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Changes in Brainstem Auditory Evoked Potential in Children Aged 1-3 Years with Receptive Language Disorder

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Abstract:
Background*: ReceptiveLanguage disorder(RLD) is a condition in which a child has trouble understanding and processing words. This disorder can affect the child's ability to communicate, learn, and play with others. Hearing loss is a common cause of language disorders including RLD leading to difficulties with behaviour and poor academic achievement. Early intervention with speech and language therapy improves language outcomes. Brainstem evoked response audiometry (BERA), which assess Brainstem auditory evoked potential(BAEP), is a non-invasive and objective way to evaluate functional integrity of auditory pathway.It evaluates hearing in terms of the degree of hearing loss and the type of hearing loss.*
Aims :*The study was done to assess the Brainstem Auditory Evoked Potential inchildren aged 1-3 years with receptive language disorderand to assess if any hearing loss is present by finding out the auditory threshold.*
Methods *:An observational cross-sectional study was done in the Neurophysiology lab, Dept of Physiology, R G Kar Medical College & Hospital, Kolkata between October, 2017 to March,2018.30 children with receptive language disorder from Paediatric Medicine or ENT Department, were taken as subjects. They were further assessed by the Early Language Milestone Scale 2 and then subjected to monaural threshold BAEP test after taking proper consent and ethical clearance.Statistical analysis was done by Student t test,*
Results *:The prolongation of wave 'I' and wave 'V' latency along with inter peak latencies (III-V, I-V) in both ears compared to Age matched controls was significant (P< 0.05). The auditory threshold was higher in both ears in children with receptive language disorder. The findings of evaluation by Early Language Milestone Scale 2 corresponded to that of BAEP findings.*
Conclusions: *The above study suggests that there is both central and peripheral neuropathy affecting auditorypathwayof the subjects having receptive language disorder.*
Keywords:*BAEP, Speech and Language impairment, Wave 'V', Hearing threshold, Interpeak latencies*

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I. Introduction

Speech and language development in children is a dynamic process. Speech refers to the mechanics of oral communication or the motor act of communicating by articulating verbal expressions. Language encompasses the understanding, processing, and production of communication. Several types of speech and language delay and disorders have been described, although the terms used to describe them vary.Basic reading problems occur when there is difficulty understanding the relationship between sounds letters, words.

Reading comprehension problems occur when there is an inability to grasp the meaning of words, phrases, and paragraphs.Reading difficulties include problems with: letter and word recognition.Children, 5 years of age or younger whose speech and language disorders are untreated may exhibit diminished reading skills, poor verbal and spelling skills, behavior problems, and impaired psychosocial adjustment. This can lead to the overall academic underachievement and a lower IQ that may persist into young adulthood. Thus, screening and identification of a language disorder can lead to early intervention and therapy.

Word comprehension begins to increase at age 9 months, and by age 13 months the child's vocabulary may be as large as 20–100 words. After age 18 months, vocabularies increase dramatically, and by the end of the second year there is typically a quantum leap in language development. The child begins to put together words and phrases.[**1**]Children need to understand spoken language before they can use language to express themselves. In most cases, children with a receptive language problem also have an expressive language disorder, which means they have trouble using spoken language.Receptive language disorder is a form of language disorder. It is also referred to as comprehension difficulties. A child with receptive language disorder

has difficulties with understanding what is said to them. The symptoms vary between children but, generally, problems with language comprehension begin before the age of three years. **[2**]

It is estimated that between 3-5 % of children have a receptive or expressive language disorder.In children 7 years old and younger in the United Kingdom the median prevalence of receptive language delay/disorder ranged from 2.63%-3.59%**[3]**.In India,the prevalence of speech and language delay was found to be 27%.**[4]** Children with receptive language disorder involving disruptions in communication development constitute a large group of patients attending the paediatric neurology clinic hereand its prevalence is increasing continuously, making it a focus of our present study.Receptive language disorder is often associated with developmental disorders such as autism, cerebral palsy or Down syndrome. In other cases, receptive language disorder is caused by damage to the brain, for example due to trauma, tumour or disease.**[5]**. In many other children with receptive language disorder, no structural or metabolic abnormality can be found possibly due to gaps in literature and these cases are labeled idiopathic.

Receptive language disorder may be related to hearing impairment, vision impairment, or attention disorders. A large no of cases with Receptive language disorder occurs due to hearing loss.**[6]**Hearing loss can affect a child's development of speech and language skills. When a child has difficulty hearing, the areas of the brain used for communication may not develop appropriately. This makes understanding and talking very difficult.The earlier hearing loss occurs in a child's life, the more serious the effects on the child's development. Hearing loss causes delay in the development of receptive and expressive communication skills. The language deficit causes learning problems that result in reduced academic achievement.

The Brainstem Auditory Evoked Potential (BAEP) is an effective and noninvasive means of assessing the functional status of the auditory pathway. The purpose of BAEP assessment is to quantify and qualify hearing in terms of screening and estimating the degree of hearing loss and the type of hearing loss, especially in difficult to test population like premature newborns, mentally retarded child, child with delayed milestones, etc. **[7]** Among the Wave parameters of BAEP, wave I, III, V latencies and the IPLs of these waves(I-III,III-V,I-V) are the significant ones used for diagnosis **[8]**Watson found that wave I displayed latency prolongation with increasing levels of high-frequency hearing loss and wave V latency was associated with both degree of hearing loss and slope of audiogram.**[9]**Many researchers have in the past used BAEP to assess hearing deficit in children with speech and language disorder but there is a paucity of research specifically evaluating the abnormalities in BAEP in children of receptive language disorder**.[10]** Data is comparatively limited in Indian population; particularly in Eastern India. This creates a milieu upon which the present study was based.The research hypothesis was , Brainstem Evoked Response Potential abnormalities were present in all children aged 1-3 years with receptive language disorders

This cross-sectional study evaluated, BAEP wave latencies among subjects aged 1-3 years with Receptive Language Disorderin comparison with normal children and assess hearing threshold by presence or absence of Wave V of BAEP. The study also aimed to document whether there were Language Impairment assessed by the Early Language Milestone Scale 2 and correlate the findings with BAEP changes among the children with Receptive Language Disorder.

II. Material And Methods

This Observational, Cross-sectionalstudy was carried out in Department of Physiology at R.G.Kar Medical College& Hospital from October, 2017 to March,2018.

1. Study Design

Observational, Cross-sectional

2. Sampling Design

Convenient sampling

3. Study Area

Department. Of Physiology at Neuro Physiology Lab, R.G.Kar Medical College, Kolkata.

4. Study Period

The study was conducted for 6 months.(October, 2017 to March,2018)

5. Study Population

The study population was children aged 1 to 3 years with receptive language disorder. These children were referred to us from the Department. of Paediatrics or from the Department. of ENT of R. G Kar Medical College, Kolkata.

6. Sample Size: By complete enumeration, our Sample Size (n) was 30.**[11]**

7. Inclusion Criteria:

a. Age: 1 year- 3 years
b. Either gender
c. Parents/ Guardians who have given informed written consent
d. Children with receptive language disorder (as diagnosed by ENT or Paediatrics Department)

8. Exclusion Criteria:

a. Children suffering from suppurative ear disease like ASOM or CSOM
b. Children suffering from Upper Respiratory Tract Infection.
c. Children with any history of use of ototoxic drugs
d. 1 year < Age > 3 years
e. Congenital anomalies including microtia or structural anomalies of Nervous System like brain tumour
f. Children suffering from developmental disorders such as autism, cerebral palsy or Down syndrome.
g. Children too ill to perform the test.

9**. Study Tool**

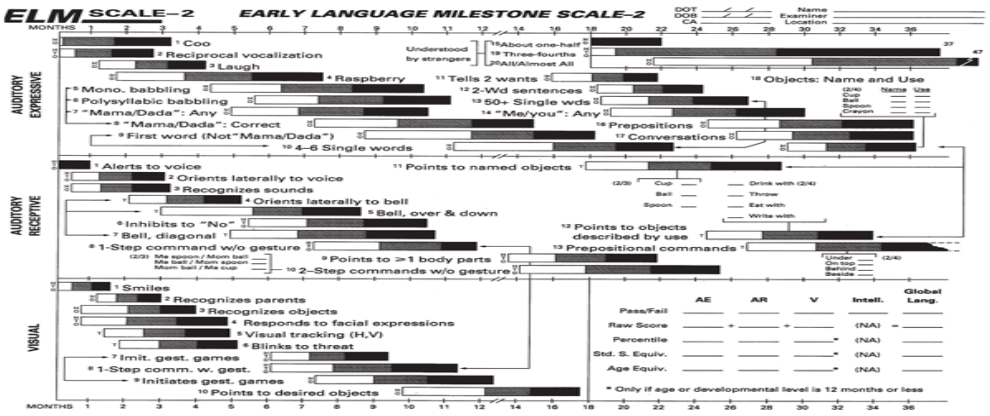
BERA test was done with Neurosoft Neuro-MEP 4 machine manufactured by Neurosoft Software ProductionS.A., Ivanovo, Russia

10. Data collection and interpretation

Children aged 1 to 3 years with receptive language disorder referred to us from Paediatrics Department or ENT Department, R. G. Kar Medical College were taken as study population as per inclusion and exclusion criteria. 30 apparently healthy children of same age group were taken as Controls from Well Baby Clinic, Department of Paediatrics, R G Kar Medical College, Kolkata.Brief History of the children was taken from their mother including birth history, age of achievement of different milestones, family history, use of any ototoxic drugs, etc.

Early Language Milestone Scale 2 **[12]** is a simple tool that can be used to assess language development in children who are younger than three years of age. The test focuses on expressive, receptive and visual language. It relies primarily on the parents' report, with occasional testing of the child.

The 43-item scale was completed on basis of parental history, direct testing or incidental observation. A pass–fail method was used to score items. The pass–fail method is the most efficient for screening. A child must pass all three subtests in those items that 90% of children in the population were expected to pass.



Early Language Milestone Scale 2.[**12**]

The items are scored to a normative age line with notation to caution, advanced and delayed items. These lines represent the normative data and the percentile ranks.

Interpretation of the Test

Normal/ NoLanguage Disorder: No delays and a maximum of 1 caution

Language Disorder: two or more Cautions and /or One or more Delays

11. Parameters Studied

1. Age
2. Early Language Milestone Scale 2 evaluation for assessing language disorder
3. Wave Latencies (I, III, V)
4.Interpeak Latency of Waves like I-III, III-V & I-V.
5.Grade of Hearing impairment by evaluating the wave V threshold after performing the ABR test at decreasing intensity measured in dB SPL.

12. Procedure

Brainstem Evoked Response Audiometry (BERA) was recorded with the help of the machine Neurosoft Neuro-MEP 4,Ivanovo, Russia . At first, parents were interviewed to fill in the study protocol [**13**]and to gather a clinical history. External ear assessment , was carried out and findings were documented. Parents or guardians of the children were explained about the test and asked to apply shampoo at the day before

examination . They were told to come on the very day along with children and after arriving, proper consent form were being explained and signed . They were also instructed to wake the children up in early morning of the test day , so that children remained asleep during the whole recording time as in order to exclude biologically derived noise due to muscle activity . Calm and quiet awake children were also accepted and included for this test. It was done in quiet and cool surrounding . Scalp and forehead were cleaned with Nuprep cleaning gel for electrode placement.The surface electrodes were used for recording Brainstem Auditory Evoked Potential. The silver cup electrodes were fixed over scalp with electrolyte paste. The electrode impedance was less than 5 kohm. The electrodes were placed at , vertex(Cz) and at both mastoids as per International 10-20 system . The mastoids, ipsilateral and contralateral to the stimulated ear are labeled Ai and Ac respectively. The ground electrode (Fz) were placed over forehead(31).Mono phasic square pulse acoustic clicks were used at 11.1 pulse/sec. Click duration was 0.1 ms. Rarefaction clicks were used with 0.5 micro-volt sensitivity and 1 ms/Div sweep speed . BAEP recording was done by applying 70 dB stimulus intensity in ipsilateral ear and 40 dB lower than stimulus intensity was used as masking noise in contralateral ear. Filter setting was adjusted between 100Hz-3000Hz. Two thousand evoked responses were averaged and two such recording were taken to assess reproducibility.The absolute latencies of waves I,III, V and the I-III, III-V, I-V inter peak latency of brainstem auditory evoked potential were compared between the study group and control group to assess any significant difference of wave latencies. When BAEP parameters of cases were prolonged in respect to these normal range of values, derived from control group, or when BAEP waves are absent, both considered as abnormal.

13. Threshold

Thresholds are used to describehearing sensitivity and dynamic range of hearing for both normal and hearing impaired individuals.For evaluating thresholds, initially 70 dB was administered, then intensity was decreased and recordings were made on 50 dB, and 30 dB. If wave V was not detectable at 70 dB intensity then further recordings at 90dB and 100 dB were taken.In our study, the stimulus is given as SPL and the threshold is reported in terms of nHL with 10 dB taken ascorrection factor.

According to the threshold level, the hearing impairment is graded into mild, moderate, severe and profound hearingloss.(Table 1)**[14]**

Table 1 : World Health Organisation Grades of Hearing Impairment (WHO, 2008)**[14]**

Grade of impairment*	**Corresponding audiometric ISO value****	**Performance**	**Recommendations**
* Grades 2, 3 and 4 are classified as disabling hearing impairment (for children, it starts at 31 dB) ** The audiometric ISO values are averages of values at 500, 1000, 2000, 4000 Hz.			
0 – No impairment	**25 dB or better (better ear)**	No or very slight hearing problems. Able to hear whispers.	
1 – Slight impairment	**26-40 dB (better ear)**	Able to hear and repeat words spoken in normal voice at 1 metre.	Counseling. Hearing aids may be needed.
2 – Moderate impairment	**41-60 dB (better ear)**	Able to hear and repeat words spoken in raised voice at 1 metre.	Hearing aids usually recommended.
3 – Severe impairment	**61-80 dB (better ear)**	Able to hear some words when shouted into better ear.	Hearing aids needed. If no hearing aids available, lip-reading and signing should be taught.
4 – Profound impairment including deafness	**81 dB or greater (better ear)**	Unable to hear and understand even a shouted voice.	Hearing aids may help understanding words. Additional rehabilitation needed. Lip-reading and sometimes signing essential.

Statistical analysis

To compare data of main group and subgroups with control population, Student's t-test was applied. The level $P < 0.05$ was considered as the cutoff value or significance.For qualitative parameter (i.e, sex), Fisher Exact test was done. The statistical analysis was done with Graph Pad Quick Calc software, California, USA.Wave Threshold was compared between cases and controls and the test of significance used was Mann Whitney U test. Software used was VassarStats: Website for Statistical Computation (vassarstats.net).

III. Result

- Sex and age wise the 30 children with Receptive Language Disorder were similar with 30 apparently healthy children, taken as control.

I) Assessment of Receptive Language Disorder

Table 2 -Showing no. of cases according to ELM scale-2

ELM scale-2 Evaluation	No. of Cases(N=30)	Proportion
Normal/ No Receptive Language Disorder	2	6.67%
Receptive Language Disorder	28	93.33%

Table 2shows that the maximum number of cases(93.33%)presented with Receptive Languagedisorder. Out of the 28 children who had Receptive Language disorder, 5(17.86%) failed in Auditory Expressivedivision,9(32.14%)failed in Auditory Receptivedivision, 3(10.71%)failed in Visualdivision, 10(35.72%)failed in both Auditory Expressiveand Auditory Receptivedivisions and 1(3.5%) failed in all the three (Auditory Expressive,Auditory Receptiveand Visual) divisions.

II) Latency (I,III, V) and Inter Peak Latency (I-III, III-V, I-V)

- **Right Ear**

In 26(86.67%) cases, wave V was present at 70 dB for Right ear, while in 4(13.33%) cases Wave V was absent.

Table 3 - Mean Wave latencies of Cases and Controls of Right ear with p-value

BAEP parameters Latency in msec	Cases (n=26)# Mean ± SD	Control (n=30) Mean ± SD	P values
Wave I	1.934±0.383	1.71±0.303	**0.0179***
Wave III	4.216±0.354	4.134±0.451	0.4575
Wave V	6.895±0.211	5.951±0.529	**<0.0001***
Wave I-III	2.279±0.443	2.135±0.401	0.2072
Wave III-V	2.815±0.516	1.879±0.18	**<0.0001***
Wave I-V	5.237±0.378	4.061±0.702	**<0.0001***

* Statistically significant# Cases where Wave V was present at 70 dB were taken into consideration.

There was Statistically Significant prolongation of Wave I, Wave V and Wave III-V, Wave I-V inter peak latency at 70 dB compared to control.

- **For Different Groups According to Receptive Language Disorder by Early Language Milestone Scale-2 (ELM Scale 2)**

1) Children without Receptive Language Disorder (No delays and a maximum of 1 caution) according to ELM Scale 2

In all the 2 (100%) childrenwithout Receptive Language Disorder, wave V was present at 70 dB for Right ear.

Table 4 -Mean Wave latencies of Cases and Controls of Right ear with p-value

BAEP parameters Latency in msec	Cases (n=2)# Mean ± SD	Control (n=30) Mean ± SD	P values
Wave I	1.415±0.332	1.71±0.303	0.194
Wave III	4.385±0.007	4.134±0.451	0.4443
Wave V	6.605±0.106	5.951±0.529	0.0956
Wave I-III	2.665±0.304	2.135±0.401	0.0783
Wave III-V	2.125±0.035	1.879±0.18	0.067
Wave I-V	4.735±0.87	4.061±0.702	0.2025

Cases where Wave V was present at 70 dB were taken into consideration

There was no Statistically Significant prolongation of wave latency of Cases at 70 dB compared to the control.

2) Children with Receptive Language Disorder (two or more Cautions and /or One or more Delays) according to ELM Scale

In 24(85.71%) childrenwith Receptive Language Disorder, wave V was present at 70 dB for Right ear, while in 4(14.29%) cases Wave V was absent.

Table 5 -Mean Wave latencies of Cases and Controls of Right ear with p-value

BAEP parameters Latency in msec	Cases (n=24)# Mean ± SD	Control (n=30) Mean ± SD	P values
Wave I	1.971±0.364	1.71±0.303	**0.0058***
Wave III	4.204±0.364	4.134±0.451	0.5404
Wave V	6.919±0.2	5.951±0.529	**<0.0001***
Wave I-III	2.251±0.442	2.135±0.401	0.3175
Wave III-V	2.873±0.495	1.879±0.18	**<0.0001***
Wave I-V	5.279±0.315	4.061±0.702	**<0.0001***

* Statistically significant# Cases where Wave V was present at 70 dB were taken into consideration.
There was Statistically Significant prolongation of Wave I, Wave V and Wave III-V, Wave I-V inter peak latency at 70 dB compared to control.

Table 6 -Comparison of Mean Wave latencies of Right ear of Children with Receptive Language Disorder (two or more Cautions and /or One or more Delays) and Children without Receptive Language Disorder (No delays and a maximum of 1 caution) with p-value

BAEP parameters Latency in msec	Children with Receptive Language Disorder (two or more Cautions and /or One or more Delays) (n=24)# Mean ± SD	Children without Receptive Language Disorder (No delays and a maximum of 1 caution) (n=2)# Mean ± SD	P values
Wave I	1.971±0.364	1.415±0.332	**0.0481***
Wave III	4.204±0.364	4.385±0.007	0.4967
Wave V	6.919±0.2	6.605±0.106	**0.0405***
Wave I-III	2.251±0.442	2.665±0.304	0.2104
Wave III-V	2.873±0.495	2.125±0.035	**0.0467***
Wave I-V	5.279±0.315	4.735±0.87	**0.0487***

* Statistically significant# Cases where Wave V was present at 70 dB were taken into consideration.

There was statistically significant correlation between Wave I, Wave V latency and Wave III-V, I-V interpeak Latencies of Right ear of Children with Receptive Language Disorder (two or more Cautions and /or One or more Delays) and Children without Receptive Language Disorder (No delays and a maximum of 1 caution) according to ELM Scale 2.

- **Left Ear**

In 27(90%) cases, wave V was present at 70 dB for left ear, while in 3(10%) cases Wave V was absent.

Table 7 - Mean Wave latencies of Cases and Controls of Left ear with p-value

BAEP parameters Latency in msec	Cases (n=27)# Mean ± SD	Control (n=30) Mean ± SD	P values
Wave I	2.201±0.395	1.677±0.269	**<0.0001***
Wave III	4.239±0.376	4.203±0.106	0.6169
Wave V	6.38±0.4	6.033±0.329	**0.0007***
Wave I-III	2.427±0.576	2.254±0.296	0.1535
Wave III-V	2.815±0.516	1.552±0.444	**<0.0001***
Wave I-V	5.237±0.378	4.045±0.644	**0.0018***

* Statistically significant# Cases where Wave V was present at 70 dB were taken into consideration.

There was Statistically Significant prolongation of Wave I, Wave V and Wave III-V, Wave I-V inter peak latency at 70 dB compared to control.

- **For Different Groups According to Receptive Language Disorder by Early Language Milestone Scale-2 (ELM Scale 2)**

1) Children without Receptive Language Disorder (No delays and a maximum of 1 caution) according to ELM Scale 2

In all the 2 (100%) childrenwithout Receptive Language Disorder, wave V was present at 70 dB for Left ear.

Table 8 -Mean Wave latencies of Cases and Controls of Left ear with p-value

BAEP parameters Latency in msec	Cases (n=2)# Mean ± SD	Control (n=30) Mean ± SD	P values
Wave I	1.655±0.106	1.677±0.269	0.9103
Wave III	4.17±0.382	4.203±0.106	0.7211
Wave V	5.845±0.403	6.033±0.329	0.4438
Wave I-III	2.055±0.007	2.254±0.296	0.3566
Wave III-V	1.895±0.064	1.552±0.444	0.2907
Wave I-V	3.945±0.064	4.045±0.644	0.8303

Cases where Wave V was present at 70 dB were taken into consideration
There was no Statistically Significant prolongation of wave latency of Cases at 70 dB compared to the control.

2) Children with Receptive Language Disorder (two or more Cautions and /or One or more Delays) according to ELM Scale

In 25(89.29%) childrenwith Receptive Language Disorder, wave V was present at 70 dB for Left ear, while in 3(10.71%) cases Wave V was absent.

Table 9 -Mean Wave latencies of Cases and Controls of Left ear with p-value

BAEP parameters Latency in msec	Cases (n=25)# Mean ± SD	Control (n=30) Mean ± SD	P values
Wave I	2.24±0.378	1.677±0.269	**<0.0001***
Wave III	4.244±0.382	4.203±0.106	0.5756
Wave V	6.423±0.375	6.033±0.329	**0.0001***
Wave I-III	2.251±0.442	2.254±0.296	0.1101
Wave III-V	2.618±0.469	1.552±0.444	**<0.0001***
Wave I-V	4.641±0.436	4.045±0.644	**0.0002***

* Statistically significant# Cases where Wave V was present at 70 dB were taken into consideration.

There was Statistically Significant prolongation of Wave I, Wave V and Wave III-V, Wave I-V inter peak latency at 70 dB compared to control.

Table 10-Comparison between Mean Wave latencies of Left ear of Children with Receptive Language Disorder (two or more Cautions and /or One or more Delays) and Children without Receptive Language Disorder (No delays and a maximum of 1 caution) with p-value

BAEP parameters Latency in msec	Children with Receptive Language Disorder (two or more Cautions and /or One or more Delays) (n=25)# Mean ± SD	Children without Receptive Language Disorder (No delays and a maximum of 1 caution) (n=2)# Mean ± SD	P values
Wave I	2.24±0.378	1.655±0.106	**0.0418***
Wave III	4.244±0.382	4.17±0.382	0.7942
Wave V	6.423±0.375	5.845±0.403	**0.0468***
Wave I-III	2.453±0.588	2.055±0.007	0.3562
Wave III-V	2.618±0.469	1.895±0.064	**0.0423***
Wave I-V	4.641±0.436	3.945±0.064	**0.036***

* Statistically significant# Cases where Wave V was present at 70 dB were taken into consideration.

There was statistically significant correlation between Wave I, Wave V latency and Wave III-V, I-V interpeak Latencies ofLeft ear of Children with Receptive Language Disorder (two or more Cautions and /or One or more Delays) and Children without Receptive Language Disorder (No delays and a maximum of 1 caution) according to ELM Scale 2.

III) Threshold (in dB) in all Cases

A) **Right Ear**

Table 11 showing number of cases in each threshold group in Right Ear of Cases according to **Grading of HearingSensitivity(WHO)**

Threshold(dB SPL)	Grading of Hearing Sensitivity(WHO)	No. of Cases (n=30)	Proportion(%)
<25 dB	Normal hearing sensitivity	3	10%
26dB-40dB	Mild hearing impairment	11	36.67%
41dB-60dB	Moderate hearing impairment	12	40%
61dB-80dB	Severe hearing impairment	1	3.33%
≥81dB	Profound hearing impairment	3	10%

Table 11 shows that most (40%) of the cases had Moderate hearing impairment in the Right ear.

Table 12 showing number of cases in each threshold group according to **Grading of Hearing Sensitivity (WHO)** in Right Ear of Cases based on evaluation by Early Language Milestone Scale 2

Early Language Milestone Scale 2 evaluation	No. of Cases (n=30)	Grading of Hearing Sensitivity(WHO)
No Receptive Language Disorder (No delays and a maximum of 1 caution)	2	Normal hearing sensitivity (**<25 dB**)
Receptive Language Disorder (two or more Cautions and /or One or more Delays)	1	Normal hearing sensitivity (**<25 dB**)
	11	Mild hearing impairment (**26dB-40dB**)
	12	Moderate hearing impairment (**41dB-60dB**)
	1	Severe hearing impairment (**61dB-80dB**)
	3	Profound hearing impairment (**≥81dB**)

B) **Left Ear**

Table 13 showing number of cases in each threshold group in Left Ear of Cases according to **Grading of Hearing Sensitivity(WHO)**

Threshold(dB SPL)	Grading of Hearing Sensitivity(WHO)	No. of Cases (n=30)	Proportion(%)
<25 dB	Normal hearing sensitivity	2	6.67%
26dB-40dB	Mild hearing impairment	9	30%

41dB-60dB	Moderate hearing impairment	16	53.33%
61dB-80dB	Severe hearing impairment	1	3.33%
≥81dB	Profound hearing impairment	2	6.67%

Table 13 shows that most (53.33%) of the cases had Moderate hearing impairment in the Left ear.

Table 14 showing number of cases in each threshold group according to **Grading of Hearing Sensitivity (WHO)** in Left Ear of Cases based on evaluation by Early Language Milestone Scale 2

Early Language Milestone Scale 2 evaluation	No. of Cases (n=30)	Grading of Hearing Sensitivity(WHO)
No Receptive Language Disorder (No delays and a maximum of 1 caution)	2	Normal hearing sensitivity (**<25 dB**)
Receptive Language Disorder (two or more Cautions and /or One or more Delays)	9	Mild hearing impairment (**26dB-40dB)**
	16	Moderate hearing impairment (**41dB-60dB**)
	1	Severe hearing impairment (**61dB-80dB**)
	2	Profound hearing impairment (**≥81dB**)

The mean threshold was calculated by Mann Whitney U test and the P-values analysed.

Table 15showing Mean Threshold of Cases and Controls with Significance

	Mean Rank for Cases	Mean Rank for Control	P1 values	P2 values
Right	42.6	18.4	**<0.0001***	**<0.0001***
Left	43.6	17.4	**<0.0001***	**<0.0001***

* Statistically significant.There was statistically significant increase of threshold of both ears of cases compared to controls.

IV. Discussion

Basic communication skills are developed (although not complete) by the time a child enterskindergarten, enabling the child to begin learning from teachers and interacting fluently with peers and caregivers **[15]**. The development of normal speech and language functions is closely related to normal hearing. Language and speech problemsare the most common types ofdevelopmental childhood disabilities**.[16]** Severe speech and language disorders can derailtypical cascade of development and have profound and wide-ranging adverse impacts [**17**].

A Receptive Language Disorder is a type of learning disorder affecting the ability to understand spoken, and sometimes written, language. Individuals with a receptive language disorder may have difficulty understanding spoken language, responding appropriately, or both. Children with receptive language disorders often have difficulty organizing their thoughts while trying to understand others, which creates problems in communicating. Some may also have problems with the pronunciation of words and speech/sound production. **[18**] Hearing undoubtedly plays a leading part in the language acquisition process.In Many of the cases, the underlying cause of Receptive Language Disorder is hearing loss.**[6]**Children with hearing loss may have difficulty with understanding sounds around them, Making speech sounds, Learning new words, Putting together sentences, Using correct grammar, Effectively expressing themselves and Understanding speech from other people.

Brainstem evoked response audiometry (BERA) has been well documented as a method of screening deafness in the very young child.There is evidence suggesting a connection between language impairments and a central auditory processing disorder; nonetheless, the underlying mechanisms are not well known[**19**]. Brainstem auditory evoked response (BAER) has proved useful in determining the hearing threshold in very young uncooperative patient.**[20]**.Further, BAER is not significantly altered by the state of consciousness, drugs and a variety of environmental factors.**[21,22]** Because of these properties, BERA can be used as a tool for assessment of auditory dysfunction in high risk infants and children .**[23]**

This cross sectional and observational study was carried out with 30 children with history of receptive language disorder and 30 age and sex matched control in the Neurophysiology lab, Department of Physiology at R.G.Kar Medical College, a tertiary care teaching hospital, Kolkata in the time interval of October, 2017 to March,2018. All the children belonged to the age group of 1-3 years. They were subjected to BERA testing following standard procedures and the BAEP findings of the cases were analysed with respect to the controls. The parameters studied were the latencies of Wave I, III, V, I-V,III-V, and I-III interpeak latency and waveV threshold of each ear. These parameters were used to assess the degree of hearing loss in the children with receptive language disorder.

The present study used Early Language Milestone Scale 2 **[12]** as a tool to assess the Receptive Language Disorder of the children. Early Language Milestone Scale 2 is a simple tool that can be used to assess language development in children who are younger than three years of age. The test focuses on expressive, receptive and visual language. It relies primarily on the parents' report, with occasional testing of the child.

Out of the 30 children, 28 (93.33%) children showed some abnormality of latency and/ or threshold in one or bothears. The major abnormalities were absence of wave V or increase in wave V latency at 70 dB.In the present study wave V at 70 dB was absent in 3(10%) cases in both ears.

For both right and left earsof the cases where Wave V was present at 70 dB, there was statistically significant prolongation of Wave I, Wave V and Wave III -V ,Wave I-V inter peak latency compared to controls.

This indicates a prolongation of both Peripheral and Central Auditory transmission time.

The findings of this study were similar to findings by various other workers. Mishra P.K. et al.**[24]** showedtransient prolongation of latencies of various waves including wave 1, wave V but no prolonged interpeak latencies**.** Watson **[9]** found that wave Idisplayed latency prolongation with increasing levels of high-frequency hearing loss.Scalais et al**[25]** showed that there was brainstem auditory-evoked response abnormalitiesincluding wave V and prolonged I-V inter peak latency suggestive of central auditory transmission.

On the other hand, **In the study by** Roncagliolo M, et al **[26]**, there were no significant differences in the central conduction time of the auditory pathway (I- V interval) of the children with language disorders aged four to nine years.

In the study conducted by Akshoomoff N **[27]** et al The BAEPs for the receptive developmental language disorder group were comparable to the control group across intensity levels and stimulation rates.

In the present study, there were several findings which were statistically significant.

Of the 30 cases, 28(93.33 %) of the children presented with Receptive Language Disorder (two or more Cautions and /or One or more Delays)according to Early Language Milestone Scale 2.

Abraham et al showed that prevalence of language delay in general population was 13.7%. Most of the delay (26.7%) was seen in 2-3 years age group**[28]**It is estimated that between 3-5 % of children have a receptive or expressive language disorder.In children 7 years old and younger in the United Kingdom the median prevalence of receptive language delay/disorder ranged from 2.63%-3.59%**[3]**.In India,the prevalence of speech and language delay was found to be 27%.**[4]**

Another finding was, latency of wave I, V and Wave III-V, Wave I-V inter peak latency was delayed. Delayed wave I latency suggested abnormality in peripheral auditory pathway transmission time (PTT). Delay of Wave V, Wave III-V and I-V inter peak latency suggested an abnormality of Central auditory transmission time. The Present study shows that children with delayed speech are at a risk of impaired auditory transmission which can be a combination of both Central and Peripheral abnormality.

This was the first study in eastern India corelating ELM Scale 2 score for evaluating speech and language impairment withBAEP parameters. We found that the children who had Receptive Language Disorder (two or more Cautions and /or One or more Delays)according to Early Language Milestone Scale 2 hadstatistically significant prolongation of Wave I and V latency & III-V and I-V interpeak Latency of both Right and Left ear at 70 dB compared to control. This indicates bothabnormality of peripheral and central auditory pathway transmission time as a cause of the Receptive Language disorder found bythe Early Language Milestone Scale 2 evaluation.

It was also found that the children who did not have Receptive Language Disorder (No delays and a maximum of 1 caution) according to Early Language Milestone Scale 2 had no statistically significant wave latency at 70 dB of both Right and Left ear compared to control. This indicates that the findings of Early Language Milestone Scale 2 corresponded with the findings of BAEP waves.

There was statistically significant prolongation of Wave I and V latency & III-V and I-V interpeak Latency of both Right and Left ear at 70 dBof Children with Receptive Language Disorder (two or more Cautions and /or One or more Delays) than Children with No Receptive Language Disorder (No delays and a maximum of 1 caution) according to Early Language Milestone Scale 2.

There was elevation of threshold of hearing with various degrees of sensorineural hearing loss and was likely a combination of both peripheral and central transmission abnormality. The children who had Receptive Language Disorder (two or more Cautions and /or One or more Delays) had increased hearing threshold.

An attempt was made in this study to analyse the different effect of Receptive Language Disorder on BAEP in different age groups. Most of the previous studies mention that there is raised threshold inchildren with speech and language disorder, especially with hearing loss. This studycategorizes the degrees of hearing loss based on the raised threshold. There were some limitations of this present study. This one was a cross-sectional study, though follow up study is always better to observe the effect of Speech therapy and Rehabilitation. Also a large number of Sample size would be useful to have adequate children to divide them in multiple age groups and to assess Early Language Milestone Scale 2 in each group.

V. Conclusion

This present study has surely demonstrated that there are significant BAEP changes in children with Receptive Language Disorder with varying degree of hearing loss. Both ears had BAEP changes indicating an abnormality of both Central And peripheral auditory transmission. We found that most of the childrenhad Moderate hearing loss.

Children who had Receptive Language Disorder according to Early Language Milestone Scale 2 score had both Central and Peripheral Auditory Transmissiondelay. This indicates both abnormality of peripheral and central auditory pathway transmission timeas a cause of the Receptive Language Disorder found by the Early Language Milestone Scale 2evaluation. Results of this study underline the importance of auditory evoked potentials in evaluating the children's auditorysystem. BERA can be an efficient tool for monitoring the auditory brainstem pathway in children who have Receptive Language Disorder. Diagnosing the auditory damage and hearing loss early can helpin formulating a treatment and rehabilitation plan.

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