COMPATIBILITY OF VISUAL REINFORCEMENT AUDIOMETRY (VRA) TO BRAINSTEM EVOKED RESPONSE AUDIOMETRY (BERA) IN DR. HASAN SADIKIN GENERAL HOSPITAL BANDUNG

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ABSTRACT

Background: Hearing impairment can interfere with a patient's quality of life, especially children. Early diagnosis of hearing impairment is critical. Currently, OAE and BERA are the standard test for hearing impairment screening, but these tests are costly and require experienced professionals to administer. VRA is one of the less expensive and easier hearing tests to administer.
Objective: This study aims to determine the conformity of VRA to BERA in normal hearing.
Methods: A diagnostic test has been carried out using secondary data extracted from the medical records of patients who have had VRA and BERA examinations in Audiology Policlinic Dr. Hasan Sadikin General Hospital Bandung between January 1, 2018 and December 31, 2020.
Results: This study reached a cutoff value of 65 dB for the VRA with 81.5% sensitivity and 91.8% specificity.
Conclusion: There is a conformity between the VRA examination and the normal ABR results.
Keywords: Brainstem Evoked Response Audiometry (BERA), Visual reinforcement audiometry (VRA), Hearing impairment, Hearing examination.

INTRODUCTION

According to the World Health Organization, hearing loss affects millions of individuals worldwide and is the fourth major cause of disability worldwide.[1] Basic Health Research (Riskesdas) revealed in 2018 that 0.11 percent of children younger than 5 years old, or around 25.000 cases, belonged to the deaf category.[2] The Ministry of Health's 1994-1996 Hearing Health Survey in seven provinces of Indonesia revealed a prevalence of 0.1% for congenital deafness.[3] Hearing loss can have a significant influence on a person's daily life if it is not properly treated.[4]

Voice stimulation in the first six months child are crucial for the development of children's language and speaking. The first three years of a child's life are a critical time for brain growth and maturation, as well as the rapid development of language and speech. It is advised that children with hearing loss receive help as soon as possible so that their language and communication skills improve rapidly.[5]

Inadequate facilities and infrastructure, as well as a lack of parental understanding, prevent many children with hearing impairments from seeing a doctor on time, particularly in remote locations. Many children are treated only after their parents recognize that they have a speech issue. Delay in diagnosis and therapy compromises the child's ability to receive sound stimuli optimally, impeding language and speech development. [4,6]

OAE and BERA are the two protocols for conducting hearing screenings on baby and children. Another examination that can be done for hearing screening is Visual Reinforcement Audiometry. ABR is an objective examination, but it is cosltly, requires more equipment and trained personnel to perform. Currently, only certain centers have BERA examination. Visual Reinforcement Audiometry (VRA) is a hearing test that is simple and inexpensive to do.[7,8]

Research is needed to find out the conformity of VRA to BERA, so that VRA can be used as a hearing screening tool in areas that do not yet have BERA facilities. There are currently no data comparing the results of VRA to BERA in normal hearing.

STUDY METHOD

This is a diagnostic investigation of VRA ability to predict BERA outcomes in normal hearing. The Data was extracted from the medical records of patients who underwent BERA and VRA at the RSHS Bandung Audiology Policlinic from January 1, 2018 through December 31, 2020. All patients who had BERA and VRA examinations at the RSHS Bandung audiology clinic met the inclusion criteria. Exclusion criteria include a previous history of tympanic membrane perforation, congenital anomalies, ear surgery, and insufficient medical records.

First, VRA examination is performed at frequencies 500, 1000, 2000, and 4000 Hz with the Interacoustic tool, followed by BERA with the biologic tool. BERA results are regarded normal if the stimulus 20 dBnHL elicits a reaction.

RESULTS

From January 1, 2018 to December 31, 2020, total of 1393 patients were examined by VRA and BERA. From total of 1393 individuals, 228 patients were excluded due to exclusion criteria (147 patients with congenital anomalies, 48 patients

with inadequate medical records, 29 patients with a history of tympanic membrane perforation, and 4 patients with a history of ear surgery), leaving 1165 patients for further analysis.

Based on the characteristics of the study participants, the median age of the studied children was 32 months, with a range of 5 to 127 months. The gender characteristic were 740 male patients and 425 female patients.

Table 1. Characteristics of Study Participants

Characteristics	N	%
Age (month)		
Mean±Std	34.84±21.261	
Median	32.00	
Range (min-max)	5.00-127.00	
Gender		
Male	740	63.5
Female	425	36.5

According to the analysis, the VRA cutoff value for this investigation is 65 dB. As the curve advances away from the 50% line and approaches 100%, the ROC (receiver operating characteristic) curve indicates that the VRA result has a high diagnostic value for normal hearing. The ROC approach yields an AUC (area under the curve) value of 88.8% with a p value of 0.0001, indicating that it is statistically significant predict aberrant outcomes in 1035 out of 1165 patients.

ROC Curve
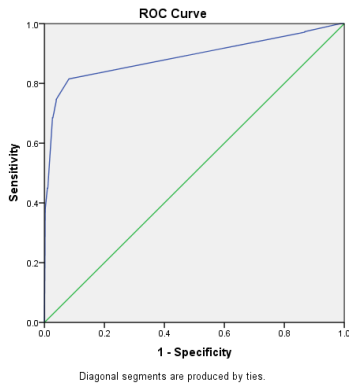
Diagonal segments are produced by ties.

Table 2 compares the VRA values of the Abnormal BERA group to those of the Normal BERA group. The value of VRA >65 dB in the group of abnormal BERA up to 370 and the value of VRA <65 dB up to 84, whereas for the value of VRA >65 dB in the group of normal BERA up to 58 and the value of VRA <65 dB up to 653, respectively.

Table 2 Comparison of VRA with BERA results

VRA Results	Hearing Ability based on BERA result		P-Value
	Abnormal	**Normal**	
	(n=454)	**(n=711)**	
>65 dB	370	58	**0,0001***
<65 dB	84	653	

The analysis of categorical data in the table above is evaluated using the Chi-Square test, and the derived p value for the variable VRA is less than 0.05, indicating that it is statistically significant or meaningful. This study obtained sensitivity of 81.5% and specificity of 91.8%. This diagnostic test yielded positive expected value of 86.4% and negative expected value of 88.6%. A level of accuracy of 87.8% is statistically significant.

DISCUSSION

Hearing impairment is a disorder that can impair quality of life and daily activities. Children can be diagnosed with hearing loss as early as 3 months of age, and treatment can begin before they reach 6 months. OAE and BERA are the two standard protocols for conducting hearing screenings on children. Brainstem Evoked Response Audiometry (BERA) or Auditory Barinstem Response (ABR) is an objective, noninvasive approach for evaluating hearing that detects electrical activity from the inner ear to the inferior colliculus. [9] BERA is a valuable device for making clinical evaluation regarding the existence, location, and type of hearing loss in individuals. Despite the objective nature of these exams, their interpretation is subjective.[10] Visual Reinforcement Audiometry and response tests are two of the other 10 tests that can be performed. Visual Reinforcement Audiometry is a hearing assessment that is much less difficult to perform and affordable. [7,8]

The purpose of VRA examination is to deliver an auditory stimulation in addition to a visual stimulus, with normal results when the subject turns his head towards the auditory stimulus. The test is appropriate for infants between 6 and 36 months of age.[11,12]

In this study, it was found that the VRA result of 65 dB was equivalent to the normal hearing threshold. The normal hearing threshold for BERA is 20 dBnHL or 10-30 dB. The difference between the results of VRA and BERA is due to: 1) the distance between the subject and the sound source, and 2). The sound stimulus in the VRA examination is given through loudspeaker located 1 meter away from the child being examined, while in the BERA examination, the sound stimulus is given through insert earphones.

CONCLUSION

Patients with VRA scores below 65 dB are predicted to have normal BERA findings.