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Association between ECG changes and cardiac enzymes in patients with acute stroke at a tertiary care hospital in Mangalore - a retrospective study

KEYWORDS

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ABSTRACT

AIM: To determine the pattern of ECG changes associated with pathophysiologic categories of acute stroke among patients without cardiovascular disease and to determine whether there is any association between cardiac enzymes with pathophysiologic categories of acute stroke. **Materials and Methods:** Retrospective observational study was done in 36 patients admitted between August 2016 and November 2016 with a diagnosis of acute cerebrovascular events including ischemic stroke, intracerebral and subarachnoid haemorrhage in Yenepoya Medical College Hospital. CT-Imaging, ECG, 2 D ECHO and cardiac enzymes of each patient were studied. **Results:** In the study population, 26(72.2%) were ischemic and 10(27.8%) were hemorrhagic stroke. Maximum number of patients had T inversion (55.56%) followed by ST elevation/depression (47.22%). CKMB was elevated in only 2 (5.6%) patients while Trop I was elevated in 11(30.6%) patients. **Conclusion:** There is increased incidence of ECG changes and increase in cardiac enzymes to the patients presenting with acute stroke but is unrelated to cardiac origin.

INTRODUCTION

Cerebrovascular accident (CVA) or stroke is the most common life threatening disorder. It is the third leading cause of death in the developed countries after cardiovascular disease and cancer[1]. It is crucial to distinguish stroke-induced ECG changes from ECG changes due to concomitant ischemic heart disease. This electrocardiographic spectrum seems to be related to the type of cerebrovascular disease and its localization. The autonomic and cardiovascular effects of stroke; however, are modulated by concomitant factors such as pre-existent cardiac diseases and electrolyte disorders.

The changes of ECG in CVA were reported in many studies. Changes occurring in ECG following stroke were changes related to T-wave, U-wave, ST-segment, QT-interval and various arrhythmias.[2,3,4] These ECG changes may resemble those of myocardial ischemia or sometime myocardial infarction[2,3,4].Cerebral infarction is responsible for about 80% of all first ever in a lifetime strokes while primary intracerebral haemorrhage (PICH) contributes for10% and subarachnoidhaemorrhage for 5%.[3]

Stroke has been shown to produce changes in autonomic function, increase the incidence of cardiac arrhythmias, cause myocardial damage, and raise plasma catecholamine levels irrespective of which hemisphere is affected. The autonomic mechanisms leads to myocardial necrosis, arrhythmias, and even sudden death through related mechanisms. Right hemisphere infarction is associated with a greater number of supraventricular tachycardia, and speculated that a decrease in cardiac parasympathetic activity in right sided infarction may cause the probable reciprocal rise in the sympathetic tone[5].

It is not surprising that the prevalence of pre-existing cardiac disease in acute stroke patients influences the risk of cardiac events. Typically, the prevalence of symptomatic IHD in acute stroke studies is 20% to 30%. Asymptomatic IHD is also common, with small studies suggesting that up to 40% of stroke patients without overt IHD may have evidence of silent myocardial ischemia. Early hypertension (SBP>220mmHg) and hypotension (SBP <150mmHg) have been identified as predictors of death within 90 days.[6] Relationship between early hypotension and mortality is explained by its association with cardiac adverse events, and may reflect underlying left ventricular dysfunction[6]. The ECG variables most highly predictive of SCAEs(serious adversecardiacevents) were prolonged QTc and presence of Ventricular premature beats on baselineECG.[6]

In this study we are focusing on the ECG changes present in patients with acute stroke which are not related to cardiac origin. The aims of our study were:

1. To determine the pattern of ECG changes associated with pathophysiologic categories of acute stroke among patients with/without cardiovascular disease.

2. To determine whether there is any association between cardiac enzymes with pathophysiologic categories of acute stroke

MATERIALS AND METHODS

After ethical committee approval, retrospective study was done in 36 patients admitted in the Intensive care unit, emergency and medical wards with a diagnosis of acute cerebrovascular events during August to November 2016in Yenepoya Medical College Hospital were included in the study. Such patients who had undergone necessary investigations like CT-Imaging, ECG, 2 D ECHO, routine blood investigations and cardiac enzymes including Troponin I (TnI) were included in the study. For analytic purposes, all ECG items are dichotomised into normal or pathological findings.TnI result is also be dichotomised into normal or pathological. The statistical method used was g*Power software. By the prevalence of 50% and effect size g=0.25, Power=80%, Level of significance =5% the sample size thus obtained was 36. The results tabulated using SPSS software, 2016.

INCLUSION CRITERIA

Patients admitted with the following diagnosis based on clinical and radiological findings on computed tomography for whom cardiac enzymes, ECG was done at the time of admission and 2 D ECHO was done to rule out the cardiac etiology were included in the study. Acute cerebrovascular events included were:

- Ischemic stroke
- Subarachnoid haemorrhage
- Intraparenchymal bleed
- Those patients that were admitted between August 2016 to November 2016 were included in our study.

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EXCLUSION CRITERIA

The following patients were excluded from the study

- unavailable ECG within 24 hours
- a head trauma within 1 week prior to the stroke
- a documented history of subdural hematoma
- stroke in the setting of dissecting aortic aneurysm
- a functioning artificial pacemaker
- Alternative diagnoses such as cerebral tumours, electrolyte disturbances
- Known case of cardiovascular disease like IHD, atrial fibrillation, cardiomyopathy, bundle branch block either from the history or documented records.

RESULTS

In the study population, 25(69.4%) were males and 11(30.6%) were females. Among the strokes, 26(72.2%) were ischemic and 10(27.8%) were hemorrhagic. Most of the patients belonged to the age group of 51-70.

In the study population, 11(30.6%) and 23(63.9%) patients were diabetic and hypertensive respectively. Other risk factors identified included 21(58.3%) and 12(33.3%) patients who were smokers and alcoholic respectively.

2D echo was done in all the patients. Most of the patients had LV diastolic dysfunction30 (83.3%), 8(22.2%) patients had LVH, while 7(19.4%) had hypokinesia of a regional wall and 7 (19.4%) had calcified aortic valve.

TABLE 1 Stroke(Ischemic or hemorrhagic) and Age category Cross tabulation

Type of stroke(in Males)		Age cat(in yrs)			Total
		30-50	51-70	Above 70	
	Ischemic	8	16	2	26
	Hemorrhagic	3	7	0	10
Total		11	23	2	36

(Chi-Square=0.586,p=0.746)

In the ECG abnormalities noted, maximum number of patients had T inversion 20 (55.56%) followed by ST elevation/depression (47.22%). 9(25%)subjects had normal ECG, while 7(19.4%) had QTc prolongation, 4(11.1%) had AF and 2(5.5%) subjects had "U wave".

TABLE 2
ECG and Stroke(Ischemic or hemorrhagic) Cross tabulation

ECG	Stroke(Ischemic or hemorrhagic)		Total
	Ischemic	Hemorrhagic	
Qtc Prolongation	6 23%	1 10%	7 19.4%
T inversion	14 53%	6 60%	20 55.5%
ST elevation/depression	13 50%	4 40.0%	17 47.22%
U wave	1 3.8%	1 10.0%	2 3.3%
AF	3 11.5%	1 10.0%	4 13.8%
Normal	8 30.7%	1 10%	9 25%

Only 10% of hemorrhagic stroke patients had normal ECGs compared to 30.7% of ischemic stroke patients. It was observed that QTc prolongation was more common in ischemic stroke patients while "U wave" was present in 10% of hemorrhagic stroke patients. T inversion, ST depression and AF were seen in both the population. ST elevation was seen in 4 (3 Ischemic and 1 Hemorrhagic stroke) patients.

TABLE 3 CKMB and TROP I with Stroke(Ischemic or hemorrhagic) Cross tabulation

		Ischemic or Hemorrhagic Stroke		
	Results	Ischemic	Hemorrhagic	Total
CKMB	ELEVATED	1(3.8%)	1(10%)	2
	NORMAL	25(96.1%)	9(90%)	34
TROP I	ELEVATED	8(30.7%)	3(30%)	11
	NORMAL	18(69.3%)	7(70%)	25

CKMB was elevated in only 2 (5.6%) patients while Trop I was elevated in 11(30.6%) patients

TABLE 4 Stroke(Ischemic or hemorrhagic) and Type of stroke (ACA,MCA,PCA,Watershed area) Cross tabulation

Stroke(Ischemic or hemorrhagic)	Type of stroke(ACA,MCA,PCA,Watershed area)				Total
	ACA	MCA	PCA	Watershed area	
Ischemic Stroke	3 11.5%	14 53.8%	8 30.8%	1 3.8%	26 100.0%
Hemorrhagic Stroke	3 30.0%	6 60.0%	1 10.0%	0 0.0%	10 100.0%
	6 16.7%	20 55.6%	9 25.0%	1 2.8%	36 100.0%

Most of the study population had MCA territory stroke followed by involvement of PCA territory.

TABLE 5 2D ECHO and Stroke(Ischemic or hemorrhagic) Cross tabulation

2D ECHO	Stroke(Ischemic or hemorrhagic)		Total
	Ischemic	hemorrhagic	
LVH	6 23.0%	2 20.0%	8 22.2%
Hypokinesia	6 23.0%	1 10.0%	7 19.4%
Diastolic dysfunction	21 80.7%	9 90%	30 83.3%
Calcified Aortic valve	5 19.2%	2 20.0%	7 19.4%
AF	2 7.6%	2 20.0%	4 11.1%
MR	2 7.6%	0 0%	2 5.5%
LA Clot	1 3.8%	0 0%	1 2.77%
MS	1 3.8%	0 0%	1 2.77%
Normal	2 7.6%	0 0%	2 5.5%

DISCUSSION

Cerebrovascular disease has been defined by WHO as 'A neurological dysfunction with symptoms lasting more than 24 hours or resulting in death before 24hours and in which after adequate investigations

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symptoms are presumed to be of a non-traumatic vascular origin[12].

In India, Community Survey have shown a crude prevalence rate for hemiplegia in range of 200 per 1,00,000 persons[1]. Nearly 1.5% of all urban admissions, 4.5 percent of all medical and about 20% of neurological cases[1].

The annual incidence of stroke in UK is about 350 per 1,00,000 and in USA they cause 2,00,000 deaths per year[13,14]

Every year, more than half a million people in the world suffer from acute cerebrovascular events, including ischemic stroke, intracerebral and subarachnoid haemorrhage[6]. Acute strokes, especially subarachnoid haemorrhage is frequently accompanied by a variety of electrocardiographic (ECG) abnormalities, some of which may be indistinguishable from those seen in association with an episode of severe myocardial ischemia and/or infarction. Patients often have simultaneous hypertension or coronary atherosclerosis, leading to ECG abnormalities. In addition, many primary cardiac disorders, like myxoma, mural thrombus, endocarditis, and atrial septal defect with deep venous thrombosis, can lead to cerebral emboli; arrhythmias, heart block, and decreased cardiac output, which may precipitate cerebral ischemia.[5]

In a study conducted in an Iranian tertiary centre (Sina hospital) which was a retrospective review of a cohort of patients admitted with a diagnosis of acute cerebrovascular events, the electrocardiographic records of 361 patients with acute stroke were studied. The most common ECG abnormalities associated were T-wave abnormalities, prolonged QTc interval and arrhythmias, which were respectively found in 39.9%, 32.4%, and 27.1% of the stroke patients and 28.9%, 30.7%, and 16.2 of the patients with no primary cardiac disease.9 Increased number of patients had abnormal T-wave for posterior fossa bleedings and more rhythm disturbances for ischemic lesions, localized in the anterior fossa.

In a study conducted in Akershus university hospital,279 patients diagnosed with acute ischemic stroke was included. 64.5% patients had a pathological finding in ECG according to the modified Minnesota code. The most frequent ECG changes were prolonged QTc (36%),ST depression (24.5%),atrial fibrillation (19.9%) and T wave inversion (17.8%).TnT was elevated(>0.04 g/L) in 26 (9.6%) patients[10]

In a study conducted at four Seattle hospitals of patients admitted with acute CVA between Jan ,1975 and Nov, 1977;Of the 150 stroke patients ,138 had an abnormal admission ECG, compared with 97 (65%) of the controls($p<0.001$). The most common ECG abnormalities associated with stroke were prolonged QT(45%),T wave inversion(29%),U waves(28%),tachycardia(28%),ST depression(27%) and LVH(26%).Atrial fibrillation occurred in 47% patients with cerebral embolus, compared with 9% patients with all other types of stroke.QT prolongation occurred more frequently in patients with subarachnoid haemorrhage (71%) than in other types of stroke(39%). Combined QT prolongation and U waves occurred more frequently in patients with intracranial bleeding (subarachnoidhaemorrhage or intracerebral hemorrhage: 25%) than without (8%;$p<0.01$).

In our study; ECG, 2D Echo and cardiac enzymes were done in each of the 36 stroke patients. It was observed that ECGs taken within 24 hours of presentation had abnormal findings in previously apparently healthy individuals (without any history of cardiovascular disease). In the ECG abnormalities noted, maximum number of patients had T inversion (55.56%) followed by ST elevation/depression 17 (47.22%). Out of which 4 patients had ST elevation. However 2 among these patients showed regional wall motion abnormalities in 2D ECHO while one other had LVH and the fourth patient showing only LV diastolic dysfunction. 9(25%) subjects had normal ECG, while 7(19.4%) had QTc prolongation, 4(11.1%) had AF and 2 (5.5%) subjects had "U wave". 83.3% patients had LV diastolic dysfunction. 8(22.2%) patients had LVH, while 7(19.4%) patients were noted to have hypokinesia and 7 (19.4%) had calcified aortic valve. CKMB was elevated in only 2(5.6%) patients while Trop I was elevated in 11(30.6%) patients.

CONCLUSION

There is increased incidence of ECG changes and increase in cardiac enzymes to the patients presenting with acute stroke in whom no cardiac abnormality was noted which suggests that these changes could be a part of stroke related autonomic dysfunction. Few other patients presented with stroke as the first event were noted to have unrecognised arrhythmias and ischemic heart disease. This study underlies the importance of studying the cardiac abnormalities in patients of acute ischemic and hemorrhagic stroke which would help early recognition of the same and in-turn better treatment of patients which helps in decreasing mortality and morbidity of these patients.

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