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Original Article

DPOAE in HIV infected adults

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Abstract:
HIV infection is associated with impairment of hearing function, at any stage of disease causing complication to the external, middle, inner ear and CNS. Audiological manifestation of HIV is a direct consequence of virus or secondary to the pharmacological treatment or viral complication.
Objectives: There is paucity of information pertaining to hearing status in HIV. As the deafness can occur at any stage of HIV with varying degree and people with HIV live longer, there is need to address the hearing problems in these individuals. So this study aimed detecting the outer hair cell functioning by doing DPOAE in normal hearing HIV infected adults.
Method: The experimental group comprised of 12 HIV infected (24 ears) within 20 to 40 years. The age matched control group comprised of 15 subjects (30 ears). All the subjects had normal hearing sensitivity. Initially puretone audiometry and immittance was performed for the subject selection. Subsequently DPOAE procedure was done.
Results: The DPOAE was abnormal in 50% of the subjects.
Conclusion: It can be concluded that the cochlear involvement is a common observation in HIV infected individuals. DPOAE test can be used as a tool for early identification of cochlear pathology in HIV infected.
Key Words: HIV, DPOAE, Outer hair cell function, Central nervous system

Introduction:

Although education about Acquired immune deficiency syndrome (AIDS) is spreading faster than the disease itself, and the ways to avoid infection are well known, AIDS continues to be one of the world's greatest health problems. A substantial number of HIV infected patients experience long term disabilities involving cognitive and motor functions, which include communication disorders.(1-4) HIV infected individuals who eventually develop AIDS may remain asymptomatic for an average of 8 – 10 years.(5) Otologic manifestations associated with HIV infection are mild hearing impairment present at any stage of disease with complication anywhere in the auditory system from external ear to the CNS.(6-8) Most otologic problems are caused by routine organisms and respond to standard therapy.(9) Audiological problems of HIV infection is considered as a direct consequence of virus or secondary to the pharmacological treatment.(10) Due to the involvement of central nervous system in HIV infection, the most direct consequence to the auditory system is central auditory nervous system abnormalities, measured with auditory brainstem response (ABR). ABR finding in adults with HIV include prolonged absolute latency of third and fifth or IPLs of I-III, I–V.(11,12) There is growing evidence of both central and peripheral hearing loss associated with opportunistic infections such as primary CNS lymphomas.(1,9,13)

Sooy reported that 45% of out of 53 patients had sensorineural hearing loss in AIDS.(14) Sensorineural hearing loss reported in persons with HIV infection ranged from 20.9 to 49%.(9) The exact cause and site of lesion for sensorineural hearing loss associated with HIV disease is unknown. Sensorineural hearing loss associated with HIV may be caused by secondary opportunistic infections of the CNS or many of the drugs used to treat HIV infection with its ototoxic complications. Another form of therapy that may cause sensorineural hearing loss is the use of radiation to treat CNS lymphomas associated with HIV.(9)

Otoacoustic emission is a non invasive procedure which enables one to identify the cochlear component of a hearing disorder and to objectively monitor minute changes in cochlear status undetectable by other audiological procedures. Its clinical utility ranges from detection of noise induced hearing loss, to check the extent of damage of outer hair cells in ototoxicity, to differentiate between cochlear and retrocochlear pathology, to diagnose functional hearing loss, auditory neuropathy etc. Oto acoustic emissions arise from the most vulnerable cellular mechanism in the ear, which is of fundamental importance to hearing, the outer hair cells.(15-17) and therefore are particularly useful in assessing damage caused by HIV infection. It has been shown that otoacoustic emissions can be recorded in almost all the normal hearing individuals.(18,19) As the hearing thresholds increase, the possibility of recording normal OAEs gets significantly reduced. The hearing thresholds beyond which the emissions may be absent is variable across studies, from 15 dB HL (20), 25 dB HL (21), 35 dB HL (22) to 40 dB HL.(23,24)

HIV infected individual has often prescribed medications as a prophylaxis or treatment of opportunistic infections that have been long associated with the development of audiological (tinnitus, vertigo, dizziness, auditory disturbances, deafness, decreased hearing, hearing loss, and otalgia) and vestibular changes regardless of a persons HIV status. The severity of ototoxic induced hearing impairment varies from patient to patient and depends upon the sensitivity of the individual, the size of the dosage, and/or the length of time the drug has been taken. Beyond ototoxicity many of the opportunistic infections are associated with the development of hearing loss. Sudden onset sensorineural hearing loss also has been reported in the HIV/AIDS populations and deserves special considerations, as this particular population is susceptible to numerous opportunistic infections, approximately one third of patients with sudden sensorineural hearing loss have some history of recent viral infection.(25)

Need of the study

However a review of the literature in Audiology revealed a paucity of information pertaining to hearing status in HIV. As the deafness can occur at any stage of HIV with varying degree and people with HIV live longer, there is a grave need to address the hearing problems in these individuals in order to help them maintain a productive and meaningful life for as long as possible. The early detection of possible underlying hearing pathology helps in drawing a meaningful intervention plan and so this study was taken up with an aim of detecting the outer hair cell functioning by Distortion product otoacoustic emissions (DPOAE) in normal hearing HIV infected adults.

Methods:

The study was conducted at a tertiary care hospital.

Subjects:

Control group comprised of a total number of 15 subjects (30 ears) between 20 to 40 years. All the subjects in the control group had normal hearing sensitivity, and none of them had otologic abnormalities. Twelve subjects (24 ears) with HIV infection comprised the experimental group within the age ranging from 20 years to 40 years. All the subjects had normal hearing sensitivity with 'A' type tympanogram and normal reflexes bilaterally.

Instrumentation:

- GSI 61 Audiometer was used to evaluate the hearing sensitivity.
- GSI Tymp star was used to analyze the middle ear function.
- GSI Audera was used to record the DPOAE.

Procedure:

All the procedures were carried out in a sound treated room. Initially a detailed history was obtained. All the subjects had otoscopic examination. This was followed by pure tone audiometry and immittance testing for the subject selection. Subsequently, the DPOAE screening was performed with the following parameters

- L1/L2 - 65/55
- F1/F2 - 1.22
- DP frequency -1KHz, 1.5KHz, 2KHz, 3KHz, 4KHz

Analysis

Obtained data was analysed in percentages by comparing the signal to noise ratio between the control group and the experimental group for different frequencies.

Results:

This study was aimed at screening HIV with DPOAE to assess the outer hair cell function in normal hearing HIV infected adults. Almost 50% of the subjects demonstrated OAE abnormality in this study. Out of the 12 ears taken for study, otoacoustic emission amplitude were reduced in 50% at 1KHz, 41.66% at 1.5kHz , 25%at 2kHz, 33.33%at 3kHz and 41.66% at 4kHz. It was also observed that in 16.66% OAE was almost absent in all frequencies in spite of having normal hearing sensitivity. The results are detailed in Table I.

Table I: Signal to noise ratio (S/N) of Distortion Product Otoacoustic Emission at different frequencies in HIV infected individuals

	1kHz	1.5kHz	2kHz	3kHz	4kHz
S1	7.57	11.24*	21.41	19.78	17.83
S2	6.34*	9.53*	17.03	15.01	11.85*
S3	10.20	22.23	20.14	21.70	24.36
S4	3.21*	27.37	7.59*	27.91	33.50
S5	17.59	24.60	23.41	11.61*	.00**
S6	.00**	16.10	22.42	10.83*	1.84*
S7	18.02	22.73	22.63	18.95	17.67
S8	23.38	12.68	22.87	20.57	32.35
S9	1.50*	11.24	21.41	19.78	17.83
S10	18.02	22.73	22.67	18.95	17.67
S11	6.09*	.00**	.00**	.00**	.00**
S12	6.31*	.88*	.00**	1.87*	.00**
S13	7.37	11.14*	21.35	19.77	17.82
S14	6.29*	9.44*	17.30	15.54	11.55*
S15	10.29	22.44	20.36	21.85	24.56
S16	3.18*	27.55	7.48*	27.63	33.06
S17	17.78	24.44	23.23	11.57*	.00**
S18	.00**	16.33	22.46	10.77*	1.82*
S19	18.34	22.53	22.43	18.65	17.66
S20	23.28	12.54	22.67	20.56	32.25
S21	1.44*	11.44	21.21	19.88	17.34
S22	18.22	22.87	22.76	18.96	17.76
S23	6.11*	.00**	.00**	.00**	.00**
S24	6.41*	1.11 *	.00**	1.89*	.00**
Normative with SD	13.24 (SD-6.22)	19.03 (SD-7.16)	19.89 (SD-9.22)	21.70 (SD-7.65)	24.66 (SD-8.10)
% of abnormal OAE findings	50%	41.66%	25%	33.33%	41.66%
* reduced amplitude; ** absent amplitude					

Discussion:

The present study focused on assessing the outer hair cell function by doing DPOAE in HIV infected adults. A clear indication of cochlear involvement was observed in 50% of the subjects included in the study. This is in consensus with Sooy, who reported that 45% out of 53 patients diagnosed with AIDS had sensorineural hearing loss.14 Lalwani and Sooy have reported sensorineural hearing loss in persons with HIV-1 infection ranging from 20.9 to 49%.(9)

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Probst et al have reported that otoacoustic emissions can be recorded in almost all the normal hearing individuals.(18,19). As the hearing thresholds increase, the possibility of recording normal OAEs gets significantly reduced. The hearing thresholds beyond which the emissions may be absent is variable across studies, from 15 dB HL (20), 25 dB HL Probst et al (21), 35 dB HL (22), to 40 dB HL.(23-24) The fact that all these subjects had normal hearing with abnormal OAE could be attributed to cochlear pathology either due to ototoxicity or HIV infection itself.

The amplitude difference with low and high frequency regions being more affected than that of mid frequency was observed in this study. Shaffer et al.(26) have commented that in normal hearing subjects the relative amplitudes of the generation and reflection components vary across frequency, with some frequency regions having greater amplitude of the generation component while in other frequency regions the reflection component may dominate.

Consequence of HIV infection on the auditory system is central auditory nervous system abnormalities, some of which can be measured with auditory evoked potential which include mainly ascending pathway i.e. afferent pathway**.** ABR finding in adults with HIV include prolonged absolute latency of third and fifth or IPLs of I-III, I–V(11-12), which indicate problem in the auditory path way. As 95 % of the ascending nerve fibers supply to the IHCs and 5% to the OHCs, and in the efferent nerve fibers, 90 % to the OHCs and 5% to the IHCs, there is a possibility that efferent pathway may also be effected, which may lead to impaired OHC function, as it controls the outer hair cells function. The same may be applicable in the present study too.

However there are hardly any studies done on the HIV infected with a special focus on the ototoxic effect of the disease on the auditory system. Otologic manifestations associated with HIV-1 infection are mild hearing impairment present at any stage of disease with complication anywhere in the auditory system from external ear to the CNS.(6-8) The fact that the integrity of the outer hair cells is questionable in HIV infected even when the hearing function is normal stresses on the importance of DPOAE screening which helps in the early detection so that possible intervention strategies can be initiated. As primary professionals in hearing health care, audiologists have responsibilities to inform themselves and other relevant health-care professionals about any of the issues associated with HIV/AIDS.(27)

Conclusion:

The present study was an attempt towards assessing the integrity of the auditory system particularly the outer hair cell function in HIV infected adults. It was observed that the OAEs were abnormal in 50% of the subjects in spite of having normal hearing ability, indicating cochlear involvement. The attributing factor for this abnormality could be the HIV infection itself or the ototoxic effect of the medication. With a lot of stress on the longer life span of the HIV infected, it is mandatory to identify problems at the earliest for drawing a meaningful intervention plan. Hearing is one of the important functions that play a major role in all walks of life. DPOAE thus can be used as a tool for the early identification of cochlear pathology in individuals with HIV infection, even prior to the hearing sensitivity being compromised because of the infection.

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