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The Pattern of Cardiac Abnormality with Subarachnoid Hemorrhage and its Outcome in Patients

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Abstract:

Objective: *To evaluate the pattern of cardiac abnormality with subarachnoid hemorrhage and its outcome in patients.* ***Methodology:*** *This cross sectional study was conducted in the Department of Neurology and Department of Neurosurgery, BSMMU, Dhaka from 01.12.2021 to 30.12.2022 after IRB approval. A total of 72 Patients were selected from indoor of the Department of Neurology, and Neurosurgery, BSMMU, Dhaka according to inclusion criteria. Those who have fallen under exclusion criteria were excluded from the study.After ethical clearance from Institutional Review Board (IRB), 72 patients were selected following the mentioned inclusion and exclusion criteria. SAH patients within ten days after SAH were taken as a sample.Informed written consent was taken from each patient or his/her attendant. Proper history was taken, physical and neurological examination was done. And ECG, Troponin I, and Echocardiography was done including a CT ofthe brain. For conformation and location of aneurysm or arteriovenous malformation patients underwent Digital Subtraction Angiography (DSA) & CT angiogram of brain.* ***Results:*** *During the study, 34.7% were in the 47-57 years age group. Followed by 26.7% in 58-68of years age group, 20% in the 36-46 years age group and majority was male. 76% had hypertension whereas 29.3% had diabetes. Followed by 21.3% had smoking status & only 1.3% had a past family history. High-grade SAH (WFNS 4) was observed in 4 (6.7%) patients, and 12 (16%) patients had modified Fisher grade 4 SAH. 6.7% had acute myocardial infarction whereas 38.7% had troponin I level and 17.3% had higher levels of CK-MB, may mean that they had a heart attack or have other heart problem.Patients between 58 to 68 years old had the highest percentage (26.67%) of cardiac abnormalities and this outcome was significant (P= 0.000). Maximum female patients (26.67%) and maximum male patients (6.67%) had IHD (P=0.000).* ***Conclusion:*** *From this study, it concludes that, Cardiac complications after SAH are associated with an increased risk of ECG & laboratory changes, where IHD & MI cases were common. Patients with electrocardiogram abnormalities and stress cardiomyopathy need appropriate follow-up for the identification of a cardiac disease or risk factors for cardiovascular disease.*

Keywords: *Cardiac abnormality, Subarachnoid hemorrhage, Heart diseases.*

Introduction:

Subarachnoid hemorrhage is associated with high risk for sudden cardiac death (SCD). Electrocardiogram (ECG) abnormalities, the release of cardiac biomarkers, and the emergence of acute stress-induced heart failure mimicking Takotsubo cardiomyopathy are some of the issues that might arise as a result of prolonged exposure to stress [1,2,3,4,5,6]. Those who have cardiac issues following SAH tend to have a more difficult clinical course, more frequent neurological sequelae, and worse functional results in both the short and long term[5,6,7,8,9,10]. Extensive catecholamine release observed with hemorrhage[11,12,13,14] rather than occlusive coronary artery disease is likely to be the source of cardiac problems following SAH.

Patients with SAH who made it through the first stages of the illness were given a fair prognosis historically. Nevertheless, more recent research

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has indicated that people with SAH are at a greater risk for cardiac and cerebrovascular events than the general population[15,16,17]. Many lines of evidence [18–20] point to an elevated risk of mortality and unfavorable cardiovascular outcomes in patients with modest, subclinical troponin release and stress cardiomyopathy. As a result, SAH patients who report with cardiac problems may be at increased risk for future cardiovascular events; nevertheless, the relationships between SAH and cardiovascular events have been poorly explored[20].

Objective:
To evaluate the pattern of cardiac abnormality with subarachnoid hemorrhage and its outcome in patients.

Methodology:
This cross sectional study was conducted in the Department of Neurology & Dept of Neurosurgery, BSMMU, Dhaka from 01.12.2021 to 30.12.2022 after IRB approval.A total of 72 Patients wereselected from indoor of the Department of Neurology, and Neurosurgery, BSMMU, Dhaka according to inclusion criteria. Those who have fallen under exclusion criteria were excluded from the study.

After ethical clearance from Institutional Review Board (IRB), 72 patients were selected following the mentioned inclusion and exclusion criteria. SAH patients within ten days after SAH was taken as sample.Informed written consent was taken from each patient or his/her attendant. Proper history was taken, physical and neurological examination was done. And ECG, Troponin I and Echocardiography was done including a CT of brain. For conformation of site of aneurysm and arteriovenous malformation patients underwent Digital Subtraction Angiography (DSA) & CT angiogram of brain.

A semi-structured data collection sheet was developed in english. This was developed using the selected variables according to the general and specific objectives. Necessary modification was done before finalizing the questionnaire and check list. Before proceeding to data collection, the detail of the study was explained to each patient and written informed consent was obtained. Data collection sheet was fulfilled by face to face interview. SAHpatients underwent Digital Subtraction Angiography (DSA) & CT angiogram of brain. Information regarding any recurrence of new ischemic stroke and control of modifiable risk factors was obtained for each sample.Descriptive analysis of all relevant variables was done by using measures of Central Tendency and Dispersion. The result was expressed as means (±SD) for continuous variables and as percentages for categorical variables. Means of parameter data was compared using one-way ANOVA. Cox proportional hazards model was used to evaluate the influences on stroke recurrence imposed by potential risk factors.P-value was obtained from ÷2 table. P-value <0.05 will be taken as significant at 5% level of significance.

Results:
Table-1 shows age distribution of the patients where 34.7% were in 47-57 years age group. followed by 26.7% were in 58-68years age group, 20% in 36-46 years age group.

Table-I
Age distribution of the patients

Age distribution	Frequency	Percent
25-35 years 1	5	6.7
36-46 years 2	15	20.0
47-57 years 3	26	34.7
58-68 years 4	20	26.7
>69 years 5	9	12.0
Total	75	100.0

Figure-1 shows gender distribution of the patients where majority were male, 65.3%.

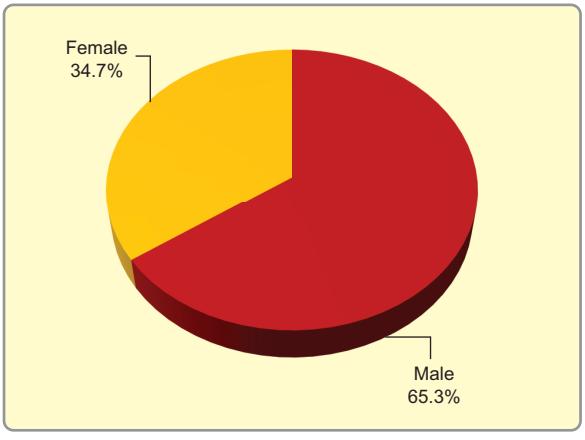

Fig.-1: *Gender Distribution*

Table-II shows clinical status of the patients where 76% had hypertension whereas 29.3% had diabetes. Followed by 21.3% had smoking status & only 1.3% had past family history.

Table-II

Clinical status of the patients

Clinical status	N	%
Hypertension	57	76
Diabetes	22	29.3
Smoking	16	21.3
Family History	1	1.3

multiple responses were noted

Figure 2 shows the association between patient's age group and cardiac abnormalities. Here, patients between 58 to 68 years old had the highest percentage (26.67%) of cardiac abnormalities and this outcome was significant (P= 0.000). See the figure below-

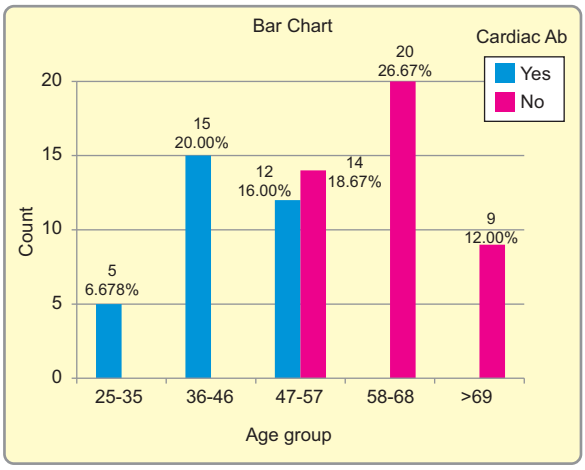

Fig.-2: *Association between patient's age group and cardiac abnormality*

Figure 3 shows theassociation between patient's sex and cardiac abnormalities (IHD, MI, Arrythmia). Here, maximum female patients (26.67%) and maximum male patients (6.67%) had IHD (P=0.000). See the figure below-

Table-3 shows grading of subarachnoid hemorrhage according to Hunt and Hess scale, Fisher grade, WFNS wherehigh-grade SAH (WFNS 4) was observed in 4 (6.7%) patients, and 12 (16%) patients had modified Fisher grade 4 SAH.

Table-III

Grading of subarachnoid hemorrhage according to Hunt and Hess scale, Fisher grade, WFNS

Hunt and Hess scale	N	%
Grade 1	8	10.7
Grade 2	28	37.3
Grade 3	26	34.7
Grade 4	9	12.0
Grade 5	4	5.3
FSH scale	N	%
Grade 1	4	5.3
Grade 2	46	61.3
Grade 3	20	26.7
Grade 4	5	6.7
WFNS Scale	N	%
Grade 1	23	30.7
Grade 2	18	24.0
Grade 3	17	22.7
Grade 4	12	16.0
Grade 5	5	6.7

Table-4 shows location of aneurysm where most of the patient's aneurysm seen in right anterior communicating artery (ACOM), 64%.

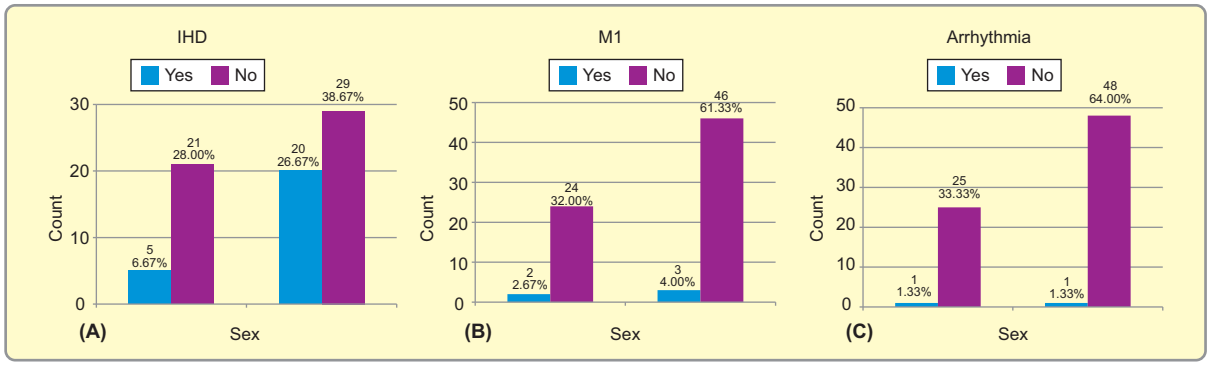

Fig.-3: *Association between patient's sex and cardiac abnormalities (IHD, MI, Arrythmia)*

Table-IV

Location of aneurysm

Location of aneurysm	Frequency	Percent
ACOM Right	48	64.0
PCOM Right	4	5.3
MCA Right	11	14.7
PCOM Left	1	1.3
MCA Left	8	10.7
BASILAR Right	3	4.0

*Multiple Responses were noted in patients

Table-5 shows ECG &laboratory changing status of the patients where 6.7% had myocardial infarction whereas 38.7% had troponin I level and 17.3% had higher levels of CK-MB may mean that they had a heart attack or have other heart problems.

Table-V

ECG & laboratory changing status of the patients

ECG	N	%
IHD: Acute MI	5	6.7
Arrythmia	2	2.7
Laboratory Status	N	%
High Troponin I	29	38.7
High CKMB	13	17.3

Table-6 shows the echocardiographic parameters of the patients on admission. All the echocardiographic parameters are shown among no cardiac dysfunction on admission and cardiac dysfunction on admission. See all the detailed information in the table below-

Table VI

Echocardiographic parameters on admission

Echocardiographic parameters	No cardiac dysfunction on admission (n=75)	Cardiac dysfunction on admission (n=75)
Left ventricular ejection fraction, %	63 (61 to 70)	61 (47 to 67)
Stroke volume, ml	83 (71 to 90)	74 (51 to 87)
Cardiac output, l/minute	5.3 (4.9 to 6.4)	4.8 (3.9 to 5.7)
Left atrium volume, ml/m2	14.8 (12.4 to 18.8)	15.7 (12.7 to 18.6)
E wave, cm/s	94 (83 to 102)	62 (50 to 94)
A wave, cm/s	64 (59 to 74)	63 (53 to 91)
E/A	1.1 (1.2 to 1.6)	1 (0.78 to 1.1)
E' lateral, cm/s	16 (14 to 17)	7.8 (6 to 9)
E/E' lateral ratio	6.1 (5.1 to 6.8)	9.2 (7.1 to 10)
E' mean, cm/s	12 (11.5 to 16.5)	7.3 (6 to 8.2)

Discussion:

SAH patients are at a higher risk of long-term death and cerebrovascular disease than the general population. According to our study 6.7% had acute myocardial infarction whereas 38.7% had troponin I level and 17.3% had higher levels of CK-MB may mean that patient have had a heart attack or have other heart problems. Which was supported by other study [11-17]. Cardiac complications after SAH are well described in the literature and occur in up to 50% of SAH patients [1,2,3,4,5,6]. Several studies have shown that such cardiac complications are independently associated with an increased risk of delayed cerebral ischemia, cerebral infarction, and poor outcomes [5,6,7,8,9,10]. Furthermore, studies have shown that minor troponin release and stress cardiomyopathy, conditions are believed to have a good prognosis, carry a high risk of death and later cardiovascular events [18,19,20].

According to this study, patients between 58 to 68 years old had the highest percentage (26.67%) of cardiac abnormalities and this outcome was significant (P= 0.000). Also, maximum female patients (26.67%) and maximum male patients (6.67%) had IHD. One study reported that, stress cardiomyopathy was not associated with an increased risk of death, but this result should be interpreted with caution because patients who underwent echocardiography had more severe disease and higher overall mortality. In contrast to this hypothesis, the increased risk of death was significant only shortly after SAH, i.e., within the first 3 months after hemorrhage [2]. Nevertheless, our results support the importance of cardiac complications in the acute care of SAH patients. This study illicit that cardiac biomarker release and ST-T abnormalities were independent risk factors for increased risk of death also after adjusting for important factors such as age, neurological status on admission, and cerebral infarction.

Cardiac complications after SAH are not due to coronary artery disease; they are most likely a consequence of sympathetic overstimulation [5,6,7]. In this study, all the echocardiographic parameters are shown among no cardiac dysfunction on admission and cardiac dysfunction on admission (Table 6). In the present study it suggest that ST-T abnormalities were an independent risk factor for cardiac events. This association was not evident for any of the other cardiac variables. Epidemiological studies of healthy subjects have shown that patients with ST-T abnormalities, including minor ST-T abnormalities, are at a higher risk of later cardiac events, suggesting that these patients may have undetected cardiac disease [14-16]. However, the present study suggests that some of these patients may suffer from undetected cardiac disease. It is possible that such disease is revealed on ECG due to the cardiac stress afflicting the heart after SAH.

This study shows clinical status of the patients where 76% had hypertension whereas 29.3% had diabetes. Followed by 21.3% had smoking status & only 1.3% had past family history. Studies have shown that patients with stress cardiomyopathy very frequently have risk factors for cerebrovascular disease, such as hypertension, hyperlipidemia, and diabetes [20]. The increased incidence of cerebral insults may also be due to undetected and untreated risk factors of cerebrovascular disease.

Based on the results of the present study, it is recommended that ECG should be routinely recorded in all patients with SAH. Echocardiographic examination for detection of stress cardiomyopathy is desirable in all patients and should, at the very least, be performed in patients with high-grade SAH or significant increase in troponin I and NT pro BNP levels [19]. Intensive hemodynamic monitoring with goal-directed hemodynamic therapy might be beneficial in SAH patients with DCI (Distressed Communities Index) and stress cardiomyopathy [18]. Patients with ST-T abnormalities and stress cardiomyopathy should receive a diagnostic workup for cardiac disease or risk factors for cerebrovascular disease. Furthermore, patients with stress cardiomyopathy should have a late follow-up echocardiography to exclude ventricular thrombus formation. It is important for ICU physicians to be aware of such findings, since these abnormalities are frequently seen in the ICU to be able to establish an appropriate follow-up plan for patients.

Conclusion:

From this study it conclude that cardiac complications after SAH are associated with an increased risk of ECG & laboratory changes, where IHD & MI cases were common. Patients with electrocardiogram abnormalities and stress cardiomyopathy need appropriate follow-up for the identification of cardiac disease or risk factors for cardiovascular disease.

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