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Brainstem Auditory Evoked Responses (BAER) in healthy term neonates

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Abstract
Objectives: To evaluate Brainstem Evoked Response Audiometry (BAER) as an objective testing of hearing assessment in normal neonates.
Methods: In 30 healthy non-jaundiced term neonates BAER recording were made and values for various parameters drawn. Criteria for labeling abnormalities were thus formatted.
Results: Mean age at the time of recording was 3.28±0.69 days and mean weight was 3.39±0.44 kg. Mean gestational age was 38.66±1.01 weeks and average serum bilirubin was 5.30±1.56 mg/dl.
Conclusion: Our study has aimed to draw normal values for various components of ABER in term healthy neonates.

Keywords: brainstem auditory evoked responses, term neonates, hearing assessment

Introduction

Many methods have been evaluated to find a reliable and effective technique for determining auditory functions in neonates. Amongst these are behavioral audiometry, impedance audiometry, crib movement system or cardiorespiratory response to auditory stimuli. Development of Brainstem Auditory Evoked Responses (BAER) has expanded the possibility of objective testing of hearing in the neonates. The electrical activity originating in the auditory nerve and the brain stem pathways is collectively known as the auditory brain stem response. It is not significantly altered by state of consciousness, drugs and a variety of environmental factors including various sensory inputs to the cortex [1]. The method can be used effectively to assess the sensitivity of hearing in neonates.

Sohmer and Freeman [2] were the first to record 8th nerve action potentials form extracochlear sources (tympanic membrane, ear canal and ear lobes) in human beings. Then came the classic and now monumental publication by Jewett *et al.* [3] who presented the first full description of scalp responses postulated to be generated by brain stem nuclei. He provided us with the famous use of Roman numbers for depicting the various waveforms of BAER and described that the waves detected at the scalp are volume conducted events from diverse areas of the brain stem and are designated as "Far field potentials".

Neonatal BAER: - Maturation of CNS has a significant influence on BAER measurements [4]. Age affects BAER variables such as latency and amplitude. Latencies are greatly prolonged in neonates and become progressively shorter in the first two years of life.

Several differences have been observed in the BAER of neonates and that of an adult. In the newborn response is smaller, wave I is often bifid, a prominent negative wave follows wave I, there is little if any wave II and amplitude ratio of wave V to wave I is much lower [6]. Data for normal BAER values have been reported from gestational age of 28 weeks and upwards. Unfortunately, inconsistencies in the selection of the normal population have lead to wide variations in the reported norms of different components of BAER at various gestational ages.

BAER as predictor of hearing impairment

Evidence of BAER as a screening tool appears conflicting, variations in failure rate have been reported to vary from less than 1% to 22% on repeated testing of infants on follow up [7]. It has been proposed that ABER testing in neonates for hearing impairment should be delayed unless the infant is close to term and medically stable, sufficient measurements must be made to exclude abnormalities caused by middle ear disease or collapsed ear canal and elevated thresholds accompanied by indications of neuromaturational delay must be interpreted with caution.

BAER can be recorded in normal neonates at 30 db. Thresholds higher than 40db NhL are a very good predictor of moderate hearing loss, thresholds higher than 30 db detect more babies who are found to have a mild hearing loss at follow up, but also increases the false positive rate.

Electrical response audiometry has also been compared with behaviorally determined threshold and reliability of BAER established. BAER results may be useful in predicting severe brain damage in term neonates. But consistent relationship of BAER to predict later ability to hear in preterm infants or in babies with severe brain damage has not been established. Sensorineural hearing loss especially in the higher frequencies is well-known sequelae of hyperbilirubinemeia in the neonatal period and may occur alone or as a part of the clinical spectrum of kernicterus.

Material and Methods

The present study was conducted in the Department of Pediatrics, Umaid Hospital, Dr. S.N. Medical College, Jodhpur. The study group consisted of 30 term healthy neonates delivered in Umaid Hospital Jodhpur with serum bilirubin <12 mg%. Babies with history of complicated pregnancy, neonates with severe birth asphyxia, pyogenic meningitis, severe septicemia, those on mechanical ventilation

were excluded from the study. Neonates who had received drugs likely to damage the vestibule-cochlear apparatus like amino glycosides and furosemide were excluded from the study.

BERA studies were done between 2nd-6th day of life and informed consent was obtained from the parents. Recordings were taken as per the methods described by Taylor (10) in a double walled, sound treated, air conditioned, dust free room, free from electromagnetic disturbances, the recordings were obtained with the instrument-Nicolet Compass Meridian – Biomedical USA. Silver coated cup shaped electrodes with a diameter of 10mm were used mounted on TDH-39p headphone.

Neonates were kept on a wooden couch in a supine position in a relaxed state with eyes closed-either in natural sleep or sedated with a single dose of trichlorophos 20mg/kg. Electrodes were placed with a conducting gel on the high forehead in midline. Recordings were obtained from each ear separately in duplicate to ensure repeatability of the response. Facility of automatic artifact rejection was used. Recordings were manually stopped if there were eye blinks, swallowing or other movements. Sweep velocity used was 10 m/sec. Click acoustic stimuli with a click rate of 10/sec alternating in polarity were presented by an earphone to each ear alternately at an intensity of 90db hearing level. A masking sound of 40db was given to the non-stimulated ear. Two-channel recording was done for each ear, electrical activity filtered and averaged to 2000 responses. Each ear was tested separately with rarefaction clicks of 0.1 msec duration administered at a rate of 50 per second and 2000 responses were averaged and initially 70 db nHL was adminstered. Intensity was then decreased and recordings made on 60 db, 45db and 30 db and this value of 30 db was taken as the normal threshold of wave V. Latency, interpeak latency and amplitude of waves were measured by placing sensor on the tracings on the screen.

Polarity convention was used to term upward of trace as positive while a downward deflection was termed negative. The first positive peak was labeled as wave I and subsequent positive peaks were labeled as waves II, III, IV, V. Trough following wave I was labeled as A and that following wave III as B. Peak to Peak amplitude for waves I, III and V are measured as I A, III B etc. Other parameters recorded were latency, interwave interval, amplitude, amplitude ratio and elimination or absence of specific components. Statistical analysis was performed using the students 't test.

Results

In our study group 21 babies were males and 9 females with a male to female ratio of 2.3:1. Mean age at the time of recording was 3.28±0.69 days and mean weight was 3.39±0.44 kg. Mean gestational age was 38.66±1.01 weeks and average serum bilirubin was 5.30±1.56 mg/dl.

Latency of waves I and V was measured at various intensities of sound from 30db to 90db.It ranged from 1.87msec to 6.25 msec. (Table I). Similarly, interwave interval was measured for the different waveforms and ranged from 2.17 msec to 4.09msec (Table II).

Criteria for abnormality of brainstem evoked response are thus derived which included

a) Absent response
b) Prolonged latency of various waves: - Mean±2SD values for wave I, II, III, IV and V at 90 db NhL were 1.65, 2.72, 4.28, 4.79 and 6.25 msec respectively. Similarly mean ± 2 SD values for interwave interval I-III, III-V and I-V were 2.15,2.07,3.90 msec respectively at 90db.
c) Increased threshold from both ears at 30db.

Discussion

Jewett (11) showed that the response evoked by a high intensity click stimulus (75db nHL) and recorded from the vertex and ipsilateral mastoid configuration consists of a series of up to seven waves. Wave I is thought to be the compound auditory nerve action potential and is similar to the action potential recorded in electrocochleography [2]. Wave II is thought to arise predominantly from the proximal regions of the auditory nerve and Wave III from the cochlear nucleus. The superior olivary complex is considered to be the main source of wave IV and wave V originates from inferior colliculus [12].

Hecox [13] observed that the latency of wave V decreases systematically in infants whose age ranged from three weeks to 32 months. Salamy and Mckean [14] reported that in infants aged 20 hours to 12 months the latencies of the first five waves reduced, as the child grew older. The changes in mean latency were greater for wave V than for wave I. Interpeak intervals were also prolonged for infants under two years of age compared with adult values and varied inversely with age. During the first year of life the I-V interpeak interval has been shown to decrease in full term neonates to 12-month-old infants [14]. An abrupt decrease in I-V interval was noted by six weeks of age, a fairly stable value through the next six months and then another abrupt decrease between the ages of six-twelve months. In normal children BAER matures to the adult pattern by the age of 18 mths-2yrs.

Latency shifts occurring with advancing ages are due to the changes in neural structures including increase in fiber diameter, progressive myelination and increased dendritic arborisation. BAER is not affected by infant's sex [15], the presence of most CNS depressants [4] and state of alertness.

Inappropriate prediction of hearing impairment has been made because of failure to appreciate that abnormality of BAER may arise not only because of hearing loss but also due to other congenital or acquired brainstem abnormalities. Abnormalities in BAER can range from an absent response to a peripheral pattern of abnormality with elevation of wave I threshold with or without increase in wave V threshold. The central pattern of anomaly consists of prolongation of I-V interpeak latency or the absence of components of ABER beyond I. Our study has aimed to draw normal values for various components of ABER in term healthy neonates.

References

1. Wood S, Marcormick B, Marson S. Auditory brainstem response in pediatric audiology. Arch Dis Child. 1988; 63:565-567.
2. Sohmer H, Freeman S, Malachi S. Muli modality evoked potentials in hypoxemia. Electroencephalography and clinical neurophysiology. 1967; 64:328-333.
3. Jewett DL, Williston JS. Auditory-evoked far fields potential averaged from scalp of human. Brain. 1971; 94:681-696.

4. Stockard JJ, Rossiter VS. Clinical and pathologic correlates of brainstem auditory abnormalities. Neurology. 1977; 27:316-325.
5. Mokotoff B, Schulman-Galambos C, Galambos R. Brainstem auditory evoked response in children. Archives of Otolaryngology. 1977; 103:38-43.
6. Starr A, Amilie RN, Martin WH, Sanders S. Development of auditory functions in newborn infants revealed by auditory brainstem potentials. Pediatrics. 1977; 60:831-839.
7. Karmer SJ, Vertes DR, Condon M. Auditory Brainstem response and clinical follow up of high risk infants. Pediatrics. 1989; 83:38-392.
8. Hyde ML, Riko K, Corbin H, Morso M, Alberti PW. A neonatal hearing screening research programme using brainstem electric response auditory. The J. of Otolaryngology. 1984; 13:49-54.
9. Levin RI, Fredericks WR, Rapoport SI. Entry of bilirubin in to the brain due to opening of the blood brain barrier, Pediatrics. 1982; 69:255-259.
10. Taylor MJ. Evoked Potentials in Pediatrics. In: evoked potential in clinical testing, 2nd edn. Ed. Halliday AM. Edinburg, Churchill Livingstone. 1993, 489-521.
11. Nilsen ST, Finne PH, Bergsjo P, Stammes TO. Males with neonatal hyperbilirubinemia examined at 18 years of age, Acta. Paediatr.Scand.1984; 73:176-180.
12. Singh M, Kalra V. Outcome of neonates with severe birth asphyxia. Indian Pediatr. 1978; 15:835-839.
13. Hecox K, Galambos R. Brainstem auditory evoked response in human infants and adults. Archives of Otolaryngology. 1974; 99:30-33.
14. Salamy A, Mckean CM. Postnatal development of human brainstem potentials during the first year of life. Electroencephalography and Clinical Neurophysiology. 1976; 40:418-426.
15. Mandal AK, Mehra YN, Narang A, Raghunathan M, Walia BNS. Brain stem Evoked Response Auditory in Neonates. Indian Pediatr. 1989; 26:566-570.