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Audiological evaluation in a child with microcephaly by zika vírus: case study

Avaliação audiológica em criança com microcefalia pelo zika vírus: estudo de caso

Evaluación audiológica en niño con microcefalia por zika virus: estudio de caso

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Abstract

Introduction: Microcephaly is characterized by measuring the head circumference of an individual with two standard deviations below the population mean for sex and age. It is known that children with microcephaly are considered at high risk for hearing loss. Therefore, it is essential to evaluate and monitor the hearing until the third year of life. Within the battery of exams, there are currently new stimuli, such as Ichirp, that can be used in the Auditory Evoked Brain Stem Potential during the evaluation. **Objective**: To describe the audiological evaluation of a child with microcephaly by the Zika virus. **Method**: A battery of audiological exams was performed: meatoscopy, behavioural evaluation, imitanciometry and the Auditory Evoked Potential of Brain Stem, with the click and Ichirp stimuli. These tests were applied on a seven-month-old child diagnosed with microcephaly by the Zika virus. Results: The child presented audiological tests within the normal range, with the exception of visual reinforcement audiometry. Conclusion: The audiological evaluation was within the norms of normality. It should be monitored until the third year of life due to the risk of progressive loss. In the BAEP, better morphology and higher wave latencies were observed in the Ichirp stimulus when compared to the click.

Keywords: Microcephaly; Zika Virus; Hearing loss.

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Resumo

Introdução: A microcefalia caracteriza-se pela medida do perímetro cefálico de um indivíduo com dois desvios-padrões abaixo da média populacional para sexo e idade. Sabe-se que crianças com microcefalia são consideradas de alto risco para perda auditiva. Portanto, é imprescindível a avaliação e monitoramento audiológico até o terceiro ano de vida. Dentro da bateria de exames, há atualmente novos estímulos, como o *Ichirp*, que se pode utilizar no Potencial Evocado Auditivo de Tronco Encefálico durante a avaliação. **Objetivo:** Descrever a avaliação audiológica de uma criança com microcefalia pelo Zika vírus. **Método:** Foi realizada uma bateria de exames audiológicos: meatoscopia, avaliação comportamental, imitânciometria e o Potencial Evocado Auditivo de Tronco Encefálico, com os estímulos clique e *Ichirp*. Esses exames foram aplicados em uma criança de sete meses, diagnosticada com microcefalia pelo Zika vírus. **Resultados**: A criança apresentou exames audiológicos dentro dos padrões de normalidade, com exceção da audiometria de reforço visual. **Conclusão**: A avaliação audiológica foi dentro dos padrões de normalidade. Deve-se monitorar até o terceiro ano de vida, devido ao risco da perda progressiva. Foram observadas, no PEATE, melhor morfologia e maiores latências das ondas no estímulo *Ichirp,* quando comparadas ao clique.

Palavras-chave: Microcefalia; Zika Vírus; Perda auditiva.

Resumen

Introducción: La microcefalia se caracteriza por la medida del perímetro cefálico de un individuo con dos desviaciones estándar debajo del promedio de la población para sexo y edad. Se sabe que los niños con microcefalia se consideran de alto riesgo para la pérdida auditiva. Por lo tanto, es imprescindible la evaluación y monitoreo audiológico hasta el tercer año de vida. Dentro de la batería de exámenes, hay actualmente nuevos estímulos, como el *Ichirp*, que se puede utilizar en el Potencial Evocado Auditivo de Tronco Encefálico durante la evaluación. **Objetivo**: Describir la evaluación audiológica de un niño con microcefalia por el Zika virus. **Método**: Se realizó una batería de exámenes audiológicos: meatoscopia, evaluación comportamental, imitanciometría y el Potencial Evocado Auditivo de Tronco Encefálico, con los estímulos clic y *Ichirp*. Estos exámenes se aplicaron en un niño de siete meses, diagnosticado con microcefalia por el Zika virus. **Resultados**: El niño presentó exámenes audiológicos dentro de los patrones de normalidad, con la excepción de la audiometría de refuerzo visual. **Conclusión**: La evaluación audiológica fue dentro de los patrones de normalidad. Se debe monitorear hasta el tercer año de vida, debido al riesgo de la pérdida progresiva. Se observaron, en el PEATE, mejor morfología y mayores latencias de las ondas en el estímulo *Ichirp*, cuando comparadas al clic.

Palabras clave: Microcefalia; Zika virus; Pérdida auditiva.

Introduction

Microcephaly is characterized by measuring the head circumference of an individual who has two standard deviations (SD) below the population average for sex and age. In Brazil, between 2000 and 2014, the number of live births with microcephaly was stable. However, from October 2015, there was an unexpected increase in these cases[1].

A study conducted in the French Polynesia, between 2013 and 2014, evidenced the perinatal transmission of the Zika virus. The researchers described the clinical and laboratory characteristics of two mothers and their newborns that contracted the virus. Confirmation was given through the collected serum (RT-PCR), four days after delivery. The infection of the newborns occurred probably due to transplacental transmission or during delivery[2].

Data from the Ministry of Health showed that, in Brazil, the prevalence of microcephaly in 2010 was 5.7/100 thousand, with a 20-fold increase in 2015 [3].

Because of this outbreak, the World Health Organization recommended all newborns with microcephaly to perform assessment and follow-up in childhood. Among the recommendations are evaluation and audiological monitoring [4].

Children with microcephaly are considered to be at high risk for hearing loss, being imperative to perform the Brainstem Auditory Evoked Potential (BAEP) as a protocol in neonatal hearing screening [5,6].

We have described in the literature the report of a newborn, twin pregnancy, with microcephaly by the Zika virus with head circumference of 28 cm, in which, in the audiological examinations, it was diagnosed a profound bilateral hearing loss. The other twin had a cephalic perimeter within the parameters of normality, without hearing loss. The authors have described that this is the first case report of hearing loss related to gestational contamination of Zika virus in the world literature [9].

It is known that the professional that acts in the audiological evaluation of children must have property not only of behavioral and electroacoustic procedures, but also electrophysiological ones. Therefore, the auditory function and the neurological integrity of the child can be evaluated. The electrophysiological exams help in the diagnosis with more precision. Among them, we have the click BAEP, which is a broadband stimulus that simultaneously stimulates the cochlea and is widely used in clinical practice. However, with this, the regions of the basilar membrane activate, one after the other, from the base to the apex, causing a temporal delay in the stimulation of the nerve fibers. Thus, there is a neuronal desynchronization in the evocation of responses in the auditory evoked potential [7].

A new stimulus, the chirp, was developed by Claus Eberling, along with other researchers. The aim was to compensate for this temporal delay, resulting in better stimulation of nerve fibers and increase in wave amplitude, especially at lower intensities. Thus, the time of the examination is reduced, being promising in the audiological evaluation of children [8].

In one study, 30 full-term neonates were evaluated, with the click and Ichirp stimuli at intensities of 60, 40 and 20 dBnHL. Larger latencies were found with the Ichirp. However, they were responses with higher amplitudes and statistically significant, when compared to the click in all intensities tested. It was concluded that the Ichirp is recommended for children's audiological evaluation because it presents good amplitude of the V-wave, allowing clarity in the identification of the tracing [10].

In another study, 11 subjects with hearing within the normal range were evaluated, in the age group of 20 to 25 years. The click and Ichirp stimuli were used at intensities of 80, 60, 40 and 20 dBnHL. The results found were significantly higher latencies for Ichirp when compared to the click. However, this presented a better visualization of the wave tracing, facilitating the analysis of the exam [11].

Electrophysiological tests aid in behavioral assessments. Among them, there is the behavioral observation audiometry (BOA), which is an evaluation used in children from 0 to 6 months of age, with calibrated or instrumental sounds. Without indicating the audibility threshold, it is an insufficient method to determine the auditory threshold. Visual reinforcement audiometry is an examination performed in children, aged over 6 months and up to 3 years old, which evaluates auditory function. Imitanciometry is an objective test that does not require the response of the subject, being possible the verification of the conditions of the middle ear and integrity of the auditory pathway[13,14,15,16].

It has been verified, in the literature consulted, that Ichirp presents good V-wave morphology and higher latencies, when compared to the click, in adults and normal children. No evidence of its use in children with microcephaly was evidenced. The Ichirp has been promising in clinical practice, since it is difficult to evaluate children with microcephaly. This happens due to the neurological conditions, considering also that these children are agitated and more sensitive, which makes it difficult to perform the exam.

Thus, the objective was to describe the audiological evaluation of a child with microcephaly by the Zika virus using, in the battery of exams, the Brainstem Auditory Evoked Potential (BAEP), with the click and Ichirp stimuli.

Clinical case presentation

This research is of a cross-sectional nature, of a descriptive and qualitative character, carried out at the outpatient of the Faculty of Speech, Language and Hearing Sciences at Federal University of Sergipe, Prof. Antônio Garcia Filho Campus, Lagarto. It respected the Resolution No. 466/2012, which was approved by the Ethics Committee (CAAE 55350316.0.0000.5546).

A free and informed consent term (TLCE) was given to parents and / or guardians, with all procedures being explained, and, subsequently, signed.

Procedures performed

Anamnesis data

Patient B.M.R.S, 6 months old, attended the Clinic School of Speech, Language and Hearing Sciences and was accompanied by her guardians presenting the diagnosis of microcephaly. The mother reported that she did not present any complications during gestation, and that the delivery happened after 9 months, normal, with apgar in the 1st minute: 9 and 5th minute: 10, and cephalic perimeter of 29.5 cm. Serology performed with positive diagnosis for Zika virus.

For audiological evaluation, the following equipment were used: AD 629B audiometer, of the Interacoustics brand, with TDH and free field earphones; Intelligent Hearing System - IHS equipment for BAEP registration; Imitanciometer AT 235, of the Interacoustics brand and Otoport Otoacoustic Emissionsportable equipment of the Otodynamics brand.

Audiological Evaluation

After consultation with the otorhinolaryngologist, the meatoscopy, the instrumental evaluation, the audiometry with visual reinforcement, the transient otoacoustic emissions, imitanciometry and the BAEP with the click and Ichirp stimuli were performed.

The parameters used in the BAEP were: speed at 27.7, alternating polarity, stimuli of 1024, stimuli click and Ichirp, window of 12 milliseconds (ms) for click and 24 milliseconds (ms) for Ichirp, being evaluated at intensities of 60 dBnHL, 40 dBnHL and 20 dBnHL, and in high and low pass filter.

Results

B.M.R.S. performed a battery of audiological exams and no auditory changes were observed.

In the behavioral evaluation, B.M.R.S. presented attention to medium and low intensity stimuli for the following instruments: rattle, reco-reco, clapper, drum and agogô. Subsequently, audiometry with visual reinforcement was performed; however, B.M.R.S. was not able to be conditioned due to delayed neuropsychomotor development. In the imitanciometer, were present type A tympanometric bilaterally curve and stapedial reflexes.

As for transient otoacoustic emissions, the results obtained were within normal bilateral limits.

In the BAEP, with the click and Ichirp stimuli, the minimum response level visualized was close to 20 dBnHL bilaterally. The best V-wave morphology with the Ichirp and higher latency was observed in the exam tracing, when compared to the click.

Table 1. Comparison of latency values with the click and Ichirp stimuli.

		Right Ear	Left Ear
60 dBnHL	Click	6,6ms	6,9ms
	Ichirp	10,2ms	9,7ms
40 dBnHL	Click	7,7ms	7,8ms
	Ichirp	11,3ms	11,2ms
20 dBnHL	Click	8,7ms	8,8ms
	Ichirp	12,4ms	12,2ms

We can visualize, in figures 1 and 2, the morphology of the V wave with the click and Ichirp stimuli.

In relation to Table 2, we can observe, in the intensity of 20 dBnHL, that the click presents a smaller amplitude in the right ear and a greater amplitude in the left ear, when compared to Ichirp .

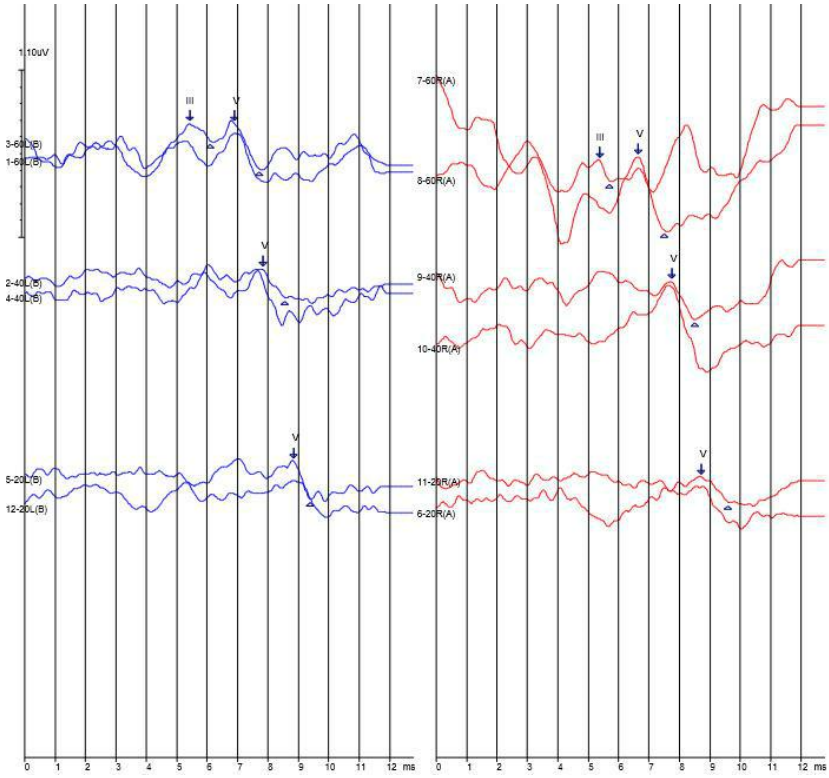

Figure 1. V-wave morphology with click stimulus.

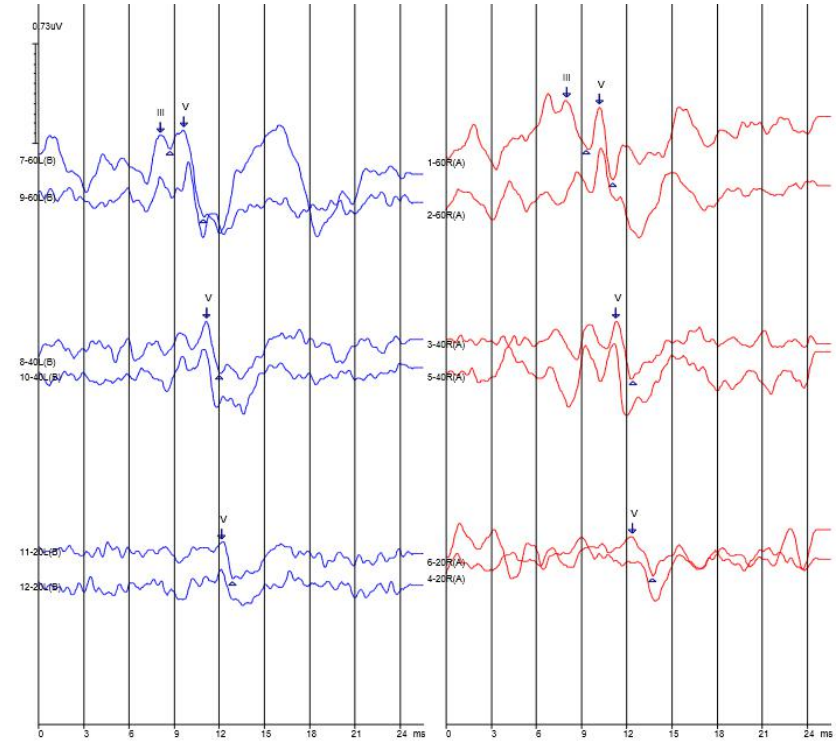

Figure 2. Morphology of the V wave with the Ichirp stimulus.

Table 2. Amplitude values of the BAEP record with the click and Ichirp stimuli in the right ear.

Amplitude	60 dBnHL		40 dBnHL		20 dBnHL	
	click	*Ichirp*	click	*Ichirp*	click	*Ichirp*
Mean ±SD*	0.895 ±0.205	0.58 ± 0.01	0.48 ± 0. 09	0.425 ±0.425	0.255 ±0.0.255	0.36 ± 0
Median	0.895	0.58	0.48	0.425	0.255	0.36

*Subtitle: SD – standard deviation

Table 3. Amplitude values of the BAEP record with the click and Ichirp stimuli in the left ear.

Amplitude	60 dBnHL		40 dBnHL		20 dBnHL	
	click	*Ichirp*	click	*Ichirp*	click	*Ichirp*
Mean ±SD*	0.33 ±0.01	0.615 ± 0.115	0.3 ± 0. 05	0.768 ±0.540	0.255 ±0.015	0.24 ± 0
Median	0.33	0.615	0.3	0.405	0.255	0.24

*Legenda: DP – desvio padrão

At the end of the audiological evaluation, B.M.R.S was referred to the audiological monitoring and the guardian for the development of hearing and language.

Discussion

It is described in the literature the relationship between the Zika virus and the cases of microcephaly, characterized by cerebral cranial malformations, in addition to arthrogryposis, which is characterized by a stiffening of the joints that can reach the ossicular chain of these children [1, 2, 9, 22].

It is of utmost importance to describe the findings of the audiological evaluation in children with microcephaly caused by the Zika virus, due to the scarcity in the literature. This population is considered to be at high-risk of hearing loss. We observed only one report of a twin pregnancy infant with microcephaly by the Zika virus, diagnosed with severe bilateral hearing loss [9,18,19].

According to the literature, the child from 0 to 3 months of age already has the ability of attention to sound and, with 6 months, he / she can already lateralize. However, in the behavioral evaluation, B.M.R.S. only presented attention to sound stimuli of the instruments: drum (125- 250 Hz), rattle (100000-120000 Hz), reco-reco (1250-5000 Hz), clapper (3000 Hz) and agogô (2000-3150 Hz). At this age, the child is already able to perform visual reinforcement audiometry (VRA), but B.M.R.S was not conditioned to perform it, considering that children with microcephaly present a neuropsychomotor delay, justifying the difficulty to perform VRA[12,16,17].

Imitanciometry and transient otoacoustic emissions were within normal range, demonstrating normal middle ear functionality, auditory pathway integrity and adequate cochlear function[3,16,20,21,22].

Larger latencies were observed in the Ichirp, with better wave morphology when compared to the click. These findings are in agreement with those described in the literature [10,11]. In this study, it was possible to visualize latencies with the Ichirp stimulus in 60 dBnHL in 10 ms, 40 dBnHL in 11 ms and 20 dBnHL in 12 ms. Promoting better visualization of the waves, facilitating the marking of the peak of the V wave, was one of the positive factors for its use in the clinical routine. It decreased the time of execution of the exam. This happens because it was possible to visualize the wave with 1024 stimuli, according to figures 1 and 2.

The amplitudes observed with the Ichirp were not significantly higher at all intensities when compared to the click, probably because the analysis was only performed with a clinical case. In the literature, were observed greater amplitudes with the Ichirp stimulus [10,17].

We can observe, in this study, that the Ichirp is promising in clinical practice. It is needed a survey with a larger sample of subjects with microcephaly caused by the Zika virus, emphasizing the increase of these cases in the last years, evidencing that they are susceptible to hearing loss.

Likewise, the early identification of hearing loss enables immediate intervention, providing conditions for the development of speech, language, sociability, psychism and the educational process of the child, allowing more favorable prognoses in these fields.

Conclusion

The child presented audiological evaluation within normal patterns. She should be monitored until the third year of life due to the risk of progressive loss. It was observed, in the BAEP, a better morphology and higher latencies of the waves in the Ichirp stimulus, when compared to the click.

From the findings of this study, it is fundamental to conduct new researches, with a larger sample, to verify the applicability of this stimulus in the audiological evaluation in the population with microcephaly by Zika virus.

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