Prognostic Value of Electrocardiography and Electroencephalography in Patients with Ischemic Stroke

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Abstract-

Purpose: Stroke is the most common disease among neurological disorders, often resulting in handicap, complications and mortality. Recent studies revealed that electrocardiography (ECG) and electroencephalography (EEG) were noninvasive but effective methods to assess the prognosis of stroke patients. The purpose of this study is to evaluate the use of EEG and ECG for the prognosis of ischemic stroke.

Methods: Thirty five patients with supratentorial ischemic stroke and muscle weakness were included in the study carried out at the Ali-EbneAbitaleb Hospital, Rafsanjan, Iran. At admission, muscle power was recorded for every patient. EEG and ECG were performed on patients within 12 hours of admission. The muscle power was re-evaluated for all study cases at 3 months. The data were analyzed using SPSS software; Mann-Whitney and Kruskal-Wallis tests.

Results: Opium addiction (45.7%), hypertension (40%), and smoking (28.6%) were the most common risk factors. ECG change was seen in 71.4% of patients (ST-T change: 51.4%, QT: 22.9%). No significant correlation was seen between ECG and muscle power changes at three months among stroke patients. 57.1% of patients had mild to severe abnormality in EEG and a significant correlation was seen between EEG and muscle power changes at three months (P= 0.01).

Conclusion: This study showed that EEG abnormality was positively correlated with poor prognosis in our patients with ischemic stroke. This study did not show any significance for ECG, which may be due to a small patient number, and further study is needed.

Key Words: Electrocardiography, Electroencephalography, Ischemic stroke

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INTRODUCTION

Stroke is both the most common neurological disease and the most frequent cause of mortality. Because of its severity, long duration, and many complications, stroke has a high morbidity rate. The most common type

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of stroke is ischemic stroke which occupies about 75% of all cases[1,2]. Recent studies indicated that electrocardiography (ECG) and electroencephalography (EEG) could be used to evaluate the prognosis of patients with ischemic stroke. Cuspine et al.[3] carried out a study on 28 patients with thrombotic stroke in Cuba and reported that EEG changes were of great value in determining the prognosis of physical disability following stroke. Studies in Italy and Russia had also suggested EEG as a prognostic tool[4,5]. Dogan et al.[6] proposed that ECG changes in patients with ischemic stroke indicated the morbidity rate of stroke. Based on these changes, it is possible to find the amount of morbidities left by stroke. A study on 10741 patients with ECG changes in Japan indicated that individuals with abnormal changes of ECG were at high risk of ischemic and hemorrhagic stroke[7]. This study was aimed to assess the prognostic value of ECG and EEG in patients with ischemic stroke in Rafsanjan city, Iran. Therefore, we could find out whether it is possible to use these non-invasive methods to determine the physical morbidity and prognosis of patients with stroke in our society.

MATERIALS AND METHODS

This study was performed as a cohort of 35 patients. Sampling was done consequently for the patients who had ischemic stroke. Patients could enter the study if they had all of the three following specifications: (1) Their level of consciousness was not impaired (Glasgow coma scale; GCS 15); (2) They had no previous history of stroke or muscle weakness; (3) Muscle weakness was present in the neurological examination. Brain CT scan was requested for all cases and brain MRI was done if necessary after 24 hours to confirm the diagnosis. Cases with transient ischemic attack (TIA), stroke in evolution, hemorrhagic stroke or cases with infra-tentorial stroke were excluded from the study. EEG and ECG were also requested for all cases within 12 hours of admission. ST-T changes including ST depression > 2 mm, ST elevation > 2mm, T inversion and tall T, and QT changes including QT prolongation and QT dispersion were all measured. Cases of cardiac arrhythmia were also recorded. EEG changes were also assessed in the following three forms: (1) Normal; (2) Mild to moderate; (3) Severe. In the normal form of EEG, there were not any abnormal EEG waveforms. Severe changes included epileptic waves, and diffuse or focal slowness, and other cases such as back ground slowing or excessive fast waves were considered as mild to moderate forms. Muscle power was categorized according to the following characteristics: (0) there was not any movement present in the extremity. (1) A little movement was found; (2) The patient could move the extremity just horizontally; (3) The patient could only move the extremity against the gravity, but he was not able to resist against force; (4) The extremity could tolerate the gravity, but it failed against the examiner's force; (5) the examiner couldn't overcome the patient's force. All cases underwent physical therapy which would be stopped if signs of muscle weakness disappeared within 3 months. An individual was excluded from the study if he/she had a stroke with poor prognosis, he/she was taking a special medication or there was a severe problem of their liver or renal function. The muscle power was re-evaluated for all cases at 3 months. A questionnaire including demographic information was recorded for all patients. The collected data was analyzed by SPSS software. In order to compare cases with or without EEG or ECG changes, the Kruskal-Wallis and Mann-Whitney tests were applied.

RESULTS

These 35 individuals included 14 men (40%) and 21 women (60%) with an average age of 62.3 $\pm$ 12.7. A history of hypertension (HTN), diabetes and hyperlipidemia (HLP) was present in 14 (40%), 8 (22.9%) and 9 (25.7%) cases, respectively. 3 patients used to take oral contraceptive; (OCP) (8.6%). 16 patients had a history of opioid consumption (45.7%) and 10 patients (28.6%) used to smoke cigarette. In this study, 15 patients (42.9%) had a normal EEG, mild to moderate EEG changes were present in 11 (31.4%) and 9 cases showed severe abnormal EEG changes. ECG of ST-T changes, QT changes, Q wave and atrial fibrillation (AF) were present in 18 (51.4%), 8 (22.9%), 3 (8.6%) and 1 (2.8%)

of cases, respectively.

Table 1 showed the mean, standard deviation and p value of patients' muscle power at admission and 3 months, and the improvement of muscle power based on EEG changes. According to Kruskal-Wallis non-parametric test, the 3 groups with normal, mild to moderate and severe EEG changes didn't show significant difference of muscle power at admission (p= 0.54), but it was significantly different at 3 months (p= 0.04). The improvement of muscle power was also significantly different in the 3 groups (p= 0.01).

Table 2 presented the average and standard deviation of muscle power at admission and 3 months and the improvement of muscle power based on ECG changes. According to Mann-Whitney non-parametric test, the 2 groups of patients with and without ECG changes didn't have significantly different muscle power at admission and 3 months (p= 0.44, p= 0.15, respectively). There was no significant difference of improvement of muscle power between the 2 groups (p= 0.69).

DISCUSSION

Looking for an efficient method to evaluate the prognosis of patient with stroke has been ongoing for a long time. The results of these investigations have to offered a spectrum of different prognostic factors including clinical signs and results of paraclinical and radiological evaluations which EEG and ECG changes are of these factors. These methods have been frequently taken into account because they are easy, cheap, available and non-invasive. In this study, 42.9% of cases had no EEG changes, while 57.1% of cases showed mild to severe changes (Table 1). In a study performed on 105 patients with ischemic stroke in Japan, 20 patients (19%) had normal EEG and 55 patients (52%) showed mild to moderate EEG changes[8]. The abnormal EEG changes in Japan study were less than those of our study, which is probably due to the difference of the size and location of lesions. In this study, we realized that the more abnormal EEG changes were present, the weaker muscle power could be found at 3 month (Table 1) (p< 0.01). Another study done on 34 patients with ischemic stroke followed

Table 1. *Comparison of muscle power according to EEG changes*

Muscle power	EEG changes			
	Normal (n=15)	Mild-moderate (n=11)	Severe (n=9)	p-value*
At admission	2.07±1.03	2.36±1.03	1.89±0.93	0.54
At 3 months	3.80±0.86	3.82±1.25	2.56±1.33	0.04
Changes	1.73±0.96	1.45±0.69	0.67±0.71	0.01

*P≤ 0.05 as significant. Independent sample t-test was used.

Table 2. *Comparison of muscle power according to ECG changes*

Muscle power	ECG changes		
	Yes (n=30)	No (n=5)	p-value*
At admission	2.50±1.09	1.91±0.9	0.44
At 3 months	3.75±1.06	3.35±1.30	0.15
Changes	1.25±0.75	1.43±0.99	0.69

*P≤0.05 as significant. Independent sample t-test was used.

up during a 6-month period in Italy presented that EEG changes were of prognostic value and could be applied as a non-invasive method to evaluate the patients[4]. A research performed on 76 patients with stroke in Russia suggested that EEG has a prognostic value[5].

The good correlation between patients with ischemic stroke and EEG changes means that the more severe changes are present in EEG, the more physical and mental disabilities are found in stroke patients[9]. In conclusion of this study and most of the ones mentioned above, all indicate that EEG changes can be beneficial as a non-invasive prognostic method for ischemic stroke. On the other hand, some recent studies have found the prognostic value of evoked potentials is better than usual EEG in clinical process of ischemic stroke[10]. In this study, 71.4% of patients had pathologic Q wave, ST-T changes, cardiac arrhythmia or a combination. In a study performed in Sweden[11], 76% of patients showed ECG changes although the out-patient cases had also entered the study. It seems that the prevalence of ECG changes was higher in patients with hemorrhagic stroke[11]. In another research conducted in Turkey in 2003, ECG changes in cases with ischemic stroke were estimated 62.1%[11]. However, another study done in Turkey found ECG changes in 65% of patients with ischemic stroke[6], and most ECG changes were related to ST-T and QT changes. Comparing to our results, QT changes had a higher frequency in studies conducted in Sweden[6] while studies done in Turkey showed a higher frequency of ST-T changes that is similar to our study[12]. In this study, there was no significant relationship between ECG changes and patients' muscle power at 3 months. Some studies indicate the prognostic value of ECG change is of minor effect. In Sweden, it was found that the severity of ECG changes in cases with ischemic or hemorrhagic stroke had a direct relationship with mortality and the severity of complications[11]. It was also found in a trial in Turkey that it could be taken advantage from ECG changes to evaluate the patients' prognosis[12]. In this study, we realized that in a 6-month follow up of patients with ischemic stroke, the patients with ECG changes showed a rate of 15.2%. Also regardless of the source of stroke, ST-T change is considered a prognostic factor of patients' mortality rate[6]. Opioid consumption (45.7%), HTN (40%) and cigarette smoking (28.6%) were the most prevalent risk factors of ischemic stroke in our study. Although the indicated factors are the main risk factors in many investigations[13], opioid consumption and cigarette smoking were considerably present on the top list of risk factors.

CONCLUSION

A point to be considered is the capability of controlling or omitting the studied risk factors that could help us decrease the risk of stroke. The results of our study indicate that it could be beneficial to follow EEG changes in patients with ischemic stroke. Further clinical studies should be carried out to evaluate the effectiveness of ECG changes.

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