Original Research Paper

Volume-9 | Issue-12 | December - 2019 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Physiology

VISUAL EVOKED POTENTIAL AND AUDITORY EVOKED POTENTIAL IN SLOW LEARNERS

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ABSTRACT

INTRODUCTION: Slow learners comprise upto 7% of the school going children in India. These children are associated with increased risk for psychopathological disorders.

AIM: The present study was undertaken to examine the functional integrity of visual & auditory pathway in slow learners. A standard psychological & neurophysiological test, if done early will help to identify slow learners & prevent behavioral problems that result due to late diagnosis.

METHODOLOGY: The subjects were selected from special education school. Psychological evaluation was done using Malin's intelligence scale. Forty subjects (IQ:70-85) in the mean age group 10-15 yrs & forty age/sex matched control were selected. Electrophysiological evaluation of VEP & BAEP was done.

RESULTS: VEP study shows significant prolongation of N75 and P100 latencies due to defect in magnocellular pathway & BAEP showed significant prolongation in I-III & I-V IPL due to delay in conduction of impulses in pontomedullary and midbrain auditory pathway in slow learners.

KEYWORDS : Visual Evoked Potential (VEP), Brainstem Auditory Evoked Potential (BAEP), Interpeak latency (IPL), Slow learner

INTRODUCTION:

Education plays a pivotal role to mould the personality of an individual. One of the major tasks of education is to help children to improve skills appropriate to the age.

Slow learners are children with below average cognitive abilities. They are not disabled, but struggle to cope with the academic demands of the regular class room. These children are limited in their social and adaptive skills, have poor receptive and expressive language skills which impede their personal development and school progress [1].

According to the American Psychiatric Association (DSM-IV) criteria, Borderline intellectual functioning (BIF) has been defined as children having an intelligence quotient in the range between 70 and 84, i.e. between -2 and -1 standard deviations[2].

Many research studies demonstrate a positive correlation between Intelligence level (IQ) and Nerve conduction velocity (NCV) in a brain neuronal pathway (VEP, BAEP). Individuals with faster NCVs were associated with faster reaction time & higher IQs , whereas those with lower IQ have prolonged nerve conduction velocity and decreased rate of information processing[3].

Behavioral disorders appear in 30% of children with BIF. Slow learners require support that facilitates proper recognition and remediation efforts, individual psychotherapy, behavior modification and specific health attention[4].

Thus, the present study will help generate awareness about slow learners among school authorities & pediatricians all over the country. Early identification of slow learners help to improve their self esteem, acquire academic & vocational skills to become productive members of the society in future.

MATERIALS & METHODS:

This study was conducted in the Research laboratory, Department of Physiology, Thanjavur Medical College, Thanjavur. The study period was 6 months and the subjects were selected from a special school for slow learners.The study group comprises of 40 subjects, 19 males and 21 females with mean IQ (79.85 ± 2.86) of mean age group (10.72 ± 0.877 years) were selected by Standard IQ Assessment Test - Malin's intelligence scale for Indian children.

Students with history of specific psychological disorders like learning disability, mental retardation, ADHD or any other neurological disorders were excluded from the study.

Out of 40 controls, 11 males & 29 females with mean age group (10.85 ± 0.834 years) and good academic performance were selected for the study. Ethical Committee approval was obtained from the institution. Informed written consent was obtained from the guardian of the children prior to the study. A detailed history of clinical, psychological & neurological examination, academic performance, behaviour history was noted.

Assessment of IQ:

Malin's Intelligence scale for Indian children [5,6]

Full scale IQ scores of children were obtained by adding both Verbal and Performance test totals and divided for getting the average.

Verbal Tests :

General knowledge and language skills

1. Information
2. Comprehension
3. Arithmetic
4. Similarities
5. Vocabulary
6. Digit span

Performance Tests:

Spatial and perceptual abilities

1. Picture completion
2. Picture arrangement
3. Block design
4. Object assembly
5. Coding
6. Mazes

The concentration of Indian children scores lies mainly between the 16th and 84th percentile anchor points. 84th percentile is equivalent to an IQ of 115.

Electrophysiological Assessment:

Evoked potentials [7]

Evoked potentials are small electrical potentials arising from neural tissue along the sensory pathways occurring in response to visual, auditory and somatosensory stimuli. Evoked potential techniques are non invasive and have excellent temporal resolution.

Visual Evoked Potential:

VEPs are summated electrical signals recorded from human scalp in response to changing visual stimulus such as checkerboard pattern of black and white squares.

It depends on the functional integrity of visual pathway including retina, optic nerve, optic chiasma & occipital cortex[8,9].

Brainstem auditory evoked potential [10,11]

BAEPs are the potentials recorded from the ear and scalp in response to

a brief acoustic'click' stimuli to assess the conduction through the auditory pathway from the auditory nerve up to midbrain.

The electrophysiological parameters were recorded using four channel digital polygraph, Digital intex colour monitor, 17"model no: IT-173 SB.

Pre test instructions [10]

1. The Guardian/subject was told about the procedure and got informed consent.
2. To avoid applying hair spray or oil after the last hair wash.
3. Not to use any miotics /mydriatics 12 hours before the test.
4. Ophthalmological examination was carried out to determine visual acuity & field of vision. Examination of external ear, Hearing tests (Rinne's test and Weber's test) were performed.
5. The room parameters should be maintained constant throughout the experiment.

Procedure (VEP):

Electrode scalp placement and recording parameters were carried out according to the standard of the International Society for Clinical Electrophysiology of Vision (ISCEV)[9].

1. The active electrode is placed at Oz (10% from inion) using electrode paste.
2. The reference electrode is placed at Fpz.
3. The ground electrode is placed at vertex at Cz
4. The procedure is conducted in dark room with subject sitting at a distance of 1 meter from the screen showing pattern reversal stimuli in checker board with reversal rate 2/sec, contrast 50-80%, check size 28-32 of arc and average number of trails is 100.

Procedure (BAEP)[10,11]

Electrodes were positioned using 10-20 electrode placement system.

1. The electrode placement is at
- Channel 1 is placed at Cz-Ai (ipsilateral ear)
- Channel 2 is placed at Cz-Ac (contra lateral ear).
- Ground electrode is placed 20% from the nasion (Fz).

2. Head phones are placed on the ears for delivery of the auditory stimulus.
- Clicks are delivered at the rate of 8-10/sec.
- Intensity of the stimulus is set at 60 db.

Statistical analysis:

The data were expressed as Mean ± SD. The analysis was done using statistical package SPSS version 20. An unpaired t test was done to compare parameters between study and control group. P value less than 0.05 was considered significant.

RESULTS:

In study group comprising of 40 subjects, 19 males and 21 females, the mean age group was 10.72 ± 0.877 years with mean IQ 79.85 ± 2.86. Out of 40 controls, 11 males & 29 females, the mean age group was 10.85 ± 0.834 years with good academic performance (mean IQ: 100.59 ± 4.40). Full scale IQ between slow learner & control group was found to be significant with p value 0.001(Table1).

Table 1: Full scale IQ in Slow learners & Control group

Parameter	Slow learner (n = 40)	Control group (n = 40)	P value
	Mean ± SD	Mean ± SD	
Full scale IQ (VT + PT)	79.8562 ±2.8644	100.5902 ± 4.4044	0.001

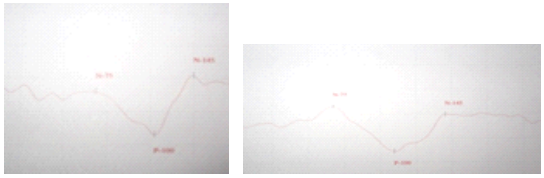
Table 2: Electrophysiological findings (VEP, BAEP) in cases & control group

Parameters	Slow learner (n = 40)	Control group (n = 40)	P value
	Mean ± SD	Mean ± SD	
VEP Latency (ms)			
N75	76.7000 ± 3.25971	69.8000 ± 3.52427	0.000
P100	107.8750 ± 4.9143	96.5375 ± 4.20834	0.000
BAEP IPL (ms)			
I – III	2.8355± 0.60783	2.1630 ± 0.42114	0.000
III – V	2.4122 ± 0.51334	2.2303 ± 0.43751	0.092*
I – V	5.2560 ± 0.70725	4.3133 ± 0.51078	0.000

***p> 0.05: Not significant**

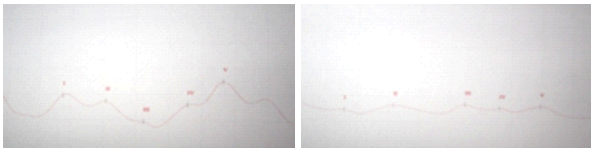
In our present study, there was a significant prolongation of N75 and P100 latencies(VEP) & prolongation of I -III & I-V IPL(BAEP) in slow learners as compared to control group and was statistically significant (Table 2).

Figure 1 shows the comparison of N75 & P100 latencies in slow learners & control group



Control group **Slow learner**

Figure 2 shows the comparison of BAEP latency in slow learners & control group



Control group **Slow learner**

DISCUSSION:

The developing brain in children undergoes multiple changes. The 'wiring' of the brain involves the formation of trillions of synapses between neurons of different parts of the brain[12]. Genetic factors play an important role in intellectual functioning of an individual. In addition, low birth weight, preterm delivery, birth asphyxia, chronic malnutrition play a contributory role in adversely affecting the intellectual ability in children[13,14]. Children with borderline intelligence experience impairments in detecting, modulating, interpreting and responding to sensory stimuli.

Recent research works have found a significant correlation between auditory processing, nonverbal IQ, receptive language skills and reading. Studies have shown that auditory processing deficits may contribute to poor academic performance in some children[15].

Maturation of VEP [16,17]

Myelination of optic nerve and tract is incomplete at term birth and continues to increase for two years postnatally. Retinal development, visual acuity and cortical cell density, mature to that of an adult pattern by 5 years of age.

Maturation of human central auditory system activity [16,18]

The auditory evoked potential to monoaural stimulation in children matures to the adult pattern by the age of about three years. The differential maturation of cochlea and brainstem, synaptic transmission, axonal conduction time and changes in the length of the auditory pathways are the possible aetiological factors for the developmental changes in the latencies of the BAEP.

In our present study, there was a significant prolongation of N75 and P100 latencies & prolongation in the latency of BAEP I -III & I-V in slow learners as compared to control group.

Visual Evoked Potential:

Our findings of the study was in accordance with those of Khalik et al., Edward et al., Gasser et al., Brannan et al., Munoz Ruata et al., In a study conducted by Khalik et al., [19] significant prolongation of N75 & P100 latency was found due to defect in the magnocellular pathway in slow learners. Edward et al.,[20] also found significant prolongation of P100 latency in a study comprised of 147 students with borderline intelligence due to delayed maturation of the brainstem pathway. Brannan et al., & Munoz, Ruata et al.,[21,22] also reported delayed VEP latency due to deficit in early visual processing in slow learners.

Brainstem Auditory Evoked Potential:

The results of the present study were consistent with those of Khalik et al, Marosi et al, Garreau et al., Skoff et al. Khalik et al., [23] studied BAEP in slow learners and found a significant prolongation in I- III &

I - V IPL due to delay in the conduction of impulses in pontomedullary and midbrain auditory pathway in children with borderline intelligence. Marosi et al.,[24] showed increased I - V interpeak latency and prolonged wave V latency in borderline intelligence children. Garreau et al., and Skoff BF et al., also showed abnormal brainstem transmission time with prolonged I - V and III-V interpeak latencies in poor readers.

Reports showed that in a population survey of more than 8000 adults, there were 12% of borderline intelligence individuals. These individuals have more emotional and behavioral problems, personality disorders, substance abuse, adaptation and social problems than the study group.

The increased rates of suicidal behavior found in adolescents with borderline intellectual capacity associated with complex socioeconomic problems have also been reported in a survey.. Children with borderline intelligence were more likely to suffer from extra-pyramidal side-effects and show evidence of negative symptoms.

CONCLUSION:

With the help of advances in Electrophysiological evaluation, the need for screening, early detection, recognition and early interventions are met, so that the children & adolescents with BIF who are at risk of developing psychopathological disorders, improves the capacities and potentialities, so as to prepare that individual to be successful in society. Thus, a multidisciplinary approach has to be implemented to provide the most effective and efficient care for slow learners such as behavioral management, psychotherapy, psychopharmacological treatment, counselling, individualized education program (IEP) to enhance and maintain optimum functioning of slow learners.

Recommendations:

However, further studies are required to evaluate the mechanisms that control the neuronal migration, neurotransmission & specific neurocognitive syndromes in the field of molecular neuroscience and also to find out the gender difference in relation to Nerve conduction velocity (NCV) and IQ level.

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