mean age of 31 years with normal visual acuity of 72%, but no significant association of visual impairment with duration of HAART was detected. The reason for this difference from our study may be because of gender (table 1), only males and transgender were there, and no female were in our study. Another reason may be because of the selection of patients. In our patient, no posterior segment pathology was detected.

Defect in contrast sensitivity has been observed in an American study by Muller et al. They analyzed visual dysfunction in HIV-positive patients without retinitis who

were on HAART treatment. In their study, 12% of eyes had low contrast sensitivity and 3 % of eyes had visual acuity worse than 6/12. They did not report any relationship between visual acuity/contrast sensitivity with duration of HAART therapy[26]. However, in our study significant association of contrast sensitivity with duration of HAART was ($p<0.05$) present. Poor contrast sensitivity was observed in 37 (33.6%) participants. Among them, 20 (23.5%) of the participants were using HAART from 4-6 years, and 14 (16.5%) ($p<0.003$) from1-3 years (table 5). While no significant association ($p>0.05$) was found between visual acuity impairment and duration of (HAART) therapy (table 4).

Longitudinal studies are needed to determine where changes in the retinal nerve fiber layer and systemic indicators such as frailty predict changes in visual function. It is recommended that further research on visual function be done as a case-control. Prospective case-control studies would be more informative where baseline data for the visual function is obtained and trends are monitored. Further research on the effects of HAART or duration of HAART therapy on visual function is recommended. There is a need for surveillance of visual function abnormalities in HIV-positive children on HAART.

Conclusion:

In our study visual acuity (VA) and contrast sensitivity (CS) were assessed in such people without any ocular manifestation and who were receiving HAART. This study's results show that poor contrast sensitivity (CS) is associated with the duration of use of HAART. Similarly, the results show that contrast sensitivity (CS) can be affected in people with HIV even if visual acuity (VA) is good.

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