

Cognitive Dysfunctions in Children with Epilepsy

Aishvarya Upadhyay*, S.K. Upadhyay**, O.P. Mishra**, Rajniti Prasad**

*PhD Scholar,**Professor, Department of Pediatrics, Institute of Medical Sciences, Banaras Hindu University, Varanasi-221005.

Abstract

Background: Epilepsy, a chronic neurological disorder is common in children. The global decline in intellectual functioning may occur in children with seizure disorder. *Objectives:* The present study was undertaken to assess cognitive function in children with epilepsy. *Method:* This was a hospital based observational study on 60 children aged 2-5 years and 68; 6-14 years suffering from idiopathic epilepsy. 74 and 64 normal age and gender matched healthy children were also selected as control. Sixty six children suffering from epilepsy aged 6-14 years were also assessed for their memory functioning with healthy control (n=71). Binet-Kulsrestha intelligence scale and PGI memory scale were used for cognitive assessment. *Result:* Epileptic children had significantly lower scores on cognitive functioning in domains of visual-perception ($p<0.001$), motor-coordination ($p<0.001$), language development ($p<0.001$), and immediate recall ($p<0.001$) as compared to control. In children aged 6-14 years with epilepsy, significantly lower values were observed for analysis, synthesis and reasoning ($p<0.001$) and memory ($p<0.001$) as compared to control. Epileptic children also had significantly lower overall IQ. *Conclusion:* Parent should be counseled about decline in cognitive functions and IQ in epileptic children for early intervention and appropriate measures.

Keywords: Epilepsy; Cognition; Memory; Intelligence Quotient(IQ).

Introduction

Epilepsy is a chronic disorder that affects intellectual abilities and memory functioning in children. They are at risk for developing learning problems due to low intelligence and memory deficit. Difficulties with abstract reasoning and reduced information processing have also been observed in epileptic children [1]. These children show poor motor precision and visual-motor coordination as well as memory impairment as compared with normal healthy children [2]. It has been documented that decreased neuronal excitability and brain damage results into slow motor and psychomotor speed, poorer attention and mild memory impairment in epileptic children [3,4].

Further, various factors are known to disrupt

neurocognitive functions in epileptic children such as seizure type and syndrome, age of onset of seizure as well as seizure frequency, intensity and duration. Studies have reported that onset of seizure before 5 years of age is significant risk factor for intellectual function in partial as well as generalized seizure [5, 6]. Mandelbaum and Burak (1997) have reported poor intellectual performance in children with generalized and non-convulsive seizures compared to partial and convulsive seizure [7].

Thus, it is important to recognize intellectual and memory deficits in epileptic children as early as possible so that appropriate medical, psychological, and educational interventions can be planned. In view of the above, present study was conceptualized with the objectives to explore specific cognitive deficits and memory functioning in children suffering from seizure disorder.

Corresponding Author: Rajniti Prasad, Professor, Department of Pediatrics, Institute of Medical Sciences, Banaras Hindu University Varanasi-221005 U.P.

E-mail: rajnitip@gmail.com

Material and Methods

The participants of the study were recruited during the period from 2010 to 2014 from the Epilepsy Clinic and Out Patient Department of Pediatrics, Institute of Medical Sciences, Banaras Hindu University.

Children aged 2-5 to 6-14 years suffering from epilepsy were taken as study groups and age and gender matched children without any disease/mild ailments served as control.

All the children were subjected to assessment for different cognitive functioning. Binet-kulshrestha intelligence scale, which is an Indian adaptation of famous Stanford-Binet test, form L-M (1960) [8] was used for both the age groups for the assessment of intellectual functioning. In this adaptation, the essential shape and features of the original L-M form have been retained. The test was administered in a separate place, in the presence of one of the family member, preferably the mother. The basal age, mental age and IQ were calculated as per the instructions given in the manual. Further, each protocol was analyzed separately for 2-6 years for the visual-perceptual, motor-coordination, language development, immediate recall, concept formation and reasoning. For 7-14 years, analysis was done for synthesis and reasoning, verbal ability, memory, spatial ability and orientation.

For memory functioning, PGI memory scale for children [9] was used. This scale was used on children above 7 year of age. It measures 10 aspects of memory such as remote memory, recent memory, mental balance, attention-concentration, delayed recall, immediate recall, similar pairs, dissimilar pairs, visual retention and recognition.

Detailed information about epilepsy such as age of onset, type and frequency of seizure, antiepileptic medications and its compliance and family history were recorded through semistructured questionnaire. The protocol of the study was approved by the Institute Ethical committee and informed consent was taken from the parents or authorized representative of each child.

Statistical Analysis

Data were analyzed using SPSS software version 16.0. Student's t -test and Kruskal-wallis test was used to compare the observations on different study groups.

Result

One hundred and thirty nine children suffering from epilepsy and 157 sex and age matched controls were included in the study. These children were further divided in two age groups i.e. 2-5 (60 epileptic and 74 controls) and 6-14 years (79 epileptic and 83 controls).

Table 1 mentioned median values for different domains of cognitive functioning in 2-5 years age groups. Epileptic children had significantly lower scores for visual-perception ($p < 0.001$), motor-coordination ($p < 0.001$), language development ($p < 0.001$), and immediate recall ($p < 0.001$) as compared to their matched controls. In the higher age group, significantly lower values were observed for analysis, synthesis and reasoning ($p < 0.001$) and memory ($p < 0.001$) in the epileptic children (Table 2). Further, epileptic children showed significantly lower overall IQ as compared to controls and were true for both the age groups (Table 3).

Children having partial seizure were compared with those suffering from generalized seizure. In the lower age groups, poor scores for language development ($p < 0.01$) and immediate recall ($p < 0.001$) were observed in children suffering from partial seizure. For higher age group, significant differences were observed for memory functioning ($p < 0.05$). However, no such differences were observed between the two groups in overall intellectual functioning.

Table 4 showed observations on memory scale. Significant differences were observed for delayed recall ($p < 0.001$), immediate recall ($p < 0.01$) and similar pairs ($p < 0.05$), when children with seizure disorder were compared with control group.

Table 1: Median values for different domains of IQ (2-5 years)

Groups	Visual perception		Motor coordination		Language development		Immediate recall		Concept formation		Reasoning	
	Median	SD	Median	SD	Median	SD	Median	SD	Median	SD	Median	SD
Controls (N=74)	0.6663	0.253	0.6660	0.380	1.000	0.209	0.5000	0.344	0.6330	0.342	0.5000	0.359
Epilepsy (N=60)	0.5000	0.264	0.2500	0.209	0.6660	0.301	0.5000	0.236	0.7500	0.356	0.6660	0.418
	Kruskal Wallis											
KW	20.745*		25.949*		24.490*		12.726*		0.469		0.025	

* $p < 0.001$

Table 2: Median values for different domains of IQ (6-14 years)

Groups	Analysis, synthesis & reasoning		Verbal ability		Memory		Spatial ability	
	Median	SD	Median	SD	Median	SD	Median	SD
Controls (N=68)	0.8333	0.214	0.6660	0.278	0.7500	0.265	0.6660	0.342
Epilepsy (N=64)	0.6000	0.301	0.7140	0.285	0.5000	0.308	0.6660	0.298
KW	34.881*		Kruskal Wallis 0.392		24.584*		0.657	

*p<0.001

Table 3: Mean±SD for intellectual functioning in both age groups

Groups	Control (N=68)	Epilepsy (N=68)	t- test
2-5 years	99.10±9.24	95.71±9.57	2.077*
6-14 years	94.77±7.45	87.81±10.15	5.043**

*p<0.05, **p<0.001

Table 4: Median values for different components of memory (mean±SD)

Memory components	Control (n=71)		Epilepsy (n=66)		KW
	Median	SD	Median	SD	
Remote memory	4.00	1.441	3.000	1.708	2.140
Recent memory	5.000	0.969	4.000	0.998	0.797
Mental balance	5.000	1.204	5.000	1.041	0.976
Attention & concentration	5.000	0.861	5.000	0.851	0.008
Delayed recall	4.000	1.92	3.000	1.694	13.049***
Immediate recall	6.000	2.76	5.000	1.807	9.467**
Similar pair	2.000	1.383	2.000	1.312	6.084*
Dissimilar pair	0.000	0.976	0.000	0.591	2.223

Discussion

Epilepsy is a chronic neurological condition resulting in brain damage which in turns leads to cognitive and behavioral difficulties which may range from mild attention and concentration problems to difficulty in recent memory and executive functioning [4,10]. Present study was focused to find out cognitive deficits in children suffering from seizure disorder. It was observed that visual-perception, motor coordination, language development, analysis-synthesis and reasoning and memory were poor in these children. Attention problems, memory and language impairment as well as deficits in executive functioning in children suffering from seizure disorder have also been reported by several other researchers [1,11,12,13]. Gulati et al (2014) [11] reported that children with epilepsy showed difficulty in learning, memory, problem solving and concept formation as has been observed in the present study. Chambers et al (2014) [12] in a case control study found that children with epilepsy have significantly lower scores on memory, language and attention as compared to controls. Language dysfunction have also been observed while lexical knowledge of word finding difficulties and anomia

is found to be more common language problems in such children [13].

Intellectual disability and cognitive impairment have been reported by a community based study on 85 children with active epilepsy [14]. Kernan et al (2012) compared complex partial seizure and childhood absence epilepsy with control. They demonstrated that children with complex partial seizure and childhood absence epilepsy showed mild generalized cognitive deficit and impaired intellectual functioning as compared to control [15]. Subnormal global cognitive functioning has been reported in approximately 1 out of 4 individuals in a community based cohort study [16].

In Indian context, very few studies are available on epilepsy and memory functioning. Nehra et al(2013) [2] reported that when 34 children with epilepsy were compared with controls using PGI memory scale significant differences were observed for memory domains such as recent memory, remote memory, attention and concentration, immediate recall, delayed recall, similar pairs, mental balance, visual retention and recognition. While, in the present study significant differences were found for delayed recall, immediate recall and memory. The hypotheses most frequently used to explain the memory deficit in

epileptic patients has been that it involves the consolidation of memory traces or the transfer of the memory trace from short-term memory to long-term storage. A lesion decreases auditory processing capabilities thus inducing a reduction in coding. This poor initial encoding of information further leads to the impairment of delayed recall.

A specific cognitive profile, observed in the present study in children with seizure disorder, showed decline in their cognitive abilities which might be the result of epileptogenic process which can irreversibly damage the brain, especially maturing brain even if seizure is well controlled with anti epileptic medications. It can lead to cognitive changes finally leading towards global intellectual deficits. Thus, early identification of cognitive deficit and its management is necessary for the favorable outcome in children suffering from epilepsy.

References

- Rijckevorsel VK. Cognitive problems related to epilepsy syndromes, especially malignant epilepsies. *Seizure* 2006; 15:227-34.
- Nehra A, Tripathi M, Bhatia R, Srivastava MVP, Singh BM, Chopra S, Kaur H, Bajpai S. Is epilepsy a cause of cognitive decline in developing brain. *Activitas Nervosa Superior* 2013; 55:112-17.
- Devinsky O. *Epilepsy: Patients and family guide*. FA Davis, Cambridge University Press. 2001:pp 434.
- Meador KJ, Loring DW, Marino S. Neuropsychological and behavioural effects of antiepileptisy drugs. *Neuropsychol Rev.* 2007; 17:413-425.
- Nolan MA, Redoblado MA, Lah S, Sabaz M, Lawson AJ, Cunningham MA, Bleasel FA, Bye MEA. Intelligence in childhood epilepsy syndromes. *Epilepsy research* 2003; 53:139-50.
- Helmstaedter C. The impact of epilepsy on cognition. *J neurol neurosurg psychiatry*.2013; 84: e1 doi:10.1136/jnnp-2013-306103.14
- Mandelbam DE, Burak GD. The effect of seizure type and medication on cognitive and behavioral functioning in children with idiopathic epilepsy. *Dev med child neurol* 1997; 39:731-5.
- Stanford-Binet Intelligence Scales. Riverside Publishing. SB5, Fifth Edition. <http://www.riversidepublishing.com/products/sb5/details.htm>.
- Kohli A. Measurement of memory in children: Construction of a simple clinical tool in hindi. *Behav Med* 1998; 1:34-42.
- Besag MCF. Cognitive and behavioral outcome of epileptic syndrome: Implication for education and clinical practice. *Epilepsia* 2006; 41:119-25.
- Gulati S, Yognath S, Chakrabarty B. Epilepsy, cognition and behavior. *The Indian Journal of pediatric*; 2014; 81:1056-62.
- Chambers RM, Morrison Levy N, Chang S, Tapper J, Walker S, Tullouch-Reid M. Cognition, academic achievement and epilepsy in school age children: a case control study in a developing country. *Epilepsy behavior*; 2014; 33:39-44.
- Thivard L, Hombrouck J, Montcel T, Dulmaire C, Cohen L, Samson S et al. Productive and perceptive language reorganization in temporal lobe epilepsy. *Neuroimage* 2005; 24:841-51 .
- Reilly C, Atkinson P, Das KB, Chin RF, Aylett SE, Burch V, Gillberg C, Scott RC, Neville BG. Neurobehavioral comorbidities in children with active epilepsy: A population based study. *Pediatric*; 2014; 133:1586-93.
- Kernan CL, Asarnow R, Siddarth P, Gurbani S, Lanphier EK, Sankar R, Caplan R. Neurocognitive profile in children with epilepsy. *Epilepsia* 2012; 53: 2156-63.
- Berg TA, Lagfitt JT, Testa MF, Levy SR, Mario FD, Westerveld M, Kulas J. Global cognitive function in children with epilepsy: A community based study. *Epilepsia* 2008; 49:608-14.