Brain Stem Auditory Evoked Potentials In Patients with Epilepsy

R F Khan S J Khan Msaeed
Department of Physiology, K.E. Medical College, Lahore
Correspondence toDr.:Rabia Farid Khan

The latencies and amplitudes of Brainstem Auditory Evoked Potentials were recorded in 40 patients, suffer from idiopathic generalized epilepsy which was poorly controlled, and 40 age and sex matched non epileptic controls to find out subclincial involvement of the cochlear nerve and retrocochlear auditory pathway in epilepsy. The absolute latencies of waves I - V were significantly prolonged in epilepsy (P<0.05). The interpeak latencies I - III and I - V were also increased significantly (P<0.05). There was non-significant correlation of all the latencies and amplitues with duration of diseases, frequency of seizures and duration of diseases, frequency of seizures and duration of treatment.Further studies are suggested in which plasma drug level of anti-convulsant drugs should be included to differentiate the effects on BAEP. It is concluded that epilepsy has a depressant effect on peripheral and central auditory conduction.

Key Words: Brainstem Auditory Evoked Potentials (BAEP or ABR). Idiopathic generalized epilepsy. Antiepileptic drugs (AED)

Audiological tests are useful in the examination of patients suspected of having retrocochlear pathology. One test procedure that seems to be particularly sensitive is the Brainstem Auditory Evoked Potentials (BAEP also called ABR)[1]. The term BAEP was formally introduced by Davis 1979. It is defined as the response within the auditory system (the ear, the auditory nerve, or auditory regions of the brain) that is evoked by sounds (auditory or acoustic stimuli)[2]. The contemporary interpretation of the neural generators of the BAEP in the humans is that wave I is generated by the auditory nerve where it exists the cochlea while wave II is generated by the portion of the auditory nerve that is close to the brainstem. Peak III and the following peaks are generated mainly by the ipsilateral cochlear nucleus, but they may receive contributions from the superior olivary complex on ipsilateral side. Peak IV is generated by more medial brainstem structures. The sharp portion of Peak V is generated by contralatral leminiscus where it terminates in the inferior colliculus and the following negativity is probably the result of dendritic activity in the inferior colliculus[3].

Brainstem Auditory Evoked Potentials are helpful in the assessment of auditory functions in multiple neurological conditions and epilepsy is one of them[4]. It is defined as the condition characterized by recurrent (two or more) epileptic seizures unprovoked by any immediately identifiable cause. An epileptic seizure is a clinical manifestation presumed to result from an abnormal and excessive discharge of a set of neurons in the brain[5].Idiopathic generalized epilepsy is one of the major classes of epilepsy[6].

It is a common epilepsy syndrome with a genetic basis and no other clinically identifiable aetiological factor[7]. There is a likely possibility that peripheral as well as central nervous system conduction is affected by seizures or medication (Antiepileptic drugs) and this influences BAEP latencies[8]. Further more analysis of the types of BAEP abnormalities detected in the patient group may provide evidence for the possible sites of actions of the epileptic process or the antiepileptic drugs[9]. The underlying mechanisms of slowed conduction in central acoustic pathways are not known. There might be either an effect on axon membranes or on synaptic transmission or on both.[10]This study was planned to investigate the influence of epilepsy on BAEP and also to assess the prognostic value of BAEP for detection of subclinical involvement of central nervous system in epilepsy.

Materials And Methods

Patients (21 males and 19 females) suffering from poorly controlled idiopathic generalized epilepsy of ages 10 to 60 years were selected by random sampling technique from epilepsy room of Mayo Hospital and outdoor clinics of Sir Ganga Ram, Services and General Hospital, Lahore. These patient had suffered from at least one attack of epilepsy in the last three months and were on antiepileptic drugs for less than a year. Forty (20 males and 20 females) age matched healthy non epileptic controls were taken from the staff and students of Post Graduate Medical Institute Lahore. Otoscopic examination after the removal of ear wax was performed on each subject followed by pure tone audiogram with the help of inter acoustics clinical auidometer AC 33 to rule out any hearing impairment.

Suffering from any other condition that is known to affect BAEP, e.g. diabetes renal insufficiency, cerebral neoplasia were also excluded. History of drug intake other than antiepileptic drugs was also an exclusion criteria. All the patients were ambulatory and independent in daily activities with no evidence of any progress neurological disorder or psychiatric handicap. These patients had no clinical evidence of brainstem toxicity viz diplopia, nystagamus, dysarthria, atoxia and cerebellar tremors.

BAEPs were recorded in a quiet room using the apparatus Neuropack Four mini Model MEB 30-4 K, with the subject in a supine position. Monoaural click stimuli were delivered by a shielded earphone at 90 db

spc rate with a repetition rate of 10/sec. The click hearing threshold of each ear was checked before the BAEP and the average threshold of all the subjects was equal to or less than 20 db hearing level in either ear. Both ears were tested separately. Three silver chloride (Ag-AgCI) surface electrodes were applied.

The active electrode CZ at the vertex, the reference electrode A1 or A2 at the mastoid process on the stimulation side and the ground electrode FPz was applied on the forehead. The impedance was checked and the electrode placement was adjusted so that the impedance value would be 5 Kilopascals or less. 1024 sweeps were averaged for each ear. [11] The parameters considered were morphology of the potential and absolute latencies and amplitudes of all the waves. The interpeak latencies I-III, I-V and III-V were then derived from the absolute latencies. The amplitude of wave I, III and V were measured from peak to the following trough.

Criteria Of Baep Abnormalities

BAEP abnormalities were defined by :-

1. Prolongation of IPL I - III, I-V and III-V beyond the mean + 3 SD values of the control subjects.
2. Absence of wave III or V in the presence of a clearly defined wave I.
3. An increase in the wave I/V amplitude ratio beyond the mean + 3SD value of the control subjects.

Statistics:-

The non paired t.test was used to compare the means between the control and patient groups. The difference was considered significant when P< 0.05. Possible correlation of BAEP findings with frequency, duration and treatment of epilepsy were also considered.

Results:-

The comparison of absolute and interpeak latencies and amplitude of brainstem auditory evoked potentials between epileptic and non-epileptic controls is shown in table I (a & b) and figure I. The absolute latencies of wave I - V are prolonged significantly (P<0.05) in the epileptic group when compared with non epileptic controls.

The interpeak latencies I - III and I - V are also prolonged significantly (P<0.05) in the epileptic group when compared with the non epileptic control group. Wave I - V amplitudes showed non-significant (P>0.05) differences in both the groups.

There was a non-significant correlation of all the latencies, interpeak latencies and amplitudes of waves I - V with duration of disease, treatment and frequency or seizures as shown in table II. Table III shows the percentage of latencies above 3SD from the norms in epileptic patients.

Table: I : Comparison of BAEP absolute latencies between controls and epileptic patients

Wave	Ear	Controls Mean ±SD	Patients Mean±SD	P-Value
I	Left	1.25±0.05	1.42±0.10	< 0.05
	Right	1.24±0.05	1.42±0.11	< 0.05
II	Left	2.3±0.12	2.6±0.13	< 0.05
	Right	2.2±0.10	2.7±0.18	< 0.05*
III	Left	3.2±0.14	3.5±0.21	< 0.05*
	Right	3.3±0.13	3.6±0.22	< 0.05*
IV	Left	4.3±0.15	4.6±0.23	< 0.05*
	Right	4.5±0.17	4.7±0.25	<0.05*
V	Left	5.2 ±0 .20	5.5±0.28	<0.05*
	Right	5.3 ±0.18	5.6±0.26	<0.05*
VI	Left	6.7±0.22	6.9±0.26	>0.05**
	Right	6.7±0.27	6.8±0.24	>0.05**
VII	Left	8.1±0.20	8.2±0.21	>0.05**
	Right	8.2±0.13	8.3±0.14	>0.05**

TABLE: II-Comparison of BAEP interpeak latencies between controls and epileptic patients

WAVE	EAR	CONTROLS Mean±SD	PATIENTS Mean±SD	Pvalue
I-III	Left	1.9±0.12	2.2±0.21	<0.05
	Right	2.0±0.11	2.2±0.22	<0.05
I-V	Left	3.8±0.20	4.0±-0.23	<0.05
	Right	3.9±0.19	4.1±0.24	<0.05
III-V	Left	1.8±0.18	1.8±0.19	>0.05
	Right	1.8±0.15	1.8±0.18	>0.05

TABL III -Percentage of latencies above3SD from the controls in epileptic patients

WAVE	left	Right
I	30.8	29.6
II	9.3	12.4
III	28.7	28.6
IV	16.2	8.3
V	18.6	17.3
VI	5	2.5
VII	8.1	2
I-III	8.2	8.6
I-V	2.8	6.8
III-V	2.1	1.7

Discussion

The changes in epileptic brain are not confined to hyperexcitable epileptic neurons but more wide spread electrophysiological phenomenon are produced. The results obtained in this study have shown that significant differences exist between normal individuals and epileptic patients as far as Brainstem Auditory Evoked Potentials (BAEP) are concerned.

The variables of age and sex were not responsible for the results since there were no significant (age and sex matched) differences between the patients and controls in this regards.[12,13,19] The faster conduction from left ear as opposed to right ear stimulation should be kept in mind when one compares results from two ears even though its clinical significance is unknown. There was no relationship observable in regard to any wave component and the number of seizures the patient had. Most relationships occurred with the early components especially wave 1 and 3 of the response rather than III V

which suggests that the main disturbance in this patient population is related to medullopontine dysfunction rather than a disorder of the midbrain or thalamus. The experiments done on animals also show that seizures induced as a result of generalized convulsunts do not appear to originate in the thalamus or cortex but in the lower brainstem[9].

Another finding that deserves special attention is the relationship between antiepileptic drugs and aspects of BAEP. A number of studies suggest that many drugs, e.g., anesthetics have depressive effects on the auditory cortex[15]. The current study suggests that the antiepileptic drugs also have depressive effects on BAEP and these influences may be demonstrable even at non toxic therapeutic levels of these centrally acting drugs[16]. It has been reported in the literature that Phenytoin sodium affects the higher brainstem portion[17,18], but anticonvulsant drugs do not explain the relationship to other clinical findings because as mentioned, these point to involvement of low rather than high brainstem structures.

The differences obtained in this study may reflect the effects of antiepileptic drugs but also could be due to seizure type or severity.

As our patients were not seizure free and the duration of drug intake was small so the latter is more likely to be the explanation. But it would be appropriate in subsequent studies to assess the effects of various types of antiepileptic drugs and their blood levels on evoked potential latencies and amplitudes.

Considerable evidence suggests that antiepileptic drugs may slow conduction in the peripheral[17] and the central nervous system and may have depressant effects on neuronal functions independent of clinical antiepileptics effects or sedation[8]. The BAEP documentation of subclinical brainstem and auditory disturbances is analogous to psychometric evidence of subclinical impairment of mental processes[19].

The latency prolongation demonstrated in our patients were less mark than in previous reports. This may be due to the fact that the duration of treatment was less than a ear and there fore the chronic effects of antiepileptic drugs were not there. Also the neurological examination was normal and the patients had no gross stigmata of brain disease of drugs were not there.

Conclusion

1. There is a multimodal disturbance in sensory projections to cortical areas in Epilepsy.
2. The results further give evidence that non-demylinating disorders but with synaptic transmission defects can produce changes in Brainstem Auditory Evoked Potentials (BAEP).

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