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NEUROLOGY

Association between the MRI Features, Interictal Epileptiform Discharges Results from EEG and the Intelligence Quotient of Temporal Lobe Epilepsy Patients

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ABSTRACT

Objective: **Cognitive consequences are very common in epilepsy, resulting to a decline in patient's quality of life. Despite the well-established relationship with cognitive function, very few references have reported on the impacts of MRI features and EEG findings.**

Design: **This study, therefore, provides evidence on the association between the MRI features, and interictal epileptiform discharges findings on electroencephalograph and the intelligence quotient of temporal lobe epilepsy patients. Chi-Square Test was used to analyze the mean difference in IQ score between both groups.**

Materials and Methods: **An observational analytic study was performed on 80 post-surgery TLE patients.**

Results: **There were significant differences in terms of intelligence quotient score, which was based on the lesion location (91.60 ± 17.68 for right side and 82.91 ± 15.82 for left side, p = 0.023). There was a correlation established between the onset age and Length of Diagnosis on IQ preoperative ($p < 0,05$).**

Conclusion: **There is a significant difference in intelligence quotient among people with epilepsy, which was identified based on the lesion location using MRI. Therefore, early surgery was confirmed to have no impact on the seizure outcome, although cognitive abilities were improved.**

KEY WORDS

epilepsy, interictal epileptiform discharges, EEG, MRI, IQ

INTRODUCTION

Temporal lobe epilepsy (TLE) is one of the most types of epilepsy, which considerably as heterogenic clinical history, ictal symptoms, electroencephalographic characteristic features and neuroimaging findings. Furthermore, the several impacts on the quality of life are observed in terms of performances and cognitive function[1-2)].

The most frequent impairments observed are related to the aspects of attention, executive function and also disturbances in the memory domain[3-5)], which has specifically been reported in 70% of untreated adult patients[6)]. In addition, intelligence quotient (IQ) is a well known predictor factor of verbal, visual and working memory, as well as mental flexibility and tracking for semantic information, although only a few pieces of evidence provide data on the association with epilepsy[7)]. Previous study has confirmed the occurrence of significantly improved postoperative verbal IQ, compared to the preoperative[8)].

The reduction in the left hippocampus is hypothesized to impact on the altered memory performance[10)]. Meanwhile, the involvement of dorsal prefrontal cortex on executive functioning is well known[11)], hence neuroimaging techniques play an important role in determining neurobiology-associated cognitive impairment in epilepsy[9)]. The cognitive processing is a recognized dynamic process, with a gap to be filled using static neuroimaging, in order to capture the exact pathology that causes cognitive decline in epilepsy[12)]. Also, there is a possibility for dynamic

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Table 1. Demographic and Clinical Characteristics of Subjects, based on the Location of Lesion identified through MRI

	Location of Lesion on MRI Findings		p-value
	Right (n = 35)	Left (n = 45)	
Age (Years)	25.23+9.01	25.98+8.97	0.712
Duration of Illness (Years)	12.11+7.30	13.86+7.74	0.310
Gender (n (%))			
Male	24 (68.6)	25 (55.6)	0.236
Female	11 (31.4)	20 (44.4)	
Education Levels (n (%))			
Below undergraduate	20 (57.1)	34 (75.6)	0.081
Undergraduate or more	15 (42.9)	11 (24.4)	
Antiepileptic Drugs (n (%))			
Single	10 (28.6)	7 (15.6)	0.158
Combination	25 (71.4)	38 (84.4)	

Table 2. Intelligence Quotient based on Location of Lesion

	Location of Lesion on MRI Findings		p-value
	Right (n = 35)	Left (n = 45)	
Intelligence Quotient	91.60 ± 17.68	82.91 ± 15.82	0.023*

Table 3. Intelligence Quotient based on Lesion type identified using MRI

	Type of Lesion on MRI Findings		p-value
	Non Sclerotic (n = 21)	Sclerotic (n = 59)	
Intelligence Quotient	87.05 ± 17.71	86.57 ± 17.04	0.918

Table 4. Intelligence Quotient based on The Presence of Interictal Epileptiform Discharges recognized using EEG

	The Presence of Interictal Epileptiform Discharge (IED) on EEG Findings		p-value
	IED (-) (n = 15)	IED (+) (n = 65)	
Intelligence Quotient	90.40+12.18	85.86+18.03	0.358

imaging, e.g., EEG to play important roles related to cognitive decline in TLE patients. Several reviews have discussed the function of neuroimaging in the process of detecting neuronal network alterations, with a tendency to achieve better benefits through an EEG-fMRI combination assessment[13]. The purpose of this investigation, therefore, is to obtain evidence on the association between the MRI features, interictal epileptiform discharges findings on electroencephalograph and intelligence quotient among post- surgery temporal lobe epilepsy patients.

MATERIAL AND METHODS

This study used an observational analytic on eighty post- surgery TLE patients of the Department of Neurology, Dr. Kariadi Hospital and Telogorejo Hospital in Semarang, Indonesia between 2014 and 2018.

The inclusion criteria for subjects accepted through consecutive admission sampling method include: a diagnosis with temporal lobe epilepsy and any other etiology, able to perform an IQ test, and signed a consent to participate in study.

A total of 80 subjects, comprising of 35 with right side and 45 left side lesion groups met the inclusion and exclusion criteria. Hence, a record was created to obtain individual identities, demographic and clinical characteristics, as well as MRI and EEG findings.

Brain MRI was performed with a 1.5-Tesla scanner (Siemens MAGNETOM Trio, Siemens Healthcare, Erlangen, Germany), using a 12-channel head coil comprising T1WFLASH, T1W3D TFL, T2WFLAIR, T2WTSE, and DWI. Furthermore, the EEG was carried out using an EEG machine obtained from Nihon Kohden and Cadwell, while WAIS II was adopted in the IQ assessment. The subjects were, therefore, classified on the basis of MRI lesion findings (two groups) and type, as well as the presence of interictal epileptiform discharges using EEG.

Statistics Analysis

The demographic and clinical data were classified into two groups, based on the location of lesion identified on the MRI, including: The first, which is characterized by individuals with right side lesion (n = 35) and the second include those with left side lesion (n = 45). Therefore, analysis was conducted using statistic software, and categorical scale data, consisting of gender, educational levels, and antiepileptic drug history were cross-tabulated using the Chi-square test. However, two-independent sample T-test was used to evaluate numerical scale data, including age, and duration of disease, due to the presence of a distinctivenormal distribution.

The IQ score was categorized based on the type, and location of lesion, which were identified using the MRI, as well as the presence of interictal epileptiform discharge (IED) collected through EEG. Consequently, the differences were analyzed using the Independent T-Test, due to the normal distribution of data. Literature research showed the nonexistence of Indonesia reports related to the use of IQ values to predict the length of epilepsy diagnosis, hence ROC analysis was used in this current study to determine an appropriate IQ cutoff point.

Ethical Clearance

This study was conducted according to the rules of the Local Research Ethics Committee, faculty of medicine, Diponegoro University Semarang, Indonesia, with ethical clearance certificate number 451/EC/FK-RSDK/2014.

RESULTS

The demographic and clinical data, including age, duration of illness, gender, education levels and history of antiepileptic drug use is shown in Table 1.

The cross-tabulation analysis conducted on the demographics and clinical characteristics based on the location of lesion, demonstrated the absence of any significant differences between all variables. This was based on the p value, which was 0.712 for age, 0.310 for the duration of illness, 0.236 for gender, 0.081 for educational levels and 0.158 for history of antiepileptic drugs. The result of data analysis that ascertains the difference in IQ scores related to MRI and EEG findings are shown in Tables 2, 3 and 4.

A comparison of IQ score classified on the basis of lesion location demonstrated the presence of a significant difference, with the right and left side lesion measuring 91.60 ± 17.68 and 82.91 ± 15.82, respectively (p = 0.023). (Table 2)

The analysis determined the possible influence of lesion type on the IQ score. The result showed the absence of any significant difference in intelligence quotient, with the sclerotic and nonsclerotic lesion, respectively measuring 87.05 ± 17.71 and 86.57 ± 17.04 (p = 0.918).(Table 3)

The comparison of IQ score, based on the presence of interictal epileptiform discharges documented using EEG provides evidence on the absence of any significant difference, with 90.40 ± 12.18 for the IED present, and 85.86 ± 18.03 for the IED not present, respectively (p = 0.358). (Table 4)

Literature research showed the nonexistence of Indonesia reports related to the use of IQ values to predict the length of epilepsy diagnosis, hence ROC analysis was used in this current study to determine an appropriate IQ cutoff point. Based on cutoff point, the data obtained was divided into 2 groups, and the correlation between IQ and each variable

Table 5. ROC analysis for IQ

	AUC	95% CI	*P*	Cutoff point
IQ	0,675	0,55 - 0,80	0,013*	83

Table 6. Non Parametric correlation between IQ preoperative for each variable

	Value	P
EEG interictal	0,04	0,824
Type of lesion	0,04	0,948
Seizure free Follow 2 Years	0,44	0,802
Age at onset (10 years)	4,05	0,044*
Length of Diagnosis	10,52	0,005*

was subsequently analyzed. The non parametric Chi-Square Test result indicates the presence of a correlation between age at onset, as well as length of diagnosis and preoperative IQ ($p < 0,05$). (Table 5, Table 6)

DISCUSSION

The cognitive impact of epilepsy has been discussed for a long time[3]. However, the analysis of participant characteristics, including age, duration of illness, gender, educational levels and history of antiepileptic drugs use among the two groups in this study indicate the absence of any significant association between all tested variables.

In contrast, evidence has shown the need to consider age at onset as an important moderator variable. This is because early epilepsy and other underlying pathologies tend to negatively influence the maturation and development of brain[9].

Despite the assumption that epileptic event dynamically affect cognition, interictal activities have been predicted to alter normal cognitive processing, achievable through a large-scale network disruption[14]. In addition, there is also a possibility for EEG to be adopted as an efficient and relatively inexpensive method for studying developmental changes related to brain-behavior[15]. This investigation, therefore, provides evidence stipulating the absence of any association between interictal epileptiform discharges and the IQ score. Also new evidences were instituted regarding the contribution of lesion localization to cognitive decline in epilepsy.

The relationship between cerebral laterality and intelligence has attracted research interest over the years, right from the 20th century. Furthermore, disturbances on the right brain have been affiliated with a severe impairment of fear, disgust, sadness, and visual memory, while inferiority in language processing and verbal memory is caused by lesion on the left. Contemporarily, there are no evidence to support information regarding the relationship between IQ score and the type of brain lesion, although this study demonstrates an association with the localization of lesion. Despite the various results showing the correlation with age at onset of seizure, as well as temporal lobe epilepsy surgical outcome, subsequent seizures were no better than in acquired pathology patients. This study data showed the absence of any changes in seizure outcomes after early surgery, although the cognitive process was improved.

CONCLUSION

Based on the results and discussion, a significant difference in IQ score was identified between the sides of lesion recognized by an MRI. However, a similar outcome was identified with the sclerotic and non-sclerotic lesion, which was also the case for the presence of interictal epileptiform discharges, ascertained using EEG on TLE patients. This study confirmed the inability for early surgery to change seizure outcomes, although cognitive abilities were substantially improved.

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