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Fluctuating ECG Change and Its Observation with Outcome in Acute Subarachnoid Hemorrhage

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Abstract

Background: *Subarachnoid hemorrhage (SAH) is a serious neurological disorder that is often complicated by the occurrence of electrocardiographic abnormalities and may worsen the outcome. Therefore this study was designed to evaluate the role of fluctuating ECG patterns for predicting outcome in patients with SAH.* ***Materials and Methods:*** *This prospective observational study was conducted for 12 months at the department of Neurology in Rajshahi Medical College Hospital. A total of 40 patients with acute SAH were included. An informed written consent was obtained from the participants or from appropriate attendant. Detailed history was obtained from the participants including risk factor for developing SAH, concomitant morbidity. ECGs were routinely obtained at admission and then periodically as determined by the treating physician. Serial troponin levels and echocardiography were performed when ECGs are abnormal. Routine laboratory testing including complete blood count, serum potassium, blood glucose, serum creatinine etc. were performed in all the participants. Functional outcomes at hospital discharge were assessed with the modified Rankin Scale (mRS). Ethical clearance was obtained before beginning of the study from the ERC of the study place. Collected data was analyzed by using SPSS 22.0.* ***Result:*** *Mean age of the patients was 58.95±11.75 SD (years) with predominant female respondents (70%). Frequency of fluctuating ECG was 40% (n=16). Among the fluctuating ECG group 62.5% had e"2 changes in ECG followed by 12.5% had T wave inversion and 25% had ST segment change in fluctuating ECG group. Length of hospital stay was prolonged in fluctuating ECG group than normal ECG group (<0.05). Mean mRS at discharge was higher in fluctuating ECG patients than the normal ECG group (5±1.71 vs 2.83±2.07; 0.001) Overall poor outcome is associated with fluctuating ECG (p<0.05).* ***Conclusion:*** *The study showed that fluctuating ECG in SAH patients is closely linked with subsequent poor outcome of the patients.* ***Keywords:*** *Subarachnoid Haemorrhage, ECG, modified Rankin Scale (mRS).*

Introduction

Subarachnoid hemorrhage (SAH) is devastating acute neurological disease. The worldwide incidence rate of spontaneous subarachnoid hemorrhage (SAH) is approximately 9.1 per 100 000 person per year but varies widely between countries. Incidences are much higher in Finland and Japan and lower in South and Central America.[1] The occurrence of subarachnoid hemorrhage peaks between age 50 and 60 years. The condition is 1.4 times more common in women than in men but this difference becomes evident only after the fifth decade.[2]

Ruptured intracranial aneurysm is the most common cause of spontaneous SAH (around 85% of cases). Alternate etiologies include peri-

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mesencephalic hemorrhage arteriovenous malformations, dural arteriovenous fistula, arterial dissection, mycotic aneurysm, and cocaine abuse.[3]

Subarachnoid haemorrhage (SAH) has long been known to be associated with electrocardiogram (ECG) changes. However the aetiology, pathophysiology and prognosis of underlying cardiac abnormalities remain unexplained to a large extent. Hypothalamic stimulations and autonomic dysfunctions have been linked but not conclusively proven to be causative. These considerations may influence therapeutic interventions as infusions of large volumes of fluids or administrations of vasopressors may prove detrimental in patients with a compromised heart.[4]

The reported prevalence of ECG changes in patients with SAH ranges from 27% to 100%. Such wide variation may be due to differences in study design, investigators' definitions of ECG abnormalities, or the methods used to evaluate ECG changes.[5]

Electrocardiogram (ECG) abnormalities, including changes in ST segment and T wave, prolonged QT interval (QTc), and P wave abnormalities, occur in 50%-100% of patients during the acute stage of SAH. ECG changes usually occur during the first 42 hours after SAH, but their duration is variable, and ECG usually returns to normal by 6 weeks after the event. Evidence suggests that cardiac dysfunction is an independent risk factor for death and disability in aneurysmal SAH.[6]

ECG changes in SAH commonly reflect ischaemic heart disease and have been known to present with ST-segment elevation and T-wave inversion.[4] Angiographic vasospasm is an important cause of morbidity and mortality after aneurysmal SAH. QT prolongation and tachycardia on ECG were independently associated with angiographic vasospasm after aneurysmal SAH.[5]

However, there is limitation of data in our country regarding ECG and outcome of SAH patients. Therefore, the aim of this study was to examine a possible link between the fluctuating ECG pattern and prognosis in patients with SAH.[7]

Material and Methods:

This prospective observational study was conducted for 12 months at the department of Neurology in Rajshahi Medical College Hospital from July 2018 to July 2019. A total of 40 patients with acute SAH were included. An informed written consent was obtained from the participants or from appropriate attendant. Detailed history was obtained from the participants including risk factors for developing SAH and concomitant morbidity. ECGs were routinely obtained at admission and then periodically as determined by the treating physician. Serial troponin levels and echocardiography were performed when ECGs were abnormal. Routine laboratory testing including complete blood count, serum potassium, blood glucose, serum creatinine etc. were performed in all the participants. Functional outcomes at hospital discharge were assessed with the modified Rankin Scale (mRS). Ethical clearance was obtained before beginning of the study from the ERC of the study place. Collected data was analyzed by using SPSS 22.0.

Result and Observations:

This was a prospective observational study conducted in department of Neurology, RMCH. Total number of respondents was 40 collected by purposive sampling. 35% respondents were aged between 50 to 59 years and 30% respondents were 70 years or above. Beside 20% respondents were aged between 60 to 69 years and 15% respondents were aged between 40 to 59 years. (Table I). In this study, mean age of the respondents was 58.95±11.75 (SD) years.

40% of the patients had fluctuating ECG while 60% had normal ECG findings. (Table II).

This study revealed that 62.5% respondents were in Grade 4, 25% respondents were in Grade 5 and 12.5% respondents were in Grade 2 in fluctuating ECG group. Beside 41.7% respondents were in Grade 2, 33.3% respondents were in Grade 4 and 25% respondents were in Grade 5 in normal ECG group. (Table III)

This study found that mRS at discharge was 5±1.71 and length of hospital stay was 7.13±3.26 days in fluctuating ECG group. Beside this, mean MRS at discharge was 2.83±2.07 and length of hospital stay was 5.92±2.98 days in normal ECG group. (Table IV).

This study shows 62.7% had hydrocephalus, 50% had rebleeding, 37.5 had symptomatic vasospasm, 25% had pneumonia and 12.5% had sepsis during hospital stay in fluctuating ECG group beside 10% had hydrocephalus and 16.7% had Pneumonia, Sepsisand rebleeding in normal ECG group. (Table V).

This study found that ECG change was significantly associated with patient's outcome. (Table VI).

Table-I

Distribution of the respondents by Age (n=40)

Age group	Frequency (n)	Percentage (%)	Mean±SD
40 to 49 years	6	15	
50 to 59 years	14	35	
60 to 69 years	8	20	
70 years and above	12	30	58.95±11.75
Total	40	100	

Table-II

Distribution of the respondents by ECG change (n=40)

ECG change	Frequency (n)	Percentage (%)
Fluctuating ECG	16	40
Normal ECG	24	60
Total	40	100

Table-III

Distribution of the respondents by World Federation of Neurological Surgeon grading scale (n=40)

WFNS scale	Grade-2 n (%)	Grade-4 n (%)	Grade-5 n (%)	Total n (%)	P value
Fluctuating ECG	2 (12.5)	10 (62.5)	4 (25)	16 (100)	.012*
Normal ECG	10 (41.7)	8 (33.3)	6 (25)	24 (100)	

*p value is determined by chi-square test

Table-IV

Distribution of the respondents by Length of hospital stay and mRS (Modified Ranking Scale) at discharge (n=40)

	Length of hospital stay (days) Mean±SD	MRS at discharge Mean±SD	P value*
Fluctuating ECG	7.13±3.26	5±1.71	0.234
Normal ECG	5.92±2.98	2.83±2.07	0.001

*p value was determined by independent sample t-test

Table-V

Distribution of the respondents by Complications during hospital stay (n=40)

Complications	Fluctuating ECG Frequency (%)	Normal ECG Frequency (%)	P value
Pneumonia	4 (25)	4 (16.7)	*0.545
Sepsis	2 (12.5)	4 (16.7)	*0.720
Hydrocephalus	10 (62.5)	10 (41.7)	*0.207
STROKE	6 (37.5)	4 (16.7)	*0.169
Rebleeding	8 (50)	4 (16.7)	*0.036

*P value was determined by chi-square test

Table-VI

Association of ECG change with patient's outcome (n=40)

ECG change	Good outcome n (%)	Poor outcome n (%)	P value
ee2 changes	0 (0)	10 (25)	*<0.01
Single change	2 (5)	8 (20)	
No change	14 (35)	6 (15)	

*p value was determined by chi-square test

Discussion:

The association of electrocardiographic abnormalities with injury to the central nervous system is well recognized. Neurogenic changes on electrocardiograms (ECGs) are particularly common following subarachnoid hemorrhage (SAH) and large clinical series indicate that 50% to 100% of patients experience at least one such abnormality during the acute stage of SAH.[8]

In this study 35% respondents were aged between 50 to 59 years and 30% respondents were 70 years or above. Beside 20% respondents were aged between 60 to 69 years and 15% respondents were aged between 40 to 59 years. Mean age of the respondents was 58.95±11.75 years of SD.

In a previous study by Chaturbedi et al.[9] observed the mean age of the patients were 45.73 ± 11.78 years of SD with the range of 24-80 years. The age group with maximum number of patients was 40-60 years (27 patients, 60%), followed by the age group 20-40 years (16 patients, 35.6%) and finally the age group 60-80 years (2 patients, 4.4%).[4] Another previous study by Elsharkawy et al.[6] observed among 20 patients mean age was 47.2±12.8 years of SD with the range of 18 to 70 years.[3] Another study by Sakr et, al. observed among 159 patients mean age of the respondents was 49.6±13.4 years of SD. Another study by Islam et, al.[10] observed mean age of the participants was 44.9±9.7 years of SD ranging from 26 to 70. Most of the patients were in the age group of 41–50 years (53.3%).

In this study 62.5% of the respondents had 2 or more than two Changes and 12.5% had T wave inversion and 25% had ST segment change in fluctuating ECG group. Beside 16.7% had T wave inversion in normal ECG group.

In a previous study by Elsharkawy et al.[6] observed among 20 patients 7 (35%) patients had normal ECGs and while 13 patients (65%) had some ECG abnormalities. Seven (53.8%) had T wave abnormalities, 6 (46.2%) had ST segment changes, 4 (30.8%) had QTc segment prolongation.[3] Another study by Sakr et al.[11] observed among 159 patients 106 (66.7%) had abnormal ECG. The most common was T wave alterations (38.7%) beside

corrected QT prolongation (34%), ST segment abnormalities (27.4%).[13] Another study by Ibrahim et al.[7] observed QT prolongation (42%) and nonspecific ST changes (9%).

In this study according to good outcome defined by MRS score 0 to 2, 14 had poor outcome and only 2 had good outcome those who had fluctuating ECG beside 14 had good outcome and 10 had poor outcome those who had normal ECG. Outcome of the patients were significantly higher those who had no fluctuation of ECG than those who had fluctuation of ECG. ECG change was significantly associated with patient's outcome (<0.01).

In a previous study by Elsharkawy et al.[6] also observed all 4 patients who had fluctuating ECG changes had a poor outcome (100%) compared to patients who had no fluctuation (33.3%, P<0.05).[3] Another study by Ibrahim et, al. also observed that fluctuating abnormal ECG had significantly poor outcome.[7]

Hajsadeghi S et al.[12] study found that abnormal primary ECG was found in five out of the six dead subjects (83.3%) and 20 out of the 54 discharged patients (37%) (P = 0.029). None of the three patients with abnormal primary echocardiograms were expired during the hospitalization.

Nikkah K et al.[13] study showed that 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). They also found that the correlation between ECG changes and the severity of unconsciousness and mortality was significant at the (0.01) level.

Conclusion:

This study concluded that overall frequency of fluctuating ECG was present in 40% of the patients having subarachnoid hemorrhage and it is clearly evident that fluctuating ECG group had higher mean of mRS score and they stayed higher duration of hospital than corresponding other SAH patients who had normal ECG. Based on the findings, it can be concluded that fluctuating ECG is closely linked with poor outcome of these patients' group. As the study is limited in several aspects, therefore, before drawing any conclusion, further study is recommended.

Ethical issues:

All patients gave informed written consents and the study was approved by Institutional Review Board of Bangabandhu Sheikh Mujib Medical University.

Conflict of interests:

The authors declare that they have no conflict of interest.

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