Study of brainstem evoked response audiometry in sensorineural hearing deafness-A hospital based study

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Abstract

Aim and Objective: To evaluate role of Brainstem Evoked Response Audiomerty in assessment of patients of sensorineural hearing loss & to evaluate cases of sensorineural hearing loss to localize the exact size of damage: Cochler, rectocochler.
Material and Methods: Type of study: Observational –Cross Sectional.
Well informed consent was taken from the patients. Each patient was subjected to ENT & Pediatric examination, whenever necessary prior to test. Patient was instructed to clean the scalp with shampoo & not to apply oil on the day of appointment. The test was started after after patient was sedated and well asleep. The first stimulus was given at 90 dBnHL level (maximum intensity available) an decreased by 10 dBnHL for next run if wave V is present. At each intensity, run efforts were made to identify wave V.
Result: In this study threshold & latency measures were obtained form 50 cases (100 ears) by Brainstem Evoked Response Audiometry. No restrictions were imposed on age, sex, degree of hearing loss or audiometric configuration. The data was analyzed separately for pediatric age group (36 cases) and Adults (14 cases).
Conclusion: BERA is the accurate & reliable estimation of hearing levels in infants and young children. It helps in early identification of hearing impairment and rehabilitative measures can be taken at an early age. In this study BERA was effective in identifying hearing loss thresholds & assessing auditory pathway in infants and children's in whom behavioral methods and PTA evaluation is not possible and in children with significant prenatal history with risk of developing hearing loss.

Keywords: BERA, SNHL.

Introduction

1. Brainstem Evoked Response Audiometry (BERA) is an electrophysiological test procedure which studies the electrical potential generated at various levels of auditory system starting from cochlea to cortex.
2. BERA was first described by Sohmer and Feinmesser in 1967[2]
3. Auditory brainstem response applications were described by Hecox and Galambos[3] (1974)
4. BERA is an objective study.

Aim and Objectives

Aim: To study BERA in Sensorineural hearing deafness

Objectives

1. To evaluate role of BERA in assessment of patients of sensorineural hearing loss.
2. To evaluate cases of sensorineural hearing loss to localize the exact site of damage; cochlear, retrocochlear.

Materials and Methods

1. This study evaluates the need of Brainstem Evoked Response audiometry (BERA) in patients of sensorineural deafness.
2. Fifty patients with sensorineural deafness were subjected to pure tone audiometry and BERA.
3. The average hearing threshold of PTA is calculated by taking average of hearing threshold at 500, 1000, 2000 Hz.
4. Stimulus given in the form of clicks @ rate of 11.3 /sec. Each click duration was between 150 to 3000 Hz. Analysis time was 10 ms, 2000 responses were averaged.

Inclusion Criteria: All subjects with pure sensorineural deafness giving reliable response to pure tone audiometry and who had given consent were included

Exclusion Criteria

1. All subjects with conductive or mixed type of deafness were excluded.
2. Unreliable response to pure tone audiometry
3. Not willing for procedure.

BERA waveform thus obtained following calculations were made:

1. Latency of each wave
2. Inter peak latency
3. Interaural latency
4. We used normative values determined by Gupta and Vishwakarma[6]

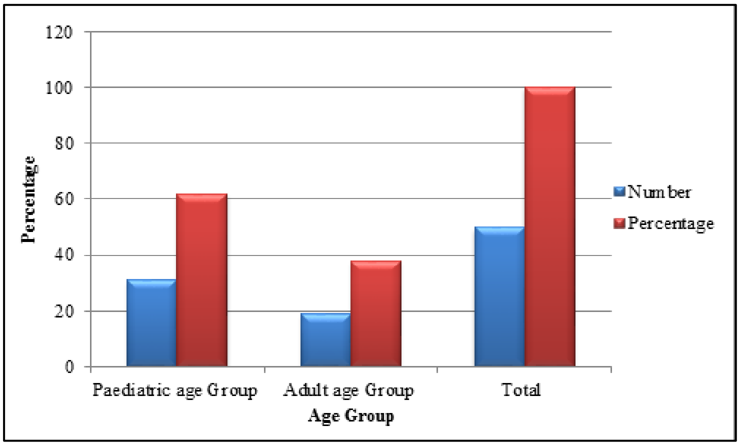
Results and Observations

Age Distribution: In our study we included subjects from the age of 4 years to 69 years.

Table 1: Age distribution

Age	Number	Percentage
Paediatric age Group	31	62.00
Adult age Group	19	38.00
Total	**50**	**100**

Chart 1: Age distribution



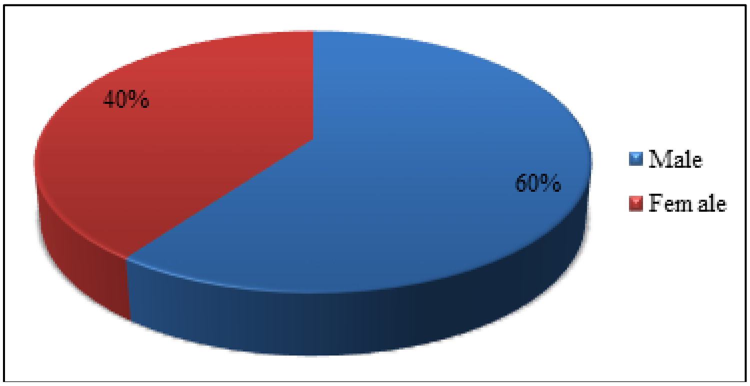
Out of 50 cases 31 cases were of paediatric age group (62%) and rest 19 cases to adult group (38%) (mean age 21.34 years).

Sex Distribution

Table 2: Sex distribution

Sex	Number of Patients	Percentage
Male	30	60
Female	20	40
Total	**50**	**100**

Chart 2: Number of patients



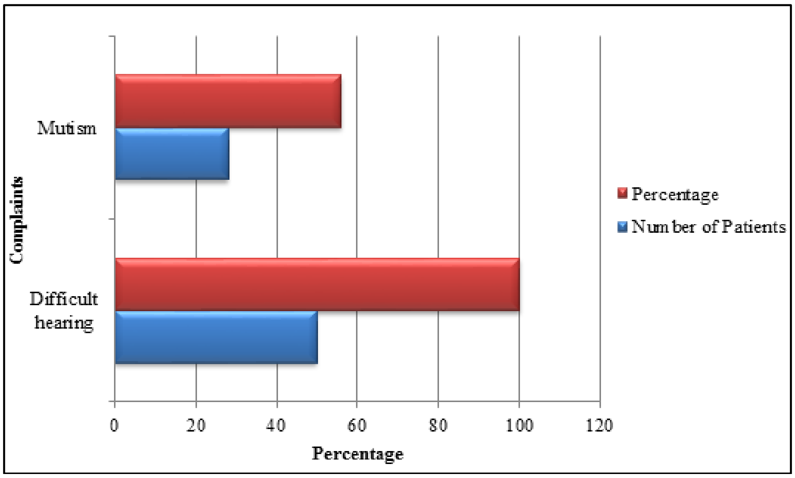
The sex distribution showed increased incidence in males (60%) and remaining 40% was females. The male to female ratio was 1.5:1.

Common presenting complaints

Tables 3: Symptoms

Symptoms	Number of Patients	Percentage
Difficulty hearing	50	100
Mutism	28	56

Chart 3: Symptoms



Hearing loss was commonest complaint (100%). Other presenting symptoms were mutism (60%) particularly in the paediatric age group.

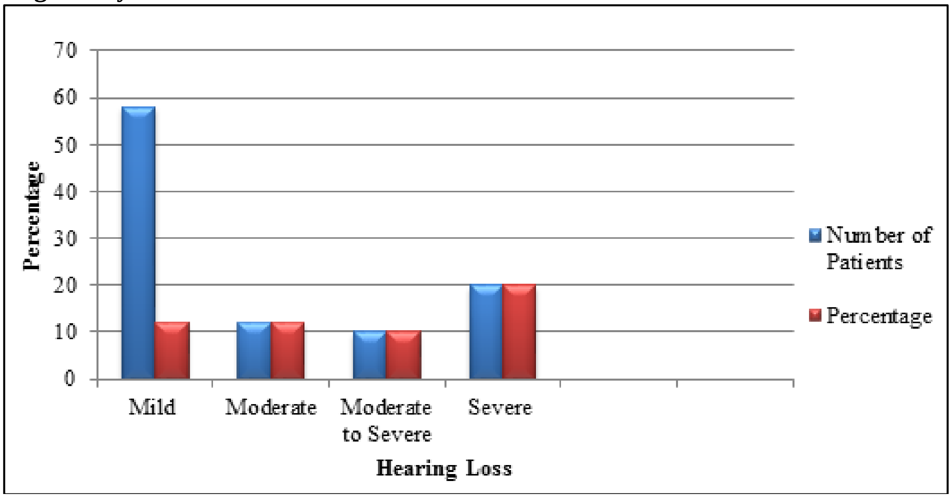
Pure tone Audiometry

Hearing Threshold: Of the 50 subjects, 29 cases were of mild hearing loss, 6 cases were of moderate hearing loss (41-50dB), 5 cases had Moderate-severe deafness (56-70dB) and 10 cases had severe deafness.

Table 4: Hearing loss by pure tone audiometry

Grade	Number of Patients	Percentage
Mild	58	58
Moderate	12	12
Moderate to severe	10	10
Severe	20	20

Chart 4: Hearing loss by PTA



Audiometric Configuration

8 of our subjects showed low frequency sensorineural deafness (20%). (Case 1,8,9,15,17,30,36,43)

6 cases showed selective high frequency loss at 4,6 Khz) (cases no 11 ,19, 22, 28,42,48) (12%).

BERA

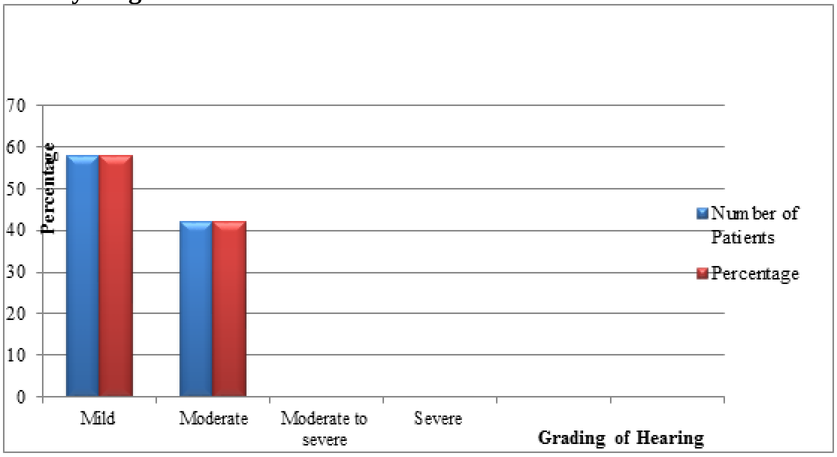
Analysis was done under following headings

Hearing Threshold by Wave V: 58 ears out of 100 ears (58%) had accurate Jerger factor (ABR X0.6 = PTA threshold) of the remaining 42 ears which missed Jerger factor, 36 had moderate severe loss (85%). This includes all the 8 cases of selective low frequency loss.

Table 5: The hearing loss categorized by applying Jerger factor

25 - 40 dB	(Mild)	58 Ears
41 - 70 dB	(Moderate)	42 Ears
56 - 70 dB	(Mod-Severe)	00 Ears
70 - 90 dB	(Severe)	0 Ears

Chart 5: Hearing Loss by Jerger factor



The Smith prediction factor (ABR-15dB=PTA threshold) was accurate in 84 ears (84%).

Another 16.6% cases fall in ± 5 dB variation.
The 16 cases which were missed by Smith factor 14 had mild hearing loss (87%).
There was no special audiometric configuration on PTA in missed cases.

Table 6: Hearing loss staged by applying Smith factor

26 - 40 dB	(Mild)	56 ears
41 - 55 dB	(Moderate)	16 ears
56 - 70 dB	(Mod-Severe)	10 ears
70 - 90 dB	(Severe)	18 ears

Chart 6: Hearing loss predicted by applying Smith factor

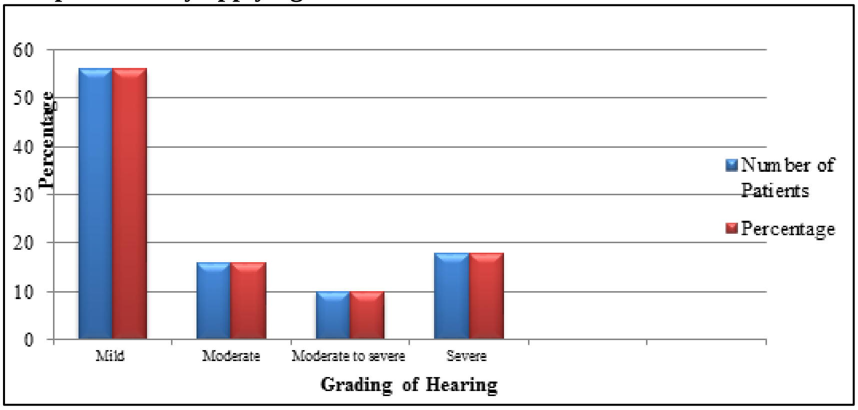


Table 7: Correlation hearing loss Jerger factor, Smith factor

Grade	**Pure tone Auditometry**		**Jerger Factor**		**Smith Factor**	
Mild	58	58%	58	58%	56	56%
Moderate	12	12%	42	42%	16	16.%
Moderate to Severe	10	10%	00	00%	10	10%
Severe	20	20%	00	00%	18	18.%

Chi square = 51.947, p value < 0.01, highly significant

Chart 7: Correlation of hearing loss Jerger factor, Smith factor

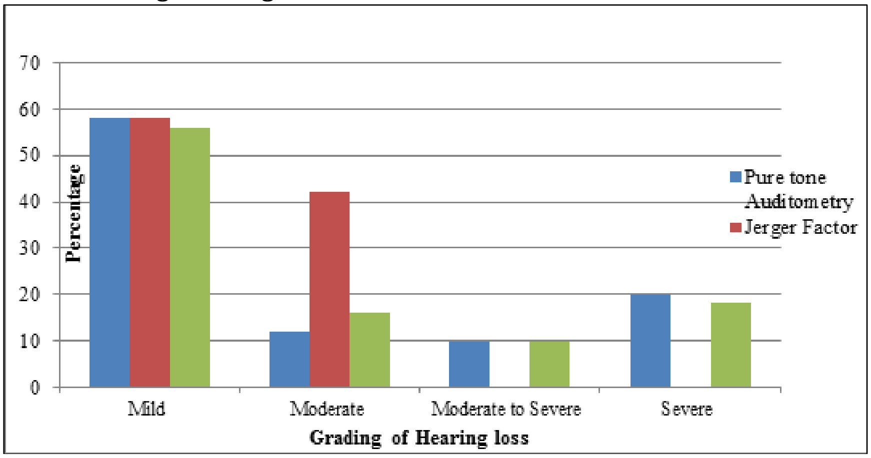


Table 8: Distribution of bera parameters on the basis smith factor

Study parameter	Hearing loss type	N	Mean	SD	P value
avg threshold rt	Mild	23	52.61	13.131	< 0.05
	Mod to Severe	27	70.74	22.956	
avg threshold lt	Mild	23	49.35	8.568	< 0.05
	Mod to Severe	27	70.74	21.29	
Latency wave I rt	Mild	23	2.04	0.209	> 0.05
	Mod to Severe	27	2.22	0.424	
Latency wave I lt	Mild	23	2.00	0.0	< 0.05
	Mod to Severe	27	2.22	0.424	
Latency wave III rt	Mild	23	4.17	0.388	> 0.05
	Mod to Severe	27	3.96	0.706	
Latency wave III lt	Mild	23	4.26	0.449	> 0.05
	Mod to Severe	27	4.11	0.641	
Latency wave V rt	Mild	23	6.17	0.388	> 0.05
	Mod to Severe	27	6.00	0.480	
Latency wave V lt	Mild	23	6.22	0.422	> 0.05
	Mod to Severe	27	6.26	0.447	

Table 9: Distribution of Bera parameters on the basis Jerger factor

Study parameter	Hearing loss type	N	Mean	SD	P value
avg threshold rt	Mild	30	49.67	12.65	< 0.05
	Mod to Severe	20	81.75	12.67	
avg threshold lt	Mild	30	47.17	8.48	< 0.05
	Mod to Severe	20	81.50	12.26	
Latency wave I rt	Mild	30	2.23	0.43	< 0.05
	Mod to Severe	20	2.00	0.0	
Latency wave I lt	Mild	30	2.20	0.407	< 0.05
	Mod to Severe	20	2.00	0.0	
Latency wave III rt	Mild	30	4.33	0.479	< 0.05
	Mod to Severe	20	3.65	0.489	
Latency wave III lt	Mild	30	4.40	0.498	< 0.05
	Mod to Severe	20	3.85	0.489	
Latency wave V rt	Mild	30	6.13	0.571	> 0.05
	Mod to Severe	20	6.00	0.0	
Latency wave V lt	Mild	30	6.37	0.490	< 0.05
	Mod to Severe	20	6.05	0.224	

Note: In both the tables, the significant p value shows that the BERA parameter is a good predictor for differentiating different types of hearing loss.

Latency - Intensity graph Plotting Anais: We could plot latency intensity graph only in 70 ears, as the rest (30 ears) had only single or two responses on high click level.

1. Graph plotting in patients with low frequency hearing loss: Low frequency hearing loss was seen in 10 cases (20%)
   The graphs in this group were normal.
2. Latency-intensity graph plotting in high frequency hearing loss. 6 of our subjects had selective high frequency hearing loss (12%)
   The graph in this group showed steep slope followed by an elevated flat curve above normal.
3. Graph in patients with no specific audiometric configuration.
   We had 54 ears in our study with such deafness. In these 54 ears, latency intensity graph plotting was done. These curve were showing following features:

a. Slopping curve placed in front of normal curve.
b. Curve intersecting normal curve around or, at threshold level. No parallel curve was obtained.
c. Wave V latency increases with a decrease in the intensity of sound stimulus.

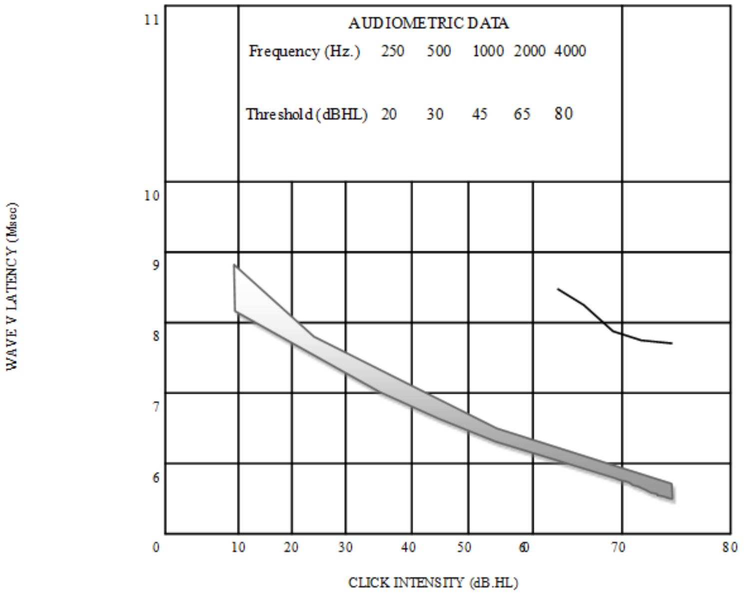


Fig. 1

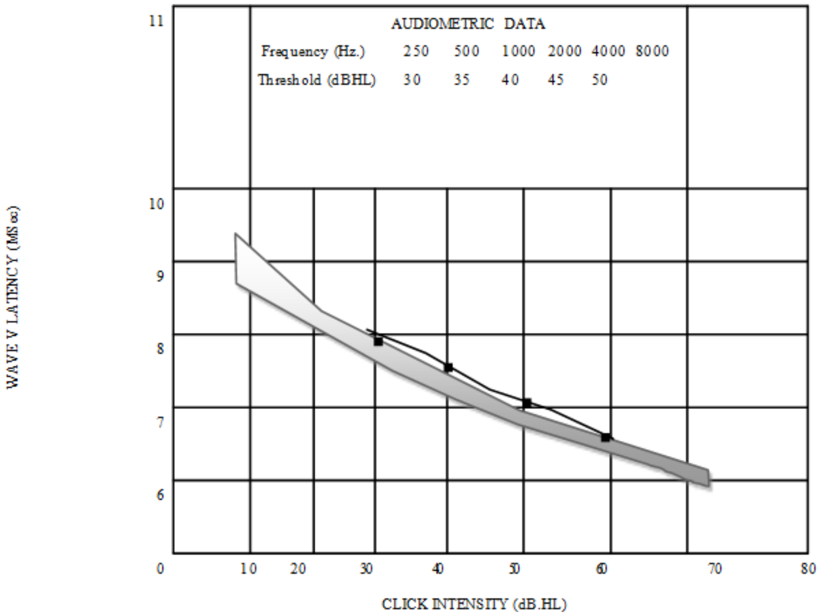


Fig. 2

Conclusion

1. Commonest complaints were hearing loss and mutism (in paediatric age group).
2. By PTA, majority had only mild hearing loss. Some cases had a different audiometric configuration such as selective high frequency or low frequency hearing loss.
3. The latencies of the waves III & V and the IPLs I-III and I-V were more prolonged in the subjects above 50 years as compared to the subjects below 50 years of age.
4. BERA is an accurate method for prediction of hearing loss. Estimation of the hearing threshold with application of Smith factor is more accurate than Jerger's method. We also found that Jerger factor overcorrects ABR threshold with high decibel loss.
5. BERA is reliable and it helps in early identification of hearing impairment so that rehabilitative measures can be taken.

Summary

1. BERA failed to detect low frequency hearing loss.
2. In selective high frequency hearing loss, latency intensity graph showed steep slope followed by flat curve which was elevated above normal.
3. BERA is a very useful confirmative test to rule out retrocochlear pathology.
4. We did not get any such cases of retrocochlear pathology.
5. BERA is a non invasive and an objective test in identifying hearing loss in infants and children.
6. It is time consuming, although it is very useful in estimating hearing thresholds in uncooperative patients.
7. It is a screening test to diagnose retrocochlear pathologies and should be used as a part of routine audiometric tests to confirm and diagnose such pathologies accurately.

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