Original Article

Artigo Original

Hearing loss in children with HIV/AIDS

Perda auditiva em crianças com HIV/AIDS

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Keywords

Hearing loss
Highly active antiretroviral therapy
Acquired immunodeficiency syndrome
Otitis
Hearing

ABSTRACT

Purpose: To investigate the occurrence of hearing loss in children with HIV and its association with viral load, opportunistic diseases, and antiretroviral treatment. **Methods:** A cross-sectional study was carried out with 23 HIV-positive children under care at two specialized centers in João Pessoa, Paraíba, Brazil. Their parents or legal guardians responded to a questionnaire, containing data on the clinical situation and the hearing health of the children, who were then submitted to audiological assessment. We complied with the guidelines for human research contained in the CNE (National Education Council) Resolution number 196/1996. The findings were analyzed through descriptive statistics. **Results:** We observed that lamivudine (3TC) was the antiretroviral drug most used in 17 (94.4%) patients, followed by Kaletra (KAL), administered in 14 (77.8%) patients, d4T in 11 (61.1%) patients, and zidovudine (AZT) in 7 (38.9%) participants. Otitis was the most frequent opportunistic disease, with 11 (61.1%) cases. In the audiometric examination, we observed 39 (84.8%) ears with hearing loss and 7 (15.2%) normal ears. After the immitance testing, we found five (10.9%) normal ears, characterized by type A tympanometric curves. The other 41 (89.1%) ears were revealed as altered, with predominance of type B curves in 67.4% of the cases. **Conclusion:** There were hearing alterations in children with HIV/AIDS analyzed in this study. Discreet hearing losses were the most occurring. We verified statistically significant associations with the use of antiretroviral therapy and otitis. Therefore, we point out the importance of auditory monitoring and intervention as soon as possible, thus favoring adequate development in language and decreasing possible difficulties in learning and social inclusion.

Descritores

Perda auditiva
Terapia Antirretroviral de Alta Atividade
Síndrome de Imunodeficiência Adquirida
Otite
Audição

RESUMO

Objetivo: Investigar a ocorrência de perda auditiva em crianças com HIV/AIDS e verificar sua associação com a carga viral, as doenças oportunistas e o tratamento antirretroviral instituído. **Métodos:** Estudo descritivo, transversal, realizado em 23 crianças com HIV/AIDS de dois serviços especializados de João Pessoa (PB). Seus responsáveis responderam a um questionário, contendo dados sobre a situação clínica e a saúde auditiva das crianças, sendo estas submetidas a avaliação audiológica. Foram respeitadas as orientações para pesquisa em seres humanos contidas na Resolução CNE Nº 196/1996. Os achados foram analisados a partir da estatística descritiva. **Resultados:** Observou-se que a lamivudina (3TC) foi o antirretroviral mais utilizado em 17 (94,4%) pacientes, seguido do Kaletra (KAL), administrado em 14 (77,8%) pacientes, do d4T em 11 (61,1%) e da zidovudina (AZT) em sete (38,9%). A otite foi a doença oportunista de maior frequência com 11 (61,1%) registros. No exame audiométrico, observou-se 39 (84,8%) orelhas com perda auditiva e sete (15,2%) normais. Na imitanciometria, encontrou-se cinco (10,9%) orelhas normais, caracterizadas por curvas timpanométrica tipo A. As demais 41 (89,1%), mostraram-se alteradas com predominância na curva do tipo B em 67,4% dos casos. **Conclusão:** Houve alterações auditivas nas crianças com HIV/AIDS analisadas neste estudo, sendo as perdas auditivas discretas as de maior ocorrência. Foi verificada associação significativa com o uso da terapia antirretroviral e com a otite. Desta forma, percebe-se a importância do monitoramento auditivo e da intervenção o mais cedo possível, favorecendo um desenvolvimento linguístico adequado e reduzindo possíveis dificuldades de aprendizagem e de inclusão social.

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Received: 04/01/2012

Accepted: 10/23/2013

Study carried out at the Hospital Universitário Lauro Wanderlei, Universidade Federal da Paraíba – UFPB – and at Hospital Clementino Fraga – João Pessoa (PB), Brazil.
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Conflict of interests: nothing to declare.

INTRODUCTION

The infection caused by the human immunodeficiency virus (HIV) triggers the onset of acquired immunodeficiency syndrome (AIDS). The disease directly affects an individual's immunological system by attacking auxiliary T lymphocytes, consequently leading to immunodepression, which enables the appearance of opportunistic diseases. Therefore, an HIV-positive individual can suffer because of maladies such as viral hepatitis, tuberculosis, pneumonia, toxoplasmosis, and neoplasia (lymphomas), manifested through prolonged fever, acute weight loss, asthenia, anorexia, polyadenopathy in several parts of the body, nocturnal sweats, wet cough, and constant diarrhea[1].

Among the many alterations and/or complications that the HIV can cause, directly or indirectly, alterations in the auditory system stand out. Hearing loss (HL) of several types (conductive, neurosensory, and mixed) in individuals affected by this virus can be associated with opportunistic infections, ototoxic drugs, and the direct action of the virus upon the auditory system[2-4]. The audiological and otologic complaints most commonly reported in children infected by HIV, with or without HL, are otalgia, otorrhea, vertigo, and buzzing in the ears[3,4].

A study conducted with HIV-positive individuals treated with antiretroviral therapy (ARVT) reveals the incidence of idiopathic HL, chronic otitis, and otosclerosis[3]. It is important to highlight the occurrence of meningitis in children, a common opportunistic infection among individuals with AIDS[5], which may cause profound bilateral neurosensory HL and labyrinthitis. In more severe cases, neurotoxoplasmosis, cytomegalovirus, and herpetic infection can lead to HL when affecting the spiral ganglion and the cochlear branch of the eighth cranial pair[6].

The ARVT aims at preserving and/or restoring immunological integrity and postponing or attenuating the consequences of the infection, thus providing a longer life span and better life quality[1]. However, the use of antiretroviral drugs in people infected by the HIV virus presents a high ototoxic potential and can cause auditory problems. Antiretroviral drugs such as didanosine (ddl), lamivudine, lopinavir/r, stavudine, AZT, efavirenz, nelfinavir, and nevirapine can be associated with HL[3,7].

The direct action of the virus can also progressively compromise the structures of the central nervous system, which includes the central auditory system. In this case, the presence of electrophysiological abnormalities is common in the brainstem auditory-evoked potentials of middle and/or long latency, including P300, throughout the progression of the disease[8]. Studies with HIV-positive individuals indicate that this population is especially vulnerable to auditory disorders[4,9-15].

It is known that HL makes oral communication difficult or impossible, directly impacting social and familial relations and interactions. HLs create stigma and affect self-image, thus prompting a perception of incapacity and dependence, potentially resulting in an individual's marginalization. In children, HL can interfere with education, with obvious socioeconomic consequences[16].

Considering the implications of HIV contamination and of ARVT for auditory health, particularly in children, and also the scarcity of studies that seek to analyze the association of these factors with HL, we consider the conduction of studies with this focus as relevant. If an association is detected, these studies are even more relevant for propitiating the possibility of early identification of auditory problems and their possible causes, allowing for a reevaluation of the therapy used to treat the disease as well as the preventive measures applied on the course of treatment. This prevention is important even in cases of temporary peripheral HL, which can become permanent if not treated adequately.

The knowledge of HL characteristics in a certain population, according to where the individuals live, is also necessary, given that other factors may have to be considered.

In light of what has been exposed, this study aimed at investigating the occurrence of HL in children with HIV/AIDS, and verifying their association with the viral load (VL), opportunistic diseases, and the ARVT in use.

METHODS

This is a descriptive, transversal, and quantitative study. Research was conducted in two health care centers specialized in HIV/AIDS located in João Pessoa, Paraíba. The population was composed of all the HIV-positive children registered in both centers. After the consideration of inclusion and exclusion criteria, 23 children totalized the final sample, which represents 37.1% of the total number of patients cared for in both centers where the study was carried out.

We excluded children who presented one or more of the following characteristics: age over 11 years; neurological impairment at birth; impossibility of transfer to other services; absence on the second stage of the study; refusal to participate; and not undergoing one of the auditory examinations proposed. The inclusion criteria of the sample were age range between 2 and 10 years; being HIV/AIDS-positive; undergoing ARVT during pregnancy, at birth, or after birth, and/or being under treatment; and signing the informed consent. Data collection was only initiated after approval by the Research Ethics Committee, report number 343/11.

The data were collected with different instruments and considering the stages of development of this study. On the first stage, we used a questionnaire devised by one of the researchers, composed of open and closed questions with each child's primary and secondary information, according to the following variables: sex, age, family income, and how long the child had been diagnosed with HIV/AIDS. We also verified data about auditory health, such as current and past otologic manifestations, history of current or past auditory impairments, and type and degree of HL, if present.

The auditory examinations were conducted and registered on their respective assessment files. We used the following

equipments: audiometric booth; Missuri otoscope; Starkey audiometer, model AA1200, with earphone model TDH-39 and a B-71 bone vibrator; interacoustic immitance meter model AT-237, with one contralateral earphone model TDH-39 and a lead-line connected to the main piece of equipment.

The procedures were carried out in three stages:

- Stage 1: Registering of information provided by the children's parents or legal guardians and complemented by data found on their medical charts, with the purpose of investigating auditory complaints and general health data, use of antiretroviral medication, VL, and opportunistic diseases contracted by the children with HIV/AIDS.
- Stage 2: Meatoscopy, with the purpose of discarding the possibility of alterations that could potentially interfere with the conduction of audiological exams and compromise the reliability of the results, and, when necessary, otorhinolaryngological assessment for the prescription of medication and subsequent removal of cerumen, if present.
- Stage 3: Audiological assessment conducted by means of conditioned tonal audiometry and immitance testing.

The children who were older than 5 years of age sat inside the booth with earphones on and were asked to pay attention to whistle sounds. Whenever they heard them, they should say 'I heard it' and move an object on a panel to signal the occurrence. The children who were younger than 5 years of age were positioned inside the booth with earphones on, sitting on their respective mothers' laps. The mothers were instructed not to interfere with the child's answer, obtained with visual support.

In both situations, we used the descendant technique with increases of 10 dB hearing level, with ascendant confirmation of 5 dB HL. The auditory threshold was obtained taking into consideration the lowest intensity in which the child answered, which resulted in 50% of the positive answers per frequency.

For the analysis of the results obtained in the audiometric examination, we considered normal the auditory thresholds of up to 15 dB HL by air, and altered when the threshold surpassed this normality criteria in at least one frequency per ear. The altered results were classified as neurosensory, mixed, and conductive HL. Although HL was classified in different types, the aim of the study was to identify the presence or absence of HL and to verify the association of this variable with the VL, opportunistic diseases, and the antiretroviral treatment in place.

The results of the tympanometric examination were analyzed under two categories: normal, when they indicated normal ear functioning, and altered, when we found any other classification of the type of tympanometric curve that was not type A (or indicative of middle ear dysfunction).

The results of the stapedius reflexes were analyzed under three categories: absent, when contra- and ipsilateral reflexes were absent in all frequencies of the ear tested; partially absent, when they were present in one or more frequencies, either in the contra- or ipsilateral reflexes of the ear investigated; and present, when we registered the reflexes in all frequencies of the ear tested.

For the analysis of the results of the immitance testing, we used the data collected from the tympanometry along with those of the stapedius reflexes. They were classified as altered when any of the results, concerning either the tympanometry or the stapedius reflexes, presented alterations. We established a normality when both results were normal, that is, when we detected Type A tympanometric curves and ipsi- and contralateral stapedius reflexes in all frequencies evaluated.

The results of the audiometric examinations and the immitance testing were presented by ear and not by individual, thus totalizing 46 ears. We classified them as normal or altered according to the criteria mentioned previously.

The data were analyzed by means of univariate and bivariate absolute and percentage distributions. We applied inferential statistics through Fisher's exact test, as long as the conditions established for the use of the χ^2 test were not verified. The margin of error used in the decisions concerning the statistical tests was of 5%.

RESULTS

We evaluated 23 patients with HIV/AIDS who were under care at two specialized centers in João Pessoa. The age range of the children who participated in the study varied from 2 to 10 years and 11 months; the age average was 5.67 years. The children were divided into two groups, according to their age: the first group was composed of children from 2 to 4 years and 11 months of age; the second gathered children from 5 to 10 years and 11 months of age. Female individuals represented slightly more than half of the participants (56%).

The patients' socioeconomic status, determined in this study by their family income, varied from less than one to five minimum salaries. The majority (82.6%) had an income lower or equal to one minimum salary, 13% between one and two minimum salaries, and only 4.3% presented a family income over two minimum salaries.

With regard to how long the children had been diagnosed with HIV, it varied between 3 months and 7 years, with a predominance of diagnoses of less than 1 year and average of 2.5 years.

Table 1 presents the children's clinical data in relation to the use of ARVT, opportunistic diseases, and VL.

With regard to the use of chemoprophylaxis administered to newborns of mothers infected by HIV, only nine (39.1%) children were given AZT, oral solution, during 42 days after their birth, even when a positive serology had not been diagnosed (Table 1).

Concerning the use of ARVT medication, we verified that five (21.7%) children did not make use of this specific therapy (Table 1). It is important to highlight, however, that out of this number, two were still on the initial stages of being diagnosed with HIV and awaiting a medical referral in order to begin treatment and three had not been clinically referred to this treatment.

Table 1. Distribution of the children according to clinical data

Variable	n	%
Use of prophylaxis with oral AZT as a newborn		
Yes	9	39.1
No	14	56.5
ARVT use*		
Yes	18	78.3
No	5	21.7
Presence of opportunistic diseases**		
Yes	18	78.3
No	5	21.7
Total	23	100,0
Viral load***		
Lower than 50 copies/mL	5	23.8
50 to 250,000 copies/mL	15	71.4
Higher than 250,000 copies/mL	1	4.8
Base**	21	

*The percentage values were obtained from the total number of 18 children who were undergoing antiretroviral therapy; **The percentage values were obtained from the total number of 18 children who had opportunistic diseases registered; ***The percentage values were obtained from the total number of 21 children who had VL registered.

Caption: AZT = Zidovudine; ARVT = antiretroviral therapy

In relation to opportunistic diseases, they had occurred in the great majority of the children (78.3%). At the moment of data collection, the HIV plasmatic VL of 21 patients varied between 0 and 387.715 RNA copies per HIV/mL, with an average of 39.182 copies/mL and standard deviation of 95,885.42. It was not possible to include the VL of two (8.7%) children owing to the absence of information on their medical charts. It is important to highlight that four patients presented VL results lower than the minimum limit (50 copies/mL), and, for this reason, it was not possible to register an absolute number for them. Therefore, they were characterized with the minimum value (0 copy/mL), but their number could vary from 0 to 49 copies/mL. In addition, we verified that the great majority of the patients presented a VL of 50 to 250.000 (71.4%).

Table 2 displays the antiretroviral medication most used by the children who participated in the study. It is important to highlight that these medications are not taken in an isolated manner. Combined therapy is frequently utilized. In this sense, we observed that lamivudine (3TC) was the antiretroviral drug most used in 17 (94.4%) patients, followed by Kaletra (KAL), administered to 14 (77.8%); d4T, used in 11 (61,1%) individuals; and AZT, administered to 7 (38.9%) participants.

Table 2. Antiretroviral therapy undergone by the children

ARVT	n	%*
Antiretroviral medication**		
Lamivudine (3TC)	17	94.4
Kaletra (KAL)	14	77.8
Stavudine (d4T)	11	61.1
Zidovudine (AZT)	7	38.9
Lopinavir + Ritonavir (LPV/r)	3	16.7
Levodyn (EFV)	3	16.7
Base*	18	

*The percentage values were obtained from the total number of 18 children who were undergoing antiretroviral therapy; **Calculation based on the number of occurrences

Caption: ARVT = antiretroviral therapy

We highlight that, out of the 18 (78.2%) patients who were using ARVT at the time of data collection, the majority (14; 77.8%) received a triple combination, such as AZT + 3TC + KAL (4), d4T + 3TV + EFV (3), d4T + 3TC + KAL (7). A quadruple combination was used in three patients (16.7%): AZT + 3TC + KAL + LPV/r (2) and AZT + LPV/r + KAL (1). Only one individual (5.6%) was administered a double combination (d4T + 3TC), prescribed at the beginning of the adhesion to the treatment.

In relation to opportunistic diseases, five (21.7%) patients presented no occurrences. Based on the 18 patients who presented one or more infections, we registered 15 different types of infection, totalizing 36 occurrences. Otitis was the most frequent infection, with 11 (61.1%) occurrences, followed by pneumonia, with nine occurrences (50%) (Table 3).

Table 3. Distribution of the children analyzed according to the data related to opportunistic diseases

Variable	n	%
Opportunistic diseases		
Otitis (with effusion)	11	61.1
Pneumonia	9	50.0
Tuberculosis	2	11.1
Hepatitis C	2	11.1
Flu	2	11.1
Polyadenylation	2	11.1
Dermatitis	2	11.1
Cytomegalovirus, toxoplasmosis, herpes labialis, poliomyelitis, oral candidiasis, encephalitis, stomatitis, pancreatitis, kala-azar, anemia, cervical polyadenopathy	11*	61.1
Base**	18	

*There was only one occurrence for each disease (5.6%); **Considering that the same child can present more than one opportunistic disease, we considered the base for the calculation of the percentages, and not the total

In accordance with the objectives proposed, we proceeded to the analysis of the association between HL and the variables VL, opportunistic diseases, and ARVT, and the results from the audiometric examination (Table 4) and the immitance testing (Table 5).

It is worth highlighting that, in the audiometry, we found 39 (84.8%) ears with HL and 7 (15.2%) ears presented normal hearing.

Table 4 summarizes that there was no difference in the percentages of HL in relation to audiometry, according to the variables VL (p=0.136) and opportunistic diseases (p=0.319). For the variable VL, we highlight the result of the exams within the category between 50,000 and 250,000 copies/mL, in which we identified HL in the great majority of ears examined (93.3%). The highest index of HL (80.6%) was also observed in patients who presented opportunistic diseases.

Upon analyzing otitis as an opportunistic disease separately (given that it was the most recurrent among the children examined), we verified, as displayed on Table 4, a significant difference between the ears with and without HL (p=0.003), with a predominance of 15 ears with HL (68.7%).

There was also a significant difference between the patients with and without HL when the latter was associated with the use of ARVT (p=0.031). Out of the 36 ears examined among the children who underwent ARVT, 33 (91.7%) had HL. We observed that normal hearing corresponded to three occurrences (8.3%), found in two children — one with normal bilateral hearing and another with normal hearing in the left ear (Table 4).

In the results of immitance testing, alterations were predominant. We found 41 (89.1%) middle ears with alterations. The type B tympanometric curve was the most recurrent, at 67.4%. We registered five type A tympanometric curves (10.9%); four type C (8.7%); and one type Ad (2,2%) curves. Stapedius reflexes were absent in the majority of the ears (30–65.2%).

Significant differences were not observed between the patients with and without HL in the results of immitance testing for the variables VL, opportunistic diseases, and ARVT (p>0.05). Nevertheless, we observed that auditory alterations were predominant in children with opportunistic diseases and those who underwent/were undergoing ARVT (Table 5).

Table 4. Association of the occurrence of hearing loss and viral load, opportunistic diseases, and ARVT use according to the audiometric results

Variable	Hearing loss						p-value
	Yes		No		Total		
	n	%	n	%	n	%	
Viral load*							
Lower than 50 copies/mL	7	70.0	3	30.0	10	100.0	0.136
50 to 250,000 copies/mL	28	93.3	2	6.7	30	100.0	
Higher than 250,000 copies/mL	2	100.0	–	–	2	100.0	
Total group	37	88.1	5	11.9	42	100.0	
Presence of opportunistic diseases							
Yes	29	80.6	7	19.4	36	100.0	0.319
No	10	100.0	–	–	10	100.0	
Opportunistic diseases (otitis)							
Yes	15	68.2	7	31.8	22	100.0	0.003**
No	24	100,0	–	–	24	100,0	
ARVT use							
Yes	33	91.7	3	8.3	36	100.0	0.031**
No	6	60.0	4	40.0	10	100.0	
Total group	39	84.8	7	15.2	46	100.0	

*This information was not available for two patients (four ears); **significance level of 5.0%.
Caption: ARVT = antiretroviral therapy

Table 5. Association between the occurrence of hearing loss and viral load, opportunistic diseases, and ARVT use according to the results of immitance testing

Variable	Immitance testing						p-value
	Altered		Normal		Total		
	n	%	n	%	n	%	
Viral load*							
Lower than 50 copies	10	100.0	–	–	10	100.0	0.621
50 to 250,000 copies	27	90.0	3	10.0	30	100.0	
Higher than 250,000 copies	2	100.0	–	–	2	100.0	
Total Group	39	92.9	3	7,1	42	100.0	
Presence of opportunistic diseases							
Yes	34	94.4	2	5.6	36	100.0	0.530
No	9	90.0	1	10.0	10	100.0	
Opportunistic diseases (otitis)							
Yes	21	95.5	1	4.5	22	100.0	1.000
No	22	91.7	2	8.3	24	100.0	
ARVT use							
Yes	34	94.4	2	5.6	36	100.0	0,530
No	9	90,0	1	10,0	10	100,0	
Total group	43	93.5	3	6.5	46	100.0	

*This information was not available for two patients
Caption: ARVT = antiretroviral therapy.

DISCUSSION

It is known that the ARVT is composed of drugs that can reduce the VL of HIV in the blood plasma to undetectable levels, increasing the count of CD4+ lymphocytes. Thus, it is responsible for delaying the progression of the immunodeficiency and/or restoring immunity as much as possible, prolonging life span and improving the life quality of the person infected[1].

The results of this study show that the majority of the children were under ARVT, but few used prophylaxis. We highlight that the study was not limited to observing the reason why a children born of an infected mother did not undergo prophylaxis, because it is known that the use of such medication right after birth reduces the chance of detecting the virus[17].

Perceiving the importance of considering how long ARVT had been used to further analyze possible ototoxic associations, in this study, we analyzed the age at which the child was diagnosed with HIV/AIDS separately. It is considered that the earlier the diagnosis is made, the longer the time period of ARVT use. This implies that many hospitalizations can be avoided by the use of ARVT, which aims at suppressing the HIV virus as much as possible and interrupting the progression of the disease.

Data from the World Health Organization reveal that few children begin HIV treatment before the first 12 months of their lives, by virtue of the unavailability of the necessary tests for diagnosis after birth. It is estimated that, without an early diagnosis followed by a prompt start of treatment, around one third of the children infected with HIV will die before their first birthday, and around 50% will die before reaching 2 years of age. However, with the purpose of reducing and eventually eliminating new HIV infections through vertical transmission, governmental organizations recommend that all women with HIV receive antiretroviral medication during pregnancy, birth, or while breastfeeding[1,17].

Among the ARVT medications used by the children, it was verified that lamivudine (3TC) was the most prescribed (94.4%), followed by Kaletra (KAL) and stavudine (d4T), with 77.8% and 61.1% of the occurrences, respectively.

It is known that AZT is on the list of risk D teratogenic medications, which put the life or the development of human fetuses at risk but can be used in the case of severe diseases for which there is no therapeutic alternative. The medication can be administered after the sixth month of pregnancy, according to the national policy of vertical prevention[1].

Some ototoxic drugs have the capacity of damaging the auditory and vestibular systems to different degrees, to the extent of inflicting profound neurosensory HL[6]. A study from Schouten et al.[18] did not reveal significance in the correlation of HL with the use of AZT or ddl. Likewise, in another study[19], the authors did not observe a significant correlation between ototoxicity and ARVT.

Bastos, Fleig and Nascimento[20] verified that the ingestion of medication to control HIV can be associated with HL and that a late diagnosis, as well as a delay in using hearing aid, is directly related to a delay in the development of a child's hearing abilities, which directly influences the acquisition and development of oral language in the first years of life.

With regard to the clinical condition of the participants who were undergoing ARVT, we observed a low percentage (23.8%) of children with a VL lower than 50 copies of viral RNA/mL of plasma, which is considered a good situation clinically. We identified only one child at risk for disease progression, with a number over 250,000 copies. Therefore, the majority of the children is out of risk of progression in relation to the plasmatic VL count, i.e., between 50,000 and 250,000 copies.

The participants of this study reported several opportunistic diseases, prevailingly otitis (Table 3). One of the most frequent otologic infections detected in children with HIV/AIDS is otitis media (acute and serous), which can incur in conductive hearing loss[7,13].

In a study[13], acute otitis media was detected as the most occurring disease in children with HIV. In another study[21], an occurrence of 14.2% of chronic otitis media was observed in children infected by the virus.

It is worth highlighting that it was not possible to describe the type of otitis in the present study due to the lack of diagnosis on the patients' medical charts.

According to another research study[9], children from 3 months to 8 years of age presented predisposition to auditory alterations, with prevalence of middle ear alterations. However, another study[14] reveals that advanced stages of disease progression cause alteration of the inner ear on a peripheral level, with an increase in the otologic and auditory symptoms.

The HL caused by mild otitis media in low and mild frequencies compromise speech intelligibility even more, interfering with the dispatch of information to the auditory cortex[22]. Balbani and Montovani[23] explained sobrescrito no [23] that the accumulation of fluids in the middle ear causes noises that distort sound perception by the cochlea.

In a study conducted with HIV-positive children[24], 33.1% had some type of otitis media, and chronic otitis media was the most prevalent among the total number of children (14.2%). Serous otitis media, also present, was more prevalent in children younger than 5 years and 11 months (14.8%) than in participants older than 6 years of age (4.6%).

In another study[25] carried out with HIV-positive children, the authors observed a group at risk for alterations in written language, reading skills, and speech awareness. It was detected that these alterations are independent of the severity of the clinical situation and of AIDS' immunological profile.

We observed that research studies on hearing loss in children with HIV/AIDS prioritize the detection of hearing losses or reporting the patients' otologic and/or auditory manifestations without associating these with the possible factors that trigger them[2,10,14,15,26,27]. The opportunistic infections that can cause hearing losses are many, but the majority of studies report cases only to demonstrate the patients' clinical situation in relation to hearing loss[26,28,29].

Upon analyzing the occurrence of hearing loss and its association with the variables VL and opportunistic diseases, we

verified that, although there was no significance, the results point to the predominance of hearing loss among children who had opportunistic diseases, both in the audiometry and in the immitance testing results. Therefore, we suggest that opportunistic diseases in children with HIV/AIDS can contribute to HL, above all when considering the results of the immitance testing, which evidence a reduced number of children with normal results.

Régal, Demaerel and Dubois[28] considered the occurrence of progressive HL in HIV-positive patients when they were affected by an opportunistic infection, such as neurosyphilis. At the initial stage of the diagnosis, the patients presented sudden and progressive HL. However, their otologic manifestations improved after treatment with infection medication.

With regard to otitis, we proceeded to the analysis of its association with HL because it is one of the main diseases to affect hearing, and also because it was frequently reported by the patients of this study. We observed significant differences among the ears with and without HL in the audiometric exam, and the main contribution for this result was the occurrence of HL in the totality of patients that did not report otitis (12 patients → 24 ears; 100%), but who presented some type of opportunistic disease.

Upon analyzing the results of the immitance test, we verified that otitis was not a significant factor for the analysis of the ears from the statistical point of view, even though 95.5% of the ears tested presented alterations in this procedure.

The data analyzed concerning the use of ARVT evidence a significant association of HL with ARVT. It is worth highlighting that, in this analysis, we indistinctly took into consideration any medication in relation to the different types of HL.

The ototoxicity of antiretroviral drugs has been described by various researchers, who associate the toxic action of these drugs with alterations in the inner ear. Silva[13] reported the association of otologic manifestations and ARVT use, especially lamivudine (3TC), which contributed to the onset of otologic manifestations in children and adolescents with HIV.

It has been suggested that the ototoxic action of antiretroviral drugs can justify the otoneurological complaints of patients with very low VLs using antiretroviral drugs[10].

A case study of a patient infected with HIV, who had no history of opportunistic diseases but underwent treatment with antiretroviral drugs for 7 years, revealed a progressive worsening of auditory thresholds. Less than 6 months later, this patient presented profound HL. In this case, the authors related the onset of HL to the ototoxic action of the antiretroviral treatment upon the auditory system[30].

In another research study[19], an association between antiretroviral drugs and HL in HIV-positive individuals was not verified, but the authors attested a relation with opportunistic diseases, such as otosclerosis and other idiopathic causes. For the individuals who had not been submitted to antiretroviral treatment and who reported otoneurological complaints and alterations, they also pointed out the possibility that these otoneurological manifestations were associated with the action of the virus, considering that the patients presented higher VLs.

In our study, there was a significant association between ARVT use and HL, which evidences that 91.7% of the ears examined in children who underwent this type of therapy presented HL. Based on this finding, we cannot affirm that ARVT use was the cause of HL in the children examined, but it can be considered a contributing factor for this occurrence.

Therefore, although the study has evidenced HL in children with HIV and proven the association of the latter with ARVT use and otitis, it is not possible to affirm that the loss is consequential of these factors. In order to verify this hypothesis, it would be necessary to carry out prospective and longitudinal studies that would allow following up the children of mothers with HIV/AIDS from birth, with the purpose of conducting initial exams that assess auditory function, with frequent appointments.

Up to this moment, studies with this approach have not been identified in the literature, although the possible association between VL, ARVT use, and the occurrence of opportunistic diseases can be found, as well as some medications to treat them as the possible causal agents of HL.

In light of what has been exposed, the necessity of conducting auditory exams in order to track the hearing health of these children with HIV/AIDS is evident. We highlight that the inclusion of a speech-language pathologist and audiologist in a multidisciplinary team can contribute to the prevention and detection of HL and avoid the onset of communication disorders in this population, one of the most significant social harms that the disease can incur. Audiological care is also relevant to the patients' life quality, and it has been increasingly subsidizing initiatives for preventive measures in Public Health.

CONCLUSION

The number of HL occurrences in the group evaluated can be considered high, and discreet hearing losses were the most predominant.

With regard to the hearing alterations identified during immitance testing, we observed a predominance in type B tympanometric curves.

We verified a statistically significant association with ARVT use and otitis, but the same did not occur for the variables VL and opportunistic diseases.

These findings corroborate the researchers' concern in actively approaching these factors, given their association with hearing losses in people with HIV/AIDS, even though it is not possible to accurately determine what is/are the specific factors responsible for the auditory alterations found.

**AKLB was responsible for data collection, tabulation and analysis, and manuscript writing; SHSO was responsible for data analysis and manuscript writing; LM was responsible for data tabulation and analysis.*

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