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RESEARCH ARTICLE

# The Difference of Intelligence Quotient (IQ) Score Before and After Temporal Lobe Epilepsy (TLE) Surgery: A Quasi-Experimental Study in Indonesia

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## Abstract

Background: Epilepsy is a serious disorder of the brain, affects almost fifty million people in the world. About 40% of the patients finally became refractory to epileptic drugs, especially those with temporal lobe epilepsy (TLE). Surgical therapy has an important role in stopping further damage to brain cells caused by repeated seizures. The elimination of the seizure after surgery will hopefully result in better intelligence score. This study aims to find out the effect of surgical therapy in TLE patients on the Intelligence Quotient (IQ) score. Method: A quasi-experimental study with pre-test and post-test group design was conducted among 15 respondents. The respondents were taken with consecutive sampling method that underwent anterior temporal lobectomy and have passed at least one-year postoperative period, and also had done an intelligence quotient (IQ) test before surgery. IQ before and after surgery were measured with WAIS and WISC-R method. The statistical tests used were paired t-test by SPSS version 20 for Windows. Result: Most of the respondents were males (66.7%), average age 24.3±7.17 years-old, and 7.7±4.70 year's duration of seizures. The verbal IQ score after surgery was 98.8±9.88 significantly higher (p=0.01) compared with preoperative verbal IQ (92.7±9.60) score. On the other hand, the performance IQ score after surgery was higher (98.2±8.64) compared with preoperative performance IQ (96.0±9.39), however not statistically significant (p=0.5). A total IQ score after surgery tends to be higher (97.8 ±7.69) compared with preoperative total IQ (93.9±9.28) but not statistically significant (p=0.08). Conclusion: Our study suggests that postoperative verbal IQ improvement was found to be significantly different compared to the preoperative verbal IQ. However, there was no significant difference in the performance and total IQ score after TLE surgery

**Keywords:** *IQ, Epilepsy, Temporal lobe epilepsy, Surgery.*

## Introduction

Epilepsy is the most frequent serious brain disorder that affects almost fifty million people all over the world [1]. Report from the previous study showed that the prevalence of epilepsy was 6.38 per 1,000 persons worldwide and did not differ by age group, sex, or study quality [2]. The incidence rate of epilepsy is still high, especially in developing country, reaching 114 cases in every 100.000 population each year [3].With its known incidence rate, Indonesia with 220 million in total population has about 250.000 new epilepsy cases each year. Related to the age, the prevalence chart shows bimodal pattern, getting higher in pediatric then come down in early and middle adult, and then rising again in the elderly [4, 5].Almost 30 to 40% of all epilepsy patients will become immune to anti-epilepsy drugs (AED) called refractory epilepsy [6, 7]. Complex partial epilepsy is a bulk of this kind of refractory epilepsy [8, 9].In complex partial epilepsy, the epileptic focus mostly located in the side part of the brain. Precisely, it is located in hippocampus area and amygdala body which sometimes involving brain surface area of temporal lobe as well [8, 10].In every single epileptic seizure, brain cells injury or even death will occur. Therefore, when the seizure frequently occurs, there will be weakening or death of brain cells, hence, will result in severe declining of intelligence ability [10, 12].

Wechsler has defined intelligence as the aggregate or global capacity of the individual to act purposefully, to think rationally and to deal effectively with his environment [13].In general; intelligence is divided into three categories, which are practical ability for problem-solving, verbal ability, and social competence. Whereas Intelligence Quotient (IQ) is an intelligence score derived from a comparison between mental age and chronology age then multiply by 100 [14].

Since 1999 epilepsy surgery has been performed in Indonesia with terrific post-operative results of seizure attack rate. However, there is no research to date have been conducted that review about the improvement of intelligence ability in post epilepsy surgery patients in Indonesia. Based on those mentioned above, this study aims to evaluate the possible effect of epilepsy surgery on their intelligence ability, by comparing their IQ score before and after TLE surgery.

## Material and Method

This study was done during March and June 2012 in Dr. Kariadi General Public Hospital, Semarang, Central Java of Indonesia. A quasi-experimental study using pre-test and post-test group design was conducted. The independent variable in this research is epilepsy surgery, whereas dependent variable is IQ score. The target population is the epilepsy patients who had had an epilepsy surgery and already passed a year-time period after the operation. Inclusion criteria consist of: a) be declared as temporal lobe epilepsy patient based on preceding clinical examination (EEG, MRI and semiology) and b) The patient has the result of IQ examination before surgery.

The exclusion criteria were: a) Patient who does not have IQ examination before surgery; b) Patient or family refuses to take part in this research; and c) Based on the medical record, there was another abnormality diagnosed which could affect the cognitive function, such as mental disorder.

All procedures performed in studies involving human participants were in accordance with the ethical standards of the Medical Faculty, Universitas Diponegoro, and Kariadi Hospital ethical research committee and with the 1964 Helsinki declaration standards. Consecutive sampling technique was used as the sampling method and successfully obtained 15 patients who meet with the criteria. IQ before surgery was collected from the medical report, whereas IQ after surgery was obtained from the direct test. Paired t-test was used for statistical analysis due to data were normally distributed.

The IQ examination after surgery was supervised by the same psychologist who also supervised IQ examination before surgery. The examination was taken place in the installation of Medical Rehabilitation of dr. Kariadi General Public Hospital. IQ score was measured by using WAIS method (Wechsler Adult Intelligence Scale) and WISC-R (Wechsler Intelligence Scale for Children) after informed consent was taken and tabulated numerically. All of data were tabulated and analysed using SPSS version 20 for Windows by mean, standard deviations, and percentage.

## Result

From Table 1, more than half of the sample is male (66.7%). The average age of IQ examination when was taken is 24.3±7.17 years old with the youngest age is 17 years old and the eldest one is 41 years. Based on the first-age experience of epilepsy seizure, the average is 14.0±7.13 years old with the youngest age is two years old and 30 years old is the eldest. Duration of having epilepsy is 7.7±4.70 years with the shortest period is one year and the longest period is 16 years. The time distance between surgery and post-surgery IQ examination is 41.6±29.7 months of average. Regarding the side of operation, most cases were in the non-dominant side (66.7%). Almost all samples became free of epilepsy seizure state (86.7%) postoperatively.

**Table 1: Baseline characteristic of respondents and factors associated with epilepsy**

| Characteristic | Mean ± SD | n (%) |
|---|---|---|
| Sex | | |
| Male | 24.3±7.17 (17-41) | 10 (66.7%) |
| Female | 14.0±7.13 (2-30) | 5 (33.3%) |
| First IQ examination (year) | 7.7±4.70 (1-16) | |
| The onset of first seizure (year) | 41.6±29.70 | |
| Duration of epilepsy (year) | | |
| Interval IQ evaluation post-operative | | 5 (33.3%) |

| | | |
|---|---|---|
| (months) | | 10 (66.7%) |
| Surgery side | | |
| Dominant side | | 13 (86.7%) |
| Non-dominant side | | 2 (13.3%) |
| Seizure state after surgery | | |
| Free seizure | | |
| Not seizure-free | | |
| IQ: intelligence quotient; SD: Standard deviations | | |

The IQ score comparison between before and after epilepsy surgery shows in Table 2. The verbal IQ score was statistically significant higher postoperatively (98.8±9.88; P=0.01) compared with preoperative states.

Even though the performance and total IQ score seem to higher postoperatively (98.2±8.64 and 97.8±7.69), the results are not statistically significant (P>0.05) (Table 2).

**Table 2: The IQ score evaluation before and after epilepsy surgery**

| Parameters | TLE Surgery (N=15) | | P |
|---|---|---|---|
| | Before surgery | After Surgery | |
| Verbal IQ (Mean ±SD) | 92.7±9.60 | 98.8±9.88 | 0.01* |
| Performance IQ (Mean ±SD) | 96.0±9.39 | 98.2±8.64 | 0.5 |
| Total IQ (Mean ±SD) | 93.9±9.28 | 97.8±7.69 | 0.08 |
| *Paired Sample T-test: statistically significant if less than 0.05; SD: Standard deviations | | | |

## Discussion

We found all of the IQ components after epilepsy surgery were higher than before surgery. However, it was merely one of IQ component, the verbal IQ that showed an escalation and had significant statistical value. This outcome can be related to part of the brain where the damages occurred. It is in the temporal lobe, part of the brain that has responsibility for language ability; therefore, any manipulation in this part will be affecting on verbal IQ [15].

The performance IQ is slightly affected by the surgery even showing an increased outcome. Total IQ which was a merge result of both verbal and performance IQ showed an improved outcome although not statistically significant. Research by Anderson et al. studying the correlation between intelligentsia and brain structure concluded that there is a significant correlation between verbal IQ and total IQ with the volume of temporal lobe both in the right and left side, and also with hippocampus structure. However, no significant correlation found with performance IQ [15].

Their result definitively supports our research and possibly underlies the mechanism of how the verbal IQ increases after epilepsy surgery. The weakness of this research was not to consider the anti-epileptic drugs. Some samples still consume AEDs routinely. In the other hand, several samples have already stopped the AEDs completely.

This weakness possibly could affect the IQ examination outcome because AEDs also could influence the cognitive function. Our research also found a limitation of the total of sample. Not only caused by the time limit but also, our study was conducted only in one centre. When the research is conducted multicenter by using cohort method, the obtained sample will be more significant in quantity.

Allegedly, one of the factors that possibly affect the increase of IQ in post-surgery epilepsy patient was external stimulation, both by the family and closest friends even from medical practitioners. In the future, we expect the management of epilepsy patient not only stopped after the surgery but also involve proper stimulation therapy for helping stimulation of brain cells activity. Moreover, the doctor has to encourage their family members who have undergone surgery to frequently give stimulation to the patient for increasing their intelligence.

## Conclusion

IQ of temporal lobe epilepsy patient is increased after epilepsy surgery. This outcome is pointed out from the escalation of verbal IQ after surgery that statistically significant, compared with verbal IQ before surgery. An increase in performance and total IQ are also found. However, they are not statistically significant.

 

## Ethical Consideration

Ethics approval has been obtained from the Ethics Committee of Medical Faculty, Universitas Diponegoro, Semarang, Indonesia prior to the study being conducted

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