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# THE EFFECT OF CD4 COUNT LEVEL ON THE MIDDLE EAR DYNAMICS OF HIV INFECTED PATIENTS

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## ABSTRACT

***Background*: HIV infection, a multi systemic disease has been identified as one of the causes of hearing loss in man.**
***Objectives*: To compare the effect of HIV infection on the middle ear dynamics of HIV infected and non-HIV infected individuals using tympanometry.**
***Design*: A prospective cross sectional study**
***Setting*: HIV Clinic at University of Benin Teaching Hospital (UBTH) in 2010.**
***Subjects*: Tympanometry was done on adults (18-45year old) patients with confirmed retroviral disease (RVD) infection and confirmed non-HIV infected adults (18-45year old) as the control group. All the patients certified the inclusion and exclusion criteria.**
***Main Outcome Measures*: More women were found with HIV infection than men at a ratio of 1:3.7(men = 21% and females = 79%). There was preponderance of type "B" tympanogram among HIV-infected individuals.**
***Result*: There was a significant correlation between CD4 cell count and type "B" tympanogram (P=0.03). The CD4 cell count measured severity of HIV infection while the type "B" tympanogram detected middle ear effusion.**
***Conclusions*: Middle ear effusion is the genesis of middle ear pathology in HIV infected population.**

## INTRODUCTION

HIV is a neurotrophic and lymphotrophic virus affecting principally the T- helper lymphocytes (CD4), resulting in suppression of cell mediated immune response and depletion of T4 lymphocytes (low CD4 count). The hallmark of this condition is that it predisposes the patient to the risk of opportunistic infections (1). Such infections can occur in the ear as acute otitis media which may progress into chronicity, chronic suppurative otitis media (CSOM) and its complications.

Hearing loss in HIV patients has been associated with other viral infections like cytomegalovirus, herpes simplex virus and other bacterial infections (2,3,4). A study by Schuknecht and Donovan found that temporal bone histopathologic studies of patients who experienced idiopathic sudden sensorineural hearing loss showed damage in the cochlea consistent with viral injuries. The pathologies found in the cochlea of these HIV patients include; loss of hair cells and supporting cells, atrophy of the tectorial membrane, atrophy of the stria vascularis, and neuronal loss. There was a similar findings in hearing loss following mumps, measles, and maternal rubella (5).

The exact mechanism of how the HIV disease causes hearing loss is not yet clear. Furthermore, controversy on the ototoxic effect of some of the antiretroviral therapies has been speculated as an independent cause of hearing loss on patients (6). To this end, the study aims to determine the effect of CD4 count level on the middle ear dynamics of HIV infected patient using tympanometer.

## MATERIALS AND METHODS

This study was a prospective cross sectional study of young adults (18-45 year old) with confirmed retroviral disease (RVD) infection. The study population was recruited from consecutive patients who attended the HIV Clinic at University of Benin Teaching Hospital (UBTH) in 2010. The control group was selected from individuals who were tested and

confirmed HIV-negative by Voluntary Counseling and Testing Section of the HIV Unit, and had no symptoms and/or diagnosis of hearing impairment. An interviewer administered questionnaire was completed for each eligible participant.

*Inclusion Criteria*: The participants of the study group met all the following criteria

1. HIV infected patients aged between 18 - 45 years.
2. HIV infected patients who gave their informed consents to participate in the study.

The participants of the control group were recruited to match the study group in age and sex. They also gave consent to participate in the study except that they tested negative for HIV I or II

*Exclusion Criteria*: The following exclusion criteria were applied in this study:

1. HIV positive patients whose ages fall outside the range 18 to 45 years.
2. HIV infected patients whose diagnosis of hearing impairment pre-dated the HIV infection.
3. Patients who refused to give a written consent to participate in the study.

*Ethical considerations*: The study protocol was submitted to the Ethical Review Committee of UBTH, Benin City and approval was received before commencing the data collection. Eligible participants signed informed consent before they were recruited into the study.

*Method of Identification of HIV patients*: Their HIV infection status was confirmed based on the diagnostic criteria recommended by United Nations Joint Programme on HIV/AIDS (UNAIDS) and World Health Organization (WHO) for making a diagnosis of HIV infection1. Confirmed HIV I or II positive patients using ELISA. First ELISA Screening test was used for preliminary identification of patiens followed by a confirmatory testing with Western Blot technique.

*A general clinical examination*: A general clinical examination was carried out on each person and in addition anterior and posterior rhinoscopy was done on the patients to rule out any mass that could be obstructing eustachain tube. Otoscopy was done on every patient using hand held auroscope and appropriate sized speculum cleaned with dilute hypochloric acid and methylated spirit. Otoscopy was used to estimate the diameter of the external ear canal and the status of the tympanic membrane (TM).This helped to exclude impacted wax, foreign body and in addition reveal any ear discharge or perforation on the tympanic membrane. Identified pathologies were treated or appropriately refered for treatment. Peripheral venous blood was obtained from the patients for CD4 cell count determination.

*Tympanometry*: The auditory canal and tympanic membrane were examined before tympanometry. Large clumps of earwax and squamous debris were removed before testing. There are several sizes of soft probe tips especially for the different diameters of the external auditory canal. The probe tip sizable for each EAM was selected for each ear to obtain a valid tracing. The ear helix was gently grasped and pulled up and backward to straighten out the ear canal and allow insertion of the soft probe tip. The automatic recording device was triggered, when the probe tip was inserted properly and hermetic seal achieved. The probe tip was left in position until the test was concluded. After a clear tracing was obtained, the procedure was repeated in the contralateral ear. There was a repeat of the procedure for each of the unsatisfactory results.

During the test, the patient did not talk, move, open or close the jaw, swallow, or startle.

*The CD4 count*: The CD4 cell count was done for every patient in the study group in the HIV unit of UBTH laboratory by the trained personnel who were approved and employed for this purpose. The CD4 cell count was used to stage the severity of the HIV disease for the commencement of antiretroviral drugs in HIV infected patient

*Data Analysis*: After the collection of the data the result was analysed using descriptive tools in statistical package for the social sciences (SPSS). Relationship between variables was assessed where necessary using Chi-Square and T-test.

P-value $\leq 0.05$ was considered statistically significant. The results were presented in both tabular and graphic forms as appropriate.

## RESULTS

Out of these 3200 patients seen in the HIV clinic during the study, 97 patients were eligible for this work based on the inclusion and exclusion criteria used. Forty-nine people who tested HIV-negative and volunteered to undergo pure tone audiometry were used for control matching their age and sex with the study group.

There were 21 males and 76 females with M:F 1:4 in the study group (Table 1). The control group was made up of 10 males and 39 females, M:F 1:4 (Table 1). The age range was 21-45 years. There were no eligible 18-20 year old participants. The modal age was 31-35 years while the least was 21-25 years age (Table 2).The mean age for the study group was 34 ±7.19 years while that of control group was 35.0 ±5.69 years. All the participants in the control group had no ear symptoms while in the study group, 80 participants complained of ear symptoms in the right and 82 participants complained of ear symptoms in

the left (162 ears complained of ear symptoms). Chi-square test shows that there is a mild statistical significant relationship ($p < 0.05$) between CD4 cell count and Type B tympanometry.

Using ANOVA to check for the difference in the Tympanometric value for the control and the study group shows a statistical significance (P=0.03) between the two groups. However, the independent t-test for test of statistical significant showed that compliance and pressure values were the ones causing the difference in the values. Type B tympanometry was more predominant than type AS, Type Ad and Type C (Table III) in the study group.

## DISCUSSION

Tympanometry is important in the diagnostic accuracy for middle ear diseases as shown in the 1997 "Guidelines for the Diagnosis and Management of Acute Otitis Media (AOM) and Otitis Media with Effusion (OME)"7,8. Middle ear pathology is the major cause of conductive hearing loss (CHL). This study showed that there were preponderance of Type "B" and Type "AS" tympanograms among the HIV infected participants than in the control group (Figure 1). Type "B" tympanogram reflects impaired compliance or increased impedance of the motion of the tympanic membrane over the continuum of pressure gradient.

The type "B" tympanogram can be seen when there is a small middle ear effusion . A middle ear cavity that contains a large effusion instead of air will reflect most of the sound energy backward and have a flat line type "B" tympanogram. However, there are other conditions that can give type "B" tympanogram such as occlusion of the probe tip by cerumen or the canal wall. Type "B" tympanogram can also occur when there is TM perforation or tympanotomy tube. These conditions were ruled out by otoscopy. Any middle ear mass, including a cholesteatoma will impede transmission of sound energy and may also be associated with a type "B" tympanogram. Type "AS" (s=shallow) tympanogram pattern shows a low peak amplitude of TM compliance which suggests stiffened middle ear system. The preponderance of these findings among HIV infected participants is suggestive of a greater predisposition to the formation of middle ear pathology that can impede transmission of sound wave than in the control group (non-HIV infected population).

Several studies reported that there is reduced nasal mucociliary action in HIV infected individuals (9, 10, 11). The middle ear having the same mucoepitheial lining with the upper air way , may be affected equally with the same aetiology. If this is possible, it means that middle ear effusion / recurrent otitis media with effusion due to the reduced mucocilliary action in the middle ear could be the major cause of the preponderance of type "B" among HIV infected patients. This may also partly explain the pathophysiology of middle ear infections that is common among HIV sero-positive individuals12,13. Chi-square test showed that there was a statistical significant relationship ($p < 0.05$) between CD4 cell count and Type B tympanometry that was observed in this work (Table III). It may be explained that the lesser the CD4 cell count the more the chances of the middle ear fluid formation, which will equally increase the risk of the patient having conductive hearing loss and/or otitis media. The CD4 cell count measured severity of HIV infection while the type B tympanogram detected middle ear effusion seen with increased severity of HIV infection. The findings in this study agrees with previous works which show that low CD4 cell count predisposes HIV sero-positive patient to a higher risk of developing otitis media (14,15,16).

Type "C" and Type "Ad" was not found among the non-HIV infected participants (control group). The type "C" tympanogram is similar to type "A" but the peak is to the left of normal pressure. It indicates extreme eustachian tube dysfunction when the pressure peak is less than –300 dePa. Eustachian tube dysfunction on its own can lead to middle ear effusion which is one of the major problems of the HIV infected patients as seen in this study [Table III]. The absence of the type "C" tympanogram among the control (non-HIV infected) group is a further proof that middle ear effusion is a major cause of hearing impairment in HIV sero-positive population.

In conclusion, we hereby recommend that there should be audiometric and tympanometric routine ear assessment and subsequent monitoring for all the HIV infected patients. Furthermore, a more sensitive advanced refractory acoustic tympanometer that can measure volume and density of the middle ear fluid should be used for more specific diagnosis of the middle ear effusion. Finally, otoacustic emission device and brain stem evoked response audiometery should be incorporated in the subsequent study to help in assessing cochlea and retro-cochlea functions.

There was preponderance of type "B" tympanogram among HIV-infected individuals which correlates significantly with the CD4 cell count levels. This work highlights the fact that middle ear effusion is commoner among the HIV infected population despite the absence of clinical features of otitis media in these patients. Therefore middle ear effusion is the genesis of the middle ear pathology seen among this group and it has an inverse relationship with CD4 count.

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