

The Prediction of Malignant Course in Cerebral Infarction by Electroencephalography

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Article information	Abstract
<p>Article history: Received: 25 Feb 2013 Accepted: 16 May 2013 Available online: 29 June 2013 ZJRMS 2014 Nov; 16(11): 40-42</p> <p>Keywords: Electroencephalography Stroke Malignant</p>	<p>Background: Prediction of the malignant course is important in patients with stroke in order to begin interventional treatment strategies. In this study, predictive value of electroencephalography was evaluated in detection of malignant cases.</p> <p>Materials and Methods: In this cross-section study electroencephalography findings were evaluate in 36 patients suffering stroke. Data were analyzed with Fishers exact test.</p> <p>Results: Fourteen patients had malignant and 22 patients had a non-malignant course. Six patients in malignant course group and 1 patient in non-malignant course group had focal delta activity ($p=0.008$).</p> <p>Conclusion: Electroencephalography findings had predictive value in malignant course in stroke patients.</p>

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Introduction

Stroke is one of the leading causes of death and frequency of ischemic type is about 75%. Middle cerebral artery (MCA) occlusion is one of the most common forms of ischemic type and the frequency of massive infarction (massive MCA infraction: MMI) is up to 15% [1]. About 50% of massive MCA infarctions are malignant (m-MCAI: malignant MCA infarction) [2] and, without surgery, they are the most leading cause of mortality due to stroke (80%) [3]. If surgery performs in the first 24 h, mortality rate will decrease [4], but the m-MCAI should be identified in time. Some studies show that EEG changes can be used for prediction of the clinical status of patients with stroke in long-term [5] and short-term [6], but studies of the value of the EEG in identifying of m-MCAI are limited. Wang et al. showed that some EEG abnormality, such as asymmetry, epileptic discharge and slowing are related to bad prognosis of massive infarction [7]. Moreover, Guo et al. in their study, showed that massive strokes are associated with sever EEG abnormality and this finding is helpful in stroke management [8]. Also, Burghaus et al. showed that the existence of delta wave in stroke patients can be useful in identifying m-MCAI [9]. However, some animal [10] and human [11] studies did not confirm this association. According to these controversies, in this study, we evaluate the EEG changes and their value in detection of m-MCAI.

Materials and Methods

This cross-sectional study was performed on patients with acute ischemic stroke in Shafa hospital, Kerman. All patients were hospitalized in the first 24 h after onset of symptoms. At admission, routine laboratory tests and

brain CT-scan were preformed to confirm the ischemic stroke, and patients with hemorrhagic stroke and abnormal laboratory tests were excluded. CT-scan of patients was evaluated by two neurologists, and if more than 50% of the MCA territory showed hypo-density, it was considered as massive MCA infarction (MMI) and the others were excluded [9]. Also, if CT-scan showed involvement of other areas or the midline shift, and in case of taking medication, especially psychiatric drugs, anticonvulsant drugs, and alcohol and substance use, the patients were excluded from the study. All patients had first stroke and they had no co-morbidities, such as hypertension, diabetes and convulsion. An EEG was performed during the first 24 h of hospitalization with NEC-SAN-ei (1A93 99Japan) system. The EEG was done according 10-20 international system (8-channels) by using bipolar and monopolar methods with 30 mm/s, impedance less than 10 k Ω and 0.53-70 HZ filtration. It was interpreted by a neurologist who was not aware of the patients' demographic and clinical conditions. Then, the patients were evaluated till hospital discharge or death, and if they had unilateral fixed mydriasis, or showed more than 5 mm midline shift in septum placitum in another brain CT-scan on fifth to seventh day (according to impairment of consciousness level), they were considered as m-MCAI case [4]. EEG was interpreted based on reference number 14. According to the guide study the abnormal changes ratio of EEG, accuracy and error were 0.80, 0.13 and 0.05, respectively and according to $N=Z^2_{1-\alpha/2}P(1-P)/d^2$, the sample size was 36. Patients were chosen randomly from emergency department. The results were analyzed by Fisher exact test with 95% confidence interval and $p \leq 0.05$. The presence of these patients in the study was with consent of their relative and

ethics committee of Kerman University approved this study.

Results

In this study, 20 patients were men and the rest were women (Table 1). The mean age of men and women were 57.3 ± 7.4 and 56.5 ± 6.7 years, respectively. There was no significant relationship between mean ages of the two groups and the time of EEG. Fourteen patients had malignant and 22 patients had a non-malignant course. Twelve patients with m-MCAI and 17 patients with non m-MCAI showed EEG abnormality. In comparison with non-mMCAI group, the focal delta slowing was significantly higher in m-MCAI group ($p=0.008$).

Table 1. Demographic information of patients

	Non-mMCAI	m-MCAI
Age (Mean±SD)	56±8.7	58.9±7.9
Gender (male/female)	14/8	6/8
EEG duration (h)	20.7±3.4	20.5±3.6
Hemisphere lesions (right/left)	11/11	6/8

m-MCAI: malignant MCA Infarction

Table 2. The frequency of EEG findings in terms of malignant and benign clinical course

Types of change	m-MCAI	Non m-MCAI	p-Value
Occipital freq. (≥ 8 cps)	4	12	0.2
Occipital freq. (< 8 cps)	7	7	0.4
Theta wave focal slowing	2	9	0.09
Delta wave focal slowing	6	1	0.008
Hemispheric slowing	8	6	0.1
Epileptic discharges	4	7	0.8

m-MCAI: malignant MCA Infarction

Discussion

As fetal hemoglobin induction considers as novel therapeutic our findings show that EEG abnormality may help in diagnosis of malignant course of ischemic stroke. The existence of focal slowing of delta wave has the most prognosis value of identifying malignant course (Table 2). Our findings are almost, as same as some of the previous studies. In a study on 25 patients in Germany, on patients with massive ischemic stroke, Burghaus et al. found that the existence of focal delta slowing in the surface lesion is associated with the worst prognosis and high rate mortality [9]. They also found that of lack of focal delta slowing or existence of beta waves were accompanied by good prognosis, but we did not find such findings in our study [9]. In a study on 16 patients, Fernandez-Bouzias et al. found that only focal delta wave is directly related to the rate of cerebral edema; this finding is consistent with our study [12]. Schneider et al. found that in the first 24 hours, the existence of some of the EEG changes could be a sign of cerebral edema (even before CT scan or MRI changes) and should be considered as surgical emergency.

Unlike our study, the most important change showing this relationship in this study was local voltage asymmetry [13]. In another study on 40 patients with massive ischemic stroke, Wang et al. showed that the EEG changes are related to the severity of symptoms and prognosis. But the mentioned relationship was not limited to a particular change, whereas our study shows that the value of some findings (like the existence of focal delta wave) is higher [7]. In a study on 32 patients with ischemic stroke, Guo et al. showed that sever EEG changes are accompanied by death [8]. In another study, Diedler et al. found that EEG monitoring after surgery may determine the continuation of the treatment course in patients who were undergone craniotomy due to the large ischemic infarction. However, the value is not limited to any specific changes in this study [14]. Although the types of changes are only consistent with some of the mentioned studies, our findings confirm them in terms of the value of EEG prognosis in short-term course and its relative ability in dividing of malignant and benign course [9-12]. New techniques, such as quantitative EEG, may have more value [15]. The etiology of EEG changes is not clear yet. Studies show that these changes occur a few minutes after the starting of the stroke, and they are secondary to decreased perfusion of pyramidal cells which are extremely dependent to oxygen [12]. Also, these changes may also occur in mild cases of stroke [11, 12] and further studies are needed. Lacks of long-term follow-up and long-term monitoring were the main limitations of this study. Although long-term monitoring and follow-up were not the aim of this study, we could use it in order to get better results about value of EEG. In conclusion, the findings of this study show that some early EEG abnormalities (particularly the existence of focal delta slowing) can predict the malignant course in patients with ischemic stroke. This finding can be used for identifying of patients for surgical intervention.

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Authors' Contributions

All authors had equal role in design, work, statistical analysis and manuscript writing.

Conflict of Interest

The authors declare no conflict of interest.

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