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The Comparative Study of ECG Findings in the Patients Suffered from Subarachnoid Hemorrhage and Control Group in Northeastern Iran

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ABSTRACT

Introduction: Subarachnoid Hemorrhage (SAH) which accounts for (5% to 10%) of cerebrovascular accidents is an important cause of mortality and disability. It can be complicated by many neurological and medical conditions including cardiovascular complications. During the course of SAH morphologic Electrocardiography (ECG) changes, arrhythmias, myocardial injury and elevation of cardiac enzymes, subendocardial hemorrhage and necrosis may be observed.

Materials and Methods: 102 SAH patients, without any history of Ischemic heart Disease (IHD), admitted in Ghaem Hospital were studied. Their clinical and radiological parameters were evaluated. Three serial ECGs were performed within the first 72 hours for each patient and the ECG findings were analyzed. The control group consisted of 102 elective patients of Ghaem hospital without any expected heart disease.

Results: ECG changes were observed in 60.8% of SAH patients with average age of (53.4±14.2) years and in (2.9%) of control group. The ECG findings were as follows: chamber abnormalities (6.9%), conduction abnormalities (7.8%), repolarization abnormalities (49%), rhythm abnormalities (22.5%) and pathologic Q wave (6.9%). According to this study, ECG changes are related to subarachnoid hemorrhage ($p<0.01$). ECG changes are independent from age and sex but they are related to clinical grading and mortality of SAH patients ($P<0.01$). ECG changes are related to presence of intracranial aneurysm ($p<0.05$).

Conclusion: Our clinical, radiological and ECG findings are compatible with the previous studies. In this study, ECG findings in subarachnoid hemorrhage are related to the prognosis and to presence of intracranial aneurysm.

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Introduction

Subarachnoid Hemorrhage (SAH) is the cause of 5-10 percent of cerebrovascular accidents. Mortality and morbidity due to subarachnoid hemorrhage are significant.

On the other hand, cardiovascular complications are frequently seen in the course of SAH. Relatively high mortality due to cardiovascular complications has been reported.

There are some reports that show SAH can result in electrocardiographic changes similar those caused by ischemic heart diseases, but without tissue pathologic changes in the heart.

The pathophysiology of these changes is not fully known (1, 2, 3, 4, 5, 6, 7) and are commonly believed to be caused by a catecholamine surge following SAH.

The relationship between electrocardiogram changes and clinical and radiographic findings in SAH is an issue that requires further review.

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Considering that Ghaem Hospital's neurologic ward is the sole center accepting patients with non-traumatic SAH from northeastern Iran, its information can serve as a valuable source of regional epidemiologic characteristics. Also, our study provides an analytical review of electrocardiographic changes in patients and clinical and radiological findings in comparison with a control group.

According to past research mainly performed in western countries, electrocardiography changes are seen frequently in SAH. However, it is not well known how these changes affect patient prognosis.

This study is designed to meet the above challenge.

When considering the importance of the analytical study of SAH patients' clinical and radiographic characteristics compared with Electrocardiography (ECG) changes, this research should prove to be of great assistance.

Materials and Methods

The study population consists of SAH patients without a history of Ischemic Heart Disease (IHD) who had been referred to Mashhad's Ghaem hospital. The control group was selected from among patients without heart problems who had been admitted to the hospital's surgery wards.

Study and control groups were matched based on age and sex. This study is cross-sectional and shows the epidemiological, clinical, radiographic and ECG findings in SAH patients who were admitted to Ghaem Hospital. In this research, ECG findings in SAH patients and the control group were compared and the relationship between the epidemiological, clinical and radiographic findings with the ECG changes was analyzed. In this study, an easy sampling method was employed.

Hunt and Hess grading system were employed.

Grade 1: Asymptomatic or mild headache and slight nuchal rigidity

Grade 2: Moderate to severe headache, stiff neck, no neurologic deficit except cranial nerve palsy

Grade 3: Drowsy or confused, mild focal neurologic deficit

Grade 4: Stupor, moderate or severe hemiparesis

Grade 5: Deep coma, decerebrate posturing

The grade is advanced one level for the presence of grave systemic disease (hypertension, diabetes, severe arteriosclerosis, chronic pulmonary disease) or angiographically confirmed vasospasm.

ECG abnormalities are divided into five main groups in patients:

(1) Atrial disorders (2) Conduction disorders (3) Repolarization disorders (4) rhythm disorders (5) Pathological Q Wave. In this study a QTc of more than 0.44 sec was considered as a long QTc, A heart rate of more than 100 minutes as Sinus Tachycardia, and a heart rate of less than 60 minute as Sinus Bradycardia.

A questionnaire was prepared based on the study, Clinical symptoms, the brain CT scan and conventional angiography findings were recorded as patients entered the emergency room. If a patient had had multiple Computed Tomography (CT) scans or multiple angiographic evaluations, the first brain CT scan and the last angiography were evaluated.

For each patient, three ECGs were performed. A cardiologist interpreted the ECGs. ECG changes were recorded based on cardiologist point of view. The findings of these electrocardiograms were recorded on the questionnaire. A Chi-square test was used for statistical analysis.

Results

In this study, 102 patients with SAH were investigated. A brain CT scan was performed in all cases, but an angiography was performed in only 65 patients. 16 patients died within 72 hours of hospitalization. In the study, 47 (46.1%) patients were males and 55(53.9%) patients were females. The mean age of patients was (51.7±17.4) years. The youngest patient was 17 years and the oldest was 87 years.

The mean age of patients with and without ECG changes was (53.4±14.2) and (49.1±14.9) years respectively.

Table 1 shows the distribution of clinical grading, mean age and the sex of the patients with SAH.

Table 1: Clinical grading distribution

Clinical Grading	Number	Percent	Male	Female	Mean Age
1	6	5.9	2	4	$13.6_{\pm}46.7$
2	21	20.6	8	13	$13.1_{\pm}52.5$
3	33	32.4	14	19	$17.3_{\pm}51.4$
4	20	19.6	9	11	$13.8_{\pm}51.8$
5	22	21.6	13	9	$13.7_{\pm}53$

The clinical signs and symptoms of 102 patients include:

Headache in (80.4%) of patients, vomiting in (72.5%), decreased consciousness in 53.9%, seizure in (15.7%), aphasia in (12.7%), hemiparesis in (6.9%) and visual disturbances in (4.9%).

Subarachnoid hemorrhage was diagnosed in 100 patients via a brain CT scan. The brain CT scans of two patients were normal or suspicious and so the diagnosis of SAH was established by lumbar puncture.

CT scan findings in these patients include: unilateral bleeding in the Sylvian sulcus in 28 patients (27.5%), bilateral bleeding in the Sylvian sulcus in 55 patients (53.9%), bleeding in other sulcuses in 32 patients (31.4%),bleeding in the anterior interhemispheric sulcus in 55 patients (53.9%), bleeding in the posterior interhemispheric sulcus in 29 patients (28.4%), bleeding in basal cisterns in 61 patients(59.8%), SAH with IVH in 10 patients (9.8%), SAH with Intra Cranial Hemorrhage (ICH) in 7 patients (6.9%) and Hydrocephaly in 10 patients (9.8%). Angiography was performed in 60 of the cases within 72 hours of the occurrence of SAH.

In five patients, this performed later because of the

delay in referring these patients to the hospital. A second angiography was done after 10 to 14 days when the first angiography was normal.

In the angiography study, an aneurysm reported in 44 patients. Angiogram was normal in 15 patients while another disorder, such as AVM and vasospasm was reported in six patients. Among the 44 patients with aneurysms, 10 had multiple aneurysms.

Table 2: Frequency of ECG findings based on age and sex

ChangesECG	Number	Percent	Age	Male	Female
Atrial Disorders	7	6.9	52.7±13.7	4	3
Right Atrial Disorders	3	2.9	52.7±13.3	2	1
Left Atrial Disorders	4	3.9	52.7±16	2	2
Conductive Disorders	8	7.8	60.1±13	3	5
LBBB	1	1	74	0	1
RBBB	3	2.9	57±13.7	2	1
LAHB	2	2	71±6.4	0	2
block AV	3	2.9	55.3±14.6	1	0
Repolarization Disorders	50	49	52.8±14	27	23
ST Elevation	11	10.8	60±8.1	7	4
ST Depression	12	11.8	46±11.2	6	6
TReverse	11	10.8	58.7±16	5	6
TFlat	8	7.8	43.2±12.4	4	4
TTall	7	6.9	52.8±4.2	3	4
TTwoPeak	5	4.9	48±17.9	2	3
WaveU	4	3.9	46±8.5	3	1
QTcProlonged	13	12.7	54±14.6	7	6
Rhythm Disorders	23	22.5	48.3±14.2	11	12
Sinus Tachycardia	9	8.8	46.9±18.1	3	6
Sinus Bradycardia	10	9.8	48.2±12.1	6	4
Ventricular Tachycardia	3	4.9	54.3±13.6	1	2
Others	2	2	61.5±23.3	1	1
Pathologic Q Wave	7	6.9	50.7±11.8	3	4
Inferior Leads	4	3.9	49.7±13.3	2	2
Precordial Leads	3	2.9	52±12.2	1	2
Total Changes in ECG	62	60.8	53.4±14.2	30	34

102 subjects in the control group were evaluated of which three cases showed ECG changes and two indicated Sinus Tachycardia and a right bandle branch block.

Table 3 shows ECG findings in patients and the control group.

Table 3: Comparison of ECG changes in two groups

	With ECG Changes	Without ECG Changes	All
Patients	62	40	102
Control Group	3	99	102
All	65	139	204

X2calculated for this table is 78.6 with DF=1. This indicates that the presence of ECG changes is related to SAH. Using a similar method, a significant association between rhythm and repolarization disorders and the occurrence of SAH was observed.

Due to statistical limitations, a comparative study of atrial abnormalities, conductive disorders, and pathological Q waves in patients and the control group was not possible. Statistical findings indicate that ECG changes are independent of patient age and sex, but are correlated with the level of consciousness, mortality, and abnormal angiography (P=0.011).

Table 4 shows the frequency of ECG changes and the aneurysm location in 34 patients.

Table 4: ECG changes and aneurysm location in angiography

Aneurysm Location	Without ECG Changes	With ECG Changes	Percent of ECG Changes
Anterior Communicating Artery	4	8	66.7
Vertebrobasilar	2	1	33
Other Arteries	9	10	52.6

According to this table, most ECG changes are seen in the anterior communicating artery aneurysms.

Discussion

According to previous studies, (75 to 80%) of SAH are due to intracranial aneurysm ruptures. The average patient age of aneurysm rupture is 50 years and the prevalence in women is slightly higher than in men (1, 9). In our study, there was aneurysm in (67.7%) of patients who had had a brain angiography. The mean age of patients was (51.7±17.4) and was slightly higher in females than in males (53.9% females and 46.1% males).

It is important that in this study, brain angiography was not performed for most patients with a severe coma (Grade IV and V Hunt and Hess).

This can influence the overall frequency of intracranial aneurysms.

According to Mohr and Kase's study, (38%) of patients with SAH were in coma upon arrival (1). In our study, (21.6%) of the patients had a grade 5 Hunt and Hess on arrival at the emergency unit and (19.6%) of patients had a grade IV Hunt and Hess, which is similar to previous studies. According to previous studies, 25% of patients die with SAH within 24 hours (1). In our study, 15.7% of patients died within 72 hours, making the mortality rate lower than in other studies. Major clinical symptoms in our patients upon their arrival included headache (80.4%),vomiting (72.5%) and decreased consciousness (53.9%), all of which were similar to the findings in the Fontanarosa study.(15.7%) of our patients experienced seizures, in contrast to previous studies, in which (20%) of patients with SAH had seizures (8).

The CT scan findings of our patients differ from Kassell study with 1,553 SAH patients that three percent of patients had normal scans (9, 10).It is critical to note this research considered findings of the first brain CT scan, but not the CT scan findings after rebleeding. This may be cause of the difference between the two studies.

In the study by Sakr and colleagues conducted in 2003 (2), out of 159patients with SAH, (66.7%) showed ECG changes. In this study, (60.8%) of patients had ECG changes.

ECG findings in the Sakrs study include atrial disorders (6.8%), conductive disorders (7.5%), repolarization disorders (83%), rhythm disorders (30.2%), and pathological Q waves (15.1%).ECG changes in this study include: atrial disorders (11.3%), conductive disorders (12.9%), repolarization disorders (80.6%), rhythm disorders (37.1%) and pathological Q waves (11.3%). By comparing these results, it is seen that atrial and conductive disorders in this study are slightly more than those reported by previous studies.

Due to various confounding factors, small sample size, and the low occurrence of atrial and conductive disorders, this difference is not probably statistically significant. Other findings in the two studies are similar. The comparison of ECG changes and their relationship with SAH in patients and the control group indicated a statistically significant correlation, at a (0.01) level that was similar to the results of previous studies.

The analysis of this study findings is indicate that ECG changes are not related to patient age and sex, an issue which has also been proven in previous studies.

There is a controversy surrounding the role of ECG changes in the prognosis in patients with SAH from different sources. Marilyn Hravnak reported that Cardiac injury was incrementally worse with increasing aneurysmal SAH severity and associated with persistent QTc prolongation and ventricular arrhythmias (11).

Crago's study results showed that cardiac complications may negatively impact outcomes in SAH patients up to 6 months following hemorrhage (12). In Ramappa's study, Patients with subarachnoid hemorrhage and elevated cardiac Troponin-I had worse neurological status at admission and had a worse neurological outcome and in-hospital mortality (13).

In our study, the correlation between ECG changes and the severity of unconsciousness and mortality was significant at the (0.01) level.

In past studies, there has not been a specific relationship established between the intracranial aneurysm location and ECG changes.

Conclusion

Our study found a significant correlation between ECG changes and the intracranial aneurysm location at the (0.05) level.

In this study, it was not possible to analyze other clinical and radiological findings, in comparison with ECG changes, due to the small volume of data.

The following is recommended based on the results: Serial electrocardiography performed for all patients with SAH, Cardiac monitoring in patients with SAH and use of electrocardiography as a prognostic criterion for patients with SAH.

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