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Original Research Article

Pure tone audiometric findings in HIV positive adults in university of Port Harcourt teaching hospital

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ABSTRACT

Background: It is known that HIV infection is a risk factor for hearing loss. Therefore this study is to determine the pattern and severity of hearing loss and whether there is a correlation between the CD4 count and hearing impairment in the HIV positive adult patients seen in the infectious outpatient clinic of university of Port Harcourt teaching hospital (UPTH).
Methods: A hospital based descriptive cross sectional study of consecutive patients that are HIV positive seen in the infectious outpatient clinic of UPTH within a period of three months, from May to July of 2020. The biodata, history of hearing difficulties and management of the disease was obtained using a semi structured questionnaire. All the patients had otoscopy done and hearing assessment with pure tone audiometry (PTA). The analysis was done with the SPSS version 25 software at a 95% confidence interval and a p value less than 0.05 was considered significant.
Results: The study involved 234 subjects comprising 127 males and 107 females. Hearing impairment was seen in n=113 (48.29%). The patients with CD4 count less than 500 cells/mm2 was found to have more hearing loss; 55.8% than those with counts greater than 500 cells/mm2. Age distribution was statistically significant with a p=0.0001.
Conclusions: The pure tone audiometric pattern in the majority of the studied population was more of CHL. The age, duration of ARVT and the CD4 count all had statistically significant association with hearing loss in the HIV positive adults.

Keywords: Hearing impairment, Human immunodeficiency virus, CD4 count, Antiretroviral therapy

INTRODUCTION

Human immunodeficiency virus infection in Nigeria has the 2nd highest burden worldwide and it is a challenge to the public health.[1]

Human immunodeficiency virus (HIV) infection is associated with a higher risk of hearing impairment based on available preliminary data.[2] It is also known that about 75% of adults with AIDS has some form of hearing impairment attributable to the commonly present opportunistic infections and possible ototoxic medications.[3] Incidence of hearing loss among these patients ranges from 20-40%.[4] The degree of hearing loss tend to worsen with increasing severity of the disease.[5] The virus can directly affect the central nervous system or affect peripherally, the auditory nerve. The peripheral affectation can be neurotropic or neurotoxic resulting in sensorineural hearing loss.[6] when it affects the central nervous system, it causes demyelination of the brain stem resulting in increased latencies on the auditory brain stem which can give rise to sudden sensorineural hearing loss.[7]

It is known that conductive Hearing loss (CHL) was commoner in children with HIV while sensorineural hearing loss (SNHL) was commoner in adults with HIV however even in adults HIV can also be associated with conductive hearing loss.[2] This is because the middle ear in these patients are often susceptible to invasion by organisms and inflammations resulting from a blockage of the Eustachian tube opening from the generalized lymphadenopathy common in these patients.[2,8] There is also a defective mechanism of chemotaxis and phagocytosis resulting in otitis media and conductive hearing loss.[9]

In HIV, there is poor humoral and cell mediated immunity which could lead to increase in opportunistic infections such as meningitis which could also affect hearing.[10]

It is also known that the CD4 count is an indicator of the degree of immunosuppression, therefore severity of disease invariably affects the level of hearing in these patients.[11] Low CD4 count has been associated with neural degeneration in HIV infected individuals.[12] The CDC classified HIV into stages; 1, 2 and 3. Stage 3 is the greatest HIV disease severity with CD4 count of less than 200. Higher prevalence of sensorineural hearing loss has been noted in those with this stage 3 disease.[13]

The ART and some ototoxic medications used in treating some of the opportunistic infections have been implicated also in hearing loss in these patients.[4,14,15] in a particular study, 89% of HIV positive patients on ART was found to be hearing impaired in comparison to 61% of those that though seropositive, were yet to commence on ART. These patients on ART were also found to have higher hearing thresholds.[16] It is postulated that the hearing loss in the HIV positive patients not yet on ART could likely be due to direct effect of the virus on the auditory system.[17] While that in the patients already on ART is thought to be in addition to direct viral invasion, opportunistic infections and /or ototoxicity.[18] The HAART which are the latest form of treatment in these patients have been postulated by many researchers as being possible ototoxic.[18,19,20] However, some others have found no correlation between ototoxicity and HAART.[21]

Improved nutrition and medical care have all made this infection to move from being a terminal condition to a more chronic health problem with increased life expectancy therefore requiring a long term hearing care.[5] This study therefore evaluates the Pure tone hearing thresholds, the pattern and severity of hearing loss and whether there is a correlation between the CD4 count and hearing impairment in the HIV positive adult patients seen in the infectious outpatient clinic of university of Port Harcourt teaching hospital (UPTH).

METHODS

A hospital based descriptive cross sectional study of consecutive patients that are HIV positive seen in the infectious outpatient clinic of UPTH within a period of three months, from May to July 2020.

The biodata, history of hearing difficulties and management of the disease was obtained using a semi structured questionnaire. All the patients had otoscopy done and hearing assessment with pure tone audiometry (PTA). The PTA was carried out from frequencies of 250 through 8000Hz for each ear in a quiet room with ambient noise at 20 to 30dB HL determined with a sound pressure meter. Diagnosis of impairment was done using WHO classification and ASHA 1981 modification that is based on Pure Tone Average calculated from air conduction thresholds using values from frequencies at 500, 1000 and 2000Hz. Values ranging from 0 to 25 dB are considered normal level of hearing. 26-40db=mild hearing impairment. 41-55db=moderate hearing impairment. 56-70=moderately severe hearing impairment. 71-90db=severe hearing impairment. 90+ db=profound hearing impairment. These were used to determine the degree of hearing impairment. Informed consent was obtained from all the subjects and approval was sought and obtained from the hospital ethical committee for the study.

Patients who had otologic problems or hearing loss prior to the diagnosis of HIV were excluded from the study. Only the patients that gave their informed consent were included in the study.

Sample size calculation

This is determined using the Cochrane formula with a prevalence of 20% from an earlier study by Fasunla et al in Ibadan.[22]

$$n = pq \div (e \div 1.92)2$$

where n is the sample size. P = prevalence =20

q = 100-p = 100-20 = 80

e = precision of 5.5%; 1.96 = standard deviation of 95% significant level.

$$20 \times 80 \div (5.5 \div 1.96)2 = 203$$

$$Na = n \div 1 - non - response = 225.5$$

Adjusting for nonresponse rate of 10% = 203. Na is approximated to 230. Therefore, a sample size of at least 230 will be adequate for the study.

Statistical analysis

The analysis was done with the statistical package for social sciences (SPSS) version 25 software at a 95% confidence interval and a p-value less than 0.05 was considered significant. All variables were presented in means, frequencies and percentages as appropriate. The differences in continuous variables were compared using

the t-test and the association of duration of treatment, demographic factors, CD4 count and severity of hearing impairment was assessed using the chi-square analysis.

RESULTS

The study involved 234 subjects comprising 127 males and 107 females, giving a male to female ratio of 1.2:1. Age group 40-49 years made up 45.3% of the population. The least was age 60-69 years with 0.4%. Majority of these patients (50.9%) have been on ARV therapy for 6-10 years. Table1. Hearing impairment was seen in n=113 (48.29%) Figure 1. More males had hearing impairment than females but this was not significant statistically. However age distribution showed age range 50-59 to have more hearing impairment compared to other age groups; 38.1% this was statistically significant with a p=0.0001. The patients that have been on ARVT for 1-5 years have more hearing impairment; 41.6% while those that have been on treatment for 11-15 years had the lowest percentage of hearing loss, 10.6%. There is a statistically significant difference between the treatment duration and hearing loss Table 2.

Table 1: Demographic distribution.

	Frequency (n=234)	Percent (%)
Gender		
Male	127	54.3
Female	107	45.7
Age-groups (years)		
30-39	73	31.2
40-49	106	45.3
50-59	54	23.1
60-69	1	0.4
Duration of ARV (years)		
1-5	52	22.2
6-10	119	50.9
11-15	43	18.4
>15	20	8.5

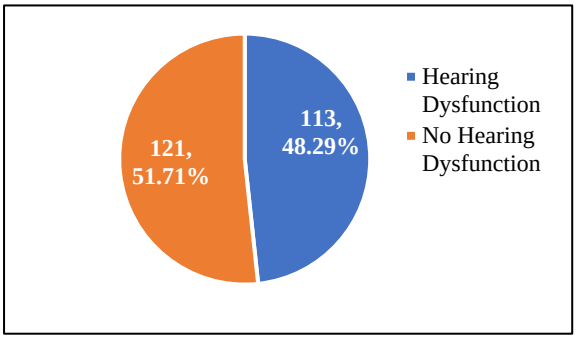

Figure 1: Prevalence of hearing impairment.

Table 2: Relationship of hearing impairment and demographic data.

	Hearing impairment (n=113, %)	Normal Hearing (n=121, %)	Chi-square (p value)
Gender			
Male	63 (55.8)	64 (52.9)	0.19 (0.661)**
Female	50 (44.2)	57 (47.1)	
Age-groups (years)			
30-39	36 (31.9)	37 (30.6)	34.83 (0.0001)*
40-49	33 (39.2)	73 (60.3)	
50-59	43 (38.1)	11 (9.1)	
60-69	1 (0.9)	0 (0.0)	
Duration of ARV (years)			
1-5	47 (41.6)	5 (4.1)	84.00 (0.0001)*
6-10	34 (30.1)	85 (70.2)	
11-15	12 (10.6)	31 (25.6)	
>15	20 (17.7)	0 (0.0)	

*statistically significant (p<0.05), ** not statistically significant (p<0.05)

Table 3: Relationship of CD4 and Hearing impairment.

Cells/MM^2	Hearing impairment (n=113, %)	Normal Hearing (n=121, %)	Chi-square (p value)
CD4 count			
≥500	50 (44.2)	24 (19.8)	16.10 (0.0001)*
<500	63 (55.8)	97 (80.2)	

*Difference is statistically significant (p<0.05)

Table 4: Distribution of PTA.

PTA Pattern	Frequency	Percentage
Conductive hearing loss.	75	32.05
Sensorineural hearing loss.	35	14.96
Mixed hearing loss.	3	1.28
Normal hearing.	121	51.71
Total	**234**	**100.00**

The patients with CD4 count less than 500 cells/mm2 was found to have more hearing loss; 55.8% than those with counts greater than 500 cells/mm2. The difference is statistically significant. Table 3. The PTA pattern showed 32.05% had Conductive hearing loss (CHL) while mixed hearing loss was least with 1.28% and 51.7% had normal hearing. Table 4. The degree of hearing impairment was mild hearing loss in the majority of the subjects for both the sensorineural and the conductive hearing loss. Unilateral hearing loss occurred more than the bilateral for all the types of hearing loss recorded. No statistically significant difference was noted however.

Table 5: Distribution of severity of hearing impairment.

Severity	SNHL N, (%)			Conductive N, (%)		
	Right	Left	Bilateral	Right	Left	Bilateral
Mild	3 (25)	2 (9.52)	1 (20)	24 (80)	17 (53.13)	8 (61.54)
Moderate	7 (58.33)	11 (52.38)	3 (60)	4 (13.33)	14 (43.75)	5 (38.46)
Severe	2 (16.67)	8 (38.1)	1 (20)	2 (6.67)	1 (3.13)	0 (0)
Total	12 (100.0)	21 (100.0)	5 (100.0)	30 (100.0)	32 (100.0)	13 (100.0)
Chi-square (p value)	2.66 (0.6152)**			7.84 (0.0985)**		

** not statistically significant (p>0.05).

DISCUSSION

The study involved 234 subjects with 113 among them having hearing impairment. This represented 48.29% prevalence of hearing impairment in this study. This prevalence in contrast is higher than that found in an earlier study in Cameroun; 21.7% but it is still within the range of the documented 14-49% earlier and later 20-50% in literature.[23,24,25] Zuniga in another earlier study had a higher level of 75%.[3] It was also closer to the findings of 52% by Matas et al.[25] On the other hand, an earlier study in Ibadan Nigeria had a lower prevalence of 33%.[26] These differences are not easily explained. It could be because different criteria and thresholds are used by different researchers to classify hearing impairment. It also depends on whether the best or worse ear was used in the calculation of the PTA. The classification used in the present study was similar to that employed in South Africa by van der Westhuizen et al with slight modification.[4] There was a slight male preponderance similar to the finding of another researcher but the difference was not statistically significant.[27]

The age group distribution of hearing impairment showed appreciable percentages of loss across all the age groups agreeing with the findings of Luque et al that in HIV, there is associated hearing loss with age.[28] The youngest age range 30-39 years had 31.9% of them with hearing impairment. However, the age group 50-59 years were the most affected. The association between age and hearing loss was statistically significant. This finding appears to agree with some researchers that noted that there seems to be an early senescence in patients with HIV infections in order words, an early onset or accelerated aging in terms of auditory structures and functions.[29] it is also possible that in addition to the infection, presbyacusis could have a part in the hearing impairment in these elderly patients.

All the subjects in this study were already on the antiretroviral therapy (ARVT) according to the new guideline that once a patient is diagnosed, treatment should be commenced. It is of note however that those that had been on treatment for the shortest duration; 1-5 years had more hearing impairment. It has been documented that the initial hearing impairment in the HIV positive adults could be as a result of direct damage on the central auditory system by the virus.[6] This in addition to possible ototoxicity from the treatment could explain this finding.[18] The duration of treatment with ARV and hearing loss was statistically significant.

The CD4 count is a measure of the immune status and therefore the stage of the disease and a major indicator of susceptibility to opportunistic infections. In the present study, as expected, the subjects with counts less than 500 cells/mm^2 had more hearing impairments similar to other studies.[30] The relationship of CD4 count and hearing impairment was significant statistically.

In the present study, the commonest type of hearing impairment recorded was conductive hearing loss. This is in contrast to the findings of some earlier works.[24,26] But similar to the work of Alabi et al.[31] This could be because these earlier works in contrast, were mainly on patients with very low CD4 counts- AIDS stage. These are postulated to have more of SNHL because of the progressive decline in their immunologic status and therefore increased chances of opportunistic infections and chances of the neurotropic effects of the virus.[24] Mixed hearing loss (MHL) is not a very common type of hearing loss in the HIV patients; in the present study, only one patient had (MHL) similarly Khoza-shangase recorded none in an earlier study.[30] An appreciable percent of the subjects had normal hearing similar to the finding by khoza- shangase.[30] Most of the subjects had Mild degree hearing loss followed by Moderate loss with no profound loss recorded similar to other studies.[28,32] Unilateral hearing loss was seen more in these patients agreeing with other researchers.[27,32] There was no statistically significant difference between the various degree of loss.

Limitations

It was not possible to rule out completely other variables that could affect hearing such as presbyacusis in the older patients. In addition, only the conventional pure tone Audiometer was used in the study therefore frequencies beyond 8000 Hz could not be assessed.

CONCLUSION

The pure tone audiometric pattern in the majority of the studied population was more of CHL with mild and moderate degree of hearing loss. The age, duration of

ARVT and the CD4 count all had statistically significant association with hearing loss in the HIV positive adults.

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