

NORMATIVE DATA FOR WAVE V ABSOLUTE LATENCY AND INTER-AURAL WAVE V LATENCY DIFFERENCE IN INFANTS USING BRAINSTEM EVOKED RESPONSE AUDIOMETRY

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Received : 20/12/2025
Received in revised form : 01/02/2026
Accepted : 18/02/2026

Keywords:

BERA (brainstem evoked response audiometry), Wave V latency, Inter aural wave V latency difference, Normative data.

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DOI: 10.47009/jamp.2026.8.2.3

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2026; 8 (2); 10-12



ABSTRACT

Background: Early detection of hearing impairment in infants is crucial for normal speech and language development. Brainstem evoked response audiometry (BERA) is an objective, non-invasive test widely used for hearing assessment in infants. Wave V is the most robust and clinically reliable component of BERA and is commonly used for threshold estimation. Inter aural comparison of wave V latency helps in identifying asymmetry in auditory brainstem conduction. Establishing normative value of absolute latency of wave V and inter-aural wave V latency difference in infants is essential for accurate clinical interpretation. Aim of this study was to determine the normative data for the absolute latency of wave V and the inter - aural wave V latency difference in healthy infants using Brainstem evoked response audiometry. **Materials and Methods:** The study was conducted in 50 healthy infants of 3-12 months age, in the Audiology lab of ENT department, Civil hospital, B.J. Medical College, Ahmedabad, Gujarat. Healthy infants were recruited from Well baby clinic of Paediatric department. Double channel BERA was done on infants using RMS MEDULLA AD 1.33 computerized machine. Absolute Wave V latency of left ear and right ear was recorded at 60dB SPL and inter-aural wave V latency difference was estimated. **Result:** The mean absolute wave V latency was 6.73 milliseconds in the right ear and 6.78 milliseconds in the left ear. The mean inter-aural wave V latency difference was 0.1 millisecond. **Conclusion:** The minimal inter-aural wave V latency difference indicates symmetrical neural conduction in the both the auditory pathways.

INTRODUCTION

Brainstem evoked response audiometry is an objective electrophysiological test of the auditory system. The test is crucial for diagnosing hearing loss in newborns and children whose hearing cannot be tested behaviorally. BERA also helps in the diagnosis of vestibular schwannomas, and brainstem lesions.^[1-3] BAEPs (Brainstem auditory evoked potentials) are the potentials recorded from the ear and vertex in response to a brief auditory stimulation. When a sound reaches the cochlea, it is converted into an electrical impulse and passes from the cochlea to the auditory cortex through the spiral ganglion of cochlea, cochlear nucleus, superior olivary complex, lateral lemniscus and inferior colliculus. The BERA test evaluates the structural integrity of auditory pathway from the spiral ganglia to the level of inferior colliculus in midbrain.^[1] BAEP comprises of five waveforms (wave I-V). Wave I is generated from the distal portion of

cochlear nerve, wave II from the proximal portion of cochlear nerve, wave III from the cochlear nucleus, wave IV from superior olivary complex and wave V from lateral lemniscus and inferior colliculus. In infants only waves I, III and V are clearly identifiable. Wave V- is the most reliable and easily identifiable wave in the BERA tracing. The hallmark of wave V is that there is a sharp negative (ie, downward) deflection immediately following the peak. It is usually the largest and the most robust of the five BERA waves.^[1]

Absolute latency of a wave is the time interval between the onset of the stimulus and the peak of the wave and is measured in milliseconds. Inter aural latency difference is the absolute latency difference of the same wave between the two ears. Inter aural wave V latency difference refers to the difference in the absolute latency of wave V between the right and left ears. It is an important parameter for detecting asymmetry in auditory brainstem conduction. Inter aural latency difference of wave V should be less than

0.3 milliseconds. If inter aural latency difference is more than 0.4 milliseconds there will be lesion in the neural pathway on the side with higher latency.^[1] It helps to identify unilateral lesions like acoustic neuroma, brainstem tumors and unilateral auditory nerve dysfunction.^[2,4]

Aim

The aim of this study was to determine the normative data for the absolute latency of wave V and the inter - aural wave V latency difference in healthy infants using Brainstem evoked response audiometry.

MATERIALS AND METHODS

The study was conducted in 50 healthy infants of 3-12 months age, in the Audiology lab of ENT department, Civil hospital, B.J.Medical College, Ahmedabad, Gujarat. Ethical committee permission was obtained for this study. Healthy infants were recruited from Well baby clinic of Paediatric department.

Subject Selection

Inclusion Criteria

- Full Term infants with normal birth weight
- Normal Apgar score
- No history of NICU admission
- No risk factors for hearing loss

Exclusion Criteria

- Infants whose parents do not consent to BERA.
- Apparently healthy infants who fail in BERA test
- Preterm infants
- Infants with history of NICU stay > 5 days, birth asphyxia, hyperbilirubinemia
- Infants with Low birth weight
- TORCH infection

Written informed consent was obtained from the parents after explaining them the procedure. A detailed medical history and ENT examination was done. Infants were sedated with syrup pedichloryl. BERA procedure was carried out in a soundproof, airconditioned, semidarkened room on sleeping subject. Double channel BERA was done using RMS MEDULLA AD 1.33 computerized machine.

After cleaning the forehead, vertex and both mastoid regions with spirit, surface electrodes were fixed at the vertex, both mastoids and forehead (ground); using RMS recording paste and it was secured with tape. Once, the electrodes and TDH-49 earphone were placed and the patient positioned for testing, the impedance of electrodes were checked and kept below 5KΩ.

BERA was done using sweep speed of 1 ms/div with a sensitivity of 250nV. Highpass and Lowpass filters were kept at 100 Hz and 2500Hz respectively. Binaural auditory stimulus consisting of alternate condensation and rarefaction clicks of 100 microseconds were delivered through electrically shielded TDH-49 earphones at a rate of 25.1/sec for time duration of 10 msec. The stimulus was first given at 70 dB SPL and if wave V appeared then intensity was progressively reduced by 10 dB until the threshold level was attained. The lowest click intensity at which the wave V persisted while decreasing the intensity of sound from 70 dB SPL was taken as the threshold of hearing of the subject. A threshold of 40 dB SPL was considered as the pass criteria for test. Wave V latency of left ear and right ear at 60dB SPL was noted and compared.

Data Analysis: Data were entered in Microsoft Excel and analyzed using SPSS software. Continuous variables were expressed as mean and standard deviation. The mean inter-aural wave V latency was calculated. Data were expressed as mean ± standard deviation.

RESULTS

The mean wave V latency in the right ear was 6.73 milliseconds with a standard deviation of 0.395 and in the left ear was 6.78 milliseconds with a standard deviation of 0.397. The mean inter-aural wave V latency difference was 0.101 milliseconds with standard deviation of 0.08.

Table 1: Mean and SD for Absolute Latency of wave V (in ms) at 60 dB SPL

Absolute latency of wave V	
	Mean±SD(msec)
RIGHT EAR (n=50)	6.7320±0.3951
LEFT EAR (n=50)	6.7804±0.3968

Table 2: Inter aural wave V latency difference

Inter aural latency difference	Mean±SD(msec)
	0.1012±0.0838

DISCUSSION

BERA parameters show variation in values depending upon age, myelination process maturation of auditory pathway and it also depends upon the characters of the sound stimulus used for eliciting the BERA response. Hence, normative data for different BERA parameters has to be established for each

neurological clinic.^[1,5] Our study was aimed at establishing normative data for absolute latency of wave V and inter-aural wave V latency difference in healthy infants of 3-12 months age.

The mean absolute latency of wave V in the right ear was 6.73 milliseconds and in the left ear was 6.78 milliseconds at 60 dB SPL. These values are consistent with expected latency range as per the

study of Mochizuki et al. According to Mochizuki et al., mean wave V latency at 3 months of age was 6.46 ms, at 6 months the latency was 6.37 ms and at 12 months it was 6.06 ms.^[3] In the study of Scaioli et al. wave V latency of infants in both right and left ears was 6.47 ms. BAEP matures to adult pattern over a period from birth to the age of 18–24 months. The absolute latency of wave V reaches the adult value by 2 years in children. During this developmental period, progressive myelination and maturation of the auditory pathway contributes to the gradual shortening of wave V latency. The study of Taneja et al. showed that the latency of wave V decreased as the age of neonate increased.^[6-9]

The mean inter-aural wave V latency difference was 0.1 millisecond, which lies within the normal limit of ≤ 0.30 ms. This minimal inter-aural latency difference indicates symmetrical neural conduction in the both the auditory pathways. Clinically, an inter-aural latency difference more than 0.4ms may suggest unilateral nerve dysfunction, asymmetric neural conduction or retrocochlear pathology.^[1,2,7] However, in our study, the observed inter-aural wave V latency difference of 0.1ms indicates physiological symmetry and normal maturation of auditory pathway. The study of Sharma M et al. showed an interaural wave V latency difference of 0.2 ms.^[8]

The establishment of normative data for infants of 3-12 months is important because auditory maturation is dynamic during this period. Using age appropriate normative values will help to reduce the false-positive interpretations in the hearing assessment of infants.

CONCLUSION

Our study provides normative reference values for absolute wave V latency and inter-aural wave V latency difference in healthy infants aged 3-12 months using BERA. The mean absolute wave V latency was 6.73 milliseconds in the right ear and 6.78 milliseconds in the left ear, with a mean inter-aural wave V latency difference of 0.1 millisecond. The minimal inter-aural latency difference indicates

symmetrical maturation of auditory pathways in this age group. The normative values will help in early identification of retrocochlear pathology, auditory neuropathy and delayed brainstem maturation in infants. Establishing age appropriate baseline data will enhance the diagnostic accuracy of paediatric auditory evaluations and supports early intervention strategies.

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