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Association Between Head Computed Tomography Scan Images and Electroencephalogram with Outcome In Post Stroke Seizure Patients

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ABSTRACT

Introduction: Seizures that occur after a stroke and have no previous history of epilepsy are referred to as post stroke seizures (PSS). Post stroke seizure increases patient mortality, disability at hospital discharge, as well as prolongation of hospital stay. Patients with post stroke seizure show poor functional outcome (mRS >2).

Objective: To determine the association between head CT scan images and electroencephalogram (EEG) with outcomes in post-stroke seizure patients at Adam Malik Hospital Medan.

Methods: This study is an observational analytic study with prospective cohort research methods with primary data sources obtained consecutively from all PSS patients who were hospitalized at Adam Malik Hospital Medan and had undergone head CT scan and EEG examinations. The outcome of PSS patients was assessed by mRS score on day 14 since seizure.

Results: There were 24 research subjects who met the inclusion and exclusion criteria aged between 18-74 years and consisted of 18 male subjects and 6 female subjects. There is a association between head CT scan images and clinical outcomes of post-stroke seizure patients based on the results of the chi square test with p value = 0.041 (<0.05) for lesion location and p = 0.018 (<0.05) for lesion size. There is a association between EEG and clinical outcomes of post-stroke seizure patients based on the results of the Chi Square test with p value = 0.001 (<0.05).

Conclusion: There is a significant association between head CT scan images and EEG images and patient outcomes.

Keywords: Post Stroke Seizure, Head CT Scan, EEG, outcome, mRS

1. Introduction

Stroke is the third leading cause of death and the primary cause of disability in developed countries, affecting one in six adults and accounting for approximately 55% of newly diagnosed seizures and 10% of epilepsy cases among the elderly.[1] This condition arises from the sudden interruption of blood supply to the brain, leading to cell damage and functional impairment. Depending on the affected brain region, stroke can result in a wide range of complications, from motor deficits to cognitive decline. As a significant health issue, stroke imposes a considerable burden on individuals and healthcare systems worldwide.

Seizure is defined as uncontrolled and abnormal electrical activity in the brain that can result in changes in awareness, behavior, memory, or feelings. Seizures that occur after a stroke without any previous history of epilepsy are referred to as post-stroke seizures (PSS). Post-stroke seizures are a common and serious complication of stroke.[2] PSS can be divided into early seizures and late seizures, depending on the timing of the seizure after the stroke.[3] Early seizures (ES) are classified as spontaneous seizures occurring within one week of the stroke event. Seizures occurring after one week of the stroke are referred to as late seizures (LS).[4] The incidence of seizures among stroke patients is 22.18%.[5] Acute seizures occur in 1-4% of ischemic stroke patients but increase to 16% in patients with intracerebral hemorrhage.[6] The incidence of ES is reported to be 2.2%-33%, whereas LS varies from 3% to 67%.[3]

The most widely used imaging procedure in acute stroke is non-contrast head computed tomography (CT), which allows differentiation between hemorrhagic and ischemic strokes, as well as lesion localization.[6] Risk factors for post-stroke seizures include extensive lesions, subarachnoid hemorrhage, and cortical location. Regarding the effects of post-stroke seizures on mortality and functional outcomes in stroke patients, animal studies show that seizures in acute ischemic stroke can increase infarct size and impair functional recovery.[3,7] EEG changes in acute stroke are associated with poor neurological status in the first days and poor functional status in the chronic period of stroke.[8]

Post-stroke seizures increase patient mortality (both short-term and long-term), disability at hospital discharge, and length of hospital stay.[9] According to previous studies, 95% of patients with post-stroke seizures exhibit poor functional outcomes (mRS > 2).[10]

2. Method

Research Subjects

Research subjects were drawn from the population at Adam Malik Hospital Medan who had undergone head CT scans and EEG examinations. Patient outcomes were assessed using mRS scores on day 14 post-seizure. Inclusion criteria included patients aged ≥18 years, ischemic stroke and hemorrhagic stroke patients who experienced seizures and had been diagnosed with post-stroke seizures, and those who had undergone head CT scans and EEG examinations and consented to participate in the study. The study sample consisted of 24 subjects.

Research Design

This research employed an observational analytic approach with both prospective and retrospective cohort study designs. Data sources were obtained consecutively from all post-stroke seizure patients hospitalized at Adam Malik Hospital Medan who had undergone head CT scans and EEG examinations, and patient outcomes were assessed using mRS scores on day 14 post-seizure.

Statistical Analysis

Research data were analyzed statistically using the Windows-based Statistical Product and Science Service (SPSS) program, version 26.0. Data analysis and presentation included univariate analysis to describe demographic and clinical characteristics of the sample and bivariate analysis to examine the relationship between independent and dependent variables using the Chi-Square test.

3. Results

Relationship Between Head CT Scan and Clinical Outcomes of Post-Stroke Seizure Patients

Table 1 displays the results of the analysis examining the relationship between head CT scan findings and the clinical outcomes of post-stroke seizure patients treated at Adam Malik Hospital Medan:

Table 1 Relationship of Head CT Scan with Clinical Outcome of Post Stroke Seizure

	Patient Outcome		p Value
	Good	Poor	
Head CT Scan			
Location			
Cortex	0	1	0,041
Subcortex	12	11	
Lesion Size			
Small	8	3	0.018
Large	4	9	

The Chi-Square test results indicate a p-value of 0.041 (<0.05) for lesion location, suggesting a significant relationship between lesion location and clinical outcomes in post-stroke seizure patients treated at Adam Malik Hospital Medan. This means patients with cortical lesions are more likely to experience poor clinical outcomes.

For lesion size, the Chi-Square test results indicate a p-value of 0.018 (<0.05), suggesting a significant relationship between lesion size and clinical outcomes in post-stroke seizure patients treated at Adam Malik Hospital Medan. This means patients with large lesions are more likely to experience poor clinical outcomes.

Relationship Between EEG and Clinical Outcomes of Post-Stroke Seizure Patients

Table 2 shows the results of the analysis examining the relationship between EEG findings and the clinical outcomes of post-stroke seizure patients treated at Adam Malik Hospital Medan:

Table 2 Relationship of EEG with Clinical Outcome of Post Stroke Seizure

EEG	Patient Outcomes		p Value
	Good	Poor	
Normal	1	0	0,001
Abnormal	5	18	

The Chi-Square test results indicate a p-value of 0.001 (<0.05), suggesting a significant relationship between EEG findings and clinical outcomes in post-stroke seizure patients treated at Adam Malik Hospital Medan. This means patients with abnormal EEG findings are more likely to experience poor clinical outcomes.

4. Discussion

Relationship Between Head CT Scan and Clinical Outcomes of Post-Stroke Seizure Patients

The Chi-Square test results indicate a p-value of 0.041 (<0.05) for lesion location, suggesting a significant relationship between lesion location and clinical outcomes in post-stroke seizure patients treated at Adam Malik Hospital Medan. This finding is consistent with a study conducted by Ernst et al. (2018), which demonstrated the impact of lesion location on functional outcomes in ischemic stroke patients. In that study, most subjects had lesions in the white matter, periventricular, and internal capsule regions, which were associated with poor clinical outcomes measured using the mRS.[11]

Similarly, the p-value of 0.018 (<0.05) for lesion size suggests a significant relationship between lesion size and clinical outcomes. This finding aligns with research by Ospel et al. (2021), which examined 1,099 research subjects and found a correlation between large lesion size and poor clinical outcomes. Infarct size and clinical outcomes vary non-linearly with infarct size. Lesion size is linearly associated with reduced functional probabilities in patients with moderate to large infarcts, but not in those with small infarcts. Extremely large infarcts demonstrate an almost deterministic relationship with poor outcomes.[12]

Relationship Between EEG and Clinical Outcomes of Post-Stroke Seizure Patients

The Chi-Square test results indicate a p-value of 0.001 (<0.05), suggesting a significant relationship between EEG findings and clinical outcomes in post-stroke seizure patients treated at Adam Malik Hospital Medan. Patients with abnormal EEG findings are more likely to experience poor clinical outcomes. In this study, subjects with normal EEG patterns showed good clinical outcomes, whereas all subjects with abnormal EEG patterns showed poor clinical outcomes. A study by Lasek-Bal et al. (2023) demonstrated that EEG changes in acute stroke are associated with poor neurological status in the first days and poor functional status in the chronic period.[2,4] Seizures and abnormal electroencephalographic (EEG) findings have been linked to poor functional outcomes in stroke patients. This aligns with research by Bentes (2017), which found unfavorable functional outcomes (mRS ≥ 3) and mortality (mRS = 6) at hospital discharge and 12 months post-stroke.[13]

This study has limitations, including an unequal number of subjects with early and late seizures. For some subjects, mRS scores were assessed based on the patient's neurological status, and dichotomous mRS determination may have been slightly more accurate than absolute mRS.

4. Conclusion

This study found significant associations between Head CT Scan and EEG findings with clinical outcomes in post-stroke seizure patients at RS Adam Malik Medan. Cortical lesion location (p = 0.041), large lesion size (p = 0.018), and abnormal EEG (p = 0.001) were linked to poor outcomes. These findings highlight key prognostic factors to guide better management and monitoring of high-risk patients.

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Conflict of Interest
The authors declare no conflicts of interest in preparing this article.

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