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THE FREQUENCY OF ELECTROCARDIOGRAM CHANGES IN PATIENTS WITH SUBARACHNOID HEMORRHAGE

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Abstract:
Subarachnoid hemorrhage is responsible for 11.3% cases of stroke and is associated with potentially lethal neurological outcomes. Many theories have been put forward to explain the presence of ECG changes in patients with subarachnoid hemorrhage. Increased activity of catecholamines is one of them.
***Study Design**: a descriptive cross sectional was conducted in the department of Medicine, Ayub Teaching Hospital Abbottabad for a total duration of 6 months i.e. from April 2, 2014 to October 1, 2014. Patients aged 25-45 years, diagnosed with subarachnoid hemorrhage were studied for ECG changes.*
***Results:** A total of 155 patients were included in this study. Out of these 39 (25.17%) had ECG abnormalities. 12 out of 39 had ST segment elevation, 11 had ST segment depression while T wave inversion and Qtc prolongation were found in 8 patients each. The ECG changes were stratified with age and gender and the results were found to be insignificant.*
***Conclusion:** The ECG changes were present in 25.16% of study population and there was no effect of age or gender on the prevalence of ECG changes in patients with subarachnoid hemorrhage.*
Keywords: *Stroke, Subarachnoid Hemorrhage, ECG, ST segment elevation, QTC prolongation.*

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INTRODUCTION:

Subarachnoid hemorrhage (SAH) is an acute medical emergency, defined as an acute extravasation of blood into the subarachnoid space. Though there are many causes of subarachnoid bleed, spontaneous rupture of the berry aneurysm is by the far the most common cause.[1,2] Subarachnoid hemorrhage has a high mortality and morbidity with about 45% of patients die with-in 30 days of an acute event and approximately 12% of these patients die before they reach a hospital.[2]Early brain injury is the leading cause of death in most patients of SAH.[3] Those who survive the acute episode may develop short term or long term complications. Cerebral vasospasm, delayed cerebral ischemia and/or neurological deficits are some of the many complications that they may develop [4,5].

Electrocardiogram (ECG) changes have been increasingly found to be associated with an acute episode of subarachnoid hemorrhage with a frequency ranging from 27% to 100%.[6] These changes include High R waves, ST segment depression, T-wave abnormalities, Large U waves and prolonged QTc intervals. Upto 10% of the patients with SAH have been found to have potentially lethal arrhythmias, such as including ventricular tachycardia, torsades de pointes, and ventricular fibrillation, often leading to shock [1,6].

A number of mechanisms have been proposed to cause ECG changes. These include increase central sympathetic drive, arterial vasospasm, hypoxia, electrolyte imbalance and raised intracranial pressure.[1,7] Altogether, 20–40% of cases of SAH demonstrate troponin T release and this positively correlates with the severity of neurological symptoms [8].

There are very few reports of ECG changes associated with subarachnoid hemorrhage from our region. In-fact in the past 5 years, only one study reports cardiac manifestations of subarachnoid hemorrhage from this region.[9] The objective of this study is to determine the frequency of ECG changes associated with SAH. This will help the physicians identify important cardiovascular events associated with SAH because therapeutic thrombolytic therapy and anticoagulation as well as withholding of life-saving neurosurgery in patients who have ST-elevation or T-inversion in their ECG may endanger their lives.

MATERIALS AND METHODS:

This was a descriptive cross-sectional study conducted from 2nd April to 1st October 2017 in the department of Medicine, Ayub Teaching Hospital Abbottabad. A total of 155 patients who were diagnosed cases of subarachnoid hemorrhage, confirmed through CT scan brain, were included in the study. Patients diagnosed within 3 days of their presentation, and aged between 25 and 45, were included. All patients with documented cardiac diseases were excluded to control the confounding. After getting approval from the ethical committee of the hospital and consent of the patient or his/her next kin, a detailed history of their illness was recorded and a complete physical examination was carried out. An ECG was also recorded in addition to the vital signs to determine the presence or absence of ECG changes. All the treatment procedures and in patient assessments were carried out under strict supervision of a consultant physician having minimum of 5 years of experience. All the information was recorded in a pre-designed pro forma. Strictly exclusion criteria were followed to control confounders and bias in the study results. Then, all the data was stored and analyzed in SPSS version 21. Mean + SD was calculated for numerical variables like age and blood pressure. Frequencies and percentages were calculated for categorical variables like gender and ECG changes. ECG changes were stratified among age and gender to see the effect modifications. All results will be presented in the form of tables and graphs.

RESULTS:

82 (52.90%) were male and 73 (43.10%) were female. These patients had been admitted to the hospital after having been diagnosed with subarachnoid hemorrhage. ECG changes were present in 39 (25.16%) patients. 116 patients (74.84%) did not have any ECG changes at the time of admission to hospital with subarachnoid hemorrhage. The age of youngest patient admitted with subarachnoid hemorrhage was 25 years while the oldest was 45 years old. Mean age of the participants was 34.57 years with a standard deviation of 6.39.

Out of 82 males in the study population, ECG changes were present in 20 (24.4%) patients. Among the female patients of study population, 19 (26.01%) patients had ECG changes and concomitant subarachnoid hemorrhage. Upon stratification of ECG changes with sex of patients, a p value of 0.82 was obtained which was more than 0.05 thereby rendering these results as insignificant. Similarly, upon stratification of ECG changes according to age, 26 patients less than 35 years of age and 13 patients

above 35years ECG changes with a *p* value of 0.13. Other results are being presented as tables.

Table-1: Sex of study participants and ST segment changes

	ST Segment Depression			**ST Segment Elevation**			**Total**
Sex of study participants	Yes	No	*p*-value	Yes	No	*p*-value	
Male	4.00	78.00	0.26	7.00	75.00	0.69	82.00
Female	7.00	66.00		5.00	68.00		73.00
Total	11.00	144.00		12.00	143.00		155.00

p value <0.05

Table-2: T-wave inversion and QTc Interval Prolongation in male and female study participants

	T wave inversion			**QTc interval prolongation**			**Total**
Sex of study participants	Yes	No	p-value	Yes	No	p-value	
Male	4.00	78.00	0.87	5.00	77.00	0.58	82.00
Female	4.00	69.00		3.00	70.00		73.00
Total	8.00	147.00		8.00	147.00		155.00

p value < 0.05

Table-3: Effect of age on presence of ST segment changes in patient with subarachnoid hemorrhage.

Presence of ST segment Elevation				
age groups of patients	Yes	No	Total	*p*-value
Age between 25-35 years	9.00	78.00	87.00	0.17
Age between 36-45 years	3.00	65.00	68.00	
Total	12.00	143.00	155.00	
ST segment depression				
age groups of patients	Yes	No	Total	*p*-value
Age between 25-35 years	7.00	80.00	87.00	0.60
Age between 36-45 years	4.00	64.00	68.00	
Total	11.00	144.00	155.00	

p value <0.05

Table-4: Effect of Age on T wave inversion and QTc prolongation.

T wave inversion				
age groups of patients	Yes	No	Total	p-value
Age between 25-35 years	5.00	82.00	87.00	0.71
Age between 36-45 years	3.00	65.00	68.00	
Total	8.00	147.00	155.00	
QTc interval prolongation				
age groups of patients	Yes	No	Total	*p*-value
Age between 25-35 years	5.00	82.00	87.00	0.71
Age between 36-45 years	3.00	65.00	68.00	
Total	8.00	147.00	155.00	

p value <0.07

DISCUSSION:

Subarachnoid hemorrhage is characterized by presence of blood in the subarachnoid space. It is a life-threatening event and usually occurs after the rupture of aneurysms present in the blood vessels supplying different parts of brain. Although aneurysmal rupture is the commonest mode of subarachnoid hemorrhage, it can occur due no non-aneurysmal causes. The 30-day mortality of subarachnoid hemorrhage is very high and approximately half of the patients with subarachnoid hemorrhage survive after this period. Moreover, more than 10% patients with subarachnoid hemorrhage die before they reach hospital [2,3].

Many ECG changes have been found to be associated with subarachnoid hemorrhage and the reported prevalence of these changes varies 27% to 100% in different studies.[6] It has been postulated that the ECG changes following SAH are precipitated because of an increased central sympathetic discharge as well as angiogenic spasm that occurs in SAH.[7] Sometimes this activity results in fatal arrhythmias e.g., ventricular fibrillation, torsades-de-pointes and ventricular tachycardias. These usually are more likely to occur when the QTc is prolonged.

The aim of this study was to determine the frequency of ECG changes associated with SAH in patients belonging to this region as there are very few reports of association of ECG changes with SAH.

There were a total of 155 patients with SAH in this study and 39 (25.16%) patients had any type of ECG changes. The ECG changes that were focused upon for this study were ST segment elevation & depression, T wave inversion and QTc interval prolongation. ST segment elevation was present in 12 (30.77%) out of 39 patients. ST segment depression was present in 11 (28.21%) patients, T wave inversion and QTC prolongation were present in 8 (20.51%) patients each.

The prevalence of ECG changes in patients with subarachnoid hemorrhage has been reported in various study and as mentioned earlier, it has ranged from as less as 27% of study population to 100% of study populations.

Recently, Chatterjee et al. reported that the commonest ECG findings in patients with subarachnoid hemorrhage were ST segment changes: both ST segment elevation and depression was noted and presence of either of these changes could also possibly reflect the presence of concomitant coronary artery disease. [6] The time interval between occurrence of subarachnoid hemorrhage and recording an ECG is of importance. This fact has been highlighted in many studies.[10,11] One study found that ECG changes were found in 90% of patients with subarachnoid hemorrhage within first 48 hours pointing towards significance of early investigations in these patients.[11] A landmark study by Rudehill et al. reported the prevalence of different types of ECG changes recorded pre-operatively in patients with subarachnoid hemorrhage.[12] They studied 406 patients with subarachnoid hemorrhage and reported that tall R waves were present in 19% of the patients. They also recorded T-wave changes in 32% patients, prominent U-waves in about 47% patients in addition to ST depression in 15%, and prolonged QTc interval (>440 ms) in 23% patients. (13) In this study, the ST segment elevation was found in 12 patients (30.77%) out of 39 patients. Likewise, ST segment depression 11 (28.21%) patients, T wave inversion and QTC prolongation were recorded in 8 (20.51%) patients each. This study didn't attempt to record the time interval between precipitation of subarachnoid hemorrhage and presentation to hospital. Another study reported that QT prolongation was the most common ECG finding in patients immediately after subarachnoid hemorrage: It was found in 42% of patients.[7] The researchers also noted that ST segment changes and tachy cardia were associated with a worse clinical outcome in patients with subarachnoid hemorrhage. No such association was sought after in this study as its objective was to determine the frequency ECG changes in patients with subarachnoid hemorrhage.

A recent study by Kumar et al. in Kerala, India reported that the ECG changes were present in 59.2% of their study population. They noted that the commonest change was the repolarization abnormalities.[1] T wave inversion was present in 48.3% of patients followed by sinus bradycardia (16.8%) and QTC prolongation (12.5%). They reported that the presence of ECG changes was associated with a poorer prognosis for patients with subarachnoid hemorrhage by univariate analysis.

In contrast, a study by Liu et al. reported that there was no significant association between ECG changes and the outcome of subarachnoid hemorrhage.[13] They reported that ECG changes were present in 63.2% patients with subarachnoid hemorrhage. The arrythmic changes were present in 22.6% patients and repolarization changes were present in 14.2% of

patients. These findings corroborate findings of another study in which 67.1% patients with subarachnoid hemorrhage had at least one ECG problem. A wide range of abnormalities was noted including bradycardia, T-wave inversion, ST segment changes, conduction blocks and QTC prolongation.[14]

CONCLUSION:

It was a descriptive cross sectional study that could not analyze the association of ECG changes with the outcome of subarachnoid hemorrhage. No effort was made to determine possible risk factors for the precipitation of subarachnoid hemorrhage.

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